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Preface

The 2nd International Conference on Financial Technology and Business Analysis (ICFTBA 2023) is an annual conference focusing on research areas including finance, economics, business, and management. It aims to establish a broad and interdisciplinary platform for experts, researchers, and students worldwide to present, exchange, and discuss the latest advance and development in finance, economics, business, and management.

This volume contains the papers of the 2nd International Conference on Financial Technology and Business Analysis (ICFTBA 2023). Each of these papers has gained a comprehensive review by the editorial team and professional reviewers. Each paper has been examined and evaluated for its theme, structure, method, content, language, and format.

Cooperating with prestigious universities, ICFTBA 2023 organized four workshops in Cardiff, London, Aberdeen and Galați. Prof. Arman Eshraghi chaired the workshop “Recent Bank Collapses - A new Financial Crisis?”, which was held at Cardiff Business School. Professor Kevin McMeeking chaired the workshop “Sustainable Finance Workshop: Accounting for Greenhouse Gases” at Brunel University London. Dr. Naser Makarem chaired the workshop “Brexit and Earnings Management” at University of Aberdeen. Professor Dr. Habil. Alina Cristina Nuță chaired the workshop “Fintech Tools and Cybersecurity Challenges - Finance Innovations That Shapes Our Lives” at Danubius University of Galați.

Besides these workshops, ICFTBA 2023 also held an online session. Eminent professors from top universities worldwide were invited to deliver keynote speeches in this online session, including Dr. Shima Amini from The University of Leeds, Dr. Kevin McMeeking from the Brunel University London, Dr. Naser Makarem from University of Aberdeen, etc. They have given keynote speeches on related topics of finance, economics, business, and management.

On behalf of the committee, we would like to give sincere gratitude to all authors and speakers who have made their contributions to ICFTBA 2023, editors and reviewers who have guaranteed the quality of papers with their expertise, and the committee members who have devoted themselves to the success of ICFTBA 2023.

Prof. Arman Eshraghi
General Chair of Conference Committee

Workshop

Workshop – Cardiff: Recent Bank Collapses - A New Financial Crisis?



September 1st, 2023 (GMT+1)

Finance and Chair of Finance and Investment, Cardiff Business School

Workshop Chair: Prof. Arman Eshraghi, Professor in Cardiff Business School

Workshop – London: Sustainable Finance Workshop: Accounting for Greenhouse Gases

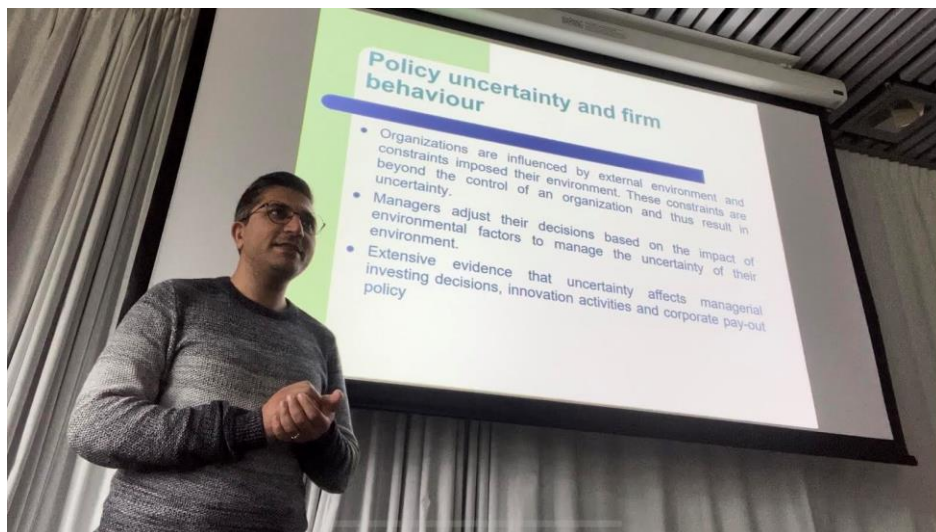


13 October 2023 (GMT+1)

College of Business, Arts and Social Sciences, Brunel University London

Workshop Chair: Professor Kevin McMeeking, Professor at Brunel University London

Workshop – Aberdeen: Brexit and Earnings Management



October 18th, 2023 (GMT+1)

Department of Accountancy and Finance, University of Aberdeen

Workshop Chair: Dr. Naser Makarem, Assistant professor in University of Aberdeen

Workshop – Galați: Fintech Tools and Cybersecurity Challenges - Finance Innovations That Shapes Our Lives



October 15th, 2023 (GMT+3)

Faculty of Economics and Business Administration, Danubius University of Galați

Workshop Chair: Professor Dr. Habil. Alina Cristina Nuță, Danubius University of Galați

The 2nd International Conference on Financial Technology and Business Analysis

ICFTBA 2023

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Interpreting the Post-Epidemic Banking Sector from a Game Theory Perspective

— Using Silicon Valley Bank as an Example

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Abstract: Overview of the trend in the banking industry after the epidemic, regarding the rise of digital banking (neobanking) and customers' investment behavior — a low-risk portfolio is what most people prefer. The trend of moving business from bank branches to online is a remarkable evolution during COVID-19 and is likely to be the future operation mode of the banking industry. From the general view of the banking industry to the specific bank, a case study of Silicon Valley Bank (SVB) is employed to explain the relationship between game theory and bank run. This paper focuses on identifying the failure of SVB through the discussion of economic aspects such as fund rate hikes and applying game theory and higher-order beliefs to SVB's case. It finds out that the unique equilibrium for players is a bank run, which needs sound policy and tangible action from authorities to reduce its negative impact on customers and other financial institutions. SVB's bankruptcy does not trigger another major financial crisis, but the severity of the bank run still needs to be taken seriously.

Keywords: game theory, bank failure, Silicon Valley Bank

1. Introduction

In light of the numerous uncertainties and global events in politics and economics, the post-epidemic period has witnessed the second largest bank failure in US history and triggered a series of chain reactions, such as public distrust of the financial system and the repercussions on the global equity market. According to the research done by Dharen Kumar Pandey et al., the Americas, Middle East, and African markets experienced dramatic negative returns in the short run, while European markets were affected over a longer time horizon [1]. Repercussions aside, there are also other papers and articles discussing and examining the reasons behind this unpredictable bank run. For example, a paper done by Lai Van Vo and Huong Le uses the unrealized losses to total assets ratio compared with its peers to prove that SVB is in bad financial shape [2]. There are sufficient papers to work out the reasons behind SVB's bankruptcy. However, few of them link the failure with game theory to explain that the bank run is an ultimate consequence under normal practices, and that it is the authority's job to have precautionary measures.

This paper will first look into the change in customers' financial behavior and examine the future trend of the banking sector, which is important for both bankers and customers. For bankers,

acknowledging clients' needs and demands is the priority when providing services. The preferences of customers regarding investment goods have a significant impact on the wealth management plans that are recommended to them. For customers, employing user-friendly platforms and technologies enhances their living standards and efficiency, avoiding the need to physically visit a bank branch and reducing information asymmetry in comparison to online platforms and human managers. The data used to support the argument is mostly retrieved from Statista. The second part scrutinizes the failure of Silicon Valley Bank (SVB) in 2023. Few factors are identified, and this essay will mainly use the game theory and higher-order belief illustrated by Franklin Allen and Stephen Morris to link with SVB [3]. Allen and Morris only put forward the theory, and this essay will help enrich examples in real life.

2. Game Theory

Game theory is generally believed to have first appeared in the book *The Theory of Games and Economic Behaviors* written by von Neumann and Morgenstern back in 1944, but it was not widely recognized and applied in the financial field at first. According to Anjan Thakor, the gaming behavior that game theory tries to explain is all around us, and game theory can be identified as a field of research that examines scenarios in which individuals form basic assumptions about the participants in a given situation and subsequently analyze the outcomes when each individual seeks to optimize their expected utility while considering the limitations imposed by their information, beliefs, resources, and production capabilities [4]. The reason for using SVB as an example to illustrate the relationship between game theory and bank runs is due to its significance and post-epidemic timing. Bank failure is not uncommon to see in the US every year, but SVB successfully raised people's concerns about whether there will be another major financial crisis in history. This can show that this level of bank failure is rare. Moreover, the years-long pandemic has also changed how people perceive the global market and the way they behave accordingly.

3. Overview of the Banking Industry After Pandemic

With the increasingly improved outbreak of COVID-19, the scope of impact on individuals, small and medium enterprises, and even giant corporations is weakened due to the ease of city lockdowns and the recovery of the tourism industry. Therefore, in order to recover economic and financial stability, authorities usually implement support measures. For example, the Hong Kong Monetary Authority permitted authorised institutions to run with a lower level of liquidity ratio temporarily under the liquidity coverage ratio and liquidity maintenance ratio regimes [5]. Similarly, the Federal Reserve (Fed) adopted a comparable measure, which tended to stimulate expenditure to achieve economic recovery by adjusting the federal fund rate. The action was called the "culprit" of Silicon Valley Bank's (SVB) failure, which will be further explained in the following [6].

Massive city lockdowns and self-quarantine measures from 2020 have caused a series of changes in the world. What the banking sector has experienced is the rapid growth of mobile banking, which transfers the businesspeople used to conducting business at branches to online applications. The observation is the emerging growth of digital banking, or so-called "neobanking," especially among teenagers aged between 15 and 24, and the forecast number of digital banking users will reach 216.8 million in the U.S. in 2025, according to Statista [7]. According to the data from Statista, the number of mobile banking app downloads in the U.S. increased sharply from 109.8 million in 2019 to 143.7 million downloads in 2022. It is shown that people's preference for digital banking has increased, partly as a result of the pandemic [8].

In addition to transitioning their banking activities to online platforms, individuals who engaged in investment activities during the pandemic, modified their investment portfolios to include low-risk

alternatives or increased their savings instead as a result of diminished optimism regarding the future prospects of the market. More than 30 percent of respondents in Hong Kong, France, Indonesia, Mainland China, and India said that they saved more money in 2020 [9]. Hence, it is foreseen that customers' confidence in the market still needs time to be reestablished, and before that, they will hold rather low-risk investment products such as bonds or value stocks. Furthermore, there is a huge difference between retail investors and institutional investors regarding trust levels in global finance. During the pandemic, due to the unstable economics, only 46% of retail investors surveyed showed trust in global finance, while 65% of institutional investors showed confidence in that [10]. The reason could be the asymmetry in information, as institutional investors should master more information regarding other companies and market performance. As a result, the percentage of institutional investors increased by 21% in 2022, while the percentage of retail investors increased by 14% [10]. Consequently, these two types of investors may act differently when designing their portfolios.

4. The SVB's Collapse and Reasons Behind

4.1. Background of SVB

SVB was established in 1983 in Santa Clara, California with the primary objective of providing assistance to the advancement of innovation and entrepreneurship within the technology industries. It emerged as the dominant bank in terms of deposit volume in Silicon Valley and earned the support of nearly half of all venture-backed tech startups. It is paradoxical that shortly before the bank's collapse, it was recognized by Forbes as one of the top American banks due to its growth rate, credit standards and profitability [2]. This paper explains why SVB collapsed and specifically examines the relationship between game theory and the unique trigger of undiversified clients in the context of the second greatest bank failure in U.S. history.

4.2. Factors Led to Failure

4.2.1. Volatile Financial Environment

The onset of the pandemic-induced economic downturn has created a state of uncertainty over the future trajectory, leaving individuals and institutions uncertain about whether conditions will deteriorate or improve. As a result, the inclination to minimise spending, retain deposits, and prioritise the most liquid assets, such as cash, is a rational decision that is commonly practised in some countries [9]. However, the economic situation deteriorated significantly since it cannot be supported without a degree of consumption. Consumption is the direct driver of GDP growth and indirectly controls the employment rate as stores may cut labour costs without sufficient revenue.

The Federal Reserve stepped in to maintain normal banking operations. In March 2020, the Fed reduced its target for the federal fund rate, which represents the interest rate at which banks borrow from one another overnight, by a cumulative 1.5 percentage points. The implemented reductions resulted in a decrease in the fund rate, bringing it within the range of 0% to 0.25% [2]. The federal fund rate serves as a reference point for various short-term interest rates and has an impact on longer-term interest rates. Apart from this, the Federal Reserve engaged in the acquisition of substantial amounts of Treasury securities and mortgage-backed assets with the objective of maintaining low long-term interest rates. Despite their intention, the actions undertaken have played a role in the expansion of the public debt, which experienced a significant increase of approximately \$5 trillion in three months [2]. This phenomenon has caused public concern regarding the country's long-term financial stability.

4.2.2. Fund Rate Hike

The epidemic had a profound impact on various aspects, including but not limited to economic uncertainty and variation. Consequently, the Federal Reserve's unexpected action of raising a record-breaking percentage of interest rate led to bank failures.

As a response measure to the elevated inflation rate observed in 2022, the Fed implemented a substantial and unprecedented rise in the interest rate, increasing it from 0.25% in March 2020 to 4.5% at the end of the year [11]. This development had a significant impact on the portfolio of the SVB, which mostly consisted of treasury bills and mortgage-backed securities. The securities can be categorised into two types: 'Available for Sale' (AFS) and 'Held to Maturity' (HTM). AFS refers to securities held by the bank that can be freely sold at any given moment. At the end of 2020, these securities, worth around \$26 billion, are valued based on their market value, which may result in actual losses being incurred due to the prevailing high interest rates at the time of the transaction [2]. In the long run, it might be shown that there is a problem with their investment portfolio.

5. Interpretation of This Scenario from a Game Theory Perspective

One of the crucial factors that led to the bank run was the lack of customer diversification. Research done by Lai Van Vo and Huong Le has shown that by the end of 2022, there was a notable rise in the quantity of bank accounts exceeding a valuation of \$250,000, reaching a total of 37,466, where the total number of deposit accounts was 143,886 [2]. These minority accounts formed a significant proportion of 89.38% in terms of the whole amount. These figures proved that SVB, possessing most deposit accounts from Silicon Valley, had the problem of lack of client diversification. As a result, they were likely to know each other and aggregate higher-order beliefs.

Franklin Allen and Stephen Morris put forward that the depositors' higher-order beliefs determined the consequences of the bank run back in 1998. According to their theory, higher-order belief implies that the fundamentals themselves are not the only concern when people make choices, but also how others perceive the fundamentals and what others' beliefs are [3]. SVB's failure can be attributed to the concentrated group of customers in start-ups, and game theory further confirmed that such higher-order beliefs determine the bank run within 48 hours.

The following game theory payoff is the modelling from Allen and Morris, which was applied in this essay in the case of SVB. For the sake of simplicity in elaborating on the issue, the assumption is that the SVB only has two depositors: D1 and D2. There are also four states of "fundamentals": both have liquidity needs, only D1 or D2 have liquidity needs, and none of them have liquidity needs. When a depositor chooses to withdraw their money from SVB, he is assured of receiving the interest, denoted as " r ". If he chooses to retain his money in the account and another depositor also chooses to retain his fund, they get a payoff of R separately. However, if he chooses to retain his fund while the other depositor makes a withdrawal, the former gets a payment of zero. In this coordination game, Table 1 lists the payoffs:

Table 1: Depositors' payoff.

	Remain	Withdraw
Remain	R, R	$0, r$
Withdraw	$r, 0$	r, r

Note that $0 < R < 2r$, the unique equilibrium of this game, is both depositors withdrawing money from the bank [3]. This is also the reality. The company unexpectedly informed investors of its requirement to generate an additional \$2.25 billion in order to shore up its balance sheet, which conveyed the message of a fund shortage to the market. Higher order beliefs made SVB's customers anticipate what others were going to do — in this case, withdraw funds from the bank. Hence, start-up companies attempted to withdraw all of their money (\$42 billion of deposits in two days) from SVB because they were afraid of getting zero at the end.

The bank run was also subject to the herd effect. Herding behavior is defined as the inclination of investors to replicate the behavior of other market participants, thereby disregarding their own information [12]. They thought that their deposits might be at risk. Tech companies in Silicon Valley tended to know each other, and the information asymmetry was weaker due to the fact that they might know what others had done. Therefore, the news spread quickly, and everyone tried to get their money back. In this sense, people disregarded their own trust and faith in this bank and performed herding behavior.

6. Conclusion

This paper interprets the current situation of the banking industry, which is gradually recovering from COVID-19. The rise of digital banking cannot be overlooked as it may be the future trend in the 21st century. The two factors causing the failure of SVB, which are unpredictable factors, are out of SVB's control as they are related to macroeconomics and epidemics that are rare to see. However, from the game theory derived, bank runs are the unique equilibrium for depositors, which will happen eventually. Therefore, as a country's monetary authority, like the Fed and the bankers, they need to figure out practical measures immediately to stabilize the economy and calm citizens' fears in urgent situations. However, the discussion scope is not enough from a global perspective since the main data focus is on the study of U.S. citizens. Circumstances can be different in other countries. Moreover, there are other factors that contributed to the bank's failure that are overlooked in this paper. A future study will focus on the strategies that authorities could employ to mitigate public panic to prevent the occurrence of bank runs. Rather than relying solely on verbal assurances, it is better to consider tangible actions and realistic strategies. The second largest bank run in U.S. history cannot be triggered easily, and other factors are crucial to examine accordingly, while this paper shows that in game theory, bank runs naturally happen. Therefore, it is the Fed's job to ensure it does not happen in the future.

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Firstly, I would like to show my deepest gratitude to my teachers and professors, who have provided me with valuable guidance in every stage of the writing of this thesis. Further, I would like to thank all my friends and parents for their encouragement and support. Without all their enlightening instructions and impressive kindness, I could not have completed my thesis.

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Research on Marketing Strategies and Trends of Art Co-Branding in the Contemporary Fashion Industry

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Abstract: Art co-branding is an increasingly huge fashion industry trend with great potential and unknown risks. In this paper, marketing strategies and trends are the main focuses in terms of the art co-branding of fashion brands. The method used includes literature research and two case studies of Louis Vuitton collaborating with Yayoi Kusama and Dior Lady Art, examining their marketing strategies and performances. Increase in product value, maintenance of scarcity, and construction of in-depth customer relationships are the three main reasons contributing to the win-win outcome of art co-branding in the fashion industry. As a result, it is shown that art co-branding can contribute to highlighting the core of fashion brands and greatly increase brand awareness by choosing an artist with a matching concept through various marketing strategies. Art co-branding has the high potential to become widely used by fashion brands and act as an effective method to benefit all fashion brands in the future.

Keywords: fashion industry, art co-branding, marketing strategies

1. Introduction

1.1. Research Background

In today's world, brands seek innovative tactics to strengthen their brand awareness and profitability. At the same time, customers pay more attention to the aesthetics and cultural value of all goods, hoping to express their tastes and identity. As a unique medium, art can be called a very perceptual universal "language". Today, brands in various industries utilize art as an infectious way to shape and spread culture, enabling them to connect with customers on an emotional level. As a result, for consumers who pay more and more attention to the humanistic spirit and aesthetic connotation, art undoubtedly brings new opportunities for the development of all brands.

Co-branding is when two or more businesses collaborate to create and promote a new product or service [1]. Co-branding is a powerful method for businesses to pool their resources, frequently resulting in higher brand visibility and revenues and lower individual expenses and risk. This approach is widely used by businesses to develop worthwhile items and tap into new consumer markets.

In this case, the artistic co-branding perfectly meets customers' demands in the fashion industry. As a result, an increasing number of artists have entered the fashion industry, and their cooperation manners have developed not only limited to launching clothing collections but have more diversified

and valuable innovations. Similarly, the co-branding strategy has become an approach frequently used by fashion brands to boost their sales and diversify their product portfolio by joining forces with other artistic figures.

1.1.1. Brief History

In fact, art collaborations within the fashion industry can be traced back a long time. In the 1930s, the most famous collaboration was between Elsa Schiaparelli, the famous Spanish artist Salvador Dali, and a group of Surrealists around him. The result and honor of this collaboration are two of Schiaparelli's iconic garments: the Organza Dress (1937) and the Tears Dress (1938). This collaborative case was usually cited as a milestone of a hybrid of art and fashion [2].

1.1.2. Current Market Observation

There have been many successful cases of fashion brands collaborating with artists on the market. For instance, on Chinese social media Weibo, the number of views of the hashtag topic #Uniqlo co-branded collection was robbed # about American artist Kaws' partnership with Uniqlo has reached 470 million, which also brought Uniqlo a recovery in its share price up 4.58% as of June 5, 2019 [3].

However, nowadays, it cannot be denied that consumers' attitudes towards homogenized cross-border co-branding are inevitably fatigued in today's markets of increasing numbers of co-branded brands. How to become popular and create a partnership with long-term efficiencies and benefits and satisfying consumer experience and revenue growth has become an urgent problem for brands to solve. In order to improve and succeed, marketing strategy, the plan a business uses to promote and sell its goods or services and attract and keep customers, plays a significant role here for all brands.

1.2. Literature Review

On CNKI, there are about 15 related articles. Wang proposed that collaborations need to focus on commercial value, pay attention to public requirements, and be socially responsible [4]. Song found that fashion brands need to select artists with a strong correlation with the spiritual and cultural connotation of the brand, expand and rebuild the way of co-design, and utilize the influence of the current symbol consumption to achieve a win-win effect [5]. From the joint name of Uniqlo and Kaws, Hong and Zhang recommended that the fashion art co-brand launch multiple product series, diversify purchase channels, and enrich the publicity content [6]. For clothing brand joint marketing, Bai and Wang discovered the problem of a lack of attraction toward customers and a lack of innovations and design efforts [7]. Focusing on Louis Vuitton and Supreme co-branding, Jia and Ran analyzed the motivation, the form of expression, and the marketing strategies, concluding with a new direction for future development in the fashion market [8].

Despite the increasing popularity of art co-branding in the contemporary fashion industry, there is a lack of comprehensive research specifically focusing on the marketing strategies and trends associated with these collaborations. Previous studies have mainly examined the general concept of co-branding or have explored collaborations in other industries, such as sports or entertainment. Thus, there is a research gap regarding the specific marketing strategies and trends employed in the art co-branding partnerships within the fashion industry. This paper aims to fill the gap by investigating the unique marketing strategies and emerging trends that drive successful art co-branding initiatives in the contemporary fashion industry.

1.3. Research Framework

This framework will guide the research process and help organize the study to address the research objectives and explore the marketing strategies and trends of art co-branding in the contemporary fashion industry. The research will first conduct a comprehensive literature review to establish a theoretical foundation and gain insights into existing theories and models of co-branding and marketing strategies. The next step will dive deeper into case studies of collaborations between artists and fashion brands. The analysis from multiple perspectives will be fully interpreted, employing content analysis techniques to identify key themes, patterns, and trends in art co-branding strategies. Finally, the findings will be presented and discussed, providing a comprehensive overview of the fashion industry's marketing strategies and future trends of art co-branding.

2. Method

2.1. Literature Research

The literature research method gathers and analyzes existing academic literature, published articles, industry reports, and relevant sources [9]. This paper will broadly use the internet to carry out literature research. This method will provide a theoretical foundation for understanding the various approaches, challenges, and opportunities associated with art co-branding in the fashion industry by analyzing and synthesizing the literature. On the one hand, it helps to understand the history and current situation of art co-branding in the fashion industry; on the other hand, it explores various marketing methods and factors and helps predict future trends. The internet contains many documents with different information, which can supplement the paper and answer questions for research from multiple perspectives.

2.2. Case Study

The case study is a research methodology that gains insights and draws conclusions from real-life issues, programs, or organizations through investigation, according to information from *myperfectwords*. In this paper, the case study method will be employed to examine and illustrate empirical evidence, especially focusing on marketing strategies. Multiple case studies of fashion brands collaborating with artists will be selected, and relevant data will be collected through other sources, such as company reports. The analysis of these case studies will enable a deeper understanding of the marketing strategies used and a further generation of the anticipation of future trends employed in art co-branding partnerships and provide practical insights for fashion brands and industry practitioners. The current situation and development of the industry can be seen through the study of existing case studies, and more powerful and well-founded suggestions, conclusions, and predictions can be generated.

3. Result

3.1. Case 1: Louis Vuitton and Yayoi Kusama

3.1.1. Brief Description

The collaboration between Louis Vuitton and Yayoi Kusama was a well-planned artistic partnership that brought together fashion and contemporary art. Kusama, known for her vibrant polka dot patterns and avant-garde style, perfectly complemented Louis Vuitton's emphasis on luxury and innovation. In the second collaboration after the first collaboration in 2012, the first products were released in China and Japan on January 1, 2023, deemed a pre-launch. On January 6, they were available in all

460 Louis Vuitton boutiques worldwide. This collaboration aimed to create a limited-edition collection of bags, shoes, and accessories that reflected Kusama's distinctive artistry, leveraging Louis Vuitton's brand visibility and expertise in the fashion industry. According to LVMH's report, the Fashion & Leather Goods business group gained an 18% revenue growth in Quarter 1, 2023, which part of the records can be attributed to this big-scale collaboration [10].

3.1.2. Brand Image Enhancement

This collaboration allowed Louis Vuitton to associate itself with artistic expression and creativity, reinforcing its position as an innovative luxury brand. By partnering with Kusama, known for her unique artistic style and avant-garde approach, Louis Vuitton showcased itself as a daring, bold, and forward-thinking brand. This helped the brand stand out by encompassing more than 450 individual products.

3.1.3. Target Customer Expansion

As the wider fashion market keeps developing and becoming saturated, all brands must constantly try to occupy a larger portion of the market [11]. Louis Vuitton's collaboration with Kusama enabled the brand to tap into a different consumer segment. Typically, Louis Vuitton's target audience is affluent individuals interested in luxury fashion. However, this collaboration helped attract a younger and more art-centric demographic, including fans of Yayoi Kusama herself. This allowed LV to diversify its customer base and leverage Kusama's art's worldwide recognition and appeal to introduce the brand to a wider audience.

3.1.4. Customer Engagement

Regarding customer engagement, Louis Vuitton has set up pop-up stores and intriguing designs and installations, exceeding the conventional collaborating collections [11]. LV has opened pop-up stores in Tokyo and New York. The interior of Tokyo's store was strongly inspired by Kusama's artwork "Infinity Mirror Rooms", and there was a giant hyperrealistic sculpture of Yayoi Kusama herself in the center of the store. With New York's pop-up, there were installations on Fifth Avenue and 57th Street, with audio-animatronic Kusama painting her polka dots on the window.

Visual merchandising is perfectly utilized in all stores. The striking pop-up stores incorporated the artist's famous polka dot design, adding an element of playfulness. The vivid colors, organic shapes, and polka dots cleverly placed brought Kusama's signature patterns and designs to life, which spoke volumes in attracting the audience. Plus, for the installations, the distinctive facial expressions, hand gestures, and following eyes made the sculptures look like the real Kusama, generating buzz on social media.

Pop-up stores and installations have succeeded in increasing consumer engagement, creating buzz, and providing a distinctive shopping experience that goes above and beyond the norm. By fostering a sense of urgency surrounding the limited-time offer, this tactic successfully grabs the attention of both devoted customers and brand-new audiences [11].

3.1.5. Omnichannel Campaign

The Louis Vuitton x Yayoi Kusama campaign involved diverse channels such as social media platforms, print media, and in-store displays. From producing behind-the-scenes content to online live broadcasts, the brands used multiple channels to increase social media followers, drive engagement, and create a buzz around their collaborations. More than 10 million people have viewed the Instagram post of the anamorphic billboard Vuitton put up in Tokyo's busy Shinjuku

neighborhood. It features Kusama looking out from a Vuitton trunk covered with animated fruit characters [12].

3.2. Case 2: Dior Lady Art

3.2.1. Brief Description

The Lady Dior bags are launched from Dior's limited edition Lady Art collections, created in association with well-known artists from across the globe. The Lady Art project's first edition was released in 2017, and there would be five more collections after that. The collection aimed to explore the colors, materials, and form themes, interpreting the iconic handbag with a unique artistic touch. All the bags produced are unique artwork, fusing Dior House's craftsmanship, heritage, and creative visions.

3.2.2. Limited Edition

The marketing strategy of the collection revolved around the concept of exclusivity. The collection was only produced in small numbers, and each handbag featured a unique design created by the collaborating artists. By limiting the availability of the collection, Dior created a demand for the product, which helped generate interest and buzz, attracting potential consumers. For its price the regular lady bag price ranges from €2900 to €5400, but the price of the Dior Lady Art #7 collection ranges from €5900 to €19000, consumed as a collectible handbag by the market.

3.2.3. Creative Partnerships

Dior's collaboration with contemporary artists was one of the key marketing strategies for the Lady Art Collection. The brand partnered with seven artists for each collection from different parts of the world, each with distinctive styles and approaches. The partnership allowed Dior to create an original product with an artistic edge and expanded the brand's reach to the vast followers of each artist involved.

3.2.4. Visual Merchandising

In promoting the Lady Art Collection, Dior implemented appropriate visual merchandising to showcase the unique designs of the handbags. Each Lady Dior Handbag was exhibited like artwork in the Dior pop-up stores worldwide. The stores' lighting, mannequin display, and color scheme were carefully curated to enhance the handbags' visibility. For instance, for the Dior Lady Art Project 2021, brand ambassador Kim Jisoo was invited to the pop-up store in Seoul, Korea, showcasing all the incredible handbags. Jisoo also posted promotional videos on her Instagram to publicize the campaign, which attracted her fans' attention towards Dior [13].

Dior's 'Art n' Dior' exhibition returned to Shanghai's West Bund Art Center after two successful stops in Shenzhen and Shanghai in 2021. The event, which began on November 10 as part of the West Bund Art and Design Fair, featured artworks from all around the world to strengthen the link between Dior and China. Based on Dior's artistic passion, the exhibition invited young generation artists and displayed the Lady Art handbags. Plus, high-profile Chinese celebrities were also invited in order to increase publicity. The hashtag "Art n' Dior" has received a remarkable 700 million views and 15 million comments as of November 14, 2022 [14].

3.2.5. Social Media

Dior effectively used social media platforms to market Lady Art. The brand utilized the power of social media through various organic and paid campaigns to amplify the collection's reach. Dior engaged their followers with exclusive behind-the-scenes content, artist Q&As, and hashtags to encourage user-generated content that further created buzz and put potential consumers on top of the funnel.

4. Discussion: Benefits and Risks of Marketing Strategies

4.1. Benefit 1: Increase in Product Value

From the cases of Louis Vuitton and Dior, it is found that when a fashion item combines artistic elements, it can often weaken its commercial attributes and obtain stronger vitality under the blessing of art, that is, the ability to add value or retain value. In 2012, LV collaborated with Yayoi Kusama for the first time, and the suitcase was auctioned at Sotheby's for 239,400 euros. The popular products of this collection have obtained the ability to add value several times higher than the original selling price. In the recent 2022 partnership it was no exception to elevate the price of products with artistic co-branded design.

Art co-branding can help fashion brands increase the value of their products by differentiating from competitors and adding an emotional connection to their products. Fashion brands can create products with deeper meaning and emotional value for their customers. For instance, a designer could collaborate with an artist to create a collection inspired by a social issue, which can evoke strong customer emotions and, thus, add value. For Yayoi Kusama, she has stated that her dots acted as something that helps alleviate her anxieties and mental health problems through repetition [15]. In this case, Louis Vuitton adds connotative ideas to its product design through co-branding.

4.2. Benefit 2: Maintenance of Scarcity

Collaborating with an artist to launch limited edition or exclusive collections can help fashion brands establish a reputation for exclusivity and premium quality while investing in the artist's talent and creativity at the same time. Scarcity helps to create a sense of anticipation and desire for customers, which means they are more likely to be willing to pay a premium price for it. Therefore, art co-branding can help fashion brands increase their profits.

The artwork is scarce and contains a certain cultural connotation and era aesthetics, which can produce spiritual resonance with different viewers. As the most valuable category of commodities at present, art stands at the top of the commodity pyramid and at the commanding heights of culture. When fashion items can give more cultural meaning to themselves and be recognized by the market, like works of art, they no longer define the role of style but become cultural makers. Art co-branding can help fashion brands stand high enough to maintain their value to be invincible in continuous expansion and competition.

4.3. Benefit 3: Construction of In-depth Relationships with Customers

Like LV's installation for Kusama Yayoi and Dior's exhibition for the Lady Art series, all these visual presentations combined with art can effectively engage consumers and give them a thorough understanding of the core of the brand or collection. These offline campaigns that visualize the brands' clothing collections and concepts are able to provide customers with immersive experiences. More and more fashion brands have become keen to hold branded art exhibitions, and more in-depth and

pure art practices may give brands richer symbolic value and upgrade fashion to more advanced art, becoming a way to inject new vitality into the brand.

Philip Kotler, a professor of economics, noted in his book ‘Marketing Revolution 4.0: From Tradition to Digital’: “In an era of attention scarcity and fragmented information, brands need to create Wow Moments for consumers.” Art events or related display manners, in this case, are effective ways to focus consumers’ attention and immerse themselves in Wow Moment. They are not just an occasion to showcase a product but also a story about the craftsmanship, spirituality, and even cultural significance behind the fashion brands.

4.4. Risk 1 — Phenomenon of Following Suit

It could be risky for the collaborations between fashion brands and art pavilions to only cater to the public’s taste and seek to maximize profits but not respect and truly incorporate art. There is the phenomenon of some brand exhibitions that enter art galleries and museums blindly exporting brand concepts, limiting themselves to superficial sensory stimulation, and treating the audience only as “consumers” rather than “viewers” in dialogue with art, losing the artistic connotation. For the example of Uniqlo partnering with MoMA in 2013, the critic’s main arguments were that Uniqlo’s retailer cropped a lot of the original looks of artworks to cater to its merchandise. “There’s too much merchandise in the world already, and I don’t want the masterpieces at the Museum of Modern Art to be seen as just more merchandise,” art critic Deborah Solomon told WNYC in the interview.

4.5. Risk 2 — Lack of Compatibility or Synergy

“Louis Vuitton understands and appreciates the nature of my art,” Yayoi Kusama told New York magazine in 2012. “Therefore, there isn’t much difference from my fashion-making process.” On the contrary, one of the primary risks of scarcity in co-branding is the potential for a lack of compatibility or harmony when collaborating between the fashion brand and the artist. Aesthetically and culturally, brand designers and artists often vary in their perspectives, and it may take multiple tries for both parties to achieve the desired result, which consumes money simultaneously. The possible result could be a collection with a jarring and chaotic outlook that confused the customers and negatively impacted the brand’s image.

4.6. Risk 3: Excessive Reliance on Artists

Another risk is the potential for excessive reliance on the artist, which may lead to a brand losing its individual identity. A co-branding partnership between a fashion brand and an artist should ideally have a mutually beneficial relationship where both sides work together to create a unique and innovative product that celebrates the strengths of each side. In the Dior Lady Art collections, the brand took a certain number of risks by relying entirely on their chosen artists to design and interpret their iconic Lady Dior bag without any involvement from their designers. Such a partnership resulted in a collection of bags distinctively different from the original Lady Dior bag. This represents a new attempt, and consumers’ preferences for the attempt are unknown initially. The artist may not be able to retain the fashion brand’s identity by only seeing through their eyes, and it may have minimal input regarding the co-branded products they are selling, creating an inconsistency in brand messaging.

5. Conclusion

5.1. Key Findings

Art co-branding is popular in the fashion industry, with the assistance of rich marketing strategies, allowing brands to blend art with fashion and create unique designs. Although it comes with risks, art

co-branding enables brands to showcase a new aspect of their creativity, access a wider audience, foster brand loyalty, and generate increased sales and revenue. Louis Vuitton and Gucci are examples of brands that have successfully used art co-branding. The future trend appears to be moving towards collaborations with artists from different mediums and culture contexts and with a substantial following on social media. Furthermore, there is a move toward creating limited-edition collections, adding to the brand's exclusivity and creating demand from consumers who want to be part of a unique experience.

In this paper, by analyzing the two examples from Louis Vuitton and Dior, the growing trend in development, the high potential of success, and the win-win relationship of art co-branding in the fashion industry are fully proven. Moreover, this research has also revealed the importance of selecting the right artist, matching brand values, and creating strategic marketing campaigns to make an impactful collaboration. Fashion brands continue to seek innovative ways to differentiate themselves in a highly competitive industry. Art co-branding has emerged as an effective marketing tool that leverages the cultural capital of art to establish a distinct brand identity.

5.2. Research Significance

The business value of the paper lies in the insights it provides for fashion brands to make informed decisions about art co-branding collaborations. By showing the effectiveness of art co-branding in creating unique brand stories and achieving business growth, the paper serves as a practical guide for fashion brands seeking to enhance their product offering, attract new customers, and increase brand loyalty through art co-branding. However, due to the lack of primary research, the results may not be complete and precise. For future studies, it will be better to use primary data from interviews or surveys conducted directly towards the customers or the brands' managers inside the market.

5.3. Limitations and Future Study

In conclusion, this research on the marketing strategies and trends of art co-branding represents a significant contribution to understanding the dynamic relationship between art and fashion in the contemporary business environment and the business potential of using art as a marketing tool to enhance brand identity and increase sales.

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The Impact of Innovation Management on the Electronic Communications Industry

–Taking Huawei as an Example

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Abstract: Innovation management emphasizes continuous innovation through effective organization and resource allocation to improve competitiveness and promote sustainable development. The purpose of this paper is to explore the impact of innovation management on the electronic communications industry and to analyze it in depth with Huawei as an example. Through the research method of literature analysis, we find that innovation management plays a crucial role in the development of the electronic communications industry, and its impact on the electronic communications industry is mainly reflected in the three aspects of technology and product innovation, business model innovation and organizational culture innovation. Research on innovation management can help enterprises improve their competitiveness in a rapidly changing market environment and enhance their innovation capabilities in all aspects, thereby increasing their market share and profitability. It also helps electronic communication enterprises to maintain the leading position in technology and business models and to establish effective R&D processes and innovation mechanisms. In addition, research on innovation management can provide lessons for other electronic communication enterprises and even other industries, so that more enterprises and industries can better cope with the challenges of the market and realize healthy and sustainable development.

Keywords: enterprise innovation management, electronic communications industry, Huawei, core competitiveness, sustainable development

1. Introduction

The impact of innovation management on the electronic communications industry has been widely researched and discussed, and this paper will discuss how innovation development can promote better business innovation, business model innovation and organizational culture innovation in the electronic communications industry.

This paper adopts the research method of literature analysis to explore the application of innovation management in the electronic communications industry, its effects, and its role in promoting the development of the industry by collecting, organizing, and analyzing literature related to innovation management, the electronic communications industry, and Huawei.

It is of great theoretical and practical significance to study the impact of innovation management on the electronic communications industry. Firstly, in-depth research on innovation management can enable enterprises to introduce new products, services and technologies of better quality, meet the changing needs of consumers, and increase their market share and profitability. Secondly, it can also help more electronic communication enterprises to stay ahead of the curve in terms of technology and business models, enabling them to establish effective R&D processes and innovation mechanisms and strengthen their technological innovation capabilities. In addition, research on innovation management can promote the creation and sharing of knowledge, help more enterprises understand how to effectively manage and utilize knowledge resources, and establish learning organizations and innovation networks.

2. Innovation Management and the Electronic Communications Industry

2.1. Introduction to Innovation Management in Business

Corporate innovation management is the process of promoting innovation through systematic approaches and strategies in the organization, resources and processes of a company [1]. Innovation management is a key factor for sustained growth and competitive advantage and can help organizations remain competitive in a changing market environment [2]. Innovation is the creation of something new with commercial value by introducing new ideas, methods, products, services or business models based on existing knowledge and technology. Innovation management, on the other hand, refers to the process of innovation in enterprises, through rational organization and management, to promote the development and application of innovation. The core of enterprise innovation management is the formulation and implementation of an innovation strategy. Innovation strategy is the process by which an enterprise clarifies and formulates its innovation objectives, scope and focus. Enterprises need to determine the direction and focus areas of innovation based on their own business strategy and market demand. The formulation of innovation strategy needs to take into account market trends, competitors, technological development and other factors to ensure that the enterprise's innovation can match the market demand.

The purpose of enterprise innovation management is to promote the innovation activities of enterprises and improve their competitiveness and sustainable development ability. Enterprise innovation management can help enterprises realize technological innovation, product innovation and business model innovation, which can improve their market position and profitability [3]. At the same time, through innovation management, enterprises can scientifically and reasonably complete the allocation of resources and the use of funds planning, clear their own market positioning, and find the enterprise's own advantageous business and develop it, which in turn helps enterprises to realize the goal of the establishment of the core competitive advantage in the market. In addition, innovation management can also promote the cooperation between enterprises and external partners to jointly promote innovation activities and accelerate the introduction and application of new technologies and new knowledge [4].

2.2. Introduction to the Electronic Communications Industry

The electronic communications industry refers to the industrial field involving electronics and communications technology, which mainly includes telecommunications carriers, equipment manufacturers, network service providers, communications software developers and other related enterprises. The scope of this industry covers a wide range of fields such as telecommunication network construction, telecommunication equipment manufacturing, telecommunication service provision, and telecommunication software development.

There are three main characteristics of the electronic communications industry. First, the electronic communications industry is an industry that is highly dependent on technological innovation, which constantly promotes the development and progress of communications technology. As technology continues to advance, the electronic communications industry continues to introduce new technologies and solutions, such as 5G, Internet of Things (IoT), artificial intelligence, etc., in order to meet people's needs for faster, more reliable and safer communications. Second, the electronic communications industry is a highly competitive market, with fierce competition among various companies in terms of technology, products and services. Telecommunications operators compete for subscriber market share, equipment manufacturers compete to launch new products, and communications software developers continue to innovate and develop new applications to meet user needs. Third, the electronic communications industry is characterized by globalization, with enterprises from various countries and regions conducting business activities on a global scale. Multinational telecommunication operators build and operate communication networks in different countries, equipment manufacturers sell their products globally, and communication software developers provide globalized applications. The development of globalization has made the electronic communications industry an important part of the global economy.

The electronic communication industry has an important position and role in modern society. First of all, the electronic communication industry is an important driving force for modern economic development. The development and popularization of communication technology provide efficient communication and information exchange methods for all walks of life, and promote the globalization and digital transformation of the economy. The development of the electronic communications industry is important for improving productivity, promoting innovation and fostering economic growth. In addition, the development of the electronic communications industry promotes the development of society and the improvement of the quality of life. Through electronic communication technology, people can make voice calls, video calls and other forms of communication anytime and anywhere, realizing instant communication on a global scale and facilitating life and work. At the same time, the electronic communication industry also provides a broad platform for the dissemination of information in the fields of news, entertainment, education and transportation.

3. Impact of Innovation Management on the Electronic Communications Industry

Innovation management plays a vital role in the development of the electronic communications industry, and it has positively impacted the industry in the following ways.

3.1. Enterprise Competitiveness

First, innovation management promotes business model innovation in telecommunication and communication enterprises. By redesigning and optimizing business processes and introducing new business models and sources of revenue, enterprises can gain a competitive advantage in a highly competitive market. For example, Telecom operators can create new business models, provide more diversified services, and increase revenue sources by providing value-added services, customized packages, and cross-border cooperation, thus improving competitiveness [5].

Second, innovation management can help companies improve operational efficiency and reduce costs. In the telecommunication and communication industry, cost control is one of the key factors of enterprise competitiveness. Through innovation management, enterprises can introduce new technologies and processes to improve production and operational efficiency, thereby reducing costs. For example, the use of automation technology can reduce labor costs and the use of cloud computing can reduce infrastructure investment.

3.2. Market Share

Innovation management has a positive impact on the competitive position and share of the market of telecommunication and communication enterprises. Firstly, innovation management improves the product differentiation ability of telecommunication enterprises. Through the implementation of innovation management, enterprises are able to continuously introduce products with unique features and advantages, thereby attracting more consumers and expanding their market share. For example, by introducing and improving existing communication technologies, such as mobile payment and video calling, consumers' demands for high-quality, convenient and diversified communication needs can be met, thus increasing the market share of enterprises [6].

Secondly, innovation management promotes the market expansion ability of telecommunication and communication enterprises. By continuously innovating and exploring new market areas, companies can expand their market share and gain more market share. For example, telecommunication operators can increase their market share by launching new packages and services and entering emerging markets, such as the Internet of Things, cloud computing, and smart homes [5].

3.3. Products and Services

Innovation management promotes the process of product innovation in the telecommunication and communication industry, and improves the quality and level of services in the industry. First of all, innovation management promotes the product innovation of telecommunication and communication enterprises. Through the implementation of innovation management, enterprises are able to continuously introduce new technologies and functions to improve the performance and quality of their products and meet consumer demand for high-quality communication products. For example, the introduction and continuous updating of technologies such as AR and VR can provide users with a faster, more stable and richer communication experience, thus increasing the competitiveness and market share of enterprises [7].

Secondly, innovation management promotes the service improvement of telecommunication and communication enterprises. Through innovation management methods, firms are able to improve service processes, enhance service quality and increase the degree of personalization and customization of services to meet consumer demand for personalized, convenient and efficient communication services. For example, the introduction of innovative service models such as intelligent customer service, online self-service and personalized marketing can enhance user experience and increase user stickiness [8].

3.4. Enterprise Performance and Culture

First, innovation management emphasizes encouraging innovative thinking and behavior among employees, thus shaping a positive innovation culture. Through the implementation of innovation management, enterprises can establish a working environment that is open, inclusive and encourages innovation. Employees are encouraged to come up with new ideas and innovative solutions. The establishment of this innovation culture helps to stimulate the creativity and innovation potential of employees and drives the enterprise to continuously pursue performance excellence [9].

Second, innovation management emphasizes teamwork and knowledge sharing, which promotes a collaborative and learning performance culture. Innovation management encourages cooperation and communication among employees and promotes knowledge sharing and transfer. Team members can work together to solve problems, share experiences and knowledge. This collaborative and learning performance culture helps firms to form effective teams and learning organizations, and improve their performance levels [10].

4. Huawei's Innovation Management Practices

Huawei, as a globally recognized electronic communications company, has been actively practicing innovation management and has successfully managed innovation in the company in the following six ways.

4.1. Culture Shaping

First, Huawei focuses on the establishment and inheritance of an innovation culture. Huawei regards innovation as one of its core values and integrates it into its corporate culture. The importance of innovation is emphasized within the company, and employees are encouraged to come up with new ideas and innovative solutions. Huawei motivates employees to participate in innovation by organizing various innovation activities and setting up an innovation reward mechanism, and permeates the innovation culture into all levels of the company [11].

Second, Huawei advocates an open and inclusive innovation environment. Huawei encourages communication and cooperation among employees and provides an open platform where employees can share and exchange innovative ideas and experiences. Communication channels within the company are open, and employees are free to raise issues, discussions and solutions. This open and inclusive innovation environment helps to stimulate employees' creativity and innovation potential [12]. Huawei also focuses on knowledge management and the construction of a learning organization. The company encourages employees to continuously learn and improve their knowledge and skills, and provides corresponding training and learning opportunities.

4.2. Organizational Structure

First, Huawei adopts a flat organizational structure to encourage employees to innovate and make decisions on their own. Huawei's organizational structure has a high degree of flexibility and adaptability, enabling it to respond quickly to market changes and technological developments. This flat organizational structure helps to reduce decision-making levels, improve the efficiency of information flow, and promote the generation and dissemination of innovation [13].

Second, Huawei has established a globalized network of R&D centers, attracting top research talents from around the world. Huawei has formed an open innovation ecosystem by setting up R&D centers around the world and collaborating with partners and research institutions around the world. This globalized R&D network helps to attract and integrate global innovation resources and improve the capacity and efficiency of innovation [14].

In addition, Huawei motivates employees to participate in innovation by organizing various innovation activities and innovation reward mechanisms. The establishment of this innovation culture helps to stimulate the creativity and innovation potential of employees and promotes the occurrence and landing of innovation [15].

4.3. Process Optimization

First, Huawei focuses on the refinement and standardization of processes. Huawei has improved work efficiency and quality through the refined design and standardized management of various business processes. Huawei has established a comprehensive process management system, including process specification, process evaluation, and process improvement, which improves the speed and effectiveness of innovation by continuously optimizing processes [16].

Second, Huawei advocates cross-departmental synergy and cooperation. Huawei promotes information sharing and resource integration between different departments by establishing cross-departmental synergy mechanisms and teams. Huawei encourages employees to cross departmental

boundaries and participate in cross-functional innovation projects, realizing cross-border integration of knowledge and experience.

In addition, Huawei focuses on process agility and rapid responsiveness. Huawei has accelerated the advancement of innovation projects by introducing agile development and rapid iteration methods. Huawei encourages employees to make quick trial and error and learn quickly, which improves the efficiency and quality of innovation through continuous iteration and optimization [17].

4.4. Resource Allocation

First, Huawei focuses on the centralized allocation of resources. By focusing resources on key innovation projects, Huawei ensures the effective use of resources and the realization of maximized value. Huawei evaluates and allocates resources at the early stages of innovation projects, and focuses limited resources on projects with high potential and strategic significance to improve the success rate of innovation and market competitiveness [18].

Second, Huawei focuses on the flexible allocation of resources. By flexibly allocating resources, Huawei is able to better respond to market demands and changes. Huawei has established a flexible resource allocation mechanism that allows it to adjust the allocation and use of resources in a timely manner according to market conditions and project needs to ensure the smooth and successful implementation of innovation projects [19].

In addition, Huawei focuses on cross-departmental integration of resources. Huawei realizes the sharing and collaborative use of resources through cross-departmental integration. Huawei encourages cooperation and coordination between different departments and promotes cross-departmental integration of resources in order to improve the efficiency of resource utilization and the comprehensive capability of innovation projects [20].

4.5. Transformation of Achievements

First, Huawei focuses on the transformation of technological achievements. Huawei establishes a technology transformation mechanism to rapidly transform R&D technological achievements into commercialized products and solutions. Huawei actively promotes the interface between technology and the market, and through the guidance of market demand and the development of product customization, Huawei transforms technological achievements into commercially valuable products, realizing the organic combination of technological innovation and commercial success [21].

Second, Huawei focuses on the transformation of knowledge achievements. Huawei promotes the flow and transformation of knowledge by establishing a knowledge management system and a knowledge-sharing platform. Huawei encourages knowledge sharing and cooperation among employees, and promotes the transformation and commercialization of innovations through internal training and exchange activities that transform R&D staff's expertise and experience into practical applications [22].

In addition, Huawei focuses on the transformation of partners' achievements. Huawei has established close cooperative relationships with its partners to jointly promote the transformation of innovations. Huawei works closely with suppliers, customers, research institutes, and other partners to share resources and knowledge, jointly develop and promote innovative products and solutions, and maximize the value of innovations [23].

4.6. Evaluation and Improvement

First, Huawei focuses on the evaluation of innovation performance. Huawei has established a complete set of innovation performance evaluation systems to evaluate innovation projects and teams through quantitative and qualitative indicators. Through the evaluation of innovation performance,

Huawei finds problems and deficiencies in a timely manner, provides data support for innovation management, and promotes the refinement and continuous improvement of innovation management [23].

Second, Huawei focuses on the improvement of the innovation process. Huawei continuously optimizes the innovation process to improve innovation efficiency and quality. Huawei also encourages employees to participate in the improvement of the innovation process, advocates rapid trial and error and continuous learning, and promotes flexibility and adaptability of innovation management [24].

Evaluation and improvement help to improve the effectiveness and efficiency of innovation management, and promote the company's continuous innovation and competitiveness.

5. Conclusion

Through the above analysis, the following conclusions can be drawn: (1) Under the rapidly changing market environment, enterprises need to innovate continuously to adapt to market demand and improve competitiveness. Innovation management can help enterprises cultivate innovation awareness, establish innovation mechanisms, and promote the improvement of organizational innovation capability. (2) As a leading enterprise in the electronic communications industry, Huawei focuses on scientific and technological innovation and organizational innovation, and constantly promotes the innovation and upgrading of its products and services through the establishment of R&D centers and technical cooperation. Huawei's innovation management practices provide useful references for other electronic communication enterprises. (3) The impact of innovation management on the electronic communications industry is mainly reflected in three aspects: technological innovation, product innovation and business model innovation. Innovation management can help enterprises strengthen technology research and development and promote technological progress; meet user needs and improve user experience through innovative products and services; and realize profitable growth and market share enhancement through innovative business models. (4) Innovation management also faces some challenges and problems in the electronic communications industry. For example, the speed of technological change has accelerated, and companies need to be more agile in responding to market changes; knowledge management and talent cultivation have become important issues in innovation management; and innovation risks and uncertainties have increased, and companies need to manage the innovation process more effectively.

Based on above conclusions and findings, this study proposes the following future research directions to further explore in depth the impact of innovation management on the electronic communications industry: (1) exploring the differences of innovation management in the electronic communications industry in different countries and regions. There are differences in the level of development and market environment of the electronic communications industry in different countries and regions, and the practice and effect of innovation management may also vary. Comparing the innovation management practices in different regions can help companies better meet the challenges of local and global markets. (2) Focus on the social impact of technological innovation and sustainable development issues. Technological innovation plays an important driving role in the electronic communications industry, but it also brings a series of social and environmental problems. Future research can explore how to balance the relationship between technological innovation and sustainable development to promote the healthy and sustainable development of the electronic communications industry.

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Study on Brand Management of Fashion Brands

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Abstract: Amidst the backdrop of swift economic progression and surging consumption rates, the global goods market is witnessing heightened brand competition. This evolving scenario has rendered domestic fashion brands particularly susceptible to various external adversities. Prominent among these challenges are misconceptions in brand management characterized by inadequate market positioning, diminished market share, nascent brand imagery, evolving marketing channels, and stagnation in social marketing innovation. To traverse this intricate environment, businesses must champion a forward-leaning stance, assimilate insights from seasoned brand management practices, and perpetually refine their branding techniques. This deliberate nurturing aims to bolster and expand their brand equity. In light of these observations, this paper articulates multiple strategies to amplify brand management, encompassing the amplification of consumer desires, recalibration of fashion marketing paradigms, in-depth consumer behavior insights, nuanced focus on marketing touchpoints, adoption of holistic multimedia marketing avenues, and harnessing the potential of fashion communication ecosystems. This synthesis is envisioned to serve as a compass for marketing aficionados, equipping enterprises to carve a distinctive niche in a saturated market, thereby charting a trajectory for resilient growth.

Keywords: fashion brands, brand management, consumer insights

1. Introduction

Why do certain brands briefly shine only to fade quickly? Why do domestic brands, even when priced lower than their international counterparts, struggle to gain acclaim? Why do sales plummet once advertising campaigns halt? How is it that a single quality issue can decimate a brand, while industry giants like Nestlé and Toshiba withstand numerous quality setbacks with minimal repercussions? At the heart of these quandaries is the observation that many Chinese enterprises possess a limited grasp of brand management, often lacking depth and breadth in their understanding. With China's induction into the World Trade Organization, its assimilation into the global market is expedited, ushering in heightened competition. As the consumer landscape shifts, the diversity of consumer demands surges, positioning a company's brand as an essential cornerstone for market stability. Confronted with fierce market rivalry and the formidable presence of renowned international brands, domestic enterprises must introspectively evaluate their marketing tactics. Historical trends indicate that in such a macroeconomic setting, cultivating a robust brand emerges as the linchpin for sustaining a competitive edge [1]. But, what constitutes a quality brand? This paper believes that the foundation of corporate success resides in embracing the

right sales ethos and executing multifaceted, empirically-backed brand strategies. This exploration primarily delves into bolstering brand marketing prowess and enhancing brand management effectiveness [4]. An in-depth foray into brand management techniques empowers businesses to underscore brand management's significance, offering a roadmap for firms to craft potent marketing blueprints, thereby magnifying their competitive advantage and setting the stage for global brand expansion.

2. Challenges in Modern Brand Management

Key challenges confronting contemporary brand management include: (1) Vague Brand Positioning: Initial product launches frequently suffer from indistinct brand positioning, resulting in diminished market resonance and an absence of strategic positioning support. (2) Limited Market Share: "Perfect Diary", as a case in point, fails to showcase distinctive advantages or innovation relative to competitors, curbing its market dominance. (3) Underdeveloped Brand Imagery: Brands such as Metersbonwe no longer align with evolving market demands or consumer aesthetics. Their inability to manifest uniqueness has caused a decline in brand clarity and resonance. (4) Sub-optimal Channel Strategy: Certain brands fall short in channel development, missing comprehensive market coverage. Additionally, channel management deficiencies exacerbate market share losses [2]. (5) Stagnant Social Marketing Innovations: Some brands adopt a reactive stance in social marketing, lacking novelty and falling short in consumer engagement, which impedes brand visibility enhancement.

3. Trajectory of Chinese Fashion Brands in Today's Marketplace

Amid the receding presence of international fashion entities in China, indigenous brands have been gaining increased consumer affinity. The rising financial clout of Chinese consumers has bolstered the prominence of native brands. Enhanced by a robust domestic supply chain, recent years have witnessed a pronounced online footprint of both local fashion brands and influencer-affiliated labels. Noteworthy trends encompass.

3.1. Continual Expansion of Industry Scale

The Chinese fashion domain has undergone rapid evolution in recent times, marked by an expanding consumer demographic. The advent of innovative retail paradigms has amplified the sector's growth prospects, luring an expansive consumer base. Concurrently, a diverse array of technologically sophisticated, tailored products with unique attributes has surfaced, piquing consumer interest. The ascent of numerous indigenous brands, championing the "national trend" or "Guo Chao", underscores a progressive and expansive fashion milieu. The rise of "new national tide" makes Chinese culture become the focus of global attention, and more and more consumers begin to spontaneously pursue products with Chinese characteristics and local cultural heritage, and have higher expectations and requirements for brands.

3.2. Evolving Consumer Demographics and Preferences

China has witnessed a notable surge in its consumer purchasing prowess. The urban middle-class demographic, which stood at 44% in 2018, saw an impressive rise to 55% by 2022. Simultaneously, there's an escalating propensity among consumers to invest in fashionable, high-quality products with superior aesthetic appeal. For instance, when examining the retail dynamics within the footwear and clothing sector, 2018 statistics revealed mid-tier and luxury products commanding market shares of 8.4% and 8.0%, respectively. Fast forward to 2022, these figures climbed to 10.0%

and 11.8%. Such data accentuates the modern consumer's elevated appreciation for fashion brands. Furthermore, fashion branding efforts are increasingly pivoting toward the urban middle and working classes.

3.3. Millennials and Gen Z: Pioneers of Contemporary Consumption Patterns

By 2022, Millennials and Gen Z in China constituted a formidable 570 million, solidifying their position as principal consumer powerhouses. Characteristically avant-garde in their purchasing behavior, this cohort showcases a distinct fashion cognizance and a profound comprehension of evolving trends. For instance, a discernible tilt toward casual and minimalist footwear and apparel prevails. Industry trends denote that the sartorial inclinations of Millennials and Gen Z exert a ripple effect on other generational consumption choices, thereby amplifying China's fashion market. Addressing these dynamics, businesses need to perpetually innovate, remain attuned to fashion zeitgeist, refine brand marketing maneuvers, bolster customer engagement acumen, and cultivate a nuanced grasp of customer predilections – all pivotal for sustaining a competitive vantage.

3.4. Proliferation of Retail Outlets

Fashion brands are fervently embracing an Online to Offline (O2O) multi-channel marketing paradigm, synthesizing online and physical retailing tactics. With e-commerce carving an indispensable niche and its trajectory ascending, online retail corridors for fashion brands are burgeoning. In tandem, physical store footprints are also expanding, transcending restrictive sales channels and ensuring product accessibility across urban sprawls and provinces.

3.5. Recession of International Retail Titans

Amid China's economic crescendo, global brands rapidly staked their claims. 2002 heralded this epoch, with Uniqlo inaugurating its Shanghai flagship outlet. The subsequent decade saw an inundation of overseas fashion brands vying for Chinese market supremacy. Yet, in recent years, the momentum of these international brands has decelerated, beleaguered by e-commerce proliferation and evolving consumer preferences. The biennium of 2018-2019 epitomized this shift. Come 2020, economic vicissitudes catalyzed the retreat of several global fashion mainstays. Emblematic of this trend, Old Navy bowed out of mainland China in March. Similarly, Esprit, in its failed quest to rival ZARA, shuttered its outlets by May's end, signaling its comprehensive exit. Such market vacuums proffered indigenous brands a window to expand and capitalize on newfound developmental avenues.

3.6. Future Direction of the Fashion Industry

3.6.1. Emergence of Holiday-Centric Consumption

The escalating income of urban dwellers has spurred a surge in expenditures spanning home decor, leisurely pursuits, and holiday-centric consumption. Fashion brands, tapping into this upswing, are poised to craft innovative, niche, and tailored thematic initiatives. This strategy, aligned with emergent consumption patterns, is pivotal for bolstering customer allegiance.

3.6.2. Accentuating Brand Culture and Identity

A discernible shift in consumer sentiment is evident; brand resonance now trumps mere quality considerations. This underscores the imperative for brands to weave a distinct cultural tapestry,

harnessing avenues of cultural dialogue and interchange, positioning this as a cardinal vector for future brand evolution.

3.6.3. Redefining Social Media Engagement Paradigms

The omnipresence of social media has impelled fashion brands to harness these platforms, amplifying their brand footprint. By aligning with influential bloggers and fashion cognoscenti, and assimilating seamlessly with novel media channels, some brands have even metamorphosed these platforms into primary marketing conduits. The objective is lucid: craft a fresh, resonant communication ethos on social media, mirroring the fluidity of the fashion zeitgeist. The shaping of a fashion brand, as well as the development of fashion marketing activities, only rely on advertising and other traditional means is far from enough, because advertising marketing is difficult to take into account the product and terminal details of the publicity, can not carry out intensive cultivation. Fine marketing, but also play not to export the power of tablet marketing.

In retrospect, the Chinese fashion domain is in the throes of dynamic growth. Noteworthy expansion of industry scale, a burgeoning consumer cohort, and an ever-widening retail outreach underscore this narrative. The nexus between online and offline realms, orchestrated via an O2O strategy, forms the industry's backbone. Employing culture as a lever, brands are recalibrating their social media dialogues, and holiday-centric consumption is forecasted to sculpt new industry contours. With fashion sensibilities in perpetual flux, and brand cognizance among consumers soaring, it behooves enterprises to ratchet up brand promotional vigor, seeking unrelenting brand salience and market supremacy. Concurrently, a recalibration of channel strategies, ensuring a judicious channel matrix, becomes paramount. Brands must also finetune their supply chain mechanisms, extending their e-commerce outreach, thus ensuring their brand ethos is ubiquitously echoed. The ultimate litmus test: engendering unwavering brand loyalty, the bedrock of sustained profitability.

4. Strategies for Optimization

4.1. Elevating Consumer Purchase Intent

In the rapidly evolving market landscape, fashion brands must be attuned to their target audience's consumption aspirations. Brands must advocate fashion evolution, dynamically displaying the tangible benefits of their offerings. Innovations in brand marketing are imperative, with an emphasis on elevating the consumer journey and engendering brand allegiance. In the marketing lifecycle, it is paramount to immerse in the cultural nuances of products, align with latent consumer inclinations, and deploy captivating visual cues, such as stark color juxtapositions, all geared towards invigorating consumer purchase fervor.

4.2. Aligning Marketing Endeavors with Core Brand Values

For brand management initiatives to resonate, the brand's intrinsic value serves as the linchpin. Brands must perpetually rejuvenate this core essence to resonate with market dynamics and chart sustainable growth trajectories. Brand is the core meaning of modern enterprise [3]. In fact, the brand is an abstract concept, there is no actual objective existence. It is a collection of ideas that exist in the minds of consumers. Building a brand is a process of constantly catering to the real market and society with the brand concept, and finding a suitable road for brand development will be a powerful weapon to stand out from the ocean of brand war. Stakeholders must predicate their strategies on the brand's ethos, be cognizant of myriad influencing factors, and endeavor to elevate the brand's intrinsic worth. By staying in sync with economic trends and gauging consumer intent,

brands can discern diverse consumer segments and tailor their offerings. Holistic market assessments can further finetune marketing campaigns, infusing the brand with profound resonance. It's crucial to predicate brand recalibrations on consumer proclivities, assimilate market insights, and recalibrate product price points. Selective geographic pilots, predicated on market nuances, can yield rich insights into consumer reception, fortifying brand positioning.

4.3. Emphasizing Behavioral Consumer Analytics

The linchpin of enduring brand growth is an intimate understanding of its consumer base. By harnessing insights into consumer psychographics, brands can tailor their flagship offerings, incessantly refining them to mirror consumer aspirations [4]. It is pivotal to underscore brand value propositions, converging premium quality with a utilitarian appeal, ensuring brand endorsement and spurring consumer expenditure. During tactical marketing endeavors, meticulous dissection of consumer predilections and product affinities is a must. These insights can steer in-store presentations and product assortments. A heightened emphasis on the experiential facets of brand engagement is vital. By recognizing consumer heterogeneity, brands can craft bespoke promotional campaigns, ensuring their messaging resonates profoundly [5]. This, in turn, crystallizes product value perceptions, igniting purchase intent and amplifying marketing efficacy.

4.4. Refined Terminal Marketing Strategies

Sole reliance on traditional advertising is insufficient for enhancing brand reach in today's evolving socio-economic environment. As consumer preferences become more individualistic, it's pivotal for marketers to adapt by refining end-user services that echo these nuances. Brands should integrate responsive fashion marketing sections within their official channels to garner real-time feedback [6]. Using platforms like Douyin (TikTok) can extend reach, while strategies such as rewarding brand-video sharing can bolster user loyalty and allure potential consumers, thereby amplifying brand stature [7].

4.5. Multi-Faceted Multimedia Marketing

Given the technological strides in the digital realm, brands must transition from one-dimensional promotional tactics to dynamic multimedia methodologies. This shift offers a dual advantage: it intrigues customers with immersive brand narratives and facilitates seamless access to current product offerings [8]. By harnessing the potential of evolving media landscapes, brands can foster more intimate relationships with consumers, ensuring not only precise service delivery but also augmented customer loyalty, culminating in heightened brand resonance [9].

4.6. Capitalizing on Fashion Media Platforms

Consumers consistently engage with fashion content, notably via televised programs. While not explicitly fashion-centric, several popular shows are perceived through a fashion lens by audiences. Brands can strategically associate with these programs to inspire a fashion narrative, enhancing their visibility manifold. Fashion, being an evergreen domain, demands brands to harness premier promotional avenues to stay contemporary [10]. Collaborations with fashion communication mediums, such as securing sponsored segments within high-profile shows, can yield more potent brand recognition than conventional advertising methods.

5. Conclusion

In an era marked by a thriving market economy, the role of brand marketing and management has never been more pivotal in steering enterprises towards successful trajectories. It is imperative for businesses, especially within domestic realms, to prioritize robust brand management, attune to the market's pulse, leverage inherent brand virtues, and cultivate an enlightened operational ethos. The objective remains clear: to delineate a brand's positioning sharply and sculpt an unparalleled brand persona of premium caliber.

It's incumbent upon marketing professionals to possess a holistic grasp of consumer inclinations, anchoring brand realities as their strategizing fulcrum. Instituting a methodical brand management framework, cherry-picking efficacious fashion marketing techniques, championing meticulous terminal marketing, and proactively troubleshooting managerial challenges are all crucial. Such adeptness in marketing stewardship equips brands with a competitive edge. Collectively, these endeavors not only fortify individual enterprises but also propel China's evolution from merely being a vast brand reservoir to emerging as a bastion of influential global brands.

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Research on Anchoring Effect

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Abstract: A psychological phenomena is the anchoring effect. It alludes to the idea of a person's judgment or choice being influenced by an otherwise unrelated reference point or "anchor." Once the anchor's value is determined in numerical anchoring, the person's following arguments, estimates, etc., may differ from what they would have been without the anchor. Traditional economics holds that people make rational decisions and are not distracted by meaningless numbers. The "anchoring effect" discovered by Daniel-Kahneman-and-Amos-Tversky is a very typical psychological bias, and it is a rejection of the assumption of a "rational person." The anchoring effect refers to the fact that when people need to evaluate an event, they will use some specific value as an initial reference value, and this initial reference value is like an anchor that restricts the evaluation result.

Keywords: anchoring effect, judgement, influence

1. Introduction

The first thing to introduce is the definition of the anchoring effect: People start with an initial figure and then alter it to get the final result when making estimates. The beginning value, often known as the starting point, may be indicated by how the problem is phrased or it may be the outcome of a partial computation [1]. Adjustments are often insufficient in both scenarios. To put it another way, different starting points result in various estimations that are skewed toward the initial values. This occurrence fits the definition of anchoring [2]. Science, 1974; Tversky and Kahneman. This historical research illustration serves as a model for future anchoring effect research and contributes to a deeper comprehension of the phenomenon.

2. Analysis of Anchoring Effects

Here are some examples of anchoring effects:

This paper focuses on the anchoring effect and its effects.

First of all, Amos Tversky and Daniel Kahneman were the ones who first notice and theorize the anchoring effect. In 2002, he was awarded the Economics Nobel Prize. In five seconds, participants were required to calculate $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$ and $8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$. Participants attempted to approximate the answers because they didn't have enough time to perform calculations. This is a pretty clear and straightforward illustration of the anchoring effect. Participants estimated 512 starting with small numbers (1 to 8); starting with large numbers (8 to 1), participants guessed 2250. The right response is 40,320. Other "estimation" have shown the same phenomenon. In 1973, Kahneman and Tversky demonstrated that people frequently give salient and memorable information

undue weight in their assessments, even distorting their perceptions as a result. For instance, doctors frequently consider the possibility of the patient's suicide when determining the risk that a patient may harm themselves out of profound disappointment. The anchor effect, which affects people's judgements at this moment, may cause the risk that the patient would attempt suicide if they are highly dissatisfied to be overestimated if a representative economic judgment is made.

The sinking anchor effect was further demonstrated in tests by Kahneman and Tversky in 1974. The experimenters were tasked with calculating the proportion of seats held by African nations in the UN. The experimenter is actually asked to estimate the numerator because the denominator is 100. To begin, participants were instructed to turn a compass that was in front of them and select a number at random between 0 and 100. The outcome of the experimenter's choice was then revealed, indicating whether it was greater or smaller than it actually was. The next step was for the scientist to calculate the molecular value by changing to randomly chosen numbers, either up or down. Through this experiment, Kahneman and Tversky discovered that separate groups' differently generated random numbers had a significant impact on subsequent estimates [3]. For instance, the average estimates for two groups with randomly chosen beginning points of 10 and 65 were 25 and 45, respectively. As a result, the experimenters anchored their estimations of the molecular value within a range of the randomly chosen number, even after adjusting for it. Thus, even though the wheel's number is chosen at random, it still provides participants with a reference point. Such an anchor point may also affect people's final answers, per the anchoring effect. In line with this result, Harvard Business School conducted the subsequent experiment.

Professor John Sen Manton asked participants with no background knowledge to answer two sets of questions: Is the population of Turkey greater than 35 million? What do you think the population of Turkey is?

Is the population of Turkey greater than 100 million? What do you think the population of Turkey is?

The experimental results showed that when the number of people asked in the first question increased, the subjects without exception increased the estimated number of people when answering the second question, which indicated that the first question set an "anchor" for the subjects. There are also plenty of examples in our lives to prove that we are easily influenced by various kinds of "anchoring" thinking and judgment, in different forms. For example, casual comments from colleagues, morning newspaper figures, people's clothes, etc. These anchors can influence our thinking and judgment on a certain problem without our awareness.

Third, in 1999, psychologists Strack and Musweller did an experiment that consisted of two questions. The first group had to answer the first question: Did the great Mahatma Gandhi die before or after the age of nine? And when they do, then the psychologist will ask you to guess how old Gandhi was. The second group also had to answer two questions below: 1. The first question the second group had to answer was did the great man Gandhi die before he was 140 or after he was 140? 2. When the second group of subjects answered, the same psychologist asked them, how old would you guess Gandhi lived? If we know anything about Gandhi, we know that he must have lived longer than nine years, and he could not have lived longer than 140 years, since the world's oldest man was 122 years old. So the first question on this test seems pretty boring, and everyone can answer it correctly, but it turns out that the first question significantly affects how people answer the second question. When asked how many years Gandhi lived, the average answer given by the first group was 50, while the average answer given by the second group was 67. So why was the first group's guess average 17 years lower? Because the first piece of information that the first group received was "Did Gandhi lose before or after the age of nine?" This information influenced the participants' judgment at the age of nine, so experimental psychologists came to the conclusion that people are more likely to be influenced by the information they receive first when making a judgment about something.

People always take the first received information as a reference, and make corresponding judgments and decisions under the anchor of the newly received information. This psychological phenomenon eventually became known as the anchoring effect. The simple understanding of the anchoring effect is that we are easily influenced by the initial information when making decisions, and we do not consciously take the initial information as a reference. Why does the first piece of information we receive affect our judgment? Our brains need a reference, in the absence of which we will feel uneasy. That is difficult to judge. When A reference appears, even if the reference is unreliable, our brain will think this is a lifeline, and as the criterion, let us make a reassuring decision! Anchoring is also widely used in marketing. For example, Procter & Gamble will put a suggested retail price of 9.9 yuan on each bottle of Rejoice shampoo, but the actual retail price is 8.5 yuan! Why would you do that? Because the first thing consumers see is 9.9 yuan, they have taken 9.9 yuan as the reference in their hearts, and the actual price is only 8.5 yuan at this time. This difference between the suggested price and the selling price makes customers feel that it is very affordable. At this time, consumers still feel offended, so they will be happy to pay [4].

Fourth, in an article for the New York Times on March 31, 2010, technology critic David Pogue wrote, "In 10 years of writing technology reviews for The New York Times, I have never seen a product as sharply divided as Apple's iPad." According to Pogue, the consensus on Apple's new product announcement has been divided between "this is truly an incredible revolution" and "this is laughing your head off." Otherwise, there was hardly any sound between the two. That means launching the iPad is a decidedly risky venture, one that could cost a lot of money if it doesn't work, and one that many see as unnecessary and unmarketable. At that time, people's minds were only fixed on either computers or mobile phones, and they didn't think it was necessary to make such a product. Portability was not as good as a mobile phone, and performance was not as good as a computer. Instead, Apple managed to sell 7.5 million iPads within six months, generating \$5 billion in revenue. Ten years later, Apple has sold more than 400 million iPads. Apple earns \$200 billion in revenue directly from these 400 million iPads. The success of the iPad must be inseparable from the product itself. Any successful product must be superior in itself. But, Mr. Jobs's launch was also crucial in persuading people to try the new product. When introducing the iPad's pricing, Jobs started by talking about market rumors and what people were speculating or saying about the new product. Then, on the screen behind Jobs, the word "999" appeared, in bold type. At this point, the reader must have assumed that 999 dollars was the price of the new product and would keep watching.

The next minute, Jobs was still introducing new products. All the while, the big \$999 character behind him remained on the screen. But when it came to pricing, Jobs said, "I'm excited to announce that our iPad will start not at \$999, but at \$499." So, because of the stereotype of \$999, it's \$499, and people think it's amazing that it's twice as cheap, and it's worth it in the back of their minds.

But if we think about it, if Jobs had offered \$499 in the first place, people wouldn't have thought it was a bargain. Now, the reason people think it's cheap is because they already have the preconceived idea that it's \$999. This is the psychological anchoring effect. To put it in a nutshell, people like to feel cheap. If the lowest price is listed at the beginning, people will not think it is cheap; it is just a normal price [5].

Fifth, an experiment in 2003 Ariely, a professor at the Massachusetts Institute of Technology, asked graduates to make a connection between their Social Security number and the price of chocolate. He asked students to write down the last two digits of their social security card number on a piece of paper. They were then asked to rate the value of some of their most frequent purchases, such as chocolate or wine. The reason for this is that once the subjects have written down two numbers, they form an anchor point in their minds to decide how much to bid on a hard-to-price item. Therefore, the higher the two-digit number, the higher the price.

Anchoring effects can occur in all aspects of life, such as economic activity. Merchants often use the anchoring effect in marketing to gain more profits.

3. Conclusion

Some studies and related literature show that the anchoring effect, as a psychological effect, has a significant impact on many aspects of economics. Therefore, anchoring effects are very common in daily life, but different “anchors” have different effects, and different “anchor” objects have different results, which is dynamic to a certain extent. In recent years, scientists have believed that the origin of anchoring is mainly the reference function of the first stage, the information acquisition stage [6]. References bring more attention to similar information, and people even use the reference itself as a reference factor, which affects the final answer. The theory, supported by other experiments, is that understanding things starts with accepting a given conclusion and then weeding out false information. Choosing the information used to compare anchor and target points is more important in predicting the outcome. The theory states that information affects the outcome only if it is relevant to the goal. Given the lack of actual experiments on anchoring effects, none of these examples are vivid enough.

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The Optimization of the Path to Energy Transformation in Areas of Weak New Energy Resources under the Double Carbon Background

---Taking Anhui Province of China as an Example

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Abstract: “Double Carbon” is the abbreviation for emission peak and carbon neutrality. In September 2020, China proposed to strive to achieve an "emission peak" by 2030 and "carbon neutrality" by 2060. In this context, the process of energy transformation and new energy substitution is accelerating. And those areas with weak new energy resources urgently need to solve the transformation problems caused by limited local resources. Taking Anhui Province of China as an example, this essay studies the trend of energy development and changes, and compares Anhui with Jiangxi Province, which shares similar resource endowments, in order to explore energy transformation plans that are in line with provincially local conditions. The consumption of typical fossil fuels and the development conditions of new energy sources in Anhui Province are analyzed by using the methods of statistical and qualitative analysis. Based on the experience of transformation in neighboring Jiangxi Province and fully considering the functional orientation of Anhui Province in energy and economic fields in East China, this paper concludes that in Anhui Province, the efficient and safe utilization of local new energy resources should be given priority, along with actively promoting the technology of new energy generation and storage. Anhui Province should also strive to transfer existing rich new energy resources and promote cooperation in new energy supply with other provinces to improve the capability of energy guarantee, which may inject new impetus into economic development.

Keywords: carbon neutrality, emission peak, new energy transformation, Anhui Province of China

1. Introduction

Energy is closely related to the stability and development of the socio-economic system. Under the background of “Double Carbon”, energy transformation has become an inevitable trend, and new energy will have an important role to play in addressing climate change and promoting economic growth. However, the quality distribution of new energy sources such as solar energy, wind energy, and biomass energy is uneven, which hinders the energy transition in resource-deficient areas. Taking Anhui Province as an example, this essay will firstly analyze the current energy consumption situation

from the perspective of three major industries, and evaluates energy consumption and industry development based on the total carbon emissions. Following this, it will explore the distribution, utilization and restrictive development factors of new energy in Anhui Province. Using the case study method, this paper will take Jiangxi, a neighboring province of Anhui in East China, as an example to study the characteristics and relevant experiences of the energy transition. Finally, the Energy Transformation Plan of Anhui Province under the "Double Carbon" target will be proposed, considering the endowment difference, economic cost, and policy orientation of this province.

After the proposal of the "dual carbon" target, Wang Jipeng believed that many areas with weak new energy resources in China are facing new challenges in energy transformation, including energy security, social benefits, economic benefits, industrial transition and so on [1]. This type of area has mostly relied on fossil fuels for production and daily energy supply for decades, facing the pressure from the contradiction between economic growth and environmental protection. This paper will study a suitable energy transformation path for this type of area, which is also helpful to promote the reform and innovation of energy supply, realize green transformation of energy and resources industry, and ultimately achieve harmonious and green development of society.

2. Energy consumption and industrial development status in Anhui Province

2.1. Analysis of energy consumption in Anhui Province

According to the Anhui Statistical Yearbook, energy consumption in the province has increased year by year, as shown in Figure 1 [2]. It increased from 130.5187 million tons of standard coal in 2017 to 153.4263 million tons of standard coal in 2021, with an average annual growth rate of 3.29%. Among them, the growth rate in 2019 reached 5.80%, which was the fastest.

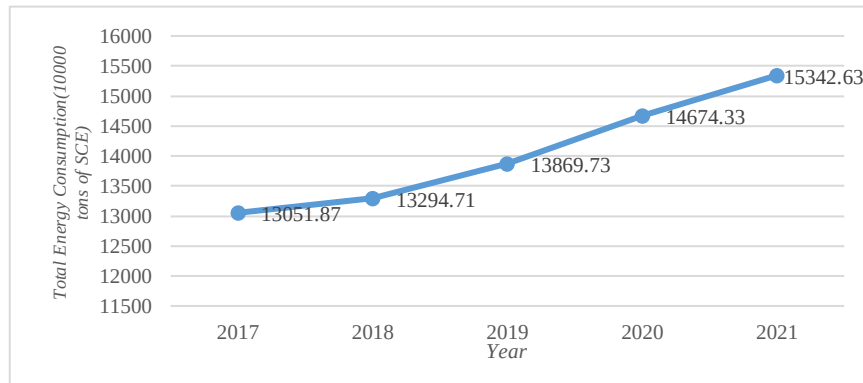


Figure 1: Trend of total energy consumption in Anhui Province from 2017 to 2021.

The elasticity ratio of energy consumption reflects the proportional relationship between the average growth rate of energy consumption and the average growth rate of the national economy. The elasticity ratios of energy consumption in Anhui Province in 2017 and 2018 were 0.33 and 0.26, respectively [2]. The gap between the growth rate of energy consumption and that of the national economy has widened further, which means that Anhui Province realizes sustained and rapid economic growth with less energy consumption.

Table 1: Elasticity ratios of energy consumption of Anhui Province from 2017 to 2021 [2].

	2017	2018	2019	2020	2021
Elasticity Ratio of Energy Consumption	0.33	0.26	0.58	1.55	0.53

According to China's National Economic Industry Classification, the three industries in China are the primary industry (agriculture, forestry, animal husbandry and fishery), the secondary industry (industry and construction) and the tertiary industry (service industry) [3]. From 2017 to 2021, the energy consumption of the secondary industry in Anhui Province was the largest, accounting for 77% to 78% of the total consumption, and it had increased year by year, as shown in Figure 2. The total energy consumption of the tertiary industry was on the rise, at 20%-21% of the total. Total energy consumption of the primary industry remained stable at the level of 2%.

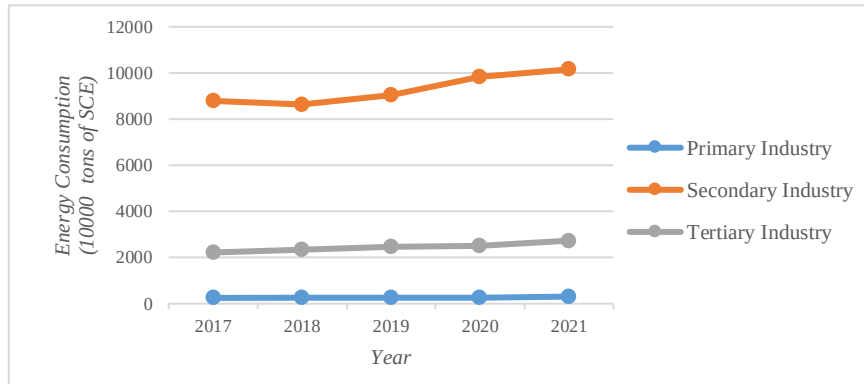


Figure 2: Energy consumption of three industries in Anhui Province from 2017 to 2021 [2].

2.2. Analysis of carbon emissions from energy consumption in Anhui Province

According to the IPCC 2006 National Greenhouse Gas Inventory Guidelines 2019 Revised Edition, based on the availability of energy statistics data of Anhui Province, eight major energy products shown in Table 2 were selected to calculate their separate carbon emissions [4]. The formula is as follows:

$$E(\text{CO}_2) = \sum_{i=1}^8 \omega_i \times N_i$$

In the formula, N_i is the consumption of energy i , calculated based on standard coal, 10^4t ; ω_i is the carbon emission coefficient of energy i ; i represents the type of energy. And the carbon emission coefficients of the eight selected energy products are shown in Table 2.

Table 2: Carbon emission coefficients of eight energy products [4].

The Type of Energy	Raw Coal	Washed and Refined Coal	Coke	Crude Oil	Gasoline	Kerosene	Diesel Oil	Natural Gas
Carbon Emission Coefficients	0.7559	0.7559	0.8550	0.5857	0.5538	0.5714	0.6185	0.5921

Since 2017, the total carbon emissions caused by energy consumption in Anhui Province have increased from 267.4442 million tons in 2017 to 275.1185 million tons in 2019, with an annual average growth rate of 0.94%.

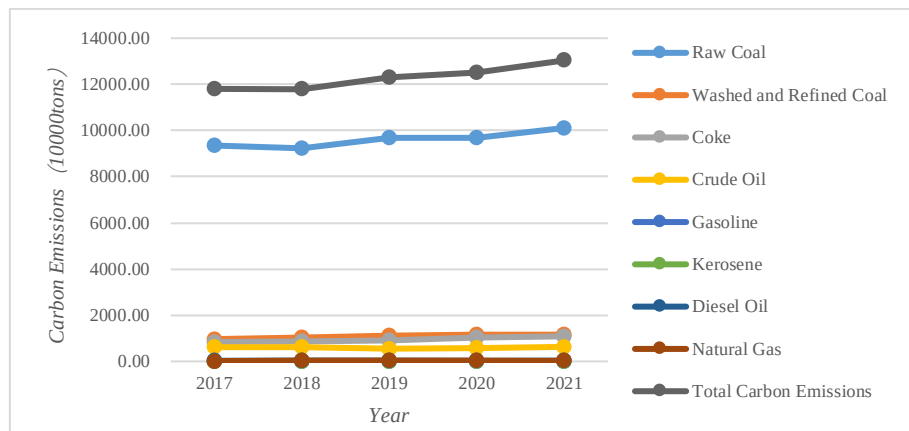


Figure 3: Carbon emissions of eight types of energy products from industrial enterprises in Anhui Province from 2017 to 2021.

As shown in Figure 3, the total carbon emissions of industrial enterprises increased from 118.2431 million tons of standard coal in 2017 to 130.3713 million tons of standard coal in 2021, indicating a high energy consumption in the industrial sector. Carbon emissions from raw coal were the largest, accounting for approximately 78% of the total emissions, with a clear upward trend after 2018. It can be seen that the industrial sector was an important driver for economic growth in Anhui Province. Therefore, in the background of "dual carbon", promoting the comprehensive energy transformation of Anhui Province is of great significance.

3. Natural resource and exploitation status of new energy in Anhui Province

The availability of new energy resources within a region largely depends on the natural resource endowment. This chapter will analyze the main natural resources in Anhui Province and explore the limiting factors for the development of new energy at present.

3.1. Natural resource conditions in Anhui Province

The natural resources which are available for the exploitation of new energy in Anhui Province are generally acceptable. Referring to the Atlas of Solar Energy Resources by Province in China, Anhui Province has an annual average total solar radiation of 4540-5460 MJ/m², which is regarded as a medium-sized solar energy resource area according to the China Renewable Energy Society. The annual average solar radiation is the largest in the northern part of Anhui, approximately at the level of 5400 MJ/m². And the area around the city called Mount Huang is the lowest in the province [5].

As far as wind energy is concerned, Anhui Province is located in a monsoon region. The annual average wind speeds in the area of Chao Lake and the peak of Mount Huang can reach 3.3 m per second and 3.8 m per second, respectively, where wind resources are superior. But the annual average wind speed in river valley area is only 1.3 meters per second. From the seasonal point, the wind speed is higher in winter and spring, and that is lower in summer and autumn.

Additionally, as a major agricultural province, Anhui has great potential for biomass energy exploitation. About 48 million tons of crop straw are collected annually, and the total amount of waste from livestock and poultry is about 56 million tons. However, this waste is still treated by traditional methods, such as composting and returning to the field. What's more, with the improvement of residents' living standards and the acceleration of urbanization, the amount of municipal solid waste in Anhui Province will also increase.

3.2. Current situation and restrictive factors of new energy development

Since 2021, the government of Anhui Province has accelerated a revolution in energy consumption in five major fields: industrial production, building heating, transportation, agricultural production and people's lives. Therefore, the proportion of new energy power installation projects has significantly increased. By the end of January 2022, the installed capacity of new energy was 30.0314 million kilowatts, accounting for 35.46% of total capacity, with a large share of photovoltaic power, as illustrated in Figure 4.

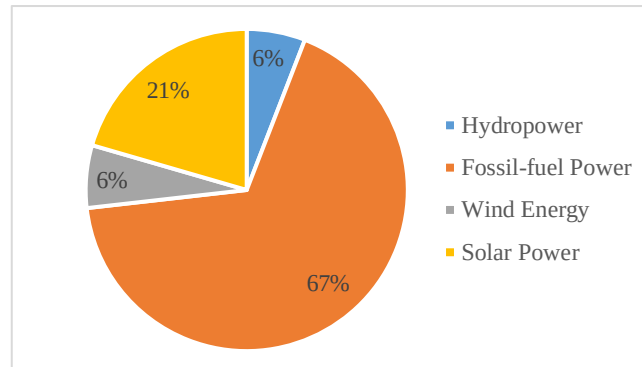


Figure 4: The proportion of installed power capacity of main energy sources in Anhui province.

At present, technological challenges have led to the high costs and limited usage of new energy resources. In addition, Li Enping pointed out that the opportunity costs of solar and wind energy exploitation are fairly high because these facilities for power generation require a large number of vacant land [6]. Most of the high-quality solar and wind energy resources in Anhui Province are in intensive farming areas, and the ground space is occupied by economically valuable agricultural land, woodland, lakes, and reservoirs, making it difficult to achieve large-scale exploitation [6]. Moreover, large-scale access to new energy power will also be affected by channels, peak shaving, energy storage, the power system, and various other factors.

4. An analysis of the transition plan of a similar resource region in China: a case study of Jiangxi Province

Jiangxi Province, located in East China, is adjacent to Anhui Province, and also has plain, mountainous and hilly. From the perspective of new energy development, Jiangxi and Anhui Province are both China's Class III solar energy resource area and Class IV wind energy resource area, with decent potential of development. Hilly and mountainous areas have relatively abundant new energy resources. In 2017, energy supply in Jiangxi Province faced big problems such as inadequate energy self-sufficiency, a coal-dominated energy consumption structure, and weak infrastructure, requiring an energy transition to achieve low-carbon development.

4.1. Energy transformation plan

In order to alleviate the difficulties in development, the Jiangxi provincial government has formulated a series of policies and measures to promote a revolution in energy production and consumption to build a clean, low-carbon and efficient energy system.

In response to the limiting capacity of energy and insufficient potential for new energy, the Jiangxi provincial government has accelerated the innovation of technology, encouraging the application of mature technologies and guiding breakthroughs in core cutting-edge technologies to improve the working efficiency of existing energy. Furthermore, efforts have been made to strengthen

infrastructure, such as the construction of power grids and oil and natural gas pipelines. The Government has also carried out model projects for solar power generation and special wind farms with low wind speed to make up for the lack of resources [7].

In view of the problem that the high proportion of coal in the energy consumption structure, the administrator of the Jiangxi provincial government has chosen a mode called "multi-energy complementation" to make a scientific plan for the exploitation and utilization of coal, oil, gas, and diverse new energy. It focused on the utilization of photovoltaic power by comprehensive power stations, such as the floating photovoltaic plant integrated with fishery. This mode also focused on the development of wind power in high-mountain wind farms so as to steadily increase the proportion of wind, solar, and biomass power generation [7]. Furthermore, the government has taken active measures to encourage residents to practice energy conservation in their daily lives.

In response to the reform of the energy market, the management department of the government and industry association actively cooperated with each other on formulating public policies and regulations and exploring market-oriented trading mechanisms. The government established a special fund to support financial needs to accelerate the transformation of current enterprises and cultivate new companies.

4.2. Current Situation of Energy Utilization

Thanks to the effectiveness of the above – mentioned policies, the total energy supply and the proportion of new energy power generation has gradually increased in Jiangxi Province. In 2022, 156,858 million kilowatt-hours of industrial power were generated in Jiangxi province. The proportion of hydropower increased by 27.9%, while the proportion of wind and solar power increased by 16.5% and 21.6% respectively. The proportion of new energy generation such as hydropower, wind and solar power accounted for 16.2% of the total electricity generation, a rise of 4 percentage on 2019. The production of raw coal decreased, with 1.946 million tons of industrial raw coal produced, a year-on-year decrease of 8.3%.

Secondly, energy savings and consumption reduction have achieved significant results. In 2022, the energy consumption per unit of industrial added value in Jiangxi Province decreased by 3.4% year on year, and the overall efficiency of industrial conversion was 62.9%, which increased by 1.4 percentage points in 2021 [8].

5. Discussion on the path of energy transformation in Anhui Province

The 14th Five – year Plan for Energy Development in Anhui Province points out that although Anhui Province is traditionally viewed as a major energy province, it is relatively rich in coal resources. And conventional hydropower resources have already been developed. Wind and solar energy resources are relatively common in China, and there is a lack of conditions for nuclear power construction. Oil and gas mainly rely on imports from other provinces, while there are also shortcomings in the diversification of gas supply and transportation capacity [9]. In 2020, coal accounted for 69.8% of primary energy consumption of Anhui Province, 13 percentage points higher than the national level, while natural gas and non-fossil energy consumption accounted for 3.6 percentage points lower than the national level. The coal-dominated situation of energy structure, which is similar to Jiangxi Province, has not changed. Therefore, the pressure on low-carbon transformation will remain high.

5.1. To make Full use of new energy resources in Anhui Province

Between 2017 and 2021, non-fossil energy consumption grew at an annual average rate of 29.3%, much faster than 1.5% increase in coal consumption. This indicates that the proportion of fossil energy consumption was further decreasing, while the application of new energy was accelerating. In

terms of electricity installation, the proportion of solar, hydro and wind power generation can reach 7.68%, which was conducive to environmental protection. *The 14th Five Year Plan for Energy Development in Anhui Province* predicts that 25% of the province's electricity will come from renewable sources by 2025, which is equivalent to an annual reduction in carbon dioxide emissions of about 69 million tons or more, and in sulfur dioxide and nitrogen oxide emissions of above 13000 tons and 16000 tons respectively [9].

In order to achieve these goals, the first step is to vigorously develop photovoltaic power generation and adhere to both centralized and distributed power generation plans. It is advised to fully utilize barren mountains, existing coal mining subsidence areas, idle water surface and other unused land to construct centralized solar power plants tailored to local conditions. The distributed application of photovoltaic power generation should be promoted on roofs of industrial parks, public buildings, residential buildings and other constructions. According to the suggestion of Lu Yufa, the vice president of the Anhui New Energy Association, the mode of complementary agriculture and solar energy is generally preferred in mining areas with medium or mild subsidence. For those areas where mining subsidence is less severe and the land is prepared for reclamation in the future, the combination of photovoltaic and ecological management mode may be adopted. For areas with permanent water logging, the mode of floating photovoltaic plant integrated with fishery had better be applied. At the end of 2022, 140,000 mu of water accumulated perennially in coal-mining subsidence areas in Huainan City, Anhui Province. And it is expected that the total area of surface subsidence will be 370,000 mu by 2030. However, it is also estimated that the installed capacity of photovoltaics on water surface in the Huainan mining area would reach over 18 million kilowatts by 2030, close to the capacity of the Yangtze River Three Gorges (18.2 million kilowatts).

Then the government should consider promoting the sustainable development of wind power. It is suggested that both centralized and scattered wind farms ought to be constructed. For example, the construction of large-scale wind power plants should be promoted in the North Plain, Anhui Province, based on different terrain conditions. And the measures for encouraging innovation in business mode of scattered wind power had better be carried out also by learning from the experience of building high mountain wind power projects in Jiangxi Province. In July 2023, the first distributed wind power project in Anhui Province, the Leida Cement Green Energy Project in Wuwei City, was launched, whose wind power generation can reach 13.65 MW. It is planned to form a distributed power generation system consisting of three wind turbines with a single unit capacity of 4550 kW and three 4550 kVA/0.69 kV transformer boxes to directly deliver electricity to the enterprise electricity distribution room, providing green power energy for the Leida Cement Company.

To efficiently utilize biomass energy, the government ought to promote the construction of agricultural and forestry biomass heating and power supply projects and reasonably plan household waste incineration to generate power. It is recommended that the utilization of biomass energy would be expanded as well. In rural areas in Anhui, villagers and companies are encouraged to develop and apply industrial biogas and bio-natural gas, which may use crop straw and organic household waste. Various enterprises should strengthen their cooperation to innovate the multi-production technology of bio-natural gas, carbon dioxide, and organic fertilizer", actively promoting the establishment of multi-production projects in the northern region of Anhui Province.

From a macro perspective, it is still necessary to accelerate the development of the new energy industry and enhance the modernization level of the industry and supply chain. New energy business should also complement the shortcomings of the industry and supply chains with strengthening the production capacity of crucial process and equipment components. Promoting the recycling industry of waste batteries, photovoltaic modules could be probable to achieve closed-loop green development throughout the entire life cycle of new energy industry.

During the construction process of new energy projects, negative environmental impacts should be prevented and reduced. Companies in the new energy industry ought to pay attention to former research and environmental arguments about the probability of power stations and formulate scientific and effective environmental protection measures to avoid damage to the region's native vegetation. The plan of roads for maintaining wind power stations in mountainous areas should be reasonably selected. What's more, biomass and garbage power generation projects not only need to be located in proper areas, but also to use advanced environmental protection equipment and energy-saving technology.

Finally, promoting cooperation between domestic and international corporations in the new energy industry is a significant measure for development. The government should fairly encourage leading enterprises in new energy industry, such as photovoltaic, wind power, and energy storage in Anhui Province, to actively participate in the division of production and the formulation of industry standard in both domestic and international markets. Relying on platforms such as universities and research institutes in Anhui Province to gather innovative technology and knowledge in energy field, the new energy industry in Anhui would carry out in-depth cooperation in international research and technology absorption.

5.2. Construction of cross-regional channels for new energy power generation transmission

Anhui Province not only needs to scientifically utilize the local new energy resources, but also to actively promote the transfer of existing affluent new energy from other provinces and areas. The 14th Five-Year Plan for Energy Development in Anhui Province calls for the need to strengthen cooperation with resource-rich regions, support energy enterprises in Anhui to leverage their comprehensive advantages, and develop energy resources outside the Anhui Province [9].

Detailedly speaking, the government should encourage enterprises in Anhui Province to give full play to their advantages in technology, equipment, talent and standards to Inner Mongolia, Shanxi, Gansu, Qinghai, Xinjiang and other resource-rich provinces to exploit renewable energy. It is suggested that Anhui Province should enhance energy and electricity cooperation with western provinces in China. For instance, the ± 1100 kV high-voltage direct current transmission project from Changji to Guquan can be accelerated to realize a full transmission capacity as soon as possible, which may continuously transfer Xinjiang's abundant electricity to Eastern China. To strengthen the coordinated planning and construction of transmission projects in new energy resource-rich areas would do a favor in meeting the requirement for new energy grid connections.

One of the most useful measures is to speed up the overall optimization of the energy system with the purpose of improving equipment utilization and system efficiency. Yao Xin pointed out that governments should pay attention to the changing trend of natural factors, such as wind, sunlight, topography and woodland to make reasonable predictions of new energy electricity production to dynamically optimize the allocation of new energy electricity [10]. And it is positive to achieve the complementary operation of traditional fossil fuels and new energy sources [10]. The government may also support the innovation of ultra-high voltage, high voltage, low voltage and other power transportation technologies and allocate electricity effectively based on the actual transmission situation.

The government of Anhui Province should also make efforts to reduce local protection barriers within the province to promote the coordinated operation of cross-regional green power trading. Yao Xin also hold a view that much attention should be paid to the design of incentive mechanisms for the transmission of green electricity, with scientifically deciding the cost of green electricity transmission, to motivate green electricity transmission into Anhui from other provinces [10].

The related administrators would be told to emphasize safety management. Furthermore, high-voltage converter stations and dense transmission channels should be necessary for their work

responsibilities to strengthen the safety protection of hub substations. For example, their management could pay more attention to the safety control of energy storage facilities and charging stations, improving the manufacturing standards of products to further upgrade the level of safety management.

6. Conclusion

Energy is an important foundation for the national economy and social development. This essay uses statistical analysis methods and a case study to analyze and research the energy transformation in Anhui Province. And the conclusions are as follows:

Firstly, as for energy consumption, the total energy consumption in Anhui Province has been increasing in recent years, showing an upward trend. Among the three major industries, the secondary industry has the largest amount of energy consumption, with raw coal as the main energy source. Then, regarding the exploitation conditions of new energy, Anhui Province has abundant solar energy resources, uneven distribution of wind energy and great potential for biomass energy. At present, the application of new energy in Anhui Province is mainly solar and wind power generation. And the development of new energy is still limited by the high cost and weak technology. However, by promoting technological revolution and innovation, making reasonable plans for traditional fossil fuels and new energy development and actively improving policies and regulations, the proportion of new energy consumption in Jiangxi Province has continuously increased, achieving great results in low-carbon development. Lastly, based on the excellent experience of Jiangxi and the actual situation of Anhui, this paper summarizes measures that can be referenced for energy transformation in Anhui Province. It will be achieved by vigorously developing solar photovoltaic and wind power generation, efficiently making use of biomass energy, improving the modernization of the industry chain of new energy and promoting domestic and international cooperation in the new energy areas.

The development and application of new energy is a long and complex process, involving many fields such as politics, economy, environment, etc. Limited by the author's cognitive level of things, there are still some shortcomings in this study. Although the Anhui and Jiangxi Province share similarities in geographical terrain, energy consumption structure and new energy resource reserves, they are not necessarily at the same stage of lifecycle in energy development. Therefore, it is better to be flexible when exploring experience at a deep level. Additionally, due to the availability of data, this paper does not conduct an input-output analysis on new energy resources.

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The Impact of COVID-19 on Firm's Financial Distress: Evidence from China

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Abstract: COVID-19 has a significant influence on firm's financial distress. How does COVID-19 influence firms' short-term financial conditions and long-term development in China, and whether and to what extent will their financial leverage deviate from the original path? Can financing support from government as a bailout policy alleviate the financial distress caused by the epidemic? In order to exam my hypotheses, I did a series of exams. The sample includes all publicly listed Chinese firms from 2017 to 2022. Results show that the outbreak of Covid-19 makes firms more difficult to borrow money. H1 is supported. However, the interaction item has no corresponding data observation value. It is predicted to be positive, which means the politically connected firms are more likely to offset the bad influence of the external environment because they can access valuable financial resource easily than firms without political connections. It is not consistent with H2. The study not only extends the growing literature exploring the deep influence of the Covid-19 pandemic on business, but also has implications for policymakers.

Keywords: Covid19, financial distress, Chinese firms

1. Introduction

The sudden Covid-19 epidemic not only changed the traditional way of life and production of human beings, as the market micro-body of the enterprise's way of doing business has also changed a lot with. Affected by the epidemic, enterprises generally encounter multiple blows such as cash flow shortages, order cancellations, and supply chain interruptions. The original operating arrangements are difficult to maintain, and strategic planning needs to be adjusted urgently. In this context, how does COVID-19 influence firms' short-term financial conditions and long-term development in China, and whether and to what extent will their financial leverage deviate from the original path? Can financing support from government as a bailout policy alleviate the financial distress caused by the epidemic? This paper aims to answer these key questions through empirical analysis.

This paper mainly focuses on Chinese firms for two reasons. First, the COVID-19 epidemic and the corresponding control measures have been lasting three years in China, which inevitably cause profound impact on Chinese society and the business field. Second, loan difficulty and financial distress is an everlasting problem for Chinese firms. Lots of prior literature has discussed the causes and consequences but has not reached the agreement yet. The unexpected outbreak of the epidemic provides a unique setting to explore the financial distress problems.

The outbreak of infectious diseases in human history usually has a huge impact on social and economic development, and even changes the course of human development [1]. For example, the “SARS” epidemic (2003) and the “H1N1 influenza A” epidemic (2009) in the last 20 years caused economic losses of relevant countries as high as US \$30 billion and US \$1.86 billion respectively. The covid-19 pandemic is not only a global public health problem, but also a serious setback and impact on economic growth and development worldwide. The International Monetary Fund (IMF) said that the novel corona virus pandemic triggered an economic recession that the world had never experienced since the Great Depression of 1929. Existing studies focus on the impact of COVID-19 on the financial asset price such as the US Treasuries, sovereign Eurobonds, corporate bonds, and stocks [2]. However, it remains unclear of the linking between COVID-19 and firms’ financing activities. During the Covid-19 epidemic period, the ability of financing and borrowing is the significant for enterprises to relieve the pressure of cash flow and survive during this crisis and there is still uncertainty surrounding the impact of COVID-19 on firms’ financing conditions.

A large number of studies have shown that in the Chinese market, which is dominated by socialist public ownership, the traditional constraints on corporate financing and the problem of political affiliation have led to the fact that private firms are often unable to produce and operate in accordance with the rules of market competition, which are two important issues that need to be resolved urgently in the course of the transformation of China’s economic growth mode in the future [3]. In recent years, Chinese government has been committed to promoting the construction of a market system that solves the financing problems of firms and have made great efforts (Like articles 14 to 23 of the Law of the People’s Republic of China on the Promotion of Small and Medium sized Enterprises.) in establishing a multi-level capital market, developing financial technology, and simplifying financing procedures. However, empirical facts tell us that the premise of the top-level design must be based on a great deal of investigation, research and evidence-gathering, and that it must follow the characteristics of a socialist market economy with Chinese characteristics in addition to traditional economic theories, and that it must fully incorporate the characteristics of the macro-environment and the micro-enterprises, and even the grass-roots practitioners, in the course of piloting. Financing constraints are still one of the key problems restricting the development of private enterprises at the current stage.

As the main part of China’s real economy, corporations are the largest and most dynamic group in the real economy, especially the non-SOEs and private firms. Their development is related to the structural adjustment, transformation and upgrading of China’s economy and society. By the end of 2021, the number of market entities registered nationwide has reached 154 million, including 48.423 million enterprises and 103 million self-employed businesses. As an important part of the market, non-SOEs and private firms have contributed more than 50% of fiscal revenue, more than 60% of GDP, more than 70% of technological innovation, and more than 80% of urban labor employment.

Through comparison, it can be found that there is a big difference in the treatment of private enterprises compared with state-owned enterprises when facing the problem of enterprise financing. The shortage of capitals has become a bottleneck restricting the development of firms. One of the main issues is the information asymmetry between enterprises and lending banks. Stiglitz and Weiss (1981) believe that information asymmetry is a common problem in the financial market. Formal financial institutions such as banks cannot identify the payment ability among loan applicants, which leads to adverse selection and moral hazard. Compared with large and state-owned firms, the problem of information asymmetry between private firms and banks is more serious, and they are more likely to be constrained by bank loan. During the period of Covid-19 epidemic period, the operation uncertainty for firms increases, which may further exacerbate the information asymmetry between borrowers and lending institutions. Therefore, how to solve the financing problems of Chinese firms during the epidemic crisis is an important problem that needs to focus on. The research question in this paper is what is the impact of COVID-19 on firm’s financial distress? Given that government

plays a vital role in China, so do politically connected firms are more likely to offset the bad influence of the external environment?

There are some contributions in this paper. The study not only extends the growing literature exploring the deep influence of the Covid-19 pandemic on business, but also has implications for policymakers. First, the financial system is still not well developed in China, which hinders the operations of multiple firms. The private enterprises can alleviate the problem of bank loan difficulties by establishing political relationships. This relationship-based contract will help promote the development of private enterprises [4]. Second, financial institutions should have a better understanding of the operating conditions of firms, especially the non-political connected firms in industries that have been hit hard by the epidemic, and take more targeted measures to provide financial support for small and micro enterprises facing temporary difficulties. Third, as the epidemic continues to recur, it is recommended that government departments continue some existing policies to benefit enterprises and introduce new supportive policies based on the evolution of the epidemic and changes in market conditions to effectively help small and medium enterprises overcome obstacles.

2. Institutional Background in China

Since the emergence of the Covid-19 pandemic, Chinese businesses have been most worried about four things: a drop in demand, a rise in uncertainty, a break in their supply chain, a drop in capacity, closures, and the health of their employees [5]. After first showing up in Wuhan in December 2019, the Covid-19 pandemic quickly expanded over the whole country of China [6]. In order to stop the spread of this illness, the government put Hubei province under a strict lockdown. Self-quarantines and social isolation were also put in place [7]. Because of the strict quarantine rules and the tight lockdown in Hubei province, supply lines for Chinese companies were messed up. Businesses had to stop or cut back on what they did in order to make sure their employees were safe. During the first three months of 2020, there were a lot of confirmed deaths from this pandemic in the central, western and coastal parts of China. China's president in response to this health concern, said that preventing and controlling illness is more important than getting the economy back on track [7]. In this situation, the impact of the epidemic on enterprises is enormous, including financial problems [8]. Firstly, the epidemic has led to a reduction in sales, a shrinking market, a reduction in corporate income, a breakdown in the capital chain, financial pressure, increased business difficulties, and even the risk of bankruptcy. Firms in various places closed their production lines, which had a big effect on their supply chains. Secondly, supply chain problems. The supply of raw materials during the epidemic is tight, transportation is limited, production capacity is affected, and product quality is affected. The operation of enterprises is affected. Thirdly, human resources problems, the increase of employment pressure caused by the epidemic, the loss of employees, the operation of enterprises is affected. Fourthly, brand image problems, the damage of enterprise brand image caused by the epidemic, the decline of market trust has a negative impact on the operation of enterprises. To sum up, the impact of the epidemic on enterprises is enormous.

3. Literature Review and Hypotheses Development

There is a general consensus in existing research on large-scale pandemics that macroeconomic growth trends tend to take a turn for the worse when hit by pandemics, in the form of retreat, shrinkage of the real economy and massive unemployment [9]. One of the most obvious sectors hit by the pandemic was the cultural and tourism industry, which saw a sharp drop in revenue after the 2003 SARs, not only in China but also in many other countries around the world [10]. Building on this, later scholars have further shown that the structural impacts caused by large-scale epidemics may be

more severe than the aggregate impacts [11]. However, when responding to a pandemic, relying solely on prior experience may not be conducive to an effective response program for businesses, as this outbreak has completely different characteristics [12]. Existing studies of the new crown epidemic have been more skewed toward macro totals [12], but few empirical studies have explored the micro-level effects of how the pandemic influences firms' financing constraints. In this section, three hypotheses are developed according to my overall consideration. Both the first and the second hypotheses form a highly correlated relationship with microenterprises financing themselves with bank loans, bond issues, and private placements. The third hypothesis tests whether political connections would influence firm's ability to access loans or external finance during current pandemic crisis.

3.1. Crisis and Financial Constraints

Bank lending behavior during economic crisis has been widely studied in the prior literature [13]. Some scholars have argued that economic crises can interfere with the spontaneous process of allocating credit resources in markets under conditions of perfect competition by triggering high financing costs through the creation of asset shortages. In times of crisis [14], the supply of bank loans generally decreases. This decline may be due to the environment uncertainty and shocks to borrower guarantees, which affects the ability of firms to raise capital when agency and information problems are significant.

The COVID-19 crisis has some similarities with the global financial crisis from 2007 to 2009, as both damage the global economy heavily through liquidity shortages, corporate bankruptcies, and unemployment. However, with the ongoing COVID-19 crisis indefinitely disrupting business revenue streams, businesses face fixed costs, including debt servicing, as well as declining cash balances. Deteriorating financial conditions make it harder for companies urgently in need of liquidity to obtain credit, as banks are reluctant to lend to borrowers with low credit quality and low asset values. Therefore, the outbreak of COVID-19 is expected to further limit a firm's access to external finance. I also expect firms to substitute for alternative sources of financing to compensate for the lack of access to bank credit. The credit supply shock theory suggests that credit-rationed firms are more likely to have higher impaired access to external capital during the crisis.

Based on the above discussion, I raise the following hypotheses.

H1a: The outbreak of Covid-19 has a negative impact on firm's external financing.

H1b: Firms are more likely to substitute bank credit with other financing instruments during the COVID-19 pandemic.

3.2. Political Connections and Financial Constraints

Previous literature provides growing evidence that political connections are valuable to firms in various countries [14]. One of the most important benefits is easier access to bank loans [15]. Due to the underdeveloped product and credit markets and the lack of institutions to support market development, the government often exercises strong control over the allocation of economic resources [16], resulting in private enterprises not being able to completely rely on the market to obtain economic resources. Bank credit is an indispensable key resource for enterprise development, but the financial system is mainly dominated by the four major state-owned banks in China. Although state-owned banks have begun to apply economic principles to make credit decisions with the continuous reform of the banking industry, the government as the ultimate owner of the bank still dominates the allocation of bank credit resources, leading to more allocation of bank credit resources to state-owned enterprises [4]. In addition, a large number of literatures have shown that Chinese banks have obvious credit discrimination against private enterprises [17]. As a result, many private enterprises are keen

to establish political relations, such as hiring current or former government officials, deputies to the National People's Congress or members of the Chinese People's Political Consultative Conference to join the company's board of directors.

Establishing political connections is important for private enterprises to obtain bank loans. The function of political connections is especially pronounced in China since the government has relatively large power to assign critical resources, and the legal environment is still weak [18]. First, in the absence of a formal legal and judicial system to effectively protect the property rights of private enterprises, economic disputes between enterprises or between enterprises and their creditors are often resolved by government officials rather than through courts [19]. In this way, enterprises with political connections can get the protection of government officials in case of economic disputes, reduce the operating risks of enterprises, and obtain bank loans more easily. Second, when the property rights of private enterprises face the threat of arbitrary infringement by the government or officials, enterprises with political connections can use their own political connections as an alternative property rights protection mechanism to avoid or reduce the property rights of enterprises from being violated by the government and officials. The arbitrary infringement of officials reduces the operating risk of enterprises, thereby reducing the risk level of bank loans to enterprises, thereby reducing the difficulty for these private enterprises to obtain bank loans [20]. Third, the relatively backward financial development makes it difficult for enterprises to obtain loans on a market-based basis, so they rely on political connections instead of formal channels to obtain loans. Private enterprises with political connections can provide loan support for enterprises through the influence of politicians on state-owned banks and overcome or reduce the problem of bank credit discrimination faced by enterprises. Therefore, under the same conditions, enterprises with political connections are more likely to obtain bank loans than those without political connections.

During the Covid-19 pandemic, the advantage of political connection for getting bank loans would be more pronounced. First, the supply of bank loans generally decreases in the crisis. Second, the deteriorating financial conditions make it harder for companies urgently in need of liquidity to obtain credit, as banks are reluctant to lend to borrowers without strong guarantees.

The discussion leads to the following hypothesis:

H2: The negative impact of Covid-19 crisis on financial constraints is less pronounced in politically connected firms.

4. Research Design

4.1. Data and Sample

The sample includes all publicly listed Chinese firms from 2017 to 2022 (Main board of Shanghai and Shenzhen stock markets) and processes them according to the following principles: (1) drop observations with missing variable data; (2) drop banks, insurance and other financial industry companies; (3) winsorize all continuous variables at the top and bottom percentile to avoid the impact of outliers on the research results. All firm-level characteristics comes from China Stock Market & Accounting Research Database (CSMAR), which includes the most comprehensive financial data about Chinses firms. The political connection data comes from the CNRDS (<https://www.cnrds.com/>) database. According to Siyoto and Sodik (2015), quantitative research employs a large number of numbers throughout the research process, from data collection through data interpretation and findings.

4.2. Model Specification

This paper sets up the DID method to evaluate the impact of COVID-19 on firms' financial constraints.

Model 1

Taking Wuhan's "closed city" (January 2020) as the time node, the independent variable is the dummy variable before and after the epidemic. For samples after January 2020, take 1, otherwise take 0. The coefficient therefore indicates the impact of COVID-19 on firms' financial credits.

The dependent variable measures the firms' ability to gain credit from banks and other informal institutions. Following prior literature, this paper mainly uses three proxies (1) Debt percent: the percentage of total bank loans (including short-term loans and long-term loans) to total assets; (2) Trade account: the percent of the sum of notes payable, accounts payable and accounts received to total assets at the end of the period; (3) SA index.

Model 2

Note: Size is 100 million yuan, and Age is years.

For the Controls, consistent with literature, this paper includes firm size (Size), profitability (ROA), and sales. To capture the impact of political power, a variable is included to indicate whether the firm is controlled by the state (SOE). This paper also includes year and industry fixed effects in all my specifications to control for common shocks that might impact firms' financial conditions.

To examine the role of political connections on the effect of covid-19 and financial constraints, this paper estimates the following model.

Model 3

The key variable of interest is PC, an indicator variable for political connection, which equals one if the firm's CEO or CFO has served as a government official or a party official currently or previously. Table 1 shows the definitions of variables.

-----Insert Table 1 about here -----

Table 1: Variable definitions.

Variable	definitions
Code	Company code
Year	Year of data report
Name	Name of the company
ACOV19	Whether the year is after the epidemic, it is 0 before the epidemic and 1 after the epidemic.
Loc	Where the province is located
Fyear	Year of establishment
Age	Years of establishment of the company
SAI	$SA = -0.737 * Size + 0.043 * Size^2 - 0.040 * Age$
NP Ratio	(Notes payable+accounts payable+accounts received in advance)/total assets
Revenue	Company revenue
SOE	Nature of the company, 1 is state-owned or state-controlled and 0 is non-state-owned.
AP Ratio	Accounts payable/total liabilities
DebtRatio	Total liabilities/total assets
Asset	Total assets
ROA	Net interest rate of total assets

5. Results

5.1. Descriptive Statistics

Table 2 presents the descriptive statistics of variables. The mean value of Covid19 is 0.5071 and the standard deviation is 0.5000. The mean value and standard deviation of age are 19.2803 and 6.6875 respectively. This is consistent with prior study. The same holds for the measure of NPRation, which

has a mean of 0.0769 and a standard deviation of 0.1130. The mean value and standard deviation of Revenue are 96.0622 and 685.2653. All continuous variables are winsorized at 1% and 99%.

-----Insert Table 2 about here -----

Table 2: Descriptive statistics.

Variable	Obs	Mean	Std.Dev.	Min	Max
ACOV19	29,833	0.5071	0.5000	0.0000	1.0000
Age	29,833	19.2803	6.6875	-1.0000	67.0000
SAI	29,833	21872.6800	607269.1000	-5.7501	3.78e+07
NP Ratio	29,833	0.0769	0.1130	0.0000	0.9084
Revenue	29,833	96.0622	685.2653	-1.1486	33181.6800
SOE	29,833	0.2172	0.4124	0.0000	1.0000
AP Ratio	29,833	0.2698	0.1707	0.0000	0.9415
Asset	29,833	155.4026	852.5662	0.0476	27329.1000
ROA	29,833	5.2062	20.3326	-2164.5910	1221.1070

5.2. The Parallel Trend Test

This paper did a parallel trend test to plot the trend of the ratio of notes payable to total liabilities (NPRatio) at the end of the period between the treatment group (ACOV19=1) and the control group (ACOV19=0) with the Year. By observing the parallelism of two groups of trend lines, we can preliminarily judge whether parallelism exists. Similarly, for APRatio, two groups of data (debt ratio and NPRatio) in time series is similar. From Figure 1, 2 ,3 and 4 we can see that the change trend of debt ratio and NPRatio is quite similar.

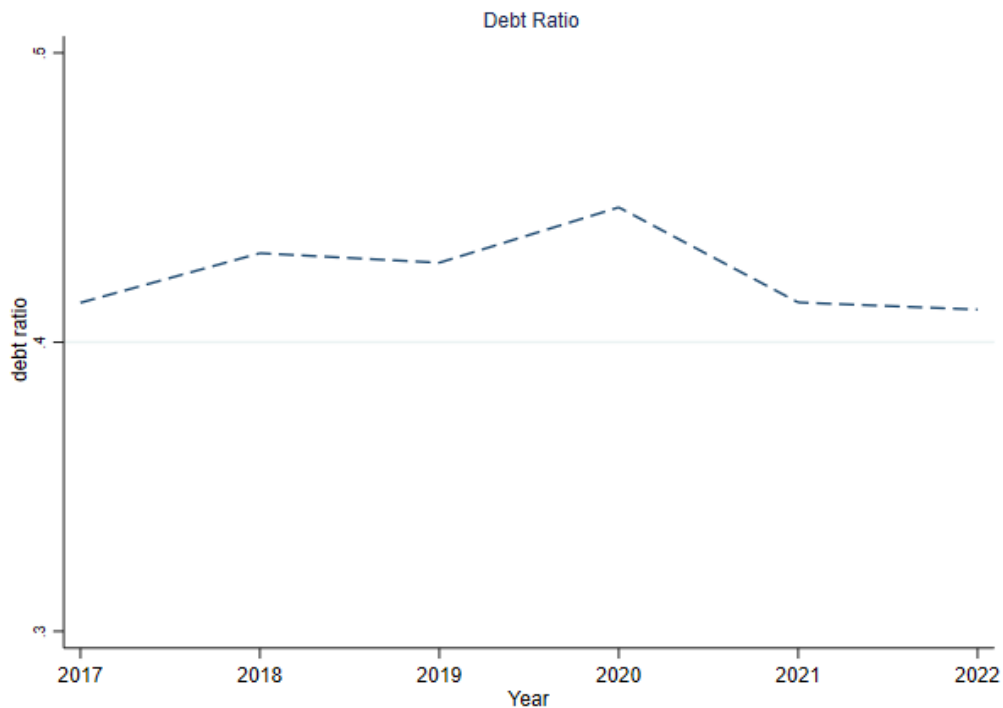


Figure 1: Parallel trend test (Debt Ratio).

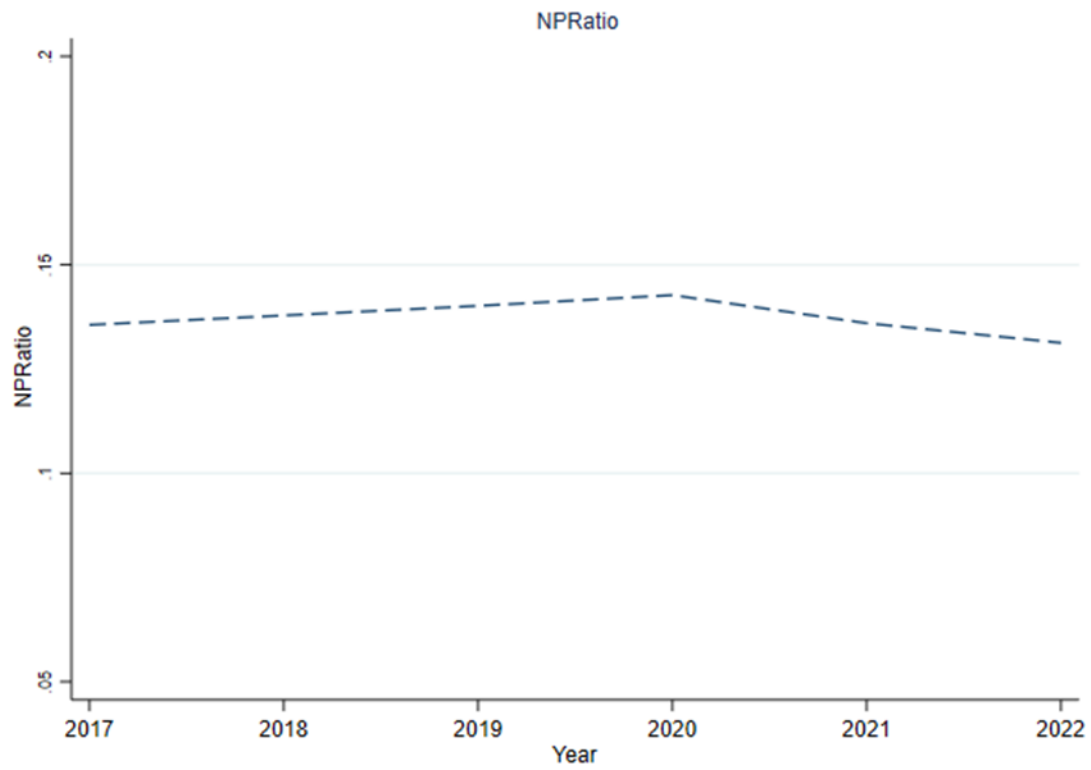


Figure 2: Parallel trend test (NPRatio).

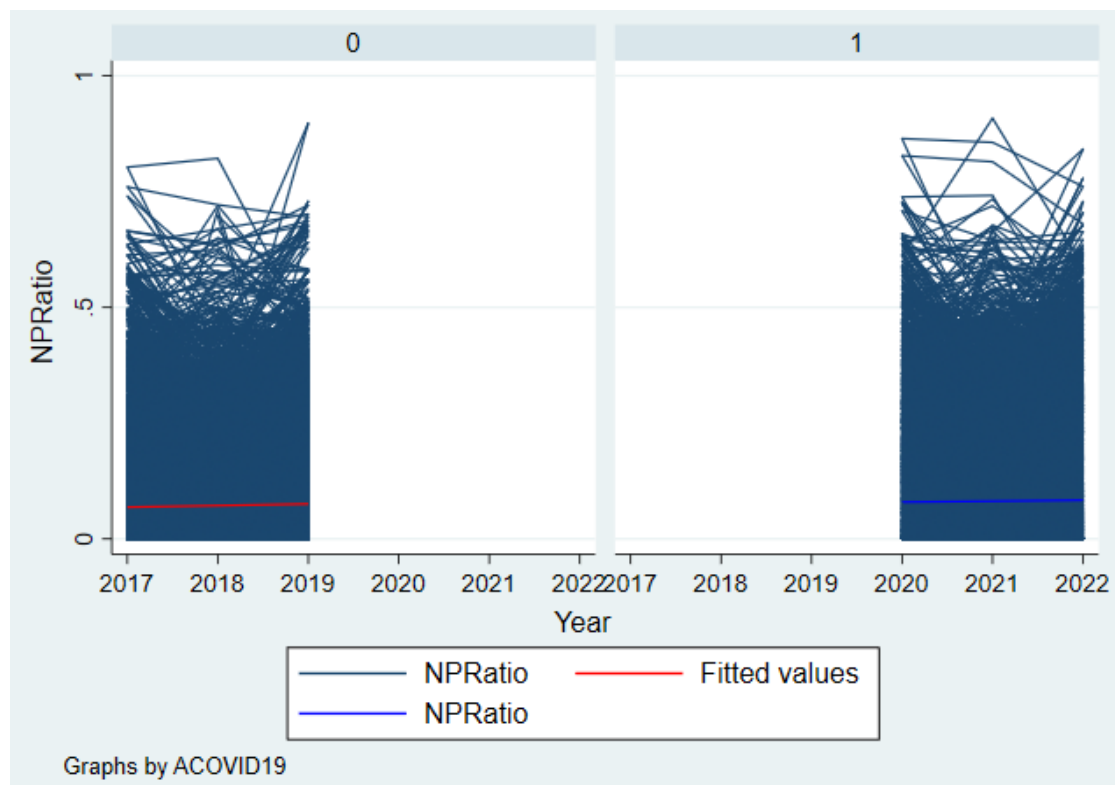


Figure 3: Parallel trend test.

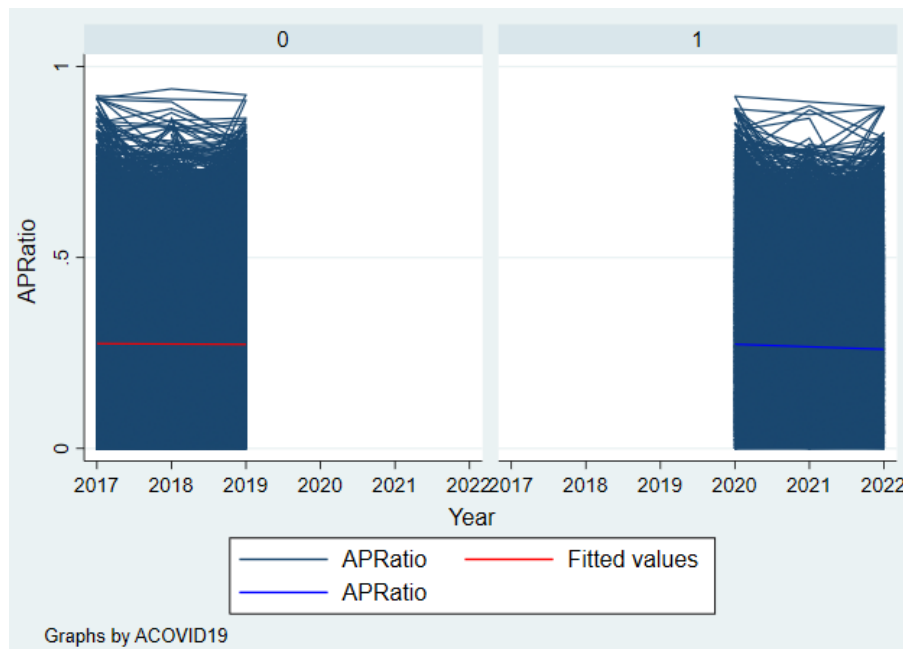


Figure 4: Parallel trend test.

This paper also did regression, aiming at the data before the epidemic (acovid 19 = 0) and after the epidemic (acovid 19 = 1). As can be seen in Table 3 and 4, the existence of parallelism can be judged by testing whether the two groups of residuals (residuals0 and residuals1) are significantly different. Ttest command is used for t-test of residual difference. The parallel trend test was passed.

Table 3: The parallel trend test.

	Debt Ratio	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
ACOV19=0	ACOV19	0	(omitted)				
	Year	0.0068	0.0038	1.78	0.074	-0.0007	0.0143
	_cons	-13.3090	7.6991	-1.73	0.084	-28.4003	1.7823
ACOV19=1	ACOV19	0	(omitted)				
	Year	-0.0177	0.0146	-1.21	0.225	-0.0462	0.0109
	_cons	36.1650	29.4432	1.23	0.219	-21.5473	93.8773

t statistics in parentheses

*p<0.05, ** p<0.01, ***p<0.001

Table 4: Residual test.

Variable	obs	Mean	Std. Err	Std. Dev	[95% Conf. Interval]	
residu~0	29,833	-0.0104	0.0062	1.0751	-0.0226	0.0018
residu~1	29,833	-0.0258	0.0062	1.0754	-0.0380	-0.0136
diff	29,833	0.0154	0.0002	0.0419	0.0150	0.0159

5.3. Correlation Analysis

Table 5 list correlation analysis results between the variables. In Table 5, the correlation relationship between detracton and covid19 is strong ($p<0.1$). Debt Ratio is also significantly related with age and SAI. Debt Ratio has strong relation with NP Ration and Revenue. Also, the relations between

Debt Ratio and SOE, AP Ration, Asset and ROA. All other inter-correlation coefficients are below 0.4, suggesting that multicollinearity is also not a severe issue.

Table 5: Correlation matrices.

	(1) Debt Ratio	(2) Debt Ratio	(3) Debt Ratio	(4) Debt Ratio	(5) Debt Ratio	(6) Debt Ratio	(7) Debt Ratio	(8) Debt Ratio
ACOV1	-0.00982*	-0.0101*	-0.00998*	-0.0157**	-0.0165*	-	-0.0156	-0.0157
D19	(-2.05)	(-2.11)	(-2.08)	(-2.63)	(-2.76)	0.0172* (-2.89)	(-1.23)	(-1.23)
Age	0.00180** *	0.00172** *	0.00179** *	0.00744** *	0.00823** *	0.00812 ***	0.00555 ***	0.00555 ***
	(4.82)	(4.61)	(4.78)	(16.15)	(18.45)	(18.22)	(5.83)	(5.83)
SAI	7.59e- 08***	7.51e- 08***	5.73e- 08***	3.98e- 08***	3.42e- 08***	2.40e-09 (0.50)	9.87e-09 (0.96)	
	(10.67)	(10.56)	(8.24)	(4.61)	(3.98)			
NP Ratio	4.943*** (395.69)	4.921*** (424.93)	4.919*** (423.87)	4.552*** (326.05)	4.552*** (325.83)	4.549** * (325.84)		
Revenue	- 0.000143* **	- 0.000142* **	- 0.0000621 ***	- 0.0000412 ***	- 0.0000340 ***			
	(-15.38)	(-15.26)	(-10.01)	(-5.36)	(-4.46)			
SOE	- 0.0208*** (-3.48)	- 0.0214*** (-3.57)	-0.0159** (-2.66)	0.0492*** (6.66)				
AP Ratio	-1.833*** (-125.66)	-1.821*** (-126.65)	-1.831*** (-127.21)					
Asset	0.0000632 ***	0.0000629 ***						
	(11.56)	(11.50)						
ROA	0.000575* **							
	(4.61)							
_cons	0.214*** (24.60)	0.219*** (25.29)	0.221*** (25.56)	-0.344*** (-37.29)	-0.349*** (-37.87)	- 0.348** * (-37.83)	0.325** * (16.94)	0.325** * (16.96)
N	29833	29833	29833	29833	29833	29833	29833	29833
R-sq	0.859	0.859	0.858	0.781	0.781	0.781	0.001	0.001

5.4. Heterogeneity Test (Interactive Regression)

The significance of ACOVID19 of interaction items is tested. The interaction term ACOVID19 is added to the DID regression model to test whether the interaction effect between the treatment group and the Year is significant. The test arm command is used to test the significance of interactive items.

5.5. Test the Hypothesis of Regression Model

Ordinary regression analysis is carried out, and then the normality test, multicollinearity test, heteroscedasticity test and residual autocorrelation test are carried out by using estat command.

From Table 6, we can see that the coefficient on Covid which tests the impact of the Covid-19 pandemic on Chinese firms' financial distress is negative and statistically significant ($\beta = -0.01$, $t = -2.11$, $p = 0.035$). It indicates that the outbreak of Covid-19 makes firms more difficult to borrow money. This is due to government policies that, for example, limit tourist visits and restrictions on community activities so that many companies in the hotel, restaurant, and tourism subsector are temporarily closed. The closure caused a decrease in the company's financial performance.

Other variables are consistent with my expectation. Adjusted R-squared is 0.8589, F value is 22696.1, suggesting that the goodness of fit of the model is good. By examine Model 1, H1 is supported. These outcomes are similar to the research conducted by Armadani et al. (2021). The results of his research show that companies experiencing financial problems have increased during the COVID-19 pandemic.

Table 6: Test the hypothesis of regression model.

DebtRatio	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
ACOV19	-0.0101	0.0048	-2.11	0.035*	-0.0195	-0.0007
Age	0.0017	0.0004	4.61	0.000***	0.0010	0.0025
SAI	7.51e-08	7.11e-09	10.56	0.000***	6.12e-08	8.90e-08
NP Ratio	4.9215	0.0116	424.93	0.000***	4.8988	4.9442
Revenue	-0.0001	9.28e-06	-15.26	0.000***	-0.0002	-0.0001
SOE	-0.0214	0.0060	-3.57	0.000***	-0.0331	-0.0096
AP Ratio	-1.8215	0.0144	-126.65	0.000***	-1.8497	-1.7933
Asset	0.0001	5.47e-06	11.50	0.000***	0.0001	0.0001
cons	0.2186	0.0086	25.29	0.000***	0.2016	0.2355

t statistics in parentheses

*p<0.05, ** p<0.01, ***p<0.00

5.6. Strategic Descriptions About Company Change

According to the regression results, as we can see in Table 7, I can draw some strategic descriptions about company changes, especially in the period around 2019. The following is a policy description of the results.

For ACOV19 (year after epidemic) variable, the coefficient of this variable is -0.01, which has a significant level ($P < 0.05$). Research shows that the companies after the epidemic have changed compared with those before the epidemic. I can further explore and compare these changes and formulate corresponding strategies to adapt to the impact of the epidemic.

For age variable, the coefficient of this variable is 0.0018, which has a significant level ($P < 0.05$). The number of years the company was established has an impact on the company's changes. Younger companies may face different challenges and opportunities and need to make corresponding strategies and development plans according to their characteristics.

For SAI variable, the coefficient of this variable is 7.59e-08, which has a significant level ($P < 0.05$). SAI indicators have a certain impact on company changes. The company can further study and optimize the SAI index to improve the company's performance and competitiveness.

For NPRatio ((notes payable+accounts payable+accounts received in advance)/total assets) variable, the coefficient of this variable is 4.9431, which is significant ($P < 0.05$). NPRatio indicators have an important impact on company changes. Companies can pay attention to and manage assets

related to bills, accounts and advance receipts to maintain good financial status and asset utilization efficiency.

For revenue variable, the coefficient of this variable is -0.0001, which has a significant level ($P < 0.05$). Revenue plays an important role in company changes. Companies should pay attention to and seek strategies to increase revenue, such as market expansion, product innovation, marketing and promotion, so as to promote the company's development and growth. Other variables: SOE (nature of the company), APRatio (accounts payable/total liabilities), Asset (total assets) and ROA (net interest rate of total assets) also have a significant impact on the changes of the company. According to the coefficient and significance level of these variables, the company can further optimize its nature, responsible structure, asset management and profit rate to meet the changing needs of the company. Specifically, I can optimize the company's nature and governance structure, improve the accounts payable management and debt structure, effectively manage and utilize the company's total assets, and increase the net interest rate of total assets. Through the comparison of the changes after the epidemic, considering the impact of the epidemic on the company, especially the significance of the ACOVID19 variable, the company should focus on the changing trend after the epidemic, evaluate its impact and adjust its business strategy accordingly. Among them, young companies have different characteristics and challenges, which need to promote their stable growth and long-term development. For financial status and asset utilization, it is particularly necessary to pay attention to the influence of NPRatio variables on the company's changes. The company should pay attention to and manage assets related to bills, accounts and advance receipts to ensure good financial status and improve asset utilization efficiency. In addition, the company needs to improve its revenue level. Revenue is very important to the company's changes, so the company should take corresponding measures, such as market expansion, product innovation, marketing and promotion, so as to increase revenue and promote the company's development and growth. In addition, for optimizing the corporate nature and governance structure, I observed the significance of SOE variables. Companies can evaluate and optimize their corporate nature and governance structure, and introduce corresponding capital composition to improve their survival rate and competitiveness.

Table 7: Tests of H 1.

Debt Ratio	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
ACOV19	-0.0098	0.0048	-2.05	0.040*	-0.0192 -0.0004
Age	0.0018	0.0004	4.82	0.000***	0.0011 0.0025
SAI	7.59e-08	7.11e-09	10.67	0.000***	6.19e-08 8.98e-08
NP Ratio	4.9431	0.0125	395.69	0.000***	4.9186 4.9676
Revenue	-0.0001	9.28e-06	-15.38	0.000***	-0.0002 -0.0001
SOE	-0.0208	0.0060	-3.48	0.001***	-0.0325 -0.0091
AP Ratio	-1.8328	0.0146	-125.66	0.000***	-1.8614 -1.8042
Asset	0.0001	5.47e-06	11.56	0.000***	0.0001 0.0001
ROA	0.0006	0.0001	4.61	0.000***	0.0003 0.0008
cons	0.2139	0.0087	24.60	0.000***	0.1969 0.2310

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5.7. The Influence of Enterprise Nature on DebtRatio

In Table 8, the coefficient of SOE variable is -0.0121, but it does not reach the level of $P < 0.05$ in statistical significance ($P > 0.05$). The results show that the influence of enterprise nature (state-owned or non-state-owned) on DebtRatio is not statistically significant. This means that SOE has no obvious influence on the relationship between total liabilities and total assets in this study.

The influence of the interaction between enterprise nature and ACOVID19 on DebtRatio. The coefficient of the interaction term (Acovid 19*SOE) between Acovid 19 and SOE is -0.0162, which is not statistically significant ($P>0.05$).

When considering the interaction between epidemic situation and enterprise nature, the statistical analysis results show that the interaction has no significant influence on DebtRatio. Therefore, it can be considered that the nature of the enterprise and the epidemic situation have no obvious interactive influence on the relationship between total liabilities and total assets.

According to the above regression results, SOE and the interaction between SOE and the epidemic did not show significant influence on DebtRatio. This means that in this study, the nature of the company and the degree of political connection did not have a statistically significant impact on the relationship between total liabilities and total assets.

Table 8: Strategic description of company change.

Debt Ratio	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
ACOVID19	-0.0063	0.0054	-1.17	0.242	-0.0169 0.0043
SOE	-0.0121	0.0085	-1.42	0.156	-0.0288 0.0046
ACOVID19*SOE	-0.0162	0.0114	-1.43	0.154	-0.0385 0.0061
1 1					
Age	0.0018	0.0004	4.79	0.000***	0.0012 0.0025
SAI	7.56e-08	7.11e-09	10.63	0.000***	6.16e-08 8.95e-08
NP Ratio	4.9432	0.0125	395.70	0.000***	4.9187 4.9677
Revenue	-0.0001	9.29e-06	-15.35	0.000***	-0.0002 -0.0001
AP Ratio	-1.8325	0.0146	-125.63	0.000***	-1.8611 -1.8039
Asset	0.0001	5.47e-06	11.56	0.000***	0.0001 0.0001
ROA	0.0006	0.0001	4.62	0.000***	0.0003 0.0008
_cons	0.2122	0.0088	24.17	0.000***	0.1950 0.2294

t statistics in parentheses

*p<0.05, ** p<0.01, ***p<0.00

5.8. The Influence of Political Relevance

For political relevance, according to the regression results, I can see that the influence of the new parameter “political” on “DebtRatio” (total liabilities/total assets). Table 9 exams H2 and the influence of political relevance on DebtRatio.

The coefficient of political variable is 0.0128, but the statistical significance is not up to the level of $P<0.05$ ($P>0.05$). Therefore, the influence of political relevance on DebtRatio is not statistically significant. This means that in this study, the degree of political connection of the company has no obvious influence on the relationship between total liabilities and total assets.

In terms of the influence of the interaction between ACOVID19 and political on DebtRatio, in the regression results, the interaction item (ACOVID19 * political) between Acovid 19 and Political is marked as (1 1), but this interaction item has no corresponding data observation value. It is predicted to be positive, which means the politically connected firms are more likely to offset the bad influence of the external environment because they can access valuable financial resource easily than firms without political connections.

Therefore, based on the above results, political relevance has no significant influence on the Debt Ratio between the company’s total liabilities and total assets. In addition, due to the lack of observation values of ACOVID19 and political relevance of 1 at the same time, it is impossible to draw the conclusion that the interaction term affects DebtRatio. However, this may also be the

deviation of the data itself, and sufficient data need to be further supplemented for further research. H2 is not supported.

Table 9: Tests of H2.

Debt Ratio	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
ACOV19	-0.0068	0.0051	-1.34	0.179	-0.0168 0.0031
political	0.0128	0.0085	1.50	0.132	-0.0039 0.0294
ACOV19*political	0	(empty)			
1 1					
Age	0.0014	0.0004	3.93	0.000***	0.0007 0.0021
SAI	7.77e-08	7.09e-09	10.96	0.000***	6.38e-08 9.16e-08
NP Ratio	4.9428	0.0124957	395.56	0.000***	4.918303 4.967287
Revenue	-0.0001	9.28e-06	-15.49	0.000***	-0.000162 -0.0001256
AP Ratio	-1.8280	0.0146	-125.55	0.000***	-1.8565 -1.7994
Asset	0.0001	5.45e-06	11.30	0.000***	0.0001 0.0001
ROA	0.0006	0.0001	4.72	0.000***	0.0003 0.0008
cons	0.2127	0.0088	24.22	0.000***	0.1955 0.2299

t statistics in parentheses

*p<0.05, ** p<0.01, ***p<0.00

6. Conclusion

This paper aims to answer following key questions through empirical analysis. How does COVID-19 influence firms' short-term financial conditions and long-term development in China, and whether and to what extent will their financial leverage deviate from the original path? Can financing support from government as a bailout policy alleviate the financial distress caused by the epidemic? In order to exam our hypotheses, I did a series of texts. The sample includes all publicly listed Chinese firms from 2017 to 2022.

Based on research on differences in financial distress conditions in companies before and during the COVID-19 pandemic the following conclusions are obtained. Results show that the outbreak of Covid-19 makes firms more difficult to borrow money. H1 is supported. However, the interaction item has no corresponding data observation value. It is predicted to be positive, which means the politically connected firms are more likely to offset the bad influence of the external environment because they can access valuable financial resource easily than firms without political connections. It is not consistent with H2. COVID-19 pandemic has had a negative impact on firm's financial performance in China.

The study not only extends the growing literature exploring the deep influence of the Covid-19 pandemic on business, but also has implications for policymakers. This study is also anticipated to assist investors in determining a company's financial health, which can be utilized to make investment decisions. In addition, this research can be used as information for companies experiencing financial distress conditions so that they can immediately make changes to be able to maintain their companies in the future.

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Research on the Synthesis of Hong Kong NFT Index Using Principal Component Analysis and Index Prediction Based on LSTM-Modified ARMA-GARCH Model

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Abstract: With the advent of the Web3.0 era, virtual assets have gained prominence in individuals' asset portfolios, making Non-Fungible Tokens (NFTs) increasingly significant within the financial trading landscape. To address the issue of multicollinearity in regression analysis, this paper employs Principal Component Analysis (PCA) to perform dimensionality reduction on five correlated foundational sectors. Moreover, to enhance the accuracy and reliability of predictive outcomes, the study combines the Long Short-Term Memory (LSTM) model with the Autoregressive Moving Average-Generalized Autoregressive Conditional Heteroskedasticity (ARMA-GARCH) model. Through the application of these methods and practical implementation, the study forecasts the NFT index of the Hong Kong stock market for the next 30 days. This forecasting of return volatility contributes vital insights for investment decision-making. The research complements and offers application recommendations in financial innovation, deepening, and regulation. By devising novel products and tools to meet investor demands, providing risk management and investment opportunities, the model's predictive outcomes can be utilized in regulatory and risk management strategies within the national financial trading market. This study provides regulatory guidance, policy formulation insights, and envisions further refinements of the research methodology by integrating information shock effects.

Keywords: NFT, principal component analysis, LSTM model, ARMA-GARCH model

1. Introduction

The NFT market in Hong Kong is rapidly growing, attracting more investors and institutions. The government of the Hong Kong Special Administrative Region has been actively working on enhancing regulatory supervision for digital assets. The Hong Kong Securities and Futures Commission (SFC) is in the process of licensing digital asset exchanges and has issued guidelines for compliance. In the NFT market, cultural institutions like the Hong Kong Museum of Art are adopting NFT technology to release historically significant digital artifacts. NFT artists in Hong Kong are also using this platform to showcase their work. This study combines the LSTM and ARMA-GARCH models to analyze the Hong Kong stock market's high-correlation sectors, including finance, telecommunications, consumer goods, and technology. The data set covers minute-by-minute data from September 14, 2020, to May 19, 2023, including the NFT World Index data. The findings offer

valuable insights for investors interested in the Hong Kong NFT index and can guide policymakers. The research methodology can be a reference for other financial markets. ARMA-GARCH models are constructed for various sectors, and a three-loop LSTM model refines predictions from these models. Using the LSTM-modified ARMA-GARCH model, the study predicts NFT return volatility. It provides recommendations for financial innovation, deepening, and regulation. This includes the development of NFT yield volatility-based options products, volatility trading strategies, risk management tools, and integrating predictive outcomes into regulatory frameworks. Model-predicted outcomes can inform market regulation and intervention policies, ensuring market fairness and integrity. Further research and validation are essential for practical applications, with potential refinements incorporating information shock effects to better understand NFT market volatility.

2. Theoretical Foundation

The advent of Non-Fungible Token (NFT) assets has garnered substantial attention from scholars both domestically and internationally. An increasing number of financial researchers have directed their focus towards the realm of NFTs. Presently, literature concerning NFTs employs various statistical econometric models to analyze and forecast the indicators of NFTs themselves [1][2]. Additionally, exploration into the transmission of returns and volatility between NFTs, cryptocurrencies, and conventional assets has ensued [3][4][5], contributing to the comprehension of trends and potentials within the NFT market.

Principal Component Analysis (PCA) finds extensive application in the realm of physical chemistry and other scientific fields. Utilizing PCA, complex datasets and interrelationships among independent variables, which are arduous to explicate, can be reduced into a lesser number of abstract factors known as principal components [6][7][8]. In the domain of economics, PCA is commonly employed for research in macroeconomics [9][10]. In this study, PCA will be employed to condense causally related sectors of the NFT index, culminating in the synthesis of a singular US NFT index, followed by the derivation of the Hong Kong NFT index.

The AutoRegressive Moving Average-Generalized Autoregressive Conditional Heteroskedasticity (ARMA-GARCH) model is widely recognized as a classical forecasting methodology. Nevertheless, this model, alongside several other conventional statistical methods, falls short in capturing the nonlinear features inherent in time series data [11][12]. Consequently, Artificial Neural Networks (ANN) have emerged as a popular tool for modeling nonlinear relationships and predicting indicators. Subsequently, Recurrent Neural Networks (RNN), owing to their consideration of the temporal influence of past information, have gained prominence for time series prediction [13]. Within RNN, the Long Short-Term Memory (LSTM) model has exhibited strong performance in predictive analysis related to time series data and is considered a comprehensive version of RNN [14]. LSTM capitalizes on historical data to benefit from a high degree of consistency in time series analysis [15]. Furthermore, when compared to either RNN or time series models in isolation, a blend of RNN and GARCH models often demonstrates superior efficacy [16][17]. Therefore, to enhance predictive capabilities, this study integrates the LSTM model with the ARMA-GARCH model to forecast the values of five foundational sectors for the forthcoming thirty trading days.

3. Principal Component Analysis for Dimension Reduction

3.1. Research Purpose and Ideas

The four basic sectors (technology, communication, finance and consumption) with a causal relationship with the NFT index will reduce their dimensions, and extract the main components to fit the US stock NFT index, and then construct the NFT representative index of Hong Kong stocks. The specific operation steps are as follows: test whether it is suitable for the main component analysis,

extracting the main components, fitting the US stock NFT index, and fitting the Hong Kong stock NFT index.

3.2. KMO and the Bartlett-Tests

In order to avoid the problem of multicollinearity in the model, this paper adopts the principal component analysis method to adopt the dimension reduction treatment for the five basic plates, and fits it to become an index to measure the NFT index of the US stock market. First, KMO test and Bartlett spherical test were used to determine whether the data are suitable for principal component analysis and do dimensionality reduction treatment. According to Table 1, KMO value of 0.785 > 0.600 and P-value of Bartlett spherical test of 0.000 < 0.001 is significant, indicating that there is correlation between variables and is suitable for main component analysis.

Table 1: KMO and Bartlett tests.

KMO price		0.785
Bartlett Sphelicity test	Approximate chi square	4309.887
	df	10
	P	0.000***

3.3. Principal Components Were Extracted

Secondly, In the variance interpretation table, at the principal component 3, the total variance interpretation was below 1, and the cumulative contribution of variable interpretation reached 86.154%, which is already greater than 85%, indicating that the extraction is sufficient. In this way, the original five variables are converted into three new and mutually independent composite indicators.

Table 2: Total variance interpretation.

ingredient	characteristic root	characteristic root	
		Variance interpretation rate (%)	Cumulative variance interpretation rate (%)
1	2.681	53.618	53.618
2	1	20.002	73.62
3	0.627	12.534	86.154
4	0.443	8.854	95.009
5	0.25	4.991	100

3.4. Fit the US Stock Market NFT Index

Table 3: The component matrix table.

name	ingredient		
	Component 1	Component 2	Component 3
Financial services sector LN yield	0.332	0.004	-0.138
Technology sector LN yield	0.326	0.002	-0.167
Communication service sector LN yield	0.292	-0.003	-0.633
Consumer sector LN yield	0.266	-0.028	1.071
The World NFT Index LN yield	0.006	1	0.029

The calculation formula for the principal components F_1 , F_2 , and F_3 is obtained from the component matrix table (Table 3) as follows:

$$F_1 = 0.332X_1 + 0.326X_2 + 0.292X_3 + 0.266X_4 + 0.006X_5 \quad (1)$$

$$F_2 = 0.004X_1 + 0.002X_2 - 0.003X_3 - 0.028X_4 + X_5 \quad (2)$$

$$F_3 = -0.138X_1 - 0.167X_2 - 0.633X_3 + 1.071X_4 + 0.029X_5 \quad (3)$$

Table 4: Factor weight table.

name	Variance interpretation rate (%)	Cumulative variance interpretation rate (%)	weight (%)
Principal Component 1	0.536	53.618	62.234
Principal Component 2	0.2	73.62	23.217
Principal Component 3	0.125	86.154	14.549

According to Table 4, the comprehensive score is calculated with the variance contribution rate of each factor as the weight:

$$F = 0.622F_1 + 0.232F_2 + 0.146F_3 \quad (4)$$

3.5. Fit the Hong Kong Stock NFT Index

To predict the trend of the securities market index, it is often only necessary to grasp the relationship between the change rate of various influencing factors and the change of the fluctuation trend of the index. In the context of economic globalization, in order to maximize profits, the frequent cross-border flow of international capital has a profound impact on the stock market. Especially after the subprime mortgage crisis in 2008, the economic ties between countries became closer, leading to the closer connection of the global stock market and the trend of global integration of the stock market. With the rapid development of the digital economy, the correlation and influence of the large basic sectors on the stock index in the stock markets of various countries are roughly the same. Therefore, it can be considered that the basic sector with the impact and correlation to the US stock NFT index plays the same role for the Hong Kong stock NFT index in China's stock market. In conclusion, fitting THE Hong Kong NFT index also uses the following comprehensive score algorithm:

$$F = 0.622F_1 + 0.232F_2 + 0.146F_3 \quad (5)$$

4. LSTM Modified the ARMA-GARCH Model

4.1. Research Purpose and Ideas

The prediction results of ARMA-GARCH model are corrected with the three-cycle LSTM model, and then the prediction results of each sector and the results of principal component analysis are used to predict the index of Hong Kong NFT index in the next 30 trading days. The specific operation process is as follows: data preprocessing, partitioning data sets, training ARMA-GARCH model, fitting ARMA-GARCH model, constructing LSTM model, LSTM model training, model correction and prediction.

4.2. Model Data Selection

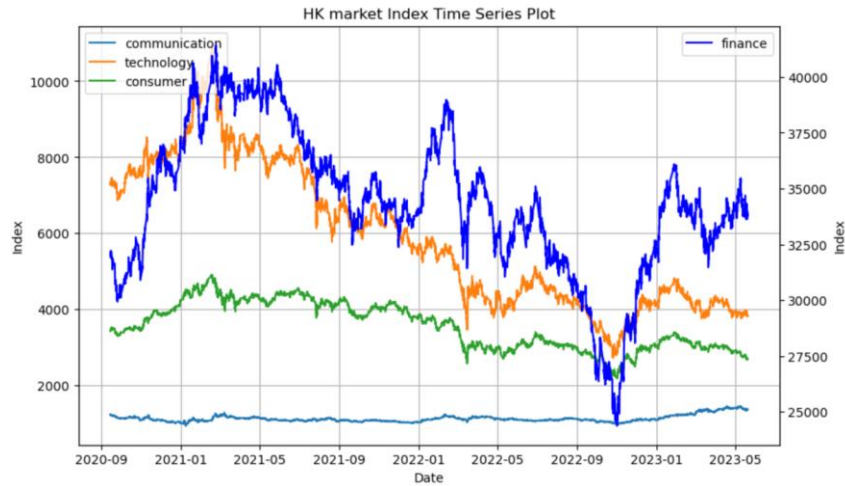


Figure 1: The four exponential timing plots.

To better predict the law between time series data and volatility, adopt high frequency trading data modeling prediction, select the hang seng financial, hang seng telecommunications, hang seng consumption and hang seng technology four index on September 14,2020-May 19,20,2023, every time-sharing data (data source: Choice database terminal), the index sequence diagram as shown above, the NFT world index also within the same range of each time-sharing data, subsequent modeling analysis to use the above data. The data were not normally distributed, considering the T distribution or the generalized difference distribution, and the T distribution was tested after the information criterion.

4.3. ARMA-GARCH Model Construction

4.3.1. Time-Series Stationarity Test

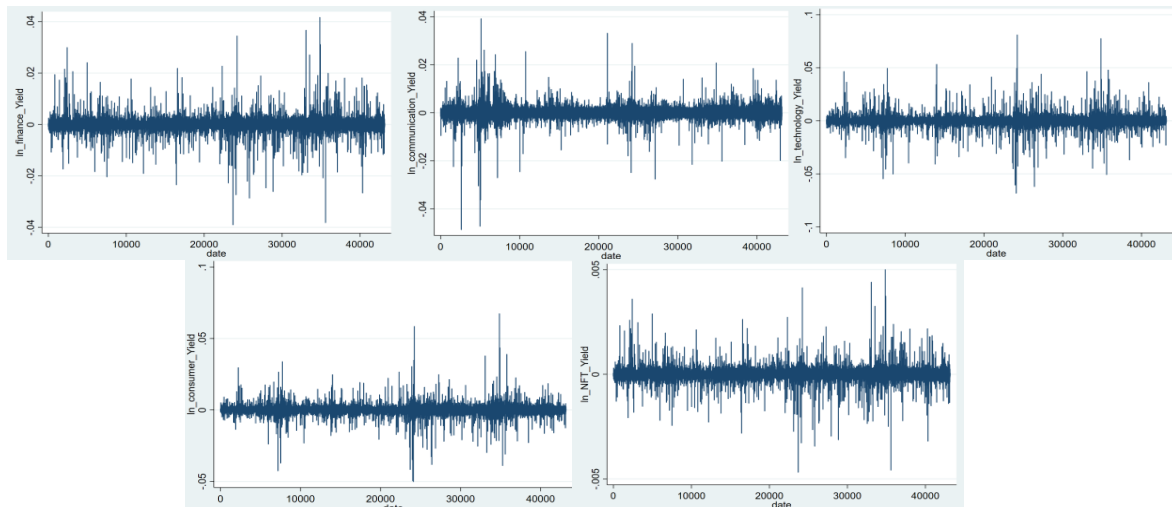


Figure 2: Time sequence chart of each index yield.

It can be seen from the timing chart of each index return rate (Figure 2) that there is variance aggregation effect and conditional heteroscedasticity. However, the p-value of the stationarity test of each index yield is <0.05 , rejecting the null hypothesis, indicating that the time series is stable.

4.3.2. Judgment of ARMA Model Building

The time series of finance, communication, consumption and NFT index yield lag 12 order p-value value is less than 0.05, rejecting the null hypothesis, indicating that there is autocorrelation in each time series data, there are conditional mean laws that can be mined, and because the time series is stable, the ARMA model needs to be established.

The time-series of technology index of 12 is higher than 0.05, so the null hypothesis cannot be rejected, indicating that there is no autocorrelation in the time series data at 95% confidence level, and because the time series is stable, it is no need to establish ARMA model and directly consider whether there is arch effect.

4.3.3. Determine the ARMA Model Order and Parameters

Through finance, communication, consumption and NFT index yield AC and PAC chart can see no obvious cut trend, unable to judge, combined with ACF and PACF, through LL, AIC and BIC information criterion comparison, determine the financial, consumption and NFT index yield AR order 3, MA is order 2, determine model selection for ARMA (3,2) model, communication index yield AR order 3, MA is order 1, determine the model selection for ARMA (3,1) model, model parameters are as follows:

Table 5: The ARMA model parameters.

			Coef.
ln_finance_Yield	AR	L1	.4319108
		L2	-.9796393
		L3	-.4469863
	MA	L1	.9836452
		L2	-.0165851
ln_communication_Yield	AR	L1	.4421813
		L2	.0428584
		L3	.01693
	MA	L1	-.5121995
ln_consumer_Yield	AR	L1	-1.362824
		L2	-.6919797
		L3	.0311373
	MA	L1	1.392042
		L2	.7365798
ln_nft_yield	AR	L1	-.3192289
		L2	-.9608591
		L3	-.0980521
ln_nft_yield	MA	L1	.191668
		L2	.9752089

4.3.4. Self-Correlation Back Test

Financial, communication, consumption and NFT index yield model parameters except the constant items are significant, and through autocorrelation back, that the condition mean rule has been discovered, then consider the condition, the residual term autoregression test and LM test, found that financial, communication index yield the residual term autoregression coefficient of three significant,

consumption index yield residual term autoregression coefficient of two significant, considering the possible ARCH effect. It is found that the autoregression coefficient of the NFT index yield residue term was not significant. Considering that the ARCH effect may not exist, the model was established and the fitting effect of the model was considered.

The yield of technology index autoregresses the square of its own lag term, and finds that the first fourth order coefficient is significant. Considering the possible arch effect, the arch / gear model should be established to treat the conditional heteroscedastic phenomenon.

4.3.5. GARCH Model

Through the comparison of LL, AIC and BIC information criteria, the ARCH of finance, communication, technology and consumption index yield model is determined as order 1, GARCH is order 1, and the model is selected as GARCH (1,1) model. The model parameters are as follows:

Table 6: Model parameters of GARCH.

			Coef.
ln_finance_Yield	ARCH	L1	.2163816
	GARCH	L1	.6923909
ln_communication_Yield	ARCH	L1	.2051661
	GARCH	L1	.670413
ln_technology_Yield	ARCH	L1	.2882047
	GARCH	L1	.7453921
ln_consumer_Yield	ARCH	L1	.2993463
	GARCH	L1	.7313484

The model parameters were significant except the constant term, which were back-tested by LM with no asymmetric effect, indicating that the conditional variance law has been fully explored, the model establishment was completed, and the fitting effect of the model was considered.

4.3.6. For each Index Yield Model Equation

1) The ARMA (2,3) -GARCH (1,1) model equation for the financial index yield is as follows:
ARMA part:

$$\ln finance yield_t = 1.486018 \ln finance yield_{t-1} - 0.5186466 \ln finance yield_{t-2} - 1.539179 \varepsilon_{t-1} + 0.5739443 \varepsilon_{t-2} - 0.0039306 \varepsilon_{t-3} \quad (6)$$

GARCH part:

$$\sigma_t^2 = 2.56e + 0.2163816 \varepsilon_{t-1}^2 + 0.6923909 \sigma_{t-1}^2 \quad (7)$$

2) The ARMA (3,1) -GARCH (1,1) model equation of the communication index yield is as follows:

ARMA part:

$$\begin{aligned} \ln communication yield_t = & 0.7419531 \ln communication yield_{t-1} \\ & + 0.1542212 \ln communication yield_{t-2} \\ & + 0.039845 \ln communication yield_{t-3} - 0.9451089 \varepsilon_{t-1} \end{aligned} \quad (8)$$

GARCH part:

$$\sigma_t^2 = 3.07e + 0.2051661\varepsilon_{t-1}^2 + 0.670413\sigma_{t-1}^2 \quad (9)$$

**3) The GARCH (1,1) model equation for the technology index yield is as follows:
GARCH part:**

$$\sigma_t^2 = 3.92e + 0.7453921\sigma_{t-1}^2 \quad (10)$$

**4) The ARMA (3,2) -GARCH (1,1) model equation of consumer index yield is as follows:
ARMA part:**

$$\begin{aligned} \ln \text{consumer yield}_t = & 0.1828829 \ln \text{consumer yield}_{t-1} \\ & + 0.8609489 \ln \text{consumer yield}_{t-2} \\ & - 0.0587044 \ln \text{consumer yield}_{t-3} - 0.1091806\varepsilon_{t-1} \\ & - 0.8707501\varepsilon_{t-2} \end{aligned} \quad (11)$$

ARCH part:

$$\sigma_t^2 = 0.2993463\varepsilon_{t-1}^2 + 0.7313484\sigma_{t-1}^2 \quad (12)$$

GARCH part:

$$\sigma_t^2 = 2.16e + 0.2993463\varepsilon_{t-1}^2 + 0.7313484\sigma_{t-1}^2 \quad (13)$$

**5) The ARMA (3,2) model equation for the yield of the NFT index is as follows:
ARMA part:**

$$\begin{aligned} \ln \text{NFT yield}_t = & -0.3192289 \ln \text{NFT yield}_{t-1} - 0.9608591 \ln \text{NFT yield}_{t-2} \\ & - 0.0980521 \ln \text{NFT yield}_{t-3} + 0.191668\varepsilon_{t-1} + 0.9752089\varepsilon_{t-2} \end{aligned} \quad (14)$$

4.4. Model Fitting

According to the model of the index yield fitting, draw the timing diagram between the predicted value and the actual value, found the trend is basically the same, and select the last thirty days of data (1440 data) as a test set, calculate the root mean square error (RMSE), the average absolute error (MAE) and the average absolute percentage error (MAPE), the result output is as follows:

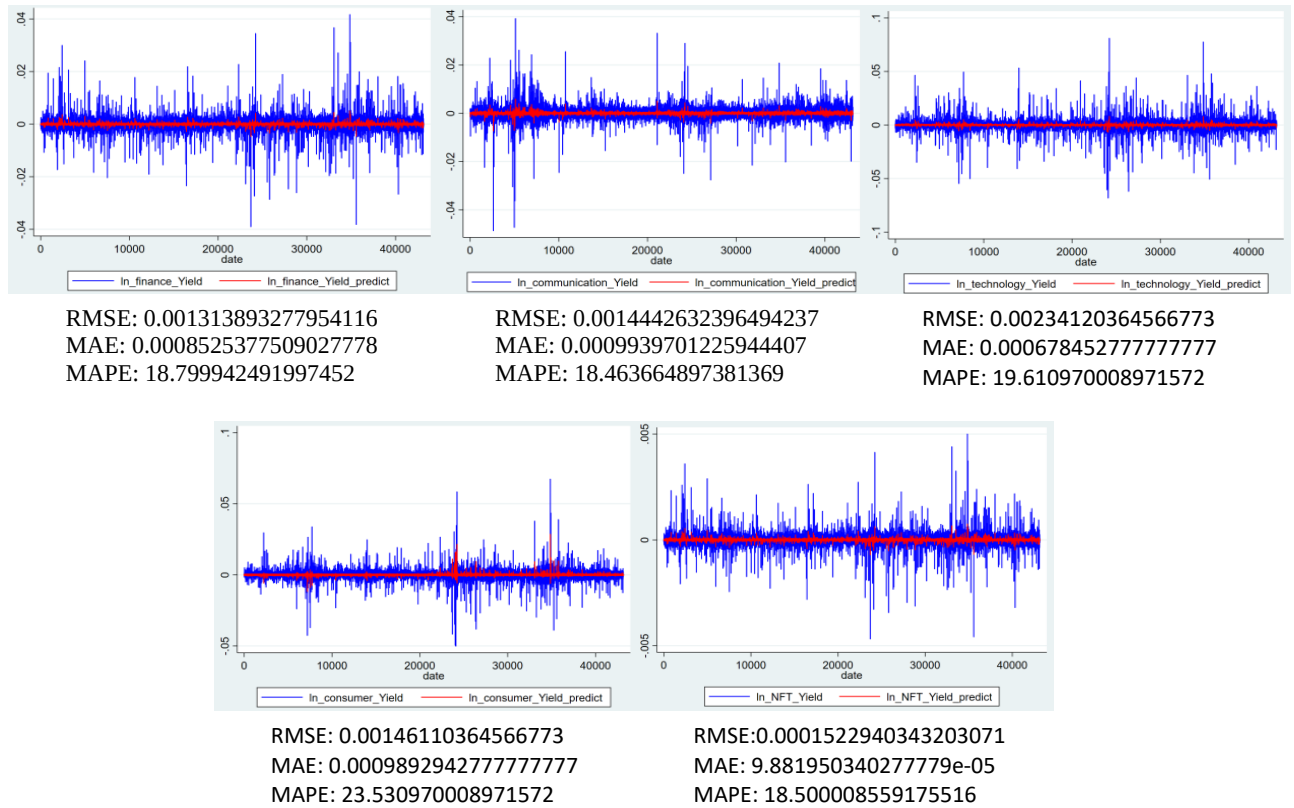


Figure 3: Time diagram of predicted value and actual value of each index.

The MAPE value was found to be 18.7%, Communication index yield test set MAPE value of 18.5%, Technology index yield test set MAPE value of 19.6%, Consumer index yield test set MAPE value of 23.5%, The NFT index yield test set MAPE value of 18.5%, Show that the fitting accuracy is not very high, Reneed to correct the prediction results of the model, Consider the prediction using the LSTM model for the exponential time series data of the data, And log-differential the predicted results, The time series of obtaining yields, Then, by combining the time series predicted by the ARMA-GARCH model and the LSTM model, Get the time series prediction results of the corrected yield.

4.5. Construct the LSTM Model

Using the exponential time series as the input data, an LSTM model was constructed using Python. The LSTM model can capture the dynamic features of the data by learning the dependencies between the sequences. Attempt to use LSTM models with different numbers of layers and compare their performance on validation data. The predictive power of the model can be compared using evaluation indicators such as root mean square error (RMSE) or mean absolute error (MAE). Looking at the performance of the model under different numbers of layers, finding a number of layers makes the model perform best on the validation set. The time series data of finance, communication, technology, consumption and NFT sector index is processed and the LSTM model is established. The fitting results are as follows:

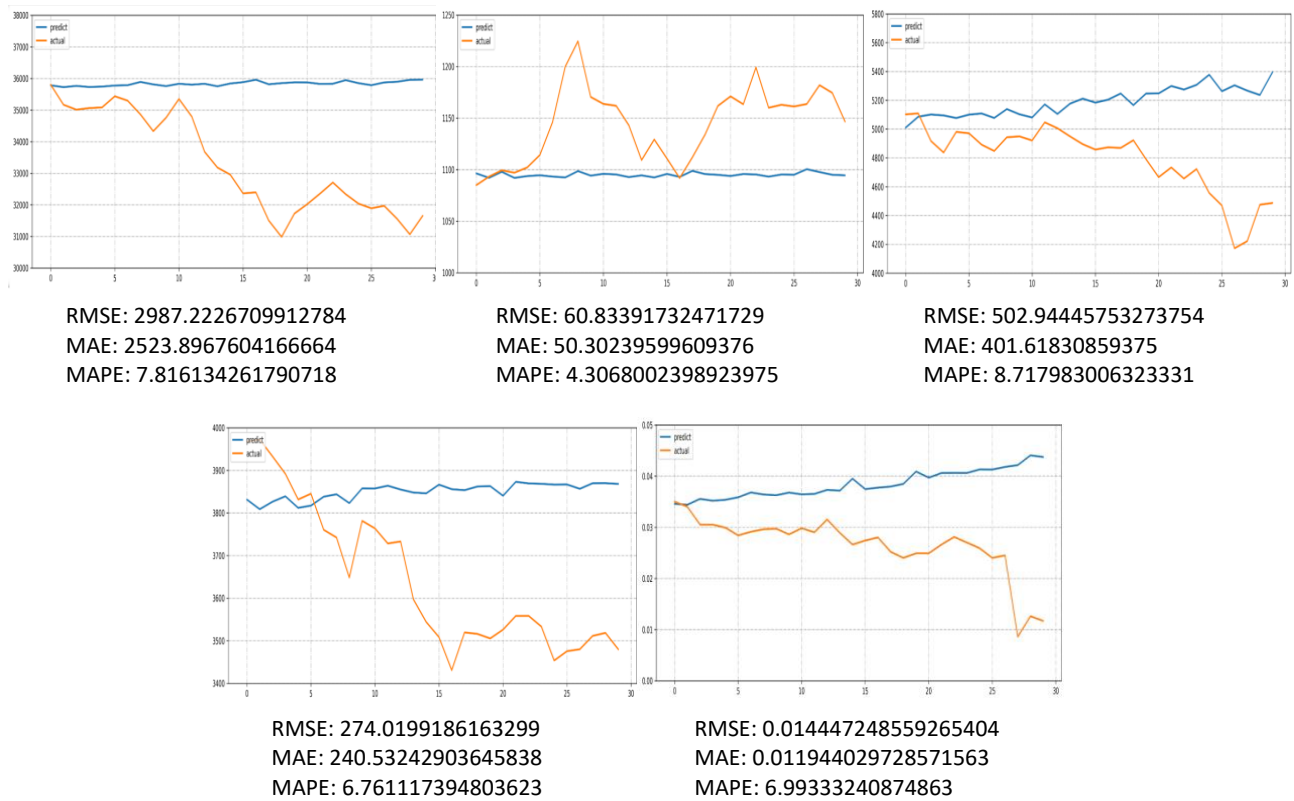


Figure 4: LSTM model fitting results for each exponential time series.

It is found that the MAPE value of financial index LSTM model is 7.81%, communication index time series LSTM model MAPE is 4.31%, technology index time series LSTM model is 8.72%, consumer index time series LSTM model MAPE is 6.76%, NFT index time series LSTM model MAPE is 6.99%, indicating that the index model has high fitting accuracy and can better describe the change trend of the index time series, which is suitable for time series prediction and the index prediction in the next 30 trading days.

Table 7: Comparison of fitting results before and after LSTM correction.

	The MAPE values of the ARMA-GARCH model	Model MAPE values from LSTM correction
ln_finance_Yield	18.7%	7.81%
ln_communication_Yield	18.5%	4.31%
ln_technology_Yield	19.6%	8.72%
ln_consumer_Yield	23.5%	6.76%
ln_NFT_Yield	18.5%	6.99%

4.6. Model Prediction Results

Each part of the LSTM model index time series prediction results for logarithmic difference get the yield prediction time series, and then with its ARMA-GARCH model yield prediction results for linear combination, get the five plate three days, reuse the coefficient of the principal component analysis method fitting Hong Kong NFT index. Besides, the data is drawn as a timing diagram, and the results are as follows:

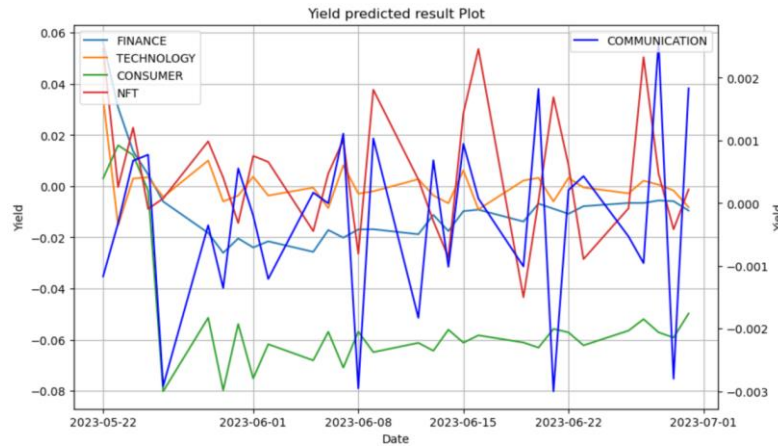


Figure 5: Time sequence chart of the forecast results of the five sectors in the next 30 trading days.

According to the above predicted return rate, the index prediction data of relevant sectors can be obtained through the inverse log difference [$P_t = P_{t-1} / (1 - \text{Exp}(Y_i))$], and the coefficient in the principal component analysis method can be used to fit the NFT index of Hong Kong. The specific data are as follows:

Table 8: Index forecast data of each sector.

Date	FINANCE	COMMUNICAT ION	TECHNOLOGY	CONSUMER	NFT	The Hong Kong stock market NFT index
2023/5/22	35737.17982	1378.940418	5218.924413	2710.521647	0.012345	8603.167578
2023/5/23	34835.61564	1380.112668	4965.863429	2745.86599	0.011696	8400.306512
2023/5/24	34246.29321	1381.486397	5057.859067	2735.400147	0.011971	8303.211182
2023/5/25	33935.0032	1381.617795	5060.327728	2697.489299	0.011596	8233.410489
2023/5/26	33578.82562	1376.531013	5021.448769	2493.980457	0.011644	8095.129435
2023/5/29	33169.00204	1380.06463	5093.588885	2566.774009	0.011907	8054.544816
2023/5/30	32910.99276	1378.685247	5012.702524	2495.086665	0.01174	7969.030231
2023/5/31	33097.80346	1381.31683	5024.266618	2560.508576	0.011533	8026.94701
2023/6/1	32980.90604	1380.277578	5061.540758	2506.62013	0.01184	7994.6365
2023/6/2	33060.31942	1378.88428	5024.25252	2540.365339	0.011812	8013.357484
2023/6/5	32924.43145	1380.783525	5039.854989	2524.343647	0.011496	7985.81444
2023/6/6	33207.22269	1380.547875	4999.735438	2552.736286	0.011758	8040.533201
2023/6/7	33107.4089	1382.081527	5083.971871	2517.22615	0.011913	8025.844352
2023/6/8	33214.59734	1376.483158	5028.05402	2552.863645	0.011395	8046.659551
2023/6/9	33216.70046	1381.976142	5032.670655	2532.468162	0.01215	8041.934356
2023/6/12	33152.20726	1378.029899	5056.537733	2541.691436	0.011731	8036.683453
2023/6/13	33403.61499	1381.494983	5024.472903	2533.838377	0.011541	8075.863581
2023/6/14	33193.17516	1379.152621	5009.144853	2554.867569	0.01138	8040.133691
2023/6/15	33453.37025	1381.85749	5073.967549	2541.841349	0.012039	8096.589979
2023/6/16	33471.93924	1380.653745	4997.088524	2549.227712	0.012345	8088.540145
2023/6/19	33317.22259	1379.16032	5053.861677	2542.031291	0.011203	8067.316651
2023/6/20	33551.49468	1383.068082	5059.204996	2536.967211	0.011633	8110.896902
2023/6/21	33484.23595	1376.416714	5012.641885	2555.599428	0.012114	8095.25897
2023/6/22	33417.75466	1380.838671	5059.111584	2552.132074	0.011797	8090.417358
2023/6/23	33517.70777	1381.146439	5040.129361	2539.218352	0.011371	8101.697088

Table 8: (continued).

2023/6/26	33559.8781	1379.818128	5028.63314	2553.912699	0.0116	8112.054708
2023/6/27	33559.36242	1379.231979	5053.571882	2565.400747	0.012306	8119.989247
2023/6/28	33592.84219	1384.097201	5045.719487	2552.169945	0.011758	8121.113566
2023/6/29	33583.60761	1376.693368	5034.119543	2546.96027	0.011504	8115.011281
2023/6/30	33460.51193	1383.080744	5001.313843	2571.03928	0.011685	8094.248031

5. Conclusions and Implications

5.1. Application Advice

5.1.1. Financial Innovation

Based on the research outcomes and methodology of predicting NFT return volatility using the LSTM-corrected ARMA-GARCH model, several viable applications can be explored, particularly within the realm of financial derivative product innovation:

1) NFT Options Products.

The design and introduction of options products based on NFT return volatility is conceivable. By applying the forecasted volatility levels and trends from the model to option pricing models, diverse types of NFT options can be tailored, including call options, put options, and combination strategies. These options can meet investors' demands for NFT market volatility, providing them with more flexible risk management and investment opportunities.

2) Volatility Trading Strategies.

Leveraging the model-predicted NFT return volatility, volatility trading strategies can be developed and executed. These strategies may encompass volatility arbitrage, volatility trading, option combination strategies, etc., to profit from fluctuations in NFT market volatility. Investors can employ the predictive outcomes of the model, coupled with appropriate trading strategies, for risk management and portfolio optimization.

3) Risk Management Tools.

The application of model-predicted NFT return volatility can be extended to the development of risk management tools. For instance, designing risk exposure indicators, risk measurement models, or dynamic risk management strategies based on the model's forecasted outcomes. These tools can assist investors and traders in comprehending and managing the volatility risk of the NFT market, thereby enhancing the accuracy and efficacy of investment decisions.

5.1.2. Financial Deepening

The research outcomes and methodology of predicting NFT return volatility using the LSTM-corrected ARMA-GARCH model offer avenues for exploring their viable applications within the context of financial deepening in the national financial trading markets. During the process of financial deepening, effective regulatory and risk management mechanisms are typically required to safeguard investor interests, maintain market stability, and foster market development. The application of the LSTM-corrected ARMA-GARCH model to predict NFT return volatility can be applied to the regulation and risk management of the NFT market in the following aspects:

1) Risk Assessment and Monitoring.

Utilizing the forecasted NFT return volatility from the model, regulators can monitor and assess the risk level of the NFT market. Regulatory authorities can periodically evaluate the volatility levels and trends in the market based on the model's predictions, thereby understanding the market's risk condition and implementing corresponding regulatory measures.

2)Risk Alerts and Interventions.

Building upon the forecasted NFT return volatility, regulatory agencies can establish risk alert mechanisms and appropriate intervention measures. When market volatility surpasses specific thresholds or exhibits abnormal fluctuations, regulatory bodies can promptly issue warnings and take suitable actions, such as restricting trading activities or intensifying regulatory reviews, to mitigate potential risks and maintain market stability.

3)Product Innovation and Standardization.

Relying on the model's predictive outcomes, the innovation and standardization of NFT derivative products can be promoted. Regulatory authorities can evaluate and oversee various NFT derivative products based on market volatility predictions, ensuring their alignment with market demand, investor protection, and market stability requirements.

4)Investor Education and Risk Management Guidance.

Leveraging the predictive results of the model, regulatory bodies can offer investor education and risk management guidance. Regulatory authorities can utilize the predictive outcomes to provide investors with information and recommendations concerning risks in the NFT market, aiding investors in better comprehending and managing market risks. This approach contributes to both investor protection and the stability of market participation.

The integration of the LSTM-corrected ARMA-GARCH model into the regulatory and risk management framework of the NFT market can enhance transparency, stability, and investor confidence, fostering a conducive environment for the healthy development of the financial sector. Nevertheless, the practical implementation of these applications should be conducted meticulously, aligning with the specific requirements and dynamics of the national financial trading markets.

5.1.3. Financial Regulation

Within the realm of financial regulation, ensuring market stability and safeguarding investor interests stands as a crucial mandate. The application of the LSTM-corrected ARMA-GARCH model to predict NFT return volatility can be harnessed for regulatory purposes and the maintenance of market stability in the NFT market in the following aspects:

1)Market Regulation and Intervention.

Building upon the forecasted NFT return volatility, regulatory policies and interventions can be designed. Regulatory bodies can implement appropriate market regulation measures when market volatility surpasses a specific threshold or experiences abnormal fluctuations. Measures such as restricting leverage trading and increasing margin requirements can be employed to prevent excessive market volatility and potential systemic risks.

2)Regulatory Guidance and Policy Formulation.

Utilizing the predictive outcomes of the model, regulatory guidance and policy formulation can be provided. Regulatory authorities can formulate corresponding regulatory policies and guidance based on the model's predictions, with the aim of safeguarding investor interests, promoting market fairness and transparency, and fostering the healthy development of the NFT market.

3)Market Behavior Monitoring and Manipulation Detection.

Drawing from the forecasted NFT return volatility, monitoring market behavior and detecting signs of manipulation can be enhanced. The model can assist regulatory bodies in identifying market manipulation and abnormal trading activities, thereby reinforcing market surveillance and investigations to maintain market fairness and integrity.

It is imperative to emphasize that the aforementioned are merely illustrative examples of potential viable applications. The specific applications will depend on market demands, risk management needs, financial derivative product innovations, as well as the requirements, regulatory framework, and market conditions set forth by national financial regulatory institutions. In practical

implementation, further research, testing, and validation are necessary to ensure the accuracy and applicability of the model's predictive results, in conjunction with the integration of other regulatory measures and tools.

5.2. Future Prospects of the Model

In analyzing NFT return volatility trends, we employed principal component analysis to synthesize returns from closely correlated sectors (finance, technology, consumer, and communication). The LSTM-corrected ARMA-GARCH model was used for forecasting, effectively capturing historical return volatility patterns and trends. However, model fit results showed that the MAPE values for predicted returns in all five sector indices exceeded 1%. This suggests that relying solely on historical return data doesn't fully encompass the market's information impact on NFT return volatility prediction. To address this, model modifications should account for information acquisition effects.

Information cascade theory posits that market participants' behavior is influenced by others and information transmission. When some participants adjust their decisions due to information impact, it triggers a chain reaction affecting price trends. Additionally, market micro-structure theory examines trading mechanisms and participant interactions. It suggests that the presence of high-frequency traders may amplify the impact of information shocks on prices, given their rapid trading and responsiveness to market fluctuations. As financial markets deepen and quantitative trading grows, understanding the impact of information shocks on index return volatility becomes increasingly crucial for model refinement.

Information shocks refer to sudden impacts on the market caused by unexpected events, news, or other information. They can significantly influence the price trends of a specific sector. Information shocks impact index return volatility through the following transmission mechanisms:

1)Market Reaction Mechanism.

Information shocks prompt immediate reactions from market participants, resulting in heightened trading activity. As participants adjust their investment decisions based on the content and interpretation of information, trading volume and prices might experience substantial fluctuations.

2)Information Dissemination Mechanism.

Information shocks rapidly spread through channels like media, news outlets, and social media. The speed and reach of information dissemination determine the degree of awareness and reaction time among market participants. Different information holds varying impacts on different sectors. When critical information reaches a broader array of participants, they might adjust their price expectations for that sector, thereby influencing price trends.

3)Information Interpretation Mechanism.

The impact of information shocks on market participants depends on their interpretation and comprehension of the information. Diverse participants might interpret the same information differently based on their perspectives and information processing capabilities. Disparities in information interpretation might heighten buying and selling pressures, thus impacting price fluctuations.

Consider using the LDA (Latent Dirichlet Allocation) model to capture the information propagation mechanism, and using the preprocessed text data to train the LDA model (LDA is an unsupervised machine learning algorithm to discover topics from text data, where topics can be viewed as different information shocks.), Then the trained LDA model is used for topic classification (such as a news article), and the LDA model gives the probability distribution of each document belonging to a different topic. Then the impact effect is evaluated, and according to the results of the theme classification, the impact effect of different information shocks on different plates is analyzed. You can calculate the distribution of each topic in different plates, and the relative weight of the subject in a specific plate. This allows the impact of different themes on different plates. At the same

time, attention should be paid to the interpretation and verification. According to the results of the impact effect evaluation, the impact mechanism of different information on different plates can be further explained and verified with the actual situation. For example, if a theme has a high weight in the financial sector, it means that the theme has a greater impact on the financial sector.

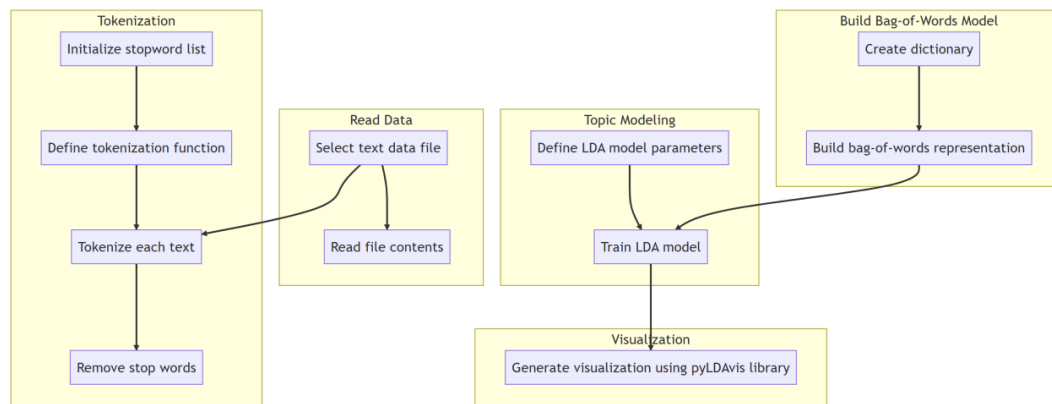


Figure 6: The LDA model construction logic.

Can consider the use of information emotional tendency analysis NLP (Natural Language Processing) model to reflect information interpretation mechanism, using pretreatment text data training emotion analysis model (emotion analysis is a text classification task, to judge the emotional tendency in the text, such as positive, negative or neutral emotion), for each text (such as a news report or a social media comments), using trained emotion analysis model for emotion classification. The model will give the emotional tendency of each text, and the corresponding emotional score or probability. Then, according to the emotion classification results, the impact effect of different information on market participants is analyzed. The distribution of emotional tendencies for different information types, and the relative weight of emotional tendencies among specific market participants can be calculated. This allows the extent to which different information affects market participants' expectations. At the same time, attention should be paid to interpretation and verification. According to the results of the impact effect evaluation, the impact mechanism of different information on the expectations of market participants can be further explained and verified with the actual situation. For example, if the distribution of emotional tendencies of a certain information type shows high negative emotions, it indicates that the information has a large negative impact on the expectations of market participants.

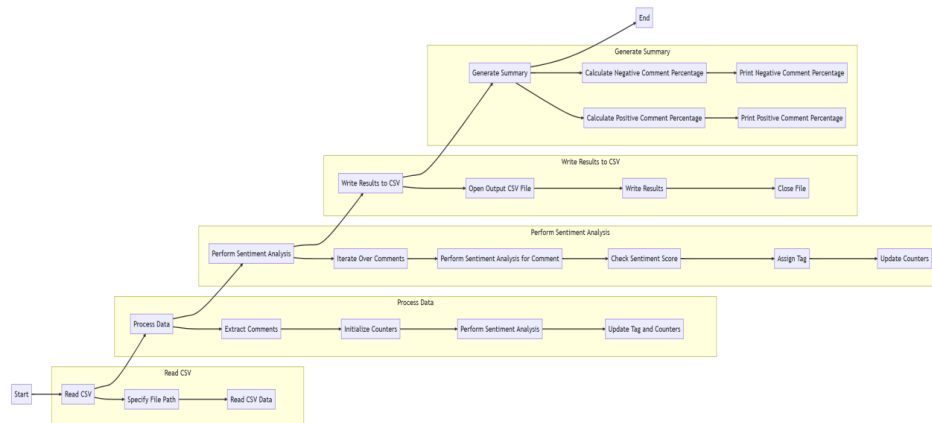


Figure 7: NLP Model Building Lics.

To sum up, considering the research method and conclusion of prediction of NFT yield volatility, can be used for financial product innovation, financial market deepening and financial regulatory response, so need to reflect the impact effect of market information, so consider the LSTM revised ARMA-GARCH model, on the basis of can introduce the analysis of NLP model and information impact theme classification LDA model, model correction.

5.3. Summary

The primary objective of this study was to analyze the volatility of Hong Kong Stock Exchange's (HKEX) NFT index returns. As the Hong Kong virtual asset exchange has yet to formally commence NFT trading, direct relevant data remains unavailable. Therefore, we adopted a strategy wherein associated high-impact basic sector index returns were used to synthesize an HKEX NFT index correlated with the global NFT sector index. To achieve this, four core sectors, namely financial services, technology, communication services, and consumer goods, were paired with the world NFT sector index to develop separate ARMA-GARCH models for return volatility prediction. However, these models exhibited suboptimal fitting. Subsequently, a three-loop LSTM model was constructed to forecast index prices for the five sectors. By logarithmically differencing these predictions, the LSTM and ARMA-GARCH forecasted return data were linearly combined, yielding a corrected set of forecasted returns. Leveraging principal component analysis, the forecasted return results for the HKEX NFT index were synthesized.

Based on our research into forecasting NFT return volatility using the LSTM-modified ARMA-GARCH model, we formulated practical suggestions and prospects for application. In terms of financial innovation, options products rooted in NFT return volatility, volatility trading strategies, and risk management tools could be designed and introduced to cater to investors' need for risk management and investment avenues within the NFT market. Concerning financial deepening, the model's predictions could be employed in national financial transaction markets for risk assessment, surveillance, risk alerting and intervention, product innovation and standardization, investor education, and risk management guidance. In the domain of financial regulation, the predictive outcomes could guide market control and intervention policies, offer regulatory guidance and policy references, and aid in market behavior monitoring to preserve fairness and integrity.

Nevertheless, it's imperative to acknowledge that the aforementioned applications are mere exemplifications. Their specific feasibility hinges on market demands, risk management requirements, financial derivative product innovations, and the specific circumstances of national financial

regulatory bodies, regulatory frameworks, and market dynamics. In practical application, further research, testing, and validation are prerequisites to ensure the accuracy and applicability of predictive results, harmonizing them with other regulatory tools and measures.

As we gaze into the future of this model, incorporating information acquisition influences for enhancement is advisable. Information cascade and market microstructure theories underscore the impact mechanisms of information shocks, encompassing market reaction, information dissemination, and information interpretation mechanisms. To this end, employing a topic-classifying LDA model for capturing information dissemination, alongside an NLP sentiment tendency model for assessing various information shocks' sectoral impacts, could offer a more comprehensive understanding and validation of NFT market volatility.

In summary, this study, rooted in the LSTM-modified ARMA-GARCH model for NFT return volatility prediction, presents feasible application suggestions for financial innovation, deepening, and regulation. Future efforts should refine the model by integrating other factors and methods to better address challenges within the NFT market, thereby fostering its sound development.

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Analysis on the Development and Progress of Tianjin's Digital Economy

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Abstract: In the modern era, the digital economy has emerged as a pivotal driver propelling global economic advancement. The rapid evolution of the digital economy has underscored Tianjin's notable domestic competitiveness. This study conducts a comprehensive analysis to delve into the prominent challenges permeating the development of Tianjin's digital economy. The analysis reveals that Tianjin is contending with several critical hurdles, including a sluggish pace of disciplinary development, constrained innovation capabilities, limited diversity of disciplines, and environmental pollution. Drawing inspiration from the accomplished strategies of digital economy front-runners in Beijing, Zhejiang, and Shanghai, this research distills three key characteristics that underscore successful digital economic growth. Based on these insights, the paper formulates a set of recommendations tailored to enhance the quality of Tianjin's digital economy expansion. By drawing parallels between effective strategies and the unique context of Tianjin, this study aims to contribute to the augmentation of its digital economic landscape.

Keywords: digital economy, economic development, success experience, Tianjin

1. Introduction

Since the beginning of the 21st century, the digital economy has flourished all over the world, the world economic system and industrial pattern have undergone profound changes, and the digital economy has become a key force for economic growth and social development. The concept of "digital economy" was first proposed by American new economist Tapscott [1]. Digital economy is a series of economic activities based on information digitization and knowledge. China attaches great importance to this and has introduced policies to support the development of the digital economy. As the largest international port city in northern China, Tianjin plays an important role in promoting the "One Belt, One Road" strategy [2]. Therefore, Tianjin firmly grasps new opportunities for the development of digital intelligence and has a rapid development of digital economy. This paper aims to examine the current state of Tianjin's digital economy using a literature-based approach. The initial phase involves dissecting Tianjin's economic growth, identifying the influencing factors on the city's digital economy progression, and synthesizing successful practices from technologically advanced regions. The study also addresses the prevalent challenges within Tianjin's digital economy development, culminating in the formulation of pertinent recommendations. These recommendations are designed to propel the advancement of Tianjin's digital economy to greater heights.

2. Overview of the Development of Digital Economy in Tianjin

In 2020, Tianjin's digital economy was vigorous and its scale accounted for 48% of GDP [3]. As an important trade port in the Beijing-Tianjin-Hebei region and the nearest outlet to the sea from Beijing, Tianjin Port accounts for about 60% to 70% of the annual import and export trade value of the Beijing-Tianjin-Hebei region [4]. Tianjin has made significant strides in the development of its digital economy, leveraging the presence of over 10 information technology industrial parks, including Binhai Innovation and Entrepreneurship Park. This progress has set the stage for a comprehensive digital transformation, characterized by a developmental trend that can be summarized as "Binhai leading the way, extending its influence to the surrounding regions, establishing focal points in various areas, and advancing collaboratively [5]."

The development advantage of Tianjin's digital economy lies in the Beijing-Tianjin-Hebei integration and the strong support of relevant policies. From 2010 to 2020, the registered capital of digital service enterprises in the Beijing-Tianjin-Hebei city cluster has shown an overall upward trend. Among them, Tianjin increased from 16.532 billion yuan to 148.902 billion yuan, with an average annual growth rate of 24.58%. Besides, more than 160 Beijing-Tianjin-Hebei enterprises established the Tianjin High-end Equipment and Intelligent Manufacturing Talent Innovation Alliance at the end of 2020. To date, a remarkable total of 45 scientific research achievements have undergone successful transformation [6]. This achievement has played a pivotal role in facilitating the seamless integration of the industrial chain, innovation chain, and talent chain across the Beijing, Tianjin, and Hebei regions. Visualization results in 2019 showed that the stimulating effect of the digital economy on sustainable development in Beijing-Tianjin-Hebei has improved significantly, indicating that the stimulating effect of the digital economy has gradually spread to the north and west [7]. In 2021, the "Tianjin Three-year Action Plan for Accelerating Digital Development (2021-2023)" was formulated and implemented, and it is planned that by 2023, the added value of the digital economy will account for no less than 55% of the gross regional product (GDP)[8], a digital life enjoyed by all people will initially take shape, and a new pattern of integrated social governance centered on people will be formed. It will provide strong support for comprehensively building a modern socialist metropolis.

3. Challenges Faced by Tianjin in Developing Digital Economy

3.1. Insufficient University Discipline Construction and Industry Development

First of all, the university disciplinary advantages are not outstanding, and there is a lack of disciplines, industries and products that lead the country in the field of digital economy. Secondly, the combination of disciplines and industries is not enough, and there are not enough innovative subjects in the field of digital economy, and even fewer leading enterprises. For example, Hefei focuses on the development of quantum communication and electroacoustic integration, and has cultivated a number of leading enterprises in the field of digital economy such as HKUST Xunfei. However, the key disciplines supported by the state in Tianjin University and Nankai University are mainly concentrated in traditional fields, and the integration of industry-university-research is not deep enough in the discipline construction of new fields and the development of characteristic industries [9]. In general, Tianjin's digital economy currently faces a twofold challenge: the absence of significant scientific and technological breakthroughs aligned with national strategic requirements and the absence of industry-leading enterprises that can spearhead innovation and drive the digital economy's growth, akin to the influential roles played by companies like Huawei in Shenzhen and Tencent in Hangzhou. These influential entities have a pronounced ripple effect, particularly in empowering small and medium-sized enterprises (SMEs).

3.2. Environmental Pollution Problem

Although the digital economy can significantly promote green growth, the massive energy consumption in the construction and operation of its infrastructure also brings a lot of carbon emissions, causing environmental pollution. High concentrations of air pollutants can harm human health, such as causing cardiac disease [10], damaging the human respiratory system [10,11], and so on. The NO₂ concentration limit (40 µg/m³) was exceeded in Tianjin in 2020[12]. At present, the carbon emission of the digital economy has not yet entered the stage of rapid growth, but with the further development of the digital economy, it may become one of the main sources of carbon emission growth in Tianjin.

3.3. Insufficient Innovation in Manufacturing

Tianjin's manufacturing industry has a relatively complete foundation, and industrial digitalization is a vital breakthrough point in promoting the establishment of the manufacturing industry. However, due to the high cost of digital technology applications and the lack of digital capability, traditional enterprises still have a large room for improvement, and the supply capacity of new digital infrastructure still has shortcomings. The core industries of the digital economy in Tianjin are currently experiencing challenges related to their innovation capacity, export capabilities, and the risk of bottlenecks in critical core segments. Moreover, there is room for improvement in the understanding of the importance of scientific and technological innovation, particularly the role of original innovation in driving development. Additionally, the perception of the digital economy often remains limited to the application level, highlighting the need for a more comprehensive understanding of its broader implications and potential for transformative growth. In the rapidly evolving landscape of information technology, there has been a notable absence of revolutionary shopping, payment, communication, and entertainment methods akin to platforms like Taobao, WeChat, and Douyin. Consequently, there is a dearth of digital economic breakthroughs capable of significantly propelling the development of a city or region.

4. Suggestions on Developing Digital Economy in Tianjin

4.1. Create a Complete Innovation Ecology and a Good Entrepreneurial Environment

The importance of the entrepreneurial environment to economic development is self-evident. Take Beijing for instance, its digital economy accounts for the largest proportion of GDP in China. Beijing has a complete innovation ecology, and has formed a multi-level collaborative innovation system of organizations, talents, technologies, business formats and capital, providing unique conditions for digital technology innovation to lead. In addition, Zhejiang has emerged as a prominent hub for the advancement of the national Internet industry, capitalizing on its pioneering position in the consumer sector. Notably, it has fostered the growth of numerous Internet and high-tech enterprises, with Alibaba standing at the forefront, not only within China but on a global scale. Due to the good "Internet +" entrepreneurial innovation ecosystem, new technologies and new business forms such as unmanned supermarkets and internet hospitals have taken the lead in Zhejiang. Consequently, it is imperative for Tianjin to establish a thriving innovation ecosystem. This involves incentivizing prominent enterprises to establish technology development hubs, enhancing the proficiency of foundational hardware and software services, and fortifying innovation-oriented support services encompassing product adaptation and incubation.

4.2. Foster an Enabling Environment for Nurturing and Harnessing Entrepreneurial Talent

To achieve high-quality economic development, capital and talent are indispensable. Beijing's good entrepreneurial environment and rich talent reserve have promoted the continuous emergence of a number of information technology enterprises, and formed a "gravitational field" that gathers high-end resource elements of the national digital economy. Similarly, Shanghai has laid the foundation for the high-quality development of the digital economy by concentrating a large number of digital talents and providing them with development paths. Studies show that the talent inflow/outflow ratio in Shanghai is 1.41. In addition, Shanghai has a high-quality investment and financing environment. There are 2,099 listed enterprises in Shanghai, accounting for 0.07% of all enterprises in Shanghai, much higher than the average level of 0.03% in China [13]. Therefore, Tianjin should formulate more policies to support digital economy and attract domestic and foreign financial institutions or social capital to invest in key projects of digital economy. In addition, Tianjin should establish a number of talent-training bases and accelerate the establishment and professional training of frontier fields, such as cloud computing, big data and artificial intelligence, to foster talents in the field of digital economy.

4.3. Strengthen the Development of the Real Economy

The real economy can not be ignored for the economic development of the city. Beijing takes the whole city as a super system to incubate and promote the digital industry. Both the construction of "three cities and one zone" (Huairou Science and Technology City, Zhongguancun Science and Technology City, Changping Future Science and Technology City, Yizhuang Economic and Technological Development Zone) and the Winter Olympics provide plentiful application scenarios for the digital industry. Furthermore, Shanghai's bustling commercial activity and high population density have created a wealth of application scenarios for the digital economy. This environment facilitates the seamless integration of online and offline activities, fostering the rapid development of new models and formats. Innovations such as online healthcare, fresh e-commerce retail, and online financial services are flourishing within the city. Besides, as a major province of traditional industries, Zhejiang is committed to deepening the all-round transformation of traditional industries by digital technology, actively cultivating a new model of "Internet + manufacturing", accelerating the digitalization and intellectualization of traditional industries, and comprehensively revitalizing the real economy [14]. The integration of the digital economy with traditional industries, agriculture, and the service sector holds the potential to revolutionize and elevate the entire social economy, fostering high-quality development. This integrated approach also presents fresh challenges that demand breakthroughs in digital technology to ensure a virtuous cycle of progress and iterative upgrading. Therefore, Tianjin needs to establish several distinctive and exemplary application scenarios to attract enterprises, in order to build the foundation of digital economy development.

4.4. Promote the Development of Clean Energy

As the digital economy continues to advance, the significant energy consumption associated with infrastructure operations could emerge as a primary contributor to carbon emissions growth in Tianjin. Therefore, there is an imperative need to enhance guidance and regulation to ensure a low-carbon and environmentally sustainable trajectory for the rapid expansion of the digital economy. To address the growing carbon emissions challenge stemming from the advancing digital economy, Tianjin must take proactive measures. It should focus on building an intelligent, agile, green, low-carbon, safe, and controllable digital information infrastructure. This infrastructure should be designed with environmental sustainability in mind, ensuring that it minimizes energy consumption and reduces its carbon footprint. Additionally, Tianjin should work on enhancing its regulatory framework to guide the low-carbon development of the digital economy. Stringent supervision and monitoring of

enterprises should be established to ensure compliance with these standards and the adoption of eco-friendly practices [15].

5. Conclusion

In conclusion, this paper's examination of Tianjin's digital economy development has identified several existing challenges: (1) A limited number of leading enterprises with absence of dedicated R&D centers or expansive production lines; (2) High energy consumption contributing to substantial carbon emissions, causing environmental pollution; (3) Inadequate innovation capacity within core digital economy sectors, coupled with supply gaps in new digital infrastructure. Drawing insights from advanced digital development regions, this study proposes four recommendations. These include creating an innovative ecosystem to attract investment, nurturing multifaceted talents, establishing tailored economic development scenarios, and promoting the adoption of clean energy data. However, it is important to acknowledge limitations in research methodology. The study solely employs literature review to scrutinize Tianjin's digital economy development. Future research will encompass data analysis and a more comprehensive exploration of factors influencing the city's digital economy growth.

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Taking H&M as an Example to Analyze the Value Production of "Fast Fashion" Brands in Online Media Communication

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Abstract: Under the background of rapid economic and technological development, the author analyzes the current situation and form of "fast fashion" in today's society, and takes H&M company as an example for analysis and investigation. Through the analysis of H&M company's personnel segmentation, corporate structure and sales proposition, understand H&M company's operation mode and business strategy. Then, by comparing the investment and income of H&M in a certain year, as well as the company's sales channels and market operation mode, the main performance and profit of H&M are analyzed. Draw a picture according to the obtained data, and give some reasonable suggestions and measures for improvement. At the same time, it also studies the influence and role of network media in the field of fast fashion. Through the analysis of the current situation of H&M, this paper expounds the advantages and disadvantages of "fast fashion" in the whole clothing industry and the future research direction.

Keywords: fast fashion, value production, H&M

1. Introduction

"Fast fashion" refers to the fastest way for clothing retailers to imitate fashion trend elements in high fashion shows, redesign and produce them, and sell them to the masses at accessible prices, and obtain profits from them.

"Fast fashion" brands emerged at the end of the 20th century. They rely on their advanced production and management mode in the clothing market to occupy the market[1]. The rapid expansion and development followed by the emergence of fast fashion brands is observed undoubtedly. The reform of traditional clothing industry provides a new direction. Although the current global economic development is slowing down, international competition is intensified, but with a series of development and reform in China, the emergence of the fast fashion brand in China still has great prospects for development. Under the condition of rapid social development, the way and value of "fast fashion" is obvious in the network communication. Chinese fast fashion companies often have strong production capacity, but in product design and supply chain management and brand marketing, they still have a large room for development [2]. The fast fashion industry in China, which spans power companies, mainly focuses on store goods and still focuses on brand building and supply chain construction.

The author takes HM Company as an example for analysis. The research aims to clearly understand the operation mode of the whole company, and effectively explore the secret of success of this enterprise. The research also tries to understand broadly the value or pros and cons of "fast fashion" to society in today's fast social scenario. Some suggestions are forwarded for the fast fashion industry and the apparel industry as a whole.

The rapid development of network media has brought new research fields in media communication. The emergence of new media represented by We-media has brought earth-shaking changes to the media. New business value is established, new form of information communication interaction is present, a new era of media culture is emerging [3]. In today's society, the media has a unique role: its mission is both the responsibility of the superintendent of public opinion, and spread of the role of information policy. Of course, the media is co-existing with modern human society, and its existence and development must also play a role around the daily political and economic activities of modern human society [4].

2. Methods

Through the comparison and comprehensive analysis of domestic and foreign literature, the author summarizes the current situation in the field of fast fashion and H&M Company, providing important data basis for the direction and research tools of this study.

The author uses H&M Company as the object of case analysis. From HM company's corporate structure, value proposition, network media and other aspects to analyze HM company's profit mode and value in the context of "fast fashion".

3. Case analysis on H&M

3.1. Corporate structure

3.1.1. Segmentation of personnel

The H&M Company staffs have different division of labor and work, which can be roughly divided into four categories: 1. Daily shelves of supermarket corresponding goods, timely replenisher 2. Pack online orders and deliver them to the delivery area 3. Cashier, catering, loading, side dishes, noodles and other work 4. Obey the management of leaders, actively participate in training, and constantly improve service skills. These employees complete their work content on time and in quantity every day to ensure the normal operation of the company [1].

3.1.2. Distribution channel

Distribution channel strategy is one of the important strategies in marketing management and serves channel variables in the marketing mix. To fully meet the needs of enterprises in the target market, it is necessary to develop and implement marketing channel management to support and strengthen the marketing team. Distribution channel strategy includes channel expansion direction, distribution network construction and management, and regional market. The choice of enterprise marketing channel will directly affect the other marketing [2]. Decision making, such as product pricing, is the key to a company's success, just like product strategy, pricing strategy, and promotion strategy. An important means to expand the market, achieve sales and business goals. The case study shows that the store represents the core of the H&M business model, as through direct control of the retail network, the company is able to develop a deep level of market knowledge, which is conducive to launching continuously successful fashion clothing [3].

3.1.3. Value proposition

H&M Company uses "many, few" as their product sales strategy. This strategy ensures that H&M keeps pace with the Times and is always at the forefront of fashion. The "multi-model" production method provides customers with a variety of choices. In this way, consumers can choose more suitable clothes according to their own preferences. A "small amount" production strategy can avoid unnecessary waste. Inventory can be emptied every month.

3.1.4. Customer segmentation

H&M divides customers into four categories according to their age, clothing needs and ability to pay [4].

15 ~ 30 years old: People in this age group are usually students. They do not have a high financial ability to buy expensive clothes. And they rarely make purchases, perhaps once a month. Therefore, they prefer products that are fast, stylish, personalized, and relatively inexpensive.

30 ~ 45 years old: These people are usually parents or adults. They have stable jobs and a high ability to pay. They can buy some expensive things. And they value the quality of the clothes and the reputation of the brand.

45 ~ 60 years old: These people buy very little, but value the quality of the clothes. They will do rational analysis and consideration before buying. They also pay attention to the convenience of purchase of goods.

Above 60 years old: These people have very traditional ideas and do not like shopping, so their purchasing desire is very low. They only buy it when they really need it. They place great importance on price and usually prefer to buy discounted clothes.

3.2. Network media

3.2.1. Data comparison of network operation input and income

Sales at Swedish fast-fashion giant H&M Group rose 5% year on year to 210.4 billion Swedish kronor in the 2018 fiscal year ended on Nov. 30, thanks to a strong 22% increase in online revenue, which accounted for 14.5% of the group's total sales [5]. During the period, group gross profit surged 21% year on year to SKR110.9 billion, with a gross margin of 52.7% and profit after tax of SKR12.652 billion. The group's fourth-quarter sales rose 12% to 56.41 billion Swedish kronor, thanks to higher full-price sales and fewer markdowns. The group's online sales grew 24% during the period, and its gross margin was 54.2%.

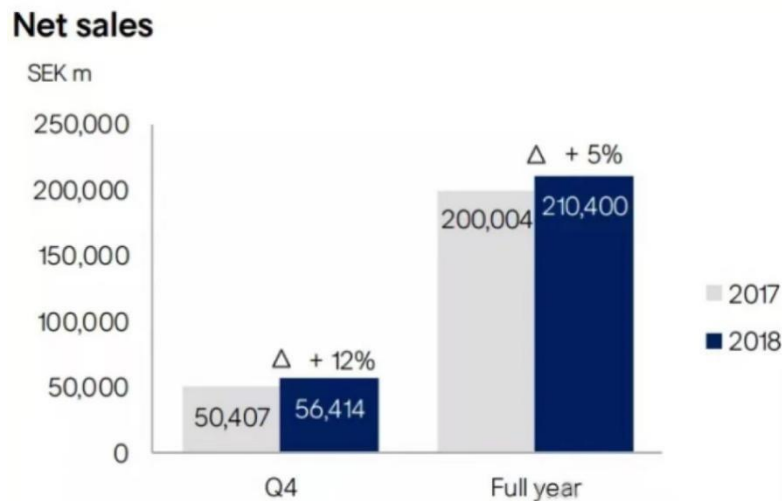


Figure 1: H&M's key results for fiscal 2018 and Q4 2018.

3.3. Marketing and financial strategy

3.3.1. Market operation mode

Firstly, HM directly interacts with customers through social media platforms to increase brand recognition. With more than 120 million followers on Instagram, they post fashion images, videos and stories to reach even more people. In addition, HM has opened its own app and online store to make it easier for consumers to buy what they like.

Secondly, HM employed a large-scale advertising campaign to increase brand exposure [6]. They have signed celebrity endorsement deals and produced numerous television, magazine and outdoor ads. For example, during the Christmas season in 2019, HM held a grand concert in Times Square in New York City and invited thousands of spectators to attend.

In addition, HM actively uses discounts, promotions, and coupons to attract consumers to buy its goods. They often launch limited-time promotions on specific festivals or holidays to attract more customers. In addition, HM offers dedicated discounts and coupons to members to increase loyalty and promote repeated business [7].

Finally, HM is committed to promoting sustainable fashion and highlight this effort in its marketing. They actively seek to make products using environmentally friendly materials and promote sustainability programs. For instance, in April 2019, HM launched the Conscious Collection, which includes clothing made from eco-friendly materials such as organic cotton, recycled polyester, and Tencel [8].

In summary, HM uses a variety of marketing methods to increase brand awareness and market share. From social media to advertising campaigns to promotions and sustainability initiatives, they constantly explore new ways to engage consumers and maintain a competitive edge.

3.3.2. Source of revenue

H&M has always emphasized that it not only pursues online distribution volume, but also ensures profits. An IR official said, hm.com is highly profitable and an important source of revenue. Integrate online and offline resources, specifically: online order, pick up goods in store, online return goods in store and scan code purchase, etc. Among them, online ordering and in-store pickup are still being tested; Store online returns have entered 10 countries and are poised for further rollout; Scan code

purchase has covered all online markets. In addition, H&M is exploring payment methods, delivery models and last-mile solutions.

3.4. Recommendations for improvement

HM can focus on market planning and be good at pre-sales analysis to lay the foundation for rapid sales. Before the product design, a detailed seasonal product design plan should be provided to the design department as a reference for design development. After the product design is completed, there should be a detailed plan for when to market, display, discount, award sales and other aspects of the work.

HM can be good at integrating sales information and analyzing the sales situation on a daily basis, so as to achieve a quick response [9]. The introduction of network technology management, every day after the business settlement, the information will be sent back to the headquarters for processing, so that all departments of the headquarters can timely understand the sales situation of products in the market, so as to make timely adjustments.

HM can accurately search for and determine the product market. Marketing should choose the right sales area according to the characteristics of brand products, not blindly develop the market.

Whether it has a "fast and accurate" market response method will become a yardstick to measure the core competitiveness of apparel brands. On the basis of improving product quality and grade, Chinese garment enterprises need to improve their ability of quick response as soon as possible and complete market prediction in real time. They will also have to change the original management thinking and business processing mode, so as to truly standardize the enterprise process, to achieve profit growth.

4. Conclusion

Through the analysis and research of HM Company, the author found that this kind of fast fashion enterprise is beneficial to the whole economic market and plays a role of promotion. Fast fashion is "affordable fashion" for ordinary consumers, and it is also considered by ordinary people as a channel for the aristocracy of the common people. It meets the needs of people with low price to enjoy fashion. Low price here refers to the fast fashion brand relative to the same sales from the perspective of the international brand fashion apparel "relatively low", consumers spend less than one over ten of the prices of top-class brand, but enjoy the top brand design, this is the greatest pleasure of fast fashion to consumers.

However, the analysis also has some limitations. The author analyzed HM as a company, which cannot represent all fast fashion companies. Therefore, the future research direction will be to analyze many fast fashion enterprises and get a general conclusion.

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An Empirical Test Based on the Validity of the Capital Asset Pricing Model of American Firms

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Abstract: Nowadays, quantitative finance has become a more and more mainstream research direction, and the origin model of quantitative finance is the capital asset pricing model (CAPM) created by William Sharp and others. This paper mainly studies the feasibility of CAPM model for the American market, in order to prove the universality and accuracy of CAPM model, and analyzes the relevant errors. The research object of this paper is 59 randomly selected listed companies in 11 industries in S&P500 index, and the regression is carried out by the ordinary least square method, and the goodness of fit is obtained, so as to prove its universality. The data comes from Yahoo Finance. Through data analysis, this paper believes that CAPM model is universal, but it has low adaptability for some special industries, so it is necessary to introduce more variable factors or carry out non-linear regression to improve the accuracy of its prediction.

Keywords: Capital Asset Pricing Model (CAPM), Ordinary Least Squares (OLS), linear regression

1. Introduction

CAPM model has attracted wide attention since its launch. Some of the empirical analysis results are considered effective, while others are considered invalid, among which some are considered effective. Black et al. selected the stocks listed on the New York Stock Exchange from 1931 to 1956 as the research object for empirical research, and the results showed that the expected return rate of high-risk return stocks was not high [1]. Low-risk stocks have higher returns; Banz proposed the small-company effect and found that companies with smaller market capitalization had higher returns on their portfolios [2]. Fama et al. conducted a cross-sectional inspection analysis of CAPM model and concluded that CAPM model may not be valid. Roll offers a Roll critique, pointing out that a fully efficient portfolio is essentially impossible to achieve in a real-world capitalist market [3].

This paper studies the effectiveness of Capital Asset Pricing Model (CAPM) in different industries and companies in the United States. Fifty-nine companies from 11 industries in S&P500 were randomly selected for research, including information technology, health care, consumer discretionary, finance, communication services, industrial, consumer staples, energy, utilities, real estate, and materials. Data from January 1, 2018 to August 1, 2023 were selected, with monthly steps. The regression function and Multiple R-squared are obtained by using the ordinary least square method (OLS) for linear regression of the data. The effectiveness of CAPM model in the American stock market is discussed, and the accuracy of predicting future returns is also discussed. The

significance of this paper is to verify the suitability of the CAPM model and find the defects of the CAPM model in the research process. In the subsequent research, the model can be further improved, such as increasing variable factors and relaxing hypothesis conditions, so as to make it applicable to more situations.

2. Theoretical Model

CAPM model is a forecasting model based on the expected return equilibrium of risk assets. Its theoretical origin is the mean-variance theory proposed by Harry Markowitz in 1952. Then, in 1964, Sharp et al. proposed the CAPM model on this basis, which provided the asset pricing model in theory for the first time, and presented the theoretical relationship between expected return and expected risk in a linear manner. The mathematical expression of the CAPM model is as follows:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f) \quad (1)$$

Where, $E(R_i)$ is the expected rate of return of a single asset or portfolio, R_f is the risk-free rate of return, $E(R_m)$ is the expected rate of return of a market portfolio, and β_i is the systematic risk coefficient of an asset, which describes the sensitivity of the rate of return of an asset to market changes and can be used to represent the systemic risk or non-diversifiable risk of a single asset or portfolio. The β coefficient reflects the sensitivity of an asset to changes in market price and classifies different assets by the difference of β values. The classification method is as follows: when $\beta < 1$, the volatility of the asset is less than the volatility of the market price, and investment in the asset can not get a good return but can help investors reduce the probability of loss; When $\beta > 1$, the price volatility of the asset is greater than that of the market, then the asset will face a greater loss than the market. When $\beta = 1$, it indicates that the rate of return obtained by the purchase of the asset is the same as the market rate of return, that is, the same loss as the market.

3. Methodology

3.1. Data selection and Preprocessing

3.1.1. Sample Selection

Table 1: Number of codes and enterprises by industry.

Industry Code	Industry Involved	Number of Enterprises
A	Information Technology	5
B	Health Care	5
C	Consumer Discretionary	5
D	Finance	6
E	Communication Services	5
F	Industrial	8
G	Consumer Staples	6
H	Energy	5
I	Utilities	5
J	Real Estate	5
K	Materials	4

The data in Table 1 are all from Yahoo Finance website, and the monthly closing price data of 59 listed companies in 11 industries of S&P 500 index is selected as the research object. Due to the widespread global impact of the epidemic, the data selection range is from January 1, 2018 to August 1, 2023, with a total of 4071 observations. Sample stocks were selected for A information technology, B health care, C consumer discretionary, D finance, E communication services, F industrial, G Consumer staples, H energy, I utilities, J real estate, and H materials. The company classification and company code are shown in Table 2.

Table 2: Information about the selected business.

Industry Involved	Stock Code				
A	AAPL	MA	MSFT	NVDA	V
B	ABBV	JNJ	LLY	PFE	UNH
C	AMZN	MCD	NKE	SBUX	TSLA
D	BAC	BRka	GS	JPM	MS
	WFC				
E	ATVI	DIS	GOOG	META	NFLX
F	BA	CAT	DE	HON	
	LMT	RTX	UNP	UPS	
G	COST	KO	PEP	PG	PM
	WMT				
H	COP	CVX	EOG	PXD	XOM
I	D	DUK	NEE	SO	SRE
J	AMT	CCI	EQIX	PLD	PSA
K	APD	CTVA	LIN	SHW	

3.1.2. Risk-Free Asset Selection

A risk-free asset is a bond that has no default risk, no inflation risk, no liquidity risk, no interest rate risk, and no arbitrary other risk. U.S. Treasury bills are often used as a proxy for the risk-free yield, R_f . In this article, the US 10-year bond is chosen as the risk-free bond, because the US dollar is the anchor of the global currency, and the US 10-year Treasury bond yield is the global risk-free interest rate indicator. By comparing this indicator with the earnings yield of the stock market (the inverse of the P/E ratio), we can calculate whether we should invest in the stock market or the bond market at present. According to the data and calculation, the average monthly yield of risk-free bonds is 1.76697%, and the average annual yield is 23.4304%.

3.1.3. Total Market Return Selection

In the US market, choose the total market return, choose the S&P 500 index as the total market return, because this index contains more companies and involves more industries, so it can better reflect the changes in the overall market. According to the data and calculation, the average monthly yield of risk-free bonds is 0.8937%, and the average annual yield is 11.2673%.

3.2. Test Method and Empirical Results

3.2.1. Test Method

In terms of data processing, the data will be processed using the ordinary least square method, the basic principle of which is to minimize the sum of distances from the fitted line to the actual point, even if the residual sum of squares is minimized. According to the CAPM model expression, investor

returns come from two parts. One part comes from unexpected returns, which is called excess returns. The other part comes from the expected return, that is, the market risk compensation return. For a given portfolio, if the expected return of the portfolio and the expected return of the market portfolio are known, the CAPM model can be tested by analyzing whether there is a linear relationship between the expected return and the β coefficient. Let the excess return of stock i be Z_i , and the excess return of market portfolio be Z_m , whose mathematical expressions are as follows:

$$\begin{cases} Z_i = \alpha_i + \beta_i \times Z_m + \varepsilon_i \\ \text{Cov}[Z_m, \varepsilon_i] = 0 \end{cases} \quad (2)$$

In the expression, Z_i is the explained variable, Z_m is the explaining variable, β is the parameter to be estimated, α_i is the intercept term, and random disturbance term.

According to Sharp's paper, the beta value can be expressed as[4]:

$$\beta = \frac{\text{Cov}(R_m, R_i)}{\text{Var}(R_m)} \quad (3)$$

In this paper, the difference between the return rate of the selected enterprises and the risk-free interest rate (US 10-year Treasury bond) is selected as the explained variable, and the difference between the market portfolio return rate (S&P 500 index) and the risk-free interest rate is selected as the explaining variable.

$$R_{it} - R_{ft} = \alpha_{it} + \beta_i(R_{mt} - R_{ft}) + \varepsilon_i \quad (4)$$

Where R_{it} stands for the yield of i enterprise at time t , R_{mt} stands for the yield of S&P 500 Index at time t , and R_{ft} stands for the yield of US 10-year Treasury bond at time t .

3.2.2. Empirical Result

The following data is processed, and the data of 59 companies from January 1, 2018 to August 1, 2023 are selected for fitting by ordinary least square method, and Table 3 is obtained according to the order of goodness of fit from the highest to lowest.

Table 3: Goodness of fit for 59 firms.

Industry involved	Stock Code	Multiple R-squared	Industry involved	Stock Code	Multiple R-squared
A	MSFT	0.9407	I	NEE	0.8547
D	BRKa	0.9364	D	GS	0.8523
G	COST	0.9217	I	D	0.8513
A	V	0.9154	I	DUK	0.8507
K	LIN	0.9138	D	MS	0.8490
F	HON	0.9117	J	PSA	0.8367
J	PLD	0.9085	F	UPS	0.8359
G	PEP	0.9043	I	SO	0.8359
K	SHW	0.9023	F	LMT	0.8236

Table 3: (continued).

F	UNP	0.9015	F	RTX	0.8140
C	MCD	0.8976	E	DIS	0.8119
E	GOOD	0.8952	G	PM	0.8091
J	EQIX	0.8937	B	PFE	0.8080
J	CCI	0.8887	F	DE	0.7900
A	MA	0.8882	F	CAT	0.7782
K	APD	0.8868	H	CVX	0.7746
G	KO	0.8840	D	WFC	0.7576
B	JNJ	0.8819	B	ABBV	0.7378
J	AMT	0.8780	B	LLY	0.7327
I	SRE	0.8777	E	NFLX	0.7291
D	BAC	0.8773	E	META	0.7128
G	WMT	0.8760	A	NADA	0.7127
D	JPM	0.8725	H	XOM	0.7091
C	NKE	0.8720	E	ATVI	0.7026
A	AAPL	0.8612	F	BA	0.6096
C	SBUX	0.8605	H	PXD	0.6018
G	PG	0.8580	H	COP	0.5513
B	UNH	0.8555	H	EOG	0.5139
C	AMZN	0.8554	C	TSLA	0.4035
K	CTVA	0.8549			

As can be seen from Table 3, the 43 randomly selected companies have different goodness of fit. Now, the companies with the highest goodness of fit in each industry are selected for analysis. The codes of these companies are MSFT, JNJ, MCD, BRKa, GOOD, HON, COST, CVX, SRE, PLD, LIN. A total of 11 companies. The regression results are shown in Table 4.

Table 4: Enterprise sample data regression results.

Stock Code	α	β	t statistic	P-value	Significance F
MAFT	0.0132	1.0652	2.7722	0.0072	3.1987E-42
JNJ	0.0051	0.9119	-0.8836	0.3801	2.4975E-32
MCD	-0.004	0.9496	-0.0677	0.9462	2.2398E-34
BRKa	0.0009	0.9302	0.2202	0.8264	3.2673E-41
GOOG	0.0078	1.0309	1.2488	0.2161	4.9065E-34
HON	0.0033	0.9550	-0.6282	0.5321	1.6794E-36
COST	0.0104	1.0845	1.8459	0.0694	3.2416E-38
CVX	-0.0023	0.8694	-0.2807	0.7798	4.9065E-23
SRE	-0.0036	0.9259	-0.5849	0.5606	7.9864E-32
PLD	0.0039	1.0851	0.6383	0.5255	5.4087E-36
LIN	0.0063	1.0018	1.1511	0.2539	7.4724E-37

Combined with the t statistic, p-value and Significance F, the equation set is proved to be effective as a whole, and the CAPM model is proved to be effective for these 11 enterprises. FIG. 1 to FIG. 11 show the scatter plot and regression line of the difference between the expected rate of return and the risk-free interest rate and the difference between the S&P 500 index and the risk-free interest rate of each enterprise, respectively.

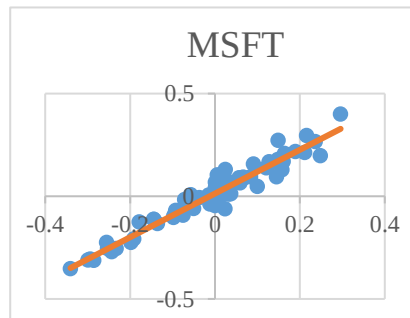


Figure 1: MSFT regression scatter plot.

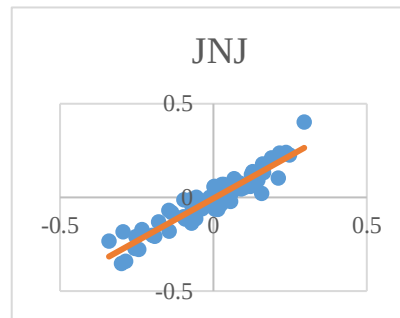


Figure 2: JNJ regression scatter plot.

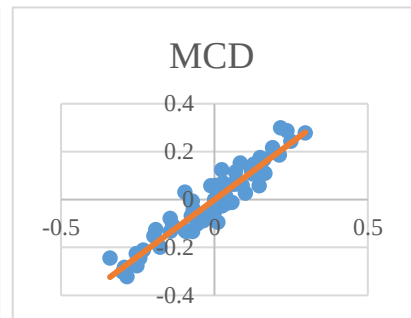


Figure 3: MCD regression scatter plot.

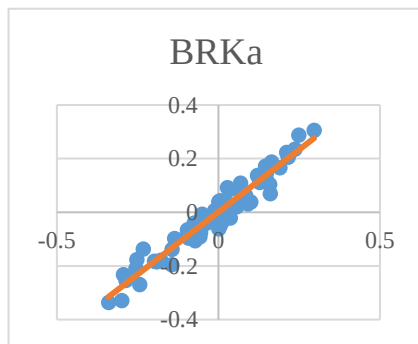


Figure 4: BRKa regression scatter plot.

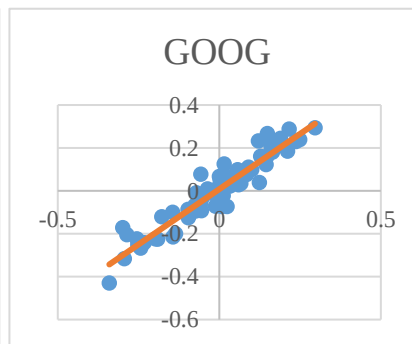


Figure 5: GOOG regression scatter plot.

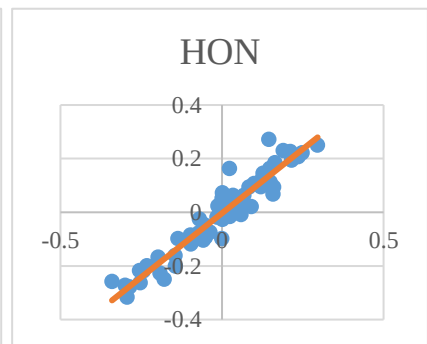


Figure 6: HON regression scatter plot.

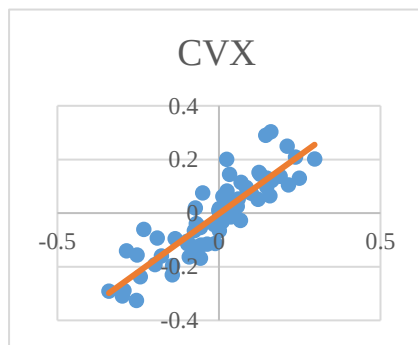


Figure 7: CVX regression scatter plot.

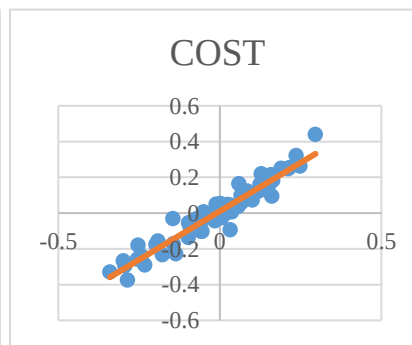


Figure 8: COST regression scatter plot.

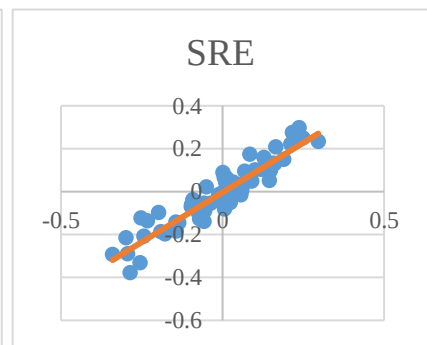


Figure 9: SRE regression scatter plot.

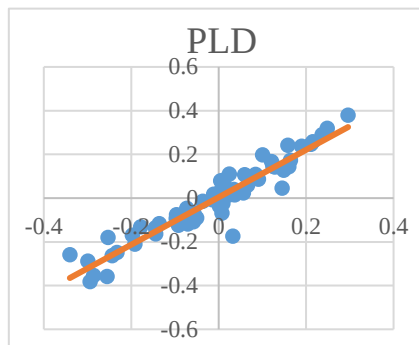


Figure 10: PLD regression scatter plot.

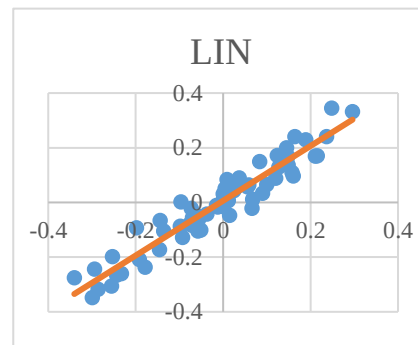


Figure 11: LIN regression scatter plot.

3.2.3. Data Feedback Analysis

According to the above regression results, it is not difficult to see that most of the selected enterprises can well verify the feasibility of CAPM model in real life, but there are still exceptions. For example, the regression coefficients of LLY, TSLA, BA, COP, EOG, and PXD are 0.7327, 0.4035, 0.6096, 0.5513, 0.5139, and 0.6018, respectively, indicating that if these enterprises use CAPM model to forecast, there is a large gap between the predicted value and the actual value. In view of the inapplicability of CAPM model in practice, the following points are put forward: Stocks in different industries may have different risk characteristics, including profit fluctuation, balance sheet structure, etc. Due to these industry-specific risk factors, a single market beta cannot fully explain the expected returns of stocks in different sectors[5]; Volatility in stock prices can be better explained by considering the impact of other economic factors, such as inflation expectations and interest rate changes, on expected stock returns[6]; The effects of economic factors (market risk, size, value, investment, and profitability) on stock returns are proposed, and in subsequent research it is found that considering these factors can more accurately explain the expected return of stocks, especially across different industries[7].

In view of the low applicability of CAPM model to the US energy industry, the following possibility analysis is given:

Non-systemic risk: It is mentioned in the premise assumption of CAPM that only systemic risk is considered, but in the actual situation, non-systemic risk still exists objectively and has a greater impact on specific industries. The U.S. energy industry may be affected by a variety of factors, such as policy influences, geopolitical influences, changes in supply and demand, etc., which may lead to the existence of industry-specific risks unrelated to overall market risks.

Long-term factors: CAPM model is built on the basis of long-term portfolio stability, but for the US energy industry, there may be changes in supply and demand that have a huge impact on the actual price, resulting in large fluctuations in portfolio returns, which makes the CAPM model not applicable;

Limitations of assumptions: There are many assumptions in the establishment of CAPM model, such as investors are rational individuals who avoid risks and maximize utility, the market is frictionless, there are no transaction fees or taxes, investors all make decisions for the same period, investors have homogeneous expectations and beliefs, all investments are infinitely separable, and investors are price takers. These assumptions are intended to make investors' behavior follow mean-variance analysis. However, if the assumption is too ideal, there will be various unexpected situations outside the assumption in reality, and there may be some special circumstances and restrictions in the

energy industry that are contrary to the assumptions of the CAPM model, so the applicability of the model will be affected.

Nevertheless, even if the CAPM model is not applicable in a particular industry, other risk assessment models or methods can be used to better analyze the risks and rewards of that industry. This may include the use of multifactor models (such as the Fama-French three-factor model), industry-specific models, or other quantitative and qualitative analytical methods to more accurately assess the risk and return relationship in the U.S. energy industry.

4. Conclusion

This paper mainly discusses whether CAPM model is applicable in the American market and analyzes the causes of error. It is concluded that CAPM model is applicable and can be predicted more accurately in most cases. There are some areas that can be improved in this paper: a. When the data is selected in month, the data accuracy is lacking. If the step size is changed to day, the data will be more and more accurate. b. The CAPM model itself has defects and is too idealized, which may be inconsistent or even contrary to the actual situation. Research on CAPM may focus on adding more impact factors to it to make it closer to the actual situation and make the prediction more accurate.

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Research on the Marketing Model of Disneyland and Its Impact on the Chinese Market

– Taking Shanghai and Hong Kong Disneyland as Examples

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Abstract: There are countless themed amusement parks around the world, but there are only six Disney theme parks worldwide. Each of these six themed parks is unique, and since the construction of the first park, Disneyland has continued to attract travellers from all over the world to hit the parks. So why are Disney theme parks so attractive? Why is the Chinese market the only one with two world-class Disneyland parks? Based on the explanation of the marketing model for Disneyland and the analysis of the marketing model, this paper finds that Disneyland and the Chinese market have common points, and the strong development potential of China's theme park market creates the conditions for Disneyland; at the same time, the special location of the city creates the radiation power of the tourism market that will be available after the opening of the park.

Keywords: Disneyland, experiential marketing, Chinese theme parks

1. Introduction

As of the end of 2022, Disneyland has six resorts around the world. These six main parks are located in California, Orlando, Tokyo, Paris, Hong Kong, and Shanghai. Among them, there are two in China. For the Chinese market, the construction of both Disneyland parks has brought advantages to Hong Kong and Shanghai: the tourism sector has become an important pillar of the region's modern service sector. During the 7-8 period, the average daily traffic at Shanghai Disneyland reached 63,600 visitors. Why has Disney World now become the world's leading theme park? And why is it so attractive to global consumers? After Disneyland entered the Chinese market, what positive impetus has it brought to the Chinese market? This study will analyze the marketing model of Disneyland and the development process of Chinese theme parks, and explore why Disneyland has a huge market in China. This paper uses the four Ps of marketing theory. It is dedicated to showing the reader a more holistic vision of what makes Disney's marketing model superior.

2. The Marketing Model of Disneyland

2.1. Experiential Marketing

Experiential marketing is to let tourists integrate into the park and have a fully integrated experience. The experiential marketing model of Disneyland will give tourists a very real play experience. Through various experience modes such as senses, thinking, behavior, and emotions, consumers can experience the products and services provided by Disneyland in person [1].

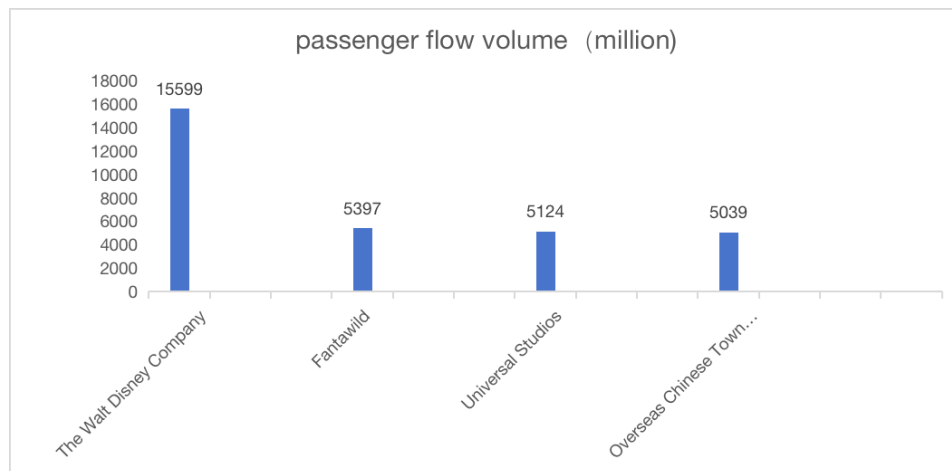


Figure 1: The bar chart of four theme parks' passenger flow.

(Data source : TEA/AECOM 2019 Theme Index and Museum Index: The Global Attractions Attendance Report)

Referring to the passenger flow of theme parks in mainland China during the same period in 2019, There is an evidence shows that the passenger flow of Disneyland in the same period was far greater than that of other theme park parent companies, showing strong market dominance. This shows that the Disney experience book service is very attractive to consumers. Such as perceptual experience and emotional experience. There are usually a large number of amusement facilities or characters in movies and TV shows in a Disneyland. These factors can stimulate consumers' strong curiosity and stimulate consumers' purchase motivation. There are many amusement facilities that can meet the requirements of consumers to enjoy sensory experiences, where customers can experience the happiness brought by different theme parks. In addition, there are many Disney film and television character dolls at Disneyland.

These characters from the animation will also provide passengers with a rich emotional experience, so that consumers can feel the emotions in fairy tale characters or fairy tales. Of course, the emotional experience that Disney brings to consumers is not only in the construction of hardware facilities and the theme planning of the park, but also relies on the enthusiastic and meticulous humanized services of countless Disney employees. Disneyland employees playing fairy tale characters can be seen everywhere in the park. Their body language and behavior are very suitable for the fairy tale characters they play, making consumers feel like they are in a real fairy tale world. These dolls will also take the initiative to interact with tourists, so that tourists can truly feel the joy of being in a fairy tale world. In addition, Disney is also committed to presenting consumers with better services and experiences in terms of details. For example, Disney will issue birthday badges to tourists who celebrate their birthdays that day, and enjoy many birthday benefits in the park; at the same time, some cast members in the park will warmly hug you and give birthday wishes when they see you have a birthday badge.

In this experiential marketing, Disney adopts a mixed strategy to provide tourists with five types of experiences, including sensory experiences, emotional experiences, thinking experiences, action experiences and related experiences. After careful planning and design, various experiences are coordinated with each other, allowing passengers to truly enjoy the joy of being in a fairy tale world. This immersive experience appeals not only to younger consumers who love animation, but also to adults. This expands Disney's consumer base and creates a good consumer base for its development in the country.

2.2. Disney Product Sales Strategy (Based on 4P Model Analysis)

(1) Product (product): Theme parks, films, music, resorts, and other Disney items are all based on well-known cartoon characters and cinematic intellectual property. On the one hand, these classic Disney icons and IPs, including Snow White and Mickey Mouse, are very well-known and can draw more customers to make service purchases. On the other side, Disney continues to develop and open new theme parks and IPs, such as the newly introduced "Lina Bell" figure in Shanghai and the recently constructed Frozen theme park in Hong Kong. Theme parks become more alluring and distinctive thanks to these new consumption hotspots. Even new product launches draw a large number of visitors. These all demonstrate the popularity of Disney goods.

(2) Price (price) "Front Door Effect": Despite the fact that Disney tickets are more expensive than those for other theme parks, the cost of the recently announced yearly pass (Wonderful Access) is more reasonable. Additionally, depending on the type of annual card, customers who have annual cards will receive a variety of preferential discounts when buying items from the park. The front door effect will have an impact on how many customers decide to buy annual passes. The Disney parks' long-term attraction is increased by acquiring an annual pass.

(3) Place (channel): Products from Disney are widely available, including through theme parks, online, offline, and other outlets. The company's brand can be better promoted through this distribution channel while also better serving the needs of various consumers. For instance, the Disney consumer market has grown as a result of Disney counters opening at Hong Kong National and Shanghai Pudong airports. Shanghai and Hong Kong both had greater consumption rates at the same time. Locating in these cities can draw clients with better potential for spending. Additionally, these two locations have a larger tourist and population density, which ensures a steady stream of visitors after the park opens [2].

(4) Promotion (promotion): Disney's marketing strategies, which are concentrated on marketing techniques, give customers a wide variety of marketing experiences, improve customer service, and help customers better understand Disney's corporate culture. It is evident from the image above that Disney invests significantly more in advertising than other businesses do. Disney was the advertiser with the greatest spend over the course of the six-month period in the first half of 2020, spending up to US\$210 million on Facebook advertisements in the US market. Disney was only surpassed by the retail giant Home Depot in terms of overall ad spending on the Facebook network in 2019. Disney, for instance, paid more than \$20 million on a 90-second spotlight advertisement in this year's Super Bowl to commemorate Disney's 100th anniversary in the 2023 NFL. The advertisement included Disney previewing new films and episodes of upcoming shows in addition to presenting iconic Disney icons like Mickey Mouse, for instance. The advertisement had a favorable impression on viewers, as later revealed in viewer interviews.

3. The Development History and Existing Problems of Chinese Theme Parks

There are three stages in the development of China's theme parks: the exploratory development stage, the growth and development stage, and the rational development stage [3]. It is worth noting

that we can find theme parks in different stages at present. For example, Hangzhou (Songcheng) in Zhejiang Province is currently a 4A -level tourist attraction in China. This theme park restores the urban style of the Song Dynasty and is a representative of the exploratory development stage of Chinese theme parks. In terms of the quality of amusement in theme parks, the quality of park service is increasingly valued. Parasuraman, et al. defined service quality as the degree of gap between customers' prior expectations for the level of service provided and the actual level of service provided [4]. A large gap between the two indicates low service quality, and a small gap between the two indicates high service quality. However, combined with the park's passenger flow and tourists' feedback, it can be found that due to the aging of the park's recreational facilities, it is too commercialized and lacks cultural value, making it inconvenient to travel. Customers are pessimistic about the actual service level of the theme park, and tourists who enter the park are less willing to come to the park with a "second brush to enter the park", which also leads to the park's continued lack of customer flow. This problem also exists in China's general theme parks.

4. The Collision Between Disneyland and the Chinese Market

With the completion of Shanghai Disneyland in 2014, the growth rate of theme parks in the Chinese market is extremely rapid. When Disney first entered the Chinese market, Hong Kong Disneyland officially opened in 2005, becoming the first Disneyland in the Greater China region. The park covers an area of 126 hectares, including four themed parks and two Disney themed hotels. The four themed parks all have rich Chinese and Western food and beverages, as well as launched tea restaurant-style restaurants unique to the Cantonese region. The restaurant is decorated in the style of Disney's fairy tales, attracting a large number of tourists to check in and experience it. According to the data, Hong Kong Disneyland has fully promoted the development of Hong Kong's tourism industry in the early days of its operation: it has filled the vacancy of Hong Kong as a "shopping paradise" that lacks tourist attractions, and has improved the structure of Hong Kong's tourism industry chain. A large number of "parent-child travel" markets from the Mainland have further enriched the tourist source market in Hong Kong [2]. In addition, the site selection of a large theme park will have a positive effect on surrounding houses and land. Hong Kong Disneyland is located on Lantau Island. During the construction period, it promoted the sale of houses around Lantau Island. In the first half of 2005 alone, second-hand housing transactions increased by 25% compared with the same period last year [5].

At the same time, due to Hong Kong's special geographical location advantages as a world-renowned free port and a trading port integrating finance, logistics, and shipping, it has a very large room for attracting potential consumer groups around the world. At the same time, the Hong Kong government relocated the Hong Kong Airport to its current location on Lantau Island in 1996 and added the "Disneyland Line" to the MTR, which greatly simplified the transportation methods and travel time for tourists. These related factors helped Hong Kong Disneyland become a very popular theme park in Asia once it opened.

In conclusion, Disneyland's introduction into the Chinese market was planned and built in a city with strong traffic accessibility and a high degree of cultural openness, fusing Disney's fairy tale aesthetic with Chinese culture. "Adapting measures to local conditions" is a planning and construction principle. In comparison to China's regional amusement theme parks, this construction type has greater benefits. The creation of the theme park, which was undertaken jointly by China and the United States, has had a positive impact on the local economies and industrial structures [6]. Disney has not only boosted the local tourism, catering and other business development in Hong Kong and Shanghai, but has also radiated more to the neighbouring and even further afield areas. Overall, this is beneficial to China's economic development.

5. Conclusion

The paper is based on the analysis of Disney's marketing model, combined with the 4P model, and analyzes experiential marketing and parks selling products and services. And the conclusions of this paper are: first, Disney, as a well-known multinational media and entertainment group, has achieved great success in the operation and management of the park with the help of the park's experiential marketing model, which not only attracts a large number of tourists but also promotes the development of the neighboring industrial chain and the real estate economy; second, China's theme park market has great development prospects, and Disney's presence in two Chinese cities has brought many advantages to both regions.

This article uses more text to discuss the points of the article. There are shortcomings within the article that are thought to be in the comparison of data that could have taken a more intuitive chart or data type of analysis to present the final point. In addition, the impact of Disney's marketing model on the Chinese market is limited to a positive analysis and lacks dialectical thinking. At a later stage, a more comprehensive perspective will be taken to explore the positive and negative impacts of Disney's presence in the Chinese market.

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Challenges and Countermeasures for the Protection of Online Consumer Rights in the Digital Economy

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Abstract: Accompanied by the booming development of new technologies such as the Internet, artificial intelligence and cloud computing, the digital economy has burst into a powerful vitality and become an important feature of the new era. However, due to the virtual nature, complexity, and monopoly characteristics of the digital economy, the damage caused to consumers. Such as the digital economy in the context of the prevalence of big data to kill familiarization and other acts of infringement of consumers' personal information, the right to free choice, the right to fair trade and other rights and interests, and consumer rights to defend the difficulty of proof of rights to defend the cost is too high. This paper analyses in depth the current situation of consumer rights and interests protection of the digital economy, reveals the problems and challenges brought by the digital economy to the protection of consumer rights and interests and puts forward corresponding countermeasures and recommendations in a targeted manner, with a view to promoting the high-quality development of the digital economy.

Keywords: digital economy, consumer rights, e-commerce, economic law

1. Introduction

At present, the concept of digital economy has not yet formed a unified and accurate definition, but with the continuous innovation and application of technologies such as big data, blockchain, algorithms and other technologies, economic and social development has entered the digital era. In the field of economic law, "digital economy economic law" has become a new research hot spot [1]. The legal community is concerned about the changes brought by the digital economy to consumer relations and the challenges to the relevant legal system. This paper analyses in depth the current situation of consumer rights and interests protection in the context of the digital economy, reveals the new problems and challenges brought by the digital economy to the protection of consumer rights and puts forward corresponding countermeasures and recommendations, with a view to promoting the high-quality development of the digital economy.

2. Characteristics of Online Consumer Rights Protection in the Digital Economy

2.1. More Subjects in Consumption Process and the Open Consumption Space

Brick-and-mortar transaction mode is only the consumer and the operator of the two subjects, but the network consumption involves not only the buyer and seller, but also payment platforms, network operators, logistics and other third-party subjects. Under the new space-time business situation, product transactions are not subject to time and space limitations and rational allocation of resources [2]. Network consumption is completely free of time and space constraints, the time cost is smaller, but the space is bigger. Therefore, the network consumption transaction subject is more complex and consumption space is more open, which means that the protection of legitimate rights and interests of consumers will also become complex, but also very important.

2.2. Virtual Nature of Online Consumption

In the process of online consumption, consumers mainly understand the products and services through the text, pictures and other online platform information released by the operator, and then decide whether to consume. In this process consumers are usually in a passive state, although there is a certain degree of selectivity, but the authenticity of the information is difficult to guarantee, which gives the operator, who originally has the initiative to convey the information, a greater advantage. If the information disseminated by the operator is false, the legitimate rights and interests of consumers will be violated. Cao and Zeng believe that operators will increase their advantages and deceive consumers through improper means such as swiping orders, positive feedback and cash back [3]. Moreover, consumption is carried out in the virtual network environment, and it is difficult for consumers to effectively defend their legitimate rights and interests within the shortest time specified. Hu and Zhou proposed that in the Internet financial consumption, there is no physical evidence, a lot of evidence is in electronic form, the operator is more likely to tamper with or destroy, thus increasing the difficulty for consumers to prove, resulting in consumer rights and interests once infringed upon, evidence collection and rights will be very difficult [4].

2.3. Monopolistic Behaviour of Operators

Under the digital economy, it is also easier for operators to form collusion among themselves to harm consumers' interests, and the forms in which operators infringe on consumers' rights and interests have become more complex. Ideally, competition in the digital market is about many operators trying their best to optimize their products and services in order to stand out from the competition. However, when data becomes a key element and resource of competition, companies with data advantages can look beyond their many rivals in the relevant industries and even have an impact beyond the economic sphere.

3. Challenges of Online Consumer Rights Protection in Digital Economy

3.1. Near-Complete Disclosure of Consumer Information

In the context of the digital economy, the privacy and security of consumer data has become an important global issue. The whole process from consumers' understanding of goods and services information, consultation, to purchase, payment, and feedback after purchase can be completed with the help of the Internet. This generates a large amount of user data, including many consumers' personal information. Although Internet companies face a series of industry regulations and constraints on the collection, use and sharing of user data, difficulties in terms of knowability, traceability and information complexity, coupled with the challenges posed by technological

advances to privacy protection, have put the security of consumers' data privacy at risk. Although China has established an information disclosure system that focuses primarily on the consumer's right to know and the operator's obligation to disclose information as the core content of information regulation, the limited cognitive ability and self-control of consumers often puts them in unfavourable decision-making situations [5].

3.2. Consumer Preferences and Behaviors Guided and Predicted by Algorithms

In the era of the data economy, the consumer relationship is composed of massive data, which is first collected, analyzed and utilized by AI, and then pushed to consumers through screening, classification and other functions. However, this data collection and processing behaviour has had a profound impact on consumer autonomy. The digital economy mines user preferences, behavioral habits and other elements through big data, enabling companies to have a more accurate and comprehensive forecasting ability for consumer demand. By intervening in advertising and search rankings, platforms build information cocoons for specific consumers and guide them in their consumption decisions. Consumers' rights to independent choice and fair trade are difficult to protect. This is because consumers can not only be defined as data, but can also be precisely quantified, which in turn influences behavioral decisions, such as the discrimination phenomenon of "big data discriminatory price".

3.3. Deficiencies in the Consumer Rights Defence System in Digital Economy

The digital economy has changed the concept and means of social governance, and strengthening the system is the fundamental way out for consumer rights. However, in the current situation, there are some defects in the consumer rights protection system. Consumers face a series of problems such as the difficulty of regulating online transactions, the weak awareness of the protection of the transaction subject, the imperfection of the consumer protection mechanism, and the difficulty of collecting and extracting consumer evidence in online transaction rights protection [6]. Digital traces generated by data interactions on the Internet platform are more likely to be difficult to identify than physical traces under the traditional economic model, especially when it comes to new types of Internet services, such as online shopping and network payments, the recording of behavioral traces is often restricted by technical means, making it difficult for consumers to adduce evidence. And due to the Internet, companies are based on the maintenance of their own corporate information security and user privacy protection needs, for the public storage of user behaviour records on the server, resolution and audit often have certain difficulties and thresholds. More importantly: even if the Internet company provides data, but in the face of the massive amount of big data, if the lack of relevant professional skills to analyse and screen these data, it is very difficult to find and determine effective evidence.

4. Suggestions for Consumer Rights Protection in the Digital Economy

4.1. Strengthen Regulations of Data and Algorithms in the Digital Economy

The prosperity of the digital economy depends on data and algorithms. To ensure the legitimacy and validity of data, regulators should set strict data access standards to guide businesses in legally accessing and using sensitive data. However, given the lack of relevant knowledge and capabilities of ordinary consumers, creating convenient channels for the collection and use of personal information and lowering the cost of defending against data breaches are important ways to strengthen consumers' right to oversight. In addition to institutional support, data regulation needs to be facilitated in terms of rights realization. First, improve the algorithmic regulatory mechanism. Given the complexity of algorithm technology and the uncertainty of fairness, the algorithm security

assessment and supervision mechanism can be strengthened by requiring data service providers or other professional organizations to submit algorithm security assessment and risk analysis reports before algorithm implementation. Second, establish algorithm management methods for different industries. According to the characteristics of the fields and data types involved in different industries, specific algorithm audit and management techniques and methods should be established to guarantee the security and stability of algorithms. Given the importance and potential risks of algorithmic technology and related activities, the NDA can clarify and centralize algorithmic supervision responsibilities to improve the professionalism and efficiency of supervision. Finally, a third-party review mechanism for algorithms should be established. Algorithms and protocols can be reviewed by third parties with expertise and the results shared with other users. Since algorithms are the core of Internet companies' competitiveness and are often protected by trade secrets, the review of algorithm content should not be equated with the review of open-source software tools, which can be reviewed and evaluated by government regulators or qualified third-party organizations and made public in a form that the public can understand.

4.2. Enhance the Disclosure and Transparency of Consumer Decision-making Information

Although the Protection of Consumer Rights and Interests Law, the Anti-Unfair Competition Law and other laws and regulations stipulate that information provided by operators must guarantee authenticity, for digital products and services, due to the complexity of their algorithms and the specialized nature of their user protocols, guaranteeing the authenticity of the information alone is insufficient to protect the rights and interests of consumers.

Because of this, on the one hand, there is a need to clarify the scope of information disclosure for consumer decision-making. The channels through which consumers purchase goods and services through online platforms are becoming increasingly diverse and complex. The E-commerce Law stipulates that e-commerce platform operators must establish a sound credit assessment system, publish credit assessment rules, and provide assessment methods to consumers, and the platform may not delete the relevant assessments. This indicates that operators and platforms are obliged to disclose information to consumers, and that the provision of relevant information can help consumers make rational consumer decisions and protect their rights and legitimate interests. Of course, merchants are not obliged to disclose all relevant information, but it should at least include basic information about products and services, as well as legal information directly related to consumer rights protection. On the other hand, there is also a need to improve the accessibility of information required for consumer decision-making. In the case of digital goods and services, due to the complexity of the algorithms and the specialized nature of the user protocols, it is not enough to guarantee the authenticity of the information to protect the rights and interests of the consumers; it is also necessary to improve the accessibility of the consumer-facing information on the basis of the guarantee of authenticity. In particular, overly specialized terms and technical descriptions should be provided to consumers in clear and concise language.

4.3. Optimize the Allocation of the Burden to Prove for Consumer Infringement

China has not yet made special provisions on the principle of attribution of responsibility for algorithmic infringement, which is generally considered to follow the principle of fault liability. However, due to the special nature of consumer protection cases in the digital economy era, the plaintiff can only prove that he has suffered damage and that the defendant has committed an illegal act, while it is difficult to prove whether the defendant is at fault and whether there is a causal relationship between the defendant's behaviour and the consequences of the damage, so it is necessary to reconsider the allocation of the burden to prove. To this end, on the one hand, it is necessary to

clarify the principle of reversal of the burden of proof. In the era of digital economy, evidence of infringement of consumer rights and interests such as algorithmic collusion and big data generally exists in the form of data, which can only be accessed and extracted by the Internet enterprises that have committed these acts, and it is difficult for consumers to record and dig up traces of infringement. In this case, whether it is to obtain evidence or to prove the subjective malignancy of the Internet company, consumers are in a weak position in the evidential activities, so it is obviously more appropriate to apply the rule of reversal of the burden of proof, and to have the operator bear the burden of proof relying on fault and causation. On the other hand, the burden of proof should be reasonably allocated according to the circumstances of the case. In the era of digital economy, there are various ways of infringing on consumers' rights and interests, and it is not difficult for consumers to obtain evidence of infringement. If consumers have sufficient knowledge and ability to obtain evidence, the reversal of the burden of proof cannot be applied; on the contrary, if it is difficult for consumers to obtain evidence, and the evidence is mainly in the hands of the operator or platform, which has more possibilities to prove, the reversal of the burden to prove can be applied.

5. Conclusion

China encourages the innovative development of the digital economy and the rapid growth of Internet platform enterprises, but the digital economy is riddled with monopolistic phenomena such as "big data killing" and platforms blocking links to other applications. The digital economy and society are changing the traditional business model, which has generated a new type of conflict of interest between operators and consumers, triggering new issues of consumer protection, and thus posing new challenges to the application of the Consumer Law. While seizing the opportunity for economic development under the digital economy model, we must consider the protection of the legitimate rights and interests of consumers. Due to the virtual, complex and hidden nature of the digital economy, compared with the traditional economic model, consumers in the digital economy are in a more disadvantaged position in terms of information mastery, difficulty in defending their rights, etc. It is difficult to achieve the dual protection of consumer rights and interests and high-quality development of the digital economy by relying solely on the existing legal system and regulatory model. Therefore, to protect the legitimate rights and interests of consumers in the digital economy mode, it is necessary to coordinate and promote the improvement of the legal system, the innovation of the government's regulatory path, and the importance of industry self-regulation.

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The Analysis of Sustainable Business Model in Traditional Chinese Tea Industry

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Abstract: Since ancient times, China has been a great tea country, the world's largest tea planting area, and the world's top tea production. Over the entire Chinese tea industry, there are countless large and small tea factories but few famous tea brands, seriously affecting the industry's sustainable development. Thus, creating a famous tea brand is a huge challenge for Chinese tea. In addition, the world currently cultivates tea in many countries, such as Sri Lanka, India, Turkey, Kenya, etc. China is a large tea producer and is always an important economic crop. With the modern, fast-paced urban life, the new tea consumption style is more suitable for the domestic and international consumer market and meets the needs of the public. This paper explores to convert and upgrade the traditional Chinese tea industry's business model by recognizing and analyzing the globally well-known brand Lipton Tea. Firstly, it is no longer limited to the traditional tea culture, and combining the tea culture with commercial activities to create a fashionable tea culture; secondly, to apply the tea to a wider range of consumer markets rather than limiting it to the tea-drinking market only; and then through the assistance of new media such as e-commerce and We media to promote the product, this series of upgrading from the internal to the external business model can improve the popularity of Chinese tea brands, the rapid development of the tea industry will also give China's economic market to bring sustainable development of the new power.

Keywords: Chinese tea, tea brands, origin brands, fashion tea culture, marketing model

1. Introduction

Recently, the demand in the global tea market has continued to grow, and according to statistical data, in 2022, the global consumption of tea will be about 6.9 billion kg. It is expected to reach 7.4 billion kg in 2025, and nearly one-third are made in China [1]. Based on the output distribution, China's industry production ranks at the top globally. However, with such huge tea production, China has yet to have a competitive tea brand that can compete in the international market. Even in China, most people still recognize tea as black and green tea; the distinction between the kinds of tea and tea brands is poorly understood. Mingyue Fan and Limin Wang mentioned some existing problems in the tea industry. The first one is that the supply of the tea market exceeds the demand, and the tea products do not match the market demand; secondly, the existing tea production and sales model is unhealthy, which cannot support the sustainable development of the tea industry [2]. Chinese tea enterprises are generally small; the market concentration could be higher to fewer well-known brands. Some tea companies have already started to transform the tea industry, such as Guizhou Qianzhiguan

Tea, which utilizes the Internet plus agriculture to help upgrade the tea industry in Guizhou [2]. However, due to its geographical remoteness, it still needs to overcome great challenges in the transformation and modernization.

The focus of this paper is placed on the internationally well-known tea brand Lipton. According to the statistics, the global sales of the Lipton company in 2019 far exceeded the total exports of 60,000 tea companies in China [3]. By researching the case of the brand Lipton, this paper explores the Chinese traditional tea enterprises to study how to transform and upgrade. With the rapid development of globalization and the Internet, enterprises, professional scholars, and others must study the entire tea industry to seek a sustainable future path for China's thousands of tea factories and thereby create a well-known tea enterprise brand that belongs to China.

2. Case Analysis

2.1. Lipton

Lipton is the world's largest tea brand. It has been rumored that Chinese 70,000 tea factories can't beat a British Lipton, meaning there are about 70,000 tea factories in China. The total export was 1.49 billion US dollars in 2016, less than half Lipton's annual production value of more than 3 billion US dollars in the previous year [3]. Lipton is a subsidiary of Unilever company; the headquarters is located in the UK, one of the world's largest daily necessities consumption companies. Since its establishment over 100 years ago, Lipton has always maintained the excellent quality, fragrance, and flavour passed down from generation to generation. With the advertisement slogan of good tea from the tea plantation directly into the teapot, it has established a good enterprise brand impression in the consumers' minds. First of all, analyzing Lipton's audience, Yuan Shengjun, Cai Dan, and Su Xin mentioned in their research that the click volume of the keyword "Lipton" on Baidu search to determine the demographic properties of the audience group and the research results show that people mainly interested in Lipton are in the age of 20-29, the middle-aged and old-aged customers less, the younger generation is the main focus of the brand, the group of people in pursuit of modern fashion. In the fast-paced life, they desire a quality of life; perhaps they are not tea enthusiasts, may not know tea, but they pursue a healthy and high-quality life [3]. In addition, Lipton developed a series of milk tea products through innovative products, which also meet the young Chinese consumer groups who like milk tea, and the products processed by it have the characteristics of convenience and fashionable packaging, which is very consistent with the fast-paced era. Therefore, the diversity of products and the degree of innovation is also an important treasure of the company's achievements, positively affecting the establishment of a good brand image and reputation.

2.2. Qianzhiguan

Qianzhiguan is a new tea-manufacturing and developing company in Guizhou, China. The brand is a new tea brand that specializes in Duyun Maojian tea, a Guizhou specialty, and utilizes Internet-based agriculture to help upgrade the tea industry in the region; both Duyun Maojian and Kweichow Moutai were awarded gold medals at the World Expo, which led to the founder's efforts to promote these varieties of tea. Since most traditional tea farmers and tea companies in China avoid the idea of modernization and transformation, most believe that they need to do a good job with their variety of tea and that building a brand and transforming the industry is a daunting task; they don't want to take the risk of innovation. However, Fan Deng, the brand's founder, is trying to take on the difficult challenge of changing the tea industry. Qianzhiguan wants to take advantage of its geographic location to combine with the rapid development of tourism to create distinctive tourism intellectual property [2]. Qianzhiguan is trying to upgrade and transform itself but utilizing the Internet to build a tea brand is still a huge challenge.

3. Recommendations for the Sustainable Development in the Tea Industry

3.1. Building a Fashionable Tea Culture

As the world's largest tea country, China's annual tea production and consumption are huge, but the operation status of various tea enterprises and manufacturers could be more optimistic. The traditional tea culture has been advocated as propaganda that is harmful to the development of the overall tea industry in the long term, and it is necessary to combine the culture with the market environment to upgrade and transform the traditional tea culture. Hao Jiaying noted the relationship between tea culture and tea branding in her study, and she believes that in today's consumer market, people are not only purchasing a product with the use of functionality but also beginning to pursue a lifestyle with taste and personality [4]. Tea beverages such as HeyTea and Nayuki also cooperate with the upper-stream tea merchants to launch a series of products. This delicious and convenient new style of tea drinks is closely integrated with the daily needs of young people and is highly welcomed by this young group of consumers and chased by the capital market. For the tea industry, cooperation with such franchise tea beverage brands cannot just play a supply chain role more to build their specific brand. In recent years, the emergence of new tea drinks similar to the café more and more; in the fast-paced urban life, the traditional style of a few hours around the fireplace tea can only become an exclusive program for middle-aged business people, more fast-paced class café model may gradually replace the social function of the tea house. Therefore, the tea store with fast consumption and social functions will make more people touch the tea.

3.2. Expanding a Wider Consumer Market

In other words, to create a brand that could occupy a leading position in the tea market, it does not lie in the number of stores and the level of products but in organizing the resources that can be utilized. Chen Yue mentioned in his paper that with the increase in the variety of beverages, the threat of substitutes faced by tea in the future will be numerous. The key to this threat to the tea enterprises is to emphasize the function of tea's health care and its competitive barriers to differentiate from its substitutes to achieve the irreplaceability of tea [5]. To create a tea brand different from the traditional tea varieties, the choice of tea types should focus on diversity. Wang Keming said China has several advantages of planting tea areas, respectively, the middle and lower reaches of the Yangtze River green tea, the southeastern coast of Oolong tea, Southwest black tea, etc. [6], the rich geographical conditions made China to become the world's more complete production of tea, this advantage can give a variety of choices for the brand. Also, the Food and Agriculture Organization of the United Nations report mentioned that between 2007 and 2016, the balance of global tea production and consumption growth was about 4.4% [7], which means that the big tea-producing countries were also big tea consumers. Therefore, expanding the tea market is necessary to develop tea beverage products and expand the other tea uses. Beginning with the nutritional value of tea, as one of the world's most popular health drinks, tea polyphenols in tea have been shown to help inhibit the formation and development of tumors in many organs [8], which makes tea can be extracted for use in many food products, medicines and daily necessities. This combination of tea with daily consumer products makes the demand for tea wider and wider.

Furthermore, tea has multiple properties: it can be a beverage, a tea for health, and a gift for emotional communication. In China, tea often has a special gift character along with high-class cigarettes and alcohol and can be traced back to ancient China. Tea was one of the most important commodities on the Silk Road. China has used tea as a messenger of cultural dissemination, promoting friendly exchanges with countries along the Silk Road [9]. To create a sustainable tea

brand, tea companies should explore the needs of different consumer groups for tea and then combine their resources to maximize the share of the target market.

3.3. Implementation of Online Marketing

With the constant development of the digital era, the inherent marketing model of tea enterprises is no longer able to meet the demands of the market because the number of enterprises in China's tea industry is large, and the market concentration is relatively low, with the characteristics of a fully competitive market. Chen Yue believes that tea enterprises can only achieve a lead over their competitors in marketing to gain a competitive advantage in the terminal of sales and ultimately enhance product sales and expand market share [5]. Marketing channels are divided into online and offline channels, and under the trend of increasingly mature e-commerce models, online channels are the centre of marketing gravity for brands. Enterprises can choose to cooperate with e-commerce to live show products and broaden the channels of sales, compared to the traditional offline channels' stores and supermarkets for the lower fixed costs, but also to break the distance and time problems, people around the world can see the brand's influence, this new type of Internet-based marketing helps enterprises to maximize the broadening of the market. It is more conducive to the creation of a familiar tea brand.

4. Conclusion

The challenge for the 70,000 large and small tea factories in China is converting Chinese tea from a "brand of origin" to a "brand of product". This paper focuses on analyzing the world-famous tea brand Lipton to create a brand of tea belonging to China. From the internal industry to break the traditional tea culture, to create a new fashionable tea culture, to expand tea consumption from beverage to more daily consumer goods while adding the latest digital marketing tools. Ultimately, through this series of internal and external business models, conversion and upgrading can create a Chinese characteristic of the tea brand. As the limitations of the length of this paper, it does not focus on analyzing the situation of the tea industry in each region.

Nevertheless, the nationalization of the brand in the later stages may bring cross-regional operational problems. How to do a good job in the later stages of the enterprise operation mode of management also needs to continue to think and improve. As Denyer mentioned in his article [10], the different tastes of tea in each country and tariff policy factors will make the brand in the international market share changes in the future to create a brand of tea made in China and how to compete in the international market with Lipton such as the veteran tea brand is also the direction of future research. In conclusion, creating a tea brand is dynamic, and each factor's influence is crucial to achieving long-term and healthy development. To keep up with the changes of the times is the realization that every enterprise should have.

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How Does Digital Finance Promote Regional Economic Growth?

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Abstract: The development of digital finance has important practical significance for regional economic growth. This article is based on the Digital Inclusive Finance Index developed by Peking University to study the impact of digital finance on economic growth in various regions of China, and uses the internet penetration rate at each provincial level as a tool variable to alleviate endogeneity issues in the model. Research has found that digital finance has a significant promoting effect on regional economic growth, and all three dimensions of digital finance have a positive impact on economic growth; Digital finance has shown some differences in the eastern, central, and western regions of China, with overall positive impacts, but its impact on economic growth in the eastern region is greater. This article provides an empirical basis for the development of digital finance in China, and provides a robustness analysis of digital finance promoting regional economic growth. Based on the current situation of digital finance development in China and the conclusions drawn in this article, it is believed that the construction of regional financial infrastructure should be accelerated, and the government should provide more financial resources for the central and western regions of China to narrow regional disparities, In order to better achieve the driving effect of digital finance on economic growth and regional coordinated development.

Keywords: digital finance, economic growth, regional differences

1. Introduction

China's reform and opening up has been a catalyst for remarkable economic growth, resulting in a succession of Chinese miracles. However, looking at China's economic development trajectory, the "extensive" economic model urgently needs improvement. The construction of a moderately prosperous society in China necessitates the implementation of inclusive finance as a key factor, which has a substantial impact on expanding financial coverage, enhancing the efficacy of financial services, and making financial services and products more accessible in various areas.

The G20 Advanced Principles for Digital Inclusive Finance, released in 2016, encourage various countries and regions to carry out inclusive finance action plans based on their own advantages. China should leverage the potential of digital finance, capitalize on the advantages of the Internet, blockchain, big data, and other elements, to foster high-quality economic growth and bolster its economic strength in this era. This article will explore the effect of digital finance on China's economic growth, primarily by exploring its expansion of financial services and products in various

regions. Computer technology's swift advancement has enabled this, so will digital finance's ascendancy be a boon to economic expansion in multiple fields? Secondly, drawing on the research results of Guo Feng et al. [1], digital finance includes three dimensions. Constructing an analytical framework to explore the influence of various aspects of digital finance on regional economic expansion could be advantageous in further uncovering the part digital finance plays in regional economic growth. Given the vastness of China's territory and the uneven development of resources in its various regions, does the evolution of digital finance have distinct functions among distinct regions, considering the disparities in regional economic progress?

The Digital Inclusive Finance Index, compiled by the Digital Finance Research Center of Peking University from 2011 to 2018, is used to empirically evaluate the influence of digital finance and its three components on regional economic growth, as well as economic growth in the eastern, central, and western regions. Research has demonstrated that digital finance has a considerable impact on regional economic growth, with all three aspects having a beneficial effect. Moreover, digital finance has shown some distinctions in the eastern, central, and western regions of China, with overall beneficial effects, yet its effect on economic growth is particularly pronounced in the eastern region. This article's research conclusions have practical and significant implications for advancing China's economic development through digital finance in the future.

2. Literature Review and Research Hypothesis

The advent of computers and the growth of communication technology have enabled digital finance to rapidly expand in China, with its expansion gradually intensifying. The convenience of financial services obtained by various regions has greatly improved, providing a practical path for economic growth in various regions. Digital finance specifically refers to the implementation of various financial services such as payment and settlement through internet platforms and digital technology between financial institutions [2]. The potential of finance to stimulate economic expansion in a range of nations [3][4] has been demonstrated by King and Levine and Rajan and Zingales. In recent times, the swift growth of digital financial firms such as Ant Financial and JD has been a notable development.com has provided convenience for the formation of inclusive finance in China, which is also the trend of future development in China.

A move from "high speed" to "high quality" can be seen in our nation's current economic growth trajectory. From the early growth model of our country, it is still in a "extensive" growth mode [5]. Under this economic development model, China has encountered problems such as low total factor growth rate, unreasonable industrial structure, and improper urban-rural development, which have affected the growth of China's economy [6]. From existing research, it can be seen that the development of digital finance can promote economic growth while promoting inclusive finance, especially in China. The Internet's growth in China has been found by Jiao Jinpu [7] to have brought financial services to underdeveloped areas, made it easier for people to access them, and digital currency has had a major impact on reducing the cost of such services and increasing coverage [8], thereby helping China achieve inclusive growth [9].

The rapid development of digital finance has alleviated the financing constraints obtained by various regions, which helps reduce the cost of obtaining funds for small and micro enterprises in various regions, thereby promoting regional economic growth. Guo Feng et al [1] believe that digital finance is gradually integrating into traditional financial institutions, and utilizing cloud computing and big data to continuously expand the scope and target audience of digital finance services. Its development in various regions is gradually increasing, reducing financial discrimination. Alipay's representation of internet finance has lowered the barrier to financial services, increased their efficiency, allowed disadvantaged groups to use them, and encouraged the high-quality growth of local economies.

The influence of digital finance on regional economic expansion is not uniform, but rather varies between structural and regional areas [10]. On the one hand, digital finance in China is mainly measured from three aspects, namely coverage breadth, depth of use, and digital level. The first two are mainly considered from the perspective of traditional finance and have practical experience in economic growth. Qian Haizhang et al. The development of digital finance and its three dimensions has been found to have a positive influence on the economic growth of China, which is currently in a transitional phase with its infrastructure yet to be developed or improved. [11] There is still room for further development of the digital level. Wang Yongcang and Wen Tao [12] found through empirical research that digital finance significantly affects economic growth and exhibits heterogeneity differences. Therefore, the actual impact of the three dimensions of digital finance on regional economic growth needs to be empirically tested; On the other hand, due to China's vast territory and differences in basic economic levels, there is a situation where the East is strong, the West is weak, and financial resources are concentrated in different regions. Despite the abundance of resources in Beijing, Shanghai, the Pearl River Delta, and other areas, a dearth of financial resources remains in the central and western regions. Furthermore, the development disparities in these regions also have an effect on how digital finance influences regional economic growth. In summary, the following hypotheses are proposed:

Research hypothesis 1: Digital finance has a promoting effect on economic growth in various regions;

Evident are structural and regional disparities in the economic growth effects of digital finance on the region, as Hypothesis 2 suggests.

3. Research Design

3.1. The Regional Economic Growth of Digital Finance Is Modeled

Based on the above theoretical analysis and drawing on the model used by Tang Song et al. [13] A model was created in 2020 to empirically assess the link between digital finance and regional economic growth. This benchmark model is as follows:

$$\begin{aligned} \ln pgdp_{it} = & r_0 + r_1 ifi_{it} + r_2 lnk_{it} + r_3 fdi_{it} + r_4 structure_{it} + r_5 urb_{it} \\ & + r_6 infrastructure_{it} + v_t + u_i + \varepsilon_{it} \end{aligned} \quad (1)$$

Rendering each province, t representing time, $\ln pgdp$ representing regional economic growth by per capita GDP, ifi representing digital finance development, $\ln k$, fdi , $structure$, urb , $infrastructure$ representing control variables of capital investment, foreign direct investment, industrial structure, urbanization rate, and infrastructure, u_i representing regional fixed effects, v_t representing year fixed effects, and ε_{it} representing random disturbance terms, these are the variables.

3.2. Variable Description and Data Source 3.2.1 Variable Description

3.2.1. Variable Description

(1) The logarithmic value of per capita GDP in each province ($\ln pgdp$) is used to gauge regional economic growth. In the robustness test, replace the numerical value ($\ln pgdp$) with actual GDP for testing.

(2) Regional entrepreneurship and resident consumption. To gauge regional entrepreneurship, this article employs the ratio of the amount of individual and private enterprise personnel in both urban and rural areas to the total number of employed individuals ($entrepre$). Additionally, per

capita consumption expenditure per province (*pconsumption*) is used to measure household consumption.

(3) Digital finance. The Peking University Digital Finance Research Center's Provincial Digital Finance Inclusion Index is employed in this article to quantify by dividing it by 100(*ifi*). The three dimensions of digital finance coverage, depth of use, and level of digitization are measured by *ifi1*, *ifi2*, *ifi3* respectively.

(4) Control variables.

Widely employed as a fundamental element in economic growth research, capital investment is the focus of this article, which employs the logarithm of the total fixed assets of the entire population as a proxy variable (*lnk*).

The ratio of total foreign direct investment to regional GDP (*fdi*) is employed as a proxy variable in this article, as foreign investment is a key factor in the growth of a country's economy and its effect on regional economic development.

Industrial structure. The ratio of tertiary industry output to secondary industry output (*structure*) is used as a proxy variable in this article, taking industrial structure as a control variable, as prior research has shown that industrial structure has an influence on regional economic growth.

This article examines the role of urbanization in the growth of regional economies, as well as the human capital it can bring to economic progress, using the ratio of urban to total population in each province (*urb*) as a proxy variable.

At the infrastructure level. Infrastructure has a significant impact on regional economic development, and the convenience of transportation has a positive impact on product entry and exit, as well as attracting funds. This article uses the highway mileage per 10000 people in each province (*infrastructure*) as a proxy variable.

3.2.2. Data Source

Drawing primarily from two sources, this article utilizes the Digital Finance Research Center of Peking University's digital finance index of 31 provinces in China from 2011 to 2018, and the China Internet Network Information Center (CNNIC)'s Internet provincial development report from the same period to obtain the Internet penetration rate of 31 provinces in the Chinese Mainland. The other macro variables are derived from the Guotai An database and statistical yearbooks.

Table 1: Variable Definition Table.

Variable	Meaning of variables	Measurement method
<i>lnpgdp</i>	economic growth	The logarithm of per capita real GDP
<i>ifi</i>	development of digital finance	Digital Inclusive Finance Index/100
<i>pconsumption</i>	resident consumption	per capita consumption expenditure
<i>entrepre</i>	regional entrepreneurship	Number of urban individual and private enterprise employees/total employment
<i>internet</i>	internet penetration rate	Number of Internet users/total number of people in each province
<i>structure</i>	industrial structure	Output value of the tertiary industry/output value of the secondary industry
<i>lnk</i>	capital	Fixed assets investment logarithm of the whole society
<i>fdi</i>	foreign direct investment	Foreign direct investment/GDP
<i>urb</i>	urbanization rate	Urban population/total population

Table 1: (continued).

<i>infrastructure</i>	infrastructure level	Highway mileage per 10000 people
<i>supervision</i>	financial regulation	Regional financial regulatory expenditure/added value of the financial industry

4. Benchmark Empirical Regression and Economic Interpretation

4.1. Benchmark Regression of Digital Finance and Economic Growth

Table 2: Descriptive Statistics.

variable	mean value	standard error	minimum value	Maximum value	sample size
<i>lnpgdp</i>	10.76	0.43	9.71	11.85	248
<i>ifi</i>	1.87	0.85	0.16	3.78	248
<i>pconsumption</i>	1.9	0.98	0.47	6.42	248
<i>entrepre</i>	0.19	0.1	0.06	0.61	248
<i>internet</i>	0.49	0.12	0.24	0.78	248
<i>structure</i>	0.04	0.04	0.005	0.21	248
<i>lnk</i>	9.4	0.88	6.25	10.96	248
<i>fdi</i>	0.34	0.35	0.05	1.86	248
<i>urb</i>	0.56	0.13	0.22	0.9	248
<i>infrastructure</i>	44.11	42.63	5.14	284.25	248
<i>supervision</i>	0.05	0.048	0.011	0.28	248

A Hausman test was conducted on the model in question to verify the precision of the regression results and to strengthen the research outcome of this article. The chi square statistic of the test was 21.95, with a P-value of 0.0012, which was less than 0.01, signifying that the original hypothesis was rejected at a 1% significance level. As a result, Table 3 in this article displays the test findings using a fixed effects model.

Table 3: Hausman test results.

Hausman test	
Chi2(6)	21.95
P	0.0012

Table 4: The Impact of Digital Finance on Regional Economic Growth: Benchmark Regression.

explanatory variable	(1)	(2)	(3)	(4)	(5)
<i>ifi</i>	0.1996902*** (0.000)	0.0859535*** (0.000)			
<i>ifi1</i>			0.0978387*** (0.000)		
<i>ifi2</i>				0.0675488*** (0.000)	
<i>ifi3</i>					0.0247153*** (0.000)

Table 4: (continued).

<i>lnk</i>		0.1614912*** (0.000)	0.1706248*** (0.000)	0.1885813*** (0.000)	0.1581469*** (0.000)
<i>structure</i>		-5.065934** (0.031)	-4.812887** (0.041)	-4.600543* (0.059)	-7.521008*** (0.000)
<i>fdi</i>		0.6709343*** (0.009)	0.6336178** (0.014)	.6423069** (0.016)	1.026843*** (0.000)
<i>urb</i>		1.587582*** (0.000)	1.295821*** (0.000)	1.968734*** (0.000)	2.823373*** (0.000)
<i>infrastructure</i>		0.0009625 (0.190)	0.0008013 (0.277)	0.0007706 (0.310)	0.0014956* (0.065)
Constant term	10.39082*** (0.000)	8.109772*** (0.000)	8.196206*** (0.000)	7.680032*** (0.000)	7.488416*** (0.000)
R^2	0.3298	0.8016	0.7558	0.7994	0.8705
Time/region effect	control	control	control	control	control

Significant values at the 1%, 5%, and 10% levels are denoted by ***, **, * respectively, with P values in parentheses.

The benchmark regression model employed a fixed effects model to evaluate the effect of digital finance on regional economic growth. To begin with, the model was evaluated without taking into account the endogeneity. Table 4.(1) reveals a positive regression coefficient of 0.20 for digital finance on economic growth, which was significant at the 1% level, when accounting for the "time province" fixed effect. This implies that for every 1% rise in digital finance, economic growth would increase by 0.2%. The results of the regional economic growth, even after taking into account the variables in Table 4(2) that are pertinent, remain significant due to the expansion of digital finance.

For other control variables, although there are differences in the magnitude of coefficient values among different models, the significance difference is not significant. Evident is the positive influence of capital investment, foreign direct investment, and urbanization rate on economic growth; capital investment has brought capital to various provinces, optimized regional resource allocation, and supplied the necessary funds for economic growth. Additionally, foreign direct investment is noteworthy at the 1% level, and has a positive effect on economic growth. Evident is the stimulating effect foreign investment has on the local economy, taking advantage of local advantages for growth. The urbanization rate can bring human capital to labor mobility in various regions, which is conducive to economic growth. The detrimental effect on economic growth of China's service-oriented industrial structure, which is reflected in the ratio of the tertiary industry's output value to that of the secondary industry, could be the cause. With the development of China's economy, excessive service-oriented nature is particularly evident, which has an impact on the real economy and is therefore detrimental to economic growth. The possible reason why infrastructure is not significant in the regression is that the infrastructure construction in each region has a long-term nature and needs to bring changes to the regional economic development over a long period of time. The local economy can be advanced through the enhancement of regional infrastructure, as evidenced by pertinent facts.

The Digital Finance Research Center of Peking University has released the Digital Finance Inclusive Finance Index, a three-part measure of coverage breadth, use depth, and digitization level. Consequently, this article will continue to investigate the influence of digital finance on regional economic development from a multifaceted perspective. To gauge the breadth of coverage, use depth, and digitization level, the fixed effects model was utilized for estimation. The estimation

results, shown in Tables 4(3),(4), and (5), demonstrate that digital finance's three dimensions have a beneficial effect on regional economic growth, especially at the 1% level.

The initial dimension is the broadness of digital finance coverage. The coverage of digital finance is mainly composed of account coverage, emphasizing the breadth of digital financial services. The expansion of regional financial services can significantly foster regional economic growth, necessitating regions to vigorously back the building of financial infrastructure to broaden digital finance's reach and propel economic growth. The second factor to consider is the extent to which digital finance is being utilized. The utilization of digital finance is largely comprised of payment, credit, monetary fund, insurance, investment, credit and other activities, which is indicative of the effective demand for financial services. The utilization of digital finance, as suggested by the results, has a considerable influence on regional economic growth, suggesting that efficient financial products and tools can be employed to stimulate regional economic growth after meeting regional demand. This necessitates local governments to popularize financial knowledge, enhance financial literacy, guarantee the precise creation of financial products and tools, and more effectively advance regional economic development. The degree of digital support services, gauged from four facets - mobility, affordability, creditability, and convenience - is the third dimension of digital development. This level stands as a measure of its own. The level of digital development can reduce the cost of residents accessing financial services and improve efficiency, making it more convenient for them to enjoy financial services, thereby effectively stimulating regional economic growth. Provinces must strive to promote digital aid, utilize cutting-edge technologies such as big data, 5G, and blockchain, and bolster digitalization to bolster the real economy, thus promoting regional economic growth.

4.2. The Impact of Digital Finance on Economic Growth in the Eastern, Central, and Western Regions

Table 5: The Impact of Digital Finance on Regional Economic Growth: A Regional Test.

explanatory variable	Overall effect		
	eastern	central	west
<i>ifi</i>	0.0957959*** (0.000)	0.0657532*** (0.000)	0.0389553*** (0.001)
Control variable	Yes	Yes	Yes
Constant term	7.928821*** (0.000)	8.163553*** (0.000)	7.54288*** (0.000)
R^2	0.7256	0.9150	0.8125
Time/region effect	control	control	control
explanatory variable	Structural effect: coverage breadth		
	eastern	central	west
<i>ifi1</i>	0.1124767*** (0.000)	0.0745981*** (0.000)	0.0397345*** (0.003)
Control variable	Yes	Yes	Yes
Constant term	8.087266*** (0.000)	8.207724*** (0.000)	7.519275*** (0.000)
R^2	0.6462	0.9089	0.8045
Time/region effect	control	control	control
explanatory variable	Structural effects: using depth		
	eastern	central	west

Table 5: (continued).

<i>ifi2</i>	0.0747192*** (0.000)	0.0470459*** (0.000)	0.0217741*** (0.026)
Control variable	Yes	Yes	Yes
Constant term	7.485113*** (0.000)	7.739391*** (0.000)	7.290368*** (0.000)
R^2	0.7819	0.8948	0.8039
Time/region effect	Yes	Yes	Yes
Structural effects: digital level			
explanatory variable	eastern	central	west
<i>ifi3</i>	0.0327374*** (0.000)	0.0189313*** (0.001)	0.0136726*** (0.003)
Control variable	Yes	Yes	Yes
Constant term	7.307441*** (0.000)	7.713706*** (0.000)	7.370292*** (0.000)
R^2	0.8690	0.9004	0.8303
Time/region effect	control	control	control

Significant values of 1%, 5%, and 10% are denoted by ***, **, * respectively, with P values in parentheses.

This paper divides 31 provinces in the Chinese Mainland into three distinct regions: eastern, central, and western. Investigate if disparities exist in the consequences of the aggregate digital finance index and its three components on economic expansion in distinct areas. In the eastern region, eleven provinces are present, such as Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan, and Liaoning; the central region, with 8 provinces, is Shanxi, Heilongjiang, Jilin, Anhui, Jiangxi, Henan, Hubei, and Hunan; and the western region, with 12 provinces, encompasses Inner Mongolia, Guangxi, Sichuan, Chongqing, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, and Tibet.

Table 5 reveals the regression results, which take into consideration the overall index of digital finance, its coverage breadth, depth of use, and digitalization level, in relation to the eastern, central, and western regions. It is evident that digital finance has a considerable effect on regional economic growth, and from a coefficient perspective, the eastern region is particularly affected. Regression results of various dimensions of digital finance on various regions demonstrate the same performance as that of the entire sample; that is, all aspects of digital finance have a substantial effect on economic growth, particularly in the eastern region, at the 1% level. For the developed eastern region, traditional finance is more mature and financial infrastructure is more complete. The development of digital finance in the eastern region provides richer channels for residents' consumption and regional entrepreneurship, and has a more significant impact on economic stimulus. Regression coefficients have revealed a widening digital divide between East, West, and Central regions, despite the fact that digital finance has enabled local economic growth in comparison to the underdeveloped central and western regions. To sum up, the regression results are in agreement with our expectations, as opposed to the basic regression. The regression outcomes of the control variables are in harmony with the fundamental regression results, thus rendering the specific outcomes visible.

4.3. Endogeneity

This article endeavors to empirically assess the influence of digital finance on regional economic development. Although relevant variables were controlled on this basis, endogeneity issues still

inevitably exist. Firstly, the development of digital finance has the characteristics of traditional finance, which has a reverse causal relationship with economic growth; Secondly, in the model, we have controlled for relevant variables that affect economic growth, but it is still inevitable to omit variables. For endogeneity issues, this article attempts to alleviate them through the following methods:

Drawing upon Xie Huali's (2018) [14] methodology, the internet penetration rate is a key element of digital finance, which is closely linked to digital finance. Therefore, the internet penetration rate meets the correlation requirements of digital finance development tool variables. In addition, after controlling for relevant variables, there is no direct relationship between internet penetration rate and regional economic growth, which meets the requirement of exclusivity. Based on the above analysis, this paper chooses the Internet penetration rate of 31 Chinese Mainland provinces that year and the lag time of digital finance as the instrumental variables of the development of digital finance in order to alleviate the endogenous problem.

Results of the instrumental variable demonstrate that no feeble instrumental variables or recognition issues exist, and the instrumental variable is efficacious. From the regression results in Tables 6a and 6b, it can be seen that both the internet penetration rate and digital finance lag for a period, and the results are very significant, with little difference from the benchmark regression results, indicating that digital finance has a significant effect on improving regional economic growth. From the viewpoint of digital finance's dimensions, the development outcomes of digitalization are of no consequence. The efficiency of residents' access to financial services and the convenience of costs are two factors that could account for this, but both of these factors have a lagged effect, and the evident promoting effect has not yet been demonstrated.

Table 6a: The impact of digital finance on regional economic growth: endogeneity issues.

explanatory variable	Tool variable: Internet penetration rate			
	Model1	Model2	Model3	Model4
<i>ifi</i>	0.0805614*** (0.002)			
<i>ifi1</i>		0.0798857*** (0.002)		
<i>ifi2</i>			0.1030093*** (0.003)	
<i>ifi3</i>				0.0588847*** (0.003)
<i>lnk</i>	0.0802305** (0.020)	0.1046421*** (0.000)	0.0802305** (0.020)	0.1008411*** (0.000)
<i>structure</i>	-8.369868** (0.032)	-7.318172** (0.048)	-8.208149** (0.037)	-8.208149** (0.037)
<i>fdi</i>	0.9425326** (0.028)	0.8807498** (0.034)	0.9425326** (0.028)	1.002304** (0.023)
<i>urb</i>	3.02852*** (0.000)	2.996672*** (0.000)	3.095223*** (0.000)	3.095223*** (0.000)
<i>infrastructure</i>	0.0032748*** (0.000)	0.0035373*** (0.000)	0.0034716*** (0.000)	0.0034716*** (0.000)
Constant term	7.810562*** (0.000)	7.778139*** (0.000)	7.963669*** (0.000)	7.730443*** (0.000)
R^2	0.9219	0.9233	0.9165	0.9153
Time/region effect	control	control	control	control

Significant values at the 1%, 5%, and 10% levels are denoted by ***, **, * respectively, with P values in parentheses.

Table 6b: The impact of digital finance on regional economic growth: endogeneity issues.

explanatory variable	Instrumental variable: digital finance lags for one period			
	Model 1	Model 2	Model 3	Model 4
<i>ifi</i>	0.0388898** (0.032)			
<i>ifi1</i>		0.0412894** (0.017)		
<i>ifi2</i>			0.0518699** (0.018)	
<i>ifi3</i>				0.0158419 (0.298)
<i>lnk</i>	0.1317002*** (0.000)	0.132114*** (0.000)	0.1223107*** (0.000)	0.143904 (0.000)
<i>structure</i>	-5.556656 (0.145)	-5.527105 (0.144)	-5.899196 (0.123)	-4.958631 (0.196)
<i>fdi</i>	0.7160084* (0.092)	0.7139137* (0.093)	0.7300581* (0.085)	0.6718149 (0.116)
<i>urb</i>	3.144901*** (0.000)	3.122788*** (0.000)	3.137971*** (0.000)	3.201194 (0.000)
<i>infrastructure</i>	0.0040083*** (0.000)	0.004*** (0.000)	0.0039093*** (0.000)	0.0041929*** (0.000)
Constant term	7.472328*** (0.000)	7.485344*** (0.000)	7.553665*** (0.000)	7.34404*** (0.000)
R^2	0.9210	0.9215	0.9197	0.9193
Time/region effect	control	control	control	control

Significant values at the 1%, 5%, and 10% levels, denoted by ***, **, * respectively, are indicated by parentheses with P values.

5. Research Conclusions and Recommendations

Digital finance has rapidly advanced in recent years, and this new category of financial services has had a big impact on China's economic expansion. Does digital finance, as an emerging model of financial industry, have a promoting effect on the regional economy? Examining panel data from 31 provinces of the Chinese Mainland from 2011 to 2018 this paper empirically tests the impact of digital finance on economic growth in all parts of China, based on theoretical analysis. Additionally, it examines the solutions to endogenous issues. The primary conclusions are: Digital finance has a considerable stimulating effect on regional economic growth, and all three facets of digital finance are beneficial to economic growth. To reduce the endogeneity issue of the model, the internet penetration rate and digital finance lag of each province were employed as instrumental variables, and the outcomes were uniform. Moreover, digital finance has exhibited some disparities in the eastern, central, and western parts of China, with general positive effects, yet has a more significant effect on economic growth in the eastern region. This study offers an empirical foundation for the emergence of digital finance in China and conducts a robustness analysis of how well digital finance promotes regional economic growth.

Recommendations for the advancement of digital finance in China, as seen in this article, are to hasten the building of regional financial infrastructure and foster a unified development of digital finance in different regions. The Chinese government should provide greater financial support to the central and western regions, bridging the divide between their progress and that of the eastern region, broadening the reach and breadth of digital finance in these regions, and augmenting the support services of digital finance, due to the economic growth taking place in various parts of

China. In the central and western areas, where financial access is both inefficient and costly, it is possible to construct extra service outlets and use computer technology to enhance the efficiency and reduce the cost of financial services; conversely, in the eastern region, with its wide-reaching coverage, digital financial innovation products can be supplied to meet the financial needs of different groups. Our goal is to bring about a unified growth of digital finance across China's regions, taking into account both supply and demand.

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Exploration the Tea Industry Development Strategy

--Taking Honey Snow City as an Example

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Abstract: With the development of economic globalization and information technology, the living standard and consumption level of residents have been significantly improved, and tea has become an indispensable thing in people's daily lives. As a leader in the affordable tea industry, Honey Snow City must have its own excellent business model. Taking the case of Honey Snow City, this paper first adopts the SWOT model to analyze its advantages such as low price, high brand recognition and superior geographical location, while its disadvantages include fewer products, obvious seasonality and fierce competition in the tea industry compared with other brands. The threat is that there are more and more competitive brands in the tea industry, the low price of products is difficult to maintain, and the products are easy to imitate and replaced by peers. The opportunity is that Honey Snow City has an excellent staff team, consumers have a high acceptance of the brand, and the main consumer group is a large number of students; Then it analyzes its development strategy, and according to its differentiated strategy development, it can be concluded that its development presents a vertical layout, and then horizontal perfection of the inverted "T" development mode; Finally, the paper studies the optimization strategy of enterprise management under the differentiation strategy, hoping to draw lessons for other businesses in the tea industry and formulate a marketing strategy suitable for their own development.

Keywords: differentiation strategy, Honey Snow City, SWOT model, business administration

1. Introduction

Statistics show that in 2022, the market size of the new tea industry exceeded 290 billion yuan, there were about 450,000 stores across the country, and the annual consumption of tea exceeded 200,000 tons. Guided by consumer demand, new tea drinks promote the initial flywheel effect on the development of tea raw materials. New tea drink refers to the use of high-quality tea, fresh milk, fresh fruit and other high-quality ingredients, through a more diversified tea base and ingredients combination of Chinese tea drinks. In addition to the innovation of raw materials, the "new" of new tea drinks is also reflected in new technologies, new groups, and new cultural communication.

This paper takes Honey Snow City as an example to explore the strategic analysis of beverage industry operation. The brand of Honey Snow City began in 1997. Honey Snow City is a chain enterprise that always adheres to the product concept of "high quality and affordable" to provide

consumers with all kinds of freshly made drinks and freshly made ice cream. It is committed to building a complete industrial chain integrating product research and development, production, warehousing and logistics, sales and chain operations, mainly engaged in the research and development, production, sales and brand operation management of existing drinks, such as existing ice cream and its core ingredients [1].

In this paper, the SWOT model is adopted to study the development strategy of Honey Snow City. It hopes that more people understand how affordable beverage companies like Honey Snow City successfully operate, to provide more companies with good management concepts, and marketing strategies, but also to avoid the shortcomings of Honey Snow City, enterprises can use reasonable references according to their own situations.

2. Analysis of Development Strategy of Honey Snow City Based on SWOT Model

2.1. The SWOT Model of Honey Snow City Brand

Table 1: SWOT model of Honey Snow City brand [2].

Strength (1) Price advantage (2) Positional advantages (3) Brand advantage	Weakness (1) Small quantity of products (2) Obvious seasonality (3) Fierce competition
Opportunity (1) The staff team (2) High acceptance (3) The main consumer group is students	Threat (1) Competing brands are on the rise (2) Low prices are hard to sustain (3) Products are easy to imitate and replace

As shown in Table 1, the SWOT model is used to analyze the strengths, weaknesses, opportunities and threats of Honey Snow City.

2.2. Advantages of Honey Snow City

(1) Price advantage: As we all know, "Let everyone in the world enjoy high quality and affordable delicious". This sentence was written into the brand story of Honey Snow City, so Honey Snow City's products have always insisted on low pricing. An ice cream is only 2 yuan, a cup of lemon water is 4 yuan, the milk tea series is basically about 8 yuan, the fruit tea series is basically about 10 yuan, and the single consumption is basically maintained at about 10 yuan. In the same industry, tea brands with greater visibility and Nai Xue's tea, the price of a single cup is as high as 30 yuan.

(2) Terrain advantages: to meet the preferences of residents' in the shopping environment, take the Honey Snow City in Xixia, for example, there are two local Honey Snow City stores in Xixia. One of the stores is directly opposite the main store of Dolma. Dolma is a local supermarket developed in Xixia. It has a history of many years in Xixia County, and it has branches in every main street of Xixia. Another store is in front of the Bandelung supermarket, which has a high reputation throughout Nanyang City, so opening a Honey Snow City next to the door of Bandelung is also a good choice. Honey Snow City store opened in this unique geographical location, every day there will be a large number of consumers from here, which will increase the possibility of buying Honey Snow City goods [3].

(3) Brand advantage: According to the investigation, Zhengzhou Cross-Strait Enterprise Management Co., LTD., owner of the Honey Snow City brand, donated 6 million yuan to the Henan Charity Federation, and Henan Dacca Food Co., LTD., a wholly-owned subsidiary, donated 1 million yuan to the Wenxian Red Cross Society for the fight against COVID-19. In response to

the Henan flood disaster, the headquarters of Honey Snow City is also here, and they set up a disaster relief center at 17 o'clock on July 20, 2021, regardless of their own safety, to investigate the situation of all employees one by one, to communicate with the returning employees in real time, and to prepare clothing, food and other materials for the temporarily trapped people. This makes the brand image deeply rooted in the hearts of the people, but also increases the national recognition.

2.3. The Disadvantages of Honey Snow City

(1) Small quantity of products

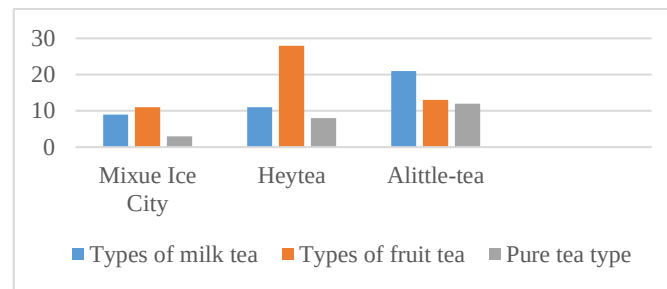


Figure 1: Product category comparison chart [2].

As shown in Figure 1, compared with other tea brands, Honey Snow City has fewer product types. The quantity of milk tea and fruit tea is smaller than that of other tea brands, and the product update speed is slower. Meanwhile, most of the updated types are similar. The consequence of long-term single products is that consumers lose freshness and reduce purchases [2].

(2) Obvious seasonality: Many products such as peach milkshakes, which are featured in Honey Snow City, are very cold, and sales in winter are much lower than in summer. There is no good main product in winter, sales can not reach a good level, and caused a huge loss of store rent, labor, logistics and other costs.

(3) Fierce competition: Due to the low investment threshold of ready-made leisure tea and the transparent operation model, which is easy to learn and copy, more and more practitioners have begun to enter this market, whether it is brands or small and medium-sized enterprises, resulting in fierce competition in the leisure tea market. According to the statistics of Changchun, there are more than 20 existing beverage stores in Guilin Road business district of Changchun City alone. The main competitor of Guilin Road Store of Changchun Honey Snow City, such as CoCo Duke, has also actively expanded the beverage market through the development of new products and strong publicity and promotion, and has grabbed a lot of market share of leisure tea drinks. These factors have brought great threats and challenges to the Guilin Road store of Honey Snow City [4].

2.4. Opportunity

The staff team of Honey Snow City brand are mostly young people. The target customer group of the Honey Snow City brand is mainly "post-90" and "post-00", so the same young employees have more personal experience and understanding of the future development trend and young people's consumer psychology, and young people will collide with more fresh ideas, and will have better development prospects [2].

As the image of Honey Snow City, Snow King not only has the visual image of the brand, but also creates a living person, is given a richer personality thought value, reduces the "physical", and excavates the "human nature". Cute and silly image in line with consumer aesthetic and personality needs at the same time, out of the brand halo effect, with their own visibility, compared with the

star will be closer to the user, not easy to create a gap between consumers and brands. Honey Snow City chooses a high plasticity and stable IP image to avoid damage to the brand image due to the star's public opinion and trust crisis, and can also be long-term and continuous in line with consumers' "aseptic aesthetic". It not only reduces the cooperation and publicity costs of asking stars to endorse, but also greatly reduces the communication cost, and also brings its own traffic and communication effect, using cultural identity to cause value resonance and enhance user stickiness [5], this also makes Honey Snow City a higher degree of recognition.

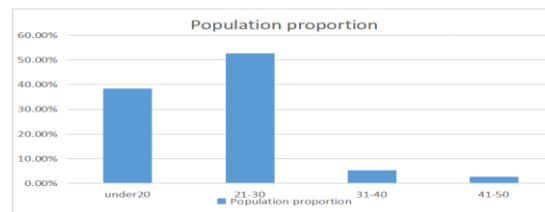


Figure 2: Age distribution of consumer groups in Honey Snow City [2].

Figure 2 shows the age distribution of consumer groups in Honey Snow City. It can be seen that the main consumer groups of the Honey Snow City brand are students and young people. The number of this group is huge, which also means that the potential consumer group of Honey Snow City is huge, and the brand of Honey Snow City can also focus on other consumer groups in order to open a broader market, such as white-collar groups [2].

2.5. Threat

In recent years, new tea brands have continued to expand, including Honey Snow City, ChaPanda, Aunteajenny and other brands that have covered more than 200 cities. In terms of the number of stores, the number of brand stores such as CoCo and ChaPanda has exceeded 5,000, and more and more investors choose to enter the tea industry, and more and more tea brands emerge, resulting in continuous intensification of industry competition.

With the rapid economic development and the impact of the COVID-19 epidemic, prices have continued to rise, with labor, store rents, fruit prices and logistics costs of raw materials all increasing. In the case of rising costs, how to maintain the low-price advantage of the Honey Snow City brand under the premise of finding greater profit space for themselves, has become the most important thing for enterprises to formulate development strategies [2].

The tea-drinking industry dominated by milk tea and ice cream is easy to imitate and replace. Consumers can replace milk tea with many other products, such as bottled milk tea and bagged ice cream. This is a threat faced by the entire tea industry, and the threat will always be there if the company's products cannot be made irreplaceable [2].

3. Analysis on the Development Strategy of Honey Snow City

3.1. The Overall Idea of Enterprise Differentiation

As shown in Figure 3, it can be seen from the differentiated strategy development of Honey Snow City that its development presents an inverted "T" development model, which is first vertically laid out and then horizontally perfected.

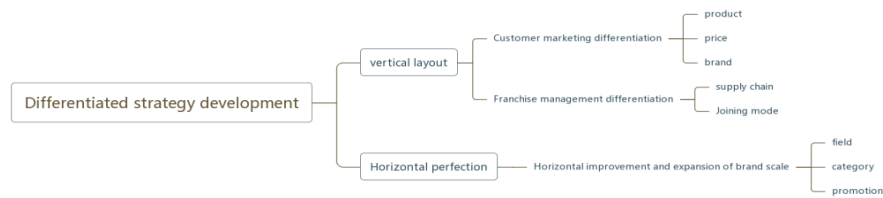


Figure 3: Honey Snow City pour "T" type strategic development model [6].

3.2. Vertical Differential Layout

From the perspective of vertical layout, Honey Snow City first anchors specific customer groups from product, pricing and brand. At the same time, Honey Snow City attracts franchisees to activate funds, establish supply chain differentiation through self-built storage centers, and then form franchise model differentiation by reducing franchise fees and corporate holding. The following is mainly for the differentiation of the franchise model analysis, compared with other kinds of tea brands, the franchise fee of Honey Snow City is low. In order to attract franchisees, Zhang Hongchao, the founder of Honey Snow City, created a new model of "interest-free loans", taking out tens of millions of yuan interest-free to lend to franchisees every year, which directly solves the financial problem of the franchisee in the early stage of opening a shop. Referring to Alibaba, Haier and other large enterprises for equity layout, regardless of the number of stores and product sales, its control is always in the hands of the founder Zhang Hongchao. The differentiation of the franchise model is standardized and upgraded, which makes Honey Snow City find a new way to quickly complete the expansion of the product brand scale [6].

3.3. Horizontal Differential Expansion

The horizontal improvement of Honey Snow City is to achieve the horizontal development goal of product "differentiation and diversification" through a series of measures. It mainly deals with three aspects, namely, field, category and promotion. The following is an analysis of promotion differentiation. After entering the era of big data, data platforms are becoming more and more important for enterprises, and their status in enterprises continues to improve. In order for enterprises to achieve better development, data platforms should continuously collect and integrate data, and at the same time realize real-time monitoring of data [7]. Honey Snow City is promoted with the help of big data platforms.

4. Optimization Strategy of Enterprise Management under Differentiation Strategy

4.1. Pay Attention to Enterprise Brand Building, Establish a Good Corporate Image

The building of brand image is an important part of differentiation strategy. Enterprises can quickly form a brand image through the Corporate Identity System (CIS), which can be combined with the positioning of the brand to carry out a comprehensive systematic audit of the brand. The design of a novel and distinctive product logo gives consumers a unique visual perception, establishes an irreplaceable image, and obtains the recognition of consumers [8].

4.2. Fully Understand the Market Situation and Identify the Market Positioning of the Product

In order to implement a differentiation strategy, enterprises must conduct in-depth research and analysis on the real internal needs of customers, and then further determine potential target

customers more suitable for their own market according to the different potential needs of existing customers [9]. Only by paying attention to the needs of consumers can enterprises accurately grasp the market trend, find the market positioning of products and entry point of differentiation strategy.

4.3. Focus on Consumer Feedback and Provide Personalized Service

In the increasingly fierce market competition, homogenized products are gradually eliminated by the market, personalized services can attract consumers. Taking the DL brand as an example, it pays attention to providing consumers with thoughtful and comprehensive service, whether it is patient guidance before purchase, or high-quality after-sales service free dry cleaning, ironing, sewing, dissatisfied return and other services. To meet the needs of consumers, attract consumers to choose first in many supermarkets, and promote the enterprise to become the leader of the industry. DL's brand differentiation strategy reflects people-oriented thought, so that consumers have the feeling of being valued, thus forming a brand image.

5. Conclusion

In today's era, the tea industry is becoming more and more popular, while it is also facing many opportunities and challenges, in the highly competitive market, all brands are constantly exploring to find a better development strategy, seize the trend of industry development, and occupy a place in the market. The main purpose of this study is to understand how affordable beverage enterprises like Honey Snow City successfully operate, to provide more enterprises with good management concepts, marketing strategies, so that they can reasonably learn from their own conditions. First, the SWOT model is used to analyze the advantages, disadvantages, opportunities and threats of the brand of Honey Snow City, and then the development strategy of Honey Snow City is analyzed, and it is found that its success in making customers consume a large amount and earn large profits lies in its precise and differentiated strategy. Honey Snow City is the inverted "T" development model, which first presents a vertical layout and then improves horizontally. Finally, this paper analyzes the optimization strategy of enterprise management under the differentiation strategy, and thinks that it should be considered from four aspects, the first is that enterprises pay attention to brand building and establish a good corporate image; Secondly, enterprises need to fully understand the market situation and identify the market positioning of products; Finally, enterprises also need to fully understand the market situation and find the market positioning of the product.

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A Review of the Applicability of Pricing Models in the Stock Market

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Abstract: The capital asset pricing model (CAPM) model has always been the core theory of asset pricing and is widely used in the world as a finance tool in the securities market, but it is not fully effective for the economic market due to the current state of development in some countries. This paper compares and analyses the CAPM model and its improved and alternative models based on existing literature and statistical data. This paper first explains the CAPM model, analyses its formula, and then describes the disadvantages and shortcomings of the CAPM model. Then it gives examples of other replaceable models, first explains those models, then lists the advantages of these models compared with the CAPM model as well as some of their shortcomings, and finally concludes through the comparison of these models to the CAPM model that although the CAPM model may not be applicable to the market in many cases, it can be replaced by other models, and even then there is no one-size-fits-all model that can replace all the market models, and conclusions need to be made on a case-by-case basis.

Keywords: CAPM, CCAPM, ICAPM, APT

1. Introduction

The capital asset pricing model is based on modern asset allocation theory (MPT). This theory expresses the relationship between the return on assets and the risk coefficient, as well as the systemic risk [1]. The assumption of CAPM is somewhat farfetched. Specifically, its conclusions often contradict experimental evidence. But its significance cannot be ignored, as it has always been an important theory in financial economics and the foundation of more advanced models. The CAPM model has a wide range of uses, including examining the connection between expected returns on assets and risky assets in equity markets to measure the return on securities, estimating the cost of capital, assessing portfolio management performance, analyzing risk, and using it as a measure of normal return in event studies and calculations to comprehend stock fundamentals and choose investments [2]. There are also some assumptions in this model. For example, markets are effective, investors are rational, the same investment cycle exists, investors can borrow at a risk-free rate, and the risk-free rate is the same [3]. This paper explains the CAPM model and extends some of the other models, using a literature review to illustrate the shortcomings of the CAPM model and the substitutability of other models.

2. Methodology

The first step is to collect data using related databases. In the process of the research, the main keywords of the article are identified into several possible sub-keywords such as CAPM, APT, ICAPM, and CCAPM. This paper reviews the literature related to the CAPM model. The articles found in the search were very extensive. However, not all of them were relevant to the topic. To find literature that is most relevant to the topic of this article, the author chose to use the Currency, Relevance, Authority, Accuracy, and Purpose model (CRAAP model) to select the study. The author identified the availability of the CAPM model through the papers found. In the first round, the author removed articles that were not relevant to the topic through titles and keywords, and in the second round, the author removed articles that were not nearly as relevant through the abstract and introduction. The final paper will be completed with the selected articles.

3. CAPM Model

CAPM is the foundation of asset pricing and portfolio theory. The reason why this model is worth studying and paying attention to is because it proposes how to evaluate risk and its relationship with expected returns [3]. First, this article starts with some explanation of the CAPM formula for a given risky asset S.

- R_S is the return variable for portfolio S;
- R_M is the return variable of the market portfolio;
- R_f is the market risk-free rate;
- β_S is the risk sensitivity of portfolio S to the market.

$$ER_S = ER_f + (ER_m - ER_f)\beta \quad (1)$$

Where R_f is the time value of the asset, which is the return generated at the risk-free interest rate. $(ER_m - ER_f)\beta$ is the risk return on the asset, which compensates the investor for the risk he assumes. $(ER_m - ER_f)$ the risky return on the market portfolio.

The CAPM model is quite helpful, yet it still has a lot of flaws and issues. Using New York Stock Exchange (NYSE) stocks from the years 1931 to 1965, in order to regress the average excess returns on the betas, Black et al. developed 10 portfolios with varied historical beta estimations [4]. Overall, they find evidence in favor of a linear relationship between average asset returns implied by the coreCAPM and their betas. However, this relationship is flatter than predicted, leading to some misspecification of low and high beta portfolios. Not only that, Fama and French found that different market values compared to book value for a portfolio of companies constituted other returns that differed from the expected returns given by a beta wash. Thus, the influencing factors are not always fully accounted for in the equation [3].

Researchers have tried to conduct indirect tests using “proxies” that simulate market portfolios. Commonly, U.S. common stock indexes are employed, although studies have also taken a wider range of assets into account, including bonds, real estate, or labor income [5]. It’s possible that the precise composition of the portfolio is unimportant given the high level of correlation between various proxies and between proxies and real market portfolios. So, whether a proxy variable is mean-variance efficient does not affect whether a market portfolio is mean-variance efficient. The results of Debondt et al. and Jegadeesh et al. using a classification of rises and falls over time also found different results from the CAPM model [6].

Banz put the CAPM to the test by determining if the firm’s size can account for the remaining variation in the average return on assets that cannot be explained by the CAPM’s beta. In fact, Banz proved that scale is indeed better than beta in explaining the cross-sectional changes in the average

return rate of a given set of assets. This research result poses a challenge to CAPM. He found that the average stock return of small companies (those with lower market capitalization) is significantly higher than that of large companies. This is the result obtained by using CAPM to explain the risk. This result is based on data from 1936 to 1975 [7]. The validity of the Fama and French study has been contested. The study's assertions that size matters a lot, the book-to-market equity ratio matters a lot, and that beta plays no role in explaining cross-sectional volatility in returns have drawn the most criticism. Studies that address Fama and French's doubts typically examine the study's data [3]. Fama and French's findings depend significantly on how their statistical tests are interpreted. Fama and French have a significant standard error in estimating beta coefficients [3][8].

There are also some different empirical results for the CAPM model, and these results are contradictory to the model in which the expected returns can be explained by β . Not only that, the CAPM model has many limitations, for instance: Complete market assumption.

4. APT Model

There are other models that avoid some of the drawbacks of the CAPM model such as the APT model and the ICAPM model. APT model was the first to make an attempt to fix the defects that the CAPM model had, despite the fact that the model as a whole was unable to do so. Factor models describe securities returns. Specifically, there are enough securities in the market to diversify risks, and an effective securities market restricts the formation of arbitrage opportunities. These three essential premises form the basis of the theory. Arbitrage pricing theory is a potential alternative for investors since it tries to explain the relationship between risk and expected return in terms of many variables rather than just one market [9][10].

In a number of aspects, the APT model is superior to the CAPM model. Its calculations are more accurate than the CAPM model calculations at forecasting stock returns. They can be used to predict stock returns, even if the Gross Domestic Product (GDP) and interest rate variables in APT only account for 51.1% of the variation in stock returns. It is possible to predict stock returns using both theories. However, it is advised to adopt the APT model rather than the CAPM model in terms of accuracy and validity. Compared to the CAPM model, the APT model is more precise [11].

Even so, there are aspects of the CAPM model that are better than APT. There is a significant difference in prediction accuracy between these two models. Specifically, it is reflected in the accuracy of predicting the return on manufacturing stocks from 1991 to 2001. The CAPM model and the APT model are significantly less accurate at forecasting stock returns in the manufacturing sector during the economic crisis. Compared to the APT model, the CAPM model is more accurate. [11]. The CAPM model is more valuable. This result comes from research using standard deviation from 2001 to 2006. When predicting stock returns, the CAPM model is more accurate than the APT model due to the use of standard deviation research results. The CAPM model is more accurate than the APT model in predicting stock returns [12]. So the APT model is clearly not a panacea either.

5. ICAPM Model

A excellent alternative to the APT model is the ICAPM model. It aids investors in estimating prospective investment returns based on levels of risk. ICAPM extends this theory by allowing for more practical investor behavior, particularly in response to the fact that most investors want to protect their assets from market fluctuations, and creates dynamic investment portfolios as risk hedging tools. By considering how investors interact with the market, the ICAPM offers a better level of accuracy than other models [13].

The ICAPM model is the CAPM model with a hedging term added to the back of the CAPM model, and it takes the parameters of many future periods into account.

$$ER_s = ER_f + (ER_m - ER_f)\beta - \sum_{i=1}^n \beta_i^h (\alpha_i^h - R_f) \quad (2)$$

When tested with the SBM25 portfolios, the Fama and French (1993) three-factor model consistently meets the ICAPM limitations the best when investment opportunities are driven by the first two moments of aggregate returns [13]. The other models, with the exception of this model and the Carhart model, cannot be supported by the ICAPM theory. In reality, the ICAPM is not a “fishing license.” [14]

6. CCAPM Model

The initial CAPM model had more flaws. Specifically, it is a static single loop model. The meaning is that although this is an equilibrium with investor participation, the impact of investor behavior on the asset market cannot be reflected in specific investment activities. The stochastic discount factor form of CCAPM, which was later developed, has been employed particularly in empirical evidence and is very suitable for theoretical research, thus even though CCAPM is more recent, it is more ideal.

The Capital Asset Pricing Model (CCAPM) is one of the capital asset pricing models proposed by Breeden [15]. The CCAPM model predicts a direct correlation between stock return volatility and consumption volatility based on predicted stock return and consumption beta. The model clarifies the relationship between changes in stock market returns and consumption trends [16]. The center of CCAPM is to determine the correlation between the overall price dynamics of stocks and macroeconomic indicators present in the economic system. In addition, the correlation between macroeconomic indicators is also at the center of this model’s consideration [17].

However, CAPM surpassed CCAPM. Specifically, it refers to goodness of fit, stock pricing accuracy, etc. In addition, regardless of other factors such as dividends and import growth rates, market systemic factors are statistically significant at the 1% level in all seven market financial sectors. It is obvious that market beta is still a useful indicator of risk and return. In theory, CCAPM and Consumer Beta Index should be able to better measure system risk. However, after verification, it was found that compared to CAPM, CCAPM’s empirical performance in seven industry segments of the Taiwan stock market is not satisfactory [18].

7. Conclusion

This paper first explains the CAPM model and then goes on to give some examples of improved models used to enhance the applicability of the CAPM, as well as some models that can be used in place of the CAPM model. Through this article, we can understand that although the CAPM is a classic formula, it is not applicable to many real market environments, and even though it can be replaced by other models such as APT, CCAPM, and ICAPM, different models may only be applicable to certain regions and times. In short, there is no one-size-fits-all formula, so any use of public notices needs to be tailored to the local context. This paper does not use a lot of real data for calculations and explanations, so this will be optimized in future research.

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The Research of Financial Fraud and Regulatory Countermeasures to the Listed Companies Based on Game Theory

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Abstract: Accounting Fraud, as immoral behavior which violates the law, may cause severe damage to economic and market trust. The listed companies may acquire short term benefits through accounting fraud; therefore, the government regulatory authority should set up severer policy to prevent and avoid this behavior from happening. This review article aims to analyze the existing problem of accounting fraud, games between listed companies and regulatory authorities based on game theory, and the mechanism that caused accounting fraud to happen. The articles have found that the behavior of accounting fraud may confuse the investors by its invalid financial report, which often results in wrong investment decisions. If the accounting fraud has been revealed and known by the public, the listed company's share price will plummet, overall market confidence will suffer, and the entire economic system and financial stability will also be affected. By damaging the financial stability and decreasing the overall investments, accounting fraud handicaps economic growth by its possible consequence of decreasing the economic activity, capital expenditures, and the employment opportunities. However, the game theory research on the games between listed companies and regulatory authorities may offer supervisory measures to reduce and prevent the occurrence of financial fraud.

Keywords: game theory, listed company, financial fraud, supervisory measurement

1. Introduction

Accounting fraud refers to the behavior of a company intentionally altering its financial statements by inflating profits to mislead the public and the relatives in the market with the aim of fabricating a deceitful facade of a company's financial health. Engaging in such conduct not only disregards ethical and legal standards, but also deceives the market, leading to severe harm to the financial well-being of investors. According to Zhengwei Long, ever since the establishment of Shanghai Stock Exchange back on November 26, 1990, the Chinese stock market has been aroused with an incessant stream of financial fraud scandals involving listed companies. These scandalous affairs have garnered significant attention from various sectors of society, igniting a sense of widespread concern. Both the academic and political realms have placed considerable emphasis on the management and control of such deceitful practices [1]. In recent years, there has been a noticeable surge in incidents involving

financial fraud committed by companies listed on the market. A prime example of this would be the recent punishment faced by Xiong'an New Power Technology Co., Ltd. which once again thrust the matter of financial fraud into the limelight. Since 2017, Xiong'an New Power Technology Co., Ltd. has been engaging in some rather questionable practices. They have been constantly changing the dates of their project, signing reports, and manipulating their financial profit income, a whopping 21 times to be exact. All of this has been done with one goal in mind - to inflate their annual profits and reduce the losses recorded in their books. In 2016, the profit attributable to their parent company was a staggering -292 million yuan, and it somehow managed to get even worse in 2018, with a profit of -475 million yuan. The China Securities Regulatory Commission found that the company's 2017 total profit reported was adjusted from 10.67 million yuan to a mere 3.49 million yuan. This raises serious concerns about the accuracy and integrity of their financial reporting. This news has had a major impact on Xiong'an New Power Technology Co., Ltd.'s stock price, which dropped by a staggering 7.6% just two days after the announcement was made. The consequences of their actions are not only limited to economic losses for the public, but it has also caused significant damage to market confidence. It's a situation that calls for immediate attention and action [2]. As the global economy thrives and the financial market grows increasingly intricately, the issue of financial fraud within businesses escalates, presenting an urgent global quandary in dire need of resolution [3]. Hence, it holds immense value both in theory and practice to conduct thorough investigations into the motivations and control techniques employed by publicly traded companies engaging in financial misconduct. Such research not only bears practical significance for the flourishing progress of the Chinese economy, but also possesses great potential for shedding light on effective monitoring approaches through the lens of game theory. The aim is to offer valuable insights and tailored solutions to combat financial fraud. Furthermore, this article is dedicated to enhancing corporate governance, mitigating financial hazards, and bolstering market equilibrium and openness.

2. The Motivation of Accounting Fraud

Due to the intense rivalry among businesses in the industry, listed companies generally have a higher economic profit tendency. When regulatory bodies lack robust oversight, this inclination towards financial deceit becomes more probable for the listed companies, fueled by unethical behavior of financial managers and company executives, and vice versa. Consequently, this paper identifies six underlying causes that drive listed companies to partake in fraudulent financial activities.

1) The Intensity of market and profit growth

Yuan Fang believes that to fulfill the market and investors' desire for substantial profit growth, companies enlisted on the stock exchange might resort to deceitful financial practices to artificially boost their earnings and overall performance. Such deceptive maneuvers can create an illusion of enhanced allure, enticing a greater number of investors and financial resources, consequently leading to an upsurge in both stock prices and market valuation [4].

2) Performance Rewards and Reward Mechanism

According to Yan Huang, the executives and management of listed companies are usually motivated by the performance reward mechanism, in which their wages and bonuses are often linked to the company's fiscal and stock market achievements. In their relentless pursuit of greater rewards, these executives may resort to engaging in deceitful financial misconduct, fabricating performance figures and inflating profits [5].

3) Debt and Reputation

Burgstahler and Dichev believe that there is a possibility that certain publicly traded corporations could find themselves burdened by substantial debts. To safeguard their standing and prevent potential consequences such as debt defaults or credit rating downgrades, these companies might opt for engaging in fraudulent financial activities to obscure their actual financial condition [6].

4) The Share Holders' Expectations

Ryan is of the opinion that certain significant stakeholders might possess a higher expectation of the company's achievements and insist on substantial profits. To fulfill these stakeholders' demands, corporations may potentially engage in acts of financial deceit to enhance the appearance of their financial reports and satisfy the shareholders [7].

5) The Market Share

Yuan Fang holds the viewpoint that the listed companies harbor a reluctance for investors to cast doubt upon their business and prospects. They aim to safeguard their competitive standing within the market. To achieve this, companies might resort to using deceptive information and manipulated financial data to bolster their public image [4].

6) The Tension arose from the market

Dongwu Niu asserts that the listed companies face continuous supervision and evaluation from the capital market. He suggests that instances of financial fraud may occur to conceal the actual state of the company's operations to prevent the potential withdrawal of investments by interested parties [8].

3. The Reference of Game and Model

Assumptions:

1. Regulatory agencies (regulators): The regulatory agencies in this model aim to prevent and discover financial fraud in listed companies and maintain market stability and investor rights. The goal of regulators is to minimize the occurrence of financial fraud while avoiding unnecessary costs to compliant public companies.

2. Listed companies (supervised): Listed companies pursue the maximization of their margin profit, and may use financial fraud to falsely report profits, assets, and income to attract potential investors, increase stock prices, and market share.

Game Model:

C: The decision of the listed company to choose to engage in financial fraud (0 means no fraud, 1 means fraud).

R: The decision of the regulator to choose a regulatory measure (0 means light regulation, 1 means severe regulation).

Parameter Settings:

$A > 0$, indicating the company's benefit from financial fraud.

$B > A > 0$, denoting the cost to regulators of detecting fraud.

Table 1: The game matrix between the government regulatory department and the financial department of listed companies.

	R=0(light regulation)	R=1(severe regulation)
C=0(no fraud)	(0,0)	(0, -B)
C=1(fraud)	(A-C _{cost} , -C _{gain})	(-B+R _{cost} , -A)

Within:

1. C_{gain} represents the benefit that the listed company obtains from financial fraud.

2. C_{cost} represents the strategy adjustment cost that the listed company may bring due to financial fraud.

3. R_{cost} represents the cost of strict supervision by regulators.

In this game matrix, the interests (utilities) of listed companies are calculated through financial fraud decision C and regulatory decision R. The interest of the regulator is the opposite number of the profit of the listed company minus the supervision cost of the regulator, because the interests of the two are opposite to each other.

Moves:

1. Regulatory agencies: Regulatory agencies can take regulatory measures, such as strengthening financial audits, raising disclosure requirements, and increasing penalties, to reduce the possibility of financial fraud.

2. Listed companies: Listed companies can choose whether to engage in financial fraud to obtain short-term benefits but face the risk of penalties and be held accountable by regulatory agencies.

Benefits and Costs:

1. Regulatory agencies: The benefits of regulatory agencies are maintaining market stability and investor confidence, but at the same time, they also need to cover the resources to implement regulatory measures, including audit costs and labor costs.

2. Listed companies: Listed companies may obtain short-term profits and stock price surge through financial fraud, but once discovered, they will face huge legal liabilities and reputation losses.

Consequences and Profit:

1. If the regulatory agencies take severe regulation measures, such as strengthening financial audits, raising disclosure requirements, and increasing penalties, the listed companies may be awarded, therefore the possibility of financial fraud can be reduced, and the market stability could also be maintained.

2. If the regulatory agencies adopt light regulation measures or they could not effectively discover financial fraud, listed companies may have greater incentives to engage in financial fraud to obtain short-term benefits.

3. If the financial fraud of a listed company is not discovered by the regulatory agency in time, it may bring profits in the short term, but once it is discovered, it will face serious penalties, including legal sanctions and reputation losses.

The “Best” move

In the game matrix of listed companies and the regulatory agencies, a Nash equilibrium strategy combination is in which neither listed companies nor regulators can change their strategies to increase their utility. In other words, in a Nash equilibrium, each player’s strategy is the best choice, and considering that the others’ strategies unchanged.

In this game model, the Nash equilibrium is achieved when listed companies choose no fraud ($C=0$), and regulators choose severe regulation ($R=1$). This is the best-case scenario when the regulatory agencies take severe regulation ($R=1$) no matter which decision the listed company will choose: ($C=0$ or $C=1$). The listed companies will never benefit from taking financial fraud, therefore choosing ($C=0$) not to fraud is the best optimal strategy for them.

Moreover, if the regulator strictly decided to choose severe regulation ($R=1$) no matter what the listed companies’ choices are, the possibility that the listed companies choose to fraud will also be significantly minimized.

To summarize, in this Nash equilibrium, listed companies cannot increase their utility by changing their strategies between ($C=0$ or $C=1$), because financial fraud will no longer bring benefits to it. Meanwhile, the regulatory agencies cannot increase its utility as well, since it has adopted the most severe strategy, and the possibility of financial fraud has been prominently decreased.

4. Suggestions on Regulatory Measures

1) It is imperative to reinforce the oversight of the government in external matters, while simultaneously urging listed companies to enhance their internal governance mechanisms. In addition, there should be a concerted effort to bolster the independence of third-party external audits, while also effectively managing the costs associated with regulators’ supervision. Such measures are crucial in safeguarding the interests of all participants within the market [9].

2) According to the Nash equilibrium of the game between the regulatory agencies and the listed company upon, the regulatory agencies can increase the penalties. If the regulatory department finds that the fine of the financial fraud does not exceed the cost B of the regulatory department's implementation of supervision, then the regulatory department will not impose penalties. At the same time, if the listed company finds that when the financial fraud is punished and the loss is less than the profit brought by the financial fraud, the possibility of financial fraud in the listed company will increase [1]. Regarding the cost of supervision by the regulatory authorities, there are two optimal suggestions. a. To increase the enthusiasm of the supervisory department to make penalties, the cost C of implementing supervision can be covered by the government so that the cost can be less or equal than to the fine F of listed companies for financial fraud, and even the personnel or groups that discover the possibility of financial fraud can be imposed a bonus mechanism is provided for incentives. b. Increase the punishment of financial fraud by the regulatory authorities so that F is greater than or equal to the cost C . Then listed companies will not commit financial fraud and other illegal acts out of consideration for their own interests and losses. All in all, under the ideal situation where costs can be amortized, regulatory agencies should strictly adopt strict regulatory strategies so that listed companies will not bring any benefits by taking their financial fraud strategies or non-fraud strategies, to ultimately minimize the possibility of financial fraud.

3) The relevant: Improving the ethical standards in accounting and shareholder practices remains a crucial objective. It is imperative for those listed publicly to take responsibility for enhancing their internal monitoring and oversight systems. One effective approach is to implement stringent internal disciplinary measures to deter any instances of financial fraud. Simultaneously, the board of directors should also formulate appropriate measures to prevent shareholders from engaging in unlawful manipulation of accounting records, thus mitigating the risk of financial fraud and other illegal activities. To further bolster moral standards, shareholders with questionable integrity should face proactive measures and sanctions. Audit institutions also have a critical role to play by overseeing the conduct of their internal auditors, ensuring they do not engage in improper collaborations with listed companies or form unethical business partnerships. These measures are essential for upholding professional ethics and safeguarding the integrity of the auditing profession [9].

4) Regulators ought to contemplate adopting a stance of strategic equilibrium when it comes to dealing with publicly traded companies. In the event that such companies engage in deceptive financial practices, it is imperative for regulators to ensure that they are capable to employ corresponding and stringent supervisory measures, thereby ensuring a system of checks and balances. This can be accomplished by means of a flexible regulatory framework, thereby enabling regulators to adapt their strategies in response to market needs and the conduct of listed companies. Drawing inspiration from the principles of game theory, regulators must display adaptability and capacity to modify their regulatory approaches in accordance with prevailing market circumstances as well as the actions of listed companies. Consequently, regulatory bodies must maintain a constant awareness of the market and promptly adjust their regulatory endeavors to effectively address potential instances of financial fraud.

5) Cooperation and negotiation take center stage in game theory, highlighting their crucial significance. The harmonious collaboration between regulators and listed companies presents a remarkable opportunity for both parties to attain mutual benefits. By joining forces, regulators can extend their support to listed companies, offering them valuable training and guidance. This proactive assistance aids in the establishment of robust internal control mechanisms, effectively diminishing the likelihood of financial fraud occurrences.

5. Conclusion

Through the lens of game theory, this paper conducted an extensive analysis of the financial fraud exhibited by publicly traded corporations and formulated a set of recommendations from a regulatory standpoint. These suggestions, rooted in the principles of game theory, seek to establish a harmonious equilibrium between regulatory authorities and listed companies. Their ultimate objective is to minimize the likelihood of financial fraud and foster a thriving marketplace.

The authors believed that in the application of game theory concepts to regulatory practices. This approach enables this paper to gain a deeper understanding of the incentives and actions of all stakeholders, thus providing invaluable support for the formulation of more efficacious regulatory strategies. It is only through the collective efforts of regulators, listed companies, and investors that individuals can establish a preferable market characterized by integrity, transparency, and stability. This, in turn, will pave the way for more sustained future economic development.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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Game Analysis of Cooperation Between Entrepreneurial Users and Tiktok Platform

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Abstract: In the new era, Tiktok platform has attracted a large number of users with short video and live broadcast functions, forming a huge user group, and the platform's purchasing power has gradually increased, providing rich profit opportunities for entrepreneurial users. Tiktok realizes business value through the output of entrepreneurial users, and both parties achieve mutual benefit in the game. This paper mainly studies how Tiktok and entrepreneurial users can make better profits through game theory. The problem is analyzed by two aspects which are business model and game ecology of Tiktok platform and game relationship between Tiktok and entrepreneurial users. And the game is based on 'Nash equilibrium', through the study, we get the conclusion that the balance of Tiktok and senior users is increasing the service fees and reducing the cost of products and that of Tiktok and novice users is decreasing the service fees and raising the cost of products.

Keywords: Nash equilibrium, short video platform profitability, entrepreneurial users

1. Introduction

In today's era of developed internet, the leading short video platform has become a globally popular social media software. Through technological means, the platform can release various marketing information accurately, repeatedly, and extensively to target consumer groups, thereby achieving the purpose of attracting customer flow [1]. At the same time, the platform also provides a variety of convenient channels for consumers and marketers to interact with each other. Through short video introduction of products and live broadcast of the use and recommendation of products, more young users seeking entrepreneurial opportunities are encouraged to join the platform ecosystem. At the same time, the Tiktok platform draws a percentage and service fees from the profits of these entrepreneurial users to generate platform profits, and ultimately achieve mutual benefit and win-win situation [2]. The main research direction of this paper is how to play games and obtain better profit choices for both parties under the cooperative relationship between business users and platforms. Through the game concept model, the analysis is carried out by assuming parameters and income matrix, which provides ideas for the future development of Tiktok platform and the profit strategy of entrepreneurial users.

2. Business Model and User Ecology of Tiktok Platform

2.1. Business Model of Tiktok Platform

With the arrival of the new era, Tiktok platform has risen rapidly and become one of the social media platforms with large user groups worldwide. Short videos and live streaming features have attracted a large number of users, allowing them to easily share their creativity and life clips. Tiktok platform has not only changed people's social media use habits, but also brought far-reaching impact on cultural communication, consumer behavior and business model [2].

2.2. Tiktok Entrepreneurial Users

The content of Tiktok entrepreneurial users is the core element to attract users' attention and win fans on the platform. They attract users' attention and love by publishing various types of content, showcasing their talents, products, or services, and achieving profitability. The following are the main aspects of Tiktok entrepreneurial user content, which includes creative short video, live content, paid content, social e-commerce content, brand cooperation content [3,4].

2.3. Relationship Between Tiktok Platform and Entrepreneurial Users

On the Tiktok platform, many entrepreneurial users have achieved a certain degree of influence and user attention by publishing various kinds of content. Entrepreneurial users showcase their talents, products, or services on the platform, and quickly accumulate fans and users through the platform's dissemination effect. At the same time, the Tiktok platform also realizes business value through the output of these entrepreneurial users, forming a symbiotic relationship [1,5].

2.4. Profit Strategy of Tiktok Platform

Tiktok platform makes profits through a variety of ways, including but not limited to advertising revenue, live broadcast with goods, paid content, e-commerce cooperation, charging service fees, etc. [6, 7]. This profit strategy not only meets the publicity and promotion needs of entrepreneurial users and brand merchants, but also provides a stable source of profit for the Tiktok platform, thus promoting the sustainable development of the platform. For entrepreneurial users, the ways to make profits through the Tiktok platform are also gradually diversified. They can earn income through flow realization, fan economy, community operation and other ways.

3. The Game Relationship Between Tiktok and Entrepreneurial Users

3.1. Conceptual Model

Tiktok platform can provide short video traffic, live broadcast function and small yellow car mall function, while entrepreneurial users want to obtain a large number of following buyers or fans first need to ensure high-quality video works and use streaming function to improve the exposure of works. If you are a high-traffic startup user, the platform will charge 10% of the revenue after a live streaming promotion, while if you are a small merchant, the platform will extract a different proportion of 2% - 5% commission based on different product categories [8]. The cost of Tiktok platform here is the development and management (labor cost and technical cost) of hot exposure, live broadcast, mall and other functions, while its revenue is the service fee paid by users and the percentage after the product is sold. The cost for entrepreneurial users is the time, effort, and miscellaneous expenses required to produce short videos, or the equipment, labor technology, and product costs required for live streaming, and their revenue is the profit from selling products [9,10].

3.2. Parameter Assumption

Under the established conceptual model, the Tiktok platform has two game options. The first is to reduce the streaming fee, live broadcast gifts and merchandise commissions; The second is to increase the above costs. For users, the first step is to reduce costs, such as hiring a small number of employees to help with video production and product promotion or choosing low-cost products; The second is to increase costs, increase the number of employees and technology to improve video quality, and pursue higher product costs. The assumed parameters are: 0 for smaller profits, -1 for losses, and 1 for larger profits. However, for users in different situations, their revenue choices are also different. It is divided into entrepreneurial user category A and entrepreneurial user category B. Class A entrepreneurial users are senior Tiktok platform users, who have won a large number of fan bases due to the wonderful short video content or excellent products; Class B refers to novice entrepreneurial users, with no traffic or sales of products.

3.3. Payoff Matrix

Table 1: The game between Tiktok and user A.

Tiktok platform/entrepreneurial user A	Reduces cost(single cost)	Increases cost(single cost)
Reduce service fees and commission	0,1	0,1
Increase service fees and commission	1,1	1,0

From the matrix, which is summarized in table1, it can be seen that in the game between Tiktok and user A, user A can make decisions based on the decisions made by Tiktok. If Tiktok chooses to reduce service fees and commissions, user A can make profits regardless of which choice it makes. It chooses to sell daily necessities at a small cost, and then sets a lower price in the market with the promotion power of senior users to make profits through sufficient sales; Choose to sell luxury goods and other products at high costs and profit from high profits. If Tiktok chooses to increase service fees and commissions, User A can still choose to sell more at a small cost, but the choice of high cost and high profit is not the best choice because the commissions of each product's profits will also increase. Therefore, the balance between Tiktok and User A is that Tiktok increases service fees and commissions while users reduce individual costs to ensure sales [5].

Table 2: The game between Tiktok and user B.

Tiktok platform/entrepreneurial user B	Reduces cost(single cost)	Increases cost(single cost)
Reduce service fees and commission	0,0	1,1
Increase service fees and commission	0,-1	1,-1

In the game between Tiktok and user B, which is summarized in table2, Tiktok doesn't want user B to sell low-cost products because user B doesn't have the same ability to carry goods and fan base as user A, so no matter what decision Tiktok makes, the final profit will be very small, while user B can sell some new products or products with few markets, such as the pet sales or local specialty sales that have sprung up in recent years, Freight and cost are relatively high, but novel items can attract the public's attention, coupled with the high quality and after-sales service of the product, it can retain a large number of customers, and for entrepreneurial user B, it can also generate profits from a single product, allowing for continuous operation. If Tiktok increases the bonus, User B cannot accept such

high bonus, so the balance between Tiktok and User B is that Tiktok reduces the service fee and bonus, while Entrepreneurial User B increases the cost to ensure the profit of a single product.

4. Conclusion

To sum up, this paper studies the cooperative profit methods of Tiktok and two different entrepreneurial users through the conceptual model, parameter assumptions and listing the income matrix, and also draws the Nash equilibrium conclusion of the two cases. It is found that Tiktok and two types of users have different cooperation ways, which makes both parties achieve a win-win situation. In this study, from the perspective of game theory, the profit relationship between Tiktok platform and entrepreneurial users is studied in depth. Through the analysis of the cooperative profit game of Tiktok platform, this paper draws the following conclusions: Tiktok platform and entrepreneurial users form a symbiotic relationship, and both sides achieve mutual benefit in the game. Tiktok platform realizes business value through the output of entrepreneurial users, and entrepreneurial users gain user attention and profit opportunities through the communication effect of the platform. The above content provides some strategic suggestions for Tiktok users who want to start their businesses in the future, serves as a reference for scholars who take short videos as the research object, and also makes some contributions to this research field.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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The Research on Marketing Strategies for Master Kong's New Products

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Abstract: Master Kong, which is the leading enterprise of instant food industries in China now is suffering from the loss of its potential profit. What caused these phenomena is the fierce competitions between the old and new brands in instant food industries. Although Master Kong can still dominate the main instant food market in China, it still needs to breakthrough its own bottleneck. In this research, new products are proposed which can also provide totally new ideas for the generation of instant food products. The online open questionnaire and in-depth research interview provide the information about the things need to be improved and the new consumer groups. The generation Z and new town youth purchasing characteristics are useful for many brands. In order to reach the generation Z and new town youth in China, specific marketing strategies are presented in this research after analyzing the real market. This research mainly dedicated into how to maintain Master Kong's leading position and lay the foundation for its future transformation.

Keywords: SWOT analysis, business plan, consumer analysis, marketing strategies

1. Introduction

Over the past decades, instant food industries in China have increased dramatically. Master Kong was founded in Tianjin by the Wei brothers from Changhua County, Taiwan. This company started its instant noodle business in 1992, and expanded operations into other foods and beverages like bottled drink, snacks in 1996. However, this leading enterprise of the instant food industries in China are now suffering from the period of stagnation due to a decline in gross margin which dragged down net profit. As the price of raw materials increased, the gross profit margin of instant noodles decreased [1].

Jeffrey had mentioned the tough situation: from 2013 to 2016, total demand for Chinese instant noodles fell from 46.22 billion packs to 38.52 billion packs, a decrease of 8 billion packs in three years, a drop of 16.7%. According to a survey conducted by Sanxiang Metropolis Daily that year, only 8% of consumers regularly eat instant noodles, while 85.7% of consumers eat instant noodles occasionally. Since then, the Chinese have almost reinvented instant food [2]. Over the past three years, driven by the epidemic situation, numerous vigorous brands in the field of instant food, for instance, Luosifen, Turkey noodles, self-heating hot pot, AIRMETER pasta has emerged endlessly. Thus, the traditional instant noodles are no longer the favorite choice of consumers. Also, the competition among the old brands of instant noodles like Baixiang, Tongyi, NISSIN made it harder for Mater Kong to maintain its leading position and increase the net income. According to the annual

report announced by Master Kong, it had been ranked among the Top Three Brands as First Choice by Chinese Consumers for ten consecutive years. However, in 2022, the Group's revenue from the instant noodle business was RMB29.634 billion, with a year-on-year growth of 4.17%, accounting for 37.65% of the Group's total revenue. During the period, the gross margin of instant noodles decreased by 0.41 percentage points year-on-year to 23.95%, due to the rise of raw material prices and shift in product-mix. Due to the year-on-year decline in gross profit margin, the profit attributable to shareholders of the Company in the instant noodles segment declined by 31.42% to RMB 1.375 billion in 2022 [3]. All these can indicate the tough situation that Master Kong is facing.

Combining external threats from the vigorous brands and the internal problems of its own, Master Kong is now on the horns of a dilemma while it still didn't figure out a better way to improve itself. With the rapid development of the instant food industry, the transformation and upgrading must be needed to overcome the dilemma.

In conclusion, after gathering and analyzing the data [4,5], also combining the SWOT analysis [6-8]. This paper will discuss how to market and promote the new products in order to help Master Kong solve some of its problem, also help it target and attract new consumer groups [9-11]. What's more, the new products proposed by this paper will provide some strategies to maintain Master Kong's leading position and lay the foundation for its future transformation.

2. Methods

2.1. Data Source

The data source for this paper are mainly from three parts, the online open questionnaire contained 166 individuals, in-depth research interview contained 8 individuals and existing report and paper searched from Google website and Chinese National Knowledge Infrastructure (CNKI).

2.2. Method Introduction

2.2.1. Company SWTO Analysis

SWOT Analysis was first proposed by Andrews, a professor at Harvard Business School (HBS). SWOT analysis is a means of evaluating the internal and external factors that impact an organization in order to formulate business strategy. The four elements are the company's strengths, its weakness, the opportunities in its competitive environment, and the threats in its competitive environment [8]. After SWOT analysis, it's easy to recognize Master Kong's own strengths and weaknesses, in addition with the opportunities and threats in the external environment. Combining and considering all these elements to determine the most suitable marketing strategies for Master Kong.

2.2.2. New Products Design Analysis

In order to determine how to design the new products "Master Kong's tour in China". The problems of Master Kong's existing products were analyzed by reading the report and setting such questions in the open questionnaire. For instance, the most important factors that may influence the consumers to buy instant food were asked and the data could show what may need to be improved while designing the new products. The data gathered from the open questionnaire were presented in the form of statistical charts to make the analysis more concise and intuitive. In addition, the designing process included the analysis on how to satisfy the new consumer groups.

2.2.3. Marketing Strategy Analysis

After processing and analyzing part of the data from the open questionnaire, the new series products “Master Kong’s tour in China” can be divided into two parts: A documentary called “Master Kong’s tour in China” and six kinds of instant noodles from different cities in China called “Smell at homeland”. The report provided the new consumer profile and the information of their purchasing characteristics. The data about which purchasing platform do consumers prefer the most was also presented as the bar chart to certify the exact publicizing platforms. In order to certify the final form of the new products and the specific way of advertising and marketing, in-depth research interview was also used as a method and a source of data.

3. Results and Discussion

3.1. SWOT Analysis

SWOT analysis is helpful in determining the marketing strategies. Table 1 below is the SWOT analysis of Master Kong which shows a visualization of its strengths, weaknesses, opportunities and threats based on today’s market.

Table 1: The SWOT Analysis for Master Kong [6].

Strengths	Weaknesses
1. The sales volume of instant noodles have large amounts of market share in China. 2. The pandemic had no effect on its strong financial performance and remarkable growth. 3. The demand of its diverse products are strongly high.	1. Some kinds of products had bad news and led to the boycott of consumers. 2. The price of raw materials has increased over the past years. 3. Some of its businesses are suffering losses and its market share is shrinking.
Opportunities	Threats
1. It may reach more consumers with the help of digitalization and social media. 2. Beijing 2022 winter Olympics create opportunity for food sponsoring.	1. Business operations may be affected because consumers now care about health issues more. 2. Greater competitions from both old and new brands in Chinese market. 3. Food shows and bloggers are not supported in China and this could affect marketing efforts.

3.2. Major Problems and Factors

Further research has proved that the instant food industries are now facing some major problems. Firstly, the fastest growing among the new generation of instant food consumers is post-85 to post-00 groups, they are the core drivers of instant food consumption growth. However, the traditional instant food company still don’t have an excellent transformation to attract the new generation. Secondly, the new generation of consumers has more options on the convenience food circuit. No longer just the pursuit of “full”, but also choose to “eat balanced, green health”, the consumers now pay more attention to food health, delicious and pleasant mood. Thirdly, the packaging design of instant food is seriously homogenized, the reduction of packaging increases confusion when consumers buy products. Fourthly, the packaging design of instant food can’t achieve consumer’s personalization requirements. At present, the packing design is still following the traditional one and it didn’t consider the brand-new changes and consumer pain point.

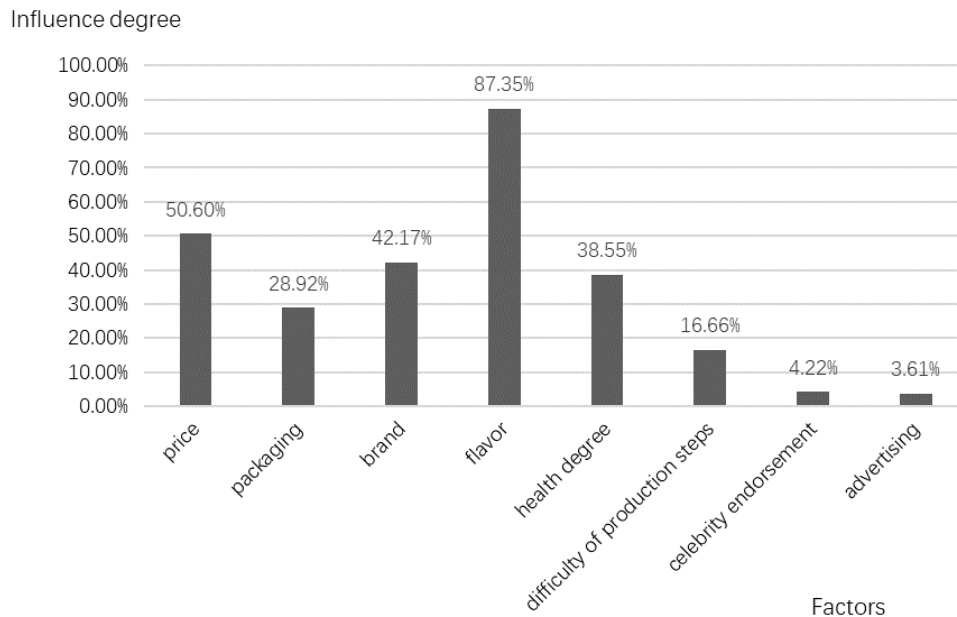


Figure 1: This caption has one line so it is centered.

Figure 1 above showed some major factors that may influence the consumers when choosing instant noodles. The most important factors are flavor, price, packaging and health degree.

3.3. Consumer Analysis

3.3.1. Consumer Age

Figure 2 shows the consumers' age for buying instant food.

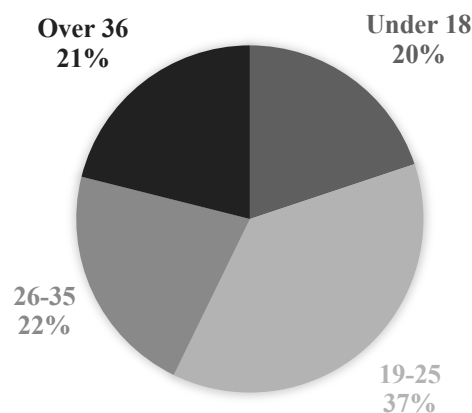


Figure 2: Consumer Age for buying instant food.

The open questionnaire surveyed the consumer age for buying instant food. As the data shown in figure 2, the consumer groups for the new products “Master Kong’s tour in China” are mainly the Generation Z and new town youth.

The consumer characteristics of these two groups are important because it can help the company design the new products and set the way of selling products.

3.3.2. Consumer Profile

The first consumer group is generation Z. According to the Chinese National Bureau of Statistics, Gen Z in China account for around 12% of total consumption in China. One key aspect of this generation is their cultural confidence. Displaying a natural affinity for traditional culture while still embracing modern trends. They are heavily influenced by social media platforms like WeChat and Douyin. Gen Z consumers in China are more technologically-savvy and embrace online shopping as a preferred method of purchasing. As a result, to effectively reach Chinese Gen Z consumers, it's important to utilize social media platforms [9].

The second consumer group is the new town youth. The family structure of new town youth is relatively stable, so they have more free time. Surfing the internet occupied about 70.7% of their free time. They love fashionable tendency and could be influenced easily by social media platform [10]. Compared with urban youth, the living expenses of small-town youth are lower. Higher education enabled them having more requirements on quality and service. Their purchasing ability and level keep increasing [11].

3.4. In-Depth Interview Analysis

The in-depth interview mainly included generation z and new town youth. They prefer the flavor and quality, not just the convenience. As a result, it would be helpful if the new products contain noodles from different cities.

In addition, when being asked if Master Kong can provide consumers an opportunity of tasting the authentic and healthy noodles without leaving home. Almost all the interviewees indicated the willingness of buying the new products.

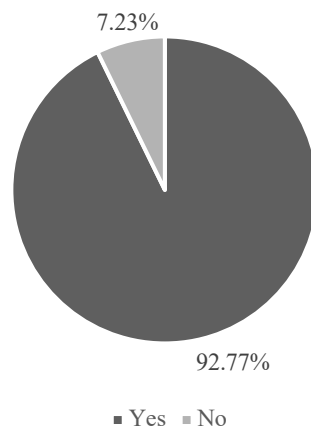


Figure 3: If the consumers are willing to try new products.

Figure 3 provides a strong consumers' willingness of trying the new products. Furthermore, the interviewees expressed they would also prefer to buy instant noodles offline like the supermarkets, convenience stores. As a result, in the long term, both online and offline should be used to sell the new products.

3.5. New Products

The new products solved problems mentioned above and some major factors were also included to satisfy consumers' requirements and preference.

The new series “Master Kong’s tour in China” contains two major products: A documentary “Master Kong’s tour in China” and six kinds of instant noodles from different cities in China called “Smell at homeland”. New products will convey two general ideas: “To protect and promote different noodle culture in China” and “Help the consumers taste the authentic and healthy noodles without leaving home.”

The “Smell at homeland” is a new series instant noodle. This series restored the original flavor of six kinds of noodles from different famous cities in China. They are Beijing Fried Sauce Noodles, Shanxi sliced noodles, Sichuan Dandan noodles, Lanzhou beef noodles, Wuhan hot dry noodles and Zhenjiang pot cover noodles. New technology improved the taste and made the instant noodle much healthier. What’s more, this new product has a totally new packaging design to satisfy the requirements of the new generations. For example, the city landmarks or representative building can be used as some elements.

The “Master Kong’s tour in China” is a documentary that recorded the process of the restoration. In order to make it useful for marketing and promotion. Four important parts should be included. Table 2 below shows the details of the four parts.

Table 2: Four important parts need to be included in the documentary.

1. In the process of visiting different places, how the company finally find the unique heritage and ingenuity of the craftsmen.	2.Master Kong’s history review and relevance while learning from artisans (health, pursuit and ingenuity as the core)
3.Discussion and research on the eating habits of contemporary young people and Master Kong’s outlook on new products (showing the heart and sincerity of consumers).	4.The technological breakthroughs in research and development of new products.

The documentary and new products need to be advertised and marketed properly. Knowing which shopping platforms these two groups use the most is important. Figure 4 below provides a visualization of the most frequently used shopping platforms preferred by Gen Z and new town youth.

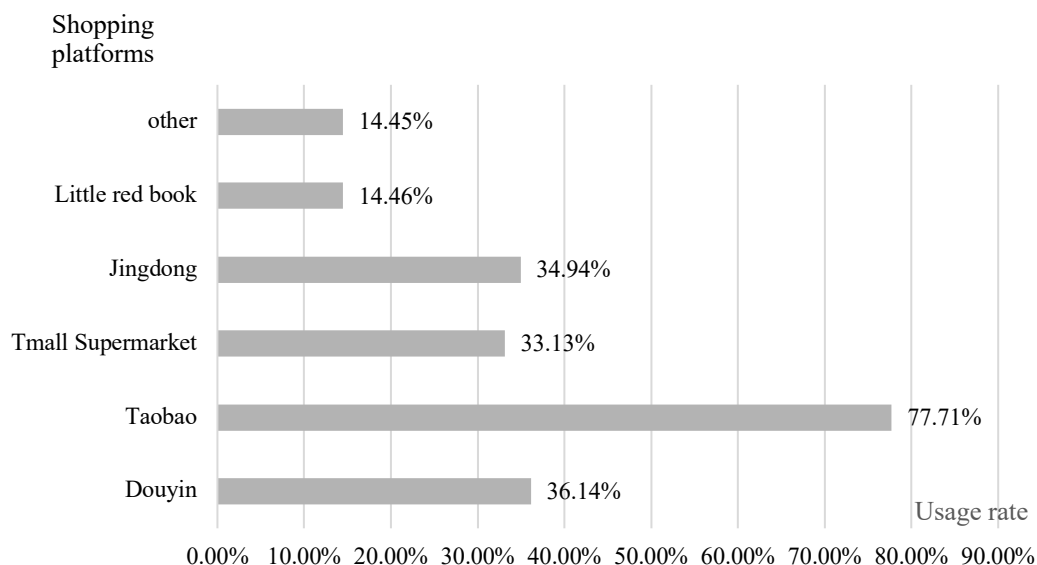


Figure 4: Shopping platforms Gen Z and new town youth use the most.

3.6. Marketing Method

At the initial stage of promotion, post the documentary “Master Kong’s tour in China” mainly on website and platforms like Douyin, Bilibili, Weibo and kuaishou. As attention rises, inviting some marketing accounts and KOLs to boost popularity. At the same time, launch new products “Smell at homeland” on shopping platforms like Taobao, Douyin, Tmall supermarket, Jingdong. If the consumers response is good, mass production should be started immediately. By utilizing existing offline sales channels to sell the new products, eventually achieve the long-term production and sales. And Figure 5 below shows a visualized process of the marketing.

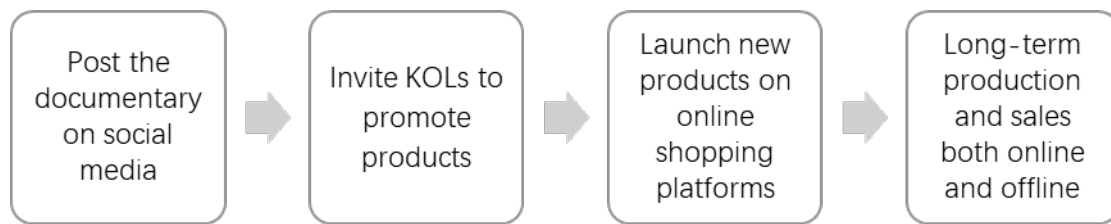


Figure 5: Flow diagram of marketing the new products.

4. Conclusion

Based on the existing study, also combining the data and results gathered from the online open questionnaire. New types of products with creative ideas may provide Master Kong with a chance to break through its bottleneck. The in-depth interview increased the practicability and feasibility of the new products “Master Kong’s tour in China”. Although the process of applying the plan into practice may have some difficulties. For example, sophisticated technology would be needed to improve the products, the process of researching and restoring the authentic flavor may be tough and so on. However, this study still has its own merits and significance. The final expected effect of this research is prospective, which can help Master Kong gain a more positive brand image. In the short run, new products can help Master Kong increase its popularity. As more generation Z and new town youth consumers dedicated into buying the new products. Master Kong may increase market share and win the customer trust. In the long run, it may lay a solid foundation for Master Kong’s transformation in the future.

Nowadays, thanks largely to the tremendous betterment of education and economy, the consumers would pay attention to many aspects of their own diet thus bring more challenges to instant food industry. As a result, the brands should have more research on consumers requirements and try to improve their products at different aspects. To sum up, the instant food industry and market still exist some problems need to be solved but as more researched progress they will no longer be a problem in the future.

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The Social Factors of the Income Gap of Digital Labour under the Transformation of Platform Capitalism

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Abstract: With the rapid development of digital technology, people are creating digital products, which has led to a digital transformation of the form of labor. The resulting platform capitalism is an economic form that will dominate society in the future, and the amount of digital labor it involves is only increasing. Based on existing literature and data, this paper discusses three separate issues affecting the income gap of digital labor by targeting audiences, social media, and advertisers. It is found that the pay of the audience as digital labor is limited by the degree of exploitation by advertisers and the extent of their use of social media. First, platform capitalism sustains the commodification of user behavior, resulting in a cashable act of digital labor. Second, big data exposes audiences to dilemmas of justice, and the exploitation of platform capitalism impacts the fairness of digital labor. Third, mediatization also impacts the income gap in digital labor, with less visible mediums earning less than more visible ones

Keywords: platform capitalism, digital labor, income gap, social media, advertisers

1. Introduction

The Internet age has become an old label, and platform capitalism is moving towards dominance. It has transcended national boundaries and broken the institutional framework, creating a new value system and economic laws through digital labor introduced by technological support [1]. However, with the transformation of platform capitalism, the gap in income levels of digital labor continues to widen, and more high-income digital labor has emerged. It is undeniable that the exploration of this phenomenon is in line with social progress, and the digital economy behind digital labor has research value for the future transformation of platform capitalism.

Platform capitalism, supported by digital platforms and digital technologies, is a form of economy at the forefront of future society, and its most obvious value is the sharing function [2]. For example, capitalism re-generates the benefits of partial use of the platform in the form of concessions [3]. Therefore, this category of scholars considers platform capitalism to be a sharing economy or information community. In contrast, Srnicek considers platform capitalism a product of data capital, which allows for a kind of standardisation of labour practices [4]. For example, platforms generate large amounts of raw data to be analysed, categorised, and transformed. The argument that gives this value is attributed to the implicit exploitation of platform capitalism, which is a central social factor contributing to the digital labour income gap. The article discusses the digital labour income gap from

three perspectives: advertisers, audiences, and social media, by reviewing relevant materials and combining the research of various scholars.

2. Literature Review

The historical trajectory of platform capitalism has been largely informed by Marx's *Das Kapital*, which has never been able to jump through the hoops of digital technology prosperity. The labor force that causes the capital market to be served by digital technology is also known as digital labor. It, like the real economy, produces income disparities consistent with basic Marxist doctrine. However, after the concept of digital labor was introduced by the Italian scholar Terranova, the question of labor in the digital economy has become less susceptible to the familiar logic of capitalist exploitation [5]. As a result, scholars in various countries have also discussed income inequality as a digital phenomenon, with a view to arriving at the causes affecting the digital labor income gap.

Tewathia argues that a prominent factor in social income inequality is the role of the digital divide [6]. It is difficult for the working class to address the negative effects of social role labels as they enter the digital labor market and are thus marginalised in digital society. For example, the caste system in India is difficult to break down. However, not all digital labor creates income disparity. For example, Wang Jing's research shows that digitalization can curb the trend of income inequality [7]. In addition to ethnic markers, gender and educational attainment also affect income gaps. In Santiago's study, disparities in education and spatial flexibility are considered potential influencing factors. For example, using differential overqualification theory to observe the spatial distance of women's job searches, it was found that this group preferred to work from home, saving on transportation costs and increasing earnings [8]. Further, Lu Jing's research found that the digital economy has significantly boosted female employment, completely breaking the limitations of women in the labor market [9].

However, the aforementioned scholars' studies only detail income gaps and social inequalities in digital labor from a single aspect, such as racial labelling, educational attainment, and gender. This does not provide an overall picture of where digital labor fits into platform capitalism. Meanwhile, Srnicek argues that digital labor is a complex socio-economic phenomenon involving audiences, social media, and advertisers, and that competition between the three leads to a significant income gap in digital labor [10]. Smythe argues that the most central aspect of this competition is the audience, as the audience is in the middle of social media and advertisers, and the resulting digital labor is also called audience labor [11]. It is from Srnicek's theory that this paper draws its inspiration, taking a holistic view of the factors that contribute to the digital labor income gap.

3. The Essence of Digital Labor Exploitation by Platform Capital

The technological explosion triggered by the rapid growth of the Internet, which led to storage devices becoming cheap and high-capacity, has profoundly revealed the social transformations based on information technology and big data, which are reflected in the forms of organization, forms of labor, and ways in which value is created in society [12]. Further, the digital platforms derived from technology have similarly influenced the ways in which capital is exploited. Harvey argues that the digital ways in which platforms have been created have not only reshaped virtually all aspects of individual existence, but have also reconfigured the relationship between capital and labor [13].

In addition to continuing to absorb labor from the sphere of production, capital platforms have even extended the tools of exploitation into the public sphere [14]. Because it is only in the digital world that one can see the behavior of such massive user usage in the public domain. These behaviors gradually evolve from user habits into a business model that is a highly efficient means of unearthing the hidden depths of routine. For example, some users post life photos or upload entertainment videos

on social platforms to show themselves, and other users like or comment on these photos and videos after seeing them. Capital platforms provide more permissions to users with a high level of attention while accomplishing revenue, such as swiping gifts.

Despite the fact that digitalization exists on a virtual platform, it has not been able to escape the trap of capitalist exploitation. Thomas Koulopoulos, a mainstream scholar who holds this view, has a clearer reading of the digitization of capital. He argues that digital behaviours, including digital labour, are digitised commodities, not valueless objects, and that capitalization can be accomplished by using machine algorithms to aggregate the experience of commodities [15]. For example, which users frequently browse web pages, which web pages are more popular among users, and which time periods are most popular for users to access the Internet? In addition, digital labour is a new form of global currency [16]. Platforms sell information (user data) aggregated from digital goods based on algorithms to advertisers, who find eligible users through precise targeting. In this way, the data filtered by algorithms can be turned into cash, and part of this cash is revenue from digital labour.

Since the user's behavior is under the management of the platform's capital, digital behavior is a new form of capital exploitation. It uses algorithms to hack into the user's network, enabling the user to datamaterialize and commodify private space without even noticing. This process makes it easy to identify more valuable users and make their digital labor more exploitable, which will earn far more than the neglected users. In essence, the workings of capitalism (also known as the invisible hand) continue to widen the income gap for digital labor.

4. The Dilemma of Justice Facing Digital Labor

In the process of capital exploitation, there exists a mechanism of platform capitalism that can sway justice, and it carries out disguised forced deprivation of digital labour, so that digital labour faces the dilemma of justice. The justice dilemma of digital labor is the conflict between the purpose and reality of the labor force demonstrated by digital technology in the context of the big data era [17]. By transforming the efficient digital products packaged by digital technology into big data justice, as well as the logic of capital disguised as the demand for justice, the labour force is forced to integrate into the proliferating flood of digital labor. The justice displayed by big data has been exposed as somewhat false. The alliance between data technology and capital has given rise to a new structured superpower. It hides the exploitation of labor by capital, and new forms of class conflict and inequality become an illusion of equal power over digital possession, with the reality being that the data controllers have the upper hand and the data subjects have nothing. This is because only data controllers have the ability to produce and utilise collections of data.

Accordingly, the majority of digital users have been normalized as unpaid laborers, and their online recreational time has become labor time for platform capitalism. This labor completely disrupts traditional perceptions and puts digital users in a situation of excessive income disparity. Krishna argues that it is the historical isomorphism between the expansion of the capitalist mode of production and the diffusion of technological progress that has led to the emergence of this gap, that is, the opposition between labor justice and capital justice as well as the conflict between labor justice and economic justice [18]. Thus, the autonomy embodied in the process of technological progress is often based on people's mastery of scientific and technological knowledge and its use for the purpose of transforming nature, and the coercive power of capital's rationality is more advantageous in the choice of technological progress.

However, this force drives the justice dilemma. From the standpoint of labor justice, capitalism and digital labor pivot to satisfy their respective needs for utility value through the exchange of commodities, but their fundamental purpose is to capture surplus value for the unlimited multiplication of capital [19]. Technological progress governs the choice of the digital labor process, but the intention of this domination is specific in that it exists only in the technologically-activated

labor process, and once the technological labor process is complete, the intention of technological domination itself ceases to exist, resulting in the drawback that labor justice cannot be realized. The root of this stems from the fact that digital labor does not go beyond the classical theory of labor value, which results in digital labor receiving different incomes for different choices.

5. The Media Response to the Impact of Global Public Emergencies

The third social factor affecting digital labor income is the role of the media in global public emergencies. Since platform capitalism is almost globally spread, it should be realized that the media deals with global emergent public events rather than a single localized event. For example, COVID-19, a typical global crisis in recent years, was a catastrophic global breaking public event. Emergencies such as this one, which can cause significant casualties, property damage, and ecological destruction, are the fastest spreading in the media and have the most impact on digital labor income [20]. For example, internet celebrities who have risen to fame on social media, or, influential public figures are more attractive when they repost stories related to viruses. It is worth noting that the average blogger on social media is exactly the most typical emerging labor group in the age of pandemics [21]. This is due to the expansion of social media in the Internet age, which has reconfigured people's information sharing patterns and broken down the government's unified voice channels.

In contrast, social media platforms that are less visible are unable to attract high-quality digital labor to their platforms, making it difficult to acquire large amounts of user data. Thus, digital labor active on such platforms tends to earn less than digital labor on common social media. The main reason for this is that the media is supposed to be connected to global emergencies, and it also exists to report, present, and publicise material of human interest. In a word, there is a mediatization of the media. The media, pulled by technology, generates action and execution through global communication, which in turn reinforces the media's communication. Krotz, a German scholar, even categorises mediatization as a meta-process of human society, along with globalisation, commercialization, and individualization, to emphasise the profound changes that media have made in the development and change of society [22]. For instance, the media accurately reflect global warnings, enabling the public to detect threats in advance and take timely measures, including the sale of life supplies, survival guides, and effective medicines. Digital labour that is able to efficiently utilise these mediums of information is certainly ahead of the digital market.

On the other hand, each crisis reporting activity by the media may be followed by reforms and leaps in the news media's response capacity and technological tools. After an emergency, people's lifestyles and ways of thinking are bound to change, and they are psychologically pressurized, very sensitive to all kinds of information, and, concerned about the news from the scene. The digital labor that rushed to the scene played a prominent role with intuitive visual impact (technical means such as high-definition cameras), infectious sound, and strong appeal. The income generated by this bill undoubtedly far exceeds that of digital labor without these advantages.

6. Discussion

This paper discusses the influences affecting the digital labor income gap through three modules. The audience is oriented towards both ends of the spectrum: platform capitalism at one end and users at the other. Social media and advertisers tend to have more power than the audience, which, combined with the sheer size of the audience, has energized platform capitalism. Overall, the income from digital labor stems from platform capitalism and, at the same time, is limited by it. However, due to the inherent limitations of platform capitalism itself, the masking of the exploitative nature has

impacted part of the digital labor, gradually creating an overly obvious income gap for digital labor. Therefore, the article puts forward several suggestions that are expected to bridge this income gap.

Firstly, improve the existing unreasonable system. The current mode of employment breaks through the traditional employment relationship, and it is difficult to use the traditional legal system to form protection for digital labor, so we can try to clarify the labor relationship. When carrying out digital labor with a clear purpose, for example, online recruitment, a certain amount of network traffic costs can be paid. Secondly, restrain digital power and strengthen the algorithmic governance of digital platforms. At the same time, an effective algorithm review mechanism should be established, and regulators should set up a special review body to monitor illegal digital labor to protect the legitimate rights and interests of digital labor, and also to avoid collusion between platforms by adopting similar algorithms. Thirdly, explore cooperative platform organizations led by state-owned capital. Over-control and over-exploitation are inherent flaws that cannot be eliminated in non-state capital-dominated platforms. In particular, when the entire platform economic system connects countless modern small producers and workers through the Internet, the digital economy transforms the platform into a production organization that maximizes profits from the surplus labour of informal wage earners, which will greatly affect the distributional order of the real economy.

7. Conclusion

The transformation of platform capitalism is an irreversible process, and digital labor will inevitably and gradually generate excessive income disparities under the operation of platforms. The audience, as users and digital labor can neither master the discourse of platform capitalism nor get rid of the exploitation of advertisers. However, it can be expected to play a positive role in the process of mediatization through the development of data technology and become an efficient tool for the benefit of the people. Labor, as a human activity, is necessarily compatible with the development of human beings and human society. The development of digital technologies centered on intelligent algorithms, the Internet of Things, and big data technologies is reshaping the way human labor is performed, and the digital economy is changing human labor products, processes, and incomes through digital industrialization, data valorization, and digital governance. How to articulate the income gap of digital labor in the historical process of human labor development still needs to be continuously explored. Finally, this paper also has obvious limitations in discussing examples of income disparity in digital labor due to the length of the paper. In the direction of future research, more emphasis should be placed on more real cases to support the argument.

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The Benefits and Potential Risks of Using Option Pricing for Investment in China's OTC Derivatives Market under the Black-Scholes Model

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Abstract: In this paper, based on the qualitative research and analysis of China's financial market, both the benefits and potential risks of using option pricing for investment in China's OTC derivatives market under the Black-Scholes model are obtained. In China, OTC derivatives mainly refer to the one-to-one contract trading between institutions, non-on-exchange financial derivatives, naturally, its environment is called "“OTC derivatives market”"; Black-Scholes model is a mathematical model for option pricing. Based on the assumption that stock price obeys geometric Brownian motion, it measures the relationship between option price and underlying asset price, term, interest rate, volatility and exercise price. Based on the above variables and their overall two aspects, the gains and losses of China's OTC derivatives market under the Black-Scholes pricing model are obtained. Some predictions and expectations are also expressed for the future of this field.

Keywords: China, financial investment, OTC derivatives market, option pricing, stock price

1. Introduction

As the 21st century unfolds, many people regard the financial engineering of the source as well as creation of money in business world, also in society [1]. Nowadays, there are many kinds of pricing models in today's financial engineering, and numerous studies on financial derivatives exist all over the world, however, there are few detailed analyses on a specific condition in China. Therefore, through this proposal, I will analyze the benefits and losses of China's OTC derivatives market under the Black-Scholes model detailly.

2. Literature Review

Various studies have assessed the efficacy of China's OTC derivatives market. As local Chinese scholars Jiang Wang and Grace Xing Hu have written in their own proposal, although derivatives play an important role in financial modeling, the development of the Chinese market, whether in theory or in daily practice, is always up and down, not stable. This result stems in part from policymakers' concerns about the benefits of derivatives, such as resource allocation; And their uncertainty can bring additional risk, as it did in the failed experiment with bond futures and warrants, which can be seen as kind of loss of China in its own OTC derivatives market [2]. What is more is that, only in the past ten years have relevant research of which gained deep insight into China's

financial markets under specific circumstances occurred. Financial derivatives are inevitable in China and will have a broader development prospect in the future. With the reform and economic growth in recent years, financial derivatives have been widely used in China, but there is still a lot of work to be improved in the actual use of derivatives and related system construction. If the financial crisis exposed the excessive development of derivatives in western financial markets, the situation in China is very different from the western kind [3]. From this we can see that China's OTC derivatives market is unique and different from other countries, with its own style of economic and financial system.

The business era pays attention to profits, and we live in a world where, in addition to digital transactions such as stocks and bonds, everything else in life can be regarded as part of the derivatives market for example, Insurance industry. Using this approach, researchers have been able to acquire intrinsic association. Environmental pollution liability insurance plays an increasingly important role in achieving China's emission reduction targets. From the perspective of Black-Scholes pricing model, insurance pricing is a key factor restricting the market share of environmental pollution liability insurance, which in turn affects the solvency of Chinese insurance companies. They first studied and analyzed the problems existing in China's compulsory environmental pollution liability insurance, and then used Black-Scholes pricing model to analyze the price of compulsory environmental pollution liability insurance and found that the premium rate was as high as 2.44%. After the regression analysis, based on the Black-Scholes pricing model, the researchers finally put forward suggestions that are conducive to the development of Chinese insurance companies in the OTC derivatives market, which can be regarded as the benefits of the Black-Scholes model for the OTC derivatives market in China [4].

Systematic reviews of BS model have been undertaken. One study by Chinese researchers answers a question for Chinese investors, especially retail investors: Is the Black-Scholes pricing model sufficient for them to make relatively perfect investment decisions? Using the absolute out-of-sample error as a measure of the model's efficiency, the researchers found that the volume-weighted average absolute out-of-sample error was 12.03% of the option premium, so investors had to tolerate an absolute error of more than 1% in almost all subsample groups, suggesting that, The use of the Black-Scholes pricing model alone in the decision-making process may have a negative impact on investment performance, namely losses to the Chinese OTC derivatives market [5].

3. Methodology

3.1. Introduction

This part reveals the methods of research to be employed by the researcher in conducting the study which includes the research design, population of the study, research instrument and its development establishing its validity and reliability, data gathering procedures, and the appropriate statistical treatment of data.

3.2. Research Aim

The purpose of this paper is to explore the opportunities and shortcomings of China's OTC derivatives market under the Black-Scholes pricing model. Among them, three research questions are as follows:

1. The adaptation and performance of OTC derivatives market in China's overall financial market;
2. Black-Scholes pricing model's intervention and help in financial engineering and financial markets ;
3. The role of Black-Scholes pricing model in China's OTC derivatives market.

3.3. Research Philosophy

This paper uses the interpretivism research philosophy method, mainly focuses on qualitative research. First of all, two separate and non-interventionless concepts are proposed: China OTC derivatives market and Black-Scholes pricing model, respectively to explain the two, and then combine the two to form a unique, regional, small-range research problem for accurate analysis. Through the continuous explanation and refinement of concepts and professional terms, the best level of appropriate understanding is reached, so as to further study.

3.4. Research Approach

According to this article, I choose the induction method. Through a lot of research and reading previous papers or journals, as an example, *Journal of Financial Management* [6], and so on. I have a detailed understanding of the views and suggestions of scholars or experts in the fields of economics and finance on Black-Scholes pricing model, China's OTC derivatives market and the combination of the two, so as to constantly enrich and improve my own views. In order to write a relatively comprehensive article.

3.5. Research Strategy

In this part, case study is my final choice. I chose the case study to facilitate more in-depth investigation in a small scope. Because one of the advantages of this method is that it does not easily extend the scope, but carries out a relative lock,

fixing the research scope and the research object, and avoiding the stray or off-topic phenomenon caused by the sudden emergence of new concepts or terms.

3.6. Data Collection

All the data for this article come from reliable authoritative papers and relevant journals, which have been marked in the references. When searching, I will enter relevant data words on the paper website to search, so as to obtain first-hand data.

3.7. Data analysis

As for the premium rate of 2.44% mentioned in the literature review, we compare and analyze this data with the general premium rate in the West, which well reflects the limitations and shortcomings of Black-Scholes pricing model when it is used alone in China's OTC derivatives market.

3.8. Summary

The methodology of this paper focuses on the use case study as the basic, with directional analysis as the criterion, in-depth analysis of the merits and demurs of BS pricing model and domestic OTC derivatives market separately and in combination, which is relatively objective, intuitive and comprehensive [7].

4. Results

The purpose of my study was to test the advantages, as well as the disadvantages of Black-Scholes pricing model for OTC derivatives market under the specific regional restrictions of China. In the process of my research, I made use of the papers of famous scholars and reliable scientific research data in the past, coupled with my own bold conjecture, careful verification and rigorous inspection,

therefore, the study demonstrates a correlation between both Black-Scholes pricing model and pure Chinese OTC derivatives market, in a intuitionistic way [8]. In addition, the data that appeared in my proposal suggest that, When using the Black-Scholes pricing model in China's OTC derivatives market, it is best not to use it alone, but should be combined with some other relevant measures, otherwise some aspects will suffer economic or resource losses, so as to achieve the realization of maximum benefits. The analysis confirms the best model and path for China's OTC derivatives and OTC derivatives market [9].

However, which is different from the previous relevant researches in China is that, I did not study a specific individual or enterprise separately. Instead, I conducted an analysis of the overall market from a macro perspective and extracted individual examples to test whether they fit the theory. Although the argumentation methods of the papers are different, our attitude on the theoretical definition is highly consistent, and I am committed to further refining and perfecting the scientific research theories of predecessors, especially for this academic paper from Shuai Chen & Jiameng Yang.

The results should be taken into account when considering how to effectively develop China's OTC derivatives market and make it fully benefit. Just like the data analysis mentioned just now, the data obtained in the paper provides a new vision and a new path for our development.

Despite the detailed analysis, there are still inevitable limitations in my paper. Due to the lack of the first-hand data, I cannot perfectly confirm very detailed financial engineering, like how to make specific decisions, and so on. Unfortunately for this aspect, due to the limited resources, I can not do it best. Therefore, I also hope that more students and scholars in the field of finance or economics can be interested in

this field of research and put into practice accordingly.

From my point of view, the combination of Black-Scholes pricing model with China's OTC derivatives market is a very promising and valuable research topic [10]. I think the future financial engineering research can further refine on the basis of my idea. For example, the development of OTC derivatives market in China's coastal provinces under the Black-Scholes pricing model, or the future of the OTC derivatives market in Beijing, Shanghai, Guangzhou and Shenzhen under the Black-Scholes pricing model under the impact of the epidemic. In other words, under the background of this research, a series of restrictions need to be added, so as to explore more and more accurate financial engineering and economic laws. When more similar studies under different background restrictions are practiced and valued, I am confident that China's financial market will gradually and steadily expand, and it will have more say in the world financial and economic market, which will further improve the living standards of employees and people engaged in the financial field. This is my wish, but also the most important research on this subject, the most realistic value of the reason and purpose.

5. Discussion

Here, importantly, this paper focus on the impact of Black-Scholes pricing model on China's OTC derivatives market. After a series of research and analysis, the conclusion shows that the use of Black-Scholes pricing model is of great benefit to China's OTC derivatives market. However, if the Black-Scholes pricing model is used only, that is, there is no other system or measure to support it, the benefits will be very limited and will not be greatly improved, which is well illustrated by the data, 2.44% ,the premium rate in the paper[11]. Compared with previous research literature in this field, innovative and comprehensive changes are made in the research, and the research is conducted under a specific framework (that is, specified a specific region - China and pricing model type Black-Scholes), which not only improved the efficiency but also improved the accuracy.

Although there important discoveries revealed by these studies, there are also some aspects for improvement. For example, the research basically stays in a relatively theoretical, less practical level. The most frustrating aspect of this research is that it is not yet possible to conduct large-scale experiments or questionnaires by individuals or to obtain data from large companies for analysis [12].

The solution to this problem is to make up for the lack of data with more rigorous analysis as possible. Through comparison and exploration of the previous academic research, I have laid a solid foundation and broad space for development of this research.

But there are still some new questions exist, which are about this experiment, waiting for me or other colleagues to solve. For example, how OTC derivatives markets in China's coastal provinces are affected by Black-Scholes pricing model; For another example, in China's inland areas, such as Sichuan, Hunan OTC derivatives market can be relatively the largest development space under the pricing model.

In the following time, more and more ideas about the new problems that been proposed are sincerely expected to appear by the group of economists, more and more of these ideas, is going to be put into practice as well. At the same time, the continued attention should be paid to the improvement of this research [13].

6. Conclusion

To summarise, this paper has given an account of Chinese OTC derivatives market under Black-Scholes pricing model and the reason why I study it is that no relevant scholars have done similar research on specific regions and specific models.

Although the content is innovative, but still, a number of caveats need to be noted again regarding the present study [14]. Despite the rigorous qualitative analysis, the thin data still make my research paper less quantitative analysis, which may need to be improved in terms of persuasion.

This study is set out to determine the status of OTC derivatives markets within a particular country, China, and the appropriate pricing model. In general, therefore, it seems that Black-Scholes pricing model is beneficial to China's OTC derivatives market but not very significant, but with some auxiliary means, the degree of benefit will be greatly improved [15].

The evidence from this study suggests that more counterparts in the economic field can further study this aspect, so that the relevant research blueprint is more complete.

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Analysis of Stock Value in the Science and Technology Innovation Board Market: A Principal Component Analysis Approach

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Abstract: The factors influencing stock returns have been extensively studied in the current academic sphere. In this study, the factor analysis method is employed to assess the investment value of stocks in the Science and Technology Innovation Board market (STAR Market) using indicators such as asset-liability ratio, current ratio, quick ratio, gross profit amount, YoY growth rate of net assets, asset return rate A, return on equity ratio ROEA, operating net profit margin, earnings per share of net assets, sales operating profit margin, and YoY growth rate of total assets. Factor scores are derived using principal component analysis. The obtained factor scores are ranked in descending order, revealing that Juchen Corporation holds a factor score of 1.11, ranking first among all companies and demonstrating the highest investment value. Following closely are EastMicro Semiconductor and Baochu Electronics. Additionally, this paper summarizes the stock performance of 20 other companies, offering investors a reference for value-based investment decisions. The quantitative findings of this study facilitate informed decision-making for investors, serving as a valuable reference for their investment strategies.

Keywords: stock returns, quick ratio, factor scores

1. Introduction

Entering the 21st century, China's economy has demonstrated a sustained and stable development trend, with significant progress in the growth of the capital market [1-2]. In July 2019, China's capital market entered the "era of the Science and Technology Innovation Board" (STAR Market).

The advent of the STAR Market has garnered considerable attention from a multitude of investors, leading some to transition from the main board market to the STAR Market [3-4]. However, compared to traditional blue-chip stocks, investing in the STAR Market carries higher risks.

Enterprises listed on the STAR Market are characterized by rapid technological iterations, long investment cycles, and substantial uncertainties. As a result, investors need to focus more on information disclosure and engage in rational investment analysis [5]. The stock market entails risks; thus, investment requires prudence. This paper takes an investor's perspective to quantitatively analyze the investment value of stocks from 156 companies listed on the STAR Market, aiding investors in stock selection and investment decisions.

The paper categorizes complex relationships among certain indicator variables, employing a multivariate statistical analysis method that utilizes a few key factors to explain correlations between multiple original data variables. This approach simplifies data and reduces variable dimensions [6-7]. Factor analysis, with its goal of simplifying original variables, aims to extract a small number of factors while ensuring these factors are interpretable, achieving the role of explaining all variables. Therefore, factor analysis proves to be an ideal method for evaluating the growth levels of companies listed on the STAR Market. This study employs 11 indicators for factor analysis, revealing that Juchen Corporation boasts a factor score of 1.11, ranking first among all companies and demonstrating the highest investment value. Following closely are EastMicro Semiconductor and Baochu Electronics. Additionally, this paper summarizes the stock performance of 20 other companies, providing investors with a basis for value-based investment decisions.

The structure of this paper is as follows: the second section describes data selection, the third section presents results analysis, and the fourth section concludes the article.

2. Data Selection

The data for this study is sourced from the Oriental Fortune Choice Financial Terminal database. Financial statement data up to December 31, 2021, was chosen for analysis. In order to provide a comprehensive depiction of the practical operational dynamics of companies listed on the Science and Technology Innovation Board (STAR Market), and to avoid biases in the experimental outcomes, samples with missing data and instances of abnormal financial statement data were excluded. Consequently, a total of 156 companies listed on the STAR Market were selected as the study's sample. Table 1 illustrates the mean, minimum, maximum values, and other various financial indicators for each individual listed company.

Table 1: Statistical Descriptions.

Variable	Observations	Mean	Std. Dev.	Min	Max
Current Ratio	156	7.566394	7.986263	0.619971	40.1724
Quick Ratio	156	6.842838	7.718028	0.461185	39.6011
Debt-to-Asset Ratio	156	0.244555	0.172029	0.026145	0.747348
Sales Operating Rate	156	2.923077	10.66391	-30.9	34.3
Gross Profit Amount	156	8.93E+08	1.75E+09	-1.00e+07	9.50E+09
Earnings per Share	156	19.39741	17.25912	-0.466	107.77
YoY Net Asset Growth	156	-0.29431	6.478734	-61.209	34.8906
YoY Total Asset Growth	156	-1.07172	10.26657	-76	52
Asset Return Rate A	156	0.032242	0.075302	-0.30066	0.212118
Return on Equity A	156	0.042755	0.10207	-0.61709	0.252004
Operating Net Margin	156	-60.5161	756.5889	-9449.73	0.605428

According to Table 1, the highest value for the Current Ratio is 40.1724, the lowest value is 0.619971, the mean is 7.986263, and the standard deviation is 7.566394. For the Quick Ratio, the maximum value is 39.6011, the minimum value is 0.461185, the mean is 7.718028, and the standard deviation is 6.842838. As for the Debt-to-Asset Ratio, the maximum value is 0.747348, the minimum value is 0.026145, the mean is 0.172029, and the standard deviation is 0.244555. Lastly, in the case of the Sales Operating Rate, the highest value is 34.3, the lowest value is -30.9, the mean is 10.66391, and the standard deviation is 2.923077.

3. Results Analysis

3.1. Results of Factor Analysis

This study focuses on analyzing the investment value of stocks from 156 companies listed on the Science and Technology Innovation Board (STAR Market) with the goal of aiding investors in stock selection and investment decisions. Financial statements, including balance sheets, cash flow statements, statements of changes in equity, and income statements, reflect a company's operational status and form the foundation for assessing its investment value. Thus, a micro-level financial analysis of listed companies can be conducted to explore their stock investment value. In order to comprehensively assess the overall capabilities of listed companies, this paper selected 11 financial indicators to construct the evaluation framework for the STAR Market.

Table 2: Indicator System.

Indicator	Indicator Code	Nature
Debt-to-Asset Ratio	X1	Moderate
Current Ratio	X2	Moderate
Quick Ratio	X3	Moderate
Gross Profit Amount	X4	Positive
YoY Net Asset Growth	X5	Positive
ROA	X6	Positive
ROEA	X7	Positive
Operating Net Profit Margin	X8	Positive
Earnings per Share	X9	Positive
Sales Operating Profit Margin	X10	Positive
YoY Total Asset Growth	X11	Positive

For the evaluation framework of the investment value of stocks from listed companies, refer to Table 2.

3.2. Data Preprocessing

Given the significant variability in financial data from companies listed on the STAR Market, data preprocessing, involving both data positivization and standardization, is necessary before conducting factor analysis [8]. The experimental software used in this study is SPSS23, which automates data standardization for factor analysis. Thus, only positivization treatment is required.

From Table 1, it is evident that only the Debt-to-Asset Ratio, Current Ratio, and Quick Ratio are moderate indicators that require positivization. These three variables are positively transformed using the formula (1):

$$Y_{ij} = -|X_{ij} - E| \quad (1)$$

In the formula (1), Y_{ij} represents the positivized value, X_{ij} is the original value, and E is the mean of the variable. Standardization is used to convert the original data into standardized data, and its formula is as follows:

$$z = (x - \mu)/\sigma \quad (2)$$

Where z represents the standardized data, x is the original data, μ is the mean of the original data, and σ is the standard deviation of the original data.

The correlation analysis of various indicators is presented in Table 3. It is observed that the Quick Ratio and Current Ratio exhibit a correlation of 0.997, while the Debt-to-Asset Ratio has the lowest correlation with the Current Ratio at -0.6496. Other correlation relationships among indicators are summarized in Table 3. Significant correlations exist among variables, thus warranting consideration for Principal Component Analysis (PCA).

Table 3: Correlation Analysis.

-	Current Ratio	Quick Ratio	Debt-to-Asset Ratio	Sales Operating Profit Margin	Gross Profit Amount	Earnings per Share	YoY Net Asset Growth	YoY Total Asset Growth	Asset Return Rate A	Return on Equity A	Operating Net Margin
Current Ratio	1.00										
Quick Ratio	0.997	1.00									
Debt-to-Asset Ratio	-0.65	-0.64	1.00								
Sales Operating Profit Margin	-0.03	-0.03	-0.02	1.00							
Gross Profit Amount	-0.03	-0.03	0.04	-0.01	1.00						
Earnings per Share	0.06	0.06	-0.08	-0.16	0.22	1.00					
YoY Net Asset Growth	0.06	0.06	-0.12	0.04	0.03	-0.08	1.00				
YoY Total Asset Growth	-0.07	-0.07	0.01	-0.02	0.02	-0.04	-0.02	1.00			
Asset Return Rate A	0.08	0.07	-0.14	0.19	-0.13	-0.08	0.08	0.06	1.00		
Return on Equity A	0.04	0.03	-0.08	0.15	-0.07	-0.08	0.14	0.06	0.95	1.00	
Operating Net Margin	-0.27	-0.29	0.10	-0.04	0.03	-0.11	-0.00	-0.02	0.14	0.10	1.00

3.3. Data Feasibility Testing

Table 4 presents the results of the Kaiser-Meyer-Olkin (KMO) and Bartlett's Sphericity tests. The KMO value obtained is 0.554, indicating the suitability of the data for factor analysis since it exceeds the recommended threshold of 0.5 [9-10]. The Bartlett's Sphericity Test resulted in an approximate Chi-Square value of 1315.680, with 55 degrees of freedom, and a p-value of 0, suggesting strong intercorrelations among variables and supporting the appropriateness of the dataset for factor analysis.

Table 4: KMO and Bartlett's Test.

KMO Value	0.554
Bartlett's Sphericity Test	Approx. Chi-Square: 1315.680, df: 55, p-value: 0
Degrees of Freedom (df)	55
p-value	0

3.4. Variance Contribution

The communalities of selected variables were tested, and the results are illustrated in Table 5. The majority of communal variances for the selected variables tend to be equal to or greater than 1. This suggests that the original variable information can be well explained by the extracted main factors. Thus, the application of factor analysis can yield conclusions with substantial explanatory power.

Table 5: Variance Contribution.

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	2.68327	0.57648	0.2439	0.2439
Factor2	2.10679	0.9111	0.1915	0.4355
Factor3	1.19569	0.15678	0.1087	0.5442
Factor4	1.03892	0.03347	0.0944	0.6386
Factor5	1.00545	0.02899	0.0914	0.73
Factor6	0.97646	0.10534	0.0888	0.8188
Factor7	0.87112	0.19396	0.0792	0.898
Factor8	0.67716	0.27231	0.0616	0.9595
Factor9	0.40485	0.36712	0.0368	0.9963
Factor10	0.03773	0.03516	0.0034	0.9998
Factor11	0.00257		0.0002	1

From the analysis, five factors have eigenvalues greater than 1. Consequently, we will proceed with a factor analysis involving these five factors to select appropriate stocks. Notably, the eigenvalue for Factor 1 is 2.68327, for Factor 2 is 2.10679, for Factor 3 is 1.19569, for Factor 4 is 1.03892, and for Factor 5 is 1.00545. The Scree Plot, shown in the Figure 1, further validates the rationale for selecting these five factors.

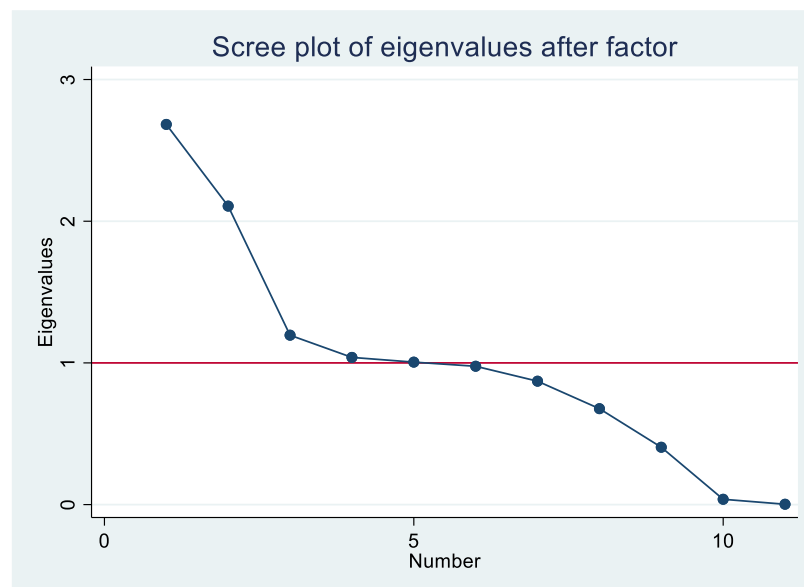


Figure 1: Scree plot of eigenvalues after factor.

Table 6: Factor Component Analysis.

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Uniqueness
Current Ratio	0.9476	-0.171	-0.0361	-0.0299	-0.0508	0.0681
Quick Ratio	0.9446	-0.1815	-0.0419	-0.0291	-0.0446	0.0702
Debt-to-Asset Ratio	-0.792	0.0337	-0.0163	-0.035	0.0711	0.3651
Sales Operating Profit Margin	0.0292	0.3282	-0.2945	0.3321	0.568	0.3717
Gross Profit Amount	-0.0768	-0.2009	0.6711	0.3315	0.3024	0.3021
Earnings per Share	0.0863	-0.2893	0.7367	-0.0559	0.001	0.363
YoY Net Asset Growth	0.1519	0.1881	-0.0261	0.6205	0.1548	0.5318
YoY Total Asset Growth	-0.0675	0.1119	0.0787	-0.6265	0.5028	0.3314
Asset Return Rate A	0.2597	0.9168	0.1967	-0.1057	-0.0501	0.0398
Return on Equity A	0.2182	0.9136	0.2354	-0.0649	-0.0224	0.0577
Operating Net Margin	-0.3302	0.2978	0.1081	0.1401	-0.5495	0.4691

We have also derived the component scores of different indicators within each factor. Among them, the component score of Current Ratio in Factor 1 is 0.948, in Factor 2 is -0.171, in Factor 3 is -0.0361, in Factor 4 is -0.0299, and in Factor 5 is -0.0508. Additionally, the factor component scores for other indicators are presented in the results shown in Table 6. Notably, within Factor 1, Gross Profit Amount obtains the lowest score of -0.0768.

Through the aforementioned analysis, I have obtained the final factor score values for different stocks and subsequently arranged them. The stocks were ranked in descending order based on their factor scores, and the top 20 rankings were selected. The results are as follows: It was discovered that these 20 stocks are comparatively suitable for investors. Among them, Jucheng Shares achieved the highest score, followed by East Microelectronics and Baichu Electronics, with scores of 0.919 and 0.917, respectively.

Table 7: Factor Score Results.

Code	Name	Score	Rank
688123	Jucheng Shares	1.111089	1
688261	East Microelectronics	0.919491	2
688188	Baichu Electronics	0.916987	3
688267	Zhongchu MediTech	0.90717	4
688091	Shanghai Yizhong	0.887627	5

Table 7: (continued).

688176	Yahuang Pharmaceutical	0.831304	6
688200	Huafeng Measurement & Control	0.823753	7
688053	Sikerui	0.747106	8
688016	XinMai Medical	0.736466	9
688114	HuaDa ZhiZao	0.732205	10
688163	SAILUN BIOLOGY	0.730169	11
688196	Excellence New Energy	0.701501	12
688222	Chengdu XianDao	0.613684	13
688212	AOJ Medical	0.594666	14
688220	Aojetek	0.582973	15
688270	ZenRay Technology	0.548842	16
688202	MeidiXi	0.538272	17
688130	Jinghua Micro	0.517866	18
688298	Orient Bio	0.504279	19
688231	Longda Shares	0.498396	20

In conclusion, the above list reflects the factor score results for the different stocks, ranked accordingly, and demonstrates the investment suitability of the top 20 stocks. Notably, Jucheng Shares secured the highest score, closely followed by East Microelectronics and Baichu Electronics with scores of 0.919 and 0.917, respectively.

4. Conclusion

This study employs factor analysis method and utilizes principal component analysis to construct factor scores using indicators such as asset-liability ratio, current ratio, quick ratio, gross profit amount, year-on-year growth rate of net assets, return on assets (ROA), return on equity (ROEA), operating net profit rate, earnings per share, sales operating profit rate, and year-on-year growth rate of total assets. The aim is to assess the investment value of stocks in the Growth Enterprise Market (GEM). The obtained factor scores are arranged in descending order, revealing that Jucheng Shares obtained a factor score of 1.11, ranking first among all companies and displaying the highest investment value. East Microelectronics and Baichu Electronics follow suit as the next valuable options. The study also provides a summary of 20 other company stocks for reference, serving as a foundation for value-based investment decisions. The quantitative analysis results in this study facilitate better decision-making for investors and provide valuable insights for their choices.

However, this study does have certain limitations. For instance, it does not include stock return rate data to explore the relationship between factor scores and stock price returns, thereby not delving into the influencing factors of stock price returns. In the future, this study intends to further incorporate the principal component scores into the Fama-French factor model to evaluate their impact on stock price returns.

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Changes of Consumer Behavior in the Internet Era and Its Impact on Advertising and Marketing

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Abstract: In recent years, the emergence of the digital economy era has prompted significant transformations in people's purchase patterns, hence presenting novel obstacles for online merchants engaged in advertising and marketing activities. The present study examines the shifts in consumer behavior and its ramifications for advertising and marketing practices within the context of the internet era. This study offers a thorough analysis of the distinctive characteristics of the internet era and explores theories and concepts related to consumer behavior and advertising marketing. This study aims to investigate the influence of the internet on consumer behavior and the emergence of individualized needs through a thorough analysis of relevant literature. The research findings suggest that the internet has had a substantial impact on consumer behavior, resulting in alterations in consumer preferences, buying patterns, and decision-making procedures. This statement underscores the critical need of implementing personalized marketing strategies that address the unique requirements of individuals within the context of the digital age. Additionally, the research highlights privacy problems and deceptive advertising as notable obstacles encountered by advertisers in the digital age. In summary, this study contributes to our understanding of the impact of the internet on consumer behavior and its subsequent consequences for advertising and marketing.

Keywords: consumer behavior, internet era, advertising marketing, personalized demands

1. Introduction

During the advent of the internet, there have been substantial changes in consumer behavior and advertising marketing strategies. The advent of the internet has brought about a significant transformation in the manner in which individuals communicate, obtain information, and participate in commercial activities. The aforementioned phenomenon has undeniably exerted a significant influence on consumer behavior and the process of making purchasing choices, as well as on the strategies employed by businesses in promoting their offerings. In order to comprehend these alterations, it is imperative to delve into the theoretical underpinnings and pertinent concepts pertaining to both the era of the internet and consumer behavior. The transformative features of the internet era, including connectivity, accessibility, and interaction, have profoundly restructured the consumer environment. In the realm of consumer behavior, various theories and concepts have been developed to establish a theoretical framework for comprehending the underlying factors that shape consumer decisions, encompassing motives, preferences, and decision-making processes.

Concurrently, the domain of advertising marketing has undergone a transformation in light of the novel prospects and complexities introduced by the internet era. Conventional modes of advertising, such as print media and television ads, have been augmented by novel digital platforms, encompassing social media advertising, influencer marketing, and tailored messaging [1]. In light of the internet's capacity to facilitate businesses in effectively and efficiently reaching a worldwide audience, the identification of target demographics and the formulation of impactful marketing approaches have emerged as crucial factors to be taken into account.

Nevertheless, the advent of the internet era presents a myriad of obstacles for advertising professionals. The prevalence of privacy concerns and deceptive advertising has escalated due to the collection and utilization of personal data for the purpose of customizing adverts. Moreover, the presence of fierce rivalry within the digital marketplace necessitates advertisers to consistently adjust their strategies and discover novel approaches to captivate consumers and establish distinct brand identities.

This study analyzes the transformations in consumer behavior and their implications for advertising and marketing in the era of the internet. It provides a comprehensive examination of the defining features of the internet age and delves into theories and concepts pertaining to consumer behavior and advertising marketing. By conducting an extensive literature review, this study explores the impact of the internet on consumer behavior and the rise of personalized demands.

2. Relevant Theories and Concepts

2.1. Definition and Characteristics of the Internet Era

The Internet era is characterized by the emergence of an information society in which the Internet plays a central role. In the contemporary digital age, individuals have come to acknowledge the rapid transmission, dissemination, and exchange of information facilitated by the Internet. This transformative phenomenon has had a profound impact on various dimensions of human society. The Internet era is characterized by several key features:

First Global connectivity: The Internet breaks geographical limits and connects people all over the world. Through the Internet, people can communicate with others anytime, anywhere, share information, work remotely, and so on. This global connection accelerates the speed of information dissemination and facilitates cross-border exchanges and cooperation.

Second, Big data and intelligence: The Internet era has produced a large amount of data, and people generate, collect and process massive data through the network. Using data analytics and artificial intelligence technologies, people can mine valuable information, make more accurate decisions and predictions, and promote scientific research, business innovation and social development.

Third, Openness and sharing: The Internet era emphasizes the concept of openness and sharing. The open Internet makes it easier to access and share knowledge, culture, resources and services. People can access all kinds of information and learning resources on the web for free and share their experiences and insights with each other. The sharing economy model has also developed rapidly in the Internet era, where people rent and exchange resources, goods and services with each other through sharing platforms.

Fourth, Channel diversification: The Internet provides a variety of channels and media for the dissemination of information. In addition to traditional text, pictures, audio and video, more multimedia and interactive forms of content have emerged in the Internet era, such as online music, live video, virtual reality and so on. People can access and disseminate information through different terminal devices and applications, providing more choice and convenience [2].

2.2. Theories and Concepts Related to Consumer Behavior

The field of consumer behavior encompasses a range of theories and concepts, which encompass various dimensions such as consumer decision-making processes, individual traits and psychological factors, social influences and group dynamics, behavior forecasting and market segmentation, consumer satisfaction and loyalty, and emerging media and digital trends. Collectively, these theories and concepts construct a complete theoretical structure for comprehending consumer behavior patterns and decision-making processes, as well as the interconnections between consumers and their surroundings, individuals, and society. By conducting thorough analysis and examination of these ideas and concepts, we may enhance our understanding of the intricacies and patterns of consumer behavior. This, in turn, enables us to offer precise strategic recommendations for businesses' marketing endeavors, thereby enhancing their market competitiveness.

3. Changes in Consumer Behavior in the Internet Era

3.1. Changes and Trends in Consumer Behavior

The advent of the Internet age has precipitated substantial transformations and patterns in consumer behavior. Historically, consumers were required to acquire information via brick-and-mortar establishments or traditional media marketing prior to making purchases of goods or services. Nevertheless, due to the widespread adoption of the Internet, individuals now have the ability to conveniently obtain diverse product information, consumer evaluations, and expert opinions via platforms such as search engines, e-commerce websites, and social media [3]. This facilitates consumers in acquiring a more extensive comprehension of product characteristics, cost-effectiveness, and other relevant factors, so empowering them to make more informed purchasing selections.

However, it may be argued that the advent of the Internet has expedited the process by which customers make purchase decisions. The conventional method of shopping necessitates a significant investment of time and exertion, as individuals must physically visit brick-and-mortar establishments in order to locate and evaluate merchandise. However, contemporary customers are now able to swiftly locate and purchase desired things online within a matter of minutes. The convenience factor significantly enhances consumer efficiency and happiness. Another notable transformation is the involvement and engagement of consumers. Consumers have the ability to utilize social media platforms as a means to share their purchasing experiences, provide ratings for items or services, and engage in communication and interaction with fellow consumers [4]. This engagement facilitates an increased exchange of feedback and suggestions for consumers, hence enhancing the bond between brands and consumers.

3.2. Influence of Internet on Consumer Behavior

The advent of the Internet has significantly influenced consumer behavior. The Internet offers a diverse range of shopping avenues, including online shopping platforms and mobile shopping applications. This has expanded customers' options beyond traditional brick-and-mortar stores, enabling them to engage in buying activities at their convenience, irrespective of time and location. Consequently, the accessibility and convenience of shopping have been significantly enhanced. Additionally, the advent of the Internet has significantly altered the consumption patterns of consumers. The proliferation of online shopping platforms and the wide range of products available have resulted in an increased propensity among customers, particularly the younger demographic, to engage in online consuming. Simultaneously, the Internet also offers consumers increased chances

for contact and participation, including engagement in product design, purchasing activities, social sharing, and more, so further catering to consumers' participatory requirements.

Simultaneously, the advent of the Internet has facilitated the growth of the sharing economy, thereby altering consumers' purchasing concepts and behaviors. The sharing economy platform facilitates the sharing or rental of goods, services, and resources among consumers within shared communities, hence enhancing resource usage efficiency and meeting individual requirements. This model not only provides cost savings for consumers, but also aligns with the principles of sustainable consumerism and resource sharing. Furthermore, the Internet has significantly contributed to the dynamics of market rivalry. The advent of e-commerce platforms and the availability of online reviews have facilitated the process of comparing product costs and quality for consumers, hence enhancing market transparency. Consequently, merchants are compelled to engage in competition and improve their offerings in order to meet consumer demands. This facilitates an expanded range of options for customers, allowing them to assess and monitor merchants, so enhancing the safeguarding of consumer rights and interests [5].

3.3. Rise and Satisfaction of Individual Needs

The advent of the Internet era has given rise to the phenomenon of individualized demand. The extensive utilization of Internet technology facilitates consumers in effectively expressing their individuality and requirements, as well as acquiring relevant products or services. The utilization of personalized recommendation algorithms enables consumers to discover information that aligns with their own interests and requirements across a vast array of products and services. This, in turn, enhances the overall happiness derived from the shopping experience. Furthermore, consumers manifest their distinctiveness and purchase preferences via various channels, such as social media, thereby fostering a cultural environment centered around the pursuit and exhibition of individuality. This phenomenon serves to amplify the fulfillment of personal demands and the dissemination of communal impacts.

4. Innovation of Advertising Marketing in the Internet Era

4.1. New Forms and Methods of Advertising Marketing

During the era of the Internet, the field of advertising marketing has extensively studied and embraced numerous novel forms and strategies in order to effectively respond to shifts in customer behavior. One of the primary forms of advertising is social media advertising. Social media sites, including Weibo, WeChat, and Facebook, have emerged as significant avenues for consumers to get information and engage in social interactions. Through the strategic placement of adverts on social media platforms, advertisers have the ability to effectively engage with their intended target audiences, thereby capturing their attention and promoting their products or services. Another aspect to consider is search engine advertising. Search engine advertising effectively targets potential buyers who have expressed interest in a certain product or service by presenting them with pertinent advertising content within the search results page. Furthermore, the contemporary landscape of advertising encompasses emerging formats such as video advertising, native advertising, as well as virtual reality and augmented reality advertising.

Furthermore, in light of the increasing prominence of content marketing, organizations are directing their attention towards the creation of valuable and pertinent content with the aim of captivating and involving consumers. This encompasses the creation of many types of content, such as articles, blogs, videos, podcasts, and other forms of media, with the purpose of offering valuable information, entertainment, or narrative that is relevant to the brand or industry. Through the

provision of relevant and engaging content, brands have the potential to cultivate trust and foster loyalty among consumers, while simultaneously enhancing brand recognition and prominence.

Moreover, programmatic advertising has emerged as a significant instrument for advertisers in the digital age. Programmatic advertising leverages algorithms and data to automate the procurement and positioning of advertisements, so empowering marketers to achieve more precision and efficacy in reaching their intended target demographic. This approach facilitates instantaneous bidding and optimization, guaranteeing the display of advertisements to the most pertinent consumers at the appropriate moment and on the suitable platform.

4.2. Target Groups and Strategies of Advertising Marketing

In the Internet era, the target group of advertising marketing has more clear positioning and personalized needs. With the support of Internet technology, advertisers can precisely target audiences according to consumers' interests, purchasing behavior and personal preferences to provide more targeted advertising content. The positioning of the target group can be based on the age, gender, geographical location, interests and other factors of the consumer [6]. In terms of advertising strategy, personalized advertising content and enhanced interactivity have become important strategies. The presentation of personalized advertising is no longer a single message push, but more attention to interaction and engagement with the target audience to improve the acceptance and conversion rate of advertising.

In the contemporary digital landscape, advertisers have embraced several tactics, like remarketing and retargeting, to effectively engage with their intended demographic. The practice of remarketing entails the strategic targeting of individuals who have previously demonstrated interest in a certain brand or product. This is achieved by presenting them with advertisements on other websites they frequent, so serving as a reminder of their initial interest and maybe motivating them to engage in a desired action. In contrast, retargeting is a marketing strategy that aims to target those who have previously interacted with a brand's website or content, however have not completed a purchase or fulfilled a desired objective. Advertisers endeavor to re-engage potential customers and stimulate conversions by strategically displaying targeted advertisements across diverse internet channels.

Furthermore, advertisers leverage data-driven insights to create customized advertising strategies. With the abundant data available in the digital ecosystem, marketers can analyze consumer behavior, preferences, and purchasing patterns to develop personalized messaging and offers that resonate with their target audience. This includes utilizing AI and machine learning algorithms to better understand consumer preferences and deliver tailored advertising experiences.

4.3. Evaluation and Effect of Advertising Marketing

In the Internet era, the evaluation and effect analysis of advertising marketing have become more detailed and accurate. Traditional advertising measurement indicators (such as exposure, click rate, etc.) can not fully reflect the effect of advertising. Internet technology makes it possible to track in more detail the behavior of consumers after the advertisement is placed, such as visiting websites, clicking on links, purchasing products, etc., which makes it possible to assess the conversion rate and return on investment of advertisements more accurately [7]. At the same time, the impact of advertising and brand awareness can also be evaluated through user feedback, comments and word-of-mouth marketing effects of social media.

Furthermore, the progress made in data analytics and attribution modeling has provided advertisers with the opportunity to acquire valuable insights into the efficacy of their advertising efforts. Key performance indicators (KPIs) like as ad impressions, click-through rates, conversion

rates, and return on ad spend (ROAS), among other metrics, can be quantified and assessed by individuals or organizations. Through the examination of these indicators, advertisers are able to gain insight into the advertising channels, messaging, and creative components that yield the greatest impact in achieving desired objectives.

In addition, the measurement of consumer engagement and interaction with advertisements can be accomplished by utilizing many indicators, including but not limited to likes, comments, shares, and post-click behaviors. This aids in assessing the degree of audience involvement and the influence of the advertising campaign on brand perception.

In the contemporary digital landscape, individuals possess more agency in managing their media intake, hence exhibiting heightened proficiency in discerning and disregarding extraneous or intrusive promotional content. Hence, it is imperative for advertisers to prioritize the delivery of pertinent and customized content in order to effectively grab and sustain customer attention. By utilizing data-driven insights, advertisers have the ability to customize their messaging and offers to specific categories, hence leading to increased engagement and improved campaign effectiveness [8].

Continuous monitoring and evaluation of advertising effectiveness is a fundamental requirement for advertisers. This enables individuals to implement essential modifications and enhancements in order to optimize the effectiveness and return on investment (ROI) of their marketing initiatives. Advertisers are now able to utilize real-time reporting and analytics tools to monitor and evaluate the effectiveness of their campaigns in a nearly instantaneous manner. This capability empowers advertisers to promptly react and make informed decisions based on data, fostering a cycle of ongoing enhancement.

5. Problems and Challenges of Advertising Marketing in the Internet Era

5.1. Privacy Issues and False Publicity in Advertising Marketing

In the contemporary digital landscape, the field of advertising marketing encounters a multitude of concerns pertaining to privacy and the dissemination of misleading information. The safeguarding of personal privacy is a significant matter that warrants attention. Advertisers have the ability to amass substantial quantities of personal data pertaining to consumers, including but not limited to their browsing history, search history, and geographic location, through the utilization of the Internet and digital technologies. This data is then employed for the purpose of targeting and delivering advertising content. Nevertheless, the improper utilization of personal data might potentially result in the peril of privacy exposure and exploitation, so compromising the rights and confidence of individuals.

Furthermore, the issue of deceptive advertising is also a prevalent challenge encountered within the realm of online marketing. The Internet offers a cost-effective and convenient platform for advertising, but it also presents the potential for malicious entities to intentionally disseminate deceptive adverts. The dissemination of inaccurate assertions has the potential to misguide consumers, leading them to make ill-informed purchasing choices and eroding trust in businesses. Given the prevailing issue, advertisers must enhance their self-discipline, adhere to the values of honesty, candor, and accuracy, and collaborate with pertinent regulatory bodies to bolster the efforts against deceptive advertising and its subsequent penalties.

5.2. Competition and Challenges of Advertising Marketing

The advertising and marketing industry in the Internet era is currently encountering intense competition and a wide range of consumer behaviors. The advertising industry is experiencing increased levels of competition. The advent of internet technology has resulted in the proliferation

and ease of advertising, while simultaneously intensifying competition. In order to catch the attention of customers, advertisers must employ new formats, content, and techniques to differentiate themselves.

Additionally, the field of advertising marketing encounters the obstacle of modifying consumer behavior. The advent of the Internet has significantly transformed the manner in which individuals obtain information and engage in consumer behavior. Consequently, consumers have become increasingly less receptive to traditional forms of advertising, instead prioritizing personalized, practical, and valuable advertising material. The efficacy of traditional advertising models and tactics has diminished, necessitating advertisers to comprehend customer demands and preferences. Advertisers must employ accurate targeting and customised push strategies based on behavioral data to create engaging and compelling advertising experiences.

Furthermore, the implementation of ad blocking and counter-advertising strategies presents significant obstacles to advertising marketing efforts. The proliferation of the Internet has led to an increasing number of consumers utilizing ad-blocking software or opting to bypass advertisements, thereby diminishing the visibility and influence of these promotional materials. In order to enhance consumer attention and amplify the visibility and efficacy of advertisements, it is imperative for advertisers to provide advertising material that is both captivating and compelling.

6. Countermeasures

6.1. Personalized Positioning and Accurate Delivery

Given the proliferation of consumer behavior data and the advancements in Internet technology, advertisers have the opportunity to employ various techniques, including data analytics and artificial intelligence, to get insights into consumers' interests, purchasing habits, and behavioral traits. By employing accurate targeting methods and implementing tailored advertising strategies, advertisers may effectively attract the attention of customers and deliver an advertising experience that aligns with their specific requirements. When considering individualized positioning and accurate delivery, there exist multiple successful approaches.

One potential advantage is that advertisers have the ability to utilize data analytics techniques in order to acquire valuable insights into customer preferences and requirements. Through the examination of customers' search history, browsing patterns, social media engagements, and other relevant factors, advertisers can acquire valuable data pertaining to consumer preferences and tendencies. These insights have the potential to enhance advertisers' comprehension of their target demographic and enable them to customize their advertising content and promotional activities [9].

Furthermore, advertisers have the capability to employ artificial intelligence technologies in order to tailor recommendations and advertising to individual users. Through the development of intelligent algorithmic models, advertisers have the ability to align advertising content and products with the individual tastes and purchase history of consumers. The implementation of tailored recommendations has the potential to enhance the pertinence and appeal of adverts, thereby bolstering consumers' engagement with those advertisements and their inclination to make purchases.

Additionally, advertisers have the ability to employ geo-targeting technologies in order to achieve more exact targeting. Through the integration of a consumer's geographical location and mobile device data, advertisers has the capability to effectively disseminate advertisements tailored to certain geographies or contextual circumstances. For instance, advertisements that pertain to a certain business sector are strategically positioned in close proximity to such sector, while advertisements that are pertinent to a specific occasion or festive period are also strategically placed. The use of such precision has the potential to enhance the efficacy of advertising, as advertisements

that align with consumers' immediate context are more inclined to elicit their attention and engagement.

6.2. Creating Valuable Content

Consumers in the Internet age have become tired of traditional advertising models and are paying more attention to useful and valuable content. Advertisers can engage consumers by creating content that is fun, educational, and engaging, with brand messages woven into it naturally. By providing valuable content, advertisers can build a good brand image and consumer relations, thereby increasing the effectiveness and influence of advertising.

One is that advertisers can focus on the interests and needs of consumers and provide information and entertainment content relevant to them. By understanding the preferences and concerns of their target audience, advertisers can create engaging articles, videos or images, as well as stories that are relevant to consumers' lives. Such content can attract consumers' attention and increase the interaction and identification between brands and consumers. The second is that advertisers can create valuable content through collaboration and cross-border promotion. By joining forces with partners in other fields or specialties, advertisers are able to combine different perspectives and domain knowledge to create content with greater depth and breadth. To provide consumers with a richer and more diverse experience, and enhance the credibility and impact of advertising. Third, advertisers can also use user-generated content to create valuable content. By inviting consumers to participate in marketing campaigns such as user reviews, taking and sharing photos, videos, etc., advertisers are able to create authentic and interesting content based on consumers' personal experiences and experiences. This user-generated content not only increases consumer engagement and empathy with ads, but also enhances trust and connection between brands and consumers.

6.3. Introducing Innovative Ways of Interacting

The advent of the Internet has presented advertisers with a plethora of novel avenues for engagement, including but not limited to voting mechanisms, contests, social sharing functionalities, and various other interactive features. By enhancing consumer engagement and interaction, advertisers have the potential to effectively captivate consumers and establish stronger connections with them. The utilization of this interactive methodology has the potential to enhance the exposure and dissemination rate of commercials, while concurrently fostering emotional resonance and brand loyalty among consumers [10].

Furthermore, the utilization of augmented reality (AR) and virtual reality (VR) technology can be employed to offer consumers immersive and engaging experiences. Advertisers has the capability to develop augmented reality (AR) or virtual reality (VR) applications, or alternatively, leverage pre-existing platforms, in order to provide customers with the opportunity to engage in virtual product trials, delve into brand narratives, or connect with virtual personas. This phenomenon not only elicits the curiosity and interest of consumers but also facilitates a distinctive and enduring encounter that enhances the relationship between the brand and the consumer.

6.4. Advocating the Principle of Transparency and Integrity

Given the apprehensions of consumers over privacy safeguarding and deceptive advertising, it is imperative for advertisers to promote openness and integrity. This can be achieved by adhering to national laws, regulations, and industry rules, while also ensuring the veracity and precision of advertising materials. Simultaneously, it is imperative for marketers to engage in proactive collaboration with regulatory bodies, enhance the self-regulatory measures within the advertising

sector, and combat the dissemination of deceptive advertisements. These efforts are crucial for upholding the positive reputation of the business and fostering consumer confidence.

In order to maintain openness and integrity in the realm of advertising, it is imperative for marketers to place a high level of importance on safeguarding consumer privacy and adhering to ethical principles. This entails practicing transparency in regards to the gathering and utilization of data, acquiring appropriate consent from consumers, and guaranteeing the secure handling of personal information. Advertisers must to abstain from engaging in deceptive or misleading advertising tactics that have the potential to misrepresent products or deceive consumers.

By espousing the tenets of openness and integrity, advertisers have the ability to not only exhibit their dedication to ethical advertising methodologies but also protect the standing of the business in its entirety. The implementation of this proactive strategy facilitates the development of consumer confidence, enhances customer connections, and advances a more open and morally sound advertising environment.

7. Conclusion

The Internet has changed customer behavior, affecting advertising and marketing. The Internet and mobile gadgets have changed customers' information and communication habits. Consumers often seek, investigate, and evaluate products and services independently, using internet reviews and opinions to make their final purchases. Consumers are less responsive to advertising and more sensitive to false promises and excessive promotions.

In conclusion, the Internet has changed advertising and marketing by forcing advertisers to prioritize personalized and meaningful content and customer engagement. Advertising marketing in a competitive market depends on The Times' growth and ability to react to consumer needs.

This study's restrictions should be addressed in future research. Primary data was collected without a survey or data collection strategy in this study. A poll would have helped understand customer behavior and preferences in the Internet age. The study's coverage of advertising and marketing consumer behavior may have been inadequate. Thus, there may be other factors that affect digital consumer behavior that were not examined in this study. Qualitative interviews or focus group discussions may help researchers understand these unknown factors. This study also examined how consumer behavior changes affect advertising and marketing. These strategies' efficacy and efficiency were not examined. In response to changing consumer behavior, future studies may use quantitative indicators like brand recognition, customer involvement, and sales outcomes to evaluate various advertising and marketing techniques.

This research advances our understanding of digital consumer behavior and its effects on advertising and marketing. However, data collection, comprehensiveness, and marketing approach efficacy evaluation can be improved. A mixed-methods strategy is needed to recognise and overcome limitations in future research to increase understanding. This would help understand the topic better.

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The Impact of Digital Finance on Tourism in Putuo Mountain

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Abstract: Digital finance is a contemporary financial paradigm that leverages information technology and Internet platforms for the execution of financial transactions and operations. Putuoshan, being one of the renowned Buddhist mountains in China, attracts a significant number of devotees and tourists. The advent of digital finance is expected to offer Putuoshan improved payment systems, wealth management options, and financial services, thereby positively influencing its economic growth and augmenting its tourism sector. The literature review approach is primarily employed to synthesize and assess the extant research findings through the collection, organization, and analysis of relevant literature. This process furnishes both theoretical and empirical substantiation for the research inquiries at hand. Digital finance plays a crucial role in mitigating the service-related challenges faced by the tourism industry. The findings indicate that the utilization of big data and mobile payment in the realm of digital finance has a substantial impact on the promotion of the tourism industry in Putuo Mountain. Based on this premise, digital finance plays a significant role in enhancing the tourism experience of travelers visiting Putuo Mountain. The advent of digital banking technology has significantly enhanced the visitor experience and revitalized classic tourist destinations such as Putuo Mountain.

Keywords: digital economy, religion, data analytics, data aggregation

1. Introduction

The expansion of the digital economy has generated significant curiosity over its impact on conventional enterprises and cultural heritage sites. Prior research has examined the influence of the digital economy on several aspects such as tourism, heritage preservation, and local economies. However, there is a scarcity of study that has been undertaken regarding the particular instance of Putuo Mountain and its engagement with the digital economy.

The present study used a mixed-methods approach, integrating both qualitative and quantitative research methodologies. The collection of data will be facilitated through the administration of surveys, conducting interviews, and the examination of secondary data sources. The study will primarily concentrate on the analysis of digitization endeavours undertaken on Putuo Mountain, encompassing the utilisation of mobile applications, online ticketing systems, and virtual reality encounters. The research will moreover examine the perspectives and encounters of various stakeholders, encompassing vacationers, local people, and management authorities.

This study enhances the current body of literature by offering valuable insights into the influence of the digital economy on a particular cultural heritage site, namely Putuo Mountain. The results of this study have the potential to enhance comprehension of the benefits and problems presented by the digital economy within the framework of religious and tourism locations. The research has the potential to provide significant suggestions for the effective management and sustainable development of Putuo Mountain. Additionally, it can offer valuable insights for other sites that are encountering issues related to digitalization. Furthermore, this study has the potential to make a valuable contribution to the wider discourse surrounding the impact of the digital economy on the preservation of cultural assets and the advancement of sustainable tourism.

2. Overview of Digital Finance

Digital finance encompasses the advancement of financial products, business models, technology applications, and business processes through the utilisation of prominent technology platforms, big data, and cloud computing. It encompasses two primary dimensions: emerging technology enterprises that employ technology to offer fintech solutions, and conventional financial institutions that leverage digital technology to enhance their services.

2.1. Definition and Characteristics of Digital Finance

Digital finance exhibits several key qualities, including cost-effectiveness, extensive reach, and a diverse array of service beneficiaries. Digital finance has the potential to overcome geographical barriers and financial constraints in sparsely populated areas with significant investment capital but limited income. Conversely, traditional financial services in densely populated and economically prosperous cities face challenges such as ineffective advertising and complex transaction procedures. However, the utilization of big data in digital finance enables precise marketing by analyzing users' information requirements. The utilization of big data in the realm of digital banking enables the analysis of consumers' information requirements, hence facilitating enhanced and precise marketing strategies. Additionally, it addresses the limitations associated with complex services, which often result in wasteful transactions. The popularization of digital money may also result in its adoption across different regions. Digital finance is predicated upon the utilization of digital technologies, including the Internet and mobile information systems. It surpasses the spatial constraints inherent in traditional financial institutions by leveraging widespread technical communication infrastructure. Consequently, it facilitates residents' access to uniform financial services and products across different locations. This has led to significant advancements in the realm of digital finance at the county, village, and community levels. The digital financial sector has experienced significant growth at the local levels, including counties, villages, and communities. According to Urbinati et al., the use of digital finance has expanded the scope of the intended demographic. The authors observed that the adaptability of digital technology enables a more effective response to the needs of the present target audience [1]. For instance, the utilisation of big data technologies has the potential to facilitate access to financial services for low-income groups and small and medium-sized enterprises. These entities often face challenges in meeting the credit assessment criteria set by conventional financial institutions. By leveraging big data, they can overcome these limitations and effectively engage in financial activities such as credit, investment, and financing, thereby achieving financial success.

2.2. Classification and Application Scenarios of Digital Finance

Accenture has previously published a significant research report titled "Smart Finance Research Report," which highlights that the future development of smart finance will primarily revolve around six sectors: payments, personal credit, corporate credit, wealth management, asset management, and

insurance [2]. In the present study, we aim to investigate the effects of various environmental factors on plant growth. However, in the context of promoting tourism in Putuo Mountain, it can be argued that financial transactions play a crucial role. Digital banking, being the most intimately interconnected channel with customers, exerts the earliest, broadest, and most profound influence on the payment requirements of the majority of users. With the further advancement of intelligent technology, the realm of payment systems will undergo a transformative shift towards a stage where “everything serves as a medium.”

Biometric payment technology, encompassing face recognition, voice recognition, iris recognition, and similar modalities, is significantly streamlining the payment procedure. Additionally, the implementation of blockchain technology is expected to significantly enhance cross-border payment systems. The implementation of this technology is expected to result in a significant reduction in the reliance on manual processing of links within the payment process, leading to a notable improvement in transaction speed. Additionally, it is anticipated that this technology will diminish the influence of intermediaries in the transaction process, thereby enhancing the liquidity of funds. Furthermore, the adoption of this technology will enable real-time confirmation and monitoring, ultimately resulting in the effective reduction of both direct and indirect costs associated with each stage of the transaction.

2.3. Development Status and Trends of Digital Finance

In the China Digital Finance Innovation Development Report, specifically the Digital Finance Blue Book [3], it is highlighted that China’s digital finance sector is expected to exhibit six prominent trends. These trends encompass the movement of digital finance regulation towards rule of law, standardisation, and digital intelligence. Additionally, it is anticipated that large fintech companies will willingly comply with regulations and gradually pursue listing. Furthermore, the business model of digital financial services catering to the real economy will undergo restructuring. The rapid adoption of digital technology is also expected to expedite the digital transformation of traditional financial institutions in China. Lastly, the utilisation of data in compliance with regulatory requirements will witness a significant increase. Digital financial innovation is expected to play a significant role as a catalyst, while the scope of digital RMB implementation in various locations and scenarios is anticipated to broaden further.

3. Development of Putuo Mountain and Current Issues

From a scenic development standpoint, Putuo Mountain holds a significant position as one of the four renowned Buddhist mountains in China and was among the first group of 5A-level scenic places designated in the country. Prior to the outbreak of the epidemic, the yearly influx of tourists amounted to approximately 20 million. In the contemporary period, it is imperative to explore strategies for Putuo Mountain to adapt to the prevailing circumstances and effectively address the challenges it faces.

The utilization of big data, artificial intelligence, and other contemporary technologies is prevalent in the tourism industry, including the Putuo Mountain scenic area. These technologies aim to enhance the tourist experience and offer intelligent products. However, there is a pressing need to assist in the development of the Putuo Mountain scenic area as a world-class tourist destination through digital empowerment and system restructuring. The improvement of quality is an urgent requirement in this regard.

Tourism serves as the primary driver of economic revenue in Putuo Mountain. The phenomenon of industrial homogeneity is readily apparent. This study aims to analyse the composition of the total local revenue in the year 2000. The majority of income, specifically 90%, was derived from tourism, while finance contributed 8%. Agriculture, on the other hand, constituted a mere 1% of the total

income. The remaining 1% was attributed to other sources of revenue. In 2019, the recorded statistics indicated that the total number of tourists visiting Putuo Mountain amounted to 6,229,194 individuals. However, as a consequence of the ongoing pandemic in 2021, the number of visitors significantly declined to 4,919,818 individuals [3]. The repeated occurrences of the pandemic have resulted in the closure of significant attractions in Putuo Mountain on numerous occasions. The current paramount concern revolves around devising strategies to reinvigorate Putuo Mountain in the face of the ongoing epidemic. Currently, there exist three primary obstacles impeding the progress of tourism development in Putuo Mountain.

Initially, it should be noted that visitors do not possess the official intelligent platform known as “one code sharing.” Prominent issues encompass challenges pertaining to arduous travel, protracted customs clearance procedures, a multitude of codes, and cumbersome payment methods. The customs clearance process is hindered by several factors, including traffic congestion and limited availability of parking spaces during peak holiday periods and morning and evening rush hours. Additionally, the presence of multiple procedures such as health codes, tickets, and trip cards further complicates the process. Furthermore, the requirement to switch between various public numbers and QR codes multiple times, coupled with the lack of consistency across official websites, contributes to the overall sluggishness of customs clearance.

Furthermore, the department is currently deficient in implementing a comprehensive knowledge management system that operates as a unified network. The data systems employed by different market entities are independent and lack integration, leading to the absence of a comprehensive knowledge management system. Consequently, the full potential of extensive visitor data resources in terms of productivity value remains untapped.

Furthermore, it can be observed that the beautiful area is deficient in the integration of the cultural tourism business, which encompasses three key components. Tourism products exhibit singularity, characterized by a weak brand presence and a lack of prominent highlights. Approximately 75% of tourists continue to concentrate their visits on the three major temples and traditional destinations such as the South Sea Guanyin [4]. The overall benefits derived from tourism consumption are limited, mostly due to an excessive dependence on ticket sales and the incomplete development of the tourism industry’s entire production chain pattern.

4. Countermeasures with the Help of Digital Finance

4.1. One Code Pass

The implementation of the ‘One Code Pass’ initiative has been undertaken by Putuo Mountain in response to the identified needs. The One Code Pass has amassed a total of 156 million elements in its integrated data resource system. Additionally, it engages in partnerships with 165 market entities encompassing various sectors such as food, residence, travel, amusement, shopping, and entertainment. It also collaborates with 27 management departments, 8 transportation businesses operating by sea, land, and air, as well as 56 public numbers and 15 QR codes. Furthermore, OneCode has a historical connection with the Buddhist Association, associating it with the concept of being the ultimate solution to all inquiries in all domains. Since its inception, there has been a notable enhancement of traffic efficiency, with a substantial rise of 70% [5]. OneCode consists of three primary areas, including Home, Announcements, and My.

The initial sub-menu corresponds to the homepage. On the homepage, there is a compilation of six components pertaining to tourism, namely the order code, checkout code, health code, which collectively facilitate a unified code for seamless movement within the beautiful area.

The online reservation platform offers a comprehensive range of services that cater to the needs of tourists, encompassing various modes of transportation like as sea, land, and air. These services

include the provision of a convenient one-ticket pass for accessing Putuo Mountain, a set of tickets for Luojia Mountain, ropeway tickets, airport flight consulting, smart parking facilities, and personalised customization options through the Star Tour feature. The Luggage Butler service offers a convenient solution for travellers by utilising mobile phone scanning technology for depositing or consigning luggage. This service provides one-key storage, real-time tracking, and comprehensive assistance, thereby shifting the traditional hotel lobby function to the forefront of airport and dock operations. As a result, travellers are able to securely store their belongings and fully immerse themselves in their travel experiences. The Drip tour guide service is an innovative addition to the tourism sector, drawing inspiration from online interactions among tour guides, visitors, and travel agencies. This service introduces a distinctive “drip taxi” concept, enabling users to conveniently place orders with a single click and receive real-time dispatch of tour guides. The objective is to construct a standardised and transparent online business platform for Putuo Mountain housing and taste culture and creative mall. This platform aims to activate the service industry quality improvement and establish a project access mechanism [6].

The subsequent sub-menu pertains to announcements. This project aims to develop a code that generates culturally significant routes based on three distinct categories: culture, natural resources, and folklore. Additionally, it seeks to incorporate an AI-based actual scene construction to enhance the visual appeal of the landscapes encountered along these routes. The proposed enhancement to the smart map involves incorporating scientific monitoring of visitor flow at attractions. This monitoring would be based on the established categories of “warning,” “crowded,” and “comfortable.” Additionally, a new category called “clean” would be introduced, which pertains specifically to the cleanliness of the attraction. By including this “clean” level, visitors would be able to make informed decisions about their choice of attractions based on the degree of visitor flow. The chosen site for analysis is the South Sea Goddess of Mercy, which is described as a location that possesses qualities of purity and suitability for the cultivation of the mind. During the online consultation, we have devised a virtual customer care platform called Putuoshan Xiaozhi, which efficiently addresses inquiries from visitors regarding pertinent policies. The online platform offers a 24-hour intelligent complaints service, where the business desk promptly identifies the complaints and forwards them to the relevant unit for joint law enforcement action. Additionally, real-time feedback on the outcomes of these actions is provided.

The third sub-menu, labelled as “My,” serves as a comprehensive representation of each tourists, providing accurate personal profiles that showcase order details and consumption spots. Based on the analysis of consumption patterns, our approach involves strategically promoting tailored items to cater to the preferences of tourists. In terms of payment behaviour, we have implemented a point-based system and an interactive platform to enhance customer engagement. Furthermore, considering the frequency and trajectory of visitors to the mountain, we have devised a mechanism to allocate points based on their level of commitment and loyalty, referred to as “my devotion.”

4.2. Putuo Mountain Cultural Tourism Brain

Regarding governance, we have developed the Putuo Mountain Cultural Tourism Brain, a system that has successfully gathered a vast amount of data totaling 156 million pieces. This achievement has facilitated the implementation of principles such as the return of public data, the sharing of management data among various departments, and the provision of open service data in diverse scenarios.

The governance component has four elements, including visitor profiling, ticketing information, traffic congestion points, and parking facilities. The data analysis process involves utilizing drill-down analysis and early warning research function. This is achieved by employing LBS intelligent recommendation and LDA theme analysis algorithm. These algorithms are used to delve into the data

arithmetic, enabling a comprehensive understanding of the visitors' needs. Consequently, the visualization display of tourism resources across the entire area is accomplished.

The analysis of ticketing data encompasses various variables, including the rate at which visitors revisit a destination and the trend in passenger traffic. Based on the analysis of the daily distribution of passenger flow and in accordance with the requirements for epidemic prevention and control in scenic areas, a scientifically designed time-sharing reservation system has been implemented. This system includes five time slots during the daytime and one time slot during the nighttime. The primary objective of this system is to efficiently mitigate the congestion resulting from abrupt surges in the number of visitors, while also guaranteeing a pleasant and uninterrupted travel experience for tourists who are exploring Xiang.

The visitor portrait examines various variables pertaining to visitors, including their gender, age, place of origin, and consumption behavior. For instance, marketing and promotion initiatives were undertaken for the cultural tourism experience tour of Putuo Mountain Zhujiajian in Hubei and Hunan Province, which currently possess a relatively small market share. These activities included campaigns such as “‘Sakura’ for you, getting better and better.” Furthermore, an examination of the demographic composition of tourists revealed that individuals born between 1980 and 1999 (commonly referred to as the post-8090s generation) accounted for 48% of the market share [6]. By examining the age distribution of tourists, it has been determined that individuals born in the 1980s and 1990s account for 48% of the overall market share. In order to appeal to a larger number of young tourists, we have implemented marketing strategies such as the “Blessing in Meizen” campaign and the “South Sea Heart” competition. These initiatives aim to engage young visitors through interactive interpretation and a focus on providing high-quality experiences [7].

The analysis of traffic chokepoints and parking lots involves examining several aspects such as traffic flow, congestion, and parking availability. This analysis is conducted using an intelligent algorithm engine based on location-based services (LBS), which allows for real-time adjustments to response levels. As an illustration, whenever the flow rate surpasses 1600 cars per hour, a diversion of traffic will occur onto 310 provincial road within a short cycle. Similarly, when the flow rate exceeds 2000 vehicles per hour, a diversion of traffic will take place onto 329 national road and 310 provincial road within a longer cycle, employing a ‘zipper’ mechanism.

5. Conclusion

The advent of digital finance has bestowed upon Putuoshan a range of convenient payment options, wealth management tools, and financial services. This development has exerted a favourable influence on the economic progress of the region and has contributed to the augmentation of its tourism sector. This study use a literature review methodology to synthesise and assess the current body of research by gathering, structuring, and analysing pertinent literature. The aim is to furnish theoretical and empirical substantiation for the research inquiries. Digital finance plays a crucial role in mitigating the service-related challenges within the tourism industry, particularly in the context of Putuoshan. The utilisation of big data and mobile payment systems emerges as a vital driver in the promotion and advancement of tourism in this region. Digital money plays a significant role in enhancing the tourism experience of travellers visiting Putuoshan. The utilisation of digital finance technology has significantly enhanced the tourist experience and imparted fresh momentum to a historical tourist destination such as Putuoshan. The digital economy, religion, data analysis, and data aggregation are four distinct topics that have garnered significant attention in academic discourse. The digital economy refers to the economic activities and transactions that occur through digital platforms and technologies. Religion, on the other hand, encompasses a wide range of beliefs, practises, and rituals that are associated with the This study elucidates the significance of digital finance in relation to the tourism sector of Putuoshan. Putuoshan leverages the benefits of digital

finance to enhance the convenience of tourism experiences and services through the implementation of the “One Code Pass” and the establishment of an intelligent management system. Nevertheless, the tourism sector in Putuoshan has several challenges, including the absence of an authorised intelligent platform catering to tourists, deficiencies in the “One Code” management system, and a limited range of tourism offerings. To address the aforementioned issues, this report suggests implementing certain steps, including the implementation of the “One Code” system and the construction of the Putuoshan Cultural Tourism Brain. The implementation of these remedies has the potential to enhance the advancement and administration of Putuoshan tourism, while fostering its sustainable growth. The utilisation of digital money plays a significant part in the advancement of Putuoshan tourism. By effectively using the benefits and capabilities of digital finance, Putuoshan has the potential to offer enhanced convenience and efficiency in its tourism services, hence elevating the overall tourism experience for visitors. Nevertheless, the tourism sector in Putuoshan encounters various obstacles and necessitates enhanced management and innovation to attain sustainable growth. The study aims to offer significant insights and references for the management and sustainable growth of Putuoshan, as well as for other similar attractions grappling with issues related to digitalization.

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Analysis of Corporate Long-Term Investment Decisions

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Abstract: The incorporation of long-term investment has consistently held a prominent position within the realm of business advancement, exerting a substantial influence on business circumstances and economic outcomes. Consequently, delving into the matter of effectively managing risk and attaining commensurate returns warrants thorough investigation. The company's experience is replete with examples of unsuccessful long-term investment choices. This paper discusses the implementation of long-term investment analysis in enterprises. It employs the methodology of literature analysis and review to examine the reasons behind enterprises engaging in long-term investments. Furthermore, it provides a detailed analysis of investment decision-making methods, identifies associated challenges, and proposes corresponding solutions. The goal of this paper is to assist enterprises in making informed decisions regarding long-term investments and ultimately selecting the most optimal choices.

Keywords: long-term investment decisions, short-term investments, cash flow

1. Introduction

Since the initiation of China's reform and opening up policies, there has been a significant transformation in the country's economic system, transitioning from a centrally planned economy to a market-oriented one. This reform of the economic system has played a crucial role in fostering investment growth and gradually enhancing the overall performance of the socialist market economy [1]. Enterprises encounter the task of selecting various forms of investment during their long-term growth trajectory. In the realm of long and short-term investments, long-term investments inherently entail greater risk due to the extended time frame involved. Consequently, this array of risk-related concerns can occasionally yield unforeseeable consequences for the company. Hence, it is imperative for enterprises to engage in proactive planning, meticulous analysis, and thorough comparison of alternatives when making long-term investment choices, with the aim of selecting the most advantageous decision that will enhance the company's competitive standing. This paper employs a literature analysis and review methodology to examine the process of selecting a company for long-term investment and the associated challenges. The objective is to encourage future enterprises to make informed decisions regarding long-term investment and development, with the aim of facilitating the company's progress and growth.

2. Main Reasons Affecting Long-Term Investment Decisions of Enterprises

2.1. Time Value of Money

The primary objective of long-term investing is to generate higher returns on a fixed capital. However, it is important to note that the value of a fixed capital, which may appear unaltered, will gradually diminish over time. Individuals who possess currency and seek to maximise their gains must possess a comprehensive understanding of the economic implications associated with the simultaneous occurrence of currency depreciation and appreciation. The currency holder anticipates not only recouping the amount lost due to currency depreciation, but also seeks to generate additional profit unaffected by depreciation. The individual who possesses the currency engages in investment or transfer of the currency into a profit-generating mechanism. Through the utilisation of capital, the value produced by labour is transformed into the monetary value of the currency, resulting in the acquisition of additional currency and monetary profit. This process represents the overall operational framework of the time value of the currency [2].

2.2. The Cost of Capital Factor of Money and Cash Flow Factor of Money

The cost of capital encompasses both the expenses incurred in utilizing funds for investment purposes and the accompanying opportunity costs. It is also regarded as the minimal rate of return that an investor can expect to obtain from a project. The cost of capital is influenced by the prevailing local financial policies, and the decision to invest in a project hinges on the combined value of the investment's rate of return and the cost of capital. This value serves as a crucial reference point for investors during the investment evaluation process.

The consideration of cash flow entails the examination of two distinct categories: cash outflow and cash inflow. It is important to note that cash encompasses not only paper money but also various non-monetary resources. When calculating the value of cash flow, it is customary to account for the time value of money. This involves determining the timing and magnitude of cash inflows and outflows during a specific period [3]. It is important to acknowledge that while cash flow holds significant importance in the decision-making process, additional information is necessary to compensate for the limitations inherent in this process. Factors such as the subjective awareness of the calculator and the various methods employed to calculate cash flow values can influence the final comparison of results.

3. Analysis of Long-Term Investment Decision of Storm Group Ltd.

3.1. Introduction of Storm Group Limited and Its Major Investment Direction

Established in January 2007, Storm Group is a renowned Internet video firm in China, with a registered capital of RMB 332 million and a workforce of over 1,300 individuals. The business operations of the group encompass a diverse array of sectors, such as Internet video, sports, film, television, virtual reality, games, electronic commerce, and finance, among others. The company possesses various brands, including Storm Sports, Storm Pictures, Storm TV, Storm Sunglasses, and Storm Video, with the aim of establishing a comprehensive "Storm Ecosystem." In 2015, the group was officially listed on the Shenzhen Growth Enterprise Market (GEM) under the stock code 300431 [3].

The company comprises over 20 participating and controlling enterprises, which are engaged in many sectors like finance, cinema and television, sports, culture, and games. The company's portfolio encompasses a diverse range of investments, including video players, Internet TV, sports, financial markets, virtual reality technologies, and the game market, among others.

3.2. Three Main Long-Term Investment Projects of Storm Group

1) Storm Magic Mirror Project. With the emergence of the virtual reality (VR) concept, Storm Group holds the belief that the VR industry exhibits significant potential for growth. Consequently, the company made its foray into the VR sector in 2015, primarily focusing on the research and management of hardware and content. The Internet industry is characterised by a significant level of uncertainty and a high degree of business risk. In order to assess the viability of a project within this industry, the return period hair is employed as a method of evaluation. The current analysis indicates that the recovery of the capital invested in the project in the short term is challenging due to the calculation of the storm group. Consequently, the project is currently in the investment stage, which carries the potential for unforeseeable impacts on the enterprise. These impacts have resulted in a series of unfavourable reactions, thereby raising concerns about the future of this investment decision.

2) Storm sports project. In 2016, Storm Group made its foray into the sports business through the acquisition of a 65% ownership in MP&Silva. MP&Silva primarily specialises in the management of distribution and acquisition of sports event rights. The evaluation of this project was conducted using the net present value technique. When the limit value is positive, it signifies that the project is expected to yield a positive return on investment. The net present value (NPV) of the sub-project in 2016 is determined to be 16,556. Based on this calculation, it can be inferred that the project will not achieve cost recovery until the year 2024. The primary rationale behind the choice of this project stems from MP&Silva's copyrights and market, which serve as the basis for constructing the company's ecosystem. However, the substantial expenditure of \$1 billion may potentially impede the growth of the Group's core business.

3) Storm TV project. Internet television encompasses a range of profit models and places significant emphasis on enhancing user experience. Diverging from conventional television, it offers viewers a multitude of utilisation options. In evaluating the Storm TV project, the internal rate of return is employed as a metric. The computation yields an internal rate of return of 6%, above the market discount rate. If the stability and development of the group have been observed, it is likely that the profit margin will be bigger. However, this may result in increased financial strain in the near term due to initial losses incurred.

The primary characteristic of the company's investment decision is its disregard for the significance of human capital. The decision-making authority is concentrated within the leadership, disregarding input from other personnel. Additionally, the decision fails to account for the time value of money, resulting in relatively lengthy payback periods for the aforementioned investments. Furthermore, the group has not adequately assessed the investment risk [4].

4. A Basic Approach to Long-Term Corporate Investment Decision-Making

4.1. Payback Period

The payback period can be calculated by dividing the net cash investment by the annual net cash benefits. When the project's daily net cash benefits demonstrate a high level of consistency, it is possible to utilize this method in order to determine the approximate time required to repay the principal investment. When selecting a project, it is preferable to opt for a shorter payback term, provided that the project's payback duration is shorter than its whole implementation length. In such cases, the organization can proceed with the project and its subsequent implementation. The primary benefit of this approach lies in its simplicity of calculation. However, it is important to note that this method does not consider several other elements, such as the time value of funds, cash flow,

and other relevant considerations. Consequently, it can only serve as one of several indicators in the decision-making process and cannot be solely relied upon as the decisive data.

4.2. Net Present Value

The specific formula for calculating NPV is: $NPV = \sum_{t=1}^n \frac{R_t}{(1+i)^t} - C_0$, where: i represents the discount rate, C_0 represents the net cash investment, R_t represents the net cash benefit in year t , and NPV represents the net present value. When the NPV is negative, it means that the enterprise will incur a loss if it invests in the project, and vice versa, the project will be profitable. Its advantage is that it takes into account the time value of money and discounts for each cash flow, and its disadvantage is that the discount rate is difficult to determine and it is difficult to compare projects of different years horizontally.

4.3. Internal Rate of Return

The specific formula for calculating the internal rate of return (IRR) is: $\sum_{t=1}^n \frac{R_t}{(1+r)^t} - C_0 = 0$, where C_0 represents the initial net cash investment and R_t represents the annual net cash benefit. The internal rate of return IRR is also the discount rate when the net present value is equal to zero, if the IRR is greater than the cost of capital of the project, it means that the corresponding net present value is greater than zero, then the programme is feasible, and vice versa, it is not feasible. If IRR is greater than zero in several project comparisons, the higher IRR is preferred.

In relation to the prevailing market structure, the payback period approach has proven to be mostly unfeasible. Instead, the NPV method and the IRR method are frequently employed, with the NPV method being more aligned with market economics [4].

5. Problems with Long-Term Investment Decisions in Enterprises and Options to Address Them

5.1. Corporate Decision-Making Level Issues

When evaluating the feasibility of an investment project, it is crucial for decision makers to consider factors such as the time value of money, cash flow, and many company-specific variables. By employing rigorous scientific calculations, decision makers may comprehensively assess the potential rewards and risks associated with altering their investment strategy. In the aforementioned Storm Group television production, the leaders of the organization committed a comparable error. When making project decisions, the use of big data analysis is frequently more precise compared to relying just on empirical assertions. Additionally, the inclusion of excessively high or low arithmetic projections throughout the calculation process can lead to significantly divergent results, potentially resulting in the failure of the final investment.

One key aspect pertains to the centralization of decision-making authority. It is imperative for the board of directors of an organization to judiciously allocate decision-making power. This allocation serves to prevent scenarios where a single individual's decision encounters opposition from a multitude of individuals. By achieving this balance, the enterprise can effectively manage the risk and return associated with its investments. Furthermore, employing a proper analytical and deliberative approach to decision-making ensures the accurate and efficient implementation of project decisions. This underscores the importance of enhancing the organizational structure. Furthermore, the deficiency in expertise among decision-makers, coupled with the rapid pace of societal progress, necessitates a continuous enhancement and expansion of knowledge systems. Exceptional decision-makers must also acquire new knowledge to enrich their experiences.

Consequently, it is imperative for enterprises to opportunistically engage professionals to facilitate knowledge transfer within the organization. This approach enables decision-makers to achieve comprehensive development while simultaneously propelling the company forward, thereby yielding positive outcomes for both superiors and subordinates. This will provide positive effects on both individuals in positions of authority and those in subordinate roles.

5.2. Risk Assessment Issues

Long-term investments in extensive projects entail higher risks for enterprises. In the initial stages of preparation, there is a possibility of failing to identify and foresee future risks, resulting in a lack of intervention and contingency planning. Consequently, the project plan may be implemented without due consideration of potential challenges. Following the execution of the project, a series of issues arising from the associated risks have emerged. The enterprise has encountered difficulties due to the absence of a suitable response programme, leading to the occurrence of various crisis situations without a viable solution. In some cases, attempts to address these crises have been made without a comprehensive understanding of the situation, resulting in a gradual deterioration of the circumstances and an eventual loss of control. The neglect of risk management by enterprises and its impact on their ability to sustain progress is a critical concern.

The enhancement strategies can be categorised into two segments. During the initial phase of enterprise preparation, it is advisable to thoroughly anticipate potential hazards, such as cash flow disruptions and technological advancements, and conduct a comprehensive analysis and evaluation to assess the risk and reward factors. In order to effectively address potential risks that may arise in the future, it is crucial to develop suitable contingency plans. By doing so, organisations can adequately prepare themselves to confront these challenges and avoid the risk of survival difficulties. Moreover, this proactive approach enables enterprises to establish a favourable position in their developmental journey.

5.3. Management Accounting Issues

Irrespective of the previously mentioned concept of the time value of money, the expenses associated with the fund as well as the cash flow, the primary determinant in evaluating a project remains arithmetic. Long-term investment prioritises long-term objectives and disregards short-term profits or declines. Conducting data research is an essential component of the decision-making process and serves as a crucial indicator for making informed judgements. Neglecting the significance of management accounting in enterprise development can potentially restrict the growth of the enterprise and hinder its long-term progress.

Enterprises must make prudent selections regarding their future development trajectory, while concurrently enhancing employee motivation. It is recommended that enterprises implement regular training programmes for management accountants in order to enhance their business knowledge and elevate the status of management accounting within the organization. This can be achieved by improving the business acumen of management accountants and aligning their skills with the economic realities of the enterprise. By doing so, the management accounting team can effectively contribute to the overall success of the organization [5].

6. Conclusion

The paper aims to investigate the rationales behind long-term investments in enterprises. Subsequently, it analyses three investments made by Storm, focusing on the calculation methods employed to determine the optimal solution for long-term investment selection. Moreover, it identifies the challenges encountered during the implementation process and proposes potential

solutions to address these issues. This study solely examines the three investments made by Storm from a theoretical perspective, without conducting specific investigations or research. It also does not provide a comparative analysis of other companies' long-term investment choices. However, further research and discussion on this aspect will be conducted in the future. Long-term investment is a crucial strategic component in the developmental trajectory of a company, serving as a pivotal juncture for the company's future growth. It is anticipated that the company will employ novel and precise methods in its long-term investment endeavors, thereby establishing a robust foundation for both the company's development and the broader business environment.

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A Comparative Examination of Stock Market Prediction: Evaluating Traditional Time Series Analysis Against Deep Learning Approaches

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Abstract: The contemporary financial landscape is characterized by dynamic market behavior. Accurate predictions of stock price movements are not only of paramount importance for financial decision-makers but also pose a significant challenge due to the inherent complexities of financial markets. This research study delves into the realm of stock market prediction by employing a comprehensive approach that combines time series analysis and machine learning techniques. The main goal is to assess different models in predicting price trends, potentially reshaping stock market forecasts and emphasizing the need for tailored predictive approaches for individual stocks. The study focuses on the example of Apple Inc. (AAPL) stock data and aims to uncover the effectiveness of various models in forecasting its price trends. Our results emphasize that the LSTM model surpasses the conventional ARIMA model in terms of forecasting accuracy, suggesting a promising path for improving stock market predictions. This comparative exploration provides insights into the potential of machine learning models in refining stock market predictions and highlights the importance of tailoring predictive methodologies to individual stock behaviors.

Keywords: stock price prediction, ARIMA, LSTM, machine learning, time series

1. Introduction

The stock market, with its intricate and dynamic nature, continues to captivate the attention of researchers and practitioners alike. A central challenge in this field pertains to accurately predicting stock price movements, a task of utmost importance for informed financial decision-making, effective risk management, and successful investment strategies. Traditionally, time series analysis has played a significant role in addressing this challenge. However, recent developments in machine learning, particularly in deep learning, have injected new vitality into this landscape. This study seeks to bridge the gap between time-honored time series analysis and cutting-edge machine learning, with a specific focus on deep learning, with the primary goal of assessing their applicability and effectiveness in stock market forecasting.

The domain of stock market prediction has traditionally relied on well-established methodologies, notably the AutoRegressive Integrated Moving Average (ARIMA) model. These techniques have been adept at unraveling the complexities within time series data, providing a foundational understanding of market behavior. Nevertheless, recent advancements in machine learning,

exemplified by Long Short-Term Memory (LSTM) networks, have demonstrated exceptional capability in capturing and interpreting intricate temporal patterns. This evolving landscape necessitates a reevaluation of established paradigms in stock market prediction. Accurate stock market predictions hold practical significance across various sectors, including financial institutions, individual investors, and broader economic systems. Decisions informed by reliable predictions significantly impact portfolio management strategies, risk mitigation, and optimal trading approaches, underscoring the urgency of refining and augmenting prediction methodologies due to their real-world implications.

Despite the progress in predictive techniques, notable research gaps persist within the realm of stock market prediction. Conventional methods may struggle to capture the complex nonlinear patterns inherent in stock market dynamics. Conversely, sophisticated deep learning models, while powerful, may lack interpretability, making their insights less accessible to decision-makers. Furthermore, a noticeable gap exists in the literature—a scarcity of comprehensive comparative analyses that juxtapose these contrasting approaches within the specific context of individual stock entities. This gap motivates our study, prompting us to address these shortcomings through a detailed exploration, with Apple Inc. (AAPL) as our case study. By analyzing the predictive performance of traditional methods and deep learning, we aim to uncover how these distinct methodologies respond to AAPL's unique stock behavior, reactions to company-specific events, and its position within the broader market landscape.

Our research journey commences with rigorous data curation, where we source historical daily closing prices of AAPL from reputable datasets. Subsequently, our preprocessing phase involves calculating daily returns and structuring the data meticulously to facilitate analysis. Our approach encompasses a wide range of methodologies, including traditional techniques like ARIMA, alongside contemporary deep learning methods like LSTM. The implementation and analysis are conducted using the versatile R programming language, known for its capabilities in statistical rigor and machine learning.

The structure of this study is purposefully designed to offer a well-organized progression through the complex field of stock market prediction. It begins with an extensive literature review, providing historical context and identifying research gaps. Simultaneously, we detail our data acquisition, preprocessing, and preparation processes to enhance transparency. As the study advances, we engage in the analysis phase using ARIMA in R Studio and LSTM in Jupyter Notebook. The study culminates in a reflective discussion, synthesizing findings and providing insights into future research directions and implications.

2. Literature Review

2.1. Traditional Approaches

Time series forecasting has held a significant place in research ever since humans began making predictions involving time-related components. As noted by De Gooijer and Hyndman (2006), the earliest statistical models for time series analysis, namely AutoRegressive (AR) and Moving Average (MA) models, were developed in the 1940s [1]. These models aimed to describe time series autocorrelation but were initially limited to linear forecasting challenges. In 1970, Box and Jenkins systematically analyzed previous knowledge, developed the ARIMA model, and expounded upon the principles and methods of ARIMA model identification, estimation, testing, and forecasting [2]. This body of knowledge is now known as the classical time series analysis method, a vital part of time domain analysis methods. During the 1980s and 1990s, the integration of seasonality into time series modeling emerged. Techniques such as X-11 and X-12-ARIMA were utilized to extract seasonal patterns and incorporate them into time-series forecasting [3].

Over the past few decades, a myriad of methods has been utilized for forecasting across various domains. These methods encompass traditional technical analysis (“charting”) of price charts [4], algorithmic statistical models [5], and contemporary approaches involving Machine Learning and Artificial Intelligence [6]. Computational time series forecasting has diverse applications, spanning weather forecasts, sales predictions, financial tasks like budget analysis, and stock market price forecasting. It has become an essential tool in domains reliant on temporal factors. Methods such as Autoregression, Box-Jenkins, and Holt-Winters have been utilized to achieve generally accepted predictive outcomes.

2.2. Deep Learning Approaches

In recent years, a surge of innovative techniques and models has emerged, leveraging the potential of deep learning methodologies. Significantly, the Long- and Short-Term Time-Series Network (LSTNet) has surfaced, incorporating both Convolutional Neural Network (CNN) and Recurrent Neural Network (RNN) designs, effectively capturing both short-term and long-term dependencies within time-series data [7]. Another distinctive approach combines the Gaussian Copula process (GP-Copula) with RNN, offering a new paradigm for enhancing time-series predictions [8]. The Neural Basis Expansion Analysis (NBEATS) recently achieved state-of-the-art recognition in the M4 time-series prediction competition, showcasing the effectiveness of deep learning methods [9]. This domain has demonstrated that deep learning methods offer a notable advantage over traditional counterparts, especially in mitigating overfitting concerns, as supported by earlier research [10].

Several studies have highlighted the superiority of classical deep learning and machine learning models over conventional ARIMA models in the realm of time-series forecasting. An array of sophisticated models, including Multi-Layer Perceptron, Convolutional Neural Networks (CNN), and Long Short-Term Memory (LSTM) networks, have been meticulously examined for their effectiveness in predicting time-series trends. Their ability to accommodate multiple input features translates to heightened accuracy compared to traditional methodologies. Notably, enhancing predictive model performance depends on careful feature extraction, even when utilizing relatively straightforward features. Some studies have ingeniously leveraged modified deep networks to extract frequency-related attributes from time-series data using techniques like Empirical Mode Decomposition (EMD) and Complete Ensemble Empirical Mode Decomposition with Adaptive Noise (CEEMDAN). These extracted features are then integrated seamlessly into LSTM models for precise one-step-ahead forecasting [11], [12]. Simultaneously, novel approaches have emerged, such as leveraging image data characteristics through the decomposition of raw time-series data into Intrinsic Mode Functions (IMFs). These IMFs are subsequently employed by Convolutional Neural Networks (CNNs) for automated feature learning [13]. Enhancing these methods, data augmentation approaches have emerged, integrating external text-based sentiment data with model-generated features, resulting in a harmonized predictive paradigm [14].

Furthermore, the field has seen the proposal of autoregressive models like the DeepAR model. This model employs high-dimensional, related time-series attributes to train Autoregressive Recurrent Neural Networks, showing demonstrably superior performance compared to competitive models [15]. Simultaneously, a groundbreaking study introduced the Multi-Step Time-Series Forecaster, utilizing an ensemble of related time-series attributes to forecast demand, showcasing the versatility of deep learning in various applications [16]. Moreover, a group of state-of-the-art methodologies has emerged, presenting promising results in general competitions such as M4 [17]. Lastly, a consensus has developed that the collective synergy of a group of models consistently outperforms any individual model, underscoring the strategic significance of a coordinated approach [18].

3. Methology

3.1. Data Description

The data underpinning this research is retrieved from Nasdaq, comprising detailed stock price information of Apple Inc. (AAPL) from September 2013 to September 2023. Figure 1 visually represents the stock's closing prices within this timeframe. Table 1 shows the parameters of the data.

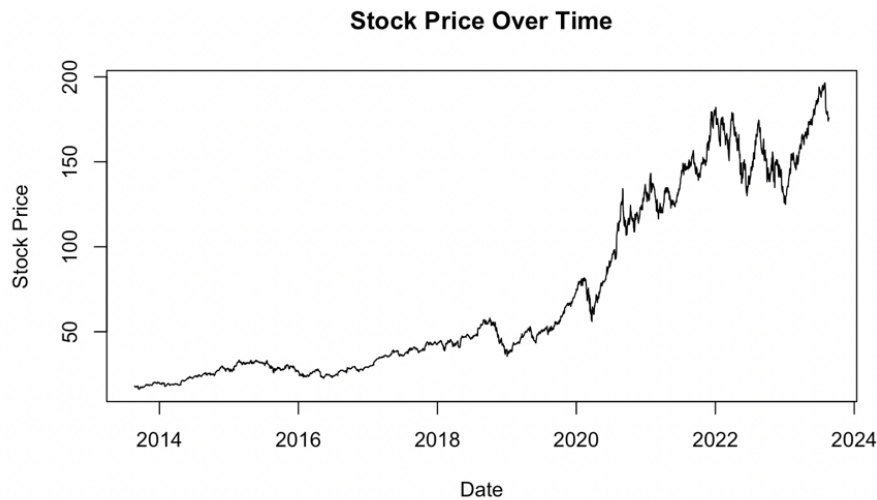


Figure 1: AAPL Stock Price Over Time.

Table 1: Statistical Parameters.

Minimum	1st quadrant	Median	Mean	3rd quadrant	Maximum
16.08	28.66	44.91	71.00	126.44	196.45

3.2. Model

For traditional time series analysis, we employ well-established methodologies such as ARIMA (AutoRegressive Integrated Moving Average) and LSTM (Long Short-Term Memory). Each of these models brings its unique characteristics and strengths to the forefront of stock market prediction.

ARIMA is a cornerstone in time series forecasting, renowned for its ability to capture temporal patterns and seasonality. It consists of three primary elements: AutoRegressive (AR), Integrated (I), and Moving Average (MA). The AR part represents the connection between the current value and previous values. The I component signifies the differencing necessary to render the series stationary, while the MA component models the association between the current value and past errors. ARIMA has demonstrated its utility in modeling linear trends and stationary time series data, establishing it as a crucial tool in financial forecasting. In contrast to ARIMA, LSTM represents a breakthrough in deep learning for time series analysis. LSTM is a type of Recurrent Neural Network (RNN) equipped with memory cells that can capture long-term dependencies in sequential data. This architecture makes LSTM exceptionally well-suited for modeling intricate temporal patterns and capturing nonlinear relationships within stock price data. LSTM's ability to "remember" past information over extended periods can reveal hidden patterns and nuances that elude traditional linear models.

The choice to employ ARIMA and LSTM in our analysis aims to provide a comprehensive exploration of diverse prediction strategies. By integrating these traditional and deep learning approaches, we seek to illuminate how each model responds to the intricate interplay of market

dynamics and economic influences. Together, they form the foundation for our comparative study, offering a holistic view of the evolving landscape of stock market prediction.

4. Results

4.1. Arima Model

In the conducted time series analysis, the optimal model was identified through the utilization of the `auto.arima` function, a component of the forecast package in R, which automates the process of selecting the best-fitting ARIMA model based on the minimum Akaike Information Criterion (AIC). The AIC is a valued metric in time series forecasting, formulated as:

$$AIC = 2k - 2 \ln(\hat{L}) \quad (1)$$

where:

- k is the number of parameters in the statistical model,
- $\hat{L}$ is the maximum likelihood estimate of the model.

In our analysis, the model that minimized the AIC was the ARIMA (0,1,1) accompanied by a drift component. The mathematical representation of this model is given by:

$$Y_t = c + \theta_1 \epsilon_{t-1} + \epsilon_t + \beta t \quad (2)$$

where:

- Y_t is the predicted value at time t ,
- c is a constant,
- θ_1 is the coefficient of the first moving average term,
- ϵ_{t-1} is the white noise error term at time $t - 1$,
- ϵ_t is the white noise error term at time t ,
- β is the coefficient associated with the linear time trend (drift), and
- t is the time period.

In this instance, the ARIMA(0,1,1) model is characterized by:

(1) No autoregressive terms $p = 0$, indicating that past values of the series are not utilized in forecasting future values.

(2) A differencing order of one $d = 1$, denoting that the series has been differenced once to attain stationarity, a requisite property to eliminate trends and seasonality in the data, ensuring a constant mean and variance over time.

(3) A single moving average term $q = 1$, which considers one past white noise error term in the forecasting process.

In summary, the findings posit the ARIMA(0,1,1) model with a drift component as a potentially robust and reliable forecasting tool for the time series at hand, exhibiting satisfactory predictive accuracy as illustrated by the metrics detailed in Table 2 and Figure 2. Future research endeavours should consider further validation of this model using diverse datasets and benchmarking its performance against other sophisticated forecasting methodologies for a holistic analysis.

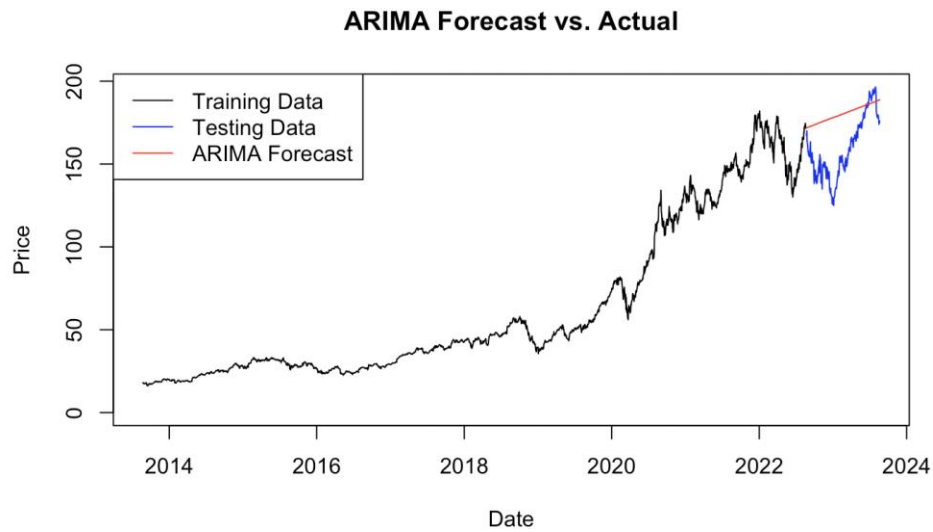


Figure 2: AAPL ARIMA Model Prediction.

Table 2: ARIMA Model Results.

MAE	21.83583
MSE	649.9216
RMSE	0.8505542
MAPE	1.249323

4.2. LSTM

The LSTM model was implemented using a Python script in a Jupyter Notebook environment. The model comprised 50 units and utilized the 'tanh' activation function, known for its efficacy in controlling the vanishing gradient problem in deep networks (Figure 3). After meticulous manual tuning, the optimal parameters for the model were determined as epochs equal to 50 and a batch size of 32. This was to ensure a balance between computational efficiency and prediction accuracy.

To evaluate the model's predictive performance, we computed several key metrics, including the Mean Squared Error (MSE) and Mean Absolute Error (MAE), which are standard metrics for gauging the accuracy of regression predictions. The mathematical formulations for these metrics are as Table 3 shows:

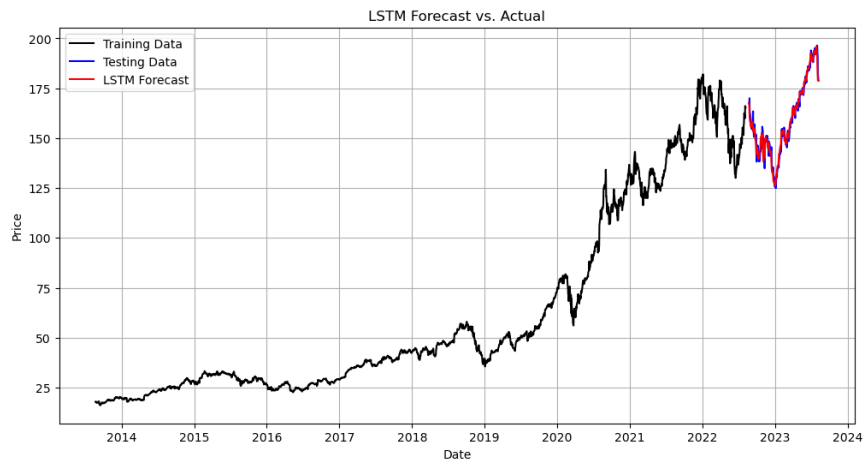


Figure 3: AAPL LSTM Model Prediction.

Table 3: LSTM Model Results.

MAE	11.323636778237018
MSE	2.4996926424018575

5. Discussion

In our study, we applied both ARIMA (AutoRegressive Integrated Moving Average) and LSTM (Long Short-Term Memory) models to predict the stock prices of Apple Inc. (AAPL). These two models represent distinct approaches to time series forecasting, and their results provide valuable insights into the dynamics of stock market prediction.

The ARIMA model is a classical statistical technique for time series forecasting. It assumes a linear relationship between past values and future predictions. In the context of stock price prediction, ARIMA can capture linear trends and stationary patterns in historical data. Our ARIMA model demonstrated its capability to provide reasonable predictions for AAPL stock prices. It offered insights into the linear components of AAPL's historical price behavior.

In contrast, the LSTM model represents a powerful deep learning approach specifically designed for time series data. LSTM excels in capturing complex, nonlinear patterns and long-term dependencies. In our study, LSTM exhibited the ability to predict AAPL stock prices with a higher degree of accuracy compared to ARIMA. This suggests that AAPL's price behavior is not purely linear, and LSTM's capacity to discern intricate temporal relationships allowed it to better capture the underlying dynamics.

The comparison between ARIMA and LSTM results is noteworthy. ARIMA provided valuable insights into linear trends and stationary aspects of AAPL's price data. However, it struggled to capture the nonlinear and complex relationships that LSTM effectively uncovered. The Root Mean Squared Error (RMSE) values, which represent the prediction error, indicated that LSTM outperformed ARIMA in terms of prediction accuracy.

It's worth noting that LSTM's superior predictive capabilities come at the cost of increased computational complexity. LSTM requires more computational resources due to its higher number of parameters, making it computationally intensive compared to ARIMA. This increased computational demand should be considered when choosing a model, especially for real-time or resource-constrained applications.

Both ARIMA and LSTM models can be valuable tools for investors in the stock market. ARIMA is well-suited for capturing linear trends and stationary patterns, providing insights into more stable aspects of stock behavior. On the other hand, LSTM's ability to predict nonlinear relationships can be instrumental in understanding complex price dynamics. Investors can leverage the strengths of each model to make informed decisions based on the specific characteristics of the stock they are interested in.

6. Conclusion

In conclusion, this study has navigated the intricate landscape of stock market prediction by juxtaposing the venerable realm of time series analysis with the innovative frontiers of machine learning, particularly deep learning. Our exploration aimed to bridge the gap between established methodologies and contemporary techniques, with a focused lens on their applicability within the context of stock market forecasting. Through a comprehensive analysis, we shed light on the strengths and limitations of these approaches, shedding insight into their potential implications for the dynamic world of financial decision-making.

The historical context illuminated the foundations of stock market prediction, where traditional methods like ARIMA have long been stalwarts. However, the rise of deep learning, exemplified by LSTM networks, unveiled an exciting potential to capture intricate temporal patterns, enriching our understanding of market behaviors. The practical significance of accurate predictions was underscored by their direct impact on portfolio management, risk mitigation, and trading strategies, resonating across financial institutions, investors, and economic systems at large.

Through rigorous methodology, our exploration encompassed data collection, preprocessing, and the construction of predictive models utilizing both traditional and deep learning techniques. Our study leveraged the power of the R programming language to facilitate insightful analysis, offering a nuanced understanding of each methodology's performance, strengths, and limitations. This study's implications reverberate throughout the landscape of financial decision-making. Our findings provide practitioners and researchers with valuable insights into the predictive capabilities of both established and contemporary methodologies. By understanding the unique strengths of each approach and their respective limitations, stakeholders can make informed choices when navigating the complex terrain of stock market dynamics.

As we conclude this study, the integration of time series analysis and machine learning in stock market prediction underscores the potential for a harmonious synthesis of tradition and innovation. While no single methodology may possess a universal panacea, our journey showcases the value of a comprehensive approach that leverages the best of both worlds. The exploration of Apple Inc. (AAPL) as a specific stock entity provided a tangible context for understanding how these methodologies respond to real-world intricacies.

In the end, our study not only contributes to the academic discourse in finance and machine learning but also equips decision-makers with the tools needed to navigate the uncertainties of the stock market with greater confidence. As the financial landscape continues to evolve, the interplay of time series analysis and machine learning offers an ever-promising frontier for predicting stock market movements and making informed, strategic choices in an increasingly complex world.

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Analysis of China's Birth Rate Prediction Based on Time Series

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Abstract: The birth rate in China has declined significantly since the last century, especially in recent years. Low fertility intentions and deferred childbirth were the main contributors to the drop in fertility. Nowadays, the aging problem has become more and more serious in our country. Therefore, raising the birth rate has become the top priority for the government and society. Our research modelled and predicted the fertility rate in China using R. We used the dataset from Health Nutrition and Population Statistics on Databank and selected the historical fertility rate data in China from 1964 to 2021. Firstly, we transformed these data to make the birth rate time series stationary. Then, we applied the ARIMA and the ETS models, respectively and chose the better model to forecast the short-term birth rate in China in the next five years. We found that the ARIMA model was more appropriate for predicting the short-term birth rate in China. As a result, we utilized the ARIMA(0,0,1) model for prediction. We calculated that the growth rate of the birth rate in China from 2022 to 2026 was - 0.117, which demonstrated that the fertility rate in China would decrease constantly at a rate of 0.117 each year over the ensuing five years. If the government of China still did not take any measures to improve the fertility problems, the fertility rate would further decline. Consequently, the fertility rate in China is facing an unprecedented crisis.

Keywords: birth rate, China, ARIMA model, prediction

1. Introduction

It is widely known that China has made huge economic progress over the past decades, and its population played an important role in it. However, the birth rate in China has also declined significantly in the past few decades, especially in recent years. Low fertility intention and delaying childbearing due to steadily rising living expenses were the main reasons for the fertility decline, even though the COVID-19 pandemic was one of the causes. The problems caused by the declining fertility rate have already attracted the attention of sociologists and statisticians more than a decade ago. Our country has implemented family planning policies, which have achieved great success in reducing the fertility rate and keeping the population at a sustainable level. However, the long-term application of these policies has also resulted in certain additional issues, such as the tilt of the population structure towards the elderly and the challenge of providing for them. Therefore, raising the birth rate has become an urgent matter for the government and society nowadays. The birth rate is a crucial demographic indicator that influences population dynamics and has significant implications for both social and economic planning.

Based on the background analysis above, we could discover that China is currently facing serious aging and fertility problems. According to the latest Statistics, by the end of 2022, the fertility rate in China will be less than 2%. Serious fertility problems affect more than China's long-term economic growth. For the whole of society, they affect all aspects of people's livelihood. Firstly, understanding the birth rate has profound implications for social policies, infrastructure planning, and economic development. Secondly, modelling and predicting the birth rate could help policymakers understand how severe the situation will be in the future and prepare for it. Thirdly, China's birth rate has been significantly influenced by government policies, such as the One-Child, Two-Child and Three-Child Policies. Therefore, analyzing the impact of these policies could guide future legislation and population control methods.

Therefore, we obtained the dataset from Health Nutrition and Population Statistics on Databank, which contained the historical data on China's birth rate from 1960 to 2021. We have discovered that the Great Leap Forward Campaign played a significant role in the key fluctuation in the birth rate data around 1962. The Great Leap Forward aimed to achieve industrialization and collectivization rapidly. However, the campaign caused severe three-year natural disasters in the first three years starting from 1960, and the birth rate in our country has dropped significantly. The birth rate began to recover after three years of natural disasters. Finally, we chose the more stable birth rate data in China after 1963.

To create a short-term projection for the future, we propose to apply the ARIMA and Exponential smoothing models to historical data on the birth rate in China from 1964 to 2021. The data will be split into training and testing sets for model fitting and accuracy evaluation. While the testing set gauges how well the model predicts the data and the training set matches the data. Firstly, we would like to make some transformations to these original data to make the times series of the transformed data look stationary, which helps us conduct further research on these transformed data. The purpose of this experiment is to forecast the birth rate for the most recent five years by analyzing historical data from the past fifty-five years. As a result, the training set would be the fertility rate data from 1964 to 2016, and the testing set would be the fertility rate data from 2017 to 2021. Secondly, we would apply the ARIMA model and ETS model, respectively, to the transformed birth rate data within the training set, and we would predict the birth rate within the testing set.

Additionally, we would create time series plots for two models that were each applied to data on fertility rates throughout the entire period. We would compare the RMSE values of the two models to decide which model is more appropriate to make a short-term forecast for the future. In addition, the model would also be used to predict China's birth rate in the following 5 years since 2021.

The first part of the rest of this paper was the Literature review. We reviewed lots of literature about China's birth rate and gained a basic understanding of the current situation in China. We also reviewed some literature about the appropriate model for forecasting the birth rate data to help us choose better prediction models. The second part was the Methodology. We introduced the origin of our dataset and how our data were processed to make our time series stationary. We also compared two different models and chose the better model to calculate the fertility rate in China over the next few years. The third part was the Results. We concluded our results about the fertility rate prediction in China in the following 5 years. The fourth part was the Discussion. We integrated our research procedures and summarized our research findings, we analyzed the similarities and dissimilarities of the forecast results by two different models. We also summed up the limitations of our project, which should be considered further. The Conclusion was the final part of our research paper. In addition, References were also included and listed on the final page.

2. Literature Review

The paper indicated that the problems brought about by the declining birth rate in China started to concern some sociologists and statisticians over a decade ago. They suggested that China's family planning policy designed to reduce its birth rate so that the country's population was kept at a sustainable level greatly succeeded. However, they countered that long-term implementation of these policies led to issues including a change in the population distribution towards the old and a rise in the cost of caring for that elderly population [1].

The research also indicated that the problem of aging has become more and more serious, although the two-child policy was released in 2015. The birth rate in China has kept a downward trend in the ten years from 2010 to 2020. He argued that factors such as household income and divorce rate had a significant influence on the fertility rate. Factors such as economic downturns and instability of the employment situation would lead to serious aging problems, which would inhibit the expectation of sustainability of development in China, which made China lag behind the developed countries further [2].

Others indicated that the birth rate in China showed a significant decrease from that in 2016, considered the lowest fertility rate since the 1960s. The decrease in fertility rate would cause changes in the demographic structure since the proportion of aging people would increase. They argued that the demographic dividend had mainly supported the continuous growth and prosperity of the economy in China. A slowdown in the economy would occur as the proportion of seniors increased. The economic downturn would cause shortages in labour and skills, leading to development stagnation and loss of vitality in society. They suggested that one of the important reasons for the fertility rate decline was that people generally changed their minds about marriage. In recent years, more and more adults, especially in urbanized regions, are more inclined towards fewer marriages and children [3].

Besides, other researchers indicated that the ARIMA models had been widely used in modelling and forecasting population variables since 1970, showing high efficiency in many different knowledge fields in demography. They suggested that many studies used the ARIMA models to calculate future fertility rates, which contributes to predicting future populations [4]. The paper reported that they examined the birth rate data in the US by using the ARIMA model since ARIMA methods could reveal the intricate structures of momentary interdependence in time series. They suggested that the ARIMA models succeeded in analyzing the patterns of seasonal interdependence in the birth rate series, which provides a basis for developing an alternative method of seasonal modification of dynamic demographic statistics [5].

According to the article, modelling and forecasting the changes in the birth rate over time are crucial since they offer crucial information for decisions on birth control, family planning, and welfare policies. They argued that finding effective models for demographic statistics, like the birth rate of a developing country, can be challenging due to the complexity of factors involved. The ARIMA models make use of the autocorrelations of the data, while exponential smoothing or the ETS models make use of the weighted averages of past observations. They recommended using the ARIMA and exponential smoothing models for fertility rate prediction since these two models are the most frequently employed in time series forecasting [6].

Some researchers indicate that the major area of interest of demographers is modelling birth rate curves to understand the fertility pattern. To anticipate the future fertility rate, people typically use prediction models, including the ARIMA and exponential smoothing models. The ARIMA models are the most commonly used forecast models because of their simplicity. They argue that the ARIMA models are usually utilized for time series prediction, which aims to identify the stochastic process and forecast future values. The ETS models minimize historical birth rates by assigning an

exponentially decreasing birth rate compared to the historical data. The multiplicative trend analysis gives exponential trend analysis, while the additive trend analysis provides linear trend analysis. They suggested that the ARIMA and ETS models had low marginal error rates in the long-term fertility prediction. However, the ARIMA models have been proven to be more accurate in fertility prediction since it has a lower accuracy measure error [7].

3. Methodology

3.1. Data Description

Health Nutrition and Population Statistics on Databank provided the dataset for analysis.

The dataset is expressed annually. The variable is the birth rate (per 1,000 people) in China within the period of over 61 years (from 1960 to 2021)(Figure 1). All variables are discrete numerical data. When choosing data, we found a critical fluctuation in the birth rate data around 1962. According to our research, we could explain this situation caused by the Great Leap Forward (from 1958 to 1962) and the Three Years of Great Chinese Famine (from 1959 to 1961).

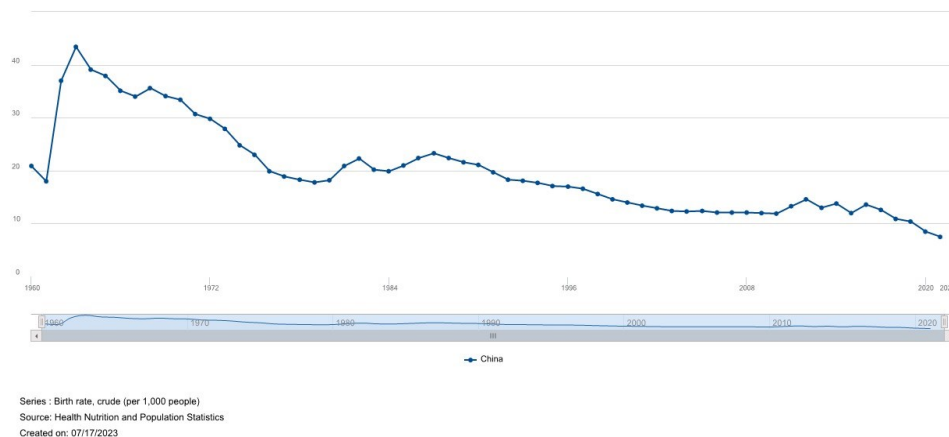


Figure 1: Time Series Plot for Birth Rate in China (1960-2021).

Note: data from: <https://databank.worldbank.org/source/health-nutrition-and-population-statistics?l=en#>.

The Great Leap Forward was a campaign to rapidly transform China from a primarily agrarian society into a socialist industrial society through rapid industrialization and collectivization. However, the campaign led to a wide range of severe social and economic upheavals. One of these upheavals was the so-called Three Years of Great Chinese Famine, a period of severe economic distress and famine.

The birth rate in China significantly fluctuated during and after these events. Due to extensive starvation and malnutrition brought on by the Great Leap Forward and the ensuing famine, the birth rate dramatically declined while the mortality rate sharply rose.

In 1960, at the height of the famine, the birth rate reportedly dropped to about 14 per thousand, from around 20 per thousand in the pre-Great Leap Forward period. In 1962, as the policies of the Great Leap Forward were reversed, the famine began to ease, and the birth rate started to recover. However, the recovery was slow and uneven due to the lingering effects of the famine and the socio-economic disruptions caused by the Great Leap Forward. Finally, we chose the more stable birth rate data in China from 1964 to 2021.

3.2. Data Processing

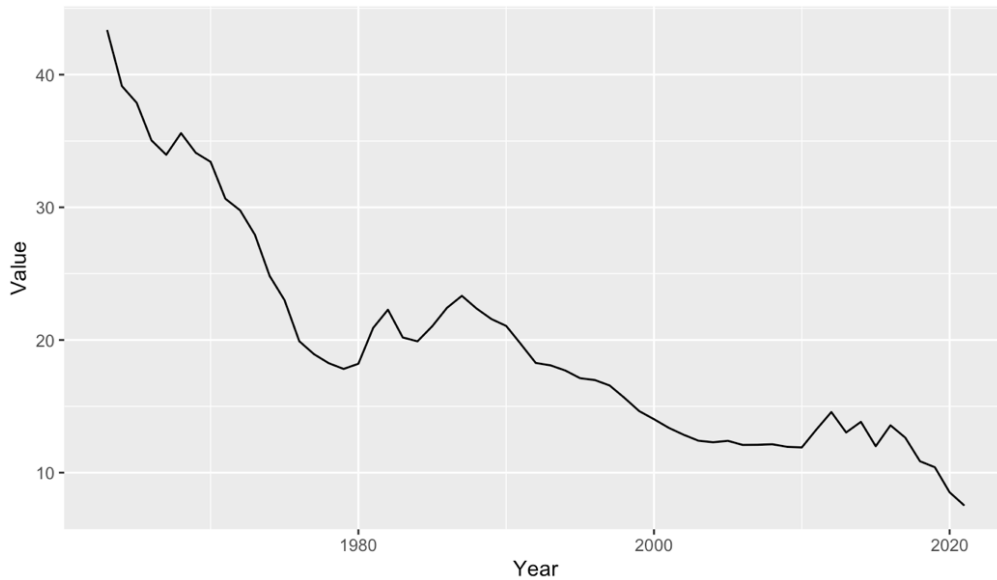


Figure 2: Time Series Plot for Birth Rate in China (1964-2021).

From Figure 2, there is a decreasing trend for the time series of the birth rate in China. We could conclude that this series is non-stationary. A stationary time series maintains its characteristics like mean and variance over time. In other words, it doesn't exhibit trends or seasonality. Many statistical models, such as ARIMA, assume that the underlying data are stationary because these models are designed to predict the constant mean, variance, and autocorrelation structure in the data.

On the other hand, non-stationary time series often contain trends or seasonal patterns. The mean, variance, or correlation structure may change over time, which makes the data harder to model. If these properties are changing, the patterns that the model learns may not apply to future periods. To illustrate, stationarity is a critical property for time series data that many statistical modelling techniques require [8].

To obtain the stationary time series, we decided to make some transformations for these data:

Firstly, transform data of average birth rate to the growth rate for each year compared with the previous year.

Then, compute the growth factor to standardize the mean of the series by reducing the variation, where the growth factor is equal to the growth rate plus one.

Then, take the logarithm of the growth factor to make the time series of birth rate data stationary.

Finally, differentiate the birth rate data to standardize the data further if needed.

Table 1: Birth Rate Values and Calculation Data related to Birth Rate Values for each year in China since 1960.

Year	Value	Year Difference	Value Difference	Growth Rate	Growth Factor
1960	20.86	NA	NA	NA	NA
1961	18.02	1	-2.84	-0.1361457335	0.8638543
1962	37.01	1	18.99	1.0538290788	2.0538291
1963	43.37	1	6.36	0.1718454472	1.1718454
1964	39.14	1	-4.23	-0.0975328568	0.9024671
1965	37.88	1	-1.26	-0.0321921308	0.9678079
1966	35.05	1	-2.83	-0.0747096093	0.9252904

Table 1: (continued).

1967	33.96	1	-1.09	-0.0310984308	0.9689016
1968	35.59	1	1.63	0.0479976443	1.0479976
1969	34.11	1	-1.48	-0.0415847148	0.9584153

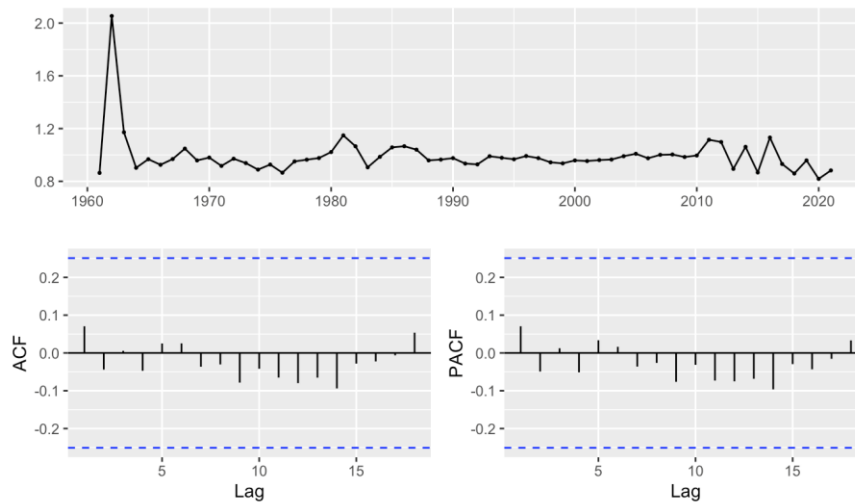


Figure 3: Time Series Plot for Growth Factor of Birth Rate.

Results after computing the growth rate and the growth factor

Table 1. above shows the birth rate values and calculation data related to birth rate values for each year in China since 1960. To better visualize and understand the data, Figure 3 shows how the growth factor of the birth rate in China has changed over time. Using the Augmented Dickey-Fuller Test, the p-value we calculated was 0.3453, higher than the 5% significance level. Therefore, we failed to reject the null hypothesis and concluded that the time series was not stationary(Figure 4).

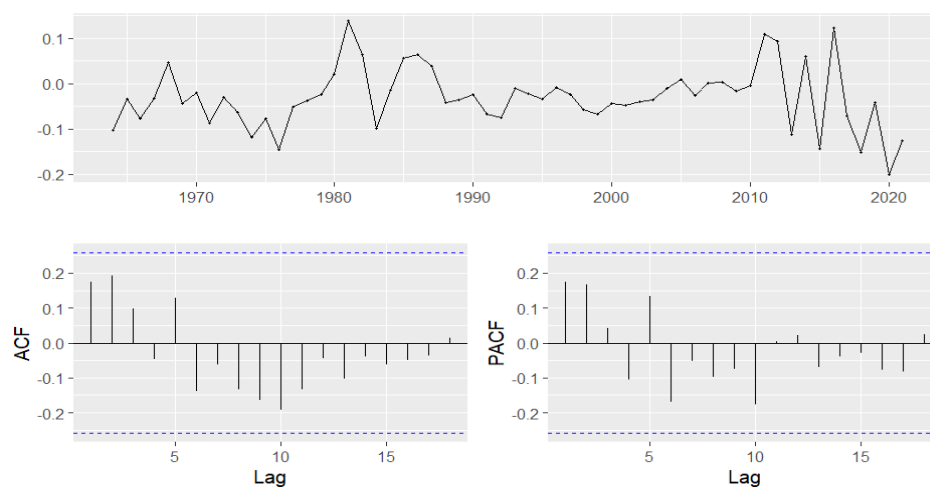


Figure 4. Time Series Plot for Log-Growth Factor of Birth Rate.

Results after logarithm transformation

To better stabilize the variance of a time series, we are aiming to perform a logarithm. transformation on the growth factor. It is particularly helpful that taking the logarithm of the data

could help linearize the time series when it displays exponential growth or decay. The p-value we calculated using the Augmented Dickey-Fuller Test was 0.359, greater than the 5% significance level [9]. Consequently, we could not reject the null hypothesis and concluded that the time series was not stationary. Logarithm transformation has not been successful in further normalizing growth factor data, which prevented the time series from becoming stationary(Figure 5).

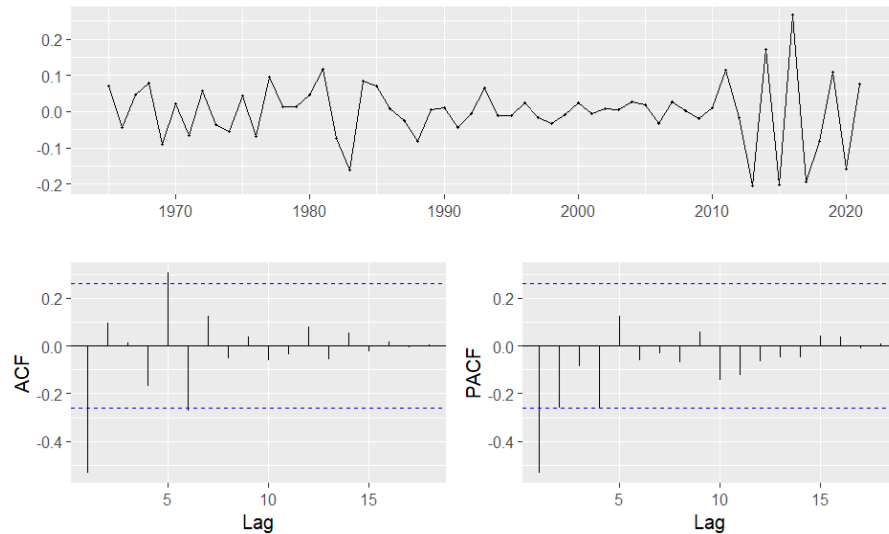


Figure 5: Time Series Plot for Differenced Log-Growth Factor of Birth Rate.

Results after differencing

By deducting the prior observation from the present observation, we attempted to differentiate the data to make the time series statistically stable. The p-value we calculated using the Augmented Dickey-Fuller Test was 0.01, lower than the 5% significance level. As a result, the null hypothesis might be rejected, and we could conclude that the time series was stationary. Since the transformed data time series was stationary based on the Augmented Dickey-Fuller Test, the log-transformed growth factor of birth rate data after one differencing is the optimum data to carry out our research further [10].

3.3. Data Partitioning

The transformed data was partitioned into two sets - the training set, which was used to fit the. data, and the testing set, which was used to test the accuracy of the models' forecasts. The data from 1964 to 2016 was chosen as the training set, and the data from 2017 to 2021 was chosen as the testing set.

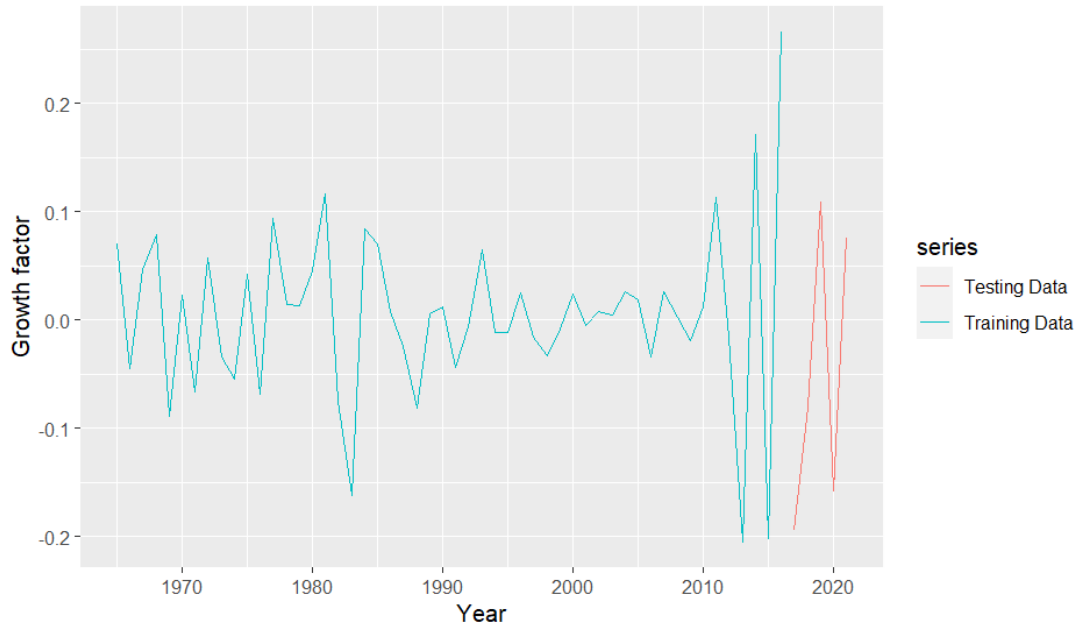


Figure 6: Times series plots of Training and Testing set for Differenced Log-Growth Factor of Birth Rate.

3.4. ARIMA Model

3.4.1. Model Description

In this instance, ARIMA modelling and forecasting were performed using the `auto-arma()` function in R. According to the paper, the `auto.arma()` function in R reportedly employs a different version of the Hyndman-Khandakar algorithm[8]. Researchers argue that the `auto.arma()` function creates an ARIMA model by combining unit root testing, AICc minimization and MLE[11]. The ARIMA(0,0,1) model with zero means was the one produced by the `auto.arma()` function, where 0, 0, and 1 stand for the order of the autoregressive model, the degree of differencing, and the order of the moving-average model, respectively. In other words, the R function automatically determined a first-order moving average model.

3.4.2. Accuracy Test

Based on the training set, the ARIMA model was used to forecast the years in the testing set. Figure 7 shows the forecasts from the ARIMA (0,0,1) model. The accuracy was tested using the `accuracy()` function in R. The results are summarized in Table 2.

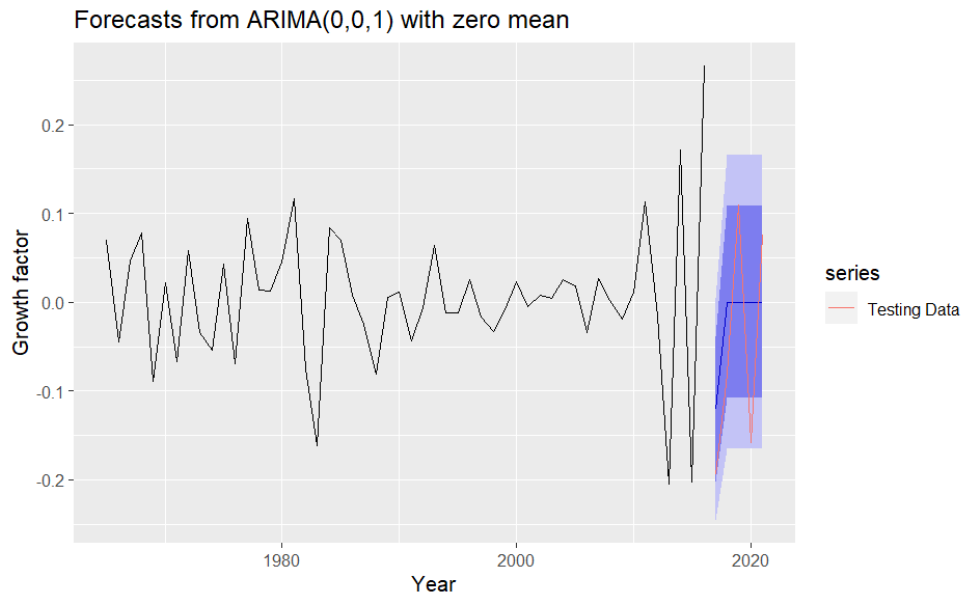


Figure 7: Forecasts from ARIMA(0,0,1) Model.

Table 2: Summary for the ARIMA(0,0,1) Model Accuracy Test.

	ME	RMSE	MAE	MPE	MAPE	MASE
Training Set	0.00959091	0.06300125	0.04647275	97.99229	166.40961	0.5295333
Testing set	0.02557882	0.10455979	0.09956321	87.60218	87.60218	1.1344721

3.5. ETS Model

3.5.1. Model Description

The `ets()` function in R was used to automatically choose the appropriate taxonomy and constants of the model. The taxonomy characterizes each model in three dimensions: error, trend, and seasonality. The paper suggested that those three dimensions could be classified as ‘additive,’ ‘multiplicative,’ or ‘none’ [12]. Under this circumstance, the ETS(A, N, N) model standing for simple exponential smoothing with additive errors, was automatically selected. The smoothing parameter α equals 10^{-4} , which is approximately 0. The study suggests that the level of the series remains constant over time if $\alpha = 0$ [11].

3.5.2. Accuracy Test

Based on the training set, the ETS model was used to predict the years in the testing set. Figure 8 displays the predictions from the ETS(A, N, N) model. The accuracy was also evaluated using the `accuracy()` function in R. The result is summarized in Table 3.

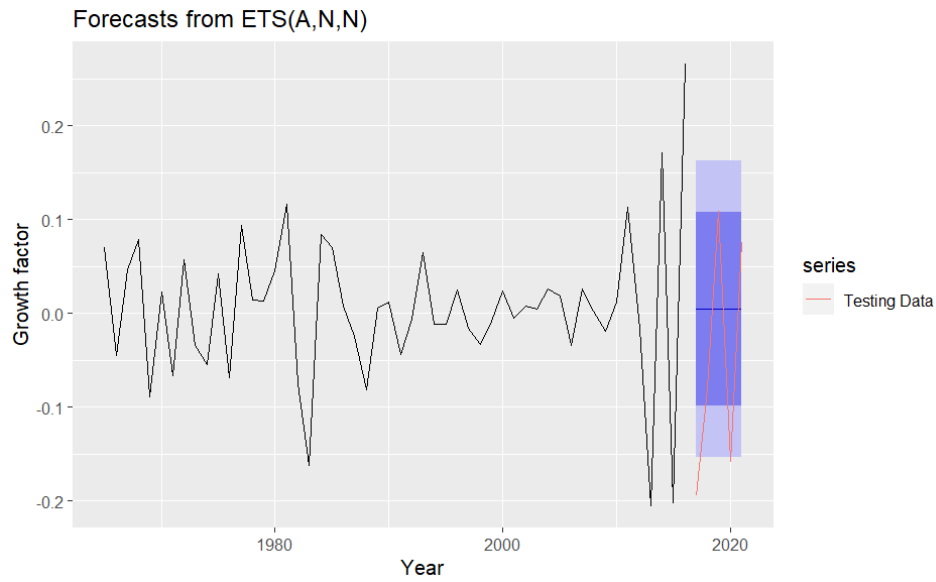


Figure 8: Forecasts from ETS(A, N, N) Model.

Table 3: Summary of the ETS(A, N, N) Model Accuracy Test.

	ME	RMSE	MAE	MPE	MAPE	MASE
Training Set	-2.318538*10-6	0.07921507	0.05447984	93.82874	97.06349	0.6207701
Testing set	-5.408744*10-2	0.13370538	0.12458407	100.12727	100.12727	1.4195721

3.6. Five-year Forecasts Using ARIMA(0,0,1) Model

The accuracy tests for both models above clearly show the RMSE values for both training and testing sets. The ARIMA model clearly shows that the RMSE value in the training set is 0.063, while it is approximately 0.105 in the testing set. In the ETS model, we can see that the RMSE value in the training set is around 0.08, while it is nearly 0.134 in the testing set.

The error measure used to determine which model to use to make the forecast was the root mean square error(RMSE), calculated by the formula:

$$e_t = y_t - \hat{y}_t \quad (1)$$

$$RMSE = \sqrt{\frac{1}{n} \sum_{t=1}^n e_t^2} \quad (2)$$

The ARIMA(0,0,1) model has a lower RMSE value, according to the accuracy test results for both models. Therefore, ARIMA(0,0,1) is a more accurate model for predicting the birth rates in China over the next five years. The training set is the same as when evaluating the models. The forecasts for 5 years are shown in Table 4 and Figure 9.

Table 4: A five-year forecast of the birth rate in China using the ARIMA(0,0,1) Model.

	Point Forecast	Lower 80% CI	Upper 80% CI	Lower 95% CI	Upper 95% CI
2022	0.0000000	-0.1079529	0.1079529	-0.1650997	0.1650997
2023	0.0000000	-0.1079529	0.1079529	-0.1650997	0.1650997
2024	0.0000000	-0.1079529	0.1079529	-0.1650997	0.1650997
2025	0.0000000	-0.1079529	0.1079529	-0.1650997	0.1650997
2026	0.0000000	-0.1079529	0.1079529	-0.1650997	0.1650997

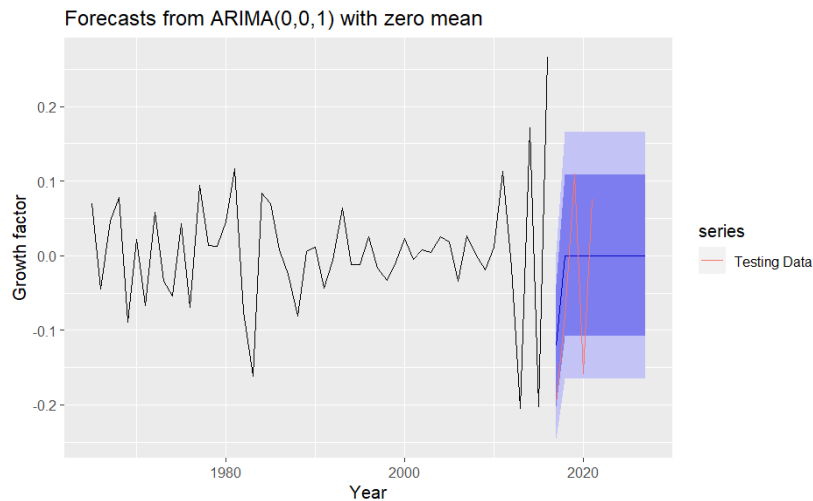


Figure 9: 5-Year Forecast using ARIMA(0,0,1) Model.

4. Results

According to our forecast using the ARIMA (0,0,1) model, Figure 6 above shows that the values are 0 in the 'point forecast' column from 2022-2026. These data demonstrate that the difference between the growth factor from year to year would be 0 for 2022 - 2026. Therefore, the growth factor would equal the value in 2021 for years 2022 - 2026, which is 0.8826291. Since the growth rate is equal to the growth factor minus one, the growth rate in China from 2022-2026 equals $0.883 - 1 = -0.117$. This means that the birth rate in China will continuously decrease at a rate of 0.117 each year for the years 2022 - 2026. Therefore, China will face a difficult situation of continuous fertility rate decline in the next five years, even in the future [13].

5. Discussions

Since the original birth rate data was not stationary, we made some transformations on the original data to make the time series stationary. Then, we compared the ARIMA model and the ETS model to decide which model is more suitable for predicting the fertility rates of China. Finally, we decided to use the ARIMA model to forecast the fertility rates of China in the following five years since 2021. From the forecasts using the ARIMA model and the ETS model, we can see that the time series plots of these two models have similar trends. After we applied these two models to the training set, we found that the time series plots on the training set have approximately the same trends. The testing set using the ETS model predicted a constant growth rate of birth rate from 2017 to 2021. However, the prediction using the ARIMA model showed that the growth rate of birth rate had an increasing trend firstly, then became a constant value in the last 5 years. Both models predicted a constant growth rate of birth rate in China from 2022 to 2026. We could deduce from the accuracy tests of these two

models that the ARIMA model had a lower RMSE value than the ETS model. We also found that compared to the ETS model, the MAE and MASE values for the ARIMA model were lower.

Additionally, the ARIMA model outperformed the ETS model regarding AIC and BIC values. Nevertheless, unlike the ARIMA model, the ETS model had a smaller ME value. The residuals from the ETS model had a substantially smaller p-value than the ARIMA model.

However, our project has some limitations, which make the project not perfect enough and need to be improved in the future. We only compared the RMSE values in the training and testing sets between the ARIMA and the ETS model. Although RMSE value is the most important factor in determining a better model between two models, we should also consider other values, such as AIC and BIC values. Moreover, the residuals from the ARIMA model were not consistent with the white noise since their p-value was significantly greater than that estimated from the ETS model. Furthermore, although the ARIMA model is better than the ETS model, it may not be the best model for forecasting future birth rates. We only chose the ARIMA and the ETS models in our project since we used them most of the time in our course and knew much about them. However, we did not compare these two models with other models due to limitations to the knowledge and usage of other models.

6. Conclusions

Through the data processing, we finally conclude that the log-transformed growth factor of original birth rate data after one differencing is the best data to use since its p-value is significantly smaller than the significance level at 5%, which makes our time series stationary. We have applied the ARIMA and the ETS model, respectively, in our training set of the birth rate data. According to the accuracy test results, the ARIMA(0,0,1) model is a more appropriate model for forecasting the birth rates in China in the future. According to our forecast by ARIMA(0,0,1) model, the difference between the growth factor from year to year would be 0 in the following 5 years from 2022. We conclude that the birth rate in China will decrease at a constant rate of 0.117 each year in these five years. Therefore, the fertility rate in China is now facing an unprecedented crisis. Our future research direction may probably focus on what kinds of social or economic factors would affect the birth rate. We would probably search for several articles or journals on relevant academic websites about the related factors affecting the fertility rate. Then, we would conduct an in-depth study on how these factors could affect changes in the fertility rate. We would extract datasets from the relevant websites and analyze the relationship between these related factors and the birth rate, which could be calculated using time series models in R studio. We would use the best time series model to forecast the changes in the birth rate when there are any changes in these related factors. Finally, we would also conduct research on what measures we would take to improve the situation of the low fertility rate in China in the future. We would consult academic literature on how government policies, such as maternity benefits or welfare measures, could help ameliorate the low fertility rate crisis. These academic materials could better help us learn about the causes of the low fertility rates and propose better solutions to reverse the current circumstance of the low fertility rate in our country.

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Unraveling the Relationship Between GDP and Unemployment in China with Okun's Law

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Abstract: As the world's second-largest economic powerhouse, China stands at the nexus of global trade, investment, and economic policies. Yet, despite its meteoric rise and the subsequent spotlight on its financial milestones, the correlation between its GDP growth and the unemployment rate remains a fertile ground for exploration. Using time-series data as the backbone of this paper, the Granger Causality Test and Vector Autoregression (VAR) methodologies are employed during the research process. These sophisticated approaches are capable of ascertaining the linear interdependencies between these variables, providing a dynamic perspective that goes beyond traditional static analyses. This research aims to answer key questions: Can the historical fluctuations in GDP serve as a reliable predictor for future unemployment trajectories, and if so, to what extent does Okun's Law hold true? Conversely, does a shift in unemployment rates offer insights into potential GDP movements? The conclusions drawn from this comprehensive analysis aim to uncover the relationship between GDP and unemployment and provide possible explanations by integrating the notion of Okun's law.

Keywords: China's GDP, unemployment rate, Okun's law, Vector Autoregression (VAR)

1. Introduction

In the global economic landscape, China's unparalleled presence and influence have transformative implications. From its evolution from a mainly agrarian society to becoming an industrial juggernaut, China's journey reshapes the contours of international commerce. Today, as the world's second-largest economy, China's economic decisions, whether trade policies or massive undertakings like the Belt and Road Initiative, send waves across the world. Internally, China has witnessed profound changes. Urbanization, technology adoption, and a burgeoning service sector have overhauled its labor market. Cities like Beijing and Shanghai are now economic epicenters, and with these changes come fluctuations in employment rates and labor dynamics. Understanding the relationship between GDP growth and unemployment is a cornerstone of macroeconomics. Yet, China's unique integration of socialism with capitalist shades makes this relationship particularly complex. Beyond numerical data, it's essential to grasp how China's cultural, policy, and regional factors modulate the GDP-unemployment dynamic.

Despite numerous studies on the GDP-unemployment relationship globally, research specifically tailored to China's unique environment is surprisingly scarce. Okun's law, often referenced in global economic studies, posits a clear inverse relationship between GDP growth and unemployment rates:

as GDP increases, unemployment should theoretically decrease, and vice versa. Yet, in the context of China, the application and nuances of Okun's law may differ due to its distinct socio-economic dynamics. It's not just another economy; it's a distinctive entity with its blend of cultural, political, and socio-economic intricacies. The rapid urbanization, diverse industrial landscape, and combination of socialism with market elements mean China defies conventional categorization. Current studies often fail to capture China's evolving dynamics, viewing the GDP-unemployment relationship, and by extension, Okun's law, in a static manner. This research's motivation lies in decoding these intricate, often overlooked causality mechanisms within China, understanding how regional variations, policy decisions, and digital economic shifts impact this essential relationship and the validity of Okun's theory within this specific context. To navigate this intricate relationship, we employ the Vector Autoregression (VAR) methodology. Its design, focusing on past values to predict future outcomes, makes it ideal to unravel the interdependencies between China's GDP and unemployment.

2. Literature Review

2.1. Theoretical Foundations and Global Perspectives of Okun's Law

The relationship between unemployment and economic output has been of considerable interest to scholars in the field of economics. One foundational premise of this relationship is Okun's Law, which posits a stable negative relationship between unemployment and real output. Proposed by the American economist Arthur Okun, this law suggests that for every 1% increase in the unemployment rate, real output is approximately 3.2% lower than its potential [1].

2.2. Empirical Validations in Developed Countries

Recent research studies have provided diverse findings concerning the validity of this law. Studies focusing on developed countries largely validate Okun's proposition. For instance, research on 16 OECD countries using panel data found that the Okun coefficient, though it varied according to method, was broadly consistent with Okun's predictions [2]. Another study focusing on ten industrialized nations found Okun's Law to hold but with the Okun coefficient dropping to 2% [3]. Moreover, an analysis at the U.S. state level concluded a negative relationship between unemployment and output, both regionally and nationally [4]. Sector-specific studies in developed countries further confirmed the law's validity [5].

2.3. Challenges in Developing Countries

In contrast, empirical research on developing countries presents a more complicated picture. A study using data from four African countries found no statistically significant relationship between unemployment and economic growth [6]. Similarly, investigations in Macedonia failed to provide robust evidence supporting Okun's Law [7]. The disconnect between unemployment and economic growth was also observed in Nigeria and some Asian developing countries [8].

2.4. China's Unique Labor Dynamics and Okun's Law

Turning to China, a rapidly urbanizing and developing nation, empirical research has yielded mixed results. While Zou and Hu's research on China's first and second industries supported Okun's Law, the tertiary industry did not conform to the law's predictions [9]. Cai's research revealed no significant correlation between economic growth rate changes and unemployment rate shifts [10]. Other scholars further challenged the validity of Okun's Law in China, suggesting that the cyclical

nature of rural labor force migration played a critical role in understanding the urban unemployment-economic fluctuation relationship [11].

2.5. The Chinese Phenomenon of Rural Labor Reservoir

A unique dynamic in China is the dual-directional migration pattern observed among rural laborers. As China's urbanization accelerates, surplus rural laborers increasingly migrate to urban centers. However, due to institutional constraints like the hukou system, these migrants don't have permanent residency rights in the cities and cannot access equal social welfare benefits. Consequently, when external economic shocks trigger urban unemployment, many of these migrant workers return to rural areas, resulting in massive reverse migration waves. Essentially, the countryside acts as a labor reservoir, absorbing backflow labor during urban unemployment surges. Thus, unemployment isn't truly reduced; it merely shifts back to rural regions [12].

2.6. Reassessing Okun's Law in Evolving Economies

Hence, while Okun's Law garners notable validation in developed nations, its pertinence in developing countries, particularly in China, warrants scrutiny. The complexities of labor migration, especially in dual-economic structured countries like China, challenge the direct application of Okun's Law [13]. Given the pivotal relationship between GDP and unemployment, it is imperative to delve deeper into this association, especially as economies evolve. This significance underpins the rationale for this research, seeking to illuminate the nuanced interplay between unemployment and economic output across varied national landscapes.

3. Methodology

The employed methods were underpinned by a deliberate and judicious blend of empirical techniques: the Granger causality test and the Vector Autoregression (VAR) model, both of which were operationalized using the R statistical software. This combination, albeit appearing straightforward, was chosen for its empirical rigor and its established precedence in econometric research. The Granger causality test, in particular, is invaluable in discerning whether one time series can predict another, a foundational step in ascertaining causality. In this paper, the Granger causality test suggests whether the past GDP data could predict the future trend of the unemployment rate. The VAR model, on the other hand, provides a more comprehensive lens, allowing for an examination of the interdependencies and dynamic interactions between the GDP and unemployment rate, and thus reflecting on Okun's coefficients.

The dataset, meticulously curated and spanning three decades from 1992 to 2022, was sourced from the esteemed National Statistical Bureau of China. Such a choice ensured that the data was not only of impeccable authenticity but also reflective of the broader economic trends and nuances specific to China. Given the longevity and depth of this dataset, it offers a temporal richness, capturing the evolutionary nuances of the Chinese economy over a transformative period. While the quantitative paradigm adopted in this study offers the precision and replicability inherent to numerical analyses, it necessitated a robust data processing regimen. The Granger test, with its emphasis on causality, required the alignment of data timelines, a step that ensured temporal consistency and chronological coherence. The VAR model demanded a deeper granularity, necessitating data normalization and validation processes. Herein, one of the preliminary challenges faced was ensuring that the vast expanse of data was both compatible with the chosen models and devoid of any anomalies or inconsistencies.

It is crucial, however, to juxtapose the methodological strengths with its inherent limitations. The simplicity of the two chosen models, while advantageous in terms of clarity and ease of interpretation,

does not afford the intricate depth some multifaceted econometric models might offer. This simplicity could be perceived as a limitation, especially when one considers the complex economic landscape of China, marked by its dual economic structures, regional disparities, and sectoral shifts. While the methodology deployed in this research might be perceived as straightforward in its design, its foundational strength lies in its empirical rigor and clarity. As with any empirical endeavor, this methodology was guided by prior academic research, thus embedding this procedure within a continuum of scholarly dialogue and ensuring the approach's academic reliability.

4. Results

4.1. Overall Trend

From 1992 to 2022, China experienced remarkable economic transformations, as evidenced by its significant GDP growth. In 1992, the GDP stood at a modest \$426.92 billion, which by 2022 had catapulted to a staggering \$17.96 trillion, marking an over 40-fold increase. This unparalleled economic ascent is indicative of China's meteoric rise on the global stage. Contrastingly, the unemployment rate trend presents a rather different picture. Beginning at 2.628% in 1992, unemployment experienced fluctuations, peaking at 5.538% in 2021 before slightly retracting to 5.041% in 2022. Notably, the economic boom did not necessarily translate to consistent drops in unemployment. In certain instances, such as between 2003 and 2004, despite significant GDP growth, the unemployment rate rose, challenging traditional economic paradigms (Figure 1).

Hence, this divergent result brings us to Okun's law, which postulates an inverse relationship between unemployment and GDP growth. Specifically, for many economies, an increase in GDP often corresponds to a decrease in the unemployment rate. However, in China's context, this relationship doesn't consistently align with Okun's expectations [13]. For example, during periods of substantial GDP growth, such as 2012 to 2015, unemployment remained relatively stable instead of decreasing. Such deviations from Okun's law underscore the unique characteristics of China's economic landscape. Influences like rapid urbanization, labor migration, regional economic disparities, and shifts from agriculture to service and industrial sectors might have affected the unemployment rate independently of GDP growth [14].

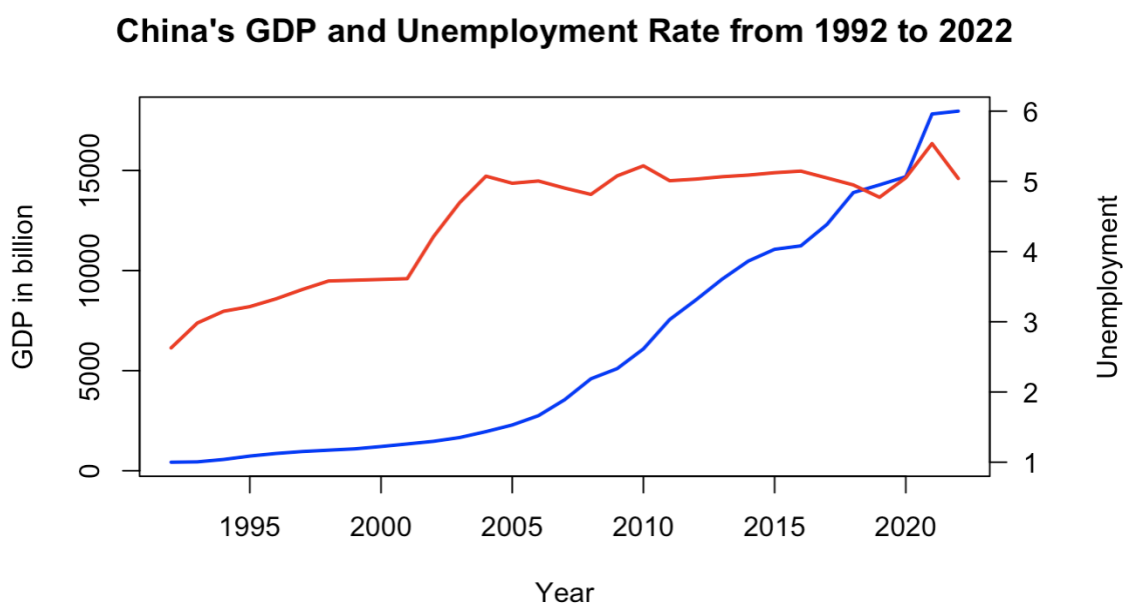


Figure 1: Trends of GDP in billion and unemployment in the past 30 years.

4.2. Granger Causality Test

Secondly, it is imperative to discern the interdependence between significant macroeconomic variables in the course of analysis. The Granger causality test offers a methodological avenue to understand such relationships, especially in the realm of forecasting one variable based on the past values of another. The Granger causality test is employed to ascertain whether China's GDP from the years 1992 to 2022 could predict future values of the unemployment rate. Delving into the results, an F-statistic value of 4.8567 with an associated p-value of 0.01694 is resulted. The primary objective of the Granger causality test in this context is to determine if the historical values of GDP furnish any foresight regarding forthcoming movements in the unemployment rate. The p-value, being notably less than the conventional significance threshold of 0.05, prompts to rejection of the null hypothesis. This null hypothesis posits that GDP does not Granger cause the unemployment rate. Consequently, the empirical evidence, rooted in this data and the designated lag lengths, posits that past GDP figures from 1992 to 2022 indeed exert predictive influence over the unemployment rate during this epoch (Table 1).

Table 1: Results of Granger causality test.

Model	Residual Degrees of Freedom (Res.Df)	Difference in Degrees of Freedom (Df)	F-Statistic (F)	P-Value (Pr(>F))
Unemployment predicted only by its own past values	26	-2	4.8568	0.01694

In terms of economic interpretation, this outcome proffers that historical GDP values in the preceding two years render valuable insights into the forecasting of unemployment rates for the subsequent years between 1992 to 2022 [15]. The p-value underscores the statistical significance of this result at the 5% level, reinforcing its academic pertinence. From a broader perspective, this analysis has palpable implications for policy formulation and economic prognostication. If GDP trajectories serve as precursors to future unemployment trends, it paves the way for preemptive macroeconomic interventions. An expanding economy, signaled by burgeoning GDP figures, typically resonates with corporate expansion, culminating in a proliferation of employment avenues and a concomitant decrement in unemployment rates [9]. In stark contrast, an economic downturn, manifested in GDP contractions, may precipitate corporate retrenchment, escalating unemployment levels [16]. The empirical validation of this interrelationship, as gleaned from the Granger causality test, underscores the centrality of GDP as a prognosticative tool for labor market dynamics in China during the specified period [17].

4.3. VAR Model

Lastly, from the constructed VAR model, several insights and results were shown. The primary finding pertains to the impact of lagged GDP growth rate changes on the present GDP growth dynamics. Notably, data from the VAR model highlights the influence of GDP growth rate changes from two periods prior on the present growth rate. Specifically, a one-unit increase in the GDP growth rate from two periods ago is associated with a decrease of approximately 0.733 in the current GDP growth rate, holding all else constant. This relationship is statistically significant at the 5% level, suggesting that it's not just a random finding. This demonstrates the oscillatory nature of GDP growth, suggesting possible cyclical patterns inherent within the economy [10]. On the other hand, past

variations in the unemployment rate demonstrate a lack of significant association with current GDP growth rate changes. Such an observation emphasizes that while GDP might inform itself across time, unemployment variations do not seem to feed into GDP growth rate predictions within our examined timeframe [15].

Shifting the analysis towards unemployment, no significant relationships were found between its past values and GDP growth rate. This implies that the unemployment rate's dynamics are perhaps influenced by factors not directly tied to the GDP's oscillatory patterns [10]. However, a deep dive into the unemployment data from the VAR model reveals a pronounced linear trend, which goes unaccounted for by other variables in the model. The significance of the constant term, at approximately 0.1001, and the trend term, at roughly -0.003942, both statistically significant at the 5% level, attest to this fact (Table 2, Table 3).

Table 2: VAR Model Results for GDP Growth Rate (gdp_diff2).

Variable	Estimate	Std. Error	t value	P-Value
gdp_diff2.l1	-0.3076	0.2835	-1.085	0.2951
gdp_diff2.l2	-0.7333	0.2934	-2.499	0.0246
Trend	0.0015	0.0026	0.591	0.5633

Notes: The model fit for GDP has Residual Std. Error: 0.06787, R-Squared: 0.4709, Adjusted R-Squared: 0.1535, F-statistic: 1.484, and P-value: 0.24.

Table 3: VAR Model Results for Unemployment (data_diff).

Variable	Estimate	Std. Error	t value	P-Value
gdp_diff2.l1	-0.3076	0.2835	-1.085	0.2951
const	-0.1413	0.1998	-0.707	0.4903
Trend	0.1001	0.0406	2.465	0.0263

Notes: The model fit for Unemployment has Residual Std. Error: 0.04783, R-Squared: 0.4811, Adjusted R-Squared: 0.1698, F-statistic: 1.545, and P-value: 0.2191.

4.4. Correlation and Okun's Law

Furthermore, while past values of both GDP and unemployment might not show a strong predictive power for future unemployment rates, the model does provide some insights into the dynamics between the two variables. The correlation matrix of residuals shows a moderate positive correlation of 0.4748. This indicates that when GDP experiences exogenous shocks or unexpected changes, unemployment rates tend to move in the same direction. Such a finding implies that there are external influences or policy shifts simultaneously affecting both GDP and unemployment [11]. The magnitude of the residuals' correlations provides a nuanced perspective. A correlation of 0.4748, while moderate, suggests that almost 22.5% of the variation in one variable's unexpected changes can be explained by unanticipated changes in the other. While not overwhelming, it is a substantial amount that policymakers and economic forecasters should consider. Moreover, the residuals' covariance matrix underlines this relationship with more explicit figures. Specifically, the covariance between GDP growth rate changes and unemployment rate changes stands at approximately 0.001541. While the figure itself might appear diminutive, it is crucial to contextualize it against the backdrop of macroeconomic indicators (Table 4, Table 5). Such a covariance figure accentuates that when GDP growth rate changes deviate from their expected values, it can anticipate a proportionate deviation in unemployment rate changes, and vice versa [15].

Table 4: Covariance Matrix of Residuals.

	GDP (gdp_diff2)	Unemployment(data_diff)
GDP (gdp_diff2)	0.004606	0.001541
Unemployment (data_diff)	0.001541	0.002288

Table 5: Correlation Matrix of Residuals.

	GDP (gdp_diff2)	Unemployment(data_diff)
GDP (gdp_diff2)	1.0000	0.4748
Unemployment (data_diff)	0.4748	1.0000

Based on the results, the relationship between GDP growth rate changes and subsequent unemployment rate alterations does echo the inverse relationship posited by Okun's Law. However, in the context of China, the observed coefficients deviate from this classical 2% benchmark [1]. This deviation might be attributed to China's unique economic dynamics that do not strictly adhere to Okun's law. Several factors could account for this divergence. China's rapid structural transformations, technological innovations, and evolving policy landscapes might be influencing the GDP-unemployment relationship differently. Additionally, the sheer scale and complexity of China's economy, with its regional disparities and sectoral shifts, could also play a role [11].

5. Conclusion

Over the three-decade span from 1992 to 2022, China's remarkable GDP growth, which surged over 40-fold, did not consistently correlate with a proportional decline in unemployment. This study, employing the Granger causality test and the VAR model, revealed that while historical GDP values significantly predicted future unemployment rates, the relationship did not strictly align with the classical coefficients of Okun's Law. The unique dynamics of China's economy, marked by transitions from agriculture to service and industrial sectors, regional economic disparities, and other intricate factors, play a pivotal role in shaping this GDP-unemployment relationship. Policymakers, businesses, and industries should recognize these nuances. At the governmental level, addressing regional economic imbalances and promoting workforce upskilling can foster a balanced growth and employment landscape. For businesses, anticipating cyclical economic patterns and embracing technological advancements can ensure resilience and sustainability. Collaborative efforts between industries and educational institutions can further bridge skill gaps and promote innovation. In essence, while Okun's Law offers a foundational understanding of the GDP-unemployment interplay in many developed contexts, its application to China demands a nuanced interpretation, emphasizing the importance of tailoring economic theories to specific socio-economic landscapes.

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Analysis and Forecast of Contemporary Chinese Population

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Abstract: The analysis and projection of current Chinese population dynamics is the main emphasis of this study. This topic is extremely important in terms of demography, economics, sociology, and international relations. With approximately 1.43 billion people, China is the most populous country in the world and a worldwide giant in both economic and geopolitical terms. This study looks at historical, cultural, economic, and policy-related issues in an effort to understand the intricacies that have led China to this demographic prominence. China's population increase may be traced back to its ancient civilization, which cultivated cultural customs and conventions that still have an impact on demographic patterns now. The “demographic dividend,” a population surge in the middle of the 20th century, signaled a turning point, and the one-child policy that followed, implemented in 1979, produced distinctive demographic contours and long-term repercussions. Fertility rates and generational dynamics have been influenced by the government's evolution of family planning programs, which have ranged from strict measures to more relaxed methods. Understanding and predicting China's population changes is urgent because of the societal and worldwide repercussions of this country's changing demographics. This study sets out on an exploratory trip to understand the complex causes and possible future trends in light of previous studies. This paper wants to contribute to a thorough knowledge of China's demographic evolution and its effects on global society by shedding light on these factors.

Keywords: China, population, trend, analysis, forecast

1. Introduction

China is an unmatched giant in the complex web of states that make up the world, not just because of its importance to the economy and to geopolitics, but also because of its enormous population. The world's most populated nation is China, which proudly claims to have “more than 1.43 billion people” right now [1]. Scholars, decision-makers, and onlookers alike have been intrigued by this astonishing demographic divergence, leading to an investigation of the complex processes that have catapulted China to the forefront of the world's demography. China's remarkable ascent as the world's most populous country is a subject of profound interest and study within the realms of demography, economics, sociology, and international relations. Over the past several decades, China's population growth has captivated the attention of researchers, policymakers, and observers, prompting a comprehensive exploration of the factors that have contributed to its demographic trajectory.

China's growth trajectory has been defined by a combination of historical, cultural, economic, and social variables that have accompanied its road to becoming the world's most populous country. While

other countries' populations are stabilizing or even declining, China's continued population growth brings opportunities and problems that need to be carefully examined. China's ancient civilization, which produced a rich tapestry of cultural norms, beliefs, and practices that continue to affect demographic trends now, is the historical setting of the country's population rise. China's rapid population growth in the middle of the 20th century, known as the “demographic dividend,” was a key turning point that thrust the country to the center of demographic discussions around the world. The one-child policy was subsequently put into place in 1979, emphasizing China's distinctive demographic profile and igniting discussions about both its immediate and long-term ramifications.

China's transformation from a largely agrarian economy to a worldwide economic powerhouse has had a significant impact on its population dynamics, according to an economic perspective. Researchers are examining how industrialization, urban migration, and employment possibilities have contributed to both the expansion and aging of China's population as a result of the interwoven relationship between economic development, urbanization, and demographic transitions.

China's demographic trajectory has been significantly shaped by government policy. From the strict one-child policy to the more modern two-child policy and its subsequent relaxation, the evolution of family planning regulations has produced a complicated interplay between demographic aims, societal expectations, and personal preferences. Researchers have been exploring the impact of these policies on generational dynamics, gender imbalances, and fertility rates as a result of this dynamic environment.

Besides, China's distinctive cultural practices and customs have had a complex impact on the country's population expansion. Changes in reproductive behavior and family structures have been brought about by the conflict between traditional values, which place an emphasis on big families, and the reality of modern living, which prioritizes urbanization and career goals. Inquiries into how cultural variables affect demographic trends in a world that is rapidly changing have been sparked by this junction of cultural legacy and societal upheaval.

China's population is still expanding and changing, and its demographic trajectory is important beyond its borders. China's population dynamics have an impact on social welfare, geopolitics, environmental sustainability, and global economics. In order to develop policies that handle the difficulties and opportunities given by China's demographic landscape, it is necessary to comprehend the complex aspects of China's population rise.

The investigation of the complex dynamics influencing China's demographic landscape is the basis for the analysis and forecast of the modern Chinese population. Numerous studies have examined various facets of this complicated topic, illuminating the difficulties, opportunities, and complexities involved in comprehending China's demographic patterns.

Scholars such as Feng Wang and Junsen Zhang have extensively examined the historical context and implications of China's one-child policy. Their work, including papers like “China's Population Destiny: The Looming Crisis”, delves into the policy's impact on fertility rates, gender imbalances, and generational dynamics [2]. Similarly, publications like “The Evolution of China's One-Child Policy and Its Effects on Family Outcomes” provide comprehensive insights into the policy's socio-economic effects and its legacy on contemporary Chinese demographics [3].

Research exploring the economic dimensions of China's population dynamics has also thrived. Studies like “The Demographic Future: What Population Growth and Composition Tells Us,” offer analyses of the wider global implications of China's demographic shifts on trade, migration, and geopolitics [4].

Furthermore, the examination of China's urbanization and its effects on population distribution has been a focus of academic inquiry. Works like “Trends in Educational Gender Inequality in China: 1949-1985”, contribute to the nuanced understanding of the links between societal norms, gender roles, and fertility decisions [5].

Understanding the social implications of China's demographic transformation from a rapidly growing to an aging society is crucial. The need to foresee problems with healthcare and pension systems, appreciate the economic ramifications of changing consumer and labor dynamics, and navigate the worldwide repercussions of China's demographic changes are the driving forces behind this research. It also adds complexity to broader conversations on social change, individual rights, and human behavior to examine how historical legacies, governmental changes, economic transitions, and cultural factors interact to shape demographic patterns. In addressing these published researches, this research not only enriches our comprehension of a society in flux but also offers vital insights for policymakers, economists, and global stakeholders seeking to engage proactively with the multifaceted dimensions of China's evolving population dynamics.

In order to analyze the current population data and forecast the future amount of population, the data selected from the national statistics website were imported into R Studio and then analyzed and subtracted by the fpp2 and forecast library. After analyzing the characteristics, this data is forecast by the Arima model. And then, is the conclusion analysis of these results.

This essay sets out on an exploratory voyage in an effort to solve the mystery surrounding China's extraordinary population rise and then give a forecast for the future population. The rest of the paper is divided into data description, forecasting models, results analysis, and conclusions. Through these sections, this paper aim to shed light on the complex interplay of factors that have contributed to China's status as the world's most populous nation.

2. Literature Review

Due to its profound consequences for society, economics, and global dynamics, the analysis and forecast of the current Chinese population have attracted significant attention from academics, policymakers, and researchers across a variety of sectors. An overview of the important issues, research, regulatory changes, economic transitions, cultural influences, and projections that have helped us better comprehend China's demographic environment is given in this survey of the literature.

China's fertility dynamics have implications beyond its borders, influencing global labor markets, migration flows, and trade dynamics. Comparative studies, such as "Changing Kinship Structure and its Implications for Old-Age Support in Urban and Rural China", situate China's fertility trends within the broader context of global demographic transitions [6]. These studies provide a holistic view of the factors driving fertility decline and their global repercussions. In general, researchers who study aging in China come to the conclusion that the country has become an old society. Besides, the author of this paper mentioned that during the next 40 years, urban residents would carry a greater "burden of support for elderly parents" [6].

How will China's population grow in the following years? "Ageing of a giant: a stochastic population forecast for China, 2006-2060" points out that China's population will increase to its maximum level in 2024 and start to "decline to 1,114 million people in 2060" [7]. This result is analyzed by China's fertility rate and mortality rate and also the population increase differences between males and females. Because females have "lower mortality at working ages and lower ages", the female population will reach its maximum level in 2026 while the male population in 2021[7].

Similarly, the CNN report that "China's population is shrinking" [8]. This report analyzes why China's population started to decline, and the status after China announced the one-child policy. And then, after 35 years of limitation to one child, China finally "scrapped the rule" [8]. China allowed couples to have two children in 2005 and then raised this to three in 2021. All this information points out a falling population will "exacerbate China's problems with an aging workforce and drag on growth, adding to its woes as it struggles to recover from the pandemic" [8].

Another report then lists the factors that will impact the population, such as housing prices, education, healthcare, welfare, etc. This report also analyzes China's first population decline, which

was in 1961. The author mentioned this change as an “era of negative population growth” [9]. The author then used the plot to compare the forecast of population between China and India after 2023. It is clear to see that China’s population starts to drop after 2023 and will have 0.77 billion people in 2100. However, compared to China’s population, India’s population will continue increasing till 2064, at its peak of about 1.7 billion people, and then after this peak, the population starts to decline and will have 1.53 billion people in 2100.

“China’s Demographic History and Future Challenges” indicates that in comparison to most other nations, China is finishing its demographic transition in a shorter amount of time [10]. Although the country has benefited from the rapid and continuous drop in mortality and fertility as well as the increasing urbanization, particularly in terms of economic growth, China also faces tremendous problems in adapting to these changes.

3. Data And Methodology

3.1. Statistics Analysis: Data Description

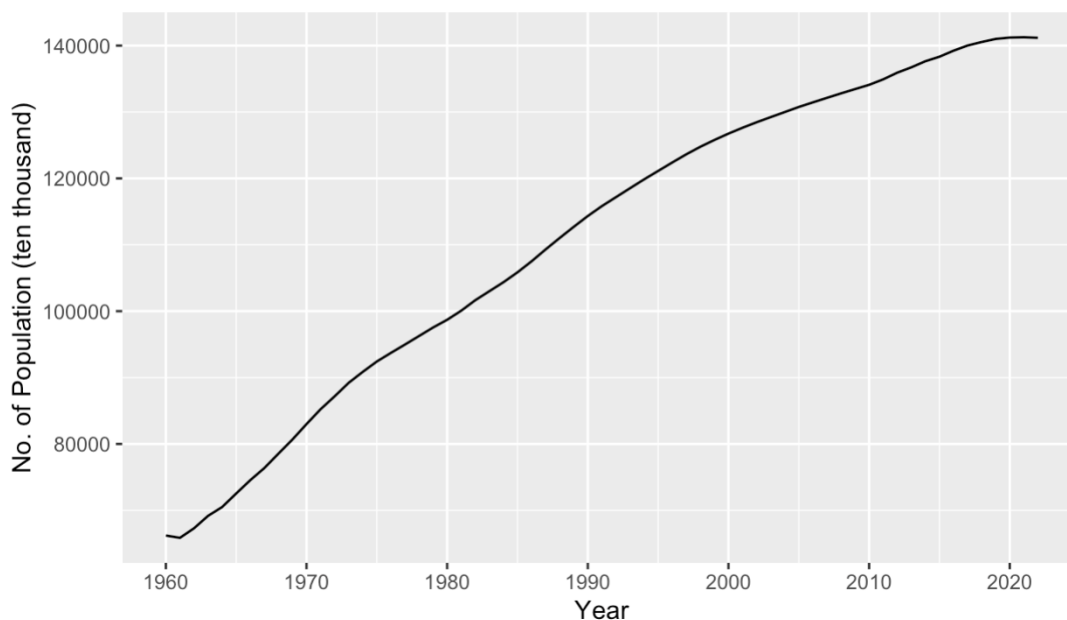


Figure 1: The total population at the end of the year.

In Figure 1, the data from the National Bureau of Statistics shows only two declines in the Chinese Population, one in 1961 and another in 2021. The decline in population in 1961 is because of the “Great Famine” and also the Economic Difficulties. China experienced an unprecedented Natural Disaster and does not have enough ability to address this problem. Therefore, the decline of the population is unavoidable at that time. Then, the population will be at its highest overall point in 2021 and start to decline after this year. Also because this data is annual data, there is no seasonality or cyclicity. However, Figure 1 has an upward positive trend since the very beginning and starts to drop a little bit after 2021. However because the National Bureau of Statistics only has one data collected after 2021, which is 2022, this paper will make a prediction for the following years’ population.

3.2. Statistics Analysis: Forecasting Models

The P-value provided by the Augmented Dickey-Fuller Test is 0.984, which is a very large value and larger than any significant level, such as 0.05 and 0.01. Because the alternative hypothesis is

stationary, therefore, people do not have enough evidence to reject the null hypothesis. That is this data is non-stationary. Therefore, this paper need to consider the forecasting models that are suitable for non-stationary time series data, such as Arima, ETS, etc.

The two methods that are used are ARIMA and ETS. These two powerful techniques could boost the process of analyzing different levels: ARIMA excels at modeling data with trends and seasonality, can handle non-stationary data, and offers flexibility in its structure for capturing different patterns. The ETS model, on the other hand, is simple yet robust, effectively managing irregularities in the data. Together, they provide easily interpretable smoothing parameters to understand underlying patterns and offer automated procedures for model selection. Both methods serve as efficient tools for forecasting with different emphasis and focus. Besides that, the random walk function, drift method, and naive model are also used to perform further forecasting procedures to check which one is the best forecasting model.

4. Results

4.1. Using ARIMA Method to Forecast

The auto Arima function gives Arima(3,2,0). In other words, there are no autoregressive as well as moving average terms in the model. But a second-order differencing on the series is needed to make this time series stationary. So this auto Arima model with order (3,2,0) is suggesting that this population data is like a random walk. Meanwhile, the forecast predicted by Arima(3,2,0) is shown in Figure 2.

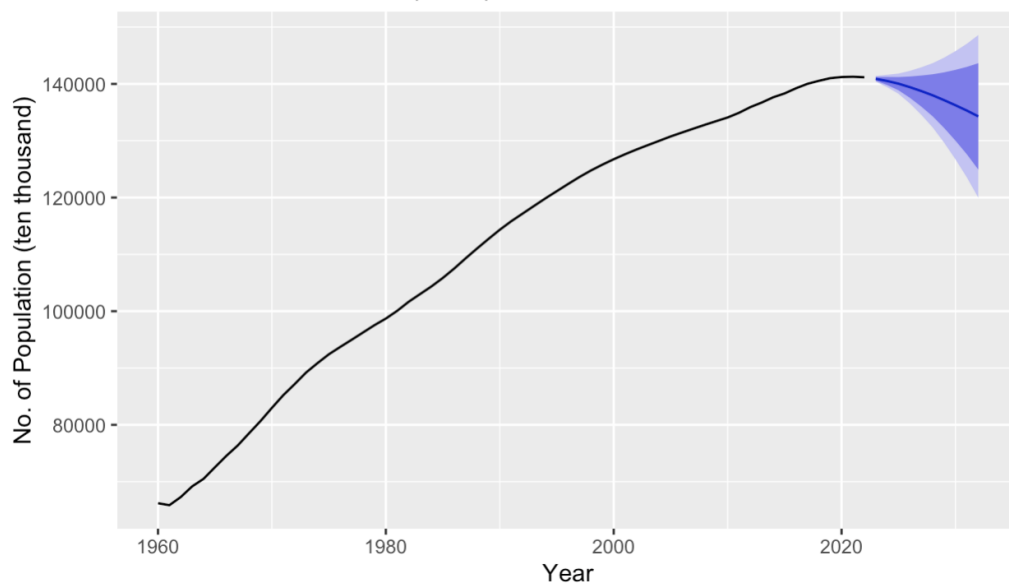


Figure 2: Forecasts plot from Arima(3,2,0).

Notice that AIC here is 856.53 and Root Mean Squared Error RMSE is roughly equal to 243.731. The p-value in the Ljung-Box test is larger than the significant level, which also suggests that residuals from ARIMA(3,2,0) are consistent with white noise.

Now, take a look at the ACF plot and the PACF plot (Figure 3):

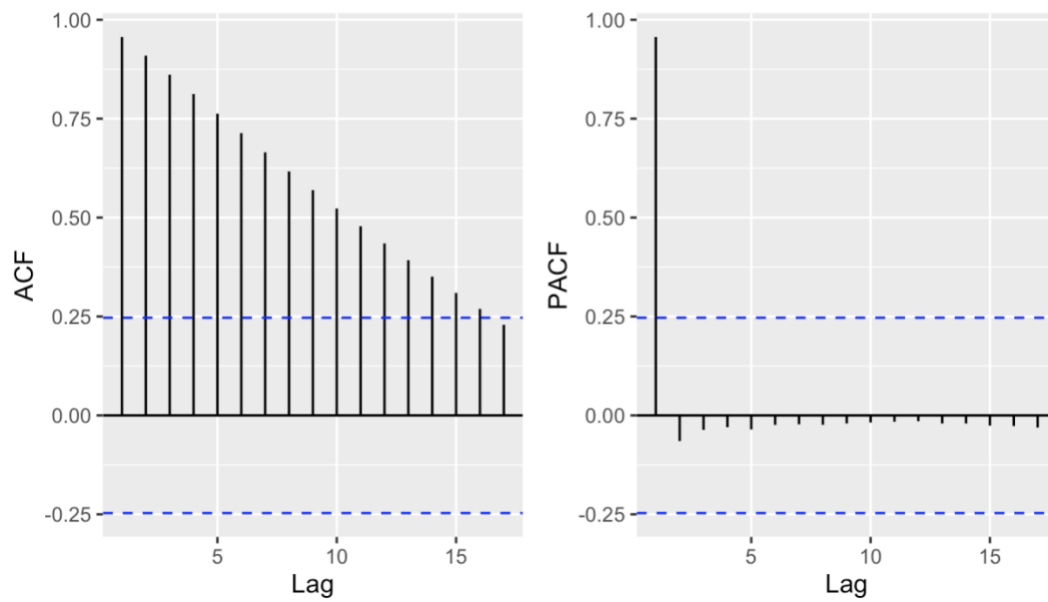


Figure 3: The ACF plot and the PACF plot of population.

The data are clearly non-stationary, as the series wanders up and down for long periods. Consequently, take a look at the differences of the data (Figure 4&5&6).

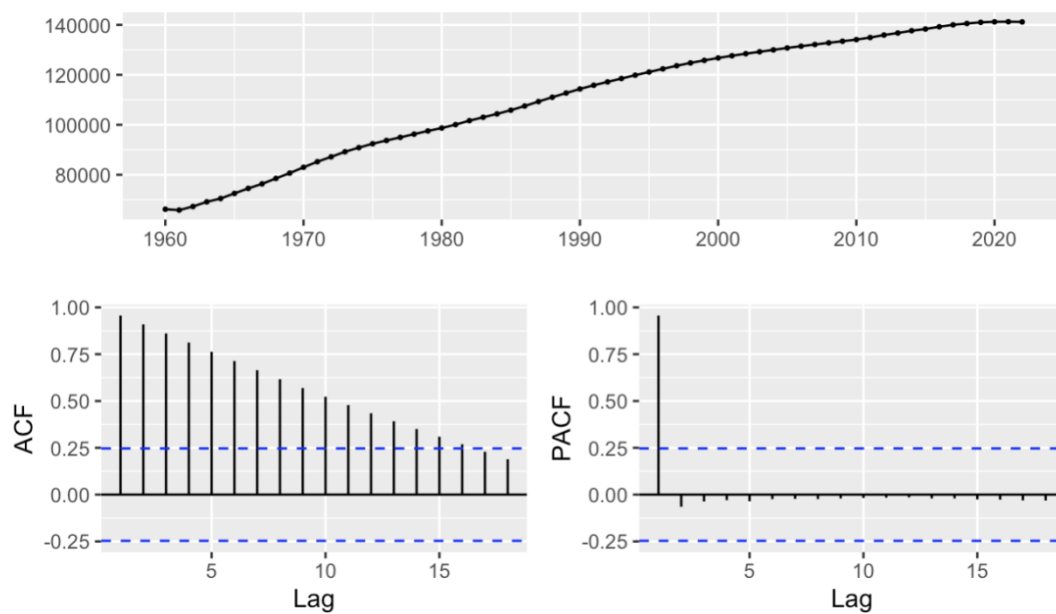


Figure 4: The original version of population data.

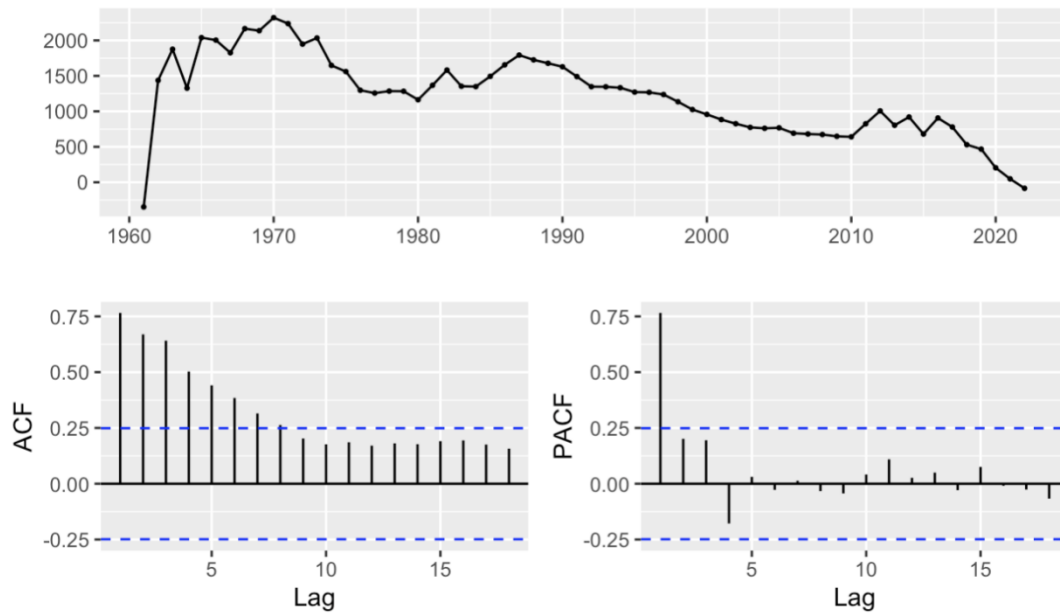


Figure 5: The first difference version of population data.

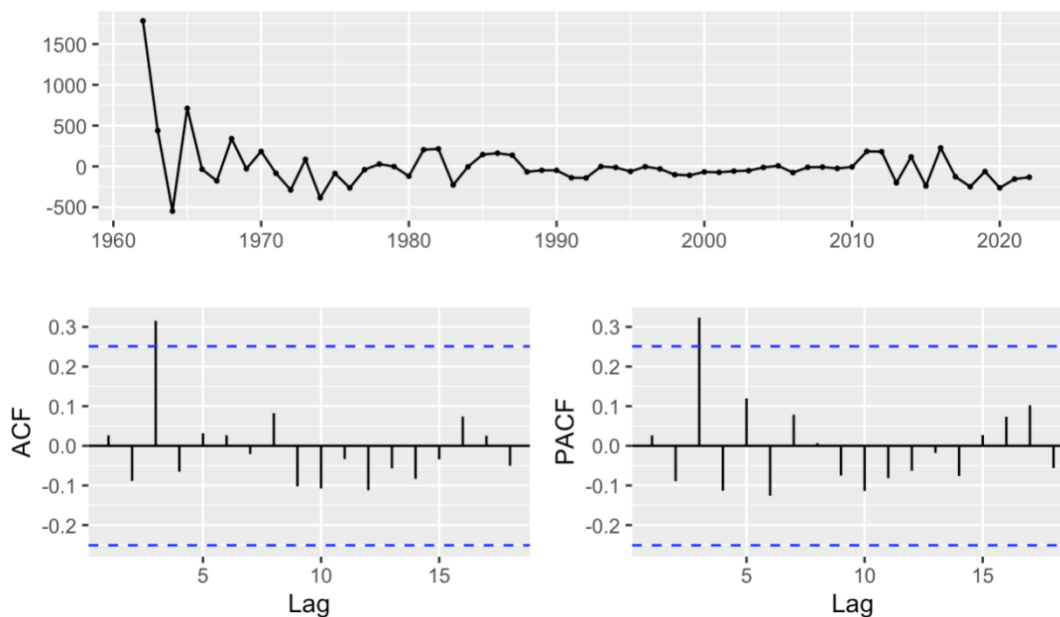


Figure 6: The second difference version of population data.

These graphs show how the time series has become stationary. One thing that stands out in this situation is that the data has less noise in first-order differencing whereas the noise increases after the first order. Therefore, this paper considers choosing first-order differencing for the Arima model. By using an autocorrelation plot, the second-order differencing has caused the immediate lag to shift to the negative side, indicating that the series has surpassed the difference in the second order.

From the PACF graph, the first lag is significantly out of the limit and the second one is also out of the significant limit but it is not that far so select the order of the p as 1. By comparison, Arima with order (1,4,9) will be analyzed in the following procedures.

Notice that AIC this time is 850.19 and Root Mean Squared Error is roughly equal to 220.9357. With comparisons, the AIC in Arima(3,2,0) is larger than the AIC in Arima(1,4,9) about 6 and the RMSE value is larger in Arima(3,2,0) for almost 23. Therefore, this paper can conclude that Arima(1,4,9) is much better than another model because the RMSE value and AIC value for Arima(1,4,9) are both smaller than the Arima(3,2,0) for a large magnitude.

4.2. Using ETS Method to Forecast

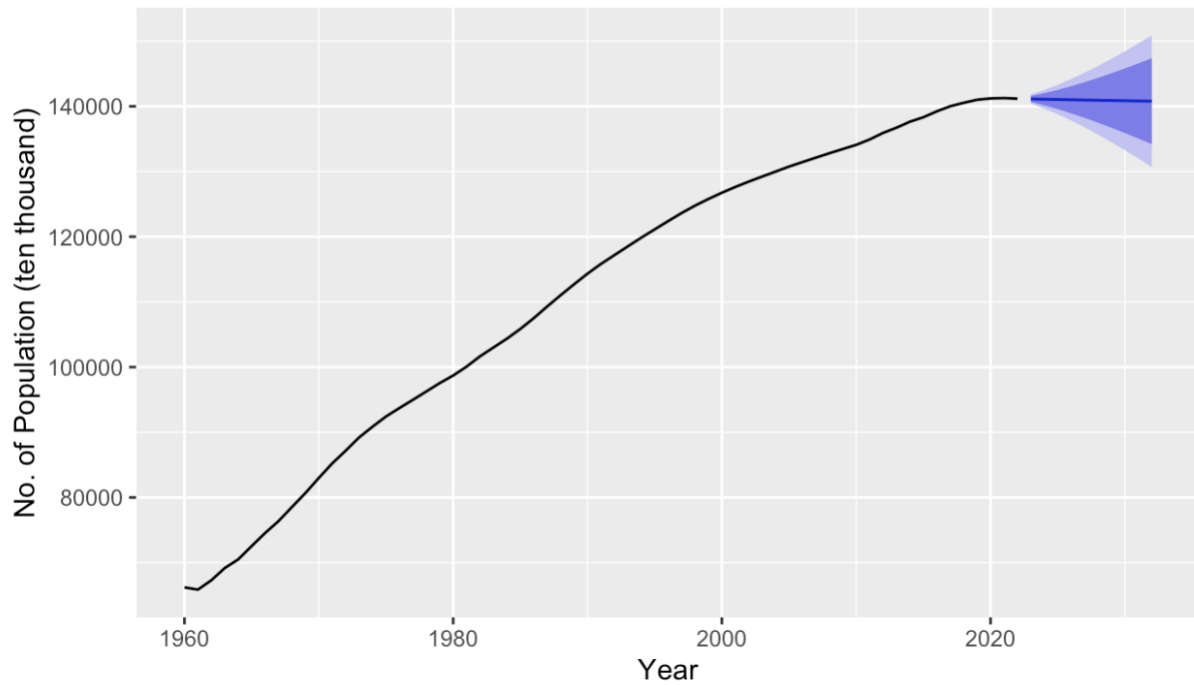


Figure 7: Forecasts plot from ETS(A,Ad,N).

The results from the ETS(A, Ad, N) mean this model underlies the damped trend method(Figure 7). In order to be more accurate, this paper tries to only care about the year after 1962, which has a continued increasing trend after this time period. After excluding the data before 1962, the values of AIC and RMSE dropped from 1009.136 to 892.0881 and from 344.5398 to 176.7601. And then, the new results from the ETS(A, A, N) demonstrate a trend that changes over time(Figure 8).

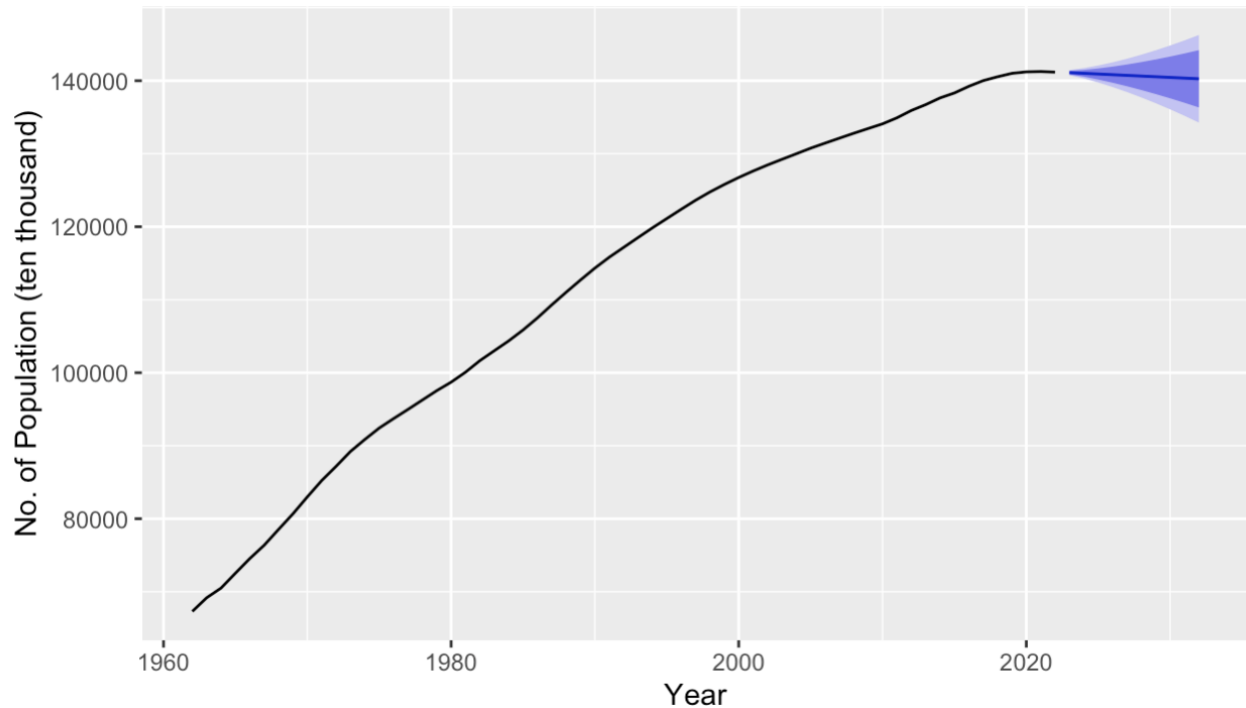


Figure 8: Forecasts plot from ETS(A,A,N).

4.3. Basic Analysis

Table 1: The results from above model.

	AIC	AICc	RMSE	MAPE
Arima(3,2,0)	856.53	857.25	243.731	0.1773001
Arima(1,4,9)	850.19	855.81	220.9357	0.1024297
ETS(A,Ad,N)	1009.136	1010.636	344.5398	0.2284568
ETS(A,A,N)	892.0881	893.1790	176.7601	0.1365558

There are three main changes in China's government policy, such as The 18th CPC Central Committee's Third Plenary Session made the decision to implement the "Single Second Child" plan in 2013. The "Comprehensive Two-Child" plan was introduced in 2015, according to the announcement made during the Fifth Plenary Session of the Eighteenth Central Committee. The Fifth Plenary Session of the Eighteenth Central Committee concluded in Beijing on October 29, 2015. The announcement of the "comprehensive implementation of the policy that a couple can have two children" was made in a communiqué that was released on the same day, signaling the end of the "one-child policy" era, which had been in place for 35 years on the basis of adhering to the fundamental national policy of family planning. It is important to note that the only population decline since the formation of the People's Republic of China took place in the years 1960 and 1961, which were also disaster-prone for our nation.

Although the population is growing overall, the growth rate is gradually decreasing. The Academy of Social Sciences forecasts that China's population will peak at 1.442 billion in 2029 and then progressively fall after that. However, China's population has started to grow negatively since the end of 2021. With the help of data, the birth population will struggle to stay at 12 million in 2020, and there will still be a net rise in births of 1.6 million. The net population increase will be less than

500,000 by 2021, and it appears that the painting industry won't be able to rebound. Less than a tenth of a century has passed since this population rise began. 10 years ahead of the estimated demographic turning point, a negative population increase in 2022 is a given. The population born between January and July 2022 is anticipated to decline by 11–12% annually based on current private statistics, sample findings, and locally released data. The estimated number of births among them in 2022 is 9.5 million, the estimated number of deaths in 2022 is 10.3 million, and the estimated net population growth in 2022 is -800,000.

By comparing all the variables in Table 1, the Arima(1,4,9) model has the smallest AIC value and RMSE value at the same time. Therefore, the Arima(1,4,9) model illustrates a 95% confidence interval [1401.782, 1411.885] (in million) with a point forecast of 1406.833 million people in 2023(Figure 9). The median value continues to decrease in the following years in a quadratic relationship. By the way, the Arima(3,2,0) model illustrates a 95% confidence interval [1403.995, 1413.952] (in million) with a point forecast of 1408.973 million people in 2023. The point forecast value will also decrease in the following years. In conclusion, the total population in China will continue to decrease in the following ten years.

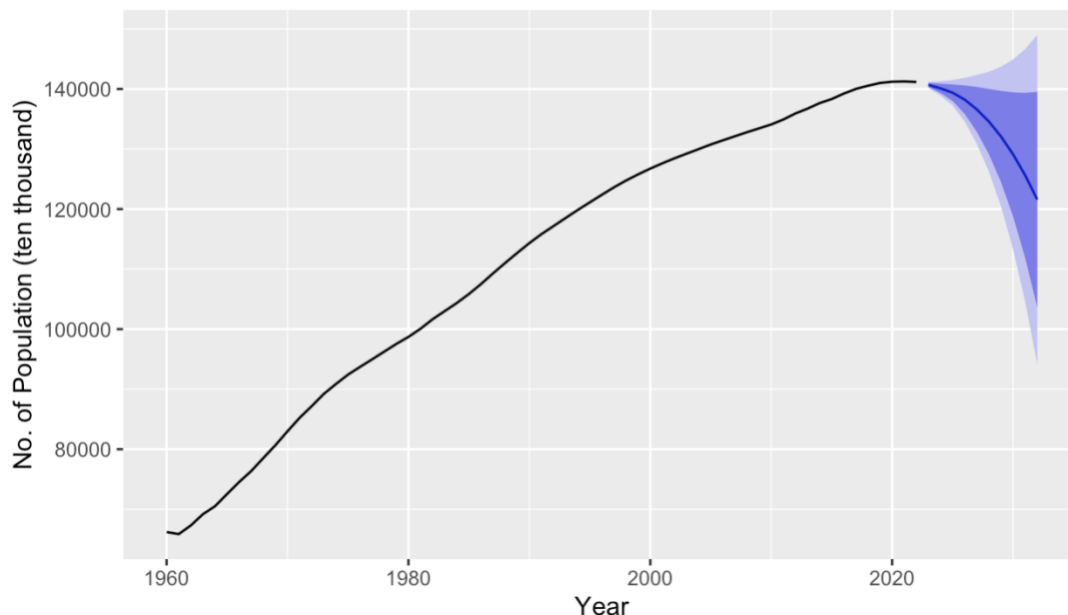


Figure 9: Forecasts plot from Arima(1,4,9).

5. Conclusion

The population development trend in China exhibits specific features along with the development of its economy and culture. Over time, China's population has been naturally growing at a slower rate. Prior to the 1970s, China's population growth rate was maintained at more than 20%. The family planning policy was implemented in China in the 1980s and the 1990s. Even though the birth rate exceeded 10% in the 1980s, the proportion of people born before the 1970s had drastically decreased. People born in the 1980s started to reach the jade age one after another in the 21st century. The population of China has grown naturally at a rate that is less than 10% since the 1990s. China started enforcing the two-child policy entirely in 2016, although the population's natural growth rate has not increased considerably. It is currently less than 6%, which is the same as the natural growth rate in 2004 and 2005. And for the following 10 years, the population will continue decreasing.

The population growth rate is declining for two main reasons: the first is a decrease in the number of people who are fertile age, and the second is a decrease in women's willingness to have children. According to the 2010 Census, which reveals that the female population has fallen by about 41% and the birth population has shrunk by approximately 35%, the decline in the number of persons of childbearing age is mostly caused by the long-term trend of population decline and the decline in the female population. These numbers also directly affect China's projected population growth rate in the future.

Meanwhile, the population's age distribution reveals the signs of aging. China's population is aging, which is primarily seen in three ways: first, a reduced age structure overall; second, an increase in the number of senior people; and third, an aging working population.

As a result, the plan for China's future development is the first to create a reliable birthing system. The declining fertility rate is one of the major issues affecting our population economics. Despite the two-child policy's implementation, China's birth rate has remained largely steady, with one-child birth rates declining while the two-child contribution rate has increased to 50%. China must therefore promote fertility and continue to enhance the related system.

Second, improve the social security program. The development and stability of our economy and society, as well as the fair allocation of labor resources and the fair arrangement of pension fund revenue and expenditure in our nation, are all related to the creation and maintenance of the ideal social security system. China's social security system now has weak binding and poor sustainability.

Third, make labor resource allocation improvements. Government will specifically enhance the information infrastructure, education system, and household registration system. The supply and demand of labor resources in China are somewhat out of balance, which is precisely why. On the one hand, there is a shortage of labor resources with advanced technology, and on the other, there is an abundance of some low-quality labor resources.

Fourth, hasten the model for economic development's transition. This is due to China's population structure being unbalanced, which would result in an increase in the proportion of elderly people and the disappearance of the previous demographic dividend. This presents the economic development model's change with both an opportunity and a difficulty. Therefore, in order to appropriately manage the process of economic transformation, people must enhance the quality of the working population, correct the coordination of aging, and properly address the relationship between economic development and population resources.

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Optimizing Supply Chain Risk Management: A Case Study of Pharmaceutical Humanwell Healthcare

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Abstract: Supply chain risk management is an important area that enterprises in globalized competition must address. Effective supply chain risk management not only helps to ensure production and delivery stability but also improves competitiveness. As an internationalized enterprise, Humanwell Healthcare faces diversified risks from various links in the supply chain. This study aims to explore Humanwell Healthcare's supply chain risk management strategy to improve its ability to identify, assess and respond to supply chain risks. Through comprehensive literature analysis and case studies, this study will provide an in-depth analysis of Humanwell Healthcare's supply chain risk characteristics and propose corresponding management methods and tools. The study results show that Humanwell Healthcare can effectively reduce and control supply chain risks and improve its overall business performance by establishing an effective risk identification mechanism, strengthening the cooperative relationship with suppliers, and adopting appropriate insurance measures. This study provides useful reference and inspiration for other supply chain risk management enterprises.

Keywords: supply chain risk, risk identification, risk assessment, response capability

1. Introduction

With the development of globalization and the intensification of market competition, supply chain management has become one of the key factors for the success of enterprises. However, the supply chain has various potential risks, such as natural disasters, political instability and supplier bankruptcy [1-4]. These risks may significantly impact enterprises' production operation and product delivery and even lead to economic loss and reputation damage. Therefore, supply chain risk management has become the focus of attention in various industries [5].

As a special industry, the pharmaceutical industry has more complex and highly sensitive supply chain risks. Pharmaceutical Humanwell Healthcare, a well-known enterprise in this field, faces many supply chain risk challenges, globalized competition, and market changes. For example, the stable supply of raw materials for pharmaceuticals, the fulfillment of compliance requirements and the long cycle of new drug development have all put great pressure on Humanwell Healthcare.

This study aims to explore the supply chain risk management strategy of a pharmaceutical company, Humanwell Healthcare, and to make appropriate recommendations to optimize its supply chain risk management effectiveness. Specific objectives include analyzing the current supply chain

risks faced by Humanwell Healthcare, including but not limited to unstable supply of raw materials, quality issues and compliance requirements; Assessing the effectiveness and limitations of Humanwell Healthcare's existing supply chain risk management practices; Propose supply chain risk management strategies applicable to Humanwell Healthcare, including improvement of existing measures and introduction of new technologies or methods; and analyze and speculate on the potential benefits and impacts of implementing the proposed strategy.

Through this study, we aim to provide targeted supply chain risk management suggestions for Humanwell Healthcare and other pharmaceutical companies to help them better cope with and avoid potential supply chain risks and safeguard their enterprises' sustainable and stable development. It can also provide a reference for related academic research and promote further research and practice development in this field.

2. Supply Chain Risk Management Theory

2.1. Definition of Risk Management

In the related research of risk management, different scholars hold different views on the definition of risk. At present, the academic community has yet to reach a consensus on the definition of supply chain risk because scholars at home and abroad have made a lot of statements on the definition of supply chain risk, and there are still big differences between different statements. However, most scholars mention the uncertainty of the occurrence of events or influencing factors and the possible adverse effects or consequences when defining risk. From their work, a definition of supply chain risk management can be summarised: the control of supply chain risks to reduce or avoid their adverse effects [6-8].

2.2. Supply Chain Risk Identification

Supply chain risk identification refers to the comprehensive and systematic identification and analysis of potential risks present in the supply chain. This process needs to consider the impact of each link, participant and the external environment on the stability of the supply chain. Common supply chain risks include, but are not limited to, logistics delays, raw material shortages, quality issues, natural disasters, etc.

Enterprises in the process of operation and development may exist in the supply chain risk, and supply chain risk will constrain the production and development of enterprises; the classification of supply chain risk can enable enterprises to understand better the understanding and identification of internal and external risks that exist in the supply chain so that they can take corresponding countermeasures to deal with the different risks, to minimize the impact of risk on the enterprise.

2.3. Supply Chain Risk Assessment

A supply chain risk assessment is a quantitative or qualitative analysis of identified potential risks to determine the extent and likelihood of their impact on supply chain operations. The assessment results can help the organization determine which risks must be focused on and develop risk management strategies accordingly.

When assessing supply chain risks, many scholars use a combination of methods, which can, to a certain extent, reduce the shortcomings of using only a single risk assessment method of a certain kind and make the assessment results obtained more accurate and comprehensive. However, appropriate assessment methods and combinations should be selected according to the actual situation when assessing supply chain risks.

2.4. Supply Chain Risk Control

Supply chain risk control refers to a series of effective measures to reduce or eliminate potential risks that have been identified and assessed. The goal is to improve the stability and sustainability of supply chain operations.

Risk identification and assessment is the first thing that should be done before implementing supply chain risk control. Controlling supply chain risks does not mean abandoning the original activities but adopting certain methods to reduce the likelihood of risks to minimize or avoid the adverse impacts and ensure the smooth operation of the supply chain when carrying out these activities. Effective control of supply chain risks can not only avoid or mitigate the adverse effects of risks on enterprises but also reduce costs and improve efficiency to a certain extent, which is conducive to the sustainable development of enterprises.

3. Current Situation and Problems of Supply Chain Risk Management in Humanwell Healthcare

3.1. Case Description

Established in 1993, Humanwell Healthcare is a leading enterprise in the pharmaceutical industry of Hubei Province, one of the top 30 enterprises in China's pharmaceutical industry, a national demonstration enterprise for scientific and technological innovation, and a pioneer enterprise in the internationalisation of Chinese pharmaceutical preparations. It has formed a leadership or leading position in the segmented areas of neurological drugs, steroidal hormone drugs, Uyghur ethnic drugs, etc., and has been gradually expanding the business of U.S. generic drugs in recent years.

The company focuses on the pharmaceutical industry, supplemented by the pharmaceutical business, and steadily promotes internationalisation. Pharmaceutical industry focuses on the development line of "quality-based enterprise", pharmaceutical business adheres to the positioning of "integrated provider of medical services", and arranges the commercial network to achieve full regional coverage; internationalisation has formed the ability of the whole value chain of pharmaceuticals, including global research and development, registration, production and sales, and exports to 70 countries and regions worldwide. The company has exported to 70 countries and regions around the world.

3.2. Management Status

In terms of supply chain risk management in Humanwell Healthcare, there are some management status quo, which bring certain challenges to the supply chain's stable operation and risk control. Several key supply chain risk management aspects in Humanwell Healthcare will be analyzed below.

Firstly, Humanwell Healthcare still needs to establish a comprehensive supplier evaluation system regarding supplier selection and evaluation. Currently, the company mainly relies on traditional empirical judgment and some simple indicators to select and evaluate suppliers. This approach leads to incomplete and subjective information and makes it difficult to identify potential risk factors promptly.

Second, in terms of contract management, Humanwell Healthcare has problems such as unclear contract terms and a lack of performance monitoring. Since the contract is the legal basis for binding the behavior of all parties in the supply chain, if the contract terms are vague or lack an effective monitoring mechanism, it will bring a series of potential risks to the supply chain.

In addition, regarding information sharing and communication, Humanwell Healthcare has the problem of information silos. The lack of effective information sharing and communication mechanisms between various links leads to poor information flow, more prominent information

asymmetry, and lag. This makes it difficult to obtain accurate information and take corresponding countermeasures when risks occur in the supply chain.

Finally, regarding supply chain visualization and monitoring, Humanwell Healthcare needs more comprehensive visualization and real-time monitoring. Currently, the company mainly relies on manual records and reports from some systems for supply chain management. It cannot comprehensively monitor the entire supply chain and risk warning. As a result, when a risk event occurs, Humanwell Healthcare often needs to spend more time and resources to react promptly.

3.3. Problem Analysis

Based on the above analysis of the current situation, it can be seen that the following problems exist in the supply chain risk management of Humanwell Healthcare:

Firstly, supplier selection and evaluation need to be more scientific and rigorous. The lack of an effective evaluation system has led to an inability to fully understand potential suppliers' capabilities, credibility and other circumstances, increasing the risk of cooperation.

Secondly, many things could be improved with contract management. Lack of clarity in contract terms can lead to disputes; inadequate performance monitoring can lead to contractual breaches.

In addition, there are problems with information sharing and communication. Information silos lead to poor information flow and increase the risk of information asymmetry and lag.

Finally, supply chain visualization and monitoring are not comprehensive and real-time. The lack of comprehensive visualization and real-time monitoring mechanisms makes it difficult for Humanwell Healthcare to promptly detect and respond to supply chain risk events.

In response to the above problems, Humanwell Healthcare needs to take a series of improvement measures to enhance its supply chain risk management capability, including establishing a scientific supplier evaluation system, improving the contract management mechanism, enhancing information sharing and communication, and introducing advanced supply chain technologies. By implementing these measures, Humanwell Healthcare can better cope with supply chain risks and improve its operational efficiency and competitiveness.

4. Optimisation Strategies and Options for Humanwell Healthcare

4.1. Risk Assessment and Early Warning Mechanisms

Humanwell Healthcare should establish a systematic risk assessment and early warning mechanism to manage supply chain risks effectively. The mechanism can be implemented through the following steps:

Firstly, a comprehensive risk identification and assessment of each link in the supply chain. This includes analyzing risks in suppliers, contracts, logistics, inventory, etc., and identifying key risk indicators and weights.

Secondly, a monitoring indicator system is established, and modern information technology means are used to achieve real-time data collection and analysis. By monitoring and analyzing key indicators, potential risk signals can be detected promptly and corresponding early warning and decision-making can be made.

Lastly, effective communication channels and collaboration mechanisms should be established to ensure that information can be shared and actions coordinated promptly among the various segments and that appropriate measures can be taken to deal with risk events that have occurred or are about to occur.

4.2. Supplier Management and Contract Optimisation

To reduce supply chain risks, Humanwell Healthcare needs to strengthen its management of suppliers and optimize contract terms. Specifically, the following strategies can be adopted:

Firstly, in terms of supplier selection and evaluation, a scientific supplier evaluation system has been established, including examining suppliers' financial status, qualification certification, production capacity and other indicators. At the same time, communication and cooperation with suppliers are strengthened to establish long-term and stable cooperative relationships.

Secondly, in terms of contract management, optimize the contract terms and clarify the rights and responsibilities of both parties and the risk-sharing mechanism. The contract should contain detailed delivery time, quality requirements, liability for breach of contract, etc., and set up a corresponding performance monitoring mechanism [9].

4.3. Information Sharing and Synergies

To improve the information-sharing and collaboration capabilities in Humanwell Healthcare's supply chain, the following measures can be taken:

First, in terms of information sharing, advanced information technology systems have been introduced to automate data collection and sharing among various supply chain links. By establishing a unified platform and standardized data formats, information can be transferred smoothly, and the required information can be obtained promptly.

Secondly, in terms of synergy, a cross-departmental collaboration mechanism and a teamwork culture are established. Communication and coordination between different departments are promoted, and collaborative discussions and problem-solving are carried out through regular meetings or workshops, etc. [10].

4.4. Technical Support and Innovation

Advanced technical support and innovative means can be used to improve the efficiency and accuracy of supply chain risk management in Humanwell Healthcare. Specific measures include:

Firstly, supply chain risk management software or system is introduced to achieve comprehensive monitoring, early warning and decision-making support for each link in the supply chain.

Secondly, supply chain risks are predicted and analyzed more accurately using technical means such as big data analysis and artificial intelligence. By mining the hidden patterns and laws in big data, potential risks can be better identified, and corresponding risk management strategies can be formulated [11].

Finally, regarding supply chain innovation, employees are encouraged to propose improvements and actively participate in supply chain optimization projects. At the same time, it cooperates and exchanges with other enterprises in the industry to jointly promote innovation and development in the field of supply chain management.

By implementing the above optimization strategies and programs, Humanwell Healthcare can enhance its supply chain risk management, effectively reduce the impact of potential risks and improve its overall operational efficiency and competitiveness.

5. Conclusion

This thesis focuses on the supply chain risk management of Humanwell Healthcare and proposes relevant status quo analysis, problem analysis, and optimization strategies and solutions. Through the in-depth analysis of the current supply chain risk management situation in Humanwell Healthcare, we found some existing problems and challenges. These problems include insufficient scientific

supplier selection and evaluation, imperfect contract management, poor information sharing and communication, and incomplete supply chain visualization and monitoring.

To solve these problems, we propose a series of optimization strategies and solutions. Firstly, it is recommended that Humanwell Healthcare establish a systematic risk assessment and early warning mechanism to detect potential risk signals promptly by monitoring and analyzing key indicators. Secondly, in terms of supplier management and contract optimization, it is recommended to strengthen the selection and assessment of suppliers and optimize contract terms to clarify the rights and responsibilities of both parties and the risk-sharing mechanism. In addition, we emphasize the importance of information sharing and collaboration, suggesting the introduction of advanced IT systems and the promotion of cross-departmental collaboration and teamwork. Finally, we advocate using technical support and innovation to improve the efficiency and accuracy of supply chain risk management.

Humanwell Healthcare can effectively reduce supply chain risks and improve overall operational efficiency and competitiveness by implementing the above optimization strategies and programs. However, we also need to realize that supply chain risk management is an ongoing process that requires continuous monitoring and improvement. Therefore, it is recommended that Humanwell Healthcare establishes a long-term and stable supply chain risk management mechanism and regularly evaluates and optimizes its effectiveness.

Finally, the findings presented in this thesis are limited to the case of Humanwell Healthcare and may differ for other companies or industries. Therefore, adjustments and adaptations must be made according to the actual situation when implementing optimization strategies and programs. This thesis's research results can provide reference and reference value for Humanwell Healthcare and other related supply chain risk management enterprises.

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Research on the Iterated Prisoner Dilemma Based on Combinations of Two-side Strategies

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Abstract: The endless prisoner's dilemma game is described as a "primer" using the perspectives of the bilateral parties. Current research focuses on which player responds most effectively, which is a kind of self-protect behavior. Content analysis and mathematical justification were undertaken for the prisoner's dilemma iteration to understand better how to improve the game in a partially competitive and cooperative collaborative setting. This aims to apply the two-side strategies to the real world, especially the political events in which the whole human outcome should be maximized. Participants, who were mostly chosen from game theory specialists from an experiment, provided the decision parameters and rules, in which they have to decide among certain personal strategy choices. The comparison's findings show that two-sided cooperation produces the best results. Still, two-sided inaction results in the poorest, and single cooperation and single noncooperation result from personal sacrifice and personal selfishness, which is a psychological phenomenon.

Keywords: infinite prisoner dilemma, two-side strategies, content analysis

1. Introduction

1.1. Research Background

1.1.1. The Description of the Game

Prisoners A and B are charged with a crime and detained separately, and each can give a confession(cooperation) or deny(noncooperation). Neither prisoner knows what the other will choose to do [1]. The payoff outcomes in each situation are listed in Table 1 [1].

Table 1: Game utility outcomes.

		B	
		Do cooperation	Cannot Cooperation
A	Do Cooperation	-2,-2	-20,0
	Cannot Cooperation	0,-20	-10,-10

1.1.2. Iterated and Infinite Prisoner Dilemma

The author can even purposefully switch from a single prisoner's dilemma to an iterated prisoner's dilemma by continually interacting with the same people, a recent trend that has been applied to some sectors [2]. Participants in an iterated prisoner's dilemma, are able to learn about their counterpart's behavioral inclinations, based on the history dependent reciprocity, which distinguishes it from the original concept of a prisoner dilemma.

Particularly, the essay focuses on the infinite prisoner dilemma, a kind of iterated prisoner dilemma with infinite iteration. The purpose of this is to use the characteristic of infinity to make the calculation more representative and comparative.

1.1.3. Future Discount

Usually, future discounts are calculated into future payoffs in infinite games, which means the future payoffs are lower than the current ones because people prefer to be satisfied now [3]. This factor leads to a drop in incentives to cooperate because the sum of infinite payoffs achieved by cooperation may be even lower than those gained by defecting in the initial round. The future discount usually represents a constant between 0 and 1 (use δ to represent it). Thus, the payoff in the n th round is the payoff of the first round times δ^{n-1} in a certain circumstance.

1.1.4. Strategies Chosen

In an iterated prisoner dilemma, the participants can gradually encourage collaboration, penalize defection, and treat cheating as noncooperation. Some common strategies have been listed and proved by previous researchers. The majority of strategies that occur in iterated prisoner dilemma are Tit for Tat strategy (TFT), always defection strategy (AD), and grim trigger strategy (GT), but some strategies that are not that commonly chosen will still be studied in the essay, like always cooperation (AC), Win-Stay-Lose-Shift (WSLS), Suspicious Tit for Tat (STFT) [4]. Besides, the Limited Punishment strategy (LP) is also included in the study. Even if there is an endless variety of tactics, this essay still takes some representative choices to figure out the best outcome to show a new perspective of the strategies chosen.

1.1.5. Pros and Cons of Strategies

Players employ the "tit for tat" tactic in the game to punish the noncooperation behavior or reward the cooperation behavior of the other player, which is a method of self-protection. It works out well because of the simplicity of strategy rules, and it is tricky to find the best response except for always cooperation, facing other's tit-for-tat strategy.

In addition, the Win-Stay-Lose-Shift strategy (which is also called perfect TFT) is advantageous because it can achieve cooperation even if two players have witnessed the dual-noncooperation (fighting), which can be applied in reality well, for instance, countries relieved from World War Two and set up the United Nations.

Similarly, the suspicious Tit for Tat strategy frequently occurs when two oppositions are doubtful of each other, such as the Cold War. It starts with defection in the first round and then repeats what the other did in the last round, so it can avoid one-sided cooperation, which brings the worst outcome for the player, but it damages the cooperation, on the other hand.

The limited punishment strategy is used for punishment for a certain period to the other player's noncooperation, which enhances the punishment to a certain amount (which is decided by the period of time), but it also brings with a disadvantage that the other can estimate the punishment period, and

cheat for benefits when the action turns from punishment to cooperation, which means the other earns for the one-off utilities in every punishment period.

The grim trigger strategy is a special type of limited punishment that punishes forever. This kind of strategy is used for frightening, but it usually brings a fatal result to both sides. For example, a nuclear weapon that can destroy the world can be seen as a grim trigger. If the side uses the weapon, there would be no cooperation from then on, which can also be seen as a game over and the bankruptcy of utility accumulation to both sides. However, nuclear weapon exists to avoid unfair or insane behaviors that happen, just like grim trigger contributes to cooperation.

The always defection and always cooperation strategies are similar in the form of permanent actions, which seems like unwise because the other players easily use this kind of strategy. However, the study of these strategies is not to research the insane groups. Instead, the strategies can be treated as a situation that both players with exterior powers achieve.

1.2. Research Framework

Recent common research is divided into two groups: new types of strategies in infinite prisoner's dilemma with different parameters of games and an evaluation of the ability to implement strategies based on experimental data regarding the frequency of strategies exists. Generally, the research focuses on one side's behavior toward different environments. However, this essay inspects the two-sided game. Both players can use the given strategy to compete with each other, and both contribute equally to outcomes. The originality of the study is not to maximize one player's benefit. Instead, it is to achieve the best situation for the whole game.

Except for the angle of view, the study is conducted with pure calculation instead of real experiments because the proof of theories is more important and economical. Therefore, the study is based on some parameters and variants that are the most well-known and recommended in iterated prisoner dilemma and finding the relationships between parameters and how they result in the best outcome for the game.

2. Method

2.1. Mathematical Calculations

Instead of experiments and real subjects playing the games, the study is based on pure mathematical calculations. The outcome of each situation of each round is given in Table 1. A future discount value is represented with the symbol: ' δ ' ($0 < \delta < 1$). ' U ' represents the sum of infinite payoffs of 'player A' (account that the action and the payoff outcomes are symmetric for both players; the calculation of a single player is representative of the whole game).

Thus, among the given set of strategies, players A and B choose one of them, and they are matched with each other. The real actions in each round will be figured out, and the total payoffs will be calculated and compared to find the best outcome with the relationships between parameters.

2.2. Content Analysis

To display the single outcome of every round and provide the materials for infinite payoffs calculation, each player's two strategies are matched and played by content analysis. This is based on the hypothesis that both players decide to use regular strategies in the same round. However, in real life, people may change their strategies or start to play a certain strategy irregularly, which makes the situation extremely complicated. The research simplifies the decisions and can be brought to every single round of real-life games, but not for the long-term strategies chosen because the environment

is influenced by macro or micro factors. Overall, the content analysis results in specific action performances in each round.

3. Results

3.1. The Permutation and Combination of Two-side Strategies

There are 49 combinations of the two players' strategies (seen in Table 2).

Table 2: Combinations of two-side strategies.

Player A/Player B	TFT	WSLS	STFT	GT	LP	AD	AC
TFT	$U^*_{1.1}$	$U^*_{1.2}$	$U^*_{1.3}$	$U^*_{1.4}$	$U^*_{1.5}$	$U^*_{1.6}$	$U^*_{1.7}$
WSLS	$U^*_{2.1}$	$U^*_{2.2}$	$U^*_{2.3}$	$U^*_{2.4}$	$U^*_{2.5}$	$U^*_{2.6}$	$U^*_{2.7}$
STFT	$U^*_{3.1}$	$U^*_{3.2}$	$U^*_{3.3}$	$U^*_{3.4}$	$U^*_{3.5}$	$U^*_{3.6}$	$U^*_{3.7}$
GT	$U^*_{4.1}$	$U^*_{4.2}$	$U^*_{4.3}$	$U^*_{4.4}$	$U^*_{4.5}$	$U^*_{4.6}$	$U^*_{4.7}$
LP	$U^*_{5.1}$	$U^*_{5.2}$	$U^*_{5.3}$	$U^*_{5.4}$	$U^*_{5.5}$	$U^*_{5.6}$	$U^*_{5.7}$
AD	$U^*_{6.1}$	$U^*_{6.2}$	$U^*_{6.3}$	$U^*_{6.4}$	$U^*_{6.5}$	$U^*_{6.6}$	$U^*_{6.7}$
AC	$U^*_{7.1}$	$U^*_{7.2}$	$U^*_{7.3}$	$U^*_{7.4}$	$U^*_{7.5}$	$U^*_{7.6}$	$U^*_{7.7}$

3.2. The Action Performance of Each Combination

'C' represents confession(noncooperation), and 'D' represents denying(cooperation), and here is the result:

If both players choose Tit for Tat, the performance would be like they cooperate forever because they both start with cooperation. They repeat cooperation following what the other player does in the last round, which achieves a positive reciprocity: (D, D) (D, D) ...

Similarly, the other combinations would act like Table 3.

Table 3: Action performances of combinations.

A/B	TFT	WSLS	STFT	GT	LP	AD	AC
TFT	(D,D)(D,D).....	(D,D)(D,D).....	(D,C)(C,D).....	(D,D)(D,D).....	(D,D)(D,D).....	(D,C)(C,C)(C,C).	(D,D)(D,D).
WSLS	(D,D)(D,D).....	(D,D)(D,D).....	(D,C)(C,D).....	(D,D)(D,D).....	(D,D)(D,D).....	(D,C)(C,C)(D,C).	(D,D)(D,D).
STFT	(C,D)(D,C).....	(C,D)(D,C).....	(C,C)(C,C).....	(C,D)(D,C)(C,C)	(C,D)(D,C)(C,C).*	(C,C)(C,C).....	(C,D)(D,D).
GT	(D,D)(D,D).....	(D,D)(D,D).....	(D,C)(C,D)(C,C).	(D,D)(D,D).....	(D,D)(D,D).....	(D,C)(C,C)(C,C).	(D,D)(D,D).
LP	(D,D)(D,D).....	(D,D)(D,D).....	(D,C)(C,D)(C,C).*	(D,D)(D,D).....	(D,D)(D,D).....	(D,C)(C,C)(C,C).*	(D,D)(D,D).
AD	(C,D)(C,C)(C,C).....	(C,D)(C,C)(C,C)	(C,C)(C,C)...	(C,D)(C,C)(C,C)	(C,D)(C,C)(C,C).*	(C,C)(C,C).....	(C,D)(C,D).
AC	(D,D)(D,D).....	(D,D)(D,D).....	(D,C)(D,D)(D,D)	(D,D)(D,D).....	(D,D)(D,D).....	(D,C)(D,C).....	(D,D)(D,D).

*The symbol means the last action performance is repeated for k periods

3.3. Calculations of PlayerA's Total Payoffs in Each Combination

Here is the result of the total payoffs of player A, seen in Table 4.

The number of combinations is too large, so only two calculation examples are given to show the process.

$$U_{1.1} = -2 - 2*\delta - 2*\delta^2 - \dots - 2*\delta^n = \frac{2}{\delta-1}$$

$$U_{1.3} = -20 - 20\delta^2 - \dots - 20\delta^{2n} = \frac{20}{\delta^2 - 1}$$

(n means infinity, and the calculation uses the geometric progression summing formula)

Table 4: Total payoffs of PlayerA in each combination.

A/B	TFT	WSLS	STFT	GT	LP	AD	AC
TFT	$\frac{2}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{20}{\delta^2-1}$	$\frac{2}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{20-10\delta}{\delta-1}$	$\frac{2}{\delta-1}$
WSLS	$\frac{2}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{20}{\delta^2-1}$	$\frac{2}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{20+10\delta}{\delta^2-1}$	$\frac{2}{\delta-1}$
STFT	$\frac{20\delta}{\delta^2-1}$	$\frac{20\delta}{\delta^2-1}$	$\frac{10}{\delta-1}$	$\frac{20-30\delta^2}{\delta-1}$	$\frac{-10\delta^k(k+2)-10\delta^2+20\delta}{\delta-1}$	$\frac{10}{\delta-1}$	$\frac{2\delta}{\delta-1}$
GT	$\frac{2}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{10\delta^2-20\delta+20}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{10\delta}{\delta-1}$	$\frac{2}{\delta-1}$
LP	$\frac{2}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{-10\delta^k(k+2)-10\delta^2-20\delta+10}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{-10\delta^k(k+1)-10\delta+20}{\delta-1}$	$\frac{2}{\delta-1}$
AD	$\frac{10\delta}{\delta-1}$	$\frac{10\delta}{\delta-1}$	$\frac{10}{\delta-1}$	$\frac{10\delta}{\delta-1}$	$\frac{10\delta^k(k+1)+10\delta}{\delta-1}$	$\frac{10}{\delta-1}$	0
AC	$\frac{2}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{-18\delta+20}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{2}{\delta-1}$	$\frac{20}{\delta-1}$	$\frac{2}{\delta-1}$

In conclusion, 25 payoffs are $(\frac{2}{\delta-1})$. 4 payoffs are $(\frac{10}{\delta-1})$, which means player A's pain times 5 because the payoffs are negative. 4 payoffs are $(\frac{10\delta}{\delta-1})$. One payoff is $(\frac{20}{\delta-1})$. One payoff is $(\frac{2\delta}{\delta-1})$. Among those payoffs, $\frac{2\delta}{\delta-1} < \frac{2}{\delta-1} < \frac{10\delta}{\delta-1} < \frac{10}{\delta-1} < \frac{20}{\delta-1} < 0$.

In addition, 2 payoffs are $(\frac{20}{\delta^2-1})$. 2 payoffs are $(\frac{20\delta}{\delta^2-1})$. There are 10 special forms of payoffs: $(\frac{20-10\delta}{\delta-1})$, $(\frac{20+10\delta}{\delta^2-1})$, $(\frac{20-30\delta^2}{\delta-1})$, $(\frac{-10\delta^k(k+2)-10\delta^2-20\delta+20}{\delta-1})$, $(\frac{-10\delta^k(k+1)-10\delta+20}{\delta-1})$, $(\frac{10\delta^k(k+1)+10\delta}{\delta-1})$, $(\frac{-18\delta+20}{\delta-1})$, $(\frac{10\delta^2-20\delta+20}{\delta-1})$, $(\frac{-10\delta^k(k+2)-10\delta^2+20\delta}{\delta-1})$, 0.

Obviously, the highest payoff is 0, which is the situation where Player A uses AD, and Player B uses AC, and the only circumstance applied to the strategies in the real world is the love of human beings. One side of the relationship claims, and the other lives forever.

3.4. Calculations of Sum of Players' Payoffs in Each Combination

Subsequently, the sum of the payoffs of the two players can be figured out in Table 5.

Table 5: The sum of the payoffs of the two players.

A/B	TFT	WSLS	STFT	GT	LP	AD	AC
TFT	$\frac{4}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{20+20\delta}{\delta^2-1}$	$\frac{4}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{20}{\delta-1}$	$\frac{4}{\delta-1}$
WSLS	$\frac{4}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{20+20\delta}{\delta^2-1}$	$\frac{4}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{20+20\delta+10\delta^2}{\delta^2-1}$	$\frac{4}{\delta-1}$
STFT	$\frac{20+20\delta}{\delta^2-1}$	$\frac{20+20\delta}{\delta^2-1}$	$\frac{20}{\delta-1}$	$\frac{40-20\delta-20\delta^2}{\delta-1}$	$\frac{-20\delta^{k+2}-20\delta^2+20}{\delta-1}$	$\frac{20}{\delta-1}$	$\frac{-16\delta+20}{\delta-1}$
GT	$\frac{4}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{40-20\delta-20\delta^2}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{20\delta}{\delta-1}$	$\frac{4}{\delta-1}$
LP	$\frac{4}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{-20\delta^{k+2}-20\delta^2+20}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{20}{\delta-1}$	$\frac{4}{\delta-1}$
AD	$\frac{20}{\delta-1}$	$\frac{20+20\delta+10\delta^2}{\delta^2-1}$	$\frac{20}{\delta-1}$	$\frac{20\delta}{\delta-1}$	$\frac{20}{\delta-1}$	$\frac{20}{\delta-1}$	$\frac{20}{\delta-1}$
AC	$\frac{4}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{-16\delta+20}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{4}{\delta-1}$	$\frac{20}{\delta-1}$	$\frac{4}{\delta-1}$

Among those results, those with bigger numbers in numerators are worse at acting as a cooperation choice. $\frac{5}{7}$ of AD choices, whoever makes this strategy has the payoff of $(\frac{20}{\delta-1})$, which brings the highest pain to players. Overall, AD is harmful to cooperation and makes the utilities of the game worse.

4. Discussion

4.1. The Pros and Cons of Content Analysis Used

In this research, the content analysis focuses on a few strategies proved in the experiment, in which the ratio and rigorousness part comes from how the experiment was conducted in a way with real experimental subjects, but it also comes with a certain extent of randomness [4].

Anyway, the research lacks a full-sided analysis of the strategies chosen; for example, an experiment researching the effective choices based on a computer tournament with theories of several sides illustrates the result of two-sided cooperation, another experiment type [5].

Future research can be conducted in a similar or improved method, which discusses other effective choices in real life or the economic world [6].

4.2. The Pros and Cons of Mathematical Calculations Used

The mathematical rigorousness comes from pure mathematical calculations with fixed parameters and situations.

However, the numbers set are specific, lacking comprehensiveness and universality. Future research can use appropriate logarithms to make a set of data based on different parameters and one-round utility, for which human-force calculation is inefficient. In addition, the benefit comparison can be done with computer simulations or real experiments in which subjects evaluate their strategies, which are a kind of sub-proof to mathematical theories.

4.3. Inefficient Use of Final Data

The comparisons in this research do not fully use the data because of the inefficient human-force calculation, so future research can apply statistical tools to the research, and make an all-round conclusion based on the data.

4.4. The Influence of Historical Reciprocity

Additionally, behavior biases have an impact on players' judgments [7]. Some people and communities have cultivated psychological and behavioral biases over time, including a higher degree of interpersonal trust, an emphasis on the long term in interactions, and a propensity for either positive or negative reciprocity in cooperative or deviant behavior. The effects of reciprocity depend on historical context. These traits may evolve over time as a result of natural selection within a society or group selection among rival civilizations [8].

In actuality, they persuade crowds of people to "irrationally" choose solutions that are actually the best for everybody. In the game, players may change their attitudes and strategies as time passes, based on the other player's strategies chosen. This research only discusses a single strategy used in a certain period. Future research can combine different strategies and study how they change with the historical reciprocity.

4.5. Real-life Situations

In real life, certain circumstances seem like infinite prisoner dilemmas, including political events (nuclear wars), environmental pollution, and negative economic competition. In those cases, players try to escape from infinite prisoner dilemmas because the payoffs are usually negative, so achieving two-sided cooperation is essential.

In the real world, the third party can change the game with some methods. For instance, the government changes the incentives that different decision-makers confront. Many prisoners' issues can be resolved more cooperatively when cooperative behavior is enforced through reputation, norms, regulations, democratic or other group decision-making processes, and explicit social punishment for defections [9, 10].

5. Conclusion

In conclusion, the research makes a hypothesis of two-side strategies in an infinite prisoner dilemma game, including Tit for Tat strategy (TFT), always defection strategy (AD), and grim trigger strategy (GT), always cooperation (AC), Win-Stay-Lose-Shift (WSLS), Suspicious Tit for Tat (STFT) and Limited Punishment strategy (LP). With a future discount and certain parameters given by another paper, the research conducts content analysis to get a table of how players react in each round with two-side strategies. For the method part, content analysis and mathematical calculations are chosen to focus on the situation of a single round and make the comparison more rigorous. Mathematical calculations deal with each player's payoffs, and the comparisons indicate that two-sided cooperation achieves the best result for the game. In contrast, two-sided noncooperation leads to the worst case. The one-side noncooperation and one-side cooperation make one of the player's payoffs the highest, which seems to be a type of love and sacrifice in real life. In the discussion part, some of the research flaws are listed, and the future research path is enlightened, including the full use of data, other methods, the diversity of parameters, and statistical tools. In addition, some specific factors that may be important are mentioned, such as historical reciprocity and behavioral biases, which can be discussed in the future. Moreover, some real-life applications and examples are listed to show the

comprehensive usefulness of the infinite prisoner dilemma game, including the game between nations, business, and personal careers.

The infinite prisoner dilemma can be discussed in different aspects of two-side or multiple-side strategies, which make the game more complex. Over the time, entrepreneurs take the advantage of reciprocity and biases, which leads to award of cooperation or the disadvantage of noncooperation.

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Analysis of KFC's and McDonald's Strategies Based on Game Theory

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Abstract: McDonald's and KFC are two giants in the Chinese fast food market. In this case, Chinese fast food brands must also seek development. So, studying their strategies can inspire and promote the local Chinese fast food industry. So, in this article, the author will use the Game Theory to analyze their strategies to find their different methods to occupy the market. The article will be divided into five parts. To begin with, introduce the research background, related literature, and the article's structure. Second, describe their basic and current situation from multiple dimensions, respectively. Third, compare their similarities and differences from many of the same aspects. Fourth, provide some suggestions to McDonald's and KFC and inspire other local brands. And summarize what the other brands can learn and take changes from their strategies. Last, accept some limitations and propose some future possible studies. So, this article can promote local brands, learn a lot from them, and strive to break the monopoly and become outstanding brands.

Keywords: game theory, McDonald's, KFC, strategy

1. Introduction

1.1. Research Background

Fast food has gradually become more significant with the acceleration of society's development and living style. With the fast food industry's rapid development in China, more brands and products are flooding the market. According to the National Bureau of Statistics, there were more than 1 million online shops, accounting for 22% of the catering industry and increasing continuously since 2011. In addition, the annual revenue of fast food could reach 150 billion yuan in 2011, which accounted for 20% of the catering industry's total profit and increased steadily [1]. According to the McDonald's website, as of September 2022, there are nearly 5,000 McDonald's restaurants in mainland China, serving over 1 billion customers annually and employing over 180,000 employees. Up to September 30, 2023, McDonald's has 4,905 stores in the Chinese market. From 2020 to 2022, KFC maintained an annual expansion rate of approximately 1,000 new stores in China, with the number of stores increasing from 7,166 in 2020 to 8,675 in 2022 [2]. However, McDonald's and KFC are always the two giants in the Chinese fast food industry. They almost achieved a duopoly in the industry. In contrast, domestic Chinese fast-food brands can rarely compete with them. So, studying their sales and marketing strategies is crucial and can inspire the development of other Chinese sellers and even the whole industry. Furthermore, in the world market, McDonald's

precedes KFC significantly regarding the number of shops and turnover. Surprisingly, in China, KFC instead has much more advantages. So, deeply understanding how their strategies and total business goals cause this result can also help promote the whole industry of fast food a lot. How KFC can win this booming and quite potential Chinese market may teach Chinese fast food brands how to develop their business in an unfamiliar environment or even stretch globally.

1.2. Literature Review

In this respect, Li compared KFC's development strategy to McDonald's and took some real examples to specify them. In her article, this author mainly compared their management strategies, competitive strategies, and core competitiveness to point out some suggestions the Chinese fast food industry can utilize [3]. Su analyzed the globalization and localization strategies of McDonald's and KFC and how KFC could adjust the Chinese environment successfully to win the Chinese market instead of McDonald's. This author mentioned that KFC made more local strategies. In contrast, McDonald's always decided from the global perspective, indirectly leading to KFC's success in the Chinese market [4]. In addition, Zhang and Wang used mathematical and statistical methods, randomly selecting some cities as samples to study McDonald's and KFC's different selling strategies in China. These two authors concluded that KFC focused more on excavating new markets in remote cities, but McDonald's concentrated on the occupied proportion of one market [5]. Zhou emphasized that Chinese fast food brands can learn not to focus on the competition of prices but on the differentiation of the products, which is the real determination of the battles. And this is also the crucial factor why KFC can win the competition. This clever and surprising strategy can inspire Chinese domestic brands and teach them brands that many factors can lead to success and not just being limited to things such as prices [6]. Xu used various models and frameworks to study the values of McDonald's and KFC brands. As a result, McDonald's had more intense brand effects, but KFC had more consumers with a higher consumption frequency [7].

1.3. Research Gap

Through these particles, they have talked about both McDonald's and KFC's development strategies in the Chinese market and how KFC can win this market instead. These authors discussed their differentiation in terms of prices, products, locations, and strategies. These articles claim McDonald's and KFC's strategies and decisions, including almost every perspective. Their traits of strategies or products seem to have been explained clearly. However, most of them just discussed them separately. There are few authors comparing people who compare them completely and analyze their decisions and actions considering each other together because their decisions will be affected, and their strategies will also influence each other.

1.4. Research Framework

Thus, in this article, the author will first discuss their respective and noticeable characteristics as completely as possible. Then, the author will analyze their similarities and differences regarding their settings and strategies of different perspectives. Then, the author will use the game theory and assume their other possible actions to compare their most remarkable strategies and see how they affect each other or whether they have made their best strategies. So, if they can do better to react to the other one's actions, the author will advise these two brands. Last, through the deep study of these two brands' tactics, the author will point out some inspirations that can instigate domestic fast-food brands. Ultimately, the author will accept the article's drawbacks or things that need improving.

2. Description of McDonald's and KFC

2.1. McDonald's

2.1.1. Price

McDonald's will set different prices in the different countries. At first, it will analyze each market and set a different and proper price. And it will change the prices according to the changes in each market. For instance, the prices of the Big Mac are different and are lowest in China [8]. So its prices are modest in each country. It seems to be localized instead of globalization. And it actually will change it even in different cities.

2.1.2. Products

From this perspective, McDonald's is more fixed and less flexible than its prices. Its products are almost the same in the whole world. Admittedly, it may change slightly in terms of materials or tastes. However, most of the products are not changed wherever the country is.

2.1.3. Advertisement

McDonald's advertisement is still pretty domestic. It will combine its products with the local culture, such as customs, language, and even values or the aspects the local people focus on, in other words. But it will still have its topic spirit and change slightly in each country. For example, in 2003, it invited Justin Bieber to be the global spokesman. However, it also invited Wang Leehom to be the spokesman for the East, which could show that its topic is youth and vigor, but it will add some traits to each part of the world to improve the focus a little bit [9].

2.1.4. Goal

McDonald's goal is not so limited in any one market. Instead, it wants to be the outstanding brand in the world and occupy a certain proportion in almost every market. So, it will not focus only on the Chinese market. In other words, it will not change so much for any one market, including the Chinese market, because its target is to be globalized instead of too much localization.

2.2. KFC

2.2.1. Price

KFC's price is also quite flexible, like the McDonald's. But it follows the steps of the McDonald's. It separates the price into more levels. And its price will change to the changes in McDonald's [10]. But it is more focused on the Chinese market. It sets prices carefully in China's each city. And its price is also modest and rarely changes a lot in order to get higher profits.

2.2.2. Products

KFC's products are pretty fit for the Chinese market. It will change a lot or even introduce new products only for China. For example, it released the Beijing chicken roll and even rice for Chinese consumers [4]. So, their products are pretty localized, at least in China. Its products are well combined with the local Chinese food and culture. It even directly purchases the original food materials from the local areas, which can better fit the Chinese's tastes.

2.2.3. Advertisement

KFC's advertisement is pretty novel and attractive. It completely combines its products and Chinese culture. It even added the Beijing Opera elements into its advertisement. Also, it caught the importance of the concept of the family for the Chinese, letting the atmosphere of family happiness run through the whole advertisement, which was quite new and appealing to the Chinese market [9].

2.2.4. Goal

KFC aims to occupy the Chinese fast food market as much as possible. So, it will take the Chinese market seriously and can change it just for the Chinese market. It focuses on the Chinese market so much but not the whole world. As a result, it will continuously launch new products in order to satisfy the Chinese's needs.

3. Comparison of McDonald's and KFC

3.1. Prices

AS the graph shows, the price changes will greatly affect each other. In fact, McDonald's price changes more frequently, whether increase or decrease, because it wants to stay or expand its profits. In contrast, KFC is much more calm and rarely changes the price. The first reason is that it has certain advantages in terms of the proportion of the market and the profits, so it does not need to change the price to get more profits. Second, KFC always uses a defensive strategy so it seems more peaceful. However, McDonald's is a little hurried to improve its status and is good at catching the opportunities. So, it will decrease the price in order to reverse the inclining tendency. Or it will increase the price when it excavates that people desire to purchase, like during the period of SARS [11]. So, the author will study KFC's reactions or other possible reactions when McDonald's changes it.

3.1.1. McDonald's Increases the Price

If KFC decreases prices, it can get a much higher market proportion. But it will at first add its production pressure. Also, it may instigate a price war, which will cause the much negative effects. And if KFC increases the price this time, they can both get higher profits and even achieve a win-win situation [11]. But they do not cooperate, so KFC cannot predict whether McDonald's will change it soon. In addition, price changes with the many other rising brands may cause bad and unpredictable consequences. But staying the same price will never cause any disadvantages in this situation, which fits KFC's defensive strategy.

3.1.2. McDonald's Decreases the Price

In this case, if KFC decreases the price, it is pretty clear that it will lead to a price war, which is not wanted by both of them. And McDonald's decreases the price for more proportion of the market, which is not so needy for KFC. So, it does not need to take an adventure. Second, KFC does not need to increase the price to gain temporary profits but loses some market proportion. Still, staying the same price is the best strategy for KFC [11].

In this case, KFC, which has more proportion, always uses the defensive strategy and rarely changes its price. And McDonald's can properly catch the opportunities to get profits, which is a more aggressive strategy continuously. Although the one who decides first can take the initiative, KFC also has found the best reaction. However, both of their strategies are fit to their situation and may maximize their profits.

3.2. Products & Advertisement

3.2.1. Products

In this case, KFC and McDonald's products have many differences, at least in China. KFC's products truly achieve localization. It can launch many aimed products for Chinese consumers, such as rice, chicken, etc. Even if McDonald's also follows it and provides some local products currently, its products are almost the same worldwide and will not change a lot in any country. It may be related to their goal, but it may also be the strategy, considering the other. So if KFC does like McDonald's or McDonald's acts like KFC, they may both lose some advantages because they will lose many characteristics. But if they mutually change the strategies, it cannot be the best. Because KFC is not so popular in the world, one of the reasons why it can succeed in China is the combination of Western civilization and Chinese culture. So, if it changes its strategy, it may not be so successful and get a certain monopoly. McDonald's has been so popular worldwide, putting so much attention as KFC does to the Chinese market, and even developing an independent brand is not so worthy of it. They have to pay more attention to the whole world. So standardization may help them build a more global model and image.

Table 1: Game theory of KFC and McDonald's.

KFC/McDonald's (Profit in China)	Localization	Standardization
localization	5,5	10,8
standardization	3,4	2,6

As Table 1 assumes, both get the dominant strategy when KFC chooses the localization, and McDonald's chooses the standardization. Also, they reach the Nash Equilibrium. So they both take the best reactions to the other one's actions in terms of the products.

3.2.2. Advertisement

From this perspective, they combine their products or the topic well with Chinese culture [9]. They both have targeted advertisements in China. But there is still a little difference. McDonald's advertisement still contains its topic and core. In addition, it adds as many Chinese elements as possible to Chinese advertisements. In contrast, KFC's advertisements are more likely to be just a mixture of its products and Chinese culture. Like the products, these strategies are their general decisions--localization and standardization.

3.3. Goals

In general, the target of KFC is to occupy the Chinese market and get a certain status in the Chinese fast food industry. Because actually, it is not as popular as its competitor--McDonald's in the world. So, China is the best opportunity for KFC to develop. However, McDonald's has been famous in the world. So it will want to hold its standard image in the world. So, it will not be as focused on the Chinese markets as KFC does. In other words, it will not change much just for the Chinese market. Their total goals lead to their actions and decisions. They are the world's McDonald's and China's KFC [4]. Their actions are controlled by their goals. And their goals are based on their status in the world. So, both of them have done the best strategies they can do based on their situation and each other's actions. That may directly cause their duopoly in China and why KFC can ultimately win the game.

4. Suggestions and Implications

4.1. Change Prices

4.1.1. Suggestions

Through the study of KFC's and McDonald's strategies of prices, it can be concluded that KFC adopts more defensive strategies and McDonald's adopts more aggressive strategies due to their different proportion in the Chinese market. And the suggestion to McDonald's is not to change the prices too frequently but just during special periods because it is a pretty adventurous method. So it is not so perfect for McDonald's to change it at ordinary times. It may even lose much more profits if accidents or unpredictable changes occur. Especially for this kind of huge company, earning these profits with a great adventure is unnecessary. And for KFC, keeping the price is quite rational and good. Because it even reached a monopoly in the Chinese fast-food industry. So it is needless to get profits by changing prices.

4.1.2. Implications

The other local brands can draw lessons from McDonald's and KFC's strategy because they do not have such a big scale, so they will meet less adventure when they change the prices. So, they can change prices to get the benefit more frequently than KFC but have to change prices rationally, like McDonald's. But it also inspires other brands that as long as they expand to some certain scale, they need to consider whether they still need to use such an adventurous way to get profits.

4.2. Meet Local Characteristics and Flavors

4.2.1. Suggestions

For KFC, it has done well in the Chinese market regarding localization. However, the suggestion is to expand its scale to other potential markets with the same operational form. And McDonald's can still maintain its strategy, which is having standard products and identical core topics and changing in every country to adjust the local culture and flavors.

4.2.2. Implications

So, their strategies in terms of products inspire local Chinese brands to adjust the local flavors and characteristics. Whatever strategy they choose, they must conform to the local culture and flavors, or they cannot achieve lasting success. Taking McDonald's as an example, one significant reason why they can succeed in the Chinese market is that their products fit Chinese's flavors after some changes, even if it adopts the standardization strategy. So, adjusting the local flavors is the crucial and indispensable base. Any fast food company cannot be successful without this, whatever excellent the other things it finishes.

4.3. Know about Companies' Situation and the Rivals

Like McDonald's and KFC, they completely know about their status in China and each other, which instigates the local brands to know their characteristics and advantages, how large their scale is, and who their pretty competitive rivals are. So they can take relative actions to respond to rivals and maximize their profits. Running a successful business can completely not depend on a personal strategy but on the Game Theory between it and other rivals. McDonald's and KFC are famous Game Theory between two companies. So, knowing about the rivals and having a rational and

reasonable understanding of themselves are necessary for every brand, which can help companies make the right choices.

5. Conclusion

5.1. Key Findings

In the article, the author mainly uses the Game Theory to discuss the competitive strategies used by McDonald's and KFC in the Chinese market regarding price, products, advertisements, and even general goals. KFC adopts the general localization strategy, and McDonald's adopts the universal tactic of standardization so that they have differences in many aspects and form a game relationship. In addition, it inspires local brands to win battles with other brands. So, according to their strategies, the author also gives some practical suggestions to the other brands.

5.2. Research Significance

In general, this article, through the study of the game between KFC and McDonald's, summarizes some key points about helping the fast food brands or even the whole catering trade become successful. So, it first gives some suggestions to KFC and McDonald's to promote their developments. In addition, it provides many values and useful strategies for local brands. So the article can also encourage the local fast food brands a lot and may help them achieve a breakthrough under the duopoly of McDonald's and KFC and eventually emerge many outstanding local fast food brands, breaking the foreign monopoly in China in the field of fast food.

5.3. Limitations and Future studies

5.3.1. Limitations

In this article, there are many restrictions, without a doubt. First of all, it is lack of some current and recent data. Much of the data used in the article is old. Also, the article lacks field investigations and only gets information online. In addition, it only includes some of the most rudimentary and significant aspects, not pretty overall and comprehensive due to the limitation of ability. And many analyses are rough and not accurate enough. Last, some suggestions are general and not precise enough, so it may not bring some practical help to the brands but just some outlines and general directions.

5.3.2. Future studies

In the future, the author can do deeper research and field investigations to get more current, accurate, and reliable data. Also, if the author has enough time, the author will do a comprehensive analysis. Last, the author can use more time to have a deeper understanding so that they can provide some more actual suggestions.

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The Research of Optimal Portfolio in Technology Industry Based on Arithmetic Average Return, CAPM, and Fama-French Three-factor Model

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Abstract: As hotspots of the stock market, technical companies are always popular to invest. In this background, this paper uses three common models in asset pricing to help the investors to make proper decisions. This paper comes to a conclusion that CAPM forecasts the ideal portfolio expected return with more accuracy than other techniques when the contrast group's time period is shorter than the experimental group's time period. Because Fama-French the three-factor model's factors don't operate over short time periods and arithmetic average return doesn't take enough market factors into account, it might not be more accurate. The conclusion in this paper takes an instruction of investment strategy to technical companies' investors. Furthermore, it also helps the investors to allocate a proper portfolio.

Keywords: optimal portfolio, CAPM, Fama-French Three-factor model

1. Introduction

After a huge fluctuation of Tesla stock, people had concentrated on stock market, especially on technology industry. More and more countries have complex and developed stock markets, which made the lots of people in this world has invested money into stock markets. In the modern world, technology has become into an essential and crucial industry for all the countries to develop, which made technology industry stocks becoming popular. Under this situation, models that can predict future stocks expected returns have become important and popular in finance. In this article, the research focuses on which model can predict optimal portfolio expected return the most precise. The research uses arithmetic average return, CAPM, and FF3F to predict expected return when the model choosing the optimal portfolio to invest. After the calculation of these three models, the research compared three results with a month expected returns under the same conditions.

The research of composing portfolio has always been focused by the academic world. Rutkowska et al. made efforts on accounting factor of CAPM testing by using the conventional approach of symmetric variance and a modified approach. The result indicated accounting factor is important in unconventional CAPM [1]. Zhang used GPT models and BERT to find extra factors in the CAPM. The result showed that the additional factor is sentiment, which can be the power of CAPM [2]. Hens and Trutwin used a parsimonious CAPM modeled various aspects of sustainable investing for modelling sustainable investing in the CAPM, finding that returns are increased by ESG grading

heterogeneity [3]. Gleißner et al. state a DCF analysis based on CAPM lead to a strong distorted company's value. The result is that the mistakes may be avoided by explicitly considering the risks of a company [4]. Zhou, et al. demonstrated that, when all other factors are equal, funds with more CAPM investors outperform those with fewer, as determined by investors' revealed use of various asset pricing models [5]. Ko et al. made a new model by using FF3F and Black Litterman Portfolio Models [6]. Schmidt et al. used regression etc. demonstrates that the industrial beta that FF5MI 'borrowed' from NBSPM greatly improves the precision of the Fama-French framework in-sample [7]. Urbano et al. suggested calculating the weights for the Efficient Frontier's point of minimal variance by calculating the var-cov matrix only from the returns that can be accounted for by the FF5F [8]. Li et al. discovered that regularization techniques like lasso and ridge work less well than OLS. The fitting power of support vector machines and random forests has improved a lot, however the neural network is inferior to OLS due to the tiny monthly data sets by using a new-built seven factors model [9]. Allen et al. found SMB and HML usually lack independence, making them susceptible to endogeneity by using rolling OLS regressions [10].

Thus, this paper will undertake a comparison analysis of the arithmetic average return, CAPM, and FF3F based on the existing research. Theoretically, this study develops and enhances the existing research. Practically, it gives investors a method for reference.

2. Data and Method

2.1. Data Collection

The research used the expected returns of Tesla, Google, Amazon, and Netflix as the research data, which are from Yahoo finance. The research used four companies' data from 2018-9-1 to 2023-7-1 into three different methods (arithmetic average return, CAPM, and FF3F) as the experimental group to calculate the expected returns, and used four companies (Tesla, Google, Amazon, and Netflix) data from 2023-7-3 to 2023-7-31 into three different methods as the contrast group to calculate the expected returns with the purpose of comparing with the experimental group expected returns. Meanwhile, the research used data from Kenneth R. French website to calculate parameters in Fama-French Three-factors model.

2.2. Method

2.2.1. CAPM

According to [11], the CAPM is an improvement of mean variance analysis. It describes the situation after everyone behaves as the analysis result. It states assets prices are valued by the contribution to the risk on the tangency portfolio. Furthermore, it will be the market portfolio. Then the author shows the CAPM equation:

$$E(r_i) = r_f + \beta_i E(r_m - r_f) \quad (1)$$

where $E(r_i)$ is the expected return of asset i, r_f is the risk-free rate, $E(r_m - r_f)$ is the equity risk premium, which is also the excess expected return.

2.2.2. FF3F

According to [12], The FF3F is a more precise, more complex model than CAPM. It advocates multiple factor models to capture the expected return. The equation of this model is:

$$r_i - r_f = a + b(r_m - r_f) + s(SMB) + h(HML) + e_i \quad (2)$$

Where, b, s, and h are coefficients of three factors. SMB is small stocks portfolio expected return minus large stocks portfolio expected return, HML is the difference between the returns on portfolios of high B/M and low B/M, and e_i is a zero-mean residual.

3. Result

3.1. Arithmetic Average Return

The research used arithmetic average return to calculate the expected returns of TSLA, GOOG, AMZN, and NFLX. The research used the MMULT function to multiply weights with expected returns of each company in excel as the portfolio expected return. Lastly, the research used solver to find the optimal portfolio, and used the weights from the optimal portfolio to calculate the optimal portfolio expected return.

3.2. CAPM

The research used CAPM to calculate the expected returns: Step 1, the research used the data from Yahoo finance to calculate SPY return, then the research used 0.001 as risk-free return to figure out TSLA, GOOG, AMZN, and NFLX excess returns, and SPY excess return. Step 2, the research used SPY return into average function to calculate the market return. Meanwhile, the research used regression from data analysis to calculate the betas of four stocks (TSLA, GOOG, AMZN, and NFLX). Step 3, the research used CAPM formula to calculate the expected returns. Lastly, the research used solver to calculate the optimal portfolio, and its expected return.

3.3. FF3F

The research used FF3F to calculate the expected return—firstly, the research used data from Kenneth R. French website to calculate the parameters, then the research used data analysis to calculate coefficients of these parameters. Secondly, the research used SUMPRODUCT function in excel to calculate the expected returns. Lastly, the research used solver from data analysis in excel to find the optimal portfolio, and the its expected return.

Table 1: Calculation result of 3 methods.

	Arithmetic average optimal portfolio	CAPM optimal portfolio	Fama-french 3 factors model
TSLA	0.7789	0.0663	0.0709
GOOG	0.2211	0.6783	0.9112
AMZN	0.0000	0.2553	0.0178
NFLX	0.0000	0.0001	0.0001
Optimal portfolio expected return (2023/7/3~2023/7/31)	-0.0115	0.0745	0.0922
Optimal portfolio expected return (2018/9/1~2023/7/1)	0.0564	0.0490	0.0088
Difference (The absolute value)	0.0679	0.0254	0.0834

3.4. Comparison

The CAPM optimal portfolio expected return has the lowest absolute value, which shows the CAPM is the best method to predict optimal portfolio expected return in the optimal portfolios. As the table 1 shows the differences between optimal portfolio expected returns in three methods, it worth noting that FF3F is not the best method when the research aiming to predict the optimal portfolio expected return, though it has three factors, which has more factors than CAPM. On the one hand, the arithmetic average optimal portfolio expected return has the biggest difference with the other methods when the research using the contrast group data (2023-7-3 to 2023-7-31). On the other hand, the arithmetic average optimal portfolio expected return is close to the CAPM optimal portfolio expected return when the research using the experimental group data (2018-9-1 to 2023-7-1). Lastly, the CAPM and the FF3F shows two similar optimal portfolios (put most of weights into GOOG) that quite different from the arithmetic average optimal portfolio, which probably because CAPM and FF3F consider more factors that play significant roles in the stock market.

4. Discussion

After observing the data and the chart again, the research took note of the contrast group data's time period is shorter than the experimental group data's time period, which leads the contrast group data more fluctuant than the experimental group data. The research believes that the reason why the hypothesis is invalid is the experimental group's result is not same with the result when the author using the contrast group data in calculation.

Under the background that CAPM optimal portfolio expected return has a lower difference (the absolute value) than the other optimal portfolio expected returns, the author makes a conjecture that CAPM predicts more precise optimal portfolio expected return than other methods when the contrast group's time period is shorter than the experimental group's time period.

As the experimental group data has a longer time period, it might make the result inoperative when the author predicting the optimal portfolio expected return in a shorter time period. For improvement, the research can make the experimental group data has the same time period with the contrast group data, which can make the result more precise.

5. Conclusion

This paper used arithmetic average return, CAPM, and FF3F to analyze two groups of technology industry companies' data, and made a comparison of them. The conclusion is when the contrast group's time period is shorter than the experimental group's, the CAPM forecasts the optimal portfolio expected return with greater accuracy than other methods. Fama-French Three-factor model may not be more precise because of its factors don't work in a short time period, and arithmetic average return doesn't consider enough factors in the market.

This paper takes an instruction for the people who are eager to invest technology industry stocks. Moreover, as the paper has made a comparison of three common models of portfolio management, it provides many pieces of information to those investors. Also, it provides a reference of the stocks in technology industry.

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The Influence of Social Network Characteristics in Shaping Consumers Behavior and Market Outcome

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Abstract: Social networks are crucial in shaping consumers' behavior and influencing market outcomes. These networks connect individuals and groups, facilitating the exchange of values, ideas, and information. Consumers within these networks are influenced by their social ties and interactions, leading to changes in attitudes, perceptions, and purchasing decisions. The structure and characteristics of these networks can impact the overall market dynamics, affecting product adoption, brand awareness, and overall market performance. Thus, understanding the influence of social networks on consumers' behavior and market outcomes is essential for businesses to develop effective marketing strategies and succeed in a highly connected world. This paper will utilize data from social and economic networks to analyze and identify key network attributes that are influential from various perspectives, drawing resources from an extensive real-world database and supporting theories. This study aims to provide practical implications for marketers and businesses who seek to optimize their strategies in building market success, also for researchers, academics, and other interested parties that can benefit from the results by learning how to apply network analysis in their studies.

Keywords: social networks, homophily, tie strength, externality network theory, social media

1. Introduction

The interaction between individuals significantly impacts consumer behavior and market outcomes. While it is widely accepted that the general structural elements of a network significantly affect the overall performance of the market, the specific ways in which individual actions are influenced by the behavior of others in the network still need to be better understood [1,2]. As a result, businesses and marketers are increasingly interested in network attributes' role in shaping consumer behavior and market outcomes. In order to make educated judgments on marketing strategy and resource allocation, understanding the intricacies of how social network characteristics impact consumers and the subsequent market dynamics is paramount [3].

For the purpose of in-depth discussion, the essay will focus on the characteristics of the network that can influence the behavior of individual consumers from various perspectives, whereby the features that distinguish them from other types of networks. The primary focus of this research revolves around the concepts of homophily and varying tie strengths, and real-world applications will be used as examples to build the main discussions. Also, the research will investigate the impact of

technological advancements, specifically social media, on these phenomena. In addition, the research will draw from the network externalities theory to explore the long-term impact of networks on market dynamics. By doing so, a more comprehensive view of the relationship between networks and economics can be discovered, and their influences on consumer behavior and market outcomes may be provided.

Social networks' impact on economics has become an increasingly important area of study over the years. These networks play a vital role in shaping the behavior and decisions of individuals and groups in society. In the contemporary world, social and economic are ubiquitous in our daily lives, impacting numerous fronts. These networks connect individuals to people they know and strangers, facilitating the exchange of information, ideas, and resources, playing a crucial role in shaping our perceptions, attitudes, and behaviors. They can significantly impact the activities individuals undertake and the decision-making process [2]. Thus, by analyzing individual and group interactions, researchers can uncover the influential network characteristics that impact consumer behavior [4]. This understanding can aid in exploring and selecting marketing strategies, content recommendation systems, and the study of online social dynamics.

Moreover, the impact of networks on consumer behavior is complex, and with new technologies like social media, the phenomena and their implication have extended beyond traditional marketing strategies. Understanding how social ties and network characteristics influence consumers' attitudes, preferences, and purchasing decisions can provide valuable insights for businesses looking to target their audience and drive market success effectively [1,4,5] By examining how information, opinions, and trends spread through social networks, new opportunities for marketing strategies, such as word-of-mouth promotion, can be discovered.

The motivation behind this essay lies in exploring how the structure, dynamics, and properties of social networks influence consumers' decision-making processes. By delving into network characteristics such as homophily, tie strength, and externality, valuable insights can be gained into how consumers are influenced by their social connections in the aspects of changes in attitudes, preferences, and purchasing decisions. Being a helpful insight to develop effective strategies for promoting social and economic development, improving public welfare, and addressing various social issues.

2. Properties That Influence Consumer Behavior and Market Outcomes

Regarding consumer behavior, the characteristics of the network in which individuals are immersed are essential considerations, and their impact on market outcomes is not ignorable. In this section, the influence of homophily and tie strength will be discussed, with an example of their application in the real world. Also, the long-run effect caused by clusters in networks will be analyzed using the externality network theory.

3. The Role of Similarity-Driven Bonds in Influencing Consumer Behavior

Homophily, referring to the tendency for people to associate with others similar to themselves, is a concept that plays a significant role in the development of consumer behavior. When individuals with similar interests, values, and preferences come together, they form bonds and foster relationships, as shown in Figure 1 [6]. This leads to the spread of ideas, behaviors, and attitudes among the group, ultimately leading to a shared set of ideals and values [7].

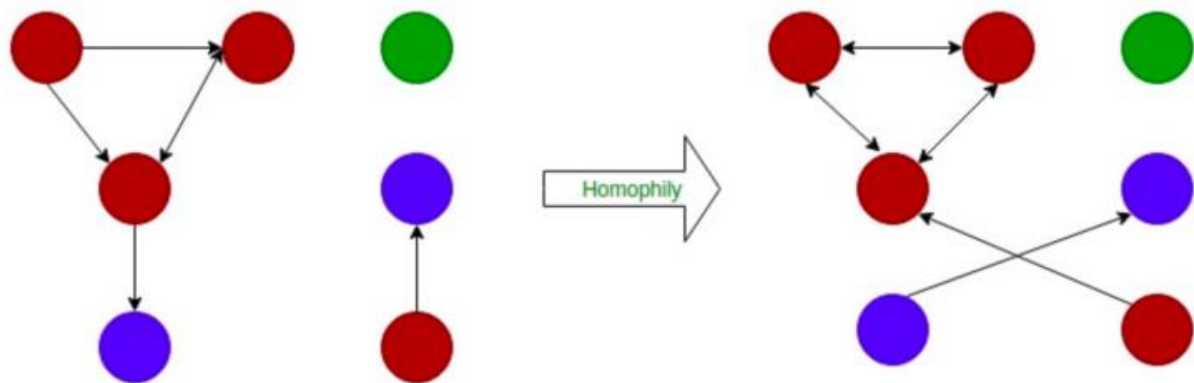


Figure1: Example of homophily [6].

For instance, if a person is part of a group where the vast majority of its members are ecologically conscious, they are more likely to adopt environmentally responsible consumption practices [8]. This is because their peers are likely to share thoughts, information, and recommendations regarding environmentally friendly products, leading to the spread of sustainable consumption practices within the group. Over time, this can lead to a shared set of ideals and values among the group [7]. In addition, homophily fosters uniformity and shared ideals among groups [6]. By associating with others who share similar interests, individuals are more likely to adopt certain behaviors and attitudes, leading to the spread of consumption practices and ideals throughout the group [6]. This can significantly impact the development of in-group behavior, as groups with strong homophilic tendencies are likely to have a more significant influence on one another. Therefore, it is crucial to understand the role of homophily in consumer behavior and how it can help shape the development of consumption practices and ideals in groups.

Moreover, homophily extends beyond traditional face-to-face interactions. With the evolution of social platforms like Facebook or Instagram, homophily plays a crucial role in shaping social circles within these digital environments. This is because consumers tend to engage with content and interact with others who share their beliefs, values, and interests; social media displays content based on the user's previous actions, resulting in selective content being exposed to the user [8,9]. This kind of exposure may result in forming groups with like-minded individuals. Therefore, reinforcement occurs when consumers are exposed to an environment with mainly information and opinions that align with their existing views [4]. These matters may significantly impact consumers' purchasing decisions, and individuals may be more likely to retain customers. Furthermore, individuals forming a social circle are likely to share the same interest in a specific product or brand. This tends to trigger a psychological response among like-minded peers known as the fear of missing out (FOMO); The fear stems from the perception that not participating in the same experiences as their peers could lead to a sense of exclusion from an event and the group [9]. As a result, consumers are more compelled to align their choices with those of their social circle, leading to an increased likelihood of making purchasing decisions that mirror the preferences of their peers. This dynamic can have a profound impact on market outcomes, as the fear of missing out can create a sense of urgency and social pressure that drives consumers to align their choices with the trends set by their like-minded counterparts [9].

4. The Impact of Network Relationships on Market Outcomes

Tie strength, or the degree to which individuals are connected, is another aspect of a network that might affect consumer behavior [10]. In many studies, frequently interacting, feeling emotionally close, and trusting one another are hallmarks of solid relationships [1,10]. These studies have also indicated that individuals are more likely to communicate knowledge and resources that can impact their consumer behavior when they are part of a network that has strong relationships between its members. For instance, if an individual receives a product recommendation from someone within their strong social network, they are more likely to trust that suggestion and make a purchase. Strong ties facilitate the smooth dissemination of information, increasing the likelihood of individuals adopting particular purchasing [1,11]. Also, those that are strongly connected can lead to the establishment of social norms and expectations, which these practices may mean that consumers conform to the preferences and behaviors of their close connections to maintain social harmony [11]. As a result, the conformity effect can impact product choices and brand preferences, as individuals are influenced and potentially pressured by their strong-tie peers [12].

However, those with weak ties with many individuals are also influential toward consumer behaviors and market outcomes. Granovetter's in 1973 study on the power of weak links found that individuals with a wide range of network connections, or those who have weak ties to many different social groups, are more likely to have access to novel information and possibilities; in contrast to strong ties, weak ties represent more distant connections, such as acquaintances or friends of friends from different social circles, and these type of links plays a crucial role in spreading information, ideas, and opportunities. An example of weak ties being more influential than strong ties can be a study comparing two neighborhoods that received subsidized home energy retrofits; it was found that the awareness of the program was higher in the neighborhood with a more significant number of social ties overall, as well as a higher proportion of weak ties [1,12], indicating that the weak ties can be essential for the diffusion of the information in the market.

5. Applying Homophily and Tie Strength to the Real-World

Businesses have already recognized the importance of the social network. Word-of-mouth marketing, for instance, has highly benefited from people's social networks [4]. Traditional WOM is simply a process of passing information from person to person with oral communication. This has acted as a potent influencer at various stages of the purchase process, including information search, alternative evaluation, and final product selection [7]. It has always been a cheap and efficient marketing method, and now, with online social media, the influence of WOM has increased. This method's impact on purchasing decisions is driven by two significant factors [4]; First, it is homophily; when consumers interact with like-minded individuals, they are exposed to content and information that aligns with their interests and preferences. As previously mentioned, social media algorithms are designed to present content based on the user's previous interactions, reinforcing existing beliefs and values, influencing their purchasing decisions, and creating echo chambers of shared interests, which can then lead to a specific group culture and purchasing behavior [6]. The second driving factor for WOM is the tie between individuals; on the one hand, consumers tend to put more trust in recommendations and opinions from their strong-tie connections, and this may lead to a ripple effect within their strong-tie network [7]. As a result, consumer clusters are formed around shared interests, and the close relationships create pockets of influence. Within the strong-tie clusters, it may heighten brand awareness and credibility, prompting potential consumers to consider and adopt recommended products [7]. These can then result in the growth of businesses through market shares, for instance. On the other hand, weak ties ensure that the information is diffused and reaches a larger audience, allowing the businesses to reach a more extensive customer base [1].

6. Effect of Interconnected Growth in the Long Run

In the long run, when a group has adopted a similar product, the added value may be presented through the product under the theory of network externalities, also known as the “Network Effect” [13]. The theory emphasizes the value a product or service gains as more users adopt it; it explains that a product’s utility increases for each user as the number of other users grows. Taking the example of mobile phones, when more individuals adopt the same operating system, there is an increase in the availability and compatibility of applications and services, enhancing the overall user experience [14]. One of the most compelling examples of the network externality’s impact can be seen in the rivalry between Android and iOS operating systems. According to Counterpoint Global statistics (2023), starting from 2021 till the present, Android holds a dominant market share with approximately 80% of the mobile operating system market, while iOS follows with around 17% in 2021 and 20% during 2023 [15]. The sheer number of Android users encourages businesses to innovate a vast ecosystem of apps and services, making it highly appealing to new smartphone buyers [16]. The continuous dominance in the market can be due to the increase in the consumer base, which may create a positive feedback loop, attracting potential users from separate networks to join the environment and adopt the product, which can significantly benefit products that establish a strong network presence [16]. While businesses may also be benefited from demand-side economics of scale with the increase of consumers and the increasing demand for smartphones worldwide, manufacturers may be able to produce them in larger quantities, leading to cost reductions due to economics of scale [17]. Businesses may be benefited from the reduction of price, leading to potential increase in profit or being more price competitive.

7. Conclusion

Social networks play a critical role in shaping both consumer behavior and market outcomes. The characteristics and features of these networks can influence attitudes, preferences, and purchasing decisions, leading to potential changes in market dynamics. Businesses and marketers can develop effective strategies to target their audience and achieve success in a highly connected world by studying how individuals are influenced by their social connections. This paper has explored the impact of network characteristics on consumer behavior and market outcomes, focusing on homophily, tie strength, and network externalities. The findings demonstrate that individuals with similar interests, values, and preferences are more likely to have an impact on one another, fostering uniformity and shared ideals among groups. Strong relationships between individuals can establish social norms and expectations, and weak ties can provide access to novel information as well as opportunities. The network effect can also enhance the overall user experience and reduce costs, allowing a better market outcome. The insights provided in this essay have practical implications for businesses, marketers, or researchers seeking to optimize their strategies or develop a nuanced understanding of the complex relationship between economics and social networks, especially regarding consumer behaviors’ influence on market outcomes. By recognizing the influence of network characteristics on consumer behavior and adopting the changes that social media brings, businesses can tailor their marketing strategies to target specific audiences and achieve market success.

While this essay highlights the importance of understanding the influence of social networks on consumer behavior and market outcomes, it is essential to acknowledge its limitations. One limitation of this research is that it only focuses on a few network characteristics, such as homophily and tie strength, and network externalities. Many other network characteristics may also significantly shape consumer behavior or influence market outcomes that were not discussed here. Future studies could explore the impact of other network characteristics, such as network topology, network density,

network centrality, and network diversity, to provide a more thorough understanding of the influence of social networks on the market. Another limitation is that this essay primarily focuses on the impact of social networks on consumer behavior and market outcomes without considering the impact of other factors, such as personal preferences, individual values, and cultural differences. To resolve so, future research could explore the interaction between social network characteristics and other factors that may influence consumer behavior and market outcomes, providing a more nuanced understanding of these phenomena. Also, other measurements like profit margin are as crucial as diffusion level to indicate a successful market outcome. Although demand-side economics of scale was shortly discussed in the essay, future research may evaluate other factors like how social network encourages information sharing and innovations, which are vital to achieving market success and businesses.

In conclusion, while this essay provides valuable insights into the relationship between social networks, consumer behavior, and market outcomes, there is still much to be explored in this field. Future studies could expand on these limitations of this essay, exploring new network characteristics and other factors that may impact consumer behavior and market outcomes. By doing so, businesses and marketers can develop more effective marketing strategies and succeed in an increasingly connected world.

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Research on the Impact of Systemic Risk on the Economic Development of a Country

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Abstract: There were several financial crises during the last decade and each of them posed great threat to the global economy. This article studies the financial contagion and the systemic risks from the perspective of network analysis. The case analysis is adopted in this article with the case study of subprime mortgage crisis in 2008 in the US at first and then the network analysis and the solution are provided at last. The author found the financial crisis is largely related with the big nodes in the global financial network. Meanwhile, the network density is moderately ascending which shows the rising risks of the financial crisis in the future. Last but not least, the centralization keeps at a similar level during these years and the degree of centralization is positively related with the potential of financial contagion. The study is significant for understanding the mechanism of the network and the future policy decision.

Keywords: finance, network, case study, financial crisis

1. Introduction

1.1. Research Background and Significance

During the last 100 years, there were several major financial crises such as the Great Depression from 1929 to 1933 and the subprime mortgage crisis in 2008. The financial crisis has always been the hot topic because it not only has severe impacts on the country where the crisis originally occurs, but also has the potential to cause the financial contagions, spreading to other countries. With the rising massive awareness of the systemic crisis, the study of the financial network becomes more and more significant. Studying the financial network will be helpful for understanding the mechanism of the spread of financial contagion and instructive for better preventing the systemic financial crisis.

1.2. Literature Review

Financial contagion is a kind of spillover effect for it is an extension and spread of one country's financial crisis to other countries and there are several potential elements that affect the level of financial contagion. Jean Helwege, Gaiyan Zhang found that the counterparty contagion and the information contagion are both two crucial channels for externality [1]. From the aspect of network, Luisa Cutillo, Giuseppe De Marco, Chiara Donnini analysed the financial networks through

simulation and proved the argument that the financial network system becomes less resilient if the amount of linkages is fewer [2]. Besides, in different macro environments the financial network's density and the potential of outbreak of the financial crisis vary. Mike K. P. So, Lupe S. H. Chan and Amanda M. Y. Chu analysed how the financial network and the systemic risks are influenced by the pandemic network and found that the systemic risks are largely affected by the pandemic [3]. Jia-Li Ma, Shu-Shang Zhu and Xiao-Chuan Pang analysed the impacts of the financial networks on the systemic risks through three different networks, inter-liability, portfolio overlapping and share cross-holding and verified the impacts given by the financial network through numerical simulation [4].

On the relation between contagion and financial crisis, Jarosław Duda, Henryk Gurgul and Robert Syrek studied how stock markets interrelate with each other from different viewpoints and found out the contagion effects on financial markets can have significantly bad influences on the real economy and a contagion is usually related to financial crises [5]. As to the specific influences of the financial crisis on the banking system, Gian Paolo Clemente, Rosanna Grassi and Chiara Pederzoli analysed the state of European banking system after the financial crisis using the method of network analysis and the research captured many features of the European banking system when signing some banks that work as the big nodes in global financial system [6]. From the perspective of firms and social performance, Kais Bouslah, Lawrence Kryzanowski and Bouchra M'Zali examined the relation between the financial crisis in 2008 and the performance of firms and society. It was found that there was a difference between the social performance and the risks during the crisis and before the crisis [7].

1.3. Research Content and Framework

This article is focused on the financial contagion based on the network analysis. This research depicts the case of subprime mortgage crisis in 2008 and then analyses the global financial network using the core-peripheral network model and finds out how the network affects the global finance and causes financial crisis. In the end some advice is given for the prevention of systemic financial crises in the future.

2. Case Description

The 2008 subprime mortgage crisis began in the US due to the bankruptcy of the subprime mortgage financial institutions and the severe fluctuations of the stock market with the first bankruptcy of Lehman Brothers.

After the burst of Internet Bubble in 2000, the US had been adopting an expansionary monetary policy [8]. The data from the Federal Reserve shows that on January, 3rd, 2001, the federal funds rate was 6.00, while after that it was reduced sharply only within one year. On December, 12nd, 2002, the federal funds rate was 1.75. According to Galbraith, John Kenneth, all the financial innovations are for the new ways of issuing debts [9]. During the formation of the housing bubble, the subprime mortgages were promoted and easier to be accessed to all walks of life, and the new financial derivatives like Credit Default Swap (CDS), Collateralized Debt Obligation (CDO) were packaged to transfer the risks. All of these had led to a booming but hollow economy with the housing bubble becoming larger and larger. With the pressure of the inflation, Federal Reserve began to raise the Federal funds rate to 5%. This sharp increase led to the increasing stress for the subprime mortgage borrowers and a lot of subprime mortgages went into default. On July 19th, 2007, Bear Stearns filed for bankruptcy. Luckily, with the help of Federal Reserve and other financial institutions Bear Stearns went through the darkness and escaped the destiny of bankruptcy. However, on September 15th, 2008, Lehman Brothers went bankrupt while Federal Reserve did not help because it did not intend to convey the message to other financial institutions to be dependent on Federal Reserve. At the same

time, Merrill Lynch was acquired by the Bank of America. The breakdown of the major financial institutions made a severe financial contagion to other countries and regions like China and the Europe. The problem of the liquidity also affected the macro economy in the US. At Q4,2008, the GDP in the US declined by 6.1%.

3. Analysis on the Problems

Applying the Core-Peripheral Network Model to global trade reveals the dominance of core regions in international commerce. Core regions contribute significantly to the world's total exports and imports, boasting diverse economies, advanced infrastructure, and skilled labor. Figure 3 illustrates the distribution of global trade volume across core, semi-peripheral, and peripheral regions [10].

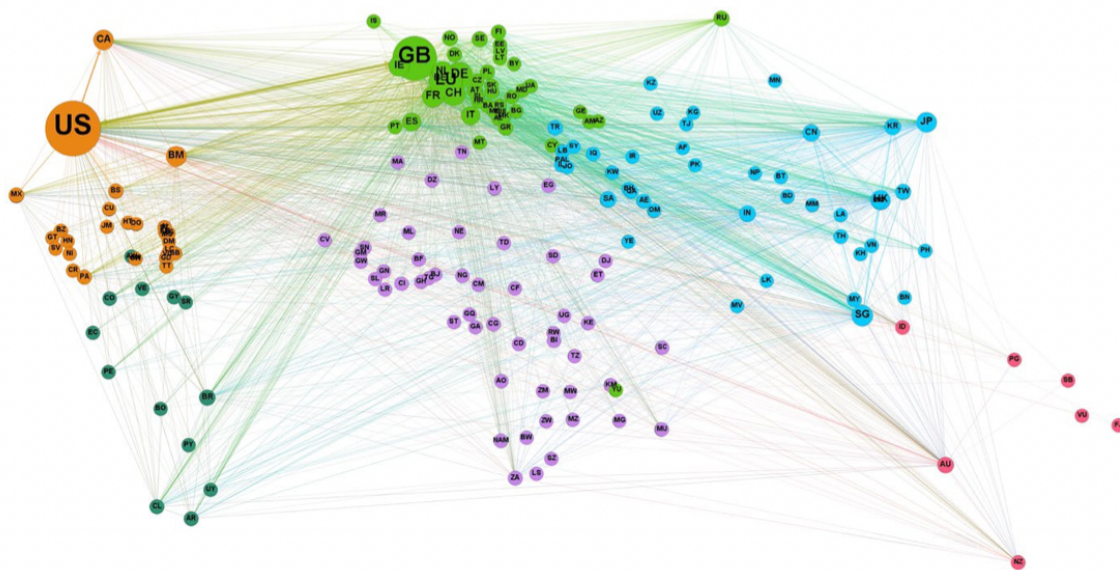


Figure 1: The networks of financial services in the year 2012 [10].

It can be seen from the Figure 1 that the node size represents the proportion to the total strength. For example, this is a core-peripheral network, with some nodes being the core, like the US, Great Britain and Japan, and the rest of them being the peripheral nodes. The node size represents the level of service flow. It can be seen that the US accounts for most of it. And the thickness of line represents the weight. It can also be observed that US is closely related to other two economies in the North America which are Canada and Mexico, because the lines are relatively thicker than others, and that's due to the geographical nearby and the existence of NAFTA. Besides, it can also be seen that the financial services' connection between the US and Europe is also strong, and that's due to that the Europe is also one of the central nodes, and the core nodes are more likely to have strong correlation with each other.

One of the largest nodes on the Figure 1 is Great Britain. In Britain, some leading banks are HSBC, Barclays and Lloyds Banking Group, etc. According to the data in Yahoo Finance, the stock price of HSBC went into a sharp 71.6% decline from 99.52 on September 30th, 2007 to 28.22 on February 28, 2009. What is more, Barclays' stock price was 53.97 on January 31st in 2007 but 4.737 on January 31st, about 91.2% decline for the entire two years. Lloyds Banking Group stock price was 45.72 on September 30th, 2007 while on January 31st, 2009 it was 3.250 with about 92.9% decline. As the leading and significant parts both in the global and British domestic financial system, the breakdown

of these stocks price will impose a large shock on the financial system and lead to systemic financial risks.

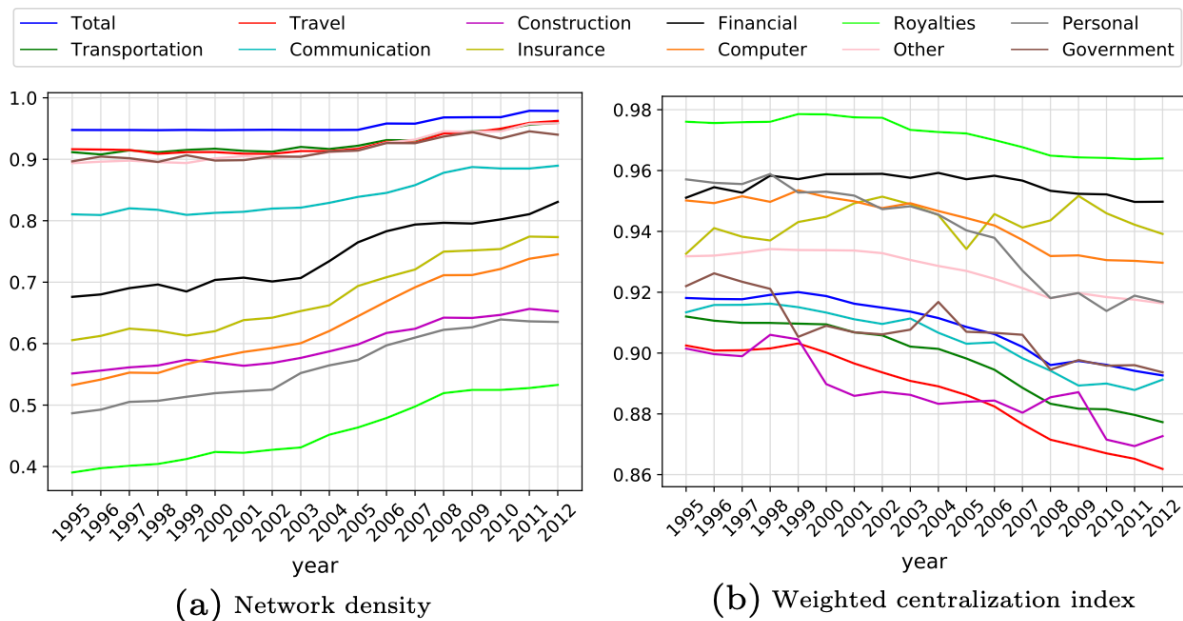


Figure 2: Network density and weighted centralization index per service category [10].

What is more, Figure 2 shows that the network density of financial services is growing gradually by years, from less than 0.7 to more than 0.8 [10]. This is an index that can indicate the degree of interaction of groups' member. A potentially growing network density will increase the risks of contagions because the possibility of each two nodes affecting each other will be higher.

At the meantime, it can be observed from the right graph that the weighted centralization index of financial service is stable in recent years. Therefore, the risks of contagions didn't decline.

An important factor is that the weight helps to increase the degree of centralization. If the impact of weight is ignored, due to the high density the degree of centralization will be very low because every nodes and linkages tend to be near homogeneous. But if the weight is taken into account, the degree of centralization will be much higher because there are only few nodes acting as the core and the higher weight between them and the rest of the world will help to centralize the whole financial network.

4. Solution

The strategies of preventing the systemic financial risks can be grouped into several sections.

First of all, it is vital to revise on the rule of control of credit and strengthen the level of transparency. The financial innovation is a kind of innovation for credit issuing. The problem lies on that the majority of subprime mortgage borrowers didn't get a thorough image of the risks of the mortgage and other financial derivatives. Improving the problem of lacking transparency will help the buyers of the financial products foster more objective and comprehensive view on them and make more rational decisions.

Secondly, with the development of the computer science, people have made the financial transactions more convenient and cost-saving. Therefore, working out how to prevent and control the safety of financial computer system is needed for the prevention of financial contagion. According to Lianxiong Du, it is advised to better the management, improve the safety control, and form a rigorous

prevention system [11]. Especially the large enterprises need to take on the responsibility to work out their compatible computer systems and implement rigorous supervisions.

Thirdly, raising the massive awareness of the financial safety will exert positive impacts on the process of preventing financial risks. The workers in the financial sector, especially accountants, have to reveal the data of financial reports transparently and the principal-agent problem needs to be alleviated or handled appropriately.

At the meantime, it is indispensable to further promote the integration and the development of the new wave of digital technology and the traditional financial services [12]. Along with the computer science, the digital technology has been stimulating more and more modern ways of transaction. For instance, the mobile payments enable people to get free of the traditional currencies and the cryptocurrency guarantees the safety of making financial transactions.

Furthermore, the big nodes like the US, has more responsibilities for preventing the global financial contagion at the very beginning and curb the spread of contagions from other countries. Being interdependent on each other, the global financial network is becoming more and more dense and centralized. So the large nodes on the global financial network will have greater influences on the spread of financial contagions. Addressing the problem of the potential spread of contagions in the large nodes and having a complete and mature financial framework in them are of great significance.

What is more, the improvement of the education on the financial safety is important. Every innovation will go through the process of gradual popularization with a few pioneers getting to know and grasp the key concepts in that field and then to the mass. However, only when the power of the mass is utilized effectively can the innovation become popularized. Therefore, it is useful to build up a more mature financial education system.

Last but not least, the laws of supervising the financial sector need to be refined. Nowadays in many countries the laws on the finance are not complete yet and there are many gaps in the monitoring waiting to be filled.

5. Conclusion

Nowadays, the globalization has made the financial transaction more convenient and cost-saving, so plenty of financial institutions are enabled to make transactions and extend their business globally. However, this also gives the risks of financial contagion and crisis, which poses a threat to the society and people's daily life such as unstable price level. So, the study of the global financial network and how the crisis is affected by the financial network is indispensable. This article adopts the method of case study. By studying the case of subprime mortgage crisis in 2008 and analysing from the perspective of network, the author found that the big nodes such as the US and Britain in the global financial network play the most significant role in spreading the financial contagion. At the meantime, the financial network density has become larger by year and the centralization of the financial network remains at a high level, meaning that the contagion is easy to be spread. This article may provide some insights and advice for the policy makers and professionals in the field of finance as this study is not only helpful for them to understand the financial network as the important element of influencing the global financial network, but it is also useful for making the future plan for the reshape of the financial network and better prevention of the financial crisis. However, the amount of data and the depth of the network analysis will have its space to be improved as the data are the crucial part for supporting the case study.

In the future, the study will be targeted at collecting more credible data and using more advanced model in the network analysis to find out the causes of the financial crisis and how the network helps to spread the financial contagion more deeply.

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A Poverty Alleviation-oriented Study on the Factors Influencing Peanut Cultivation

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Abstract: In the context of continued poverty alleviation and high demand in China, the plantation industry is an indispensable way to help farmers get rich. China is the world's top producer of peanuts and the world's top consumer of peanuts, and the demand for peanuts is very high. Therefore, promoting peanut production by farmers can not only increase chemical production, but also bring farmers income and get rid of poverty. So it is of great significance to explore how to promote peanut cultivation. On the basis of previous research, this paper lists four factors affecting the peanut planting area, and finds the data of 16 provinces in China from 2012 to 2021, and carries out regression analysis. From the results, it can be seen that the government gives subsidies and strengthens the degree of mechanization can significantly increase the peanut planting area. When the number of employees reaches a certain level, further increase will fail to improve the output and have a negative impact. This concludes that government subsidies and increased mechanization can promote peanut cultivation, which in turn promotes poverty alleviation in an efficient manner.

Keywords: poverty alleviation, peanut cultivation, factors affecting peanut planted area, binary logit model

1. Introduction

In the past decades, each country has been seeking effective anti-poverty measures according to its own national conditions. China is the country with the largest number of poor people in the world. In order to change the country's poverty and backwardness, China has mentioned in the 13th Five-Year Plan that it will strive to basically reach the goal of poverty eradication by 2020 [1]. At present, China has made great achievements in this field. In the five years since the implementation of the policy of precise poverty alleviation, the number of rural poor nationwide has been reduced from 98.99 million to 30.46 million, an average annual reduction of 13.7 million. The incidence of poverty has fallen from 10.2 per cent to 3.1 per cent, a cumulative decline of 7.1 percentage points [2]. However, China's rural areas are vast, and the poor are mainly concentrated in rural areas. For natural, historical and other subjective and objective reasons, poverty in these areas is widespread and deep, affecting the overall development of China's economy and society. Then, the country is committed to fully developing land in areas with high peanut production and alleviating poverty by focusing on agricultural development. For instance, China has long been engaged in land exploring and scientific and technological poverty alleviation in the peanut agricultural plantation fields. In 1990, Shandong

Peanut Research Institute carried out scientific and technological poverty alleviation work in Yinan County. Ten thousand mu (a Chinese unit) of land were developed, and peanut optimized cultivation techniques were vigorously implemented in the development zone, and yield targets were fully achieved [3]. In addition, Zhengyang County in Henan Province, in conjunction with the fight against poverty, has taken the lead in opening up areas in all poor villages in the county to plant new varieties of peanuts through the support of the peanut industry. Through a series of measures such as optimizing formula fertilization and upgrading planting technology, it ensures that peanuts planted by poor households are sold at high prices online [4]. Therefore, how to expand peanut planting area and increase production has become a major research objective in the fight against poverty. This paper focuses on exploring what factors have a positive or negative impact on peanut planting area. The relationship between the independent variables and dependent variable (peanut planting area) is explored by establishing a binary logit model. By processing the data and regress them in the model, the results will be presented. Based on the results, poverty alleviation related suggestions are given. Through this study, it is possible to know more clearly how to alleviate poverty precisely through peanut cultivation, which will be helpful for more in-depth research.

2. Method

As an important cash crop and a major oil seed crop in China, peanut research is currently focused on two major areas, which are peanut production and export trade. Research on peanut mainly focuses on the import and export of products, changes in the comparative advantage of the main producing areas and spatial evolution characteristics [5-7]. The natural conditions, socio-economic conditions, and technical level of the main producing areas of peanut are different, resulting in large changes in the peanut planting area of the main producing areas, but there is a lack of in-depth research on the factors affecting the changes in the planting area of the main producing areas of peanut. This paper analyzes the factors affecting the planting area of each peanut planting main producing area through the binary Logit regression model, and puts forward policy suggestions to promote the development of peanut main producing areas, which is of great significance for promoting the sustainable growth of peanut industry and alleviating the poverty of peanut planting farmers.

Since technology has a significant impact on peanut production. Increased levels of mechanization can reduce the need for labor and increase productivity, and increased rates of technological progress can increase yields [8]. This paper choose the factors of the total power of agricultural machinery and the original value of agricultural machinery of rural households in those provinces. In addition, subsidies can reduce farmers' peanut planting costs and increase their returns, thus increasing the farmers' incentive to plant [9]. Therefore, this paper choose the original value of productive fixed assets from social security and welfare in rural households as a variable. Based on the theory of farmer behavior, Johnston et al. argue that human capital and markets influence the behavior of farmers, which affects the change in acreage in production areas [10]. So the number of rural practitioners is considered in this case. In general, this paper choose 4 main aspects. They are the total power of agricultural machinery, the original value of agricultural machinery of rural households, the original value of productive fixed assets from social security and welfare in rural households, and the number of rural practitioners in those provinces.

In this model, 16 major peanut production provinces are selected. Those are Jilin, Liaoning, Hebei, Shanxi, Shandong, Henan, Jiangsu, Anhui, Hubei, Hunan, Sichuan, Jiangxi, Fujian, Guangdong, Guangxi, and Guizhou respectively, in order to study the factors affecting peanuts cultivate. Then, from National Bureau of Statistics, the author finds the data of these four factors in those 16 provinces and select the time period from 2012 to 2021[11].

In order to quantitatively analyze the effects of several variables on the increase or decrease of farmers' peanut sown area, on one hand, the dependent variable is represented by the changes in

farmers' peanut sown area, with "1" indicates an increase in peanut sown area in every two years from 2012 to 2021 and "0" indicates a decrease in peanut sown area in every two years from 2012 to 2021. On the other hand, the explanatory variables include binary selection variables such as total power of agricultural machinery, the original value of productive fixed assets from social security and others listed as before. Similarly, this paper represents the variables with "1" indicates an increase in those variables in every two years from 2012 to 2021, and "0" indicates a decrease in those variables in every two years from 2012 to 2021. There are total four variables and denote them by X1, X2, X3, and X4. Therefore, all the variables are either 0 or 1. The following table shows the details of the data.

From the Table 1, the maximum value, minimum value, mean value and standard deviation are listed. Compare the mean with 0.5 and use the standard derivation to determine the accuracy. The author initially finds that X1, X3, and X4 are the main increasing variables.

Table 1: Data of four variables.

Variable	Title	Meaning of the variables	Maximum value	Minimum value	Average value	Standard deviation
X1	Increase or decrease in the number of rural practitioners	increase=1 decrease=0	1	0	0.7625	0.1830
X2	Increase or decrease in the original value of productive fixed assets from social security and welfare in rural households	increase=1 decrease=0	1	0	0.4750	0.2525
X3	Increase or decrease in total power of agricultural machinery	increase=1 decrease=0	1	0	0.8500	0.1290
X4	Increase or decrease in the original value of agricultural machinery of rural households	increase=1 decrease=0	1	0	0.9250	0.0700
Y	Increase or decrease in acreage over the past three years	increase=1 decrease=0	1	0	0.4875	0.2530

Since the dependent variables are binary selection variables, utilize a binary response model, which is the Logit model as follows:

$$P = G(x) = \frac{e^{(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4)}}{1 + e^{(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4)}} \quad (1)$$

Taking the logarithm of equation (1) and simplifying it:

$$\ln \frac{p}{1-p} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 \quad (2)$$

If X_i is assumed to be a roughly continuous variable, its bias effect on the response function can be obtained by finding the following partial derivatives:

$$\frac{\partial G(X)}{\partial X_i} = g(X_i)\beta_i \quad (3)$$

where $G(X)$ is the joint probability distribution, and $g(X_i)$ is the probability density function.

When X_i varies sufficiently small, the above equation can be converted to:

$$\Delta G(X) \approx [g(X_i)\hat{\beta}_i]\Delta X_i \quad (4)$$

In the binary response model, $e^{(\beta_i)}$ represents the odds ratio (OR value), which refers to the multiple of change in the ratio of increases divided by decreases of peanut sown area when the independent variable changes by one unit. On one side, if the variable X_i has no effect on the dependent variable Y , then the value of $e^{(\beta_i)}$ is always 1 regardless of the change in X_i . On the other side, if X_i has influence on Y , positive influence is reflected when X_i increases, $e^{(\beta_i)}$ is greater than 1, and vice versa.

3. Results

From the Table 2, the p-value of X_1 , X_2 and X_4 are smaller than 0.05, thus X_1 , X_2 and X_4 are significant to have effect on Y . And since the p-value of X_3 are larger than 0.05, thus X_3 do not affect Y .

Table 2: Binary logit regression analysis results.

Variables	Logit coefficients	Standard deviation	Z value	Wald χ^2	P value	OR value	OR value 95% CI
X_1	-3.193	1.103	-2.895	8.378	0.004	0.041	0.005 ~ 0.357
X_2	0.349	0.599	0.582	0.339	0.031	1.417	0.438 ~ 4.588
X_3	-0.264	0.753	-0.351	0.123	0.726	0.768	0.176 ~ 3.356
X_4	3.696	1.530	2.415	5.833	0.016	40.293	2.007 ~ 808.998
Intercept	-0.869	1.375	-0.632	0.400	0.527	0.419	0.028 ~ 6.208
Dependent variable: Y							
McFadden R square:0.177							

Moreover, from the logit coefficients, X_1 have a negative effect on planting peanuts, X_2 , X_4 have a positive effect on planting peanuts. The results also can be obtained from the OR-value, where the value of X_1 is smaller than 1, and the value of X_2 , X_4 is greater than 1.

Finally the equation can be shown, according to the information obtained above:

$$\ln \frac{p}{1-p} = -0.869 - 3.193X_1 + 0.349X_2 + 3.696X_4 \quad (5)$$

where p represents the probability when Y is equal to 1, and $(1-p)$ represents the probability when Y is equal to 0.

Taking peanut farming in Guangxi as an example. The author select data from Guangxi and put the data into the Binary logit model for regression. And the regression analysis was done on the original value of agricultural machinery of rural households and the planting area of peanut from 2000 to 2021. Then obtain a series of regression data shown in Table 3 and the line graph (Figure 1).

Table 3: Regression analysis on the model.

	Coefficients	Standard error	t Stat	P-value	Lower bound 95.0%	Upper limit 95.0%
Intercept	41.40995	2.12792	19.46032	1.81941E-14	36.97119	45.84871
X Variable	0.00318	0.00053	5.94865	8.10914E-06	0.00206	0.00429

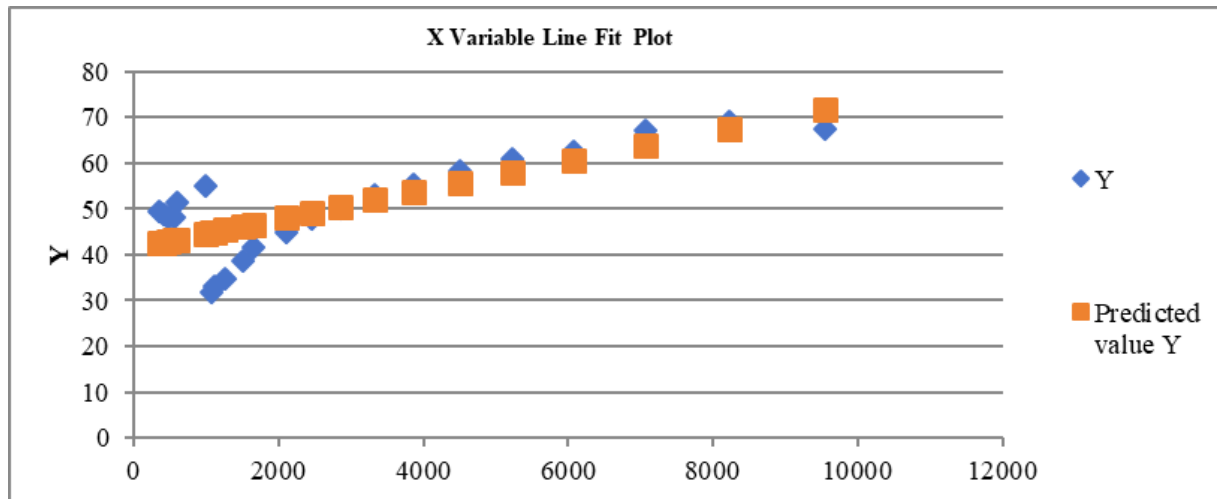


Figure 1: The relationship between the original value of agricultural machinery of rural households and the planting area of peanut

Figure 1 shows a positive relationship between the original value of agricultural machinery of rural households and the planting area of peanut from 2000 to 2021 in Guangxi. The predicted values and true values have roughly the same trend and the standard deviation is not significant. In this case, the binary Logit regression model yields a relatively good model fit.

4. Discussion

From all the analysis above, the value of agricultural machinery in rural households and the value of productive fixed assets from social security and welfare in rural households play a positive role in the fight against poverty. Subsidizing farmers and promoting mechanization can effectively increase peanut planting area. Besides, increase or decrease in total power of agricultural machinery has no significant impact on peanut acreage. It shows that increasing the total mechanized power cannot accurately promote the efficiency of peanut cultivation by farmers. As Joachim et al. mentioned, improving the technology of mechanical appliances can greatly reduce the supply of total mechanical power, and also improve efficiency [12]. Thirdly, the number of rural practitioners play a negative role on peanut planting. Because reducing the number of people working in agriculture decrease labor costs. Unlike the ever-increasing factors of material inputs, labor is one of the factors of production in the ever-decreasing peanut production inputs. With the increase of employment opportunities in non-agricultural industries, agricultural labor force is gradually transferred to non-agricultural industries. The number and structure of agricultural labor force are undergoing a transformation. According to the data on 21 peanut-producing provinces in 2012, the phenomenon of young and middle-aged laborers going out to work in farming families is very common, and most of those who stay at home to work in agriculture are the old, weak and women [13]. Since the reform and opening

up, the amount of labor input in peanut production has been decreasing, from 28.1 workdays/mu (a Chinese unit) in 1981 to 9.91 workdays/mu in 2011, a decrease of 64.73% [13]. However, the price of labor is rapidly increase. The labor cost of peanut planting has not declined due to the decrease in the amount of labor used.

5. Conclusion

In the context of China's continued focus on poverty alleviation and the high demand for it, farming is an indispensable way to help farmers get rich. China is the world's number one producer of peanuts and the world's number one consumer of peanuts, and the demand for peanuts is very high. Therefore, promoting farmers to produce peanuts can not only increase the amount of production, but also bring profit to farmers and get out of poverty. It is of great significance to explore how to promote peanut cultivation. This paper lists four factors affecting peanut planting area based on previous research, and finds the data from 2012-2021 for 16 provinces in China and conducts regression analysis. From the results, it can be seen that the government gives subsidies and strengthens mechanization can significantly increase the peanut planting area. When the number of practitioners reaches a certain level, further increase does not improve the yield.

There are some existing shortcomings. Restricted by the acquisition of data and information, this paper adopts the data on macroeconomic operation without regional subdivision based on regional differences, and the data used of each province is the average value in the majority. Although the fit of the model is high, the improvement of the accuracy of the data measurement needs to be further improved in future research.

In addition, this paper has explored the influencing factors of peanut cultivation, but there are still many directions for further research. For example, researchers can further study the impact of farmers' knowledge level and technical capacity on peanut cultivation. Farmers' knowledge level and technical ability play a crucial role in the application and effectiveness of planting techniques. Therefore, it is a good way of providing them with appropriate training and support to enhance the effectiveness and sustainability of peanut cultivation. Besides, researchers can also delve into the impact of policy and institutional environment on peanut cultivation. It plays an important role in guiding and supporting the development of peanut cultivation and poverty alleviation. Thus, scholars can provide targeted policy recommendations to the government and relevant organizations by studying the impact of policy, so as to promote the development of peanut cultivation and poverty alleviation.

In conclusion, the influencing factors of peanut cultivation is a complex and diverse subject that requires continuous research and exploration. Through further research, scholars can continue to improve the effectiveness and sustainability of peanut cultivation and make greater contributions to poverty alleviation. It is hoped that future research will explore more aspects in depth, and provide more support and guidance for the development of peanut farming and the success of poverty alleviation efforts.

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Exploring the Social Network Structure Differences Between Team and Individual Video Games in the Market from an Economic Perspective

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Abstract: The video game industry has undergone exponential growth and transformation, adding various economic models and social networking influences. This study aims to dissect these complexities by comparing the economics of team and single-player games, analyzing the role of social networks in shaping consumer purchase behavior and taking a closer look at different monetization strategies. Using a combination of literature reviews, case studies, and quantitative analysis, the study reveals the significant impact of social networks on consumer choice, with team-based games often enjoying higher long-term profitability due to their inherent social elements and micro-event-based models. Single-player games, on the other hand, offer unique value through narrative depth and personal experience. This research is of critical importance to stakeholders such as video game developers, digital marketers, economists, and policymakers working on or studying the digital economy. While the study provides important insights, it also acknowledges the limitations posed by the rapidly evolving nature of the industry. Future research should focus on emerging technologies such as virtual reality and blockchain to fully understand their impact on the video game economy.

Keywords: video game market, social network structures, economic models, monetization strategies, consumer behavior

1. Introduction

1.1. Research Background and Significance

Today, with the rapid development of digitization and the Internet, the global game market is characterized by rapid growth and great potential [1]. From the early days of arcade games and home consoles to today's mobile games, video games have always been an important part of the entertainment industry. With the global video game market growing year over year from \$134.9 billion in 2018 to a projected \$19.8 billion in 2022, the segment has undoubtedly become an economic force to be reckoned with. Among them, as two important branches of the market, team games and individual games have their own unique social network structure, which directly or indirectly affects their performance in the market [2]. The global COVID-19 pandemic in 2020 has had a significant impact on this market. People rely more on electronic entertainment, which accelerates the consumption of video games. In addition, the rapid development of cloud gaming and virtual reality

(VR) technology has also brought new opportunities to the market. Against this background, this paper aims to explore the economic differences between team games and individual games in the structure of social networks. This paper will delve into how these differences affect revenue models, user engagement, and market acceptance in order to provide valuable insights for game developers and market analysts [3].

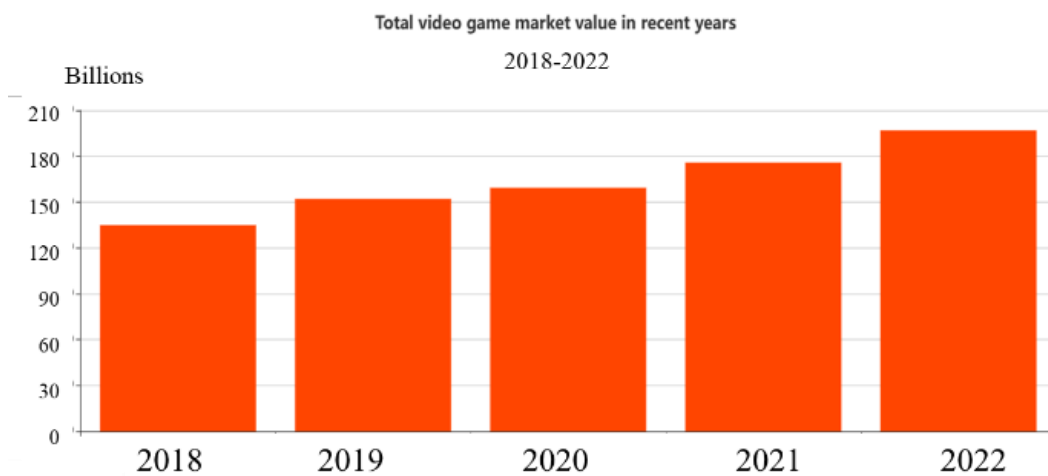


Figure 1: Total video game market in recent years.

In nearly five years (from 2018 to 2022), the video game market expanded from \$134.9 billion to an estimated \$196.8 billion. The overall increase was about 45.82%. Continued growth, even in challenging times, indicates a strong and resilient market. Constant technological innovation shows that the market is rapidly evolving and adapting. Future innovations are likely to continue to shape and possibly enhance market value (in Figure 1).

Team games are games that require teamwork to complete tasks together. For example, League of Legends or Valorant. Individual games are games that a single player can play independently, like “Breath of the Wild” or “Angel Comes”. According to data shared by the famous game platform Steam, seven of the ten best-selling games in 2022 are multiplayer games and three are single-player games [4]. However, Statista’s November 2021 data shows that a whopping 59 percent of US gamers prefer to play video games alone [5] (in Figure 2).

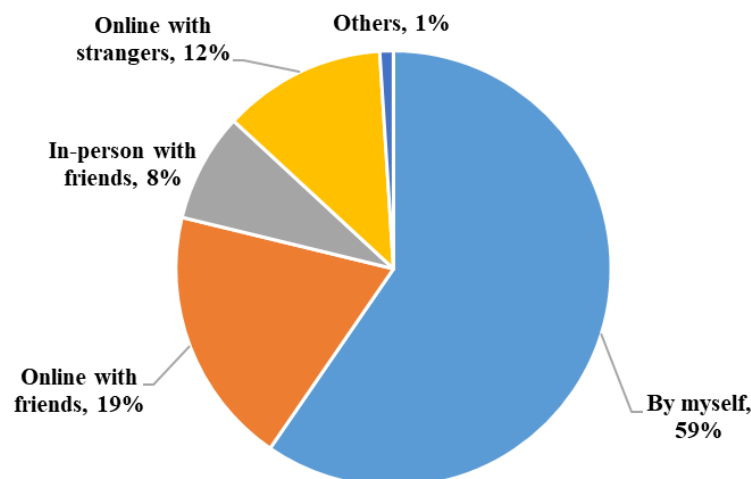


Figure 2: American player preference.

1.2. Literature Review

The rapidly growing video game industry has attracted a lot of attention not only because of its huge market size but also because of the complex dynamics of its continued growth. While there is a large body of literature examining various aspects of video games, such as technology adoption, consumer behavior, and economic models, there is still a clear research gap when it comes to taking an integrated look at how the structure of social networks affects the economics of different types of games, especially team games and individual games. Video games are increasingly being defined as social platforms that transcend the boundaries of pure entertainment. Researchers study video games from a framework of social interaction, focusing on in-game communities, social capital, and network effects. Meanwhile, on the economic side, a lot of research is exploring monetization models, including free-to-play models, microtransaction, and secondary markets for virtual goods. However, these surveys are often conducted in parallel and rarely cross over to provide a comprehensive understanding of how the structure of social networks affects the economic viability and sustainability of video games. Furthermore, while there are studies that measure consumer preferences for team or single-player gaming experiences, these studies are not sufficiently linked to economic contexts. Factors such as peer pressure in a team environment, the influence of social media, and even the “viral” potential of a game can significantly alter revenue streams and market acceptance and therefore require more careful investigation.

This literature review aims to bridge these gaps by synthesizing key findings from economic disciplines in the context of the social networking and video game industries. In this way, the author hopes to gain a better understanding of how the social network structures of team games and individual games differ, and how these differences affect their respective economic models and consumer behavior.

1.3. Research Content and Framework

In the context of the dynamic development of the video game industry, this study aims to comprehensively examine the economic complexity of team and single-player games. The study builds on existing academic literature to shed light on the unique revenue models of each game genre. Using a variety of methods, including literature reviews, case studies, and data analysis, the author dissected various revenue streams and assessed the sustainability of the revenue models in both categories. This research suggests that social networks are crucial in influencing players’ purchase decisions. This aspect gives game developers a way to specialize in promotions based on the type of game (whether team or single-player). Social networks further facilitate trade and cooperative play, contributing to the economic landscape. The study also takes an in-depth look at marketing strategies tailored to each game genre and assesses their effectiveness. In addition, this paper investigates consumer behavior to identify spending patterns, with a focus on the economics of virtual goods and in-game purchases.

2. Differences in Economic Models

2.1. Comparison of Income Sources

The video game industry has multiple revenue models, the most important of which can be divided into game sales and game top-up systems.

In the video game market, the various revenue models have their own unique advantages and limitations, which are largely influenced by the type of game and the target audience. The traditional game sales model, the one-time purchase model, often works well for individual games that focus on narrative or a single experience. This model provides an initial funding stream for game developers,

but long-term revenue will be limited unless game makers release more downloadable content (DLC) or sequels. On the other hand, the game store system, in which players use game currency to buy their favorite game items, provides a consistent monetization model for developers. This approach is consistently profitable by constantly introducing new accessories, but too many new designs can lead to player fatigue, which can affect the reputation of the game. These models and their respective strengths and weaknesses not only reflect differences in the structure of games' social networks but also have profound implications for the long-term economic sustainability of games [6].

2.2. The Profit Model and Benefits of Team Games and Individual Games

Team games tend to be free-to-play, earning revenue through in-app purchases, advertising, and collaborative activities [7]. League of Legends - a famous MOBA game with hundreds of millions of players worldwide. It's a free game, so how does it make billions of dollars a year?

The first is the in-game mall system, where players need to buy in-game virtual currency if they want to get nice in-game accessories (skins). This allows the game to be highly profitable at almost zero cost. In addition, the development of e-sports is also one of the main ways for the League of Legends to profit [8]. Riot holds world-class competitions to attract players around the world to buy tickets and other derivative products, such as "favorite e-sports player uniforms" and "dolls of game characters" [9,10]. Another group game monetizes a little differently than League of Legends. A famous example is Counter-Strike - a steam FPS game. One of the main ways it makes money is by selling keys, which are dropped during the game and must be purchased to open it. Once unlocked, the player will receive weapons of varying value depending on their luck. One of the most interesting points is that the weapons players get by opening chests can be traded. Valve built a strong and stable trading system, but it never interfered with players' trading behavior, and even Valve's chairman had to go to the market to buy a certain weapon skin. All players control the direction of the market, and game accessories can be worthless or valuable. Another important way Valve makes money is by charging commissions for trading in-game accessories.

Single-player games rely more on first-purchase or single-purchase models [11]. Unlike freemium group games, which are monetized, buyout games require a purchase to play, usually at a higher price. For example, the Steam platform game "Red Dead Redemption". Single-player games can only make more money through marketing campaigns and the launch of new Downloadable Content (DLC).

3. Spread and Influence of Social Networks

3.1. Players' Purchasing Decisions

Recommendations and word of mouth: Players are likely to buy a game based on recommendations from friends, family, or online influential people.

In the economic landscape of the video game market, social media platforms play an important role, especially in the context of the different social network structures between team and individual games. On the one hand, by sharing game screenshots, videos, or livestreams to social platforms, players can not only increase the visibility of the game, but also stimulate the interest of potential users, thus driving game purchases. This bottom-up approach opens up more possibilities for the game community to grow. On the other hand, through social network advertising, game companies can directly interact with the target audience and capture their interest and attention. This more direct and targeted marketing strategy not only increases the market reach of the game, but also provides the company with more diversified and flexible ways to monetize.

3.2. The Promotion Strategy of Team and Individual Games on Social Platforms

In the video game market, team games and individual games show clear differences in social network structure in terms of content creation and sharing, as well as interaction and community engagement. Team games emphasize a spirit of cooperation, and their content is often shared on social media, including highlight moments, video clips of teamwork, and instructional content on game concepts. In contrast, individual games are more focused on the player's personal achievements and game walkthroughs, such as high score records, game walkthroughs, or solutions to specific levels. In terms of interaction and community engagement, companies of team games often organize tournaments and encourage players to create teams and share experiences through social networks. Individual games, on the other hand, are more focused on one-on-one interaction with players, such as responding to player feedback, issuing challenges, or launching specific social network achievement badges.

3.3. Facilitates Trading and Cooperation Between Players

The rise of social networks and communication platforms has provided multifaceted ways for players to interact and collaborate, greatly enriching the ecosystem of MMORPGs and online multiplayer games. One of the key features of these platforms is to facilitate the exchange of virtual items between players, thereby enhancing the game's internal economy. Social networks act as marketplaces where players can easily find trading partners, accelerating the flow of in-game resources.

In addition, these platforms have become important hubs for communication strategy and team coordination. Tools such as Discord and Teamspeak provide real-time communication that facilitates strategic planning and enhances the overall gaming experience. This is especially important for games that require complex teamwork and completing common tasks or challenges. In many cases, large teams in MMORPGs are organized through social networks to work collaboratively on complex in-game activities, amplifying the potential for in-game social interaction and community building.

In addition, social networks enable game developers to incentivize collaboration through social reward systems. The ability to reward players who invite their friends to join the game or work together on a quest not only encourages existing players to become more involved but also serves as a marketing strategy to recruit new players. This creates a virtuous cycle that encourages players to share, recruit, and participate in the game, which in turn increases player retention and revenue. The synergy between social networking platforms and gaming environments helps create a more interactive, collaborative, and economically dynamic gaming ecosystem.

3.4. Marketing Strategy for Team and Individual Games

The different strategies that team games and individual games employ when it comes to leveraging social media platforms have clear economic implications [12]. Team games typically focus on facilitating player interaction through in-game group events and esports tournaments. This interactive strategy not only cultivates a large base of loyal players but also generates positive word of mouth and creates a favorable gaming environment. Single-player games, on the other hand, primarily engage players by emphasizing narrative content, character development, and innovative game mechanics. Promotions may include the release of screenshots, trailers, and developer logs, as well as restricting access to the private beta to raise expectations and thus increase sales.

In terms of the application and efficacy of social network marketing tools, targeted advertising on platforms such as Twitter, Instagram and Facebook's Lookalike Audience tool has proven to be cost-effective for reaching potential players who are similar to existing players. Influencer marketing, driven by partnerships with well-known YouTube streamers and Twitch streams, taps into the trust between influencers and their audiences, resulting in increased engagement and player acquisition levels [13]. In addition, community building - achieved through the establishment and active

management of official social media accounts - becomes a two-way communication channel between developers and players. This not only improves player satisfaction and retention but also keeps players up to date on updates and future releases, enabling real-time engagement.

In summary, whether it's a team game or an individual game, the overall goal is the same: generate interest and drive sales. However, the specific social networking strategies employed are tailored to the characteristics and expectations of each game genre, differentiating their value and economic viability in the marketplace.

In addition, there is a commonly used marketing method. The company encourages players to interact and invite each other by studying the relationship network between consumers, to achieve the purpose of increasing the number of customers, to achieve viral marketing [14].

4. Differences in Consumer Behavior

4.1. Player Spending Patterns on Team and Individual Games

The drivers of in-game spending are different in team and individual games, reflecting the unique group dynamics and player motivations inherent in each form. In team-based games, team dynamics often put implicit peer pressure on players to buy upgrades, skins, or other in-game items to improve their skill level and aesthetic appeal. In addition, the ongoing roll-out of events, competitions, and challenges that require team participation creates an environment of continuous engagement that leads to a long-term revenue stream for developers. In contrast, individual games show different patterns of in-game purchases. Here, players are often guided by personal preferences rather than external influences, resulting in a custom payment structure. Additionally, while team games may prioritize cooperative items and features, individual games often emphasize personalization elements, forcing players to invest in aesthetic upgrades to their characters.

4.2. The Economic Impact of Virtual Goods and In-Game Purchases

With the advent of virtual goods and in-game purchases, the monetization landscape for game developers has undergone a major shift, shifting the primary source of revenue from initial game sales to ongoing microtransactions. This change is not just an adjustment in revenue sources; It also has a profound impact on player retention and engagement. By constantly introducing new items, features, and content, developers can maintain and even improve the appeal and playability of their games over time. This iterative form of content delivery not only deepens player engagement but also provides a more sustainable revenue model. As such, the shift from a one-time purchase model to a focus on in-game stores and subscription plans represents an innovation in economics and gameplay that enhances the longevity and continued profitability of games.

5. Conclusion

The video game industry has undergone a major transformation over the past few years, with its market size growing and its influence permeating all sectors of the economy. The changing dynamics between team and single-player games, the role of social media in shaping consumer behavior, and innovative monetization strategies have all contributed to the complexity of this industry. Understanding these elements is critical not only for stakeholders in the gaming ecosystem, but also for economists, marketers, and policymakers interested in the digital economy.

This research uses a variety of methodologies, including literature reviews, case studies, and data analysis. This paper explores the economics of team and single-player games by studying academic papers, industry reports, and first-hand data. In addition, this paper analyze how social networking platforms influence purchasing decisions and the effectiveness of different marketing strategies.

Statistical tools will be used to quantify consumer behavior trends. This finding suggest that social networks significantly influence consumer purchase behavior in the video game industry. In addition, team-based games often enjoy higher long-term profitability due to their built-in social elements and microtransaction models. However, single-player games still have a unique value proposition through narrative depth and individual player experience. The study should be of interest to video game developers, digital marketers, economists who study digital goods, and policymakers concerned about the regulation of virtual transactions. Understanding the complexity of the video game economy can lead to more sustainable business models and smarter regulatory decisions. While this research provides valuable insights, it is limited by the rapidly changing nature of the gaming industry and consumer trends. Future research should focus on exploring the impact of emerging technologies such as virtual reality and blockchain on the video game economy. This research fills a gap in understanding the economics of the video game industry, especially in the context of the impact of social networks and diverse monetization methods.

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Commercialization of Social Networks

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Abstract: Under the background of new technology and new media, social commerce has developed rapidly and has produced a variety of new scenarios such as live shopping. Many people have studied social commerce and social networks before, but there is still a lack of research on new business models. The paper intends to summarize the current way of social network commercialization and put forward prospects for future development: it mainly summarizes the current development of social commerce and analyzes social networks in it; Also, it summarizes the problems arising in these new scenarios and puts forward solutions. The study finds that the current new social business model makes efficient use of social networks to increase sales, but the problems it brings are also serious and should be paid attention to. It is hoped that the research can make social commerce pay attention to sustainable development in the future and solve problems promptly, and also provide a reference for future research on social commerce.

Keywords: social network, influencers, consumers

1. Introduction

1.1. Background

Social commerce is a combination of social media and e-commerce. It allows sellers to promote products on social media, and consumers can buy products through social platforms. This convenient and efficient way of shopping is preferred by people. The outbreak of COVID-19 has accelerated the development of social commerce as being at home strengthened the contact between brands and consumers. Research has shown that when U.S. consumers had more time at home during the pandemic, their social media use increased, which in turn increased their social platform engagement [1]. At the same time, brands were trying to strengthen communication with consumers through social media to increase their sales volume. For instance, when in-store sales were not possible, a skincare brand started offering skincare advice online and successfully increased sales [2]. Due to the pandemic, social commerce has been booming-TikTok is a good example. The future of social commerce is limitless.

1.2. Related Research

Stephen and Toubia studied online stores before and after the formation of social networks between sellers. They employed time series analysis at the market level and Bayesian statistical analysis at the

store level. The results showed that social commerce networks formed by sellers are very important for sales-network density, and network location is a factor that influences their performance [3].

Through Facebook, Linda analyzed the current trends and changes in social commerce and proposed new directions for the future. Linda believed that in the future, online shopping companies that promote collaboration among users of the World Wide Web would be successful. Besides, successful companies should be those that encourage consumers to participate in and guide the design of products and services [4].

Hajli used theories to create a framework for accepting social commerce. The model showed that trust persisted in e-business and could be established at the time of social-commerce creation. Also, suppliers for online businesses can enter new business plans through forums, reviews, and some other channels [5].

Hajli conducted an empirical study using PLS-SLEM to prove the important influence of SCCs on purchase intention while the SCCs were positively correlated with trust. The biggest contribution of the study was that social commerce constructs showed that social relationships and interactions can influence individuals' purchase intentions. Participation, information sharing, and other activities were also allowed by these constructs, which were conducive to improving consumers' purchase willingness [6].

Liang et al. adopted an empirical method and used a popular microblog to show that consumers' use of social commerce was positively influenced by social support and website quality. The result is helpful when explaining the reasons for the popularity of social commerce and designing future social commerce strategies [7].

Chen and Shen studied social shopping and social sharing. They created a model based on social support theory. Results showed that social shopping and social sharing intentions were influenced by consumer trust as well as a community commitment, both of which can be influenced by emotional social support and informational social support [8].

Curty and Ping established a framework to study the transactional, relational, and social of e-commerce. Then they used it to study five e-commerce companies. It is found that these three characteristics have always been reflected in the company and affected the company's strategy for many years. Companies have tried to strengthen the relationship between consumers and merchants through relational features [9].

A model based on theories such as social support was proposed by Hajli and Sims and it focused on the effect of social media on consumer communication. The author used SEM-PLS data analysis to prove that social media promoted online communication through social commerce constructs and that consumer behaviors were generated while social support was also affected [10].

Bugshan and Attar collected data on consumers in the Asian market by sending questionnaires in the form of emails. Using PLS-SEM analysis, they found that purchase intention increased because shared social commerce information improved trust and reduced perceived privacy risks [11].

Maia et al. surveyed 229 users on Facebook and found that trust was the main factor affecting an individual's social commerce engagement, with perceived importance and information quality also influencing social commerce engagement. Research also showed that ratings, recommendations, and comments were used more for expensive goods and computer-related goods than for other goods such as books [12].

1.3. Objective

The second chapter mainly summarizes the latest development of social commerce: First of all, the new scenes under the new social commerce include their appearance and operation mechanism; and then the use of social networks in each of these situations. In the third chapter, firstly, the problems brought by the new social commerce are put forward, then potential solutions for different groups of

people who play important roles in social commerce are proposed and finally, there is a beautiful vision of social commerce.

2. The Development of Social Networks

2.1. New Scenes of Social Commerce

Under the scenario of new technology and new media, live shopping and buying goods through video are two popular shopping methods. Also, fun group chats have become popular.

For live shopping, it was used by approximately half a billion people in China [13]. It runs in the form that sellers show the products in a live way to explain the products and encourage viewers to buy, and buyers can interact with the sellers and ask some questions about the products. On the live page, buyers can purchase goods directly within the platform or go to the purchase website by clicking on the link [13]. This way of selling has made many people successful, for instance, Velez generated \$100,000 per day through live streaming while closing all his locations [14].

Buying goods through video refers to the purchase behavior generated by an advertiser's advertising on the influencer's video. With the development of platforms, it is much easier for brands to contact satisfied influencers for advertising [15]. The following steps are required for creator collaboration on YouTube: To begin, the brand will find the creator to negotiate the price and other issues. After the negotiation, the two sides will develop a concept for the video. Then the creator will create according to this concept and may communicate with the brand during the creation. Following that, the brand needs to make sure that the video follows the rules before it is published [16].

In Douyin, influencers would build their fan group chats after accumulating a large group of followers. In these fun group chats, influencers would communicate with their fan. Interestingly, many influencers give benefits to those with high follower ratings, which are determined by factors such as activity within the group.

2.2. Applications of Social Networks in New Scenes

Now, the marketing tools that make social commerce successful are becoming more diverse. The essence of these methods is to enhance the communication between influencers and fans. Social networks have played a crucial role.

Many of the items in the live stream are purchased in "packages"-consumers need to buy a "package" at once even though many of the items in it may be things they are not interested in. Despite that, there are still many people who buy because of the low price. Among these consumers, some use their social networks to maximize their advantage wittily-they buy the "package" with their friends or family members. Such behavior not only allows customers to enjoy the low price but also avoid waste thanks to the contribution of social networks. Furthermore, to look at it deeply, this sales model and the purchase behavior of fans have promoted the development of the broadcast room and influencers. In theory, consumers would choose to purchase orders with someone who has the same demand for goods of a certain category, then because of such demand, he/she is likely to become a fan of the broadcast room or the influencer (each influencer is likely to have a specific content positioning and every broadcast room usually sells products in certain categories). In real life, peer recommendations increase this probability. Then, assuming the person becomes a fan, his/her purchasing behavior with another person in the social network will also attract fans-in the same way that he/she is attracted. The spread of information and peer effect in social networks result in a larger number of fans for broadcast rooms and influencers. Thus, sales are increased.

Apart from the content of influencers' videos, collaboration with influencers also takes social networks as a tool for finding suitable influencers to make videos. Influencers have their fan network, in which characteristics are obvious such as age and video preference. The adviser would choose the

influencer whose fan network has the characteristics of targeting audiences. For example, cosmetics advertisers tend to collaborate with influencers who have a fan network of young females. Social networks are helpful to advisers when they are targeting their collaborators to increase sales.

Building fan group chats can bring the relationship between influencers and fans closer and increase fan engagement. It turns out that there is a positive correlation between fan engagement and loyalty. So because of increased loyalty [17], fans are more likely to be influenced by influencers' recommendations on products. Building fan group chats is a way to drive business activity. The same goes for benefits given by influencers to high-level followers-encouraging fans to interact more by creating a competitive atmosphere to increase engagement and ultimately loyalty. From another perspective, the essence of building fan group chats is that influencers artificially influence the fan network. For example, in a group where two people who would otherwise not know each other become friends because they resonate on the same topic, the fan network will add a connection; or two old classmates meeting again may turn a weak connection in the fan network into a strong one. In short, the fan group chats can make the fan network more complex. Therefore, when some items are sold in "packages", fans will not give up buying because they can not find a partner, and sales will therefore increase.

3. Problems, Solutions, and Expectations

3.1. Problems

Social commerce does bring many benefits such as authentic customer engagement, but it still has problems.

First and foremost, a large number of influencers rely on traffic to sell goods in their broadcast room, they may not understand the product well, so in the process of explaining the product, they may mislead consumers. Second, some influencers are not strict when choosing products for video cooperation or even just for high advertising rewards given by advertisers. Third, many brands spend less on research and development than on advertising on social platforms. Fourth, it is a characteristic of social platforms that everyone is given the equal opportunity to speak, but some consumers use this characteristic to deliberately publish videos including bad feelings to attract attention, resulting in brand reputation loss. Fifth, some influencers would use their fan group chats to lead their fans to attack other influencers by commenting on the bad stuff. In the worst cases, such an "attack" can even run afoul of the law. Sixth, it is difficult to protect privacy on social platforms. Every time customers buy something, their address, and personal information are exposed, causing security risks [18].

3.2. Solutions

The development of social commerce requires the efforts of many people. The platform should strengthen supervision and improve its rules and regulations. Brands should concentrate on making products better and do moderate publicity. While enjoying the opportunities brought by The Times to ordinary people, the influencers should also be strict with themselves, strictly select products, and consider the interests of consumers. At the same time, a consumer or a fan of an influencer should have their judgment and not blindly believe the information on the Internet. They also need to raise legal awareness and not follow the trend to "attack" other influencers.

3.3. Expectations

In addition to the impact of the epidemic, the tremendous development of social commerce in recent years is also inseparable from the change of platforms, brands, influencers, and consumers-the potential of social commerce is huge because people are willing to change. In the future, it is hoped

that social commerce can vigorously develop its advantages and effectively avoid disadvantages- brands strive to make good products, consumers can sincerely voice suggestions for the brand, and social platforms provide effective communication channels in this process and help to promote good brands and products. Finally, brands and consumers will achieve mutual benefits and a win-win situation. A harmonious and friendly social business environment is a beautiful vision.

4. Conclusion

The paper studies the latest developments of the commercialization of social networks. The developing problems and solutions are also proposed. It turns out that live shopping, advertising cooperation with influencers' videos, and fan group chats are new scenarios arising from the development of social commerce. These ways can enhance communication between influencers and fans, through live interactions, comment sections, and in the form of daily chats. Meanwhile, the characteristics of these scenarios also make them achieve the effect of increasing sales. The "bundled purchase mechanism" of live streaming enables consumers to use their social networks to buy with others, which plays a good role in publicity; When cooperating with influencer videos, advertisers can use social networks as a tool: advertisers can find the influencer whose fan network attributes are most consistent with the characteristics of the targeting audience, to achieve the effect of accurate delivery; Fan group chat is a way to increase fan purchases by increasing fan loyalty or by making the fan network more complex. The development speed of social commerce is rapid, but people can not only focus on their immediate interests. Instead, they should make the potential of unlimited social commerce to achieve sustainable development. Therefore, all people involved in social commerce should be strict with themselves and make efforts for harmonious and prosperous social commerce in the future.

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Social Networks and the Bank Run of Silicon Valley Bank

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Abstract: On March 10, 2023, Silicon Valley Bank was closed after a 40 billion dollar deposit outflow and a predicted 100 billion dollar deposit outflow. This paper first describes the causes of this incidence chronologically from the aspects of Macroeconomics policies, flaws in portfolios, and a large proportion of uninsured depositors based on a Fed report. Next, based on previous literature and speeches about bank runs in the United States history, the 2008 crisis in particular, this paper connects the panic in social networks to bank runs. Then, based on past experiments, this paper sets up a model to illustrate how social networks influence depositors' decisions. Following this model, this paper subsequently presents a recurrent model based on the Diamond-Dybvig model. With the finding in the first two models, the paper shows how herd behavior could lead to bank runs through two models. Last, this paper connects the findings in four models back to the case of the bank run of Silicon Valley Bank.

Keywords: bank run, social network, game theory, herd behavior

1. Introduction

Bank run, in its broadest definition, refers to the failure of a bank returning depositors their principles when a large number of depositors withdraw. Less than a century ago, irrational individual, firm, and government behaviors triggered the Great Depression; less than two decades ago, the blown-up subprime mortgage bubble destroyed the stock markets and led to the Great Recession; less than a year ago, the contagious panic of U.S. depositors almost ignited another financial crisis, causing commercial banks to collapse. Less than a year ago, the contagious panic of U.S. depositors almost ignited a financial crisis, causing commercial banks to collapse. This paper thus aims to discuss the causal relationship between behaviors in the social network consisting of individuals and firms and bank runs by introducing hypothetical scenarios based on previous literature and drawing connections from those scenarios to the collapse of Silicon Valley Bank (SVB). In the first section, this paper will narrate the failure of SVB by highlighting the key causes and events in a Fed report. Next, this paper will explain the significance of panic in bank runs based on two reflections on the 2008 crisis. In the third section, this paper will construct four scenarios based on the Diamond-Dybvig Model and other papers to demonstrate the effects of social networks alleviating potential bank runs and, on the other hand, its exacerbation of bank runs where panic plays a vital role. Then, this paper will tie the results from Section 3 back to the Silicon Valley Bank case in Section 1, reaching the conclusion that in the case of SVB, the panic due to multiple reasons has a high possibility of causing the bank run and the

collapse of the bank before entering the conclusion, including a summary, limitations, and possible areas for future research.

2. Crisis Chronology

2.1. Pre-Crisis

Until 2022, for years, the U.S. administered rates were kept low by the Federal Reserve, especially during 2020 and 2021, to combat and recover from the COVID-19 Recession along with other expansionary monetary policies. When the recession ended, the U.S. economy soon heated up. The private sector, namely the big firms in the tech sector in Silicon Valley, made huge profits, many of which were deposited in the Silicon Valley Bank. SVB, in turn, “invested these deposits in long-dated securities” [1].

However, in 2022, the Fed started to cool down the economy by increasing the Interest Rate On Required Reserves, leading to two consequences. First, SVB suffered from realized losses, and second, its depositors started to withdraw.

When a bank has an unrealized loss, the actual return on their financial investment is less than the expected return because the change in the value of the securities bought by SVB is inversely related to the change in interest rates. That is, securities and deposits are substitutes; when interest rates increase, depositing money is more profitable than buying securities, so the demand for securities decreases, leading to the depreciation of securities. Yet this loss was only unrealized that if SVB held the securities and waited for it to mature, then it could still gain from the purchase. However, if SVB sells its securities, the loss would be realized because the price sold would be less than the price purchased.

Unfortunately, the second consequence of depositor withdrawals forced SVB to sell its securities. The large depositors of SVB, the tech companies, usually buy capital through borrowing. Nonetheless, due to the increase in interest rates, the cost of borrowing increased, so they must liquidate their assets like deposits to maintain capital purchases. SVB, consequently, also faced liquidity issues.

Moreover, SVB relied heavily on uninsured depositors. Uninsured depositors are not guaranteed by the insurance to compensate for their losses during a banking crisis, meaning that if there is a sign of market shock, they probably will withdraw.

2.2. Crisis

In 2023, Silicon Valley Bank’s “deposit outflows accelerated as clients burned through cash.” On March 8, it announced a complete sale of its \$21 billion available-for-sale securities despite a “\$1.8 billion after-tax loss” and “a planned equity offering of \$1.8 billion” [1].

However, uninsured depositors interpreted this as “a signal” that “the bank was in financial distress.” Sensitive to this information, they began to withdraw their deposits on March 9, causing a deposit flow of over \$40 billion. According to the Fed, “this run on deposits at SVB appears to have been fueled by social media and SVB’s concentrated network of venture capital investors and technology firms that withdrew their deposits in a coordinated manner with unprecedented speed” that SVB expected that there would be an “additional \$100 billion outflow on March 10.” Without such liquid money, SVB was closed on the morning of March 10.

3. Reason Analysis

Aside from the consequence of the Fed’s increase in interest rates, an underlying yet significant cause of this bank run is social panic. Depositors feared that the bank in the future could not return the deposit with the granted return rate, so they withdrew their money, causing more liquidity issues for

the bank. As a result, more assets were sold, triggering even more social panic. As more depositors panicked, the deposit outflow exacerbated, and eventually, the bank failed to liquidate its assets to return the deposits, and a bank run became a self-fulfilling prophecy. One could find similar descriptions in the reflection of previous crises. For instance, in Governor Kevin Warsh's speech at the Council of Institutional Investors 2009 Spring meeting, he referred the 2008 crisis as "The Panic of 2008," and mentioned that "the stories of panics in U.S. history were generally marked by widespread bank runs as depositors lost confidence in large segments of the banking system" [2]. Likewise, former Chairman Ben S. Bernake, in his speech at the Morehouse College, more specifically, in the section "How Did We Get Here?", mentioned how investors in 2008 were "stunned by losses on assets they had believed to be safe, began to pull back from a wide range of credit markets" [3].

Additionally, in academic literature, economists reached similar results. In Friedman and Schwarz's paper in 1963, they evaluated the monetary history of the U.S. and argued that the crises in 1837, 1857, 1873, and 1907 were cases of panic [4]. Moreover, in Diamond and Dybvig's paper in 1983, they argued in the first paragraph that "During a bank run, depositors rush to withdraw their deposits because they expect the bank to fail. In fact, the sudden withdrawals can force the bank to liquidate many of its assets at a loss and to fail." Also in their paper is the Diamond-Dybvig Model, which is going to be discussed in the next section [5].

Hence, it seems plausible to suggest that in a social network, the contagion of panic heavily influences decision-making. Nonetheless, despite that the contagion of panic in networks is worth elaborating on, it is difficult to quantify the level of panic contagion directly as individual levels of panic vary. Therefore, for convenience, in the next section, the level of panic is analogous to the expected number of withdrawals.

4. Theoretical Models

4.1. Theoretical Setup

This part will present the theoretical model set up based on the works by Banerjee [6], Diamond and Dybvig [5], Diamond [7], Kiss et al. [8], and Gu [9].

There are three depositors (players), each owning \$1 initially. All models have 3 stages: at $T = 0$, all players deposit their money in the bank; at $T = 1$, players can choose whether to withdraw; at $T = 2$, players who did not withdraw at $T = 1$ will receive their returns. At $T = 1$, there are three periods where 3 players, at random sequence, make choices in $t = i, t = j, t = k$, respectively.

The players are classified into two types—patient and impatient—an initially patient (denote type P) can choose whether to withdraw or not at $T = 1$, while an impatient player (denote type I) will always withdraw at $T = 1$.

From Diamond's work in 2007, the bank will use all deposits to make financial investments. There are two types of assets available in the bank's portfolio: R_1 matured at $T = 1$ with a return rate of 1, and R_2 matured at $T = 1$ with a return rate of 2. The bank is in a perfectly competitive market and, therefore, has no profit at $T = 2$ (long run). Based on the equations given in Diamond's paper, the return for the players r_1 at $T = 1$ and r_2 at $T = 2$ is calculated as follows, assuming that the bank expects only $1/3$ of the players ($z = \frac{1}{3}$), or 1 player, will withdraw at $T = 1$:

$$\frac{r_2}{r_1} = \sqrt{R_2} \quad (1)$$

$$r_1 = \frac{\sqrt{R_2}}{1-z+z\sqrt{R_2}} = \frac{\sqrt{2}}{1-\frac{1}{3}+\frac{1}{3}\sqrt{2}} \approx 1.24 \quad (2)$$

$$r_2 = \frac{R_2(R_1 - zr_2)}{1-z} \approx \frac{2\left(1 - \frac{1.24}{3}\right)}{1 - \frac{1}{3}} \approx 1.76 \quad (3)$$

And the bank will have zero profit at $T=2$, calculated as follows:

$$2(3 - 1.24) - 2(1.76) = 0 \quad (4)$$

In addition, the bank can convert between two assets with no transaction costs.

If all players are rational, they will change their type only if changing player type generates a greater utility. A type P player's utility function is set to be increasing, concave (in other words, he is risk averse); on the other hand, an impatient player, for whatever reason (i.e., urgent use), only maximizes his utility when he withdraws at $T = 1$. In other words, if withdrawal at $T = 1$ is more profitable, a type P player will withdraw and vice versa. Yet a type I player only withdraws at $T = 1$.

Bank run, in turn, is when the bank fails to return the promised return to the withdrawn players at $T = 1$ or $T = 2$. A bank run, in this case, will happen if at least 1 type P player changes his mind and withdraws at $T = 1$ (Kiss et al., 2014), calculated as follows:

When 1 type P player withdraws at $T = 1$:

$$2[3 - 2(1.24)] = 1.04 < 1.76 \quad (5)$$

When 2 type P players withdraw at $T = 1$:

$$3 - 2(1.24) = 0.52 < 1.24 \quad (6)$$

4.2. Model with No Market Shock

In this scenario, all players know that there are 2 type P players and 1 type I player but do not know the entire sequence (they only know when they will make their decision). They are also assumed to be rational, or always maximizing their utility, implying no influence by panic. This scenario, thus, could be evaluated using game theory, where “ideas from graph theory” could be used to provide a “framework” to discuss the outcome of a game [10]. The three players, hence, could be graphed into a network, “a collection of points jointed together in pairs by lines” [11]. Those points, or nodes, represent the players, and the link connecting the two nodes means that the latter player can observe the decision by the former. The network is unweighted because only the decision travels in the network, so there are only two results, withdrawal or no withdrawal, matching the definition of an unweighted network [12].

Nonetheless, in this scenario where all players are not affected by market shock, there is an equilibrium regardless of the structure of a network.

In this 3-player game with 1 type I player and 2 type P players, there are three possible sequences: IPP , PIP , and PPI . Since a type I player never changes his choice, this scenario (and the rest of this section) will only focus on type P players. Using backward induction, if a type P player decides at $t = k$, his dominant strategy is no withdrawal, as shown in Figure 1, where n and w denote no withdrawal and withdrawal, respectively.

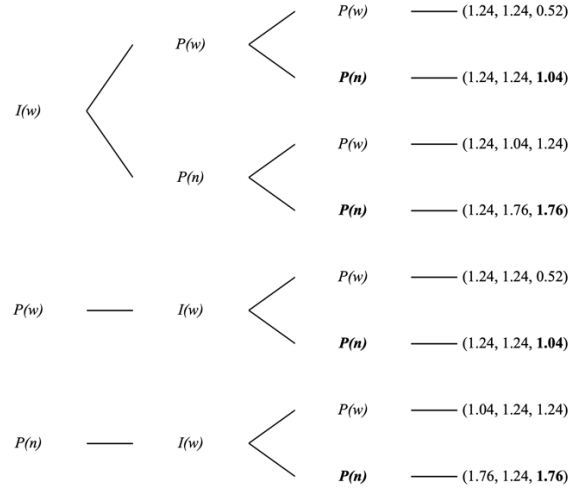


Figure 1: Sequential Game with Type P Player at $t = k$.

Then, the return for a type P player deciding at $t = j$ as shown in Figure 2.

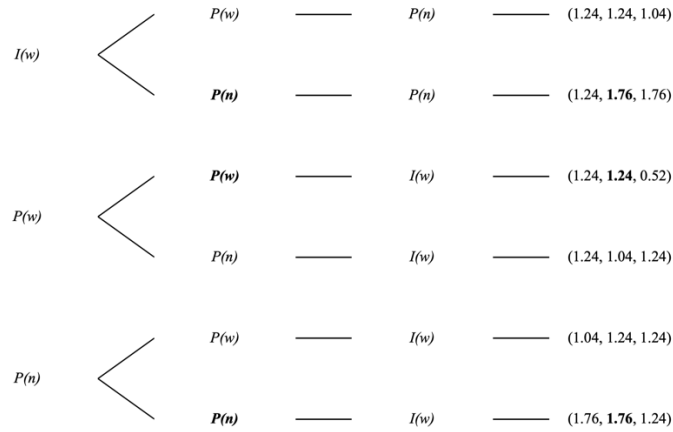


Figure 2: Sequential Game with Type P Player at $t = j$.

As shown in Figure 2, therefore (given that a type P Player at $t = k$ never withdraws), if a type P player decides at $t = j$, he will never withdraw unless a type P player withdraws at $t = i$. However, this situation will never happen because a type P player will never withdraw at $t = i$, as shown in Figure 3.

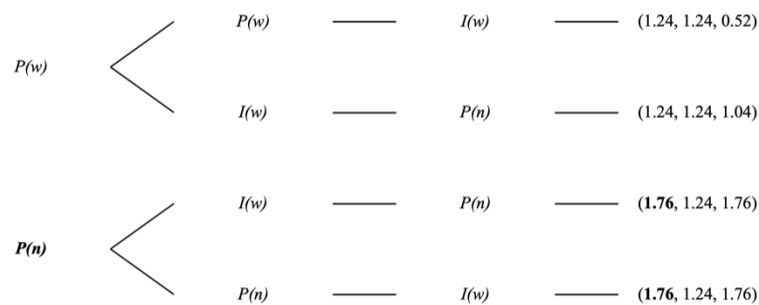


Figure 3: Sequential Game with Type P Player at $t = i$.

Therefore, since a type P player never withdraws at $t = i$, a type P player at $t = j$ never withdraws, as shown in Figure 4.

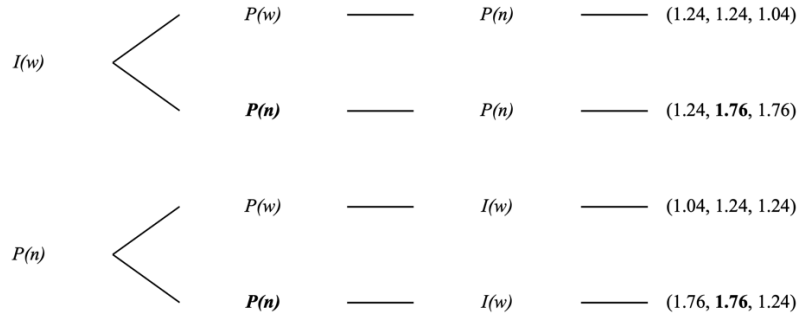


Figure 4: Sequential Game with Type P Player at $t = j$.

Now, given that a type P player never withdraws regardless of the sequence, a bank run shall never happen unless players are affected by other factors, and this conclusion could also be extended to games with more than 3 players.

Kiss et al. also conducted an experiment where two human participants were type P players, and a computer was type I . The setup of this experiment is the same as this scenario. The results are as follows [8]:

- 1) The network structure is statistically significant. Bank runs are less likely when the network structure has more links, especially when link ij exists.
- 2) When the computer decides in $t = i$, the link ij increases the likelihood of bank runs; when the player at $t = i$ is not a computer, the likelihood decreases in the presence of link ij .
- 3) Compared with the case with no links, both the link ij and the link ik significantly reduce the probability of withdrawal in $t = i$.
- 4) Compared with the case with no links, the link ij affects behavior in $t = j$. There is a tendency to follow the previous decision.
- 5) Compared with an empty network, the probability of withdrawal decreases (is not affected) when a player at $t = k$ can infer (cannot infer) what the other patient depositor has done.

While result 3 shows that the network is undirected (both decisions made in $t = i$ and $t = j$ affects each other), the rest of the results reflects the real world and some limitation of this scenario. Results 1, 2, and 4 convey that despite a more connected network, as a whole, reduces the chance of a bank run, players are still affected by their observed information and examine a tendency to follow the previous player's decision (this tendency will be discussed in Scenario 3). Also, Result 5 shows that players sometimes cannot make full use of their information, implying that in real life, some players are influenced by panic and, thus, might lead to wrong decisions.

4.3. The Diamond-Dybvig Model

Alternatively, in the Diamond-Dybvig model [5] [7], the influence of panic is highlighted, and Scenario 2 is based on this model. The model presents a case where decisions are simultaneously made, meaning that there is no observed withdrawal but only expected withdrawal. No observable decision is analogous to an empty network [8].

Following the calculation by Diamond (2007), there is a fraction f^* such that when f^* of the depositors withdraw, withdrawal becomes the better choice for the remaining players.

$$f^* = \frac{R_2 - r_1}{r_1(R_2 - R_1)} = \frac{2 - 1.24}{1.24(2 - 1)} = 0.61 \quad (7)$$

The reactions of type P players at $t = x$ depend on the following equation:

$$\hat{f}_x = \bar{\alpha} f'_x. \quad (8)$$

$\hat{f}_x$ denotes the expected fraction of withdrawals at $t = x$; if $\hat{f}_x > f^*$, then be impatient.
 $\bar{\alpha} \geq 1$, signal of market shock.

f'_x denotes the predicted fraction of withdrawals at $t = x$.

Therefore, if a type P player expects two withdrawals, regardless of predicting 1 withdrawal (the minimum) with a large $\bar{\alpha}$ or predicting 2 withdrawals, he should withdraw.

$$\hat{f}_x = 0.66 > 0.61 \quad (9)$$

The expected utility for this player is thus $\frac{2}{3}U(1.24) + \frac{1}{3}U(0.52)$ if withdrawal and $U(1.04)$ if no withdrawal. When the player is risk averse that the utility of withdrawal exceeds no withdrawal, he will withdraw, thus making $\hat{f}_x$ approaching to 1. When $\hat{f}_x$ equals 1, then a bank run becomes a self-fulfilling prophecy. Similarly, this result could be applied to a game with more players.

The limitation of the scenario is that, in reality, it is impossible to find a bank with depositors completely unconnected (empty network) due to new media and technology. Therefore, in Scenario 3, a more realistic scenario with a network where all nodes are connected will be presented.

4.4. Models with Herd Behavior

From previous scenarios, one can conclude that in a real-life social network, the decision is made in sequence, affected by observed behavior (panic), and may not be rational. In this scenario, the network will be a complete network, and the sequence is IPP . Furthermore, the network is directed, meaning that the decision-making in later periods will not affect those in previous stages. For instance, the decision made at $t = k$ has no influence on $t = j$. The rest of the setup is the same as in Scenario 2.

In this directed, unweighted network where the first player is impatient and withdraws, the other players will follow, showing herd behavior.

Herd behavior, according to Banerjee [6], refers to “everyone doing what everyone else is doing, even when their private information suggests doing something quite different.” This paper will first construct a scenario based on Banerjee’s work and extend it based on Gu’s work in 2011 [9].

A player’s decision is now based on 3 factors: 1) the information suggesting a market shock; 2) his initial type: the first player’s type is I while the others are P (from this, one could possibly argue that the market shock is mild); 3) the observed behavior (panic), marked by the observed number of withdrawals. Factor 2) and 3) have the same weight, meaning that if a player’s type is P and observed a withdrawal, then those two factors are neutralized, making this player indifferent when only these two factors exist. However, due to the market shock, this patient player will withdraw.

By definition, the first player (I) will withdraw. Then the second player (P) will make his decision based on the equation. Since his initial type P is neutralized by an observed withdrawal, given the market shock, he will withdraw.

The same logic also applies to the third player, who also will withdraw because there are two prior withdrawals outweighing his player type P , and the market shock suggests a withdrawal. Therefore, he will withdraw, and a herd behavior will happen, causing a bank run. Ceteris paribus, this simple model also applies to any case with more than 3 players.

However, Gu (2011) mentions the payoff externality that one's payoff also depends on others. In other words, the network should also be undirected to show the impact of the actions afterward.

Scenario 4 thus changes the 3-players game into a game with N people to match Gu's setting. Further, the patient players now have two subtypes: P_i , who noticed the market shock, and P_u , who did not. A P_i player will make his decision prior to all P_u players. However, unlike Gu's settings, this game does not allow players to wait but instead must make their decision at their period. Moreover, the influence of panic is still considered. Gu's paper also measures the change in player type using probabilities of returns. This paper, however, supposes that those probabilities are inversely related to $\hat{f}$ in Scenario 2 because a high probability of getting a high return at $T = 2$ means a low $\hat{f}$ (a low fraction of withdrawals at $T = 1$). Notably, since the game is now sequential, $\hat{f}$ does not have to approach 1 for a bank run to happen and includes the fraction of observed withdrawals f_x .

$$\text{For type } P_i: \hat{f}_x = f_x + \bar{\alpha}f'_x. \quad (10)$$

$$\text{For type } P_u: \hat{f}_x = f_x + f'_x. \quad (11)$$

Based on Diamond and Dybvig's work and Gu's work, here is this paper's description of herd behavior in a bank run. The first several impatient players' withdrawals increase type P_i players' $\hat{f}$, making them withdraw as $\hat{f} > f^*$. The $\hat{f}$ of type P_u players then follow this trend, and, eventually, the bank fails to liquidate its assets at $T = 1$.

Therefore, in this scenario, herd behavior caused a bank run.

In the SVB case, the market shock is the continuously increasing administered rates and the announcement about the complete sale of AVS securities on March 8. For the depositors initially patient (type P), it is a signal suggesting future crises. On March 9, those type P players (P_i players), already observing deposit outflow, or withdrawals, for some period of time, withdrew \$40 billion, leading to a more serious crisis the next day of an estimated \$100 billion (more P_i players and P_u players), causing the failure of the bank. This increasing deposit outflow, or increasing quantity of money withdrawn, could be interpreted as herd behavior. However, there are many differences between the theoretical model and real life, and those differences will be further discussed in the conclusion section.

5. Conclusion

In conclusion, in Section 1, this paper named some factors, including Silicon Valley Bank's losses from its long-dated securities and the increase in deposit outflow mainly due to the withdrawal of tech-sector firms, which demanded more liquid money resulting from the Fed's contractionary monetary policy to cool down the inflation rate before describing the crisis itself starting from March 8 where announcement of securities sales despite losses was made to March 10 when the bank closed because it could not return the expected \$100 billion deposits. In section 2, this paper reviewed some speeches made by Fed governors about the 2008 crisis as well as literature to highlight the underlying cause of bank runs—panic. In section 3, this paper first sets up a 3-stage model with 3 players. Then, in Scenario 1, it discussed the equilibrium of no bank run in all networks when all players are rational. Also in this scenario is the experiment made by Kiss et al., showing that in real life, people are not always rational. In Scenario 2, this paper elaborated on the Diamond-Dybvig model to show the effects of panics in an empty network. Following this scenario are Scenarios 3 and 4, showing a bank run in a complete and unweighted network could be caused by herd behaviors. Last but not least, in Section 4, Scenario 4 is tied back to the SVB case.

The main limitation of this paper is that the models and assumptions are oversimplified. As mentioned, for convenience, the level of panic is simplified into the difference between observed no withdrawals and withdrawals, and the utility functions of both type P and I players are not directly provided. Similarly, in the models, all decisions are observable, but in real life, it is hard to know the exact number of no withdrawals. Moreover, in the case of SVB, the deposit outflow has exacerbated long before the crisis, so perhaps the herd behavior is not caused by an impatient player. Furthermore, to make the setup similar to the setup in the restaurant example, other important factors like the size of deposits and insurance coverage were not taken into account. There might also be other oversimplifications not included.

Other than oversimplification, this paper heavily relied on theocratical discussion instead of statistics, partially because the SVB case happened in March 2023.

Nevertheless, this paper brought other notable topics for future research. For instance, to better measure the level of panic, one can use biological, psychological, and sociological approaches to study the spread of panic as an emotion. Similarly, the contagion of bank failures—how the collapse of a bank leads to the failure of other banks and eventually an economy. On the other hand, one could also study how central banks prevent such contagion from happening, perhaps by analyzing the Federal Reserve's action of preventing the possible financial contagion in 2023 caused by the fall of Silicon Valley Bank.

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