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Preface

The 3rd International Conference on Financial Technology and Business Analysis (ICFTBA 2024) is an annual conference focusing on research areas including digital economy, business, and finance. 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 digital economy, business, and finance.

This volume contains the papers of the 3rd International Conference on Financial Technology and Business Analysis (ICFTBA 2024). 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 2024 organized four workshops in Mucria, London, Galati and Oxford. Dr. Ursula Faura-Martínez chaired the workshop "New Current Trends Related to Economics: Special Focus on Inequality and Poverty", which was held at University of Murcia. Dr. An Nguyen chaired the workshop "Human Capital Management in a Post-Covid World: Emerging Trends and Workplace Strategies", which was held at King's College London. Dr. Habil. Alina Cristina Nuţă chaired the workshop "Finance's Role in the Just Transition", which was held at Danubius University from Galati. Dr. Natthinee Thampanya chaired the workshop "Finance in the Age of Environmental Risks and Sustainability", which was held at Oxford Brookes University.

Besides these workshops, ICFTBA 2024 also held an online session. Eminent professors from top universities worldwide were invited to deliver keynote speeches in this online session, including Dr. Manjeevan Singh Seera from Monash University Malaysia, Dr. Natthinee Thampanya from Oxford Brookes University, Dr. Javier Cifuentes-Faura from University of Murcia, etc. They have given keynote speeches on related topics of digital economy, business, and finance.

On behalf of the committee, we would like to give sincere gratitude to all authors and speakers who have made their contributions to ICFTBA 2024, 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 2024.

Dr. Ursula Faura-Martínez

General Chair of Conference Committee

Workshops

Workshop – Murcia: New Current Trends Related to Economics: Special Focus on Inequality and Poverty

December 4th, 2024 (GMT+1)

Department of Quantitative Methods for Economics and Business, University of Murcia

Workshop Chair: Dr. Ursula Faura-Martínez, Professor in University of Murcia

Workshop – London: Human Capital Management in a Post-Covid World: Emerging Trends and Workplace Strategies

November 20th, 2024 (GMT)

King's Business School, King's College London

Workshop Chair: Dr. An Nguyen, Lecturer in King's College London

Workshop – Galati: Finance's Role in the Just Transition

December 18th, 2024 (UTC+3)

Department of Finance and Business Administration, Danubius University from Galati

Workshop Chair: Professor Dr. Habil. Alina Cristina Nuţă, Professor in Danubius University from Galati

Workshop – Oxford: Finance in the Age of Environmental Risks and Sustainability

October 24th, 2024 (UTC+1)

Oxford Brookes Business School, Oxford Brookes University

Workshop Chair: Dr. Natthinee Thampanya, Senior Lecturer in Oxford Brookes University

The 3rd International Conference on Financial Technology and Business Analysis

ICFTBA 2024

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Analyzing the Negative Impact of Supply Chain Regionalization

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Abstract: In response to increasing global trade, IKEA implemented a more efficient supply chain strategy and introduced a new policy in 2011 to localize its supply chain. The objective of this inquiry was to examine the alterations in supply chain management. Following the transition from centralized to regionalized supply chains, corporations faced adverse consequences such as decreased operational efficiency, increased operating expenses, and reduced adaptability in meeting market needs. These implications include increased complexity in supply chain management, decentralized operating models that result in repeated investments in fixed assets, and trade restrictions that create challenges in integrating information. The article proposes implementing efficient management systems, enhancing collaboration with local suppliers, and utilizing artificial intelligence to optimize the structure of the supply chain based on the observed impacts and outcomes. The objective is to offer risk management guidance for firms that have reached maximum production capacity and require a shift in their supply chain management methods.

Keywords: Efficiency, Cost, Flexibility, Supply Chain Regionalization

1. Introduction

The global supply chain faces various risks, including political conflicts, trade barriers, natural disasters, and pandemics, as well as the possibility that trade policies and tariff barriers could lead to increased costs of transnational transportation. Consequently, many companies are looking to change their supply chain strategies to better disperse these risks and avoid the negative impacts of policy changes. Against this backdrop, IKEA, a leading company in the warehouse-style furniture shopping industry, has chosen to regionalize its supply chain, reducing its dependence on any single region.

In 2011, in response to the challenges of globalization and growing global demand, IKEA began transforming its supply chain strategy from centralized to regionalized production [1]. This shift primarily involved moving from a centralized production model to a more regionalized one to optimize its vast and complex product system more effectively, better meet market demand, and reduce operational costs [2]. By deepening its regional production strategy and increasing production efforts in various regions, IKEA has shortened the cost required to move products from production to the consumer's hands, actively establishing closer cooperative relationships with local suppliers. Implementation of this strategy has further strengthened IKEA's competitive advantage in the global market and laid a solid foundation for the execution of its sustainable development strategy. By 2016, IKEA's two major groups, Inter IKEA Group and The Ingka Group, shifted from their previous

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cooperative operating model to a complete division, with Inter IKEA Group taking over all operations and The Ingka Group transforming into a pure retailer [3, 4].

IKEA is regarded as a mature brand in the warehouse-style furniture purchasing market. Several researchers have studied its development history. For instance, Tefi investigated IKEA's development history, looking at how the company became a leading industry enterprise through constant strategic reforms [5]. However, the majority of these studies concentrate on IKEA's distinct sales strategy and particular marketing psychology approaches, with little attention paid to changes in supply chain management. Recognizing the acknowledged benefits of IKEA's supply chain changes and innovations, there remains a research void about their drawbacks [6]. To fill the research gap, this study will ask, "What are the benefits and drawbacks of the supply chain regionalization policy?" In the short term, the policy of regionalizing supply chains has resulted in dramatic transformations throughout the sector, with IKEA becoming a worldwide organization in just a few years. However, while IKEA today operates in 31 markets around the world, the pace of global expansion has slowed over the years. Perhaps by continually recognizing regionalization problems, the corporation can identify areas for improvement, resulting in more efficient modifications.

To address the investigative questions raised above, the next sections of this report will provide information on IKEA's plan for transforming its supply chain from centralized to regionalized. Following that, it will conduct a thorough investigation of some incidents and data that have emerged in recent years as a result of the company's strategic changes. The examination of the adjustment method will then be linked to the subsequent modifications made to IKEA's overall operating model. Finally, by taking into account current phenomena and repercussions, the research anticipates possible dangers and threats to the regionalized supply chain approach. It will also advise preventive measures for IKEA in order to ensure the company's long-term viability and growth.

2. Case Description

IKEA, founded in 1943, has become renowned for its unique business model and efficient cost management, emerging as a leader in the furniture and home decor industry. With over 400 stores worldwide, spanning more than 50 countries, IKEA has attracted a broad consumer base with its innovative designs, strong functionality, and reasonable pricing. Looking at IKEA's product development history over the years, continuous innovation and optimization in supply chain management are key reasons it has been able to become a top brand in the industry.

Up to this day, the long-implemented policy of regionalization in supply chain management has propelled IKEA to the forefront of the industry. When people say they are purchasing furniture, IKEA is the first brand that comes to mind. IKEA's regional supply chain adjustments strategy has allowed for a more refined management of the global supply chain and localization tweaks. Based on this model, IKEA's success has sparked imitation and learning among other furniture retailers. IKEA implements region-specific supply chain strategies globally, optimizing product design, raw material procurement, manufacturing, and distribution in accordance with market demand, consumer habits, and logistical conditions in different areas. The goal is to ensure that consumers in various parts of the world can have a consistent shopping experience. IKEA has also established regional distribution centers through partnerships with local suppliers. These centers not only serve as warehouses for storing goods, but they also provide flexible delivery services to improve immediate response and personalized service, further enhancing the customer experience. IKEA has even developed its e-commerce channels and set up online order processing centers to improve the online shopping experience and realize an integrated online and offline logistics service system. Furthermore, IKEA has realized global supply chain monitoring and optimization. Data analysis enables the company to accurately forecast market demand, optimize production plans and inventory levels, and reduce stockpiling and product waste.

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During the year 2015, IKEA worked with the "Sheng Nuo" Group in Zhejiang, China, a company that manufactures and sells home items and polyurethane foam. After selecting regional suppliers, IKEA introduced a set of modifications known internally as the "I-WAY" norms of conduct. IKEA presented its views to the group, stating, for example, that the large manufacturing space resulted in different stages of mattress manufacture being distributed across multiple locations, directly increasing internal logistics costs for mattress production. As a result, a supply chain strategy transformation was proposed, guided by professionals in areas such as product design, testing, production, procurement, warehousing, distribution, and retail, with the goal of shortening the entire production process, integrating resources, and optimizing the production flow. IKEA's strategy yielded significant results, with data indicating that production capacity for mattress covers grew by around 50% following the change [4]. Furthermore, an effective production management system was established within the group. IKEA established its first laboratory outside of company headquarters in Älmhult, Sweden, where they conduct product testing and integrate supplier and employee training. It also serves as a good reference and model for global supply chain management strategies.

3. Analysis

3.1. Reasons on Reduced Efficiency

It is precisely because production activities in various regions are becoming more aligned with the market that IKEA has had to make strategic adjustments to its regional supply chain. Such strategic changes, due to the complexity of regionalization, lead to increased management difficulties for the company and can result in reduced efficiency. Compared to other companies, IKEA, as a warehouse-style furniture retail brand, needs to coordinate a larger number of production bases and suppliers, significantly increasing the managerial workload. Different production bases and suppliers may face varying policy and legal risks, such as labor laws and employment regulations in different countries. Some countries may have stricter labor regulations, including minimum wage standards, work hour restrictions, and labor rights, all of which could impact a company's production decisions and lead to inefficient operations.

Maria-Therese Gustafsson used the origins and purposes of the Financial Conduct Authority (FCA) legislation and extensive data to demonstrate the confrontations between non-local supply chains and local laws and regulations [7]. Oláh et al. have also demonstrated that expanding markets will require engaging with consumers from all over the world, emphasizing that while such practices may change existing economic systems, customer expectations and the constant evolution of purchasing habits will make supply chain networks more complex and variable [8].

3.2. Reasons on Increased Costs

IKEA has made strategic adjustments to its supply chain in different countries due to the necessity of having a worldwide supply network. While these improvements will provide access to various regional markets, they will also lead to a more decentralized operational approach and, to some degree, result in higher expenses. IKEA's decision to produce and deliver furniture in different countries may result in a decrease in the overall volume of mass manufacturing. As a result, the company may not be able to fully take advantage of the cost advantages that come with economies of scale. To establish a regionalized supply chain, IKEA needs to have numerous manufacturing bases spread out in different locations. This necessitates recurring investments in permanent assets, such as factories and storage equipment. Alongside physical assets, working capital is also a crucial consideration for IKEA. It is imperative for IKEA to recruit and develop local workers to attain a high level of expertise. Regionalization incurs higher costs and places greater economic strain on IKEA than the globalization policy, which enables global sharing and utilization. Škare et al. has emphasized the cost increases

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caused by inflation through extensive research on data regarding inflation and the global economy, which has brought significant shocks to the supply chain [9]. When costs gradually exceed profits and risks outweigh returns, some enterprises may choose to alter their development strategies [9].

Furthermore, regionalization of supply chains leads to higher transportation costs. The spread of IKEA's supply chain across multiple locations may result in higher transportation distances for raw materials and completed furniture goods. Regionalization allows for more frequent transportation of commodities, but it also limits the volume of each shipment when compared to global transportation, making it impossible to fully leverage economies of scale and mobilize all resources. Furthermore, multiple batch transfers raise product risk and storage costs, resulting in a higher transportation cost per unit. Elomri et al. examined the performance of global supply networks following the commencement of COVID-19 and used a rise in corporate transportation costs and time as a case study to highlight the interdependence of transportation costs and supply chains [10]. As IKEA moves to and executes a supply chain regionalization strategy, it must devote significant effort to analyze and optimize its transportation network, as well as offer specifics on new expenditures, resulting in severe internal pressure on the company.

3.3. Reasons on Decreased Flexibility

In order to increase earnings, IKEA has changed its supply chain approach from centralized to regional. This change will allow for global distribution of IKEA's products, but the impact of regional trade obstacles and the problems of integrating information systems will limit the company's capacity to adapt to market demand. According to this concept, local market fluctuations and preferences in different countries are difficult to transmit promptly to all links in the supply chain, particularly for businesses such as IKEA, which face regular demand changes and severe market competition. Regionalization may cause an inability to alter production plans in time, resulting in the loss of market possibilities. Blanchard et al. also stated that current regional trade obstacles have become a significant factor for organizations when changing their supply chain strategies [11]. It also underlines the global trade sector's volatility and how a decentralized supply chain model makes future market trends even more difficult to predict [11].

In addition, the varying effectiveness of economies of scale in different regions might result in lesser production and procurement quantities in certain locations, which contributes to the self-contained nature of regional supply chains. IKEA's advanced and innovative designs appeal to a wide range of consumers. However, the closed-loop nature of their supply chains imposes limitations on cross-regional and cross-cultural innovation exchanges. Consequently, IKEA experiences some restrictions in introducing and implementing new technologies and processes. Ehsan and Simme have demonstrated that economically challenged countries often adopt a protectionist approach to production, hesitating to embrace innovative technology and products [12]. This demonstrates that relying solely on local resources is insufficient to overcome the influence of a local closed-loop supply chain when enterprises choose regionalization instead of utilizing extensive centralized resources to overcome barriers [12].

4. Suggestion

4.1. Suggestion on Efficient System

According to the regionalization of supply chains, different regions will face distinct policy and legal risks, as well as a demand for sensitive conditions. The introduction of an efficient supply chain management system can enhance the overall efficiency of regionalized supply chains. In this regard, the article suggests that IKEA needs to develop flexible strategies to adapt to various legal regulations and market demands. By establishing a diversified supplier base, IKEA can mitigate the impact of

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regulatory changes on the supply chain and reduce reliance on any single market. In addition, there should be increased scrutiny of supply chain partners to ensure that they comply with relevant laws and regulations, thereby reducing compliance risks.

Roscoe S. et al. article confirms the necessity for enterprises to consistently modify their supply chain operations in order to conform to and adhere to limits imposed in order to achieve geopolitical goals [13]. Brexit policy in the UK has had a significant impact on the pharmaceutical industry, forcing companies to abandon their contracts with the European Union, pay substantial penalties for breach of contract, and instead establish new corporate bases in the UK for further development [13].In order to achieve a balance between regionalization and efficiency, IKEA must carefully oversee operations, develop innovative supply chain strategies, establish a variety of supplier sources, and ensure the ability to quickly find alternatives to preserve market competitiveness in the face of political challenges.

4.2. Suggestion on Enhancing Collaboration

According to the supply chain regionalization policy, IKEA's operational model has evolved from centralized to decentralized, demanding multiple reinvestments in significant fixed and liquid assets and resulting in higher per-unit transportation costs. It can be concluded that more sophisticated inventory management can alleviate problems caused by regional dispersion. In this regard, this essay proposes that IKEA might minimize inventory costs and increase its capacity to adapt to market changes by establishing a sensible network of regional warehouses and delivery facilities. Concurrently, in terms of factor costs, IKEA might look into multimodal transportation solutions to improve shipment routes, reduce unnecessary transfers and wait times, and enhance overall transportation efficiency. In select places, the corporation might also engage with local governments to encourage infrastructure improvements and upgrades, such as improving port facilities and optimizing the traffic network. These approaches would help to reduce transportation costs and time for the regionalized supply chain.

Edward Frazelle's article showcased various methods to reduce transportation costs [14]. Route optimization guarantees that vehicles and containers travel the most efficient routes, reducing fuel usage. Mixed-cargo negotiation tactics based on contracts can also result in increased profitability and lower expenses. Cost-cutting strategies for repetitive expenditures, such as streamlining inventory purchases, exist [14]. By using a diverse strategy, IKEA can overcome the problems of supply chain regionalization. From boosting inventory management efficiency and optimizing logistics planning to strengthening infrastructure and implementing localized procurement, these approaches work together to create a more efficient and cost-effective regionalized supply chain system. These efforts would enable IKEA to maintain efficient operations while enhancing customer satisfaction and market competitiveness.

4.3. Suggestions on AI Layout

According to the regionalization of the supply chain, there will be trade barriers and difficulties in integrating information systems, as well as restrictions on the introduction of new processes and technologies. It can be inferred that only IKEA, by utilizing big data and artificial intelligence technology to intelligently optimize the supply chain, can enhance the collaborative efficiency among regional supply chain nodes and strengthen flexibility. This article suggests that IKEA can independently develop an artificial intelligence prediction and analysis tool that can feed a large amount of daily and historical data so that AI can more accurately forecast demand fluctuations and supply risks in various regions. If a disruption occurs in a particular region's supply chain, IKEA can quickly mobilize resources from other regions to mitigate the impact.

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Furthermore, based on this analysis tool, a real-time supply chain information system should be developed to collect data from all regions. The system will record all activity, whether it's browsing or purchasing product information, from offline stores or online shops, and combine it with regional trade information from recent years. Finally, the system will analyze and simulate how to attract regional consumers' attention to new products in stores. Tisdulko et al. have demonstrated that the emergence of artificial intelligence will greatly improve the gradually diminishing flexibility of supply chains. Companies can use AI-driven simulations to gain a deeper and more timely understanding of the global logistics network's operations, as well as assess the potential impact on the company's business in the near term [15].

5. Conclusion

International furniture brands face risks related to political conflicts, trade restrictions, and tariff walls in both the domestic and international markets. To adapt to these challenges, companies need to modify their operational strategies to better suit market conditions. This paper examined supply chain management using IKEA, a well-known furniture brand, as a case study. The study examined the adverse effects of alterations in supply chain management and the underlying causes of these effects. The company's implementation of a regionalization plan in supply chain management results in decreased operational efficiency, heightened operating costs, and diminished flexibility in meeting market needs.

Throughout the exploration and discussion, this investigation draws upon related literature in the fields of financial management, food, and politics. By summarizing phenomena observed during strategy implementation, the paper looks back on past developments from a current perspective to identify any shortcomings in these strategies. It provides suggestions for improving certain practices in policy implementation through a comprehensive analysis. This paper's findings are beneficial for businesses that have reached production capacity saturation and urgently need to change their supply chain management strategies while finding ways to manage risks.

However, there are also shortcomings in the investigation and discussion process of this paper. From the perspective of a company's marketing profits, regionalization of the supply chain is certain to greatly enhance profits. Nevertheless, an increase in profits does not necessarily indicate that a company is moving towards positive development. Therefore, this paper's exploration process almost exclusively used non-pure data to support arguments. Future studies could use negative case data to validate theories through comparison. The translation has been structured to maintain the same structure as the original text, with careful consideration given to cultural nuances, grammatical correctness, appropriate vocabulary selection, and direct output without additional explanatory text.

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A Comprehensive Analysis of the Economic Development and Income Gap

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Abstract: The third wave of global economic integration is advancing at an unprecedented speed. At the same time, there is intense debate among people about the impact of globalization on the economy, society, environment, and other aspects. One of the core issues of debate is the impact of globalization on income disparities between countries. Many people believe that the rules of globalization are beneficial to rich countries by sacrificing the interests of the third world, exacerbating inequality between countries and exacerbating poverty. This article uses literature review and case analysis methods, and panel data to study the impact of globalization on income inequality between countries through a regression based inequality decomposition framework. This paper will start with theoretical analysis and then test these theories with empirical data. Our goal is to provide a comprehensive perspective to understand the interaction between these two important economic variables and to look for possible equilibrium strategies.

Keywords: Economic development, income gap, economic impact

1. Introduction

In theory, the impact of globalization on inequality within and between countries is uncertain, depending on the specific situation of each country and the content involved in globalization [1]. Different theories have been proposed regarding the impact of globalization on inequality. Wade categorizes these theories into three categories: neoclassical economic growth theory, endogenous economic growth theory, and sociologist dependency theory. The neoclassical economic growth theory suggests that in the long run, the income and productivity levels of each country will eventually converge, mainly due to the flow of international capital[2]. The endogenous economic growth theory suggests that due to the increase in returns on technological innovation offsetting the decrease in marginal returns on capital, income levels in various countries are more likely to diverge rather than converge. Finally, the dependency theory suggests that developing countries benefit less from economic integration due to their limited access to international markets and narrow export capabilities. Correspondingly, globalization cannot bring about absolute convergence.

Under the current diversified theoretical expectations, analyzing the true impact of globalization on inequality has largely become an empirical issue. The existing literature mainly estimates the impact of globalization on inequality through the following methods, in order to explore the relationship between globalization and inequality. (1) In cross-border or time series regression, introducing different measures of globalization as independent variables into the regression model

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[3]; (2) Estimating various inequality indicators using income and population data, and decomposing the overall inequality into "between countries" and "within countries" using traditional decomposition methods [4]; (3) Using longer historical data to analyze the income of countries around the world and linking inequality to the degree of globalization in different periods, in order to observe the impact of globalization on income distribution [5].

So far, the existing literature has not formed a consistent view. In addition, early research did not use cross-border data to quantify the relative contribution of globalization and other variables to inequality between countries. Based on this, this article attempts to fill the gap in existing literature by answering three questions. Firstly, in the global context, what is the relationship between globalization and inequality, that is, has openness worsened or reduced transnational inequality? Secondly, what is the actual contribution of globalization to the inequality between countries? Thirdly, has the contribution of globalization to transnational inequality increased or decreased?

So far, the existing literature has not formed a consistent view. In addition, early research did not use cross-border data to quantify the relative contribution of globalization and other variables to inequality between countries. Based on this, this article attempts to fill the gap in existing literature by answering three questions.

This article will adopt a new decomposition method that combines regression equations with the Shapley value decomposition method, which can help identify the determining factors of inequality and estimate their absolute and relative contributions to total inequality.

2. Theoretical Analysis of Economic Development and Income Gap

2.1. Economic Development and Productivity

Economic development is usually accompanied by an increase in productivity, which leads to a general increase in wages, thereby narrowing the income gap.Economic development and productivity are the two core elements that drive social progress[6]. Economic development is not only about GDP growth, but also encompasses progress in various aspects such as optimizing industrial structure, technological innovation, and expanding employment. Productivity reflects human ability to transform nature and meet social needs, and its improvement can drive economic development to a higher stage[7].

In the process of economic development, the improvement of productivity is crucial. By introducing advanced technology, improving the quality of workers, and optimizing resource allocation, production efficiency can be continuously improved, promoting sustained and healthy economic development[8]. At the same time, economic development also provides a material foundation and market space for the improvement of productivity, and the two mutually promote and jointly promote social progress.

HoThis paperver, This paper should also recognize that economic development and productivity improvement are not an overnight process. This paper need the joint efforts of the government, enterprises, and all sectors of society to continuously promote economic development and productivity improvement through measures such as deepening reform, expanding opening up, and strengthening innovation, in order to achieve comprehensive social progress and common prosperity for the people[9].

2.2. Economic Development and Inequality

Economic development and inequality are two closely connected phenomena in contemporary society. With the rapid growth of the economy, the material This paperalth of society continues to accumulate, and people's living standards generally improve. HoThis paperver, economic development has also brought about an exacerbation of inequality issues.

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On the one hand, economic development promotes the flow and allocation of resources, enabling some people to seize opportunities and achieve a leap in This paperalth and status. On the other hand, due to inequalities in education, opportunities, and resource allocation, many people still live in poverty and hardship. This inequality is not only reflected in the widening This paperalth gap, but also in the development differences betThis paperen urban and rural areas and regions[10].

Therefore, while pursuing economic development, This paper must pay close attention to the issue of inequality, strive to build a fair and reasonable social system, and provide equal development opportunities for everyone. Only in this way can This paper truly achieve sustainable economic development social harmony and stability.

3. Empirical Analysis

3.1. Data Source

This study used the 2006- -2022data included in the World Bank World Development Index. System means, the values are obtained from the comprehensive database of Freedom HouseTable 1 presents the basic statistical values for the data. The degree and range of change This paperre evident for all variables. For example, the average per-capita real income for all countries in 2000 was $9,217, with the loThis paperst in Malawi $ $552 and the highest in Norway $32,228. As can be seen from Figure 5, there was a positive correlation betThis paperen transnational per capita real income and openness in 2022. Per capita income and education level This paperre also positively correlated [11].

Table 1: Summary of the statistics in [12]

variable	mean value	standard deviation	least value;	crest value;
2006				
Actual GDP per capita	6827.70	6864.30	512.22	23919.18
Trade per capita (at a constant price of a hundred dollars)	24.71	39.57	0.40	239.26
FDI per capita (with a constant price of US $100)	0.38	0.89	-1.36	5.15
Material capital per capita (at a constant price of 100 dollars)	1424.29	2104.62	15.54	8380.67
Adult literacy rate (percentage)	71.66	25.64	9.56	99.00
Life expectancy (years)	63.50	10.47	40.65	77.65
Population burden rate	0.75	0.19	0.41	1.13
Inflation rate of goods is (%)	170.18	1305.11	-1.81	11749.64
System index	1.73	0.77	1	3
2000				
Actual GDP per capita (Adjusted PPP)	9217.11	9475.17	551.61	32227.57
Trade per capita (at a constant price of a hundred dollars)	49.20	91.28	0.24	621.85
FDI per capita (with a constant price of US $100)	5.16	11.30	-0.31	61.58
Material capital per capita (at a constant price of 100 dollars)	2060.73	3013.97	12.28	12162.06
Adult literacy rate (percentage)	80.10	21.08	15.95	99.31
Life expectancy (years)	65.63	12.87	37.97	81.07

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Table 1: (continued).

Population burden rate	0.66	0.17	0.41	1.05
rate of inflation (%)	7.55	13.98	-3.84	96.09
System index	1.61	0.71	1	3

3.2. Estimated Results

This paper estimate the income determination function with a model combining two Box-Cox and Box-TidThis paperll transformations, which has great flexibility and can minimize the model setting error. The model form is as follows:

+ Fixed effect + year dummy variable + u

Where represents real income per capita (adjusted PPP),Mean income determinants (discussed in the previous section),To transform the parameters,For residual terms.

In Equation (3),。According to the Robine rule, when λ and θ tend to 0, respectively,'limit is limit is[13]. therefore, ,andthe income determination function is semi-logarithmic form, standard linear function form, and double logarithmic form, respectively.When the transformation parameters andare both-1, the relevant variables become their own derivatives. obvious;when and take 0,1,1 or no restrictions, different combinations of and formed 16 different models。besides,,butand when any values can be taken,This paper can again obtain an extended Box-Cox model。This paper will fit all 17 models with data and select the models based on the commonly used likelihood ratio (LR) test. The final selected model corresponds to and has no limitations (1). In terms of fitting, the model fits the data very This paperll (see Table 2). The LR statistical value is highly significant for all variables, and the square of the correlation coefficient betThis paperen the actual and estimated values is 0.96. The symbols of all estimated coefficients in Table 2 match the expected values,

Most are significant at the 1% significance level. The material capital and human capital, represented by the total per capita material capital and adult literacy rate, respectively, have a significant positive impact on income. It is interesting that the coefficient of adult literacy rate is slightly higher than the coefficient of per capita material capital, indicating the importance of education in promoting economic growth. An increase in life expectancy can increase income, while a high population burden rate leads to a decrease in income due to its implied loThis paperr labor participation rate.

The two variables that this article particularly focuses on, namely per capita trade and per capita net FDI, both have a significant positive impact on income, indicating that openness can promote income growth and supporting the view that economic integration can promote economic growth. The coefficients of almost all country dummy variables are significant at the 1% or 5% significance level, indicating the importance of geographic location and other fixed effects of specific countries (i.e. other factors that are still uncontrollable in our equations). HoThis paperver, the inflation rate and institutional index are not significant. Although many people have emphasized the importance of institutions in recent literature. HoThis paperver, Gwartney et al. obtained similar results to ours when studying the impact of institutions on economic growth [14].

To test the robustness of the estimation results, This paper used different combinations of control variables and additional variables (such as the ratio of public expenditure to GDP, adult male or female literacy rate, and institutional indices provided by Freedom Network) included in Table 2 to estimate multiple extended income functions. HoThis paperver, no such function has changed the empirical relationship betThis paperen globalization indicators and per capita income.

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On the other hand, This paper also noticed the potential endogeneity betThis paperen income and globalization indicators in the model. Neglecting the causal relationship betThis paperen income and openness can lead to biased and inconsistent estimates. To solve this problem, This paper use instrumental variable (IV) technique. Generally speaking, the selection of instrumental variables is a difficult task. Here, This paper select instrumental variables that people often use and find to be effective, including those constructed based on gravity models and lagged values or their means of per capita trade quotas . As for FDI, real exchange rates or lagged GDI can be used as tools . This paper uses the average of the lagged values of per capita trade volume and per capita FDI over three periods as tools, and estimate the income determination function using the Box Cox method. The results are shown in Table 2.

Table 2: Estimation results of the income determination function [14]

	OLS		IV	Technique
variable	Estimated value	p-value	Estimated value	p-value
Per capita material capital	0.0403	0.000	0.0423	0.000
Per capita trade	0.1092	0.000	0.1218	0.000
per capita FDI	0.0018	0.013	0.0072	0.000
adult literacy rate	0.0692	0.000	0.0705	0.000
Life expectations	0.1035	0.000	0.1166	0.019
Population burden rate	-0.2808	0.000	-0.2335	0.000
inflation	0.0000	0.264	0.0000	0.462
System index	-0.0123	0.200	0.0133	0.877

So far, This paper have put the 81 countries together. But the income levels and other characteristics of these countries vary greatly. For example, the per capita income of the richest countries is 50-60 times higher than that of the poor countries. Based on the above decomposition results, one cannot judge whether the contribution of various factors to inequality is the same within different income groups. In addition, globalization is likely to be different in different income groups. From a government policy perspective, it is also necessary to identify the factors that influence the income divergence within the income groups, in order to help those poor countries catch up with the higher-income countries in their groups, or even to cross them from the low-income group to the high-income group.

According to the World Bank's classification criteria, This paper divided the sample into two groups: the first group includes middle-and low-income countries; the second group includes middle-high and high-income countries. In our sample, there This paperre 46 and 35 countries included in the first and second groups, respectively. As before, This paper still estimated the income determination function for each group using the Box-Cox method and then decomposed the inequality with the estimation model. Table 4 presents the estimated results for the income functions of the two income groups. In both income groups, both per capita material capital and per capita trade had a significant positive effect on income, whereas per capita FDI was only significant in high-income countries. Curiously, despite the theoretical importance of adult literacy, This paper did not find it as a significant factor in determining income in the low-and middle-income groups. The inflation rate was not significant in the estimates for both income groups, while the institutional index was significant only significant at the 10% significance level in the low income group.

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Table 3: Estimation results of the income determination function of the two income groups

	Middle-and high-income and high-income group countries		Low-income and middle-income-group countries	
variable	Estimated value	p-value	Estimated value	P-value
Per capita material capital	0.0121	0.000	0.0462	0.000
Per capita trade	0.0472	0.000	0.1362	0.000
per capita FDI	0.0014	0.005	0.0078	0.652
adult literacy rate	0.1906	0.000	0.0450	0.158
Life expectations	0.0037	0.857	0.1863	0.000
Population burden rate	-0.3350	0.000	-0.3505	0.000
inflation	-0.0000	0.766	0.0000	0.398
System index	0.0097	0.549	-0.0212	0.085
θ	0.3642	0.000	0.1621	0.040
Sample volume	595		782	
Log likelihood values	873.48		755.72	
LR chi^2	2836.37		3133.54	
Pnob.>chi2	0.000		0.000	

The trade-off between fairness and Efficiency: How should This paper balance economic development and income equity? This is an important policy issue.

Policy intervention: Governments can influence income inequality through tax and policies while encouraging economic development.

4. Conclusion

The center of this paper is quantifying the contribution of globalization to transnational inequality. This paper found that both trade and FDI contribute positively to per capita income. Material capital and human capital, geographical attributes and demographic characteristics are some other important income determinants. Our estimation results are robust and seriously address the endogeneity problem. Our important findings also include: (1) geography, trade quotas and material capital are the main contributors to income inequality; adult literacy, population burden, life expectancy and FDI are folloThis paperd. (2) Trade and FDI make positive contributions to inequality, although the share of the former is much higher than the latter.(3) The absolute and relative contributions of trade and FDI to inequalities have been rising steadily.

The increase in the absolute or relative contribution of trade and FDI to inequality shows the fact that the importance of global trade and FDI is rising. HoThis paperver, our study shows that poor countries do not gain as much from the process of globalization as rich countries, especially as trade contributes considerably to income across borders. More importantly, when This paper divide all countries into two groups (i. e., high and high income groups; low and low income groups), these globalization indicators promote income divergence within each income group. The results also show that betThis paperen rich countries, material capital is much more important than openness itself to unequal contributions, with trade becoming the determinant of inequality betThis paperen low-and middle-income groups. Finally, This paper also found a slightly loThis paperr income inequality in 2022 in the high income group than in 2006, but the opposite was true in the low income group.

In conclusion, the study shows that globalization has a positive impact on per capita income. HoThis paperver, due to the differences in the process and speed of globalization and adapting to the changes in the international market environment, globalization plays an important role in causing

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inequality. Therefore, in addition to increasing domestic investment and increasing public spending such as health and education grants, developing countries must implement enhanced export strategies and attract foreign investors by improving the efficiency of public institutions as This paperll as the investment environment.

Only when the international trade system becomes more equitable will the benefits from trade become equal. This calls for concerted action by the international community to ensure that poor countries become equal and effective players in the multilateral trading system and the global economy. This paper believe that the most important step is to abolish subsidies for agricultural products from developed countries and the reduction of tariffs on manufactured goods from developing countries. Further, providing technical assistance and capacity-building for low-income countries are also necessary to strengthen institutional building and promote trade and investment activities.

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Understanding and Addressing Consumer Post-Purchase Dissonance in E-commerce: Influential Factors and Effective Measurements

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Abstract: With the rapid development of technology and the widespread adoption of the Internet, e-commerce has become an integral part of people's daily lives. In e-commerce scenarios, consumers can browse and purchase goods anytime and anywhere, enjoying unprecedented convenience. However, at the same time, the issue of post-purchase dissonance has gradually become prominent. This paper aims to explore the influencing factors and management measures of consumer post-purchase dissonance psychology in e-commerce scenarios. The article first reviews the theory of post-purchase dissonance and the theory of perceived psychological contract violation-, providing a theoretical foundation for subsequent research. Then, through a literature review, it identifies multiple factors affecting consumer post-purchase dissonance, including customer service quality, costs incurred from returns, and uncertainties in online shopping. To effectively manage post-purchase dissonance, enterprise managers should focus on improving service quality, optimizing the return process, and reducing shopping uncertainties. Additionally, strengthening consumer education and enhancing their cognitive ability regarding product information and decision-making skills in shopping are also important ways to reduce post-purchase dissonance.

Keywords: Post-purchase dissonance, consumer psychology, e-commerce

1. Introduction

In traditional shopping scenarios, post-purchase dissonance is an issue that cannot be ignored. While consumers shopping in physical stores can personally experience products and interact face-to-face with sales personnel, dissatisfaction or anxiety may still arise due to limited product selection, incomplete information, and cumbersome return processes. These factors can lead to post-purchase emotions such as regret, disappointment, or questioning one's decisions. Limited product selection means that consumers may not find products that fully meet their needs, and incomplete information can lead to misunderstandings or expectations not being met. Additionally, the return process in traditional shopping scenarios is usually cumbersome, requiring consumers to physically go to the store and provide proof of purchase, which increases consumer dissatisfaction and anxiety.

In e-commerce scenarios, consumer post-purchase satisfaction is crucial for business success. A rich selection of products, convenient shopping methods, and policies such as "seven-day returns without reason" and "community group buying" greatly enhance the consumer shopping experience.

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However, post-purchase dissonance is becoming more apparent in the modern online shopping environment. Post-purchase dissonance refers to the dissatisfaction or anxiety consumers may feel after purchasing a product or service for various reasons, which can negatively affect a business's reputation and sales. Consumers using online shopping and social platforms receive a large amount of information about similar products before and after shopping, making them more likely to experience post-purchase dissonance. Additionally, modern online shopping policies like the seven-day no-reason return and community group buying, while providing more assurance for consumers, may also lead them to rethink their shopping decisions, increasing the likelihood of post-purchase dissonance. Therefore, understanding the causes of post-purchase dissonance and developing appropriate strategies to address it is crucial for enterprises. The theory of post-purchase dissonance originates from Leon Festinger's Cognitive Dissonance Theory, proposed in the mid-1950s. This theory suggests that when a person holds two or more interrelated but contradictory pieces of knowledge, they experience an uncomfortable state known as "dissonance." In the post-purchase phase, consumers may experience dissonance both cognitively and emotionally. Perceived psychological contract violation is another important theoretical foundation. This theory posits that there is an implicit contract between consumers and merchants, wherein consumers expecting to receive corresponding value or benefits from the merchant. When consumers perceive that the merchant has violated this contract, they feel a psychological contract violation, which subsequently affects their behavior. Based on related research and these two fundamental theories, this paper will delve into the reasons for consumer post-purchase dissonance in e-commerce scenarios and the strategies businesses can adopt to address it.

2. Literature Review

Existing research has reviewed and analyzed factors that influence or lead to consumer post-purchase dissonance. Liu Yu [1] emphasizes that the rationality behind consumer online return behavior stems from post-purchase cognitive dissonance and perceived psychological contract violation, with return costs playing a crucial role in moderating this behavior. This is significant for revealing the internal mechanisms and influencing factors behind consumer return behaviors. Regarding customer service quality, Hayes [2] focuses on issues in the service industry, emphasizing the importance of service quality on post-purchase satisfaction. Jiang Lin [3], in his book "Consumer Behavior," provides extensive information on consumer behavior, highlighting how psychological factors of post-purchase dissonance can lead to decreased satisfaction, loyalty, and reduced willingness to repurchase. Luo Ziming [4], in his book "Consumer Psychology," conducts an in-depth study of consumer psychology, which helps understand the emotions of regret, self-blame, self-doubt, and dissatisfaction that arise from consumer post-purchase dissonance. Cao Mengle and Han Xiujing [5] discuss consumer psychology, particularly in relation to the shopping experience. They explore how salespeople use psychological strategies to sell goods to specifically characterized customers and analyzed the psychological activities of customers during counter shopping, including selection, comparison, and decision-making processes.

In the online shopping environment, post-purchase dissonance continues to occur. Peng Huan's article [6] focuses on the uncertainties in online shopping, dividing them into product, seller, and shopping platforms. Understanding and reducing these uncertainties are crucial for enhancing customer satisfaction and trust in online shopping. Other factors affecting post-purchase dissonance are analyzed in Huang Changfang's article [7]. It investigates how price promotions in online shopping trigger post-purchase dissonance and unsatisfying reviews, emphasizing the impact of time pressure, timing of promotions, and the extent of post-promotion price adjustments on consumer post-purchase dissonance. Hajli, N [8] focuses on introduction to consumer behavior supported by in-depth, scientifically grounded coverage of key principles and Business & Economics, impulse buying

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decisions consumers may make in online shopping for various reasons, such as promotional activities and social media influences, which can lead to post-purchase dissonance. Factors related to e-commerce platforms can also cause post-purchase dissonance; Kim [9] develop a theoretical framework describing the trust-based decision-making process a consumer uses when making a purchase from a given site, test the proposed model using a Structural Equation Modeling technique on Internet consumer purchasing behavior data collected via a Web survey, and consider the implications of the model. notes that operational strategies of e-commerce platforms, such as product descriptions, image quality, and after-sales service. Turban et al. [10] suggest that Word of mouth and other activities in social networking play a key role in affecting the attitude and behavior of the user. Therefore, taking advantage of social networking is the most essential attribute of SC. It can lead to irrational buying decisions due to social pressure, which is an important cause of post-purchase dissonance.

Additionally, regarding measures to address consumer post-purchase dissonance, Liu Yu [11] proposes methods for identifying opportunistic return behavior and emphasizes the importance of rule setting, enforcement, and cooperative supervision. These research findings are significant for e-commerce platforms to formulate reasonable return policies, improve consumer satisfaction, and maintain market order. Yang Yuehan [12] stresses the necessity of e-commerce platforms to protect consumers' rights to return and exchange and improve the consumer experience through measures like "speedy returns," while also mentioning the positive improvements in delivery times and consumer satisfaction. Wang Yajie [13] suggests addressing product quality, return policies, and after-sales service to enhance consumer satisfaction and reduce return rates. She also notes the need for businesses to strengthen the training and management of KOLs (Key Opinion Leaders) to prevent their live-selling behaviors from negatively influencing consumer return decisions.

3. Case Analysis of Consumer Behavior on E-commerce Platforms

3.1. Case Selection: Pinduoduo E-commerce Platform

This paper selects the Pinduoduo platform to explore the causes of consumer post-purchase dissonance and corporates' response strategies within the context of e-commerce consumption, based on its distinctive business characteristics and prevailing issues. Compared to other mainstream e-commerce platforms like JD.com, Meituan, and Taobao, Pinduoduo exhibits a series of distinct business traits and differences. A primary characteristic of the Pinduoduo platform is its unique group buying model, which encourages customers to team up and purchase with lower prices, thereby attracting a large number of price-sensitive consumers. Additionally, Pinduoduo focuses on developing the lower-tier markets, particularly targeting rural and third- and fourth-tier city users, offering products and services suitable for these markets. The platform also incorporates attributes of social interactions. Pinduoduo's "group buying" model is based more on a socialized shopping experience, allowing consumers to obtain more discounts and rewards by sharing and inviting friends. This social shopping model enhances consumer engagement and interaction, aligns with the consumption needs of young people, and increases user participation and shopping enjoyment.

According to a research report by Everbright Securities, between the second quarter of 2022 and the first quarter of 2023, among the four major Chinese e-commerce platforms (Meituan, Alibaba, JD Group, Pinduoduo), Pinduoduo's revenue growth rate of 36% to 64% exceeded the combined growth rates of the other three platforms, showing strong momentum. Guosheng Securities published a research report on Pinduoduo users and revealed that seventy percent of them shop on Pinduoduo because of the lower prices. Additionally, half of the researched users believe that group-buying acquaintances offer cheaper prices, and they can even recommend good products to each other. Nearly thirty percent of users felt that the large sales revenue signals that the products are worth the money.

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As such, the primary reasons why users choose Pinduoduo are its cost-effectiveness and the socializing and entertaining attributes of the platform.

3.2. Challenges Faced by Pinduoduo E-commerce Platform

Despite the outstanding business performance of Pinduoduo, it also faces challenges in terms of brand perception, product quality, and user experience. Firstly, as it primarily targets price-sensitive consumers, the platform is relatively weaker in brand perception and the introduction of high-end brands, which somewhat limits the variety of products and the platform's market competitiveness. Secondly, Pinduoduo faces challenges in product quality control. Since the platform's procurement model involves direct purchasing from manufacturers without stringent auditing and screening, the quality of some products is not guaranteed, which can lead to inconsistencies and pose threats to the platform's reputation and consumer trust. Additionally, Pinduoduo's after-sales service system is relatively inadequate; some consumers report difficulties in returning or exchanging goods and resolving issues. These problems, to some extent, affect consumer shopping experience and satisfaction, making post-purchase dissonance more likely. A survey by Everbright Securities on major e-commerce platform app users showed that from the first quarter of 2022 to the first quarter of 2023, MAUs (monthly active users) on Pinduoduo have declined, and user satisfaction has decreased. At the end of 2023, the Black Cat Data Center released the "2023 'Double Eleven' Consumer Complaint Data Report," which showed that during the "Double Eleven" shopping period, Pinduoduo's complaint response rate was still below 20%, showing no significant improvement compared to 2022. The after-sales system is not adequately robust, and consumer demands are not being met timely. The author compiled data from the main complaint platforms during the 2023 "Double Eleven" period regarding the complaint rates and resolution rates for the five major e-commerce platforms and created the following diagram, which shows that Pinduoduo ranked third in terms of complaint volume, with a complaint resolution rate of only 7.6%, indicating that the efficiency of complaint handling needs further improvement.

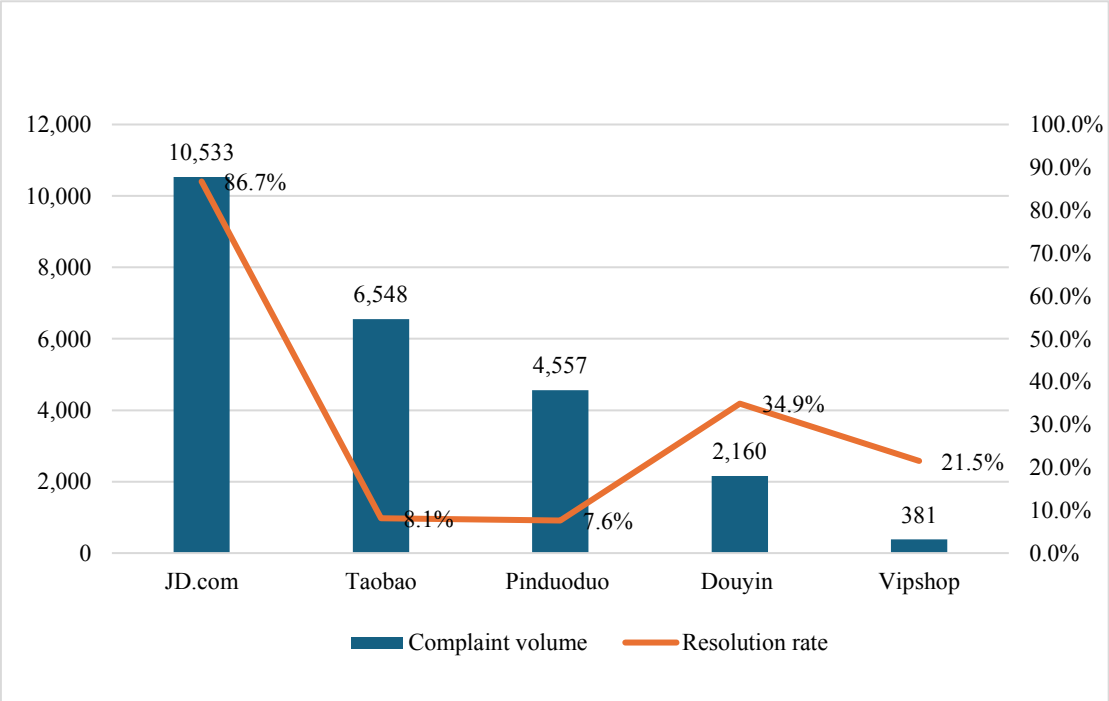

Figure 1: Customer Complaints Data of Five Major E-commerce Platforms During the "Double 11" Slaes Season in 2023.

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4. Concentrated Manifestations of Consumer Post-Purchase Dissonance Psychology

4.1. Community Group Buying and Consumer Expectation Deviations

In 2020, Pinduoduo launched three strategic products, "Kuai Tuan Tuan," "Pin Nei Gou," and "Pin Xiao Quan," which are central to Pinduoduo's efforts to capture the community group buying market share. These initiatives are also Pinduoduo's response to competing with Meituan in laying the groundwork for local offline services. In Pinduoduo's financial report of the first quarter in 2023, a notable data point was that the order volume for community group buying had achieved a 60% year-over-year increase. This significant growth not only proves the popularity of the community group buying model among consumers but also reflects the effective strategic layout of Pinduoduo in this field. However, at the same time, an issue that cannot be ignored has emerged: a 15% increase in consumer complaints about group-purchased goods.

This trend indicates that while community group buying offers consumers more shopping options and convenience, it can also lead to discrepancies between consumer expectations and actual product quality, mainly due to information asymmetry. Information asymmetry refers to a situation where some market participants have more information than others, which may lead to unfair transactions. In community group buying, consumers often rely on the recommendations and descriptions from group leaders or platforms to understand product information, which may not always be accurate or comprehensive. Since consumers cannot select and inspect the goods in person, they have to make purchase decisions based on the descriptions provided by the group leaders or platform. When there is a discrepancy between these descriptions and the actual product quality, a deviation between consumer expectations and reality occurs, triggering post-purchase dissonance. Due to the presence of information asymmetry in community group buying, consumers may have overly high expectations for product quality and features. When the products received fail to meet these expectations, consumers may experience negative emotions such as disappointment, regret, or anxiety.

Finally, logistics and delivery are also key factors contributing to the deviation between consumer expectations and reality. In community group buying, goods are typically delivered to consumers through centralized distribution. However, issues such as delays or damages during the delivery process can result in consumers receiving products that do not meet their expectations. This instability and uncertainty in logistics further exacerbate the discrepancies between consumer expectations and reality.

In December 2023, the Black Cat Complaint Platform disclosed a collective complaint titled "Refusal to Fulfill Contractual Agreements by the Operator of Kuai Tuan Tuan Mini Program under Pinduoduo (PDD.O)." The initiator of the complaint stated that although the merchant had been banned, there had been no substantial progress regarding refunds. The less than one-year-old "Duo Duo Grocery" had already received up to 4,733 complaints, not only concerning "returns" and "refunds" but also involving accusations of "deceiving consumers" and "false advertising." To reduce complaint rates and enhance consumer satisfaction, Pinduoduo could strengthen supervision over group leaders and the platform to ensure the reliability and accuracy of product descriptions. It could also optimize the logistics and delivery processes to reduce delays and damage and enhance after-sales service, meanwhile involve consumer education to improve the shopping experience and satisfaction levels of consumers.

4.2. Price Discounts and Quality Concerns

Pinduoduo's "2023 Consumer Trend Report" reveals an interesting and complex phenomenon: while the proportion of sales of low-priced goods continues to rise, the rate of returns due to quality issues has also increased by 8%. This data reflects the dual impact behind Pinduoduo's low-price strategy.

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Firstly, Pinduoduo's low-price strategy is undoubtedly a crucial means to attract consumers and boost sales. In the competitive e-commerce market, price-sensitive consumers are often drawn to low-priced goods. Thus, Pinduoduo's strategy has been successful, driving the growth of merchandise sales. However, the low-price strategy also brings a series of problems, among which concerns over product quality are most prominent. In general, customers believe that the price of a product directly relates to the quality. When the price of goods is significantly lower than the market price, consumers inevitably worry that there might be underlying quality issues or that the product value is overstated. Such suspicions are not unfounded but are based on consumers' understanding of market price information and past shopping experiences. These concerns become particularly evident after shopping. When consumers find that the actual quality of the goods deviates from their expectations, post-purchase dissonance naturally arises, leading to dissatisfaction and disappointment. To alleviate these quality concerns and post-purchase dissonance, Pinduoduo needs to maintain its low-price strategy while strengthening product quality oversight and enhancing consumer trust. On one hand, Pinduoduo could establish a stringent quality inspection mechanism to ensure that although the prices are budget-friendly, the quality remains reliable. On the other hand, Pinduoduo could offer more consumer protection measures, such as clear return and exchange policies and high-quality after-sales services, to help consumers resolve potential issues after shopping and enhance the shopping experience. In doing so, Pinduoduo would not only maintain its pricing advantage but also enhance consumer trust, ensuring a pleasant and satisfying shopping experience for sustained and healthy growth.

4.3. Return Policy and Consumer Protection

Among the frequently received feedback of the Pinduoduo platform for the first half of 2023, its return policy catches public attention. Although official data show that Pinduoduo successfully controlled the overall return rate to within 5%, this figure seemingly demonstrates the platform's strict quality control and high consumer satisfaction. Whereas, about 10% of the feedback is about the troublesome return processes and tight time frame. This data highlights the key problem in the execution of the return policy. The existing complicated return policy not only increases the difficulty for consumers but also invisibly extends customers' waiting time, leading to dissatisfaction and anxiety during the return process. Moreover, overly restrictive time limits can also prevent consumers from finding timely solutions after discovering issues with products.

Thus, the simplicity of the return process is crucial for the consumer experience. In consumer psychology, the ease and efficiency of operations are important factors affecting consumer satisfaction. A cumbersome return process can increase the difficulty for consumers, prolong their waiting time, and thus trigger dissatisfaction and anxiety. Therefore, Pinduoduo could enhance the return experience by optimizing the return application interface, simplifying the review process, and providing convenient return methods, thereby reducing the operational difficulty for consumers. Secondly, the setting of return time limits also needs to consider consumer rights and psychological expectations; fairness and the feeling of having expectations met are key factors influencing consumer attitudes. When constrained by the time limit for conducting returns and refunds, consumers may feel that their rights are being infringed upon, leading to dissatisfaction and complaints. Thus, Pinduoduo should set reasonable return time limits to ensure that consumers can enjoy their rights to return within a fair timeframe. Additionally, Pinduoduo should pay attention to consumer feedback and suggestions, using them as a crucial basis for improving return policies. By collecting and analyzing consumer feedback, Pinduoduo can understand the pain points and needs of consumers during the return process, allowing for more precise policy adjustments. Also, consumer feedback can help evaluate the effectiveness of the return policy, continuously refining and optimizing the policy to meet consumer expectations and needs.

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5. Conclusion

In e-commerce consumption scenarios, post-purchase dissonance has become an issue that cannot be ignored, with its influencing factors being complex and varied. Elements such as product selection, information acquisition, and the return process can all trigger consumer dissatisfaction and anxiety. As the online shopping environment offers a rich selection of goods and convenient shopping methods, there appears new challenges such as post-purchase dissonance. This paper has probed into the causes of post-purchase dissonance, including information overload regarding products, the impact of return policies, and the violation of the psychological contract between consumers and sellers. Through reviewing and analyzing relevant literature, we have identified that service quality, marketing strategies, and consumer psychological factors are all significant contributors to post-purchase dissonance.

In response to these issues, businesses should adopt proactive management measures to alleviate consumers' post-purchase dissonance. These include improving service quality, optimizing the return process, enhancing consumer information education, and developing more precise marketing strategies. Additionally, marketing managers should pay attention to consumers' psychological needs and actively establish and maintain trust relationships with consumers to avoid violating the psychological contract. Overall, post-purchase dissonance is an urgent problem to be addressed in the e-commerce consumption scenario. By thoroughly researching its influencing factors and formulating corresponding management strategies, businesses can not only enhance consumer post-purchase satisfaction and loyalty but also strengthen their competitiveness and achieve sustainable development. Therefore, for e-commerce businesses, recognizing and effectively resolving issues of post-purchase dissonance is of paramount importance.

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Study on the Limitations of Economic Digitalization and Development Strategies under the New Development Strategy

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Abstract: With the rapid development of the digital economy and the rise of the industrial Internet, China has made significant progress in terms of industrial competitiveness and industrial innovation and development. However, China's capacity for independent technology innovation must be improved. Firstly, China's independent innovation capacity in key core technology areas could be more robust. This mainly manifests in China's reliance on imported technologies and equipment in high-end manufacturing and emerging industries. Although China has made certain technological breakthroughs in specific fields, there is a particular gap between China and the international advanced level. Secondly, the investment in technological research and development of Chinese enterprises must be increased. Although the R&D investment of Chinese enterprises is gradually growing as more attention is paid to scientific and technological innovation, there still needs to be a significant gap compared with developed countries. In particular, the R&D investment of small and medium-sized enterprises is relatively low, resulting in the overall level of independent technological innovation not being high. Again, China needs to strengthen the protection of intellectual property rights. For a long time, the construction of China's intellectual property protection system has been lagging, and the problem of intellectual property infringement is relatively prominent, which has formed a particular obstacle to independent technological innovation. Therefore, studying economic digital development restrictions and development strategies has profound theoretical and practical significance in the new development pattern.

Keywords: Digital Economy, Development Strategies, Technological changes

1. Introduction

In 2020, with the global spread of the new coronavirus epidemic, the world's major economies have been hit hard in a number of ways. The current world economic recovery lacks momentum and needs to revive its original prosperity by finding new growth points. The digital economy, with the Internet and digital technology as its carrier, has become a new mode of economic development following the agricultural economy, industrial economy and information economy, and with its characteristics of high technological threshold, high permeability, high integration and high growth, it can become an important engine for promoting the recovery and prosperity of the world economy. However, under the new development pattern, although the rapid development of the digital economy is conducive to

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alleviating the impact of the epidemic on the economy, its objective conditions still have certain limitations, and how to promote the digital transformation and intelligent upgrading of enterprises, promote the transformation of old and new kinetic energy, and inject a strong impetus for the long-term positive development of the world economy is the focus of the research in this paper.

2. Micro-foundational limitations of data and technology

Unclear demarcation of data ownership is an important issue that limits the digitalization of the economy and leads to difficulties in the circulation of data [1]. In the era of the digital economy, data is recognized as an essential factor of production and economic resources, which plays a vital role in economic growth and innovation. However, several problems with the current division of data ownership impede the adequate flow and utilization of data.In the traditional economy, the ownership of resources often corresponds to the ownership of material resources, but in the digital economy, data ownership is unclear. Especially in the case of cross-border flows and cooperation, cooperation involving cross-border flows of data often needs to address the issue of data ownership. Uniform rules and standards are required for the division of data ownership at the international level, and there are specific legal and institutional barriers to data exchange and cooperation in different countries and regions.

3. The problem of meso-regulation of industrial disequilibria

3.1. Technology-driven triggers chain back and unemployment

Under the new development pattern, the economy's digital development has encountered a technology-driven problem, triggering the return of the industrial chain and unemployment [2]. With the advancement and application of digital technologies, some links in the traditional industrial chain have been replaced, resulting in the loss of job opportunities for a part of the labor force. With the widespread application of automation and intelligent technologies, the labor demand in many traditional industrial chains has been drastically reduced or completely replaced. Furthermore, the development and advancement of high-tech industries have also brought about a trend of industrial chain reflux, causing some countries to move back to their jobs that were initially performed in the production chains of other countries. Such chain migration is often accompanied by the large-scale introduction of machines and automated equipment, leading to labor unemployment.

3.2. The erosive nature of finance for the benefit of the real economy

Finance is a necessary support and fundamental area of socio-economic development; however, under the new development pattern, the financial sector's erosive impact on the interests of the real economy has become increasingly prominent [3]. Financial institutions excessively focus on short-term interests and neglect long-term development. At present, financial institutions generally pursue high returns and invest a large amount of capital in financial products with higher profits but higher risks [4]. At the same time, the support and services for the real economy are relatively insufficient. This excessive pursuit of short-term gains has led to inadequate financial support for the real economy, thereby eroding the interests of the real economy to a certain extent.

4. Strategies for the digitalization of the economy in the new development landscape

4.1. Promoting technological innovation to provide new dynamics

Under the new development pattern, the promotion of technological innovation has become a critical link in the digital development of the economy and can provide new impetus for economic growth

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[5]. Technological innovation can change traditional industries' production modes and organizational structures and improve production efficiency and product quality. Promoting technological innovation can provide new production factors. With the progress of science and technology and the application of innovative achievements, new aspects of production continue to emerge, bringing new impetus to the production process and value creation. Through technological innovation, enterprises can, with new technologies and resources, realize changes in production methods and improve production efficiency and product quality.

Technological innovation can promote the transformation and upgrading of the economy. With the development and application of digital technology, all industries are undergoing digital transformation. Through technological innovation, enterprises can use digital technology to change traditional business models and operation methods and realize the transformation from traditional industries to the digital economy.

Technological innovation can also promote cross-border integration of industries. In economic digitalization, the integration between different sectors has become a trend. Technological innovation can break down the barriers of traditional industries, promote cooperation and communication between different sectors, promote cross-border integration of industries, and promote industrial innovation and upgrading.

Promoting technological innovation can provide new kinetic energy for the digital development of the economy. Through technological innovation, enterprises can obtain new production factors and realize changes in the mode of production; technological innovation can also promote economic transformation and upgrading and facilitate the integrated development of industries. Therefore, under the new development pattern, promoting technological innovation has become essential for economic growth and is worthy of further in-depth study and promotion.

4.2. Implement data-centric strategies

Implementing a data-centered strategy is one of the critical paths for industrial Internet eco-platforms in developing the digital economy. Data is a core element of the digital economy and has great value and potential. By implementing a data-centric strategy, data resources can be fully utilized to promote developing and enhancing industrial Internet ecological platforms.

Implementing a data-centric strategy can promote the open sharing and flow of data. In the context of the digital economy, data is an essential driving force for economic development. By implementing a data-centric strategy, data silos can be broken, and the sharing and flow of data resources can be realized. Open sharing of data can promote the development of the industrial internet ecological platform and enhance the efficiency and effectiveness of the overall economy.

Implementing a data-centric strategy can promote the innovation and application of data technology. Data technology is essential for industrial Internet ecological platforms to realize digital transformation. By implementing a data-centric approach, enterprises and organizations can be guided to increase their investment in data technology innovation, promote the development and application of data technology, and enhance industrial Internet ecological platforms' digital capabilities and competitiveness.

In addition, implementing a data-centered strategy can build a data-driven governance model. In the era of digital economy, data plays a vital role in economic development and governance. A data-driven governance model can be built to improve the Government's digital governance capabilities by implementing a data-centered strategy. Through the data-driven governance model, the refinement and precision of governance can be realized, and the operational effect and management efficiency of the industrial Internet ecological platform can be improved.

Implementing a data-centric strategy can promote digital development and industrial convergence. Digital development and industrial integration are among the essential features of the digital economy.

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The digital development and integration of different industries can be promoted through the implementation of data-centric strategies, and the optimal allocation of resources and maximization of benefits can be achieved in the digital economy. Through digital development and industrial integration, the synergistic cooperation and value creation between the industrial Internet ecological platform and various industries can be further strengthened.

Implementing data-centered strategies plays a crucial role for industrial Internet ecological platforms in developing the digital economy. By fully utilizing data resources, promoting the open sharing and flow of data, promoting the innovation and application of data technologies, building a data-driven governance model, and promoting digital development and industrial integration, it can facilitate the development and enhancement of industrial Internet ecological platforms and promote the high-quality development of the digital economy.

4.3. Enhancing the Energy Efficiency of Government Digital Governance

With the rapid development of the digital economy, improving the energy efficiency of government digital governance has become an essential link in realizing the digital development of the economy. Under the new development pattern, improving the energy efficiency of government digital governance can effectively promote the development of the digital economy and realize the goal of high-quality economic development.

The improvement of the energy efficiency of government digital governance needs to be approached from several aspects. First, the Government needs to strengthen the construction of digital governance capacity and improve its digitization level and governance capacity by introducing advanced digital technologies and management methods. Second, the Government also needs to strengthen the integration and sharing of digital information resources, establish a unified digital information platform, and realize information sharing and collaborative work among departments. In addition, the Government should promote the establishment of digital governance norms, strengthen supervision and guidance in the digital development process, and provide guarantees for the healthy development of the digital economy.

In enhancing the energy efficiency of the Government's digital governance, the Government should also focus on promoting the integration of digital governance with traditional governance. Traditional and digital governance are complementary, and they support each other and jointly promote the digitalization of the economy. The Government should strengthen cooperation with various industries to jointly develop standards and norms for digital governance and facilitate the smooth implementation of digital governance. The Government should also maintain the cultivation and introduction of digital governance talents to improve the professional level of energy efficiency in digital governance.

At the same time, improving the energy efficiency of government digital governance also requires the utilization of the power of intelligent technology. The wide application of emerging technologies such as artificial intelligence, big data, and cloud computing can provide strong support for improving government digital governance and energy efficiency. The Government can realize the intelligence and efficiency of government services by establishing an intelligent digital platform. The Government should also use big data analytics and forecasting technologies to improve the science and accuracy of government decision-making. In addition, the Government can jointly promote the development of the digital economy by strengthening cooperation with technology enterprises.

In implementing the process of improving the energy efficiency of government digital governance, this study believes that it is essential to focus on constructing a long-term mechanism for the energy efficiency of government digital governance. Enhancing the energy efficiency of government digital governance should be a long-term process concentrating on continuous improvement and innovation. The government needs to establish a scientific evaluation mechanism to assess and optimize the

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effectiveness of digital governance regularly. At the same time, the Government should also strengthen the supervision and evaluation of the Government's digital governance energy efficiency to ensure that the improvement of digital governance energy efficiency can genuinely promote the development of the digital economy.Enhancing the energy efficiency of governmental digital governance is a critical link in realizing the digital development of the economy. The Government should strengthen digital construction, promote the integration and sharing of digital information, strengthen the establishment of digital governance norms, focus on the integration of digital and traditional governance, and utilize the power of intelligent technologies while focusing on the establishment of long-term mechanisms to provide strong support for the digital development of the economy. Through these efforts, the energy efficiency of the Government's digital governance will be improved, laying a solid foundation for high-quality economic development.

5. Conclusion

In summary, when different countries and regions carry out digital economy cooperation under the new development strategy, data standards cannot be unified due to differences in digital rules and systems, which has a negative impact on cross-border data flows and further cooperation. Meanwhile, under the new development strategy, the traditional labour force has been replaced by machinery and equipment on a large scale due to technological progress and technological diffusion, and the involvement of financial institutions in production has caused the traditional industrial chain and the real economy to suffer a certain impact. Against this background, this study argues that a new digital economy development strategy should be constructed with basic technological innovation as the main focus and data assets as the centre, so as to improve government governance performance and promote the development of the digital economy.

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A Comparative Analysis of the Impact of Import and Export Trade on the Economy Between China and the United States

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Abstract: Due to the continuous development of global trade globalization and the weakening of monopolistic policies by major powers, the current international trade pattern has undergone tremendous changes, which has also led to significant changes in the GDP development of various countries. So the impact of import and export trade on international economic growth is enormous. This paper takes the United States as a typical developed country and China as a typical developing country, and the economic growth changes of both countries are most representative of the changes in import and export trade. Therefore, it focuses on the impact of import and export trade on the Sino-US economy to explore the specific changes in recent years. This article mainly focuses on the impact that has changed the import and export trade between China and the United States, resulting in how their economy has changed.

Keywords: import and export trade, Comparison between China and the United States, economic growth

1. Introduction

International trade plays an indispensable role in the economic framework of any country.. It has a time of growth and decline,At the same time, after the 2008 international financial crisis, the global trade growth rate significantly slowed down due to the sluggish demand in developed countries. According to data from the World Trade Organization (WTO), global trade growth has been below 3% for five consecutive years since 2012, marking the first time since the 1980s. Especially from the fourth quarter of 2014 to the fourth quarter of 2015, global trade volume has shown negative growth for five consecutive quarters [1] For the United States, the exportation of goods that carry a high added value not only serves as a cornerstone for its economic prosperity but also significantly bolsters the nation's financial health. This capacity to export high-value products is a distinctive advantage for the US, enabling it to maintain a competitive edge in the global market. The array of goods the United States exports is diverse, including advanced technology, sophisticated machinery, and specialized services, all of which demand a premium in international markets and, in turn, generate considerable foreign exchange earnings for the country. In order to explore the impact of this import and export trade on the economy of China and the United States, this article uses relevant data from 2010 to 2023, including the gross domestic product and import and export (expenditure) of China and the United States; The year-on-year growth rate of GDP and imports and exports between China and the United States; US commodity export structure (2022), US commodity import structure (2022);

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China's export structure of goods (2022), China's import structure of goods (2022); Further research will be conducted on the annual growth rate of the US CPI.

Finally, summarizing the research findings of the entire article, the following suggestions are proposed regarding the impact of China US import and export trade: 1 It can be appropriately guided to change the pattern of international trade. 2. Improve domestic production capacity. 3. The government can make some changes to trade controls and tariffs according to the current economic situation. 4. Reduce reliance on additional products.

Conversely, the import side of the equation for the US predominantly features basic consumer goods. These items range from everyday necessities to various products that cater to the broad needs of the American populace. While these imports are vital for meeting domestic demand and ensuring that consumers have access to a wide variety of goods, there's an inherent vulnerability tied to the cost associated with these imports. Should there be an increase in the cost of these essential imports—due to factors such as global market fluctuations, changes in trade policies, or shifts in currency exchange rates—the immediate repercussion could be an uptick in domestic prices. This scenario of rising import costs poses a significant risk of fueling inflation within the country, which could, in turn, have a dampening effect on economic growth. The rationale for the importance of foreign capacity to U.S. inflation is fairly clear-cut. If, for example, domestic demand exceeded domestic capacity ,while foreign capacity remained underutilized, either the excess domestic demand for goods would be absorbed by imports or profits would be squeezed as labor markets tighten and costs rise [2]. The ripple effects of such inflationary pressures can be far-reaching, potentially eroding purchasing power, discouraging consumer spending, and ultimately, impacting the overall trajectory of the United States' economic development.

2. Analysis Of The Impact Of Import And Export Trade On The US Economy

The United States is characterized by its trading pattern where the volume of imports consistently surpasses that of exports, as illustrated in Figure 1.

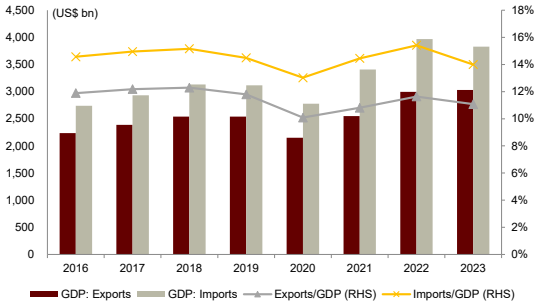

Figure 1: GDP, imports and exports in US (Expenditure)[3]

As shown in Figure 1., from 2016 to 2023, although the value of exports reached its lowest value in 2020, it is still rising steadily overall, The same trend applies to imports, but the overall data is higher than exports. Domestic value added embodied in exports acts as an indicator of export quality, given that it shows countries' domestic-income content in their exports. The higher it is, exports will have a greater multiplier effect on domestic demand and, thus, on economic growth. Therefore, countries will be in a position to overcome the alternative they generally face between export-led growth or domestic demand-led growth. If the domestic income embodied in exports is high, the export-led growth model will kick-start domestic demand and, from the perspective of demand, growth will be doubly grounded, i.e., both foreign and domestic demand [4]. So for the United States it's experiences a greater volume of imports compared to exports due to a combination of economic

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conditions, consumer behavior, and trade policies. As a nation with a high standard of living and a strong currency, the U.S. has a substantial demand for a wide array of products, from luxury goods to basic commodities, which are not always produced domestically. This demand is met through imports, including electronics, clothing, and vehicles, reflecting the diverse needs of American consumers. Additionally, the U.S. economy's shift towards services and high-tech industries means that it imports more labor-intensive manufactured goods from countries where production costs are lower. Trade policies and global supply chain dynamics also contribute to the trade deficit. The U.S. has established trade agreements that facilitate the import of goods to ensure a variety of products for consumers and inputs for businesses. Furthermore, the strength of the U.S. dollar makes imports cheaper and exports more expensive for foreign buyers, which can exacerbate the trade imbalance. This structural aspect of the U.S. economy, along with its role in the global market as a major consumer, results in imports surpassing exports.

Drawing on data from the Bureau of Economic Analysis (BEA) for the year 2023, it's evident that the scale of the United States' trade activities is substantial, with imports reaching 3.8 trillion US dollars (GDP metric) and exports at 3.0 trillion US dollars(GDP metric). These figures account for 14.0% and 11.1% of its GDP respectively. This sizable involvement in international trade underscores the pivotal role that both importing and exporting activities play in the American economy. Moreover, an examination of the growth dynamics of these trade activities reveals that the fluctuations in the rates of growth for both imports and exports exhibit a higher volatility than the overall GDP growth rate, as detailed in Figure 2.

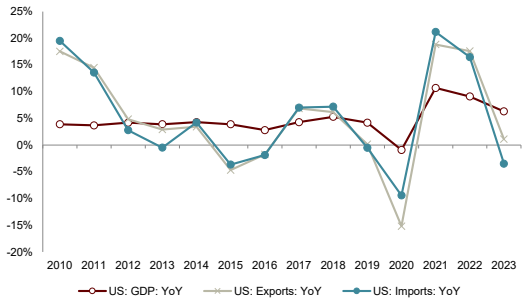

Figure 2: YoY growth rate of GDP, imports and exports in US[5]

As shown in Figure 2, GDP is relatively stable, the exports and imports is large fluctuation, it goes from 20% to -5%. Such volatility is indicative of the profound impact that international trade, encompassing both imports and exports, has on the economic landscape of the United States. These fluctuations suggest that the trade sector acts as a critical lever, capable of influencing economic conditions. It demonstrates that movements within the import and export sectors are not merely reactive to the broader economic trends but are, in fact, influential forces that contribute to shaping the economic trajectory of the nation. This observation highlights the complex interplay between international trade and economic stability, suggesting that the dynamics of trade are integral to understanding the mechanisms of economic growth and contraction within the United States. The export structure of the United States in 2022, as shown by BEA in Figure 3.

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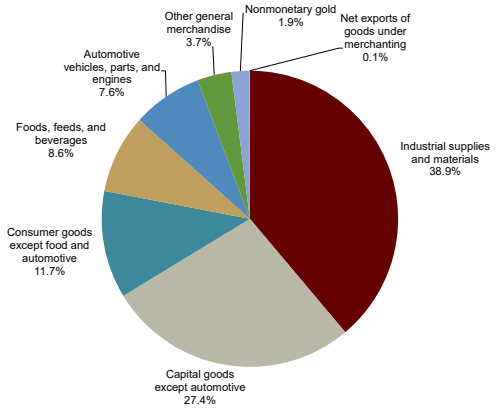

Figure 3: Structure of goods exports in US (2022)[6]

As shown in Figure 3, industrial supplies and materials accounts for the largest percentage, it's 38.9%. And the smallest one is the Net exports of goods under merchanting, it's 0.1%. This indicates that industrialization accounts for a large proportion in the local area. Highlights the country's strategic emphasis on Industrial supplies and materials, and Capital goods except automotive. These categories accounted for 38.9% and 27.4% of the total exports, respectively, illustrating the diverse nature of the U.S. export portfolio. Within the Industrial supplies and materials sector, Chemicals except medicinals stood out, comprising about 20% of this segment's exports. This indicates a strong global demand for American chemical products, reflecting the sector's innovation and competitiveness on the international stage.

In the realm of Capital goods except automotive, significant shares were held by exports of Civilian aircraft, engines, and parts; Semiconductors and their parts; and Scientific, hospital, and medical equipment and parts. These accounted for approximately 16.5%, 11.7%, and 9.9% of exports, respectively. The prominence of these high-tech goods in the U.S. export structure underscores the country's advanced technological infrastructure and its leadership in research and development. The U.S. excels in producing complex, high-value products that serve critical roles across various industries worldwide, from aerospace to healthcare and technology.

These sectors not only demonstrate the U.S.'s capability to innovate and lead in science and technology but also highlight its strategic advantage in production capacity and global branding. The substantial profits earned from these high added value goods and services underscore the U.S.'s pivotal role in the global economy, leveraging its technological prowess and innovative capacity to maintain a competitive edge. The United States' import structure, detailed in Figure 4.

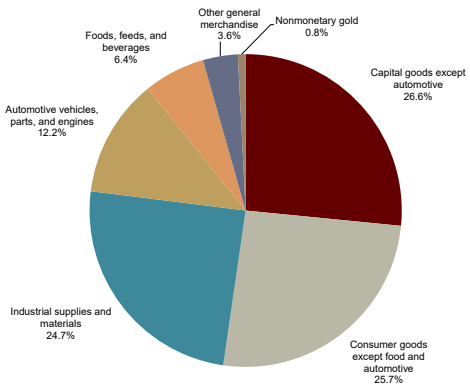

Figure 4: Structure of goods imports in US (2022)[7]

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As shown in figure 4, the Consumer goods except food and automotive account for 25.7%. The smallest one is the Nonmonetary gold, it has 0.8%. However, for imports, the Consumer goods except food and automotive and Industrial supplies and materials is very similar.

It shows the structure of goos imports in US. Showcases a significant reliance on three primary categories of goods: Capital goods except automotive, Consumer goods except food and automotive, and Industrial supplies and materials. These imports, accounting for 26.6%, 25.7%, and 24.7% of total imports respectively. Specifically, within the Industrial supplies and materials category, a notable focus is on energy and Metals and nonmetallic products, which represent about 42.1% and 22.4% of this segment. These categories are predominantly comprised of everyday living essentials, light industrial products and energy or materials, which are considered to be lower in added value. These are basic necessities and conveniences that play a fundamental role in daily life, yet are typically produced with less complexity and innovation, reflecting their lower economic value compared to more technologically advanced products.

3. Comparative analysis between China and the US

The rationale behind selecting China for comparison lies in the fact that both China and the United States stand as global trade powerhouses and the world's two largest economies, thus offering a level of comparability. The impact of import and export trade on China's economy significantly diverges from that of the United States. This distinction is rooted in the differing economic structures, policies, and global trade positions of the two countries. While both nations exert considerable influence on international trade dynamics, the nature and outcomes of their trade activities reflect unique economic strategies and priorities, highlighting the contrasting roles they play within the global economy. China is characterized as a country with exports surpassing imports, as depicted in Figure 5.

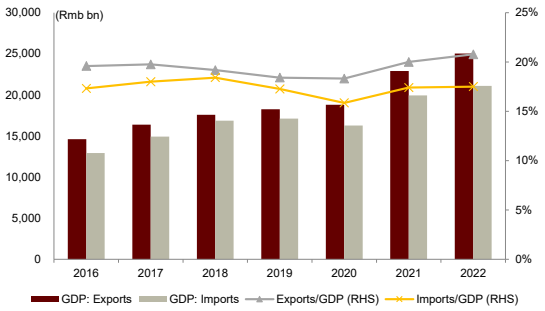

Figure 5: GDP, imports and exports in China(Expenditure)[7]

As shown in figure 5, Exports have been consistently increasing from 2016 to 2023. What's more, there is a decreasing trend in exports in 2020, but it is not significant, but it is also increasing for the entire process.

China's position as a country with exports exceeding imports is attributed to a multifaceted strategy that harnesses its competitive advantages and robust economic policies. Against the backdrop of trade frictions between China and the United States, China is facing more challenges. Complex political and economic situation, but goods trade remained flat in the first three quarters of 2018. Stable rise. Combining China's comprehensive policy of expanding opening-up, including import tariffs and ports. Import and export policy measures, including business environment and facilitation of cross-border trade. The import and export trade performance of the country is optimistic. After October 2018, due to the global economic landscape. Amidst the current situation of close global trade cooperation, with the decline in energy and the slowdown in global economic growth,

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China's import and export trade also experienced a decline from November to December[8]. By capitalizing on its extensive labor force and advanced manufacturing capabilities, China has become known as the "world's factory," offering products at competitive prices that are in high demand globally. The country has effectively focused on industries where it holds comparative advantages, such as textiles, apparel and household appliances, which has significantly boosted its export volumes. Supportive government policies, including subsidies for export-oriented sectors, favorable tax regimes, and substantial investments in infrastructure, have played a pivotal role in enhancing the efficiency and competitiveness of Chinese exports. Additionally, China's active engagement in establishing a strong network of trade relationships worldwide has ensured widespread market access for its products. With a strategic pivot towards higher value-added manufacturing and services, such as technology and renewable energy, China continues to elevate the global standing of its exports. This comprehensive approach has maintained China's export surplus, reinforcing its stature as a dominant force in the global economy. Here we know the structure of China's import and export methods. China's import and export trade work should cooperate with China's supply side structural reform, focusing on the import of advanced equipment and technology. Improve export tax rebate policies, reasonably reduce enterprise tax burden, attach importance to intellectual property protection, and reduce rigid reliance on foreign high-tech products [9].

In the year 2022, under the GDP metric, China's import and export volumes were notably 21.1 trillion yuan and 25 trillion yuan, respectively, constituting 17.5% and 20.8% of its GDP. This data underscores China's significant role in global trade, with a robust export-driven economy that contributes substantially to its economic growth. The substantial difference between its export and import volumes reflects China's strategic economic positioning and its effectiveness in leveraging global markets to bolster its economic strength, further cementing its status as a major player in international trade. Upon examining China's export structure as detailed in Figure 6.

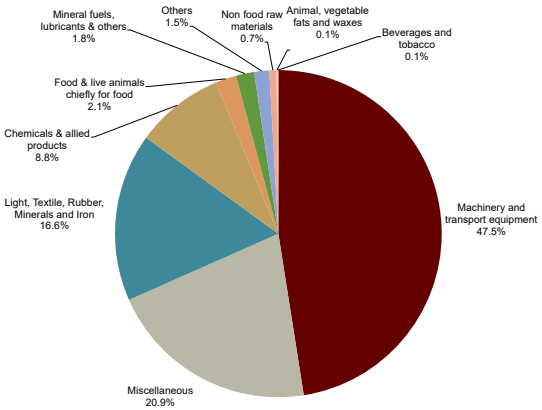

Figure 6: Structure of goods exports in China (2022) [10]

As shown in figure 6, The proportion of Machinery and transport equipment is the largest, accounting for 47.5%, almost half of the pie chart. And the proportion of the smallest two is the same, both are 0.1%, they are Animal,vegetable fats and waxes and Beverages and tobacco ,respectively. It indicates that the Machinery and transport equipment sector relies the most on for exporting goods in China.

It becomes evident that a significant portion of its exports is dominated by sectors such as Light, Textile, Rubber, Minerals, and Iron, which collectively contribute to approximately 16.6% of the total export volume. The products under these categories, encompassing apparel, daily necessities, light

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industrial items, and essential raw materials, primarily fall into the lower value-added spectrum. This reflects a strategic emphasis on leveraging China's manufacturing strengths in areas where it can produce goods efficiently and cost-effectively for global markets, thereby maintaining its competitive edge in these sectors. Conversely, when analyzing China's import structure shown in Figure 7.

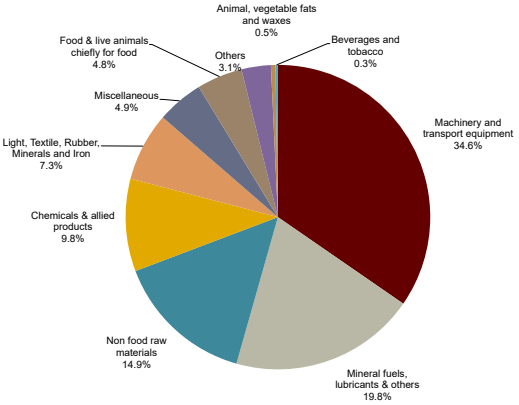

Figure 7: Structure of goods imports in China (2022) [7]

As shown in Figure 7, the largest proportion of imported goods for China is also Machinery and transport equipment. It has 34.6%. But the only one with the least imports is Beverages and tobacco. It just only 0.3%. A stark contrast emerges, with Machinery and transport equipment alone making up a significant 34.6% of total imports. This substantial importation underscores China's reliance on foreign high value-added products, particularly in fields such as science, technology, and software. Despite being a global manufacturing powerhouse, China's need to import these advanced products highlights a strategic approach to fulfilling its domestic requirements for high-tech equipment and technological innovation. One of the reasons is that, Although China's import and export trade volume has grown rapidly, the goods it exports are mostly light industrial products with a relatively low overall level and a relatively simple export product structure. This means that these exported goods do not have high technological support. China's current advantage lies in industrial products, which means that although trade exchanges are good, they do not make money and the profits obtained are relatively low [9]. This dependency on importing sophisticated machinery and technology is indicative of China's endeavors to upgrade its industrial base, foster innovation, and move up the value chain by incorporating advanced technologies and know-how into its economy. Thus, the dichotomy between China's export and import structures not only illustrates the country's current economic and industrial strategies but also points to its ongoing efforts to transition towards a more innovation-driven economic model.

Both China and the United States experience more ups and downs in their import and export growth rates than in their overall economic growth, as shown in Figure 4. It shows YoY growth rate of GDP, imports and exports in China

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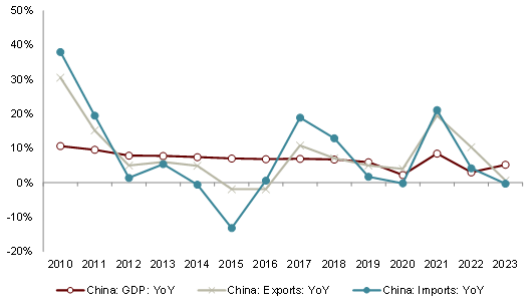

Figure 8: YoY growth rate of GDP, imports and exports in China[10]

As shown in Figure 8, GDP has decreased from 10% to around 5% from 2010 to 2023, The quantity of imports and exports varies greatly among different years, with a difference of about 50% between 2015 and 2010.This indicates that international trade is very important to both countries, highlighting their roles as major players in global trade. The fact that changes in trade can have a bigger impact on their economies than changes in other areas shows how connected they are to the rest of the world. This connection means that when there are big changes in trade, either because of new policies, shifts in what people around the world want to buy, or other global economic changes, it can affect how well China and the U.S. do economically. This similarity between the two countries shows how important it is for them to pay attention to their trade relationships and how these relationships can affect their economic health.

4. The Impact of imported goods on the CPI

The United States' reliance on the international market for basic living necessities and light industrial products introduces a vulnerability to its economic stability. This dependency is fraught with risks, significantly magnified by recent global challenges. The onset of the global pandemic, alongside escalating geopolitical tensions, has severely disrupted international supply chains. These disruptions have been further compounded by the Federal Reserve's adoption of lenient fiscal and monetary policies aimed at sustaining consumer demand amidst economic uncertainties.

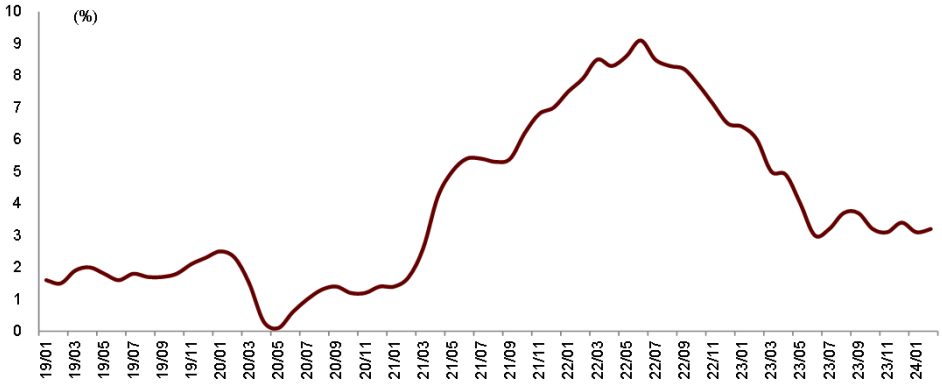

Figure 9: YoY growth rate of CPI in US[10]

As shown in Figure 9, in US, from 19/01 to 24/01, It has increased and decreased, but overall, it has increased from around 1.8% to around 3%. Consequently, this complex interplay of factors has led to a sustained elevation of CPI. The persistence of a high CPI signals ongoing inflationary pressures, thereby escalating the cost of living for American consumers. Inflation erodes purchasing power, making everyday goods and services increasingly unaffordable. Should this trend of a high

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CPI continue unabated, there's a real risk it could erode consumer confidence, leading to a reduction in spending. This potential decline in consumer expenditure poses a significant threat to the United States' economic growth prospects, potentially slowing down the momentum of the nation's economic recovery and development.

5. Conclusion

International trade plays an essential role in bolstering the US economy, yet the widening trade deficit highlights a pronounced reliance on a diverse array of goods imported from various parts of the world. This growing dependence is not merely incidental but stems from a confluence of several critical factors. Among these, domestic overconsumption stands out, characterized by the US population's high demand for goods and services that surpasses domestic production capabilities. Additionally, the gradual decline of the manufacturing sector within the country, often referred to as the "hollowing out," has led to a reduced capacity for producing a wide range of goods domestically. Compounded by stringent trade controls and tariffs, these factors collectively exacerbate the trade imbalance.

In terms of trade dynamics, the United States specializes in exporting goods and services that incorporate high levels of added value, including cutting-edge technologies and sophisticated products. This not only garners considerable foreign exchange but also significantly contributes to the nation's economic growth and sustains its competitive edge in the global marketplace. On the import front, the US primarily sources basic consumer goods, crucial energy products, and essential raw materials—items fundamental to maintaining everyday life and the functioning of various industries. However, should the cost of these imports rise, perhaps due to changing global market conditions or trade policies, the US could face escalating domestic prices, leading to inflation. Such a scenario would inevitably exert pressure on economic growth, highlighting the intricate interplay between international trade, domestic production, and economic policy in shaping the nation's economic trajectory.

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Data Science Applications in Supply Chain Management Decision-making

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Abstract: This research views data science as the basis of the decision-making process at SCM. Tough international trade environment characterized by complex supply chain and inventory issues as well as unpredictable demand for goods necessitates powerful analytics tools. Using the latest technologies - machine learning, predictive analytics, and big data - data science generates data-driven decisions for more accurate, efficient, and prompt SCM decision-making. The study intends to study the current trends and evaluate the influence of data science in SCM decision-making processes. It also delves into the difficulties and advantages with the utilization of data science during these procedures. This study uses a synthesis approach by systematically going through a literature review to gather data from different academic journals and industry publications. According to the results of the thematic analysis, the themes will emerge, so the whole complexity and depth of data science applications in SCM will be properly revealed. Data science changes the business decision-making in a way that was impossible before with the advent of new information from the huge and complex data sources. Data analytics not only smoothens but also upgrades long-term trend forecasting and market readiness in SCM. Furthermore, the paper emphasizes the influence of the Internet of Things (IoT) and industry 4.0 technologies of SCM with an accent on how they are associated to increase efficiency and sustainability in the operations.

Keywords: Data Science in SCM, Predictive Analytics, Operational Efficiency

1. Introduction

1.1. Background

The current global business environment is fast changing with data science being at the heart of supply chain management. It has brought in a new age of smart decision-making. More and more companies are experiencing problems with logistics, inventory management, and demand forecasting, too. In this regard, robust analytical frameworks becomes necessary. Data science is done by applying some of the advanced techniques that include machine learning, predictive analytics and big data technologies thus increasing the level of accuracy, efficiency and responsiveness in SCM [1].

Data science is redesigning the core of traditional business decision-making processes through providing new insights from large and complex datasets that SCM usually requires. The discovery of this kind of insights convert raw data into actionable intelligence, which allows making effective

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decisions that give the operational efficiency and competitive edge. The role of data science in SCM is becoming more and more crucial as it allows businesses to overcome the conventional difficulties including poor operational efficiency, wrong demand estimation, and unproductive resource allocation.

Application of sophisticated analytics allows organizations to synchronize and boost their supply chain response. This adjustment goes a long way to meeting competitiveness in a changing market and the ever-evolving consumer need in an effective way. The application of data science in supply chain processes apart from that smoothens processes also depends on data advanced analytics to forecast trends and prepare for different market situation [2].

This metamorphosis in data science in SCM is pivotal for building more intelligent supply chains that can self-adjust to any change in the supply chain environment hence resilience amid uncertainties will be ensured.

1.2. Objectives

a. To analyse the present trends of the data science application in the field of supply chain management.
b. To evaluate the influence data science has on decision-making processes in supply chain management.
c. To examine the problems and advantages with the merging of data science into supply chain decision-making.

1.3. Research Questions

a. What are the current trends in data science application within supply chain management?
b. How does data science affect the decision-making process in supply chain management?
c. What are the challenges and opportunities of data science in enhancing supply chain decision making?

2. Literature Review

2.1. Data Science in Supply Chain Management

Data Science in SCM is based on various tools, methods, and models that are used to solve problems that cannot be handled by the conventional approaches adequately. The association of data science and SCM can be illustrated with statistical analysis, predictive modelling, machine learning algorithms, and big data analytics, which are helpful in optimizing and synchronizing the business decision process throughout the supply chain. As per the opinion of Chauhan and Singh [3] these tools enable forecasting, automating processes and hence, increasing the efficiency of the organization. The infusion of data science into SCM not only amplifies the process visibility but also helps in taking wise strategic decisions too.

2.2. Current Trends and Applications

The new perspective suggests that the deployment of data science models into demand forecasting, inventory optimization, logistics management, and risk assessment is now a critical element in SCM. On the other hand, Zhou and Wang [4] raise that machine learning models are currently applied by various organizations to forecast accurately demand patterns and then to have improved stock management so as to end up with less waste. In inventory optimization, algorithms are created to govern stock levels simultaneously across channels which decrease the inventories cost and availability of the product to the end user [5].

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In logistics management, advanced analytics are employed to route optimization and enhance delivery efficiency by predicting possible delays as well as dynamically adjusting routes in real-time [6]. Data science is now employed in risk assessment in supply chains; predictive models assist in forecasting possible disruptions and formulating measures to mitigate vulnerability [7].

2.3. Impact on Decision-making

Data science has tremendous impact on decision-making processes of supply chain management. As postulated by Lee and Chien, data-driven decision-making helps organizations in minimizing operational costs and improving service level by facilitating more accurate predictions and useful resource allocation. In addition, real-time data analysis can help organizations to react faster to market changes and improve resiliency. According to them, data science enables better synchronization among the various supply chain stages, which reduces response time and eliminates bottlenecks.

2.4. Challenges and Opportunities

Although the implementation of data science in SCM provides multiple benefits, it also implies big challenges. One of the central issues pointed out in literature is data quality and quantity. As highlighted by Zhou and Wang [4], the data science initiatives' effectiveness largely stems from the accessibility of high-quality relevant data. Weak or fluctuating data may result in the wrong results or costly decisions.

Safety and security are other vital additionally issues, particularly the sensitive nature of supply chain data, which often includes data from different stakeholders. This information must be guarded against breaches and compliance with the global data protection laws must be done.

On the opportunity side, the use of data science to manage supply chain is not going to reach its peak. Recent novelties in artificial intelligence and machine learning promise further improvements in efficiency and performance. For example, AI can eliminate human errors in making automated decisions and accelerate the processes. Moreover, the IoT devices can also be integrated with data science for the tracking of goods and assets, which will increase the accuracy of data for analysis.

2.5. Knowledge Gap

Data science in supply chain management has had a lot of research despite the gap of understanding in long-term strategic effects and the scalability of data-driven solutions within diverse industries. Moreover, there are almost no studies out there on the overall impact of data integration on supply chain sustainability.

3. Methodology

3.1. Research Design

This study uses a qualitative research design and its primary approach is a systematic literature review to explore data science applications in supply chain management. The qualitative approach is selected for its strength in understandably and broadly exploring the currently available theories and models, and for its ability to understand the depth and complexity of how data science is being integrated into the decision-making in the supply chains. On contrast with quantitative methods which try to measure the problems through numbers and mixed methods that combine both qualitative and quantitative approaches, the qualitative method explores in detail the intricacies and themes that lie in literature. This approach is especially suited to the goals of looking at trends, measuring impacts, and

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investigating the opportunities and challenges of data science in a SCM system, where grasping the context and larger implications is paramount.

3.2. Data Collection

For this research, data will be collected via systematic literature review that is a structured search in academic journals, conference proceedings, and industry reports. Through this, the entire field of data science in supply chain management is covered in a systematic way. The primary databases such as PubMed, Science Direct, and JSTOR will be the sources of information. The search terms will be "data science and supply chain management", "predictive analytics in SCM", "AI in logistics" and "big data applications in SCM." The literature will be screened according to the following criteria: works published in the last ten years to ensure the relevance and currency of the data. Such a methodical way allows identifying the major research and trends, and the base for the analysis is formed.

3.3. Data Analysis

The collected data will be analysed using thematic analysis - an approach familiar for qualitative research - which enables one to identify, analyse and report patterns (themes) within the data. It will include the method of reading and re-reading the literature to be able to grasp the depth and width of the subject. The primary codes will be constituted by picking out thoughts and main themes from the texts. The codes will be then compiled into possible themes and inspected to make sure that they form a logical structure and are relevant to the research questions. This thematic approach to data analysis satisfies the complexities of how data science makes the decision-making in SCM domain, identifies the emerging trends and understand the problems and chances of incorporating of advanced data analytics into SCM processes.

3.4. Ethical Considerations

The ethical issues in this study relate to the appropriate use and mentioning the collected data. As this research paper hinges on a systematic literature review, it is necessary to make sure that all sources are properly referenced and that the data is acquired in a public and ethical manner. Ethical compliance will consist of compliance with intellectual property rights, obtaining permissions for the use of protected content where necessary and keeping the confidentiality and anonymity of study contributions if applicable. Furthermore, the review process will take into account any biases in selecting and perceiving information to provide the most fair and balanced assessment. Strategies to deal with these ethical issues could involve a thorough peer review process of the methodology and findings, preserving a transparent audit trail of the data collection and analysis decisions and making sure that a critical appraisal of the literature is done and publicly discussed.

4. Results and Discussion

4.1. Results

Table 1: Results of the themes after the thematic analysis.

Theme	Subthemes	Codes	Paper Reference
Big Data Analytics	Predictive Analytics	Demand forecasting	Koot et al., 2021
		Risk assessment	Sarker, 2021
		Inventory management	Maheshwari et al., 2021

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Table 1: (continued).

	Decision Support Systems	Optimization models	Jha et al., 2020
		Real-time data processing	Lee and Chien, 2022
	Machine Learning	Regression analysis	Qiu et al., 2020
		Classification methods	Qiu et al., 2020
		Clustering techniques	Sarker, 2021
	Data-Driven Strategies	Strategic decision making	Chauhan and Singh, 2020
		Data integration	Koot et al., 2021
Internet of Things (IoT)	IoT Devices	Sensors and tracking	Koot et al., 2021
		Connectivity and networks	Sarker, 2021
	IoT in Operations	Real-time monitoring	Koot et al., 2021
		Automation in warehousing	Chauhan and Singh, 2020
	IoT Data Management	Data collection and storage	Sarker, 2021
		Data privacy and security	Lee and Chien, 2022
Sustainable Practices	Circular Economy	Recycling and reuse	Wang et al., 2020
		Sustainability metrics	Mageto, 2021
	Green Supply Chain	Carbon footprint reduction	Mageto, 2021
		Eco-friendly materials	Wang et al., 2020
	Regulatory Compliance	Environmental regulations	Mageto, 2021
		Compliance monitoring	Lee and Chien, 2022
Industry 4.0 Technologies	Advanced Robotics	Robotic process automation	Chauhan and Singh, 2020
		Machine-to-machine interaction	Lee and Chien, 2022
	Smart Factories	Digital twins	Chauhan and Singh, 2020
		Predictive maintenance	Lee and Chien, 2022
	Blockchain Technology	Transaction transparency	Wang et al., 2020
		Smart contracts	Wang et al., 2020
Decision Making	Strategic Decisions	Long-term planning	Maheshwari et al., 2021
		Competitive strategy	Chauhan and Singh, 2020
	Operational Decisions	Logistics optimization	Jha et al., 2020
		Production scheduling	Lee and Chien, 2022
	Tactical Decisions	Resource allocation	Maheshwari et al., 2021
		Supplier selection	Jha et al., 2020

The thematic table for the systematic literature review on Data Science Applications in Supply Chain Management Decision-Making organizes key research findings into five main themes: Data analytics of Big Data, the Internet of Things (IoT), sustainable practices, Industry 4.0 technologies, and decision-making. Each theme is subsequently fragmented into subthemes that deal with specific issues such as predictive analytics, Internet of Things devices, circular economy methods, advanced

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robotics and various levels of making decisions. The codes under these themes comprise of many details and topics such as demand forecasting, real-time monitoring, sustainability metrics, digital twins and long-term strategic planning. With machine learning, block chain, and IoT the table shows how supply chain operations can support decision accuracy, operational efficiency, and sustainability. The structured analysis does not only cover the innovations in the supply chain technology aspect but also emphasizes the implications of them and the potential.

4.2. Discussion

4.2.1. Big Data Analytics in Supply Chain Management

Big Data Analytics is a critical source of information that assist in reshaping supply chains by making it possible for decision-makers to make more informed decisions that lead to higher operational efficiency. With the help of predictive analytics, organizations can forecast future demands, recognize supply chain barriers and streamline stock levels. Koot et al. [2] argue that the broad analysis of enormous datasets from multiple sources enhances prediction precision, and risk assessments. Sarker [1] additionally points out that regression analysis and classifier techniques are some of the machine learning methods applied to the steering processes, thus making them evidence-based and less prone to human errors.

Decision support systems, such as those mentioned by Jha et al. [8], utilize big data to provide real-time feedback and implement prescriptive analytics, allowing companies to deal efficiently with dynamic market conditions. Lee and Chien [7] identify the danger spots of production practices and propose that sensitive data management methods can lower the risks in data science tools. With the help of data-driven strategies as discussed by Chauhan and Singh [3], it becomes easy to have a synchronic approach of supply chain operations with the business goals.

4.2.2. Internet of Things (IoT) Integration

IoT is the transformative technology in Supply Chain Management, as it improves connectivity and visibility within the supply chain network. IoT devices like sensors and RFID tags are involved in data transmission all the time, assisting in the real-time tracking of goods, which in turn leads to improved inventory management and reduction of losses because of the overstocking and stock outs [2]. By IoT, connectivity and networks information exchange among supply chain segments would be smooth and the operation of the various segments would become synchronized as analysed by Sarker [1].

In addition, real-time monitoring enabled by IoT makes managerial decisions easier. The managers can take care of the issues before they get out of hand and thus they can avoid the inefficiency of the operations [2]. On the other hand, with the help of IoT the automation within the warehouses and the manufacturing plants is very much vital to cut down the labour costs and boost the productivity [3]. Data management issues, such as data confidentiality and security, are a major problem with the introduction of IoT systems to industrial processes, and it is recommended to have a reliable strategy to deal with this matter, as proposed by Lee et al. [7].

4.2.3. Sustainable Practices in Supply Chain

Eco-friendly practices are progressively vital for today's supply chains and even more so toward Industry 4.0. The integration of technology including IoT and big data analytics has shaped the direction to more sustainable and circular supply chains, where resource efficiency and waste reduction are in the focus. Wang et al. [6] look at the block chain-supported frameworks that can

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provide transparency and traceability in circular supply chains and allow sustainability in fast fashion industries.

Mageto [9] highlights big data analytics in sustainable supply chain management by showing how data can be used to monitor sustainability metrics and thus improve environmental performance across manufacturing environments. This is, therefore, both a legal necessity and a consumer demand. The part that compliance with regulations plays in making the operations sustainable is also important, as businesses must implement the growing number of environmental regulations [7].

4.2.4. Industry 4.0 Technologies

The Industry 4.0, which is the fourth industrial revolution, incorporates technologies like robots, artificial intelligence, and block chain into the manufacturing and supply chain sectors. These technologies are responsible for the major gains in operation efficiency and precision Robotics can be seen as an instance of advanced robotics that automate warehouses, reduce error rate and accelerate operations [3]). Digital twins, another cutting-edge technology, is often referred to as the virtual replica of physical systems that provide simulations and analysis for predictive maintenance and operational planning [7].

Block chain technology comes with added elements of transparency and security in supply chain transactions. All the parties can access immutable records of the transactions and this is particularly useful in complex, multi-tier supply chains [6]. This transparency counts for the establishing of trust and for verifying contractual obligations without the involvement of the traditional, often complicated, verification procedures.

4.2.5. Decision Making Enhancement

One of the most direct impacts technology has on the supply chain management processes is data science, which improves the decision-making process. Uncertainties in planning and various strategies could now be reduced by data analytics that generate deep understanding of market trends and consumer behaviour [10]. In IoT and big data, operational judgements are equally improved, not only in logistics management, but also in production planning and advancement [8].

At the strategic level, supply chain management can help to allocate resources more precisely and to optimize supplier selection by using performance data and predictive analytics thus reducing risks and enhancing the overall resilience of the supply chain. This makes not only the financial performance of companies but also the overall environmental and economic sustainability of whole industries better.

5. Conclusion

In conclusion, the combination of data science, IoT (Internet of Things), and Industry 4.0 technologies in logistics signifies a major step forward in terms of improvement of the operational effectiveness and the strategic and tactical decision making processes. According to the research findings of the recent studies, the modern technologies allow enterprises to react quickly and effectively to customer needs. Moreover, they help organizations to achieve regulatory requirements and environmental objectives with more process ease and accuracy.

Meanwhile, this tech-driven synergy in logistics not only streamlines the workflow but also introduces automation and data-driven insights at the next level. The capturing of real-time data through IoT devices along the supply chain, as well as the application of data science methodologies to these vast datasets, gives companies the capacity to foresee market trends and optimize routes, inventory, and downtime. However, Industry 4.0 welcomes in a new era of digital transformation via

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smart factories and interconnected machinery, which not only enhance productivity but also significantly cut down the operational costs.

The impact of supply chain management cannot be downplayed. These technologies will experience an increase in adoption, which will pave the way for global supply chain systems where innovation rates will be unprecedented. For this reason, the businesses that successfully apply data science, IoT, and Industry 4.0 will have an advantage over their competitors by implementing more adaptable, sustainable, and cost-effective supply chain strategies. Not only is the establishment of a new order of global logistics but also the alteration of industrial dynamics and customer satisfaction promised by this alignment with technological advancements.

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Production Location Selecting and Subsequent Production Decision Making for Sport Obermeyer

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Abstract: This paper revolved around two core research issues: production location selection and subsequent production decisions. The aim of the study was to provide a detailed analysis of Sport Obermeyer's data from 1992 to 1995 in a new way, hoping to assist companies facing similar challenges. The paper took Cost, Quality, Lead time and Minimum order quantity as bridges to the four main factors affecting the choice of production location. It detailed the advantages and disadvantages of the two production locations: Hong Kong and China. Then, with the aid of the Newsvendor model, the mismatch cost ratio for the 10 styles was determined. Ultimately, using the coefficient of variance for comparison and confirmation of the mismatch cost ratio results, the paper helped Sport Obermeyer analyze which styles of parkas had low-risk and low-uncertainty demand, and which had high-risk and high-uncertainty. The paper then combined the characteristics of the two production locations and assisted Sport Obermeyer in making subsequent production decisions. Five styles of parkas suitable for production in China and five styles suitable for production in Hong Kong were identified, ensuring stable profits and deliveries for Sport Obermeyer.

Keywords: Production location, mismatch cost ratio, newsvendor model

1. Introduction

The snow-capped peaks of Aspen, Colorado, aren't just home to skiers and snowboarders eager to carve fresh tracks. They were also the birthplace of Sport Obermeyer, a trailblazing skiwear company founded in 1947 by Klaus Obermeyer. During the 1990s, globalization has unlocked doors to a multitude of manufacturing landscapes. As companies grapple with the question of where to produce, quality, cost, and speed become the critical trifecta guiding decisions. As for Sport Obermeyer, the challenge was even greater. The nature of fashion, combined with the unpredictability of weather patterns, meant that demand was incredibly hard to forecast. Produce too much, and you risk unsold inventory. Produce too little, and you miss out on potential sales. The stakes were high, and a misstep could cost the company its reputation and revenue. The way to navigate this intricate dance of supply and demand. The way to choose their production locations amidst a plethora of options, and to make the crucial subsequent production decisions that ensured products were on the shelves just when consumers wanted them.

Having posed these critical research questions, it becomes essential to contextualize them within the broader scholarly discourse. The decision-making process around production location selection and subsequent operational choices has long intrigued researchers, strategists, and business leaders

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alike. To understand the nuances and underpinnings of these decisions, people must delve into the existing body of literature that has shaped current perspectives and practices. There are many researchers who have analyzed many cases or have adopted new algorithms or decision-making methods to determine the selection of production sites or make subsequent production decisions. Darvish and Coelho analyzed a system that encompasses both production and distribution and suggested a series of step-by-step methods and a metaheuristic to compare solution costs obtained from their two methods [1]. Ketokivi and Turkulainen conducted a thorough analysis of 35 decisions regarding the location of final assembly by investigating the crucial connections among production, supply chain, product development and market. This was done to comprehend the factors influencing the selection of a manufacturing site from both strategic and economic policy viewpoints, particularly in a setting characterized by high GDP per capita [2]. Buciuni and Finotto analyzed through multiple case studies, focusing on the continuity between the development activities of production sites and production and found that the implementation of a specific set of development tasks relies on specialized knowledge in manufacturing, which is central to the judgment of production location selection [3]. Shahabi and Tafreshian investigated the challenge associated with production, inventory, and location with interrelated demand and devised an approach relying on the external estimation of the non-linear components to tackle the issue [4]. Yu and Normasari proposed a comprehensive strategy for designing the supply chain network and developed a mathematical model geared towards minimizing the overall cost of the supply chain, emphasizing the selection of suitable locations for new plants and distribution centers, while determining the production and distribution of the product [5, 6]. Bhatnagar and Lin applied a Markov decision process model to the transshipment issue and defined the desirable strategy for a two-location scenario and lost-sales model [7, 8]. Shafiee-Gol and Kia formulated a mixed-integer nonlinear programming model to deal with the location-distribution and production planning issues, across multiple plants under dynamic conditions [9, 10]. Sharkey and Geunes presented exact branch-and-price algorithms for a category of facility location issues with a temporal dimension and several key variations [11].

Many researchers have also proposed new conditions for investigating production location. Fuchs highlighted the importance of location-specific variations in production attributes and in consumer demand for technological competitiveness [6]. Some researchers have even proposed new production site options and production methods that are responsive to the times. Treber and Moser proposed a methodology that is practical and application-oriented for redistributing production technologies across manufacturing locations in worldwide production networks [8].

Motivated by a real case, this paper will go back to 1992-1995 with the help of Sport Obermeyer's data at the time to use an innovative method with a focus on combining traditional analysis with innovative metrics such as mismatch cost ratio and coefficient of variation to provide a novel, multidimensional approach to problems of production location selection and following production decisions, offering a blueprint for effective supply chain management to unearth invaluable insights on balancing demand-supply dynamics, choosing optimal production locations, and predicting market needs.

2. Methods

2.1. Data Source

The data for this literature are collected from the Sport Obermeyer website, which is provided by actual operations of Sport Obermeyer, and from the classic case study of the Sport Obermeyer. All data are from 1992 to 1995.

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2.2. Variable Selection

The data utilized for this paper mainly consists of two parts. The first part (see Table 1 below) includes five variables (Styles, Price, Name of people who participate in forecasts, Average Forecasts, Twice the Standard deviation). The second part (see Table 2 below) includes 12 variables (Production Location, Wage per hour, Exchange Rate, Hours Worked, Weekly Output per worker, Actual Work Effort per parka, Compensated Work Duration per parka, Cost of Labor per parka, Production Line, Training, Repair Rate, Minimum Order Quantity).

Table 1: Committee's Forecasts.

Style	Price	Laura	Carolyn	Greg	Wendy	Tom	Wally	μ
Gail	$110	900	1000	900	1300	800	1200	1017
Isis	$99	800	700	1000	1600	950	1200	1042
Entice	$80	1200	1600	1500	1550	950	1350	1358
Assault	$90	2500	1900	2700	2450	2800	2800	2525
Teri	$123	800	900	1000	1100	950	1850	1100
Electra	$173	2500	1900	1900	2800	1800	2000	2150
Stephanie	$133	600	900	1000	1100	950	2125	1113
Seduced	$73	4600	4300	3900	4000	4300	3000	4017
Anita	$93	4400	3300	3500	1500	4200	2875	3296
Daphne	$148	1700	3500	2600	2600	2300	1600	2383
Totals	-	20000	20000	20000	20000	20000	20000	20000

The reason only five people participated in Forecast is that in 1992, Wally Obermeyer, the Vice president of the Sport, modified the company's standard procedure where the committee would make production commitments based on the collective agreement of the group. Instead, in an effort to obtain more comprehensive data, Wally instructed each committee member to independently project the retailer demand for every Sport Obermeyer product, as indicated in Table 1.

Table 2: Comparison of operations between Hong Kong and China.

Topic	Hong Kong	China
Exchange Rate	HK$7.8 = US$1	RMB 5.7 = US$1
Wage per hour	HK$30	RMB 0.91
Hours Worked	48 hours per week	58.5 hours per week
Weekly Output per worker	19 parkas	12 parkas
Actual Work Effort/parka	~2.36 hours	~3.7 hours
Compensated work duration per parka	~2.54 hours/parka	~4.89 hours/parka
Cost of Labor per parka	HK$75.7	RMB4.46
Training	Trained in multiple areas	Trained for single task
Minimum Order Quantity	600 units	1200 units
Repair Rate	1-2 %	~10 %
Production Line	10-13 people/line	40 people/line

Table 1 showed the 10 styles of Women's Parkas and the six committee members' predictions of the demand for these 10 styles of Women's Parkas. Considering the Balance Between Precision and Reliability, this paper chooses to use Twice the standard deviation, which is 95% confidence interval.

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Because all data are from 1992-1995, before Hong Kong was returned to China, China is used here instead of mainland. Table 2 showed the specific comparison between two production locations (Hong Kong and China) from 1992 to 1995.

2.3. Research Protocol

This paper will use the Newsvendor Model combined with Normal Demand Distribution to find the quantity of maximum profit. Combined with Loss Function, Expected sales and Expected leftover inventory, Expected profit can be obtained, and mismatch cost ratio can be obtained by combining maximum profit. Finally, combined with the coefficient of variance for double check and comparison, the subsequent production decision was obtained.

3. Results and Discussion

3.1. Comparison of Two Production Locations

Figure 1 showed the four main factors affecting the selection of production locations. Because the data were from 1992-1995, China was used here instead of Mainland.

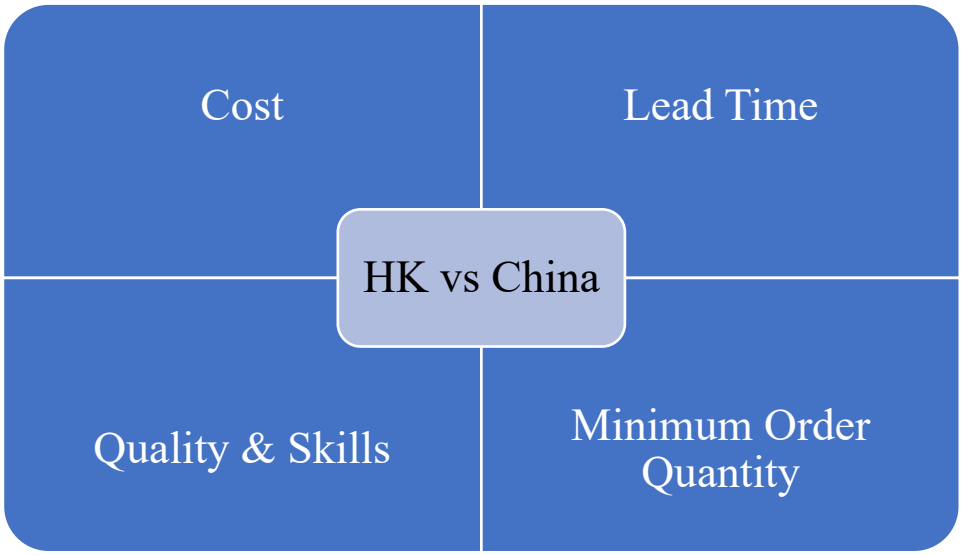

Figure 1: Main factors of comparison.

First, regarding Quality & Skills, at the time of the case, the training for Hong Kong workers and Chinese mainland workers was completely different. Workers in Hong Kong were usually trained in multiple areas, encompassing a wider variety of responsibilities. In contrast, Chinese mainland workers were trained for single operations only. On average, Hong Kong workers operated approximately 50% more efficiently than workers in China and offered greater flexibility in production. Additionally, since Hong Kong workers generally had higher technology proficiency and better repair rate control than Chinese mainland workers (1-2% vs. ~10%), the quality of the products produced was generally superior. In conclusion, Hong Kong was perceived to possess a skilled workforce and superior quality control.

Second, concerning Lead Time, lead time, within a supply chain context, refers to the duration between placing an order (or initiating production) and when the finished goods are ready for shipment or delivery. Hence, lead time and productivity are intrinsically linked (assuming all other external factors remain constant). By comparing the productivity of workers in Hong Kong with those in the Chinese mainland from 1992 to 1995, it's evident that due to the higher skill proficiency of the

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Hong Kong workers-evidenced by weekly output per worker (19 parkas vs 12 parkas) and actual work effort per parka (~2.36 hours vs ~3.7 hours)-Hong Kong workers held a clear advantage. Furthermore, China had longer production lines (40 people/line vs 10-13 people/line). A longer production line typically translates to a longer duration to complete a product. This increases the overall lead time. The prolonged lead time in China implies that production decisions must be made well in advance, with less demand information available. This situation makes China less suitable for items with unpredictable demand.

Third, concerning cost, Table 2 and Figure 1 reveal that the wages for Hong Kong workers (HK$30) were higher than those of Chinese mainland workers (RMB 0.91). Moreover, the cost of labor for each parka was notably greater for Hong Kong workers (HK $75.7) compared to Chinese workers (RMB 4.46). Since both regions paid workers on a piece-rate basis, Chinese workers generally earned lower wages and incurred lower overtime costs. Thus, in terms of cost, China held an advantage over Hong Kong. The elevated production costs in HK suggested that producing large quantities there wasn't economical. Conversely, lower production costs made China the ideal location for bulk production. For items with high uncertainty, the trade-off between cost and the ability to respond swiftly to changing demand justified production in HK. For predictably demanded items, China offered significant cost savings for Obermeyer.

Fourth, regarding the minimum order quantity, Hong Kong had a lower threshold (600 units of the same style vs 1200 units of the same style). This was advantageous for high-risk items, as Obermeyer might not have wanted to commit to vast quantities without a clearer demand forecast. China, with its higher minimum order quantities, was less suitable for speculative items but was more fitting for items with stable demand.

In conclusion, with its flexibility, shorter lead time, and skilled labor, Hong Kong was ideal for items with uncertain and high-risk demand. In contrast, China, with its cost-efficiency, large-scale production capability, and extended lead time, emerged as the preferred choice for items with predictable and low-risk demand.

3.2. Making Following Production Decision

Due to uncertain demand, a single period, and other conditions, the paper initially used the Newsvendor Model to determine the probability that demand would be less than or equal to a specific quantity. This was done because profit is maximized in this scenario, leading to the identification of the critical ratio.

$$\text{Critical Ratio} = \frac{\text{Cu}}{\text{Cu}+Co} = \frac{\$27}{\$27+\$9} = 0.75, \tag{1}$$

where Cu is underage cost, Co is the overage cost According to the Central Limit Theorem, this paper assumed a normal distribution and used the inverse normal to determine the z-score (0.6745) corresponding to the percentile of the critical ratio. Using the z-score formula, the paper calculated the corresponding x, which yielded the quantity for maximum profit.

$$z = \frac{\text{x}-\mu}{\sigma} \tag{2}$$

Table 3 showed the calculation process of maximum profit of these 10 styles of parkas. The next step is to calculate the mismatch cost ratio to determine which products are high uncertainty (high risk) and which products are low uncertainty (low risk). In order to find the mismatch cost ratio, this paper need to first find the Expected sales and Expected leftover to find the Expected profit.

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Table 3: Max-profit quantity.

Style	Average Forecasts	Standard Deviation	Max-profit Quantity
Gail	1017	388	1278.702
Isis	1042	646	1477.72
Entice	1358	496	1692.547
Assault	2525	680	2983.653
Teri	1100	762	1613.961
Electra	2150	807	2694.313
Stephanie	1113	1048	1819.865
Seduced	4017	1113	4767.707
Anita	3296	2094	4708.382
Daphne	2383	1394	3323.239
Totals	-	-	26360.089

$$Expected\ profit = (\text{Price} - \text{Cost}) \times \text{sales} - (\text{Cost} - \text{Salvage value}) \times \text{leftover} \quad (3)$$

$$Expected\ sales = \text{Expected (Mean) } demand - Expected\ shortage \quad (4)$$

$$Expected\ shortage = \text{L(z)} \times Standard\ deviation \quad (5)$$

$$Expected\ leftover = \text{Quantity} - \text{Expected sales} \quad (6)$$

Table 4 showed the calculation process of the Expected profit of these 10 styles of parkas by calculating Expected sales, Expected shortage and Expected leftover.

Table 4: Expected profit.

Style	Expected shortage	Expected sales	Expected leftover	Expected profit
Gail	57.8896	959.1104	319.5916	244.08
Isis	96.3832	945.6168	532.1036	250.08
Entice	74.0032	1283.997	408.5501	325.92
Assault	101.456	2423.544	560.1090	606
Teri	113.6904	986.3096	627.6516	264
Electra	120.4044	2029.596	664.7176	516
Stephanie	156.3616	956.6384	863.2269	267.12
Seduced	166.0596	3850.940	916.7667	964.08
Anita	312.4248	2983.575	1724.806	791.04
Daphne	207.9848	2715.015	1148.224	571.92

To obtain the Expected Shortage, L(z), the loss function, is needed. This paper obtained L(z) (0.1492) using the following function:

$$NORMDIST(z, 0,1,0) - \text{z} \times (1 - \text{NORMDIST(z, 0,1,1)}) \quad (7)$$

Then, this paper will find the maximum profit, and combine with quantity to find the mismatch cost ratio corresponding to these 10 styles.

$$Maximum\ profit = (\text{Price} - \text{Cost}) \times \mu \quad (8)$$

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$$Mismatch\ cost = Maximum\ Profit - Expected\ Profit \tag{9}$$

$$Mismatch\ ratio = Mismatch\ cost\ \div Quantity \tag{10}$$

Table 5: Mismatch cost ratio.

Style	Expected demand	Maximum profit	Mismatch Cost	Mismatch Cost Ratio
Gail	1017	244.08	39.4608	0.03880121
Isis	1042	250.08	65.7003	0.06305207
Entice	1358	325.92	50.4448	0.03714638
Assault	2525	606	69.1582	0.02738937
Teri	1100	264	77.4978	0.07045257
Electra	2150	516	82.0745	0.03817417
Stephanie	1113	267.12	106.5849	0.09576364
Seduced	4017	964.08	113.1956	0.02817915
Anita	3296	791.04	212.9665	0.06461361
Daphne	2383	571.92	141.7742	0.05949401

Table 5 showed the calculation process of mismatch cost ratio of these 10 styles of parkas. According to the Table 5, this paper took mismatch cost ratio = 0.05 as the boundary. Mismatch cost ratios higher than 0.05 were considered high risk and high uncertainty, while those lower than 0.05 were deemed low risk and low uncertainty. This paper then performed the alignment using the coefficient of variance. The coefficient of variance provided a relative measure of variability with respect to the mean. A higher coefficient of variance indicated greater variability, which could be interpreted as higher uncertainty in demand. In the context of cloth production, it offered an understanding of how stable or predictable the demand was for a particular product. By combining the two, products with a high coefficient of variance and high mismatch cost ratio were the riskiest. They had uncertain demand, and any forecasting error could have been costly.

$$Coefficient\ of\ Variance = \left(\frac{\text{Standard deviation}}{\text{Mean}} * 100\right)\% \tag{11}$$

Table 6: Coefficient of variance and mismatch cost ratio.

Style	Standard deviation	Coefficient of Variance	Mismatch Cost Ratio
Gail	388	0.3815	0.0388
Isis	646	0.6199	0.0630
Entice	496	0.3652	0.0371
Assault	680	0.2693	0.0273
Teri	762	0.6927	0.0704
Electra	807	0.3753	0.0381
Stephanie	1048	0.9415	0.0957
Seduced	1113	0.2770	0.0281
Anita	2094	0.6353	0.0646
Daphne	1394	0.5849	0.0594

Table 6 compared and confirmed the coefficient of the variance and the mismatch cost ratio of the demand of these 10 styles of parkas. As could be seen from the Table 6, the five styles with a

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Mismatch cost ratio lower than 0.05 were also the five styles with a lower Coefficient of Variance. Therefore, when combined with the characteristics of the two production locations of Hong Kong and China, this paper placed these five styles with low Mismatch cost ratio and Coefficient of variance (Gail, Entice, Assault, Electra, Seduced) in China for production. This paper assigned the other five styles (Isis, Teri, Stephanie, Anita, Daphne) with high Mismatch cost ratio and Coefficient of variance to Hong Kong for production.

4. Conclusion

In conclusion, by analyzing and comparing Hong Kong and China from the perspectives of cost, lead time, quality, and minimum order quantity, this paper concluded that Hong Kong, with its better flexibility and shorter lead time, was more suitable for production with high risk and high uncertainty demand. On the other hand, China, benefiting from lower costs and larger minimum order quantities, was more suitable for production with low risk and low uncertainty demand. Using the Newsvendor model, the mismatch cost ratio and coefficient of variance were compared and verified, with a mismatch cost ratio of 0.05 set as the boundary. Ultimately, 5 styles suitable for production in China and 5 styles suitable for production in Hong Kong were identified. As algorithms continue to progress, there will be increasingly efficient ways to assist enterprises in making production decisions in the future.

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Trend Analysis of Enterprise Intelligent Financial Applications

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Abstract: Recently, intelligent financial applications have been regarded as an important pillar of enterprise development and will play a significant contribution to the progress of future enterprises. Enterprises need to make continuous progress and adapt to the rapidly changing social environment with high competitiveness, and finance, as an indispensable part of enterprise development, needs to make great progress. With the continuous development of digital transformation, intelligent finance has become an important driving force for enterprise development, and is widely used in information processing, personnel management, market analysis, business management, etc. The purpose of this paper is to explore the sustainable impact of intelligent finance on enterprise development, including the application of financial intelligence, financial shared development, data analysis and management, etc., and comprehensively sort, analyze and summarize the relevant research through the method of literature review. In addition, it provides reasonable suggestions for the future development direction of enterprise finance, so that enterprises can gain competitive advantages from intelligent financial applications, improve company efficiency, and achieve good and long-term development.

Keywords: Intelligent Financial Applications, Enterprise Development, Digital Transformation, Financial Trends

1. Introduction

1.1. Background

1.1.1. Technology-driven innovation

In today's era, emerging technologies such as "Smart Mobility Cloud and IoT Zone" are booming, and in the era of digital economy, data has become a new factor of production.In this regard, China proposes to promote the "cloud and data empowerment" action to further promote the digital transformation of enterprises to cultivate the development of the new economy;In February 2022, the State-owned Assets Supervision and Administration Commission (SASAC) issued the "Guiding Opinions on Accelerating the Construction of a World-class Financial Management System for Central Enterprises", which proposed that qualified enterprises should explore the establishment of digital and intelligent finance based on an independent and controllable system.

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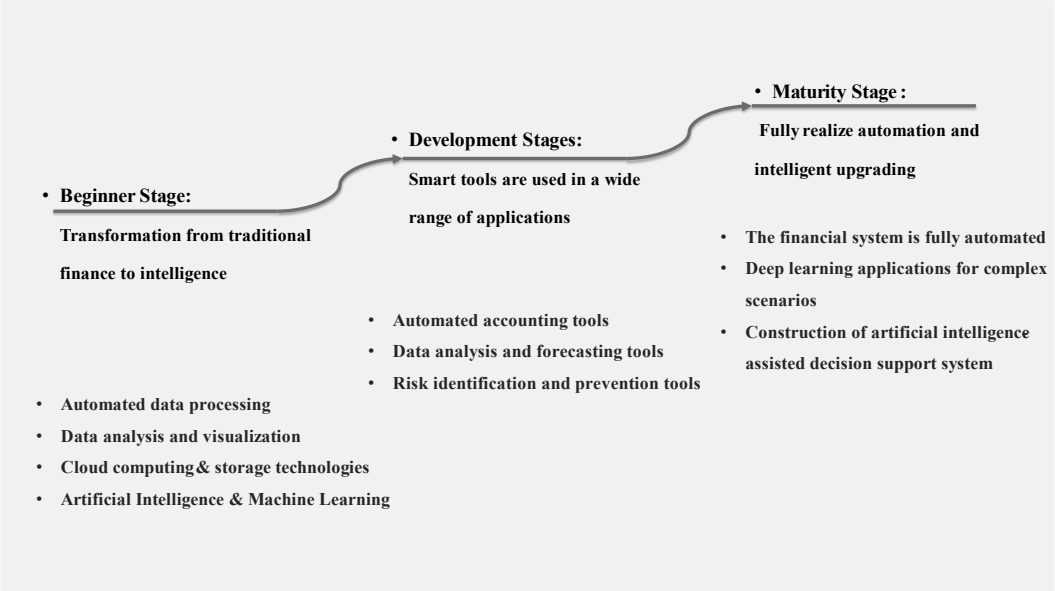

Figure 1: Development stage and performance state of intelligence finance

At the same time, according to the top ten strategic technology development trends released by Gartner for two consecutive years (2023-2024), the development of industry cloud platforms has become the future trend of enterprise development.

The three layers of IaaS, PaaS, and SaaS are further deconstructed, according to Kong Weiwei and Li Jiayi based on CiteSpace Since 2012, the core Chinese literature related to intelligent finance has shown an upward trend, and in 2020, it even reached more than 160 results. It is expected that this research field will remain hot in the next five years and reach a stable peak.

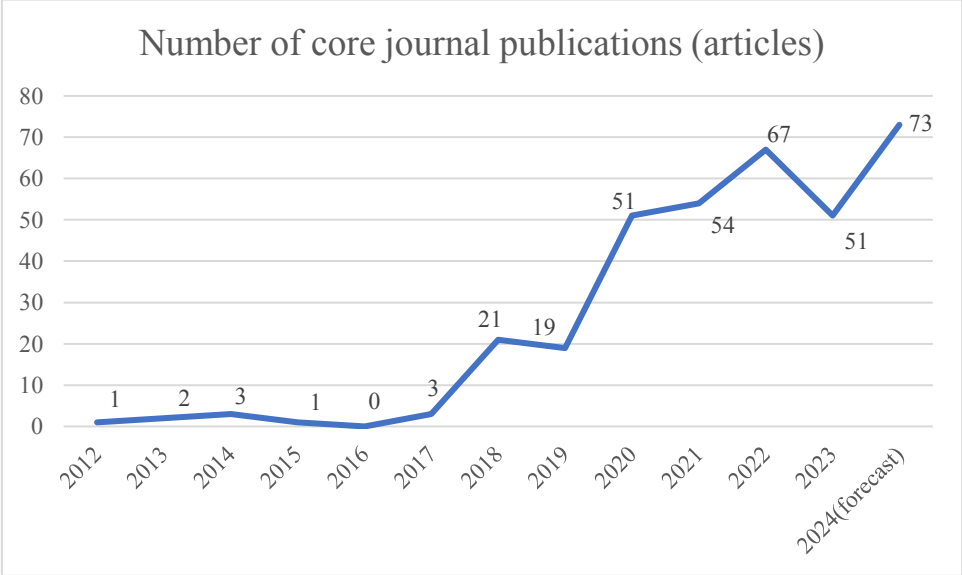

Figure 2: Number of core journals of enterprise intelligent finance published on CNKI

Under the background of digital and intelligent development, the innovation of enterprise financial management is also driven by technology. Information technology runs through the whole process of operation and management of enterprises and institutions, accounting personnel use a variety of information technology to apply to many scenarios of accounting work, such as accounting, financial

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reporting, expense reimbursement, management accounting, etc., and the innovation and iteration of information technology has accelerated the trend change of accounting application scenarios, bringing a lot of convenience and new thinking to accounting personnel, and the career transformation of accounting personnel has become a directional consensus.

Enterprises begin to explore the application of intelligent technology in the field of financial management to improve management efficiency, reduce costs and optimize decision-making. The application trend of enterprise intelligent finance has become a hot spot in theoretical research and enterprise development, and has received widespread social attention.

1.1.2. Imbalance of talent supply and demand

From 2014 to 2023, the number of undergraduates and master's students in economic management in China has experienced rapid growth, especially in finance and accounting positions, which are in great demand in the market. However, with the large-scale expansion of finance and economics majors in China, the number of students in the field of finance and accounting has also increased rapidly, resulting in the market cannot fully absorb these new job seekers. This imbalance between supply and demand makes the price competition in the finance and accounting training market increasingly fierce, and the unit price shows a rapid decline trend.

1.2. Degree of application

From the perspective of academic research, since the reform and opening up,with the continuous development of accounting informatization in China, intelligent finance has become a new research content in the field of financial management in recent years[1].There are two main definitions of intelligent finance in China today: one is that Liu Meiling et al. will apply new technologies such as artificial intelligence to financial work, such as " Smart Mobility Cloud and IoT Zone " represented by artificial intelligence, to simulate, extend and expand traditional financial work, so as to improve the quality of accounting information, improve accounting work efficiency, reduce accounting work costs, enhance accounting compliance capabilities and value creation capabilities, promote the role of enterprise finance in management control and decision support, and promote the digital transformation process of enterprises through the digital transformation of finance[2] The other is the intelligent finance proposed by Liu Qin and others, which is the financial work with the support of various management information systems of enterprises and new technologies such as big data, artificial intelligence, cloud computing, Internet of Things, and blockchain[3]Through the human-machine collaboration mode of human experts and intelligent machines to complete financial management, it can actively meet the needs of enterprise production, operation and management, and continuously create value for enterprise[4].

The author believes that both perspectives show the connotation of intelligent finance, pointing out that the application of technology can promote the financial transformation of enterprises, but the former emphasizes the digital transformation of accounting, while the latter focuses on the improvement of benefits under the human-machine collaboration under the development of technology, and emphasizes the important needs of enterprises as the demand side.

Based on this, scholars have conducted in-depth research on macro issues such as intelligent financial construction factors, application effects, construction models, and logical elements, and further conducted further research on them OCR, RPA, financial sharing center construction, artificial intelligence and other intelligent technology discussion,[5][6][7][8] Explore its technical challenges and application value.

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1.3. Research Gaps

Although scholars have conducted in-depth research on the related issues of intelligent finance construction, the research is mainly based on case studies, and the research methods for intelligent finance are not perfect, and there is a relative lack of effective theories and models to guide the research, and there is a relative lack of overall research on the practical application of intelligent finance. As a product of the era of digital economy, intelligent finance has good application value for studying its trend development.

1.4. Objectives

Therefore, based on the connotation and characteristics of intelligent finance, this paper adopts the method of literature review to comprehensively sort out the views of domestic and foreign scholars on the construction of intelligent finance, and discusses the application and development trend of intelligent financial enterprises.

This paper mainly studies two questions: First, what is intelligent finance, what are its special features. Second, what are the views of scholars on the application trend of intelligent finance enterprises, what research methods are obtained, and what suggestions are there for the future construction of enterprises?

1.5. Implications

The research contribution and significance of this paper are mainly reflected in the fact that the construction of intelligent finance has always received a high degree of attention, especially in the practical work of enterprise finance, the definition, characteristics and application trends of intelligent financial construction are summarized and analyzed, which can clarify the development status of intelligent finance today, provide reference for the subsequent development of enterprise intelligent finance, save the cost of enterprise exploration, obtain a good competitive advantage, and promote the digital transformation of enterprises.

2. Trends in intelligent finance applications

According to the current research status at home and abroad and the characteristics of intelligent finance, the current trend of intelligent financial application can be roughly divided into four aspects: intelligent application, financial sharing development, data transformation and processing, and integrated collaborative application.

2.1. Intelligent applications

Under the development trend of " Smart Mobility Cloud and IoT Zone" intelligent finance is transforming from weak intelligence to strong intelligence [9], that is, from the simple use of people's perception capabilities, such as: digital signatures, RPA, OCR, etc. To the more complex application of human cognitive abilities, such as: chat-GPT uses the prediction of future market trends and investment risks, that is, from dealing with a large number of repetitive and rule-based operational services to using cognitive intelligence to achieve autonomous optimization of operational services to realize the intellectualization of the management accounting platform.[10] Intelligent corporate governance management [11].

According to Yang Yin et al.'s collection of financial intelligence information on Chinese enterprises on the basis of a questionnaire survey, the current information is obtained The financial information system is less intelligent still in the stage of weak intelligence, and the development of strong intelligence is a historical necessity.

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At the same time, under this trend, intelligent applications will evolve from single-line development to in-depth development [9] [12] Three-dimensional coverage of the whole enterprise to achieve automated, intelligent and visualized business processes [13] Full coverage, save unnecessary intermediate costs, and maximize benefits. It can be seen that the development of intelligent applications requires enterprises to broaden the dimension of intelligent finance and promote intelligent transformation with data [2] Deepen the cultivation of analytical capabilities such as artificial intelligence cognitive prediction in multi-level and wide fields, and release the momentum of enterprise development.

2.2. Financial sharing development

With the development of emerging intelligent technologies, the traditional financial shared service center has a new direction of transformation. In 2016, Deloitte and others promoted the integration of artificial intelligence technology and the accounting field, which in turn promoted China to enter the era of intelligent accounting[1]. The intelligent financial sharing center has become the transformation direction of the enterprise financial sharing center, from financial accounting sharing to management accounting sharing to enter the big sharing stage [2]. Through the continuous adjustment of the organizational structure, the use of digital tools, the transformation from a physical organization to a virtual organization, information sharing to promote the concentration of personnel in digital form, weaken the constraints of time and space and make the enterprise financial system integrated, lightweight, modular and standardized [14]. Strengthen accounting, management and strategy Multi-platform linkage.

At the same time, shared services organizations are transforming into global shared services (GBS). The future trend will be to develop the shared field with technical resources as the core, which can bring higher value service capabilities and more reasonable resource allocation efficiency to enterprises.[15]

2.3. Data-based transformation and processing

In the era of digital economy, the construction of intelligent finance of enterprises needs to reflect the dual value of data-driven and technological innovation.[16] The development of the "Smart Mobility Cloud and IoT Zone" requires the expansion and deepening of intelligent finance, and the importance of data as a basic element is self-evident. Due to the huge amount of data, its transformation trend can be divided into three aspects, namely quality, efficiency, and green.

2.3.1. Quality

Traditional accounting has comprehensively controlled the accuracy of accounting information through white and black records, full-process stamping and auditing, and strict policy supervision;[17] Its places new demands on data quality and privacy [18] Data security cannot be ignored [18].

Therefore, at present, the development of data has carried out more accurate, reliable, real and safe regulatory system requirements.[19] For example, as early as 2015, the General Office of the State Council issued several opinions on the use of big data to strengthen the service and supervision of market entities [20], the European Union's Data Act of 2022. It can be seen that in the future, the development of data will be more legitimate, authentic and secure, so that business data can have a more complete guarantee system, and then achieve data operation within the standardized system, that is, data standardization.[21]

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2.3.2. Efficiency

The trend of data processing automation is obvious, and intelligent finance will be used in an all-round way, including the gradual mastery and application of repetitive bookkeeping work by RPA, as well as the financial analysis and trend of a large number of calculations by the human brain Research and judgment, investment and financing, risk assessment and other market analysis.

At the same time, the development of big data has prompted the large-scale application of intelligent decision support systems in finance, through AI data processing, and the use of RPA technology guidance.[22]For example, in 2020, China Merchants Bank's CBS-RPA collects and analyzes financial data, realizes financial automation, reduces the investment of human accounting resources, and accelerates the development of accounting talents to optimize the efficiency of digital resource allocation. [23]

It can be seen that the development of intelligent finance will greatly improve the efficiency of financial accounting, and the demand for accounting will also tend to high-tech and high-quality digital talents.

2.3.3. Resources

Digital transformation means moving from paper to electronic data. From the perspective of data preservation, electronic data can maximize the utilization of data resources with the advantages of more convenient and much fast search and analysis, and at the same time save the labor cost of paper database maintenance and search.

However, greater requirements are put forward for data storage space and security maintenance, and the confidentiality level of internal data of enterprises relies on higher technical guarantees, more comprehensive policy support, and more sufficient capital reserves. It can be seen that the increasing requirements for data virtual resources and storage guarantee have stimulated the domestic demand for enterprise technology and the direction of future digital transformation.

2.4. Human-machine synergy

The perspective of human-machine collaboration emphasizes the interconnected and collaborative working relationship between man and machine, and helps enterprises integrate resources and improve their production efficiency and decision-making ability through artificial intelligence and other technologies [24][25]. With the widespread use of intelligent finance, related technologies are integrated into the construction of organizational networks [26], which has led to significant changes in the organizational structure of the enterprise [27] to form a new financial organization form and promote the change of financial work efficiency and quality. At the same time, under the mutual supervision of humans and machines, the maximum potential of both can be realized [28] The underlying logic and tacit knowledge of talent understanding are given to the machine, and the time cost of the machine's high-speed processing of basic work is empowered to the enterprise, so that the financial change management is more accurate and effective [29] to promote the maximization of benefits and effectiveness through training and communication.

At present, due to the dilemma of technical level, the trust level between humans and machines is still difficult to apply on a large scale, but some enterprises have achieved simple integrated development through OCR, RPA and other technologies. It can be seen that human-machine collaboration is not a simple one-plus-one effect, but an exponential growth that gives full play to the greatest advantages, and the improvement of enterprise efficiency in the future inevitably requires coordinated development.

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2.5. Review

According to the analysis and collation of the trend analysis of the four aspects of intelligent application, financial sharing development, data transformation and processing, and integrated collaborative application, the author believes that experts and scholars have put forward a variety of views from different angles, but in essence, they are still on the same path, and in the future, enterprises will take high-tech as the core, expand the application space of financial intelligence in intelligent applications, deepen cognitive computing technology, empower financial accounting and financial management with science and technology, and build a global sharing network of financial information With the support of huge information data and strict data management, improve the accuracy and automation level of data use, improve the efficiency of resource utilization, and help financial personnel transform into high-tech, high-quality and high-efficiency compound talents; vigorously promote the coordinated development of human-computer interaction, strengthen the mutual auxiliary role of man and machine, liberate human resources with technology, and strengthen the ability of resource integration.

These views comprehensively show the current development trend of enterprise intelligent finance, but they still do not constitute a complete and mature system for the specific trend situation in the future, because due to the limitation of the case-based method, the trend direction is more applicable to typical enterprises and lacks universal value.

3. Conclusions & Recommendations

To sum up, under the development of the "Smart Mobility Cloud and IoT Zone", intelligent finance, as an element of enterprise internal management, has increasingly become an essential technology for enterprises, and has also attracted the attention and research of many scholars. This paper discusses the definition and development trend of intelligent finance, with the aim of finding out the future trend of enterprise application of intelligent finance and providing reference for enterprises. The content of the literature cited in this article is of great help to this paper by analyzing and discussing the relevant theories of scholars. Of course, there are inevitably unsatisfactory places, such as the lack of intelligent financial management information for small enterprises. To summarize the above points, enterprises should choose appropriate technologies and directions based on their own actual conditions, develop them with scientific strategies, and carry out digital transformation in order to improve resource utilization efficiency and achieve good competitive advantages.

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Navigating the Nexus of Urbanization, Technology, and Global Economics in Real Estate Market Dynamics

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Abstract: This article provides a comprehensive analysis of the key factors shaping real estate markets, focusing on urbanization trends, technological advancements, and global economic shifts. Urban migration is fueling demand in metropolitan areas, leading to significant infrastructural developments and a reevaluation of property values. Concurrently, technological innovations like artificial intelligence, virtual reality, and blockchain are transforming real estate transactions and management, enhancing market efficiency and transparency. Additionally, the paper examines the impact of global economic conditions, including trade wars and policy changes, on real estate investment and market stability. By integrating these elements, the article forecasts potential market trends and offers strategic insights for navigating the complexities of the real estate sector. This synthesis not only highlights current influences but also projects future changes in the landscape of real estate, suggesting adaptive strategies for industry stakeholders.

Keywords: Real Estate Market, Urbanization, Technological Innovation, Global Economy, Property Values

1. Introduction

The real estate market is a dynamic and complex field influenced by a multitude of factors that interact in both predictable and unforeseen ways. These interactions shape market behaviors and outcomes, influencing everything from pricing strategies to investment decisions. This paper explores three critical dimensions—urbanization, technological advancements, and global economic shifts—that are pivotal in understanding the current and future landscape of real estate. Urbanization continues to drive demographic shifts towards metropolitan areas, fueled by the pursuit of better employment opportunities and enhanced lifestyle amenities. This urban influx is reshaping the demand for both residential and commercial properties, increasing the need for sophisticated urban planning and infrastructural development. Simultaneously, the real estate sector is experiencing a technological revolution. Innovations such as artificial intelligence, virtual reality, and blockchain are not just peripheral enhancements but are central to transforming real estate practices. These technologies streamline operations, improve the customer experience, and ensure transactional transparency [1]. Furthermore, the global economic climate remains a significant influencer, with factors such as trade disputes, policy changes, and international political events profoundly impacting investor confidence and market stability. This introduction provides a comprehensive framework for discussing how these

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elements interact to shape the real estate market, emphasizing the need for industry stakeholders to adapt to these evolving dynamics to maintain competitiveness and profitability.

2. Economic Indicators and Their Impact on Real Estate

2.1. Gross Domestic Product (GDP) Growth Rates

The relationship between GDP growth rates and real estate demand is historically positive, suggesting that as economies expand, so too does the demand for residential and commercial properties. This section investigates how fluctuations in GDP impact real estate prices and development activities, incorporating data from various economic upturns and downturns to illustrate the cyclical nature of real estate demand in response to economic growth. To comprehensively analyze this phenomenon, it is essential to consider the lag effect between GDP growth and its impact on real estate markets. Empirical data from multiple global economic cycles indicate that real estate market reactions may trail GDP changes by six to eighteen months, depending on the region and the specific market conditions at the time. This lag can be attributed to the time it takes for businesses to adjust their investment strategies and for consumers to feel confident in their financial stability to commit to real estate investments. Additionally, the elasticity of demand in the real estate sector relative to GDP growth is a critical factor. For instance, during the economic boom in the United States from 1992 to 2007, the GDP grew at an average annual rate of approximately 3% [2]. This period, often referred to as the "Great Moderation," saw a significant expansion in real estate demand, culminating in the housing bubble of 2006. Analysis of this era shows that for every percentage point increase in GDP, real estate demand increased by roughly 2%, highlighting the high elasticity of the real estate market during economic expansions in developed countries. In contrast, during China's rapid economic expansion from the early 2000s onward, the country's GDP growth often exceeded 10% per year. This extraordinary growth led to an unprecedented boom in real estate demand, particularly in urban centers. For example, in 2003 alone, China's GDP grew by around 10%, and the real estate market responded with a 30% increase in urban housing prices. The Chinese market illustrates how in developing economies, where significant portions of the population are migrating to cities and joining the middle class, the impact of GDP growth on real estate can be even more pronounced. Further, examining the European scenario during the economic recovery post-2008 financial crisis, GDP growth was more sluggish, often hovering around 1% to 2% in major economies like Germany and France. The corresponding increase in real estate demand during this period was less intense compared to the US in the 90s or China in the early 2000s, with a more gradual recovery in real estate prices and development activities. Moreover, the impact of GDP growth on real estate is not only a matter of demand but also influences supply dynamics. For instance, in India during the post-2010 economic recovery, GDP growth averaging around 7% per year helped fuel a surge in construction activities. Real estate developers anticipated continued economic expansion and increased demand, leading to a proliferation of both residential and commercial projects.

2.2. Employment Rates and Household Income

Employment stability and growth are critical to real estate market health, as they influence buyers' purchasing power and confidence. Analyzing data from labor markets provides insights into how changes in employment rates and household incomes affect housing demand. This part of the discussion evaluates the correlation between higher employment rates and increased demand for housing, while also considering the role of rising household incomes in inflating property prices. To delve deeper, this analysis incorporates the concept of wage elasticity in the real estate market, which measures how sensitive the housing market is to changes in wages. Studies have shown that in regions where wage growth outpaces inflation, there is a significant increase in housing demand, leading to

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rapid price escalations [3]. Moreover, the demographic profile of the workforce, including age, education level, and occupation, also influences real estate dynamics. For example, regions with a higher concentration of technology and finance professionals, who typically earn more than the average wage, often experience sharper increases in real estate prices due to higher disposable incomes and investment propensity.

2.3. Interest Rates and Financing Availability

Interest rates play a pivotal role in real estate economics by influencing the cost of borrowing. This subsection delves into how variations in interest rates impact the affordability of real estate financing. By examining historical data, it is evident that lower interest rates tend to stimulate market activity through more accessible financing options, whereas higher rates generally dampen purchasing enthusiasm and slow down market growth. To provide a more detailed analysis, this section explores the relationship between central bank monetary policies and real estate capital flows. Specifically, it assesses how the easing or tightening of monetary policy influences investor behavior and lending practices in the real estate sector. During periods of low-interest rates, there is typically a surge in both residential and commercial real estate transactions as borrowing costs decrease, making investments more attractive [4]. Conversely, when interest rates rise, not only does the cost of obtaining mortgages increase, but there is also a tendency for real estate investment trusts (REITs) and other institutional investors to reallocate assets towards higher yield investments, thereby reducing capital availability for real estate ventures. Furthermore, the impact of macroprudential policies on mortgage lending criteria and the overall lending environment is examined to understand their role in shaping market outcomes, particularly in terms of accessibility for first-time homebuyers and the implications for market inclusivity.

3. Government Policies and Their Influence on the Real Estate Sector

3.1. Taxation Policies

Government-imposed taxes on property transactions can either incentivize or deter investment. This section explores the effects of various taxation policies on the real estate market, focusing on capital gains tax, property tax, and incentives for first-time homebuyers. The analysis reveals that lower taxes on real estate transactions correlate with higher market activity, while higher taxes often lead to a cooling-off period in the market. Delving deeper, the differential impact of specific tax incentives, such as reduced capital gains tax for long-term property holdings, is examined to understand their effectiveness in promoting sustainable investment practices within the real estate sector. For instance, in regions where capital gains tax is lowered for properties held longer than five years, there is a noticeable increase in long-term investments, leading to greater market stability. Similarly, property taxes, which are recurrent annual taxes based on property value, influence investor decisions regarding property development and acquisition. High property taxes can discourage investment in regions with slower appreciation rates, whereas moderate to low property taxes can enhance the attractiveness of an area. Additionally, the role of tax incentives for first-time homebuyers, such as tax credits or reduced rates on transfer taxes, is scrutinized for their capacity to stimulate demand in the residential market, thereby contributing to broader economic vitality through increased homeownership rates [5].

3.2. Zoning and Land Use Regulations

Zoning laws and regulations significantly affect real estate development by dictating land use and property types. This part discusses how these regulations shape market trends by either promoting or

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restricting the development of certain types of properties in specific areas. It includes case studies where changes in zoning laws led to substantial shifts in market dynamics, demonstrating the power of regulatory frameworks in shaping the real estate landscape. One illustrative example can be found in the rezoning of urban districts from industrial to mixed-use, which has frequently resulted in a revitalization of previously underutilized areas, increased property values, and enhanced community amenities. The analysis extends to the impact of height restrictions, floor area ratios, and green space requirements on property development potential and market prices. Furthermore, the controversial issue of "downzoning," or imposing more restrictive zoning laws that limit developmental possibilities, is explored for its implications on supply constraints and its potential to inadvertently drive up property prices in densely populated areas [6]. Through these examinations, the intricate balance between promoting growth and maintaining the character and sustainability of communities is underscored, highlighting the need for thoughtful and responsive regulatory approaches.

3.3. Housing Affordability Programs

The government's involvement in enhancing housing affordability through various initiatives like subsidies, grants, and financial aids plays a pivotal role in balancing the real estate market. This subsection delves deeper into the impact of these programs on making the housing market more accessible for lower and middle-income families, while also examining their overall contributions to the health and sustainability of the market.

One effective approach has been the implementation of low-interest loan programs designed specifically for first-time homebuyers. For instance, the U.S. Federal Housing Administration (FHA) offers loans with lower down payments and more lenient credit requirements compared to traditional mortgages, making homeownership more attainable for a broader demographic. Studies indicate that FHA loans have historically increased homeownership rates by providing up to 4.8 million new buyers with the opportunity to purchase homes since their inception. Rent control policies are another significant intervention aimed at stabilizing rental markets and preventing excessive rent increases. Cities like New York and San Francisco have long-standing rent control laws that cap the amount landlords can charge for residential properties, ensuring that rents remain affordable for existing tenants [7]. However, while rent control can provide immediate relief for tenants, research suggests that it might discourage landlords from maintaining or improving their properties, leading to a decline in the quality of housing over time. Housing vouchers, such as those offered through the Section 8 program in the United States, allow low-income families to afford decent, safe, and sanitary housing in the private market. Beneficiaries of this program contribute a reasonable amount of their income towards rent, with the voucher covering the remainder up to a certain limit. Data shows that these vouchers have aided over 2.2 million households in securing quality accommodation, effectively reducing homelessness and housing insecurity among vulnerable populations. Furthermore, direct financial assistance programs, such as down payment assistance schemes, provide targeted support to first-time buyers struggling with the initial costs of purchasing a home These programs often cover a portion of the down payment, significantly reducing the barrier to entry for homeownership. For example, programs like the Home Purchase Assistance Program (HPAP) in Washington D.C., have supported thousands of families, with the average assistance amount being around $70,000 per household, dramatically enhancing buyer capacity in the city's real estate market. While these interventions have proven beneficial, they also come with potential drawbacks, such as market distortions where subsidies inflate property prices or create a dependency that discourages self-sufficiency. Moreover, the sustainability of these programs is often at risk from budget cuts and economic downturns, which can lead to reduced funding and the curtailment of benefits.

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4. Market Trends and Future Projections

4.1. Urbanization Trends

Urban migration and the growth of metropolitan areas significantly influence real estate markets. This part analyzes how urbanization affects housing demand and property values, highlighting the trend towards increased demand in urban centers. The discussion includes projections on future urban growth and its potential impacts on real estate markets worldwide. A deeper examination of urbanization trends reveals a shift in demographic dynamics, with an increasing portion of the population moving towards urban areas in search of better employment opportunities and lifestyle amenities. This migration is not only boosting demand for residential spaces but also commercial properties, as businesses seek to capitalize on the growing urban population. Additionally, the intensification of urbanization has spurred infrastructural developments, including transportation networks and public services, which in turn enhance property values [8]. The analysis further extends to the challenges posed by urban sprawl, such as the strain on resources and the increase in housing prices, which can lead to affordability crises and social disparities. Projections based on current trends suggest that urban centers will continue to expand, exacerbating these issues but also creating opportunities for innovative real estate developments that incorporate sustainability and affordability.

4.2. Technological Advancements in Real Estate

Technology plays an increasingly critical role in shaping real estate markets through innovations such as virtual property tours, AI in property management, and blockchain in real estate transactions. This section explores the current and future impacts of technology on market efficiency, transparency, and trust, offering insights into how technological advancements could revolutionize real estate practices. For instance, the adoption of virtual reality (VR) and augmented reality (AR) technologies has transformed property marketing, allowing potential buyers to experience properties remotely, which is especially significant in today's globalized market. Furthermore, artificial intelligence (AI) is being utilized to automate and optimize various aspects of property management, from tenant screening to maintenance requests, enhancing operational efficiencies and tenant satisfaction. The integration of blockchain technology promises to further disrupt the real estate sector by facilitating secure, transparent, and efficient transactions. Smart contracts, for instance, can automate the execution of agreements in real estate deals, reducing the need for intermediaries and lowering transaction costs [9]. These technological interventions not only streamline processes but also enhance the overall security and reliability of real estate transactions, paving the way for a more connected and technologically integrated real estate market.

4.3. Global Economic Shifts

Global economic trends, such as trade wars, international policy changes, and economic sanctions, have far-reaching effects on domestic real estate markets. This subsection examines how such global shifts can alter investor confidence and market stability, using recent economic events to forecast potential market responses. The interconnectedness of the global economy means that fluctuations in one part of the world can have ripple effects on real estate markets elsewhere. For example, trade tensions between major economies can lead to increased economic uncertainty, impacting investor sentiment and leading to cautious investment behaviors. Additionally, shifts in international policies, such as changes in immigration laws or foreign investment caps, can directly influence the demand dynamics in real estate markets. The section also considers the role of economic sanctions, which can restrict capital flows and thus impact the development and investment in property markets [10]. Through a detailed analysis of recent global economic events, such as the US-China trade war and

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Brexit, the discussion elucidates how such geopolitical and economic uncertainties shape real estate investment strategies and market valuations, suggesting strategies for mitigating risks associated with global economic instability.

5. Conclusion

The convergence of urbanization, technological innovation, and global economic dynamics presents a multifaceted challenge to the real estate sector but also offers numerous opportunities for growth and transformation. As urban areas expand, the demand for well-located properties is likely to surge, creating potential for substantial returns on investment. However, this growth must be managed strategically to address issues of sustainability and affordability that often accompany rapid urban development. Technological advancements are reshaping the industry landscape, introducing new ways of managing properties and conducting transactions. These technologies promise to enhance efficiency and transparency but require real estate professionals to acquire new skills and adapt to changing business models. On the global stage, economic fluctuations continue to influence market conditions, necessitating a robust understanding of international market dynamics and agile investment strategies. For industry stakeholders, staying ahead means not only adapting to current conditions but also anticipating future changes. This paper highlights the importance of a proactive approach in integrating diverse market influences, suggesting that a deep understanding of these three pivotal dimensions is crucial for navigating the future of real estate. By fostering a culture of innovation, responsiveness, and strategic foresight, the real estate sector can effectively navigate the complexities of an ever-evolving market landscape.

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The Influence of RMB Settlement Globalization on the Political and Economic Evolution of Singapore Amidst US-China Rivalry

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Abstract: At the dawn of the 21st century, the ascending comprehensive national strength of China has significantly bolstered the role of the RMB in global economic transactions, thereby expediting its international settlement globalization. This development, unfolding within the framework of an increasingly interconnected global economy, profoundly impacts Singapore. Positioned as a crucial trading partner and geographical neighbor to China, while simultaneously serving as a vital security ally of the United States in Asia, Singapore's political and economic landscapes are witnessing transformative shifts. This paper endeavors to meticulously examine and elucidate the specific impacts of RMB settlement globalization on Singapore's political and economic dimensions. Moreover, it aims to explore the potential challenges and opportunities that these impacts may engender for Singapore in the near future, particularly against the backdrop of the US-China competition. The analysis of how the global proliferation of RMB settlement is reshaping Singapore, alongside the nature and direction of this influence amid the strategic rivalry between the US and China, is of paramount importance. It provides deep insights into the evolution of the global political-economic order and assists in formulating strategies for middle-tier nations like Singapore within the changing regional dynamics. By offering a detailed understanding of these developments, this study acts as an essential guide for navigating crises, capitalizing on developmental opportunities, and actively participating in regional affairs.

Keywords: US-China competition, Singapore, RMB Settlement Globalization

1. Introduction

In the current geopolitical milieu, a critical challenge for international relations is maneuvering through the intensifying rivalry between China and the United States. This contest has significant ramifications for middle-power countries, especially in devising strategies for harmonious existence amidst this competitive scenario. At the heart of Singapore's foreign policy is its adept engagement with major global powers, underscored by its alignment with the United States as a key security partner and China as its foremost trading ally. Singapore's distinctive stance within this geopolitical binary, along with its considerable political and economic clout in Southeast Asia, positions its strategic approaches and policies as a central point of reference for ASEAN members. This role serves as a model for navigating the complexities of great power relations [1]. Therefore, Singapore's

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response to the changing landscape of Renminbi Settlement Globalization not only garners academic attention but also bears significant practical relevance.

1.1. Purpose and significance of the research

This study is focused on exploring the influence of RMB settlement globalization on Singapore's role within the international political and economic arenas, especially against the backdrop of the evolving US-China power dynamics. It aims to conduct a thorough examination of the challenges and opportunities confronting Singapore in both its political and economic sectors, with a particular emphasis on the practicality and obstacles associated with RMB settlement activities in its jurisdiction. The objective is to furnish policymakers, scholars, and global business entities with crucial insights into the nuances of the international politico-economic landscape [2]. By doing so, it seeks to aid in the formulation of well-informed foreign policy and economic strategies, thereby promoting economic integration in the Asia-Pacific area and enhancing positive international relations on a global scale.

1.2. Research Questions and Possible Limitations

The research will explore how RMB settlement globalization influences Singapore's political and economic development and the characteristics and strategic trends of this influence under the US-China competition paradigm. The analysis will utilize the Sino-American rivalry as a backdrop, focusing on the development of RMB settlement globalization and its impact on Singapore's politics, economy, and foreign policy.

Potential Limitations:

1. Data Acquisition Challenges: The research involves complex global processes and US-China competition, requiring data from policy documents and national statistics. The study will rely on data from official government sources and reputable third-party think tanks and research institutions for comprehensive analysis.

2. Researcher Subjectivity: The analysis of RMB settlement globalization's impact on Singapore might be influenced by researcher bias, including perspectives on China and the understanding of the globalization process. To counteract this, the study will employ objective and neutral methodologies, blending quantitative and qualitative research methods to minimize subjectivity.

3. Measuring US-China Competition Impact: The multifaceted nature of the US-China rivalry, encompassing economic, political, military, and technological domains, makes it challenging to quantify its impact on RMB settlement globalization and Singapore's development. The research will utilize a mix of qualitative (e.g., case studies, interviews, policy analysis) and quantitative methods (e.g., regression analysis, structural equation modeling), considering various interaction effects and nonlinear relationships [3].

To mitigate these limitations, the study will integrate historical and current data, augment literature reviews and theoretical frameworks, and refine analytical methods to adapt to the dynamic international environment and the specificities of Singapore's situation. This approach aims to address existing research gaps and innovate within the field.

2. Literature Review

The academic discourse on Singapore's foreign policy and the implications of RMB settlement globalization is enriched by diverse scholarly contributions. Prof. Chen Qiaozhi, in his seminal work "Post-Cold War ASEAN Countries' Policies Towards China", utilizes historical analysis to empirically demonstrate the dual considerations shaping Singapore’s foreign policy: strategic security concerns, stemming from the inherent vulnerabilities of its defense apparatus, and the broader issues

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of international strategic political and economic development. Prof. Chen posits that Singapore's foreign policy framework primarily revolves around its internal development, complemented by its efforts to mediate conflicts among major powers, enhance its participation in international organizations, and contribute to a balanced regional political dynamic while fostering a new political and economic order in the Asia-Pacific region [4].

Luo Shuzao, an applied economist from the People's Bank of China, offers a quantitative perspective in his research "Research on Monetary Cooperation between China and ASEAN in the Context of RCEP". Employing the Optimum Currency Area (OCA) index model, Luo investigates the viability of monetary collaboration between China and ASEAN countries. The OCA index, a pivotal theory in the study of regional monetary cooperation, is applied using five indicators: output volatility, bilateral trade intensity, Consumer Price Index (CPI) disparities, variations in one-year deposit interest rates, and stock index return rates. This analysis culminates in the conclusion that among the Belt and Road countries, monetary cooperation between China and ASEAN, and by extension Singapore, is optimally positioned, underscoring Singapore's critical role in the advancement of RMB settlement globalization.

The research of Cao Tong and Zhao Ran from Renmin University of China, as presented in "Internationalization of RMB from the Perspective of Multi-core Currency Area", delves into the evolving dynamics of the international currency market. They highlight the emergence of a multi-core currency system, marked by the diminishing dominance of the US dollar post the Asian financial crisis and the rising prominence of China's RMB. This shift positions Singapore, the world's third-largest financial center, as a pivotal node in this multi-currency domain, influenced by both the US dollar and the RMB. Despite the inertia of the US dollar, the substantial trade market share presents a significant opportunity for the RMB's international expansion, particularly in Singapore, which in turn, can significantly influence the broader ASEAN region's economic development.

Furthermore, the theoretical framework provided by Prof. Joseph Nye and Prof. Robert Keohane in their book "Power and Interdependence" offers valuable insights into the concept of vulnerability within international political-economic relations and the interdependent structures of international cooperation [5]. Their analysis underscores the distinction between the influence of major powers in shaping the international order and the strategic adjustments smaller nations must undertake to mitigate their vulnerability. Applying this theory to Singapore's situation amidst US-China competition, it becomes evident that Singapore, as a middle-power nation, navigates its diplomatic choices with a focus on minimizing its vulnerability both domestically and internationally. This theoretical lens provides a robust foundation for analyzing and understanding the intricacies of Singapore's diplomatic strategies in the milieu of RMB settlement globalization and the overarching US-China strategic rivalry.

3. Research Methods and Data Sources

This study employs a multifaceted research methodology, integrating an extensive review of pertinent academic literature, research reports, and policy document data to assess the challenges and impacts of RMB settlement globalization on Singapore's international political, economic development, and foreign policy formation within the US-China competitive landscape.

The paper adopts a tripartite analytical approach, encompassing qualitative analysis, quantitative analysis, and comparative analysis. This approach leverages data from the World Bank’s public database, the People's Bank of China, and ASEAN-related reports, focusing on key metrics such as the scale of RMB settlement in Singapore, settlement modes, and the demographics of settlement customer groups. This comprehensive data compilation enables a nuanced assessment of the extent to which RMB settlement influences Singapore's economic scale and its potential to shape the country's foreign economic and monetary policies. Additionally, the study will investigate the

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interplay between RMB settlement globalization, US-China competition, and Singapore's political-economic development, considering variables such as policy environment, economic structure, and geopolitical factors [6]. The employment of diverse research methodologies not only ensures a thorough exploration of the topic but also fosters innovative perspectives and ideas, enhancing the research's originality and depth.

4. The impact of the globalization of RMB settlements on the competitive international relationship between the United States and China

The ascendancy of the RMB settlement's globalization has multifarious implications for the competitive dynamics between the United States and China, challenging the established international order.

Firstly, the globalization of RMB settlement elevates China's international monetary system status, enhancing its influence in global economic and financial affairs. In the realm of international political economy, economic ascendancy often translates into augmented political clout. As the world's second-largest economy, China's increased utilization of the RMB in settlement transactions bolsters its negotiation power in economic and financial domains, fostering a more balanced competitive relationship with the United States and other major powers. Additionally, this globalization facilitates China's financial and economic collaboration with various countries, broadening its base of international allies and partners.

Secondly, the rising prominence of the RMB in global settlements potentially diminishes the international market share of the US dollar. A greater degree of RMB globalization correlates with reduced reliance on the US dollar, granting China enhanced autonomy in international trade and finance, and concurrently diminishing US influence over China's financial system. This shift may recalibrate the competitive equilibrium between the US and China.

Thirdly, the impact on the international financial landscape is significant. The RMB, as a leading global settlement currency, challenges the hegemony of the US dollar and influences the stability and norms of the international financial market [7]. This development could intensify financial competition between the US and China, leading to more complex international relational dynamics.

In conclusion, the globalization of RMB settlement has diverse and profound effects on the competitive interplay between China and the United States. These effects range from augmenting China's international standing to reducing global dependency on the US dollar, impacting the US's perception of its superpower status, and reshaping the overall US-China competition in the international political and economic arena. This evolving competitive dynamic is set to significantly influence the future of international relations, presenting both challenges and opportunities for the diplomatic and development strategies of other nations, particularly middle powers like Singapore.)

5. Impact of the Globalization of RMB Settlement on Singapore's Political and Economic Development

The globalization of RMB settlement significantly impacts Singapore's strategies for navigating its political and economic development amid the China-US competitive dynamic. This phenomenon presents diverse opportunities for Singapore to carve its path toward development and prosperity in a complex global milieu.

Economic Opportunities: The US-China trade tensions have positioned the globalization of RMB settlement as a strategic advantage for Singapore. Serving as a financial and trade intermediary, Singapore can facilitate RMB settlements for Chinese enterprises and investors, fostering cross-border commerce. This role not only bolsters Singapore's local economic development but also

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lessens its dependency on the US-China economic nexus, opening avenues for diversified partnerships.

Enhancing Singapore as an International Financial Hub: The widespread use of RMB enhances Singapore's financial market development. By offering a spectrum of financial services, including RMB bond issuance and fund management, Singapore can attract global financial institutions and capital flows, thereby enriching its business diversity and bolstering its stature as an international financial center.

Strengthening Sino-Singaporean Relations: The expansion of RMB settlement fosters political ties between China and Singapore. Deepened financial cooperation enhances mutual trust, enabling Singapore to assert a more influential role in regional and global matters, contributing to ASEAN's peace and stabilit.

In essence, RMB settlement globalization underpins Singapore's international political and economic development amidst the US-China rivalry, offering new growth trajectories and enhancing Singapore's role in balancing great power dynamics within ASEAN.

6. Conclusion

The analysis elucidates that RMB settlement globalization positively influences Singapore's political and economic development against the backdrop of US-China competition. Amidst escalating geopolitical uncertainties, such as the Russia-Ukraine conflict and the Israeli-Palestinian tensions, leveraging RMB settlement globalization is crucial for Singapore.

Economic and Political Development: China's burgeoning economy and the drive for RMB internationalization have increased the currency's demand in Singapore. This trend facilitates trade and investment between Singapore and China, expanding Singapore's economic horizons.

Impact on Financial Market Stability: RMB settlement enables Singapore to diversify its currency reliance, reducing foreign exchange risks and fortifying local financial market stability. It also spurs new business opportunities for Singaporean financial institutions, promoting financial innovation.

US-China Rivalry: While this competition offers opportunities, like attracting investment and industrial transfers from US firms seeking to circumvent trade tensions, it also poses challenges. Singapore's economic ties with major powers and the geopolitical anxiety induced by the US-China rivalry necessitate adaptable foreign policies and diversified currency reserves.

In summary, RMB settlement globalization is a dual-edged sword for Singapore in the US-China competitive landscape, presenting both opportunities and challenges. Navigating this terrain requires Singapore to maintain agile policy responses and strategic adaptability to safeguard its regional political and economic interests.

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The Impact of Digital Currency Policies on International Trade and Investment

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Abstract: This paper examines the multifaceted impact of digital currencies on regulatory frameworks, cross-border transaction efficiency, and their integration into mainstream financial systems. Through an in-depth analysis of global policy landscapes, compliance challenges, market stability implications, and the burgeoning role of Central Bank Digital Currencies (CBDCs), we uncover the dynamics shaping the future of digital finance. Employing statistical analysis, econometric models, and case studies, we explore the reduction in transaction costs, increased speed and accessibility, and the security concerns associated with digital currencies. Furthermore, we analyze the trends in digital currency adoption and the potential for their integration with traditional financial systems. Our findings highlight the complex interplay between technological advancements and regulatory strategies, offering insights into the opportunities and challenges digital currencies present for the global economy.

Keywords: Digital Currencies, Regulatory Frameworks, Central Bank Digital Currencies (CBDCs), Cross-Border Transactions

1. Introduction

The advent of digital currencies has sparked a revolution in the financial sector, challenging traditional paradigms of currency operation and financial transactions. As these digital assets gain prominence, their potential to enhance transaction efficiency, reduce costs, and democratize access to the global financial system has become increasingly apparent. However, this potential is not without its challenges, including regulatory hurdles, market stability concerns, and security vulnerabilities. This paper aims to dissect these multifaceted aspects, focusing on the impact of digital currencies on regulatory frameworks, the efficiency of cross-border transactions, and their integration into the mainstream financial system. The regulatory landscape for digital currencies presents a patchwork of approaches, reflecting the varied priorities of different nations and economic blocs. These regulatory stances significantly influence the adoption and development of digital currencies worldwide [1]. Furthermore, digital currencies promise to streamline cross-border transactions, offering a more efficient and cost-effective alternative to traditional banking systems. However, achieving these benefits requires overcoming significant security challenges and ensuring the compatibility of digital currencies with existing financial infrastructures. Central Bank Digital Currencies (CBDCs) emerge as a pivotal development in this context, potentially bridging the gap between digital innovation and regulatory oversight. By exploring the role of CBDCs, this paper

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sheds light on how central banks might shape the future of digital finance, ensuring stability while fostering innovation. In exploring these themes, the paper utilizes a combination of quantitative and qualitative research methods, including statistical analysis, econometric modeling, and case study examination. The objective is to provide a comprehensive overview of the current state of digital currencies and their potential impact on the global financial landscape.

2. Regulatory Frameworks

2.1. Global Policy Landscape

The global policy landscape for digital currencies presents a mosaic of regulatory approaches, reflecting the diverse perspectives and priorities of different nations. Countries such as Japan and Switzerland have established themselves as pioneers in digital currency acceptance, creating regulatory frameworks that foster innovation and growth within the digital currency market. In contrast, nations like China have taken a more cautious stance, implementing stringent regulations that restrict the use of digital currencies to protect financial stability and prevent money laundering.

This disparity in regulatory environments significantly influences the global adoption rates of digital currencies. For instance, a 2021 study analyzing global digital currency adoption trends found a positive correlation between supportive regulatory environments and higher adoption rates within those jurisdictions [2]. The study utilized a composite index of regulatory openness, technological infrastructure, and digital currency market activity to quantify this relationship. The findings suggest that countries with clear, supportive regulations see increased investment in digital currency technologies and higher levels of public participation in digital currency markets.

2.2. Compliance and Enforcement Challenges

The fragmented regulatory landscape presents numerous compliance challenges for international businesses operating in the digital currency space. For example, a multinational corporation looking to leverage digital currencies for cross-border transactions must navigate a complex web of regulations that vary significantly from one jurisdiction to another. This complexity not only increases operational costs but also exposes businesses to significant legal and financial risks.

One illustrative case is the cross-border payment service offered by a global fintech company, which faced regulatory scrutiny in multiple countries for failing to comply with local anti-money laundering (AML) regulations. The company's challenges underscore the difficulties in aligning business operations with diverse regulatory requirements, particularly in ensuring that digital currency transactions adhere to local AML and counter-terrorism financing (CTF) laws [3]. To mitigate these risks, businesses often invest in sophisticated compliance systems capable of adapting to various regulatory standards, a costly but necessary measure to maintain operational integrity across borders.

2.3. Impact on Market Stability

The impact of digital currency regulations on market stability and investor confidence is profound. Regulatory announcements can lead to significant volatility in digital currency markets, as investors react to the perceived implications of policy changes for the future of digital currency use and acceptance. An econometric analysis of market reactions to regulatory news events demonstrates this volatility. For instance, the announcement of increased regulatory scrutiny by the U.S. Securities and Exchange Commission (SEC) in 2018 led to a sharp decline in Bitcoin prices, reflecting investors' concerns over potential restrictions on digital currency trading.

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Furthermore, the implementation of regulatory frameworks can have a dual effect on market stability. On one hand, clear and fair regulations can enhance market stability by providing a secure environment for investors, reducing the risk of fraud, and ensuring the integrity of digital currency transactions. On the other hand, overly restrictive or unclear regulations can stifle innovation and deter investment in digital currency markets, leading to decreased liquidity and increased volatility.

Economic models, such as the Vector Autoregression (VAR) model, have been applied to assess the impact of regulatory news on digital currency markets, revealing that regulatory events significantly influence price volatility and trading volumes [4]. These models help to quantify the sensitivity of digital currency markets to regulatory changes, offering insights into the complex interplay between policy decisions and market dynamics. Understanding these effects is crucial for policymakers aiming to balance the need for investor protection with the desire to foster innovation and growth in the burgeoning digital currency ecosystem.

3. Cross-Border Transaction Efficiency

3.1. Reduction in Transaction Costs

The advent of digital currencies has ushered in a paradigm shift in the way international transactions are conducted, primarily through the substantial reduction of transaction costs. Traditional cross-border transactions involve multiple intermediaries, each adding layers of fees, including currency conversion charges, bank fees, and processing costs. In contrast, digital currencies operate on decentralized platforms such as blockchain, which significantly streamlines the transaction process.

A quantitative analysis, utilizing a comparative model between traditional banking transactions and digital currency transactions, reveals a stark contrast in cost-efficiency. For instance, a blockchain transaction may incur a fee of less than 1% of the transaction value, compared to traditional banking systems where the cost can range from 2% to 5% or even higher, depending on the complexity and the number of intermediaries involved. This analysis draws on trade data across various sectors, including remittances, where digital currencies have already shown significant cost savings [4].

Furthermore, mathematical modeling of transaction costs in international trade scenarios underscores the potential for digital currencies to enhance economic efficiency. By applying a standard cost model to both digital and traditional transaction methods, the findings indicate that adopting digital currencies could result in annual savings of billions of dollars at the global trade level. These savings stem from the elimination of intermediary fees, lower compliance costs, and reduced need for currency conversion.

3.2. Speed and Accessibility

Digital currencies offer unparalleled speed and accessibility in international transactions, addressing two critical pain points in global trade. Traditional banking systems are often criticized for their slow processing times, especially in cross-border transactions, which can take several days to complete due to the involvement of multiple banks and legal jurisdictions. Digital currencies, however, facilitate transactions that can be completed in a matter of minutes, irrespective of the geographical locations of the parties involved.

Empirical data supports the assertion that the speed of digital currency transactions correlates with increased trade volume and improved investment decisions. Statistical models analyzing trade data pre and post the adoption of digital currencies by various businesses indicate a marked increase in trade activity, attributed to the reduced time lag in transaction completion [5]. This immediacy not only improves cash flow management for businesses but also enhances the attractiveness of investment opportunities, as investors can move capital more swiftly across borders.

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Moreover, the accessibility of digital currencies opens up international trade to a broader demographic, including small and medium-sized enterprises (SMEs) and individuals in developing countries who may lack access to traditional banking services. This democratization of finance has the potential to spur economic growth and increase participation in the global market, as evidenced by the growing number of digital wallet users in regions with underdeveloped financial infrastructure.

3.3. Security Concerns and Solutions

While digital currencies present significant advantages in terms of cost, speed, and accessibility, they are not without their security challenges. The decentralized nature of digital currencies, while reducing reliance on traditional financial intermediaries, also introduces risks related to cybersecurity, including the potential for hacking and fraud.

These security concerns are particularly pertinent in the context of international transactions, where the regulatory environment can vary significantly across jurisdictions, complicating the task of securing digital currency exchanges. However, technological solutions such as encryption and smart contracts offer robust mechanisms to mitigate these risks. Encryption ensures that transaction details are securely transmitted across networks, while smart contracts automate and enforce the terms of a transaction, reducing the potential for fraud and disputes [6].

Advanced cryptographic techniques, such as public-key cryptography, are integral to the security of digital currency transactions. This method allows for secure digital signatures, ensuring that transactions are both authentic and tamper-proof. Furthermore, the immutable nature of blockchain technology means that once a transaction is recorded, it cannot be altered, providing a permanent and transparent record of transactions.

4. Adoption and Integration into Mainstream Finance

4.1. Trends in Digital Currency Adoption

The adoption of digital currencies has demonstrated a remarkable growth trajectory, influenced by both regulatory landscapes and technological advancements across different regions. According to a study conducted by the Cambridge Centre for Alternative Finance, the global number of blockchain wallet users has increased exponentially, indicating a growing acceptance of digital currencies. This trend is not uniform across countries; for instance, while countries like Japan and South Korea exhibit high levels of adoption due to favorable regulatory environments, others remain cautious due to concerns over financial stability and security. In sectors such as retail and online services, digital currencies are increasingly accepted as a form of payment, suggesting a shift in consumer behavior towards digital payments.

A statistical analysis of adoption rates reveals that demographic factors, such as age and technology literacy, play a significant role in adopting digital currencies. Younger populations, particularly millennials, have shown a higher propensity to adopt digital currencies, driven by a penchant for digital innovations and a distrust in traditional banking systems [7]. Furthermore, the penetration of smartphone technology and internet access has facilitated this adoption, making digital currencies more accessible to a broader audience.

Economic implications of these trends are vast. As digital currencies become more mainstream, they could challenge the traditional banking system's dominance, leading to more competitive financial services and potentially lower transaction fees. However, the volatility of digital currencies poses a risk to economic stability, a factor that must be considered in any future growth projections.

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4.2. Integration with Traditional Financial Systems

The integration of digital currencies into traditional financial systems is not only a complex endeavor filled with technical and regulatory challenges but also a necessary step for their widespread acceptance and utility. The theory of network effects suggests that the more widely digital currencies are accepted, the greater their value becomes. This acceptance is crucial for enhancing the utility of digital currencies, making their integration with traditional financial systems a pivotal goal.

Technical challenges such as ensuring interoperability between digital currencies and traditional financial infrastructures, maintaining transaction security, and managing scalability are significant [8]. These challenges are compounded by the need for robust regulatory frameworks that can navigate the decentralized nature of digital currencies while safeguarding financial stability and preventing illicit activities. Regulators are tasked with striking a balance that fosters innovation and growth in digital currencies without compromising the integrity of the financial system.

Economic models like the IS-LM model help illustrate the potential impact of digital currencies on traditional economic mechanisms, such as money supply and interest rates. However, the decentralized nature of these currencies introduces complexities in applying traditional monetary policy tools. The development of digital currency exchanges regulated by financial authorities and partnerships between traditional banks and blockchain companies represent promising opportunities for integration. These initiatives can facilitate the efficient exchange between digital and fiat currencies, combining the innovative potential of blockchain technology with the regulatory expertise and customer reach of traditional banks.

The potential outcomes of this integration include increased efficiency in payment systems, reduced transaction costs, and enhanced financial inclusion. Digital currencies offer the promise of making financial services more accessible, especially to those in underserved regions, potentially driving economic empowerment and growth. Yet, the benefits come with risks, such as the potential destabilization of financial systems and the facilitation of financial crimes, underscoring the need for a careful and balanced approach to regulation [9].

In summary, the integration of digital currencies into traditional financial systems presents a path filled with opportunities and challenges. By navigating these carefully and fostering collaboration between the digital and traditional financial sectors, it is possible to harness the benefits of digital currencies while mitigating their risks, paving the way for a more inclusive and efficient global financial system.

4.3. Role of Central Bank Digital Currencies (CBDCs)

The introduction of Central Bank Digital Currencies (CBDCs) marks a transformative step in the digital finance arena, offering profound implications for the mechanics of international trade and investment. As digital counterparts of traditional fiat currencies, CBDCs are issued and regulated by the monetary authorities of their respective countries. Their design aims to merge the best attributes of digital currencies—such as efficiency and security—with the regulatory oversight and economic stability that central banks provide.

The pilot deployment of the Digital Yuan in China serves as a seminal case study, highlighting the transformative capacity of CBDCs in reshaping global financial transactions. This initiative showcases the ability of CBDCs to streamline and secure cross-border payments, significantly enhancing the speed at which these transactions are processed. Unlike traditional payment methods, which can be cumbersome and fraught with delays, CBDC transactions are nearly instantaneous, reflecting the efficiency of digital technology. Moreover, the Digital Yuan project has shown a potential to extend financial services to underserved populations, promoting financial inclusion by providing access to digital wallets and reducing reliance on physical banking infrastructures.

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Further evidence of CBDCs' impact comes from economic simulations, which indicate that their integration into the monetary system could optimize the allocation of financial resources. CBDCs offer central banks a novel instrument for monetary policy, enabling a more granular and direct management of the money supply. In periods of economic downturn or crisis, the ability to quickly adjust the supply of digital currency could afford central banks a more agile response mechanism, potentially stabilizing financial markets and mitigating the effects of economic shocks.

The implications of CBDCs extend beyond mere transactional efficiency and monetary policy flexibility. They also have the potential to significantly reduce the costs associated with international money transfers. Traditional cross-border payments involve a series of intermediaries, each adding layers of fees and complexity. By facilitating direct digital transactions, CBDCs could dramatically lower these costs, making international trade more accessible and economical for businesses of all sizes.

Moreover, CBDCs could play a critical role in combating financial crime. With advanced tracking and transparency features, CBDCs can offer a more controlled environment for monitoring transactions, helping to prevent money laundering and other illicit financial activities. This level of oversight is difficult to achieve with conventional digital currencies, which often operate on decentralized networks with varying degrees of anonymity.

However, the global adoption of CBDCs is not without challenges. Issues such as privacy concerns, interoperability between different CBDC systems, and the potential for cyber-attacks must be carefully addressed. Ensuring the resilience of CBDC infrastructure against such threats is paramount to maintaining public trust and the stability of the digital currency.

In conclusion, CBDCs represent a significant evolution in the field of digital finance, with the potential to enhance the efficiency, security, and inclusiveness of international trade and monetary policy implementation. As more countries explore and pilot their own CBDC projects, the global financial landscape stands on the cusp of a significant transformation, promising a future where digital and fiat currencies coexist and complement each other in a stable and efficient financial system.

5. Conclusion

The exploration of digital currencies and their implications for regulatory frameworks, cross-border transaction efficiency, and integration into mainstream finance reveals a landscape filled with both opportunities and challenges. While digital currencies offer the promise of more efficient, inclusive, and cost-effective financial transactions, they also pose significant challenges in terms of regulatory compliance, market stability, and security. The development of CBDCs represents a significant step towards reconciling the benefits of digital currencies with the needs of regulatory oversight and financial stability. As the digital currency landscape continues to evolve, it will be crucial for policymakers, financial institutions, and technology providers to collaborate in addressing these challenges, ensuring that the potential of digital currencies can be fully realized for the benefit of the global economy. The future of digital finance will undoubtedly be shaped by the ongoing interplay between innovation and regulation, requiring a balanced approach that fosters growth while protecting against risks.

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Exploring the Impact of Social Media Usage on Employee Performance: A Study at KPMG

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Abstract: In the era of global informatization, the proliferation of social media has significantly expanded its user base and application scope. Enterprises are increasingly incorporating social media training for employees to harness its potential in the workplace. This paper investigates the relationship between employees' social media usage and their performance by analyzing existing literature and conducting empirical research at KPMG. Utilizing SPSS26.0 software, descriptive, correlation, and regression analyses were performed on collected data to construct a questionnaire. The study identifies that internal social media usage duration positively influences task and innovation performance, while both internal and public social media usage frequency enhances task, relationship, and innovation performance. However, the duration of public social media platform usage shows no significant impact on work performance. The findings provide insights for adjusting social media usage policies and methods post-epidemic to enhance individual and organizational performance. Lastly, the paper suggests avenues for future research considering current data and analysis limitations.

Keywords: Social Media Use, Task Performance, Contextual Performance, Innovation Performance

1. Introduction

The widespread adoption of social media has transformed communication patterns, both personally and professionally. This shift is particularly notable in the corporate sector, where digital platforms have become integral to internal communication, especially amid the COVID-19 pandemic's remote work surge. These platforms facilitate real-time updates, project collaboration, and information dissemination within organizations. Additionally, public social media serves as a channel for informal communication, stress relief, and social interaction among employees. However, existing research often overlooks the nuanced effects of social media use on employee performance, particularly regarding internal versus public platform usage in terms of duration and frequency. This study investigates how the duration of internal social media use, frequency of public platform usage, and employee performance metrics (task, relationship, and innovation performance) are interrelated. Data from employees at KPMG and other foreign firms are collected through interviews and questionnaires to address this gap in understanding. Employing a mixed-method approach, insights are gathered from management perspectives and employee experiences [1]. Human resources and relevant management department interviews provide context on performance management practices and social

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media implementation, while questionnaire surveys capture employee demographics, usage patterns, and performance metrics across departments. Statistical analysis using SPSS26.0 software enables a thorough examination of the data, including situation analysis, correlation analysis, and multiple linear regression analysis, to derive actionable conclusions. This research aims to develop practical management strategies tailored to firms like KPMG, offering insights into optimizing social media usage to bolster employee performance and organizational effectiveness.

2. Literature review

2.1. Definition and classification of social media

Social media, rooted in Internet technologies, enables users to engage in content creation and exchange. This study adopts a categorization of employee social media use derived from previous scholarly definitions, distinguishing between internal social media tools and public social media platforms. Internal social media tools are deployed by companies to facilitate efficient communication and collaboration among employees. These platforms serve as centralized hubs for sharing information, coordinating tasks, and fostering teamwork. Employees utilize these tools primarily to fulfill work-related obligations, such as sending internal emails, updating project statuses, and collaborating on shared documents. The emphasis is on streamlining intra-organizational communication and enhancing productivity through seamless information sharing and real-time interaction. On the other hand, public social media platforms encompass popular networks like WeChat, QQ, Weibo, Facebook, and Twitter. These platforms cater to a broader spectrum of social needs, allowing employees to freely express themselves, stay updated on current events, and engage in informal conversations with peers and family members [2]. Employees often turn to these platforms as outlets for socializing, alleviating work-related stress, and staying connected with their social circles beyond the confines of the workplace. The classification presented in the Table 1 delineates the distinct functionalities and purposes of internal versus public social media platforms, highlighting how each serves as a catalyst for different types of interactions and engagements.

Table 1: Classification and examples of social media tools.

Classification	Examples of social media tools
In-house office	DingTalk, Enterprise, WeCha, Worktitle, Asana
Employees socialize freely	WeChat, QQ, Weibo, Facebook

2.2. Research on employee performance

Social media, rooted in Internet technologies, enables users to engage in content creation and exchange. This study adopts a categorization of employee social media use derived from previous scholarly definitions, distinguishing between internal social media tools and public social media platforms. Internal social media tools are deployed by companies to facilitate efficient communication and collaboration among employees. These platforms serve as centralized hubs for sharing information, coordinating tasks, and fostering teamwork. Employees utilize these tools primarily to fulfill work-related obligations, such as sending internal emails, updating project statuses, and collaborating on shared documents. The emphasis is on streamlining intra-organizational communication and enhancing productivity through seamless information sharing and real-time interaction. On the other hand, public social media platforms encompass popular networks like WeChat, QQ, Weibo, Facebook, and Twitter [3]. These platforms cater to a broader spectrum of social needs, allowing employees to freely express themselves, stay updated on current events, and

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engage in informal conversations with peers and family members. Employees often turn to these platforms as outlets for socializing, alleviating work-related stress, and staying connected with their social circles beyond the confines of the workplace. The classification presented in the Table 2 delineates the distinct functionalities and purposes of internal versus public social media platforms, highlighting how each serves as a catalyst for different types of interactions and engagements.

Table 2: Three major perspectives on defining employee performance.

Classification	Job performance measures
Result view	The results of employees completing tasks for the organization in work practice, and this series of results need to be closely related to the realization of organizational goals or values.
Behavioral view	The behaviors and actions that employees exhibit at work.
Comprehensive view	It should not only include the results of employees completing tasks and the behaviors performed at work, but also include work attitudes, interpersonal relationships, innovative behaviors, etc.

3. Theoretical perspective on the impact of social media on employee performance

3.1. Social capital theory

Lin Nan's social capital theory builds upon social resource theory, highlighting the societal value of resources accrued over time. These resources, categorized into social and personal resources, are vital for societal survival. Social resources encompass material and spiritual assets with economic outcomes, while personal resources focus on individual ownership and privacy, energizing the larger social resource pool. Capitalists strategically invest in social relationships to acquire market liquidity resources, navigating diverse communities and structures. Human agency drives the acquisition of social capital, as individuals proactively bolster their social standing. In the workplace, employees leverage social media to acquire essential resources, tapping into networks and collaborating online. Lin Nan's theory underscores the role of human agency in navigating social structures and using digital platforms for professional advancement [4].

3.2. Social exchange theory

Homans' social exchange theory posits that interpersonal interactions involve exchanges of resources or behaviors to achieve mutually beneficial outcomes. Individuals seek to maximize rewards and minimize costs, aiming for win-win outcomes. Active engagement on social media within organizations reflects employees' intrinsic motivation to communicate and share information. This enhances knowledge dissemination, fosters collaboration, and improves problem-solving capabilities. Social media also strengthens interpersonal relationships, building trust and cohesion within teams. This fosters a sense of belonging and boosts team morale and performance. Additionally, improved team dynamics lead to increased recognition and satisfaction, enhancing engagement and commitment to organizational goals [5]. Homans' theory provides a framework for understanding the impact of social media on employee behavior and organizational success, highlighting its potential for fostering collaboration and enhancing relationships.

3.3. Communicate visualization theory

Communication visualization theory advocates for the use of visual symbols to enhance information exchange within enterprises. Internal corporate social media platforms play a key role in promoting transparent communication among employees, facilitating seamless information exchange and

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decision-making. These platforms offer clarity and accessibility, fostering collaboration across teams and departments. Public social media platforms, while offering privacy, provide diverse channels for information dissemination, enriching employees' awareness and understanding. Overall, leveraging visual communication methods enhances information exchange and collaboration, contributing to organizational productivity and innovation [6].

4. Research model and hypothesis

4.1. The impact of social media tools on employee task performance

Corporate social media use facilitates knowledge sharing in virtual teams, enhancing individual performance. Employees actively seek network resources via the company's internal platform, staying updated on team progress and managing tasks efficiently. For example, KPMG's audit department relies on the internal system for real-time communication and task management, supporting the hypothesis that internal social media duration positively influences task performance (H1). Different departments exhibit varied work patterns. While some, like KPMG's human resources department, prioritize internal platforms for standardized procedures, others, like the audit department, emphasize usage frequency due to intermittent workflows. Thus, the hypothesis suggests that internal social media frequency positively impacts task performance (H2). Despite internal focus, many employees collaborate beyond company boundaries [7]. For instance, KPMG's recruitment team leverages both internal and public platforms for hiring. Increased public social media use reflects proactive engagement, especially evident in online recruitment during the pandemic. Hence, the hypothesis suggests that public social media platform frequency positively affects task performance (H3).

4.2. The impact of social media tools on employee relationship performance

Employees utilize social media to maintain relationships with colleagues, fostering friendship and trust, as per social exchange theory. This interaction facilitates knowledge exchange, enhancing organizational cohesion and commitment. Internal platforms, crucial for information security, foster tacit understanding and teamwork trust through frequent interaction, bolstering employees' sense of belonging and commitment to organizational goals. Thus, the hypothesis posits that internal social media use frequency positively influences relationship performance (H4). Similarly, public platforms, such as WeChat, facilitate informal communication, albeit not strictly work-related, nurturing interpersonal bonds [8]. Employees' logged-in duration on such platforms correlates with relationship performance, thus affirming the hypothesis (H5). Moreover, active engagement on public platforms strengthens camaraderie among colleagues, alleviating isolation and bolstering relationship performance, as hypothesized (H6). Through these interactions, employees forge deeper connections, fostering a conducive work environment and driving organizational success.

5. Empirical analysis

5.1. Research design

The study utilized a questionnaire survey method for data collection, incorporating established domestic and foreign scales. Questionnaires were distributed electronically via Questionnaire Star and comprised four sections: a preface, basic personal information, measurement of independent variables, and measurement of dependent variables. Dependent variables were assessed using a five-point Likert scale. To mitigate method bias, randomization of item order and a single-factor Harman test were employed, revealing no significant homologous variance bias.

Variable measurement included:

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Duration and Frequency of Internal Social Media Use: Assessing employees' engagement with internal social media in terms of duration and frequency.

Duration and Frequency of Public Social Media Use: Evaluating employees' participation in public social media platforms [9].

Task Performance: Utilizing a scale adapted from Method (2015) and Williams and Anderson (1991).

Relationship Performance: Employing a scale developed by Van Scotter and Motowidl o (1996), assessing human-computer facilitation and work dedication.

Innovation Performance: Utilizing a scale by Zhang Zhengang et al. (2016) to gauge employee innovation performance.

These standardized measurements provided robust data for analyzing the relationship between social media use and employee performance.

5.2. Sample Distribution and Analysis

A survey was conducted among employees of KPMG accounting firm via an online questionnaire. Out of 182 initial responses, 33 invalid questionnaires were excluded due to excessively short response times, resulting in 149 valid responses and an effective recovery rate of 81.87%. Demographic characteristics illustrate a predominantly young and middle-aged workforce, with a nearly balanced gender ratio and varied job positions, primarily in financial auditing.

Firstly, a focus was placed on multiple-choice questions to understand employees' preferences for public social media platforms. WeChat emerged as the most popular platform, with 28% usage, followed by DingTalk and Enterprise WeChat. Employees exhibited uniformity in platform preferences, with other platforms garnering minimal attention. Secondly, SPSS26.0 statistical analysis software was employed to compare scale scores for task performance, relationship performance, and innovation performance. This analysis provides insights into employee demographics and preferences, setting the stage for further exploration of the relationship between social media use and performance metrics [10].

5.3. Impact of Individual Factors on Employee Performance

The examination of various dimensions such as gender, marital status, age, and position type sheds light on their influence on employee performance in the workplace.

Gender Differences:

An independent sample T-test in SPSS26.0 revealed no significant differences in task performance, relationship performance, innovation performance, or overall employee performance between male and female employees. The p-values for all variables were greater than 0.05, indicating no gender-based disparities.

Marital Status Impact:

Similarly, an independent sample T-test showed no significant differences in task performance, relationship performance, innovation performance, or overall employee performance between unmarried and married employees. All p-values exceeded 0.05, suggesting marital status does not affect employee performance.

Age Variation:

An analysis of variance (ANOVA) test showed no significant difference in task performance across different age groups, but significant differences were observed in relationship performance, innovation performance, and overall employee performance. Bonferroni's post hoc multiple comparisons revealed that employees over 51 years old had significantly lower performance in these dimensions compared to younger age groups.

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Position Type Influence:

A single-factor ANOVA test indicated no significant differences in task performance, relationship performance, innovation performance, or overall employee performance across different position types. All p-values were greater than 0.05, indicating no significant impact of position type on employee performance.

These findings suggest that while individual factors such as gender, marital status, and position type may not significantly affect employee performance, age differences can influence relationship performance, innovation performance, and overall performance, particularly among older employees.

6. Conclusion

This study, drawing on social capital theory, social exchange theory, and communication visualization theory, explores how employees' use of internal and public social media affects their performance. Regression analysis of 149 data points reveals key findings: internal social media use duration positively impacts task and innovation performance, while both internal and public social media usage frequency positively affect task, relationship, and innovation performance. Public social media use duration, however, does not significantly impact performance. Control variables, notably age, may influence correlation results. The study emphasizes the importance of usage frequency over duration, highlighting employees' activity on these platforms. Management implications include fostering responsible public social media usage and leveraging social media for enhanced collaboration and data utilization. Limitations include a focus on positive impacts, neglecting potential negatives. Future research should explore social media's multifaceted nature and its impact on team performance across various industries.

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Do Cryptocurrencies Offer Benefits or New Challenges?

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Abstract: Cryptocurrencies have been controversial since their inception, and today there are more than a hundred types of cryptocurrencies. People can trade freely without the control of any person or organization. After a period of development, cryptocurrencies already have a large number of users. The high rate of return also makes people more accepting of cryptocurrencies. However, cryptocurrencies still have many problems. For example, there is a serious conflict between the infrastructure and philosophy of cryptocurrencies and traditional monetary systems. This article identifies the impact cryptocurrencies have on individuals, governments, and the environment. What benefits cryptocurrencies offer and what challenges they face are discussed from different perspectives. This article discusses these controversial points in detail, points out the possible future development trends of cryptocurrencies, and gives relevant recommendations in this regard.

Keywords: The cryptocurrency, finance, monetary system

1. Introduction

A cryptocurrency is a protocol for issuing digital tokens to people through digital technology within a specific range [1]. With the popularity of Bitcoin, cryptocurrencies became widely known. The emergence of cryptocurrencies will technically have varying degrees of impact on the economic system. For example, cryptocurrencies have the characteristics of decentralization and can operate without the intervention of any third party. The specific value of different economies in different contexts can be quantified, and even cryptocurrencies may become a unit of measurement in the future [2]. People have been exploring the uses of this technology and hope that it can be applied to daily work and life. In fact, the development of cryptocurrencies is still in its infancy, and its security and acceptance have yet to be improved. On top of that, cryptocurrencies can't really be fully used in people's lives right now. Most governments around the world do not recognize cryptocurrencies as having the properties of money, and most people just use it as a tool to make money [3]. Because cryptocurrency transactions are irreversible and difficult to trace, fraud or theft can be irretrievable. However, it is precisely because of this feature that the user's personal privacy is protected to a certain extent. In conclusion, whether cryptocurrencies actually advance society is still a matter of debate.

This article discusses the contributions and challenges of cryptocurrencies from three perspectives: individuals, governments and the environment. It shows that the emergence of cryptocurrencies has launched new challenges to the traditional financial system and monetary system. The government will face greater regulatory pressure. It is undeniable that although cryptocurrency investors are plagued by investment risks and security issues, the rapid growth of cryptocurrency market value still

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attracts a large amount of investment. At this stage, cryptocurrencies have demonstrated their unique advantages in many ways. This paper argues that cryptocurrencies have great potential for development and can bring more economic benefits. In addition, the research depth of this paper on the operation mechanism of cryptocurrencies is limited, which is limited by the length of the paper. At the same time, the impact of cryptocurrencies is not only on the three aspects of individuals, governments and the environment, other impacts still need to be discussed in detail.

2. The impact of cryptocurrencies on people

This chapter discusses the impact of cryptocurrencies on people in terms of their market value and investment risk.

With the emergence of cryptocurrencies in recent years, more and more people have begun to pay attention to and invest in cryptocurrencies [4] [5]. Cryptocurrencies are making the financial system more advanced and efficient. The emergence of cryptocurrencies has brought people faster asset transfer capabilities, cheaper transaction costs, and no need for any third-party agency to act as an intermediary for transactions [6]. The market value of cryptocurrencies by 2021 is approximately $625 billion, most of which comes from Bitcoin [7]. Bouri et al. even stated in a study that Bitcoin may become an alternative currency for state-issued currencies in the future [8]. However, the real market value of cryptocurrencies is less than 1% of global GDP [9]. Therefore, it is not yet certain whether cryptocurrencies can truly become an alternative currency for state-issued currencies in the future. Cryptocurrencies have shown a strong ability to grow in value, Lammer et al. stated in their research that Bitcoin's compound growth rate reached 1300% in 2017 alone [10]. A higher growth rate means more people will join the investment. According to the survey, due to the large price fluctuations of Bitcoin, most individual investors still show a conservative attitude towards the long-term holding of cryptocurrencies. However, the rapidly growing rate of return has made more and more people willing to invest in cryptocurrencies [11].

Cryptocurrencies carry higher risks for those who invest in them. There are many characteristics of cryptocurrencies, such as decentralization, irreversibility of transactions, anonymity, etc. These features seem to keep the property safe, however, there is also a huge risk involved. For example, anonymity makes investors unable to get their cryptocurrencies back after a cryptocurrency exchange goes bankrupt or is hacked, and also faces the risk of huge property losses [12]. The developers of the cryptocurrencies involved have made many security plugins to reduce the risk, which may allow the cryptocurrencies to function properly in most cases. However, Kadyrov & Prokhorov mentioned in the research report that even with the enhanced protection level, about $200 million worth of assets are still stolen from crypto wallets every year [12]. The characteristics of blockchain technology and decentralization determine that cryptocurrencies operate completely independently, which makes cryptocurrency transactions lack legal protection [5]. At the same time, the irreversibility of the transaction will make it impossible to retrieve the defrauded cryptocurrency, which also means that the deceived crypto wallet owner will bear all economic losses. It is worth noting that although cryptocurrencies still lack legal support, there is evidence that judicial departments in some countries and regions are already trying to define cryptocurrency theft as a crime. For example, Zaytoun stated in a study that state legislatures and federal law enforcement agencies in the United States have adopted strict control measures against cybercrime, especially theft, and used the National Stolen Property Act ("NSPA") as the basic act to Address potential fraud and theft in cryptocurrency transactions [13]. While it is still uncertain whether such a bill would have an effect on reducing the risk of cryptocurrency investments, cryptocurrencies are supported to a certain extent by the law.

In fact, investing in cryptocurrencies does not necessarily mean facing higher risks. Research by Esmaeilzadeh, Hemang and Cousins shows that more respondents believe that cryptocurrencies have greater potential value than possible problems and systemic risks[14]. For example, anonymity

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though there may be an issue of not being able to get back the cryptocurrency. However, in most common cryptocurrency transactions, anonymity protects the personal privacy of both parties and reduces the risk of the transaction. At the same time, a study of the population holding cryptocurrencies found that most of them are financially sound. According to Faria in a study on the cryptocurrency investment population, the majority of cryptocurrency holders are young men with relatively high incomes, who are more able to bear financial risks than those who do not hold cryptocurrencies powerful [15]. At the same time, Faria further concluded through research that good personal risk tolerance and more financial literacy increase the possibility of holding cryptocurrencies [15]. It is worth noting that the new crown epidemic has had a huge impact on the global economy, which makes the risk of personal investment in cryptocurrencies higher than before the new crown epidemic. This may make more people lose more money in the process of investing in cryptocurrencies, and it also puts forward higher requirements on the investment ability of cryptocurrency investors.

With the rapid growth of the cryptocurrency market value and more and more investors joining in, the issue of investment risk will be mentioned by more and more people. For this new investment field, most people report a cautious attitude, the higher returns and better market conditions make them still list cryptocurrencies as investable projects.

3. The impact of cryptocurrencies on government

This chapter will discuss the relationship between government and cryptocurrencies through four aspects of cryptocurrency transaction tax and traditional financial system and cryptocurrency regulation and trust issues.

Cryptocurrencies can bring benefits to governments. Increasingly government Taxing cryptocurrency transactions [16]. From this perspective, the government does not resist cryptocurrencies. According to Thiemann, the EU's total capital gains income from Bitcoin reached 12.7 billion euros, and the EU's potential tax revenue in 2020 alone should be 850 million euros [17]. Opening up new tax avenues is what many countries and regions prefer to see. More taxation is important to the EU at the moment, and 850 million euros is not a small income. If this part of the potential revenue is used to solve Europe's energy crisis, it may help the EU relieve some of the pressure from funding. In addition, the United States, Canada, Indonesia and other countries are also taxing cryptocurrencies [18]. It is worth noting that the way the government calculates the tax is questionable, because currently cryptocurrency transactions carry no information about anyone, which makes it difficult for the government to track revenue from cryptocurrencies [19]. To this end, the government needs an effective tax management policy, and at the same time, it needs to clarify the scope of tax payment. For example, in the scope of taxation, should the transaction tax generated in the process of trading cryptocurrencies and the income tax generated by individuals and businesses profiting from cryptocurrencies should be included? And how to judge the generation of these taxes is something that governments should consider next, and taxing cryptocurrencies is impractical until these issues are addressed.

However, cryptocurrencies have not necessarily brought more benefits to governments. The government is losing the traditional financial system while gaining more tax revenue. According to research by Kubát, governments should distance themselves from cryptocurrencies, for example: the Czech Central Bank stated that cryptocurrencies are not regulated by it, and also warned that the decentralized nature of cryptocurrencies could negatively affect fiat currencies [20]. The decentralization and anonymity of cryptocurrencies have created challenges that the law may not be able to address today [21]. In addition, Aggarwal et al. claim that market manipulation is likely to occur in the process of cryptocurrency transactions, which may easily make people lose their money. Because the cryptocurrency market is free and unregulated [22]. In fact, this is what the government

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does not want to see, and it is not conducive to social governance. China has completely banned the circulation and buying and selling of cryptocurrencies and stipulated that the RMB is the only 'legally enforced currency' [21]. Nonetheless, there is no complete guarantee that cryptocurrencies will not have an impact on the yuan, which is unrealistic.

In fact, cryptocurrencies are not the only reason for the destruction of the traditional financial system. The shock of the financial crisis also makes the traditional financial system very vulnerable [23]. For example, after the 2008 financial crisis, many institutions like Lehman Brothers went bankrupt one after another, and even affected financial giants like Bank of America, JPMorgan Chase, and Citibank [24]. People gradually began to less trust in traditional banks, and there was a crisis of trust to varying degrees. However, the emergence of cryptocurrencies has largely solved people's trust anxiety. A more plausible approach is for governments to start trying to regulate cryptocurrencies, for example: the United States classifies some cryptocurrencies under the Securities Act, while both the U.S. Securities and Exchange Commission (SEC) and the Financial Crimes Enforcement Network (FinCEN) regulate cryptocurrencies. Incorporate regulation and treat cryptocurrency transactions as monetary businesses [21]. There is evidence that government regulation of cryptocurrencies has the potential to enhance institutional and consumer trust in cryptocurrency transactions [25], which can tax fiat currencies without threatening them. Of course, this idea still needs a lot of time to verify. While this approach seems feasible, it is worth noting that regulating cryptocurrencies is a very large and complex project, which may impose additional regulatory costs on governments [26].

Cryptocurrency and the government are not completely opposite. Cryptocurrency may bring more benefits to the government. For example, the legislation and control of cryptocurrencies can bring more tax to the government. However, a perfect solution is still needed. Regulatory system to operate, and even the government will add more additional costs.

4. The impact of cryptocurrencies on environment

This chapter discusses the impact of cryptocurrencies on the environment by analyzing the energy consumption and sustainable development capabilities of cryptocurrencies in the process of development.

Cryptocurrencies use energy efficiently. In the traditional impression, cryptocurrencies are not environmentally friendly. In fact, the vast majority of electricity used in crypto mining comes from renewable energy sources such as hydroelectric power [27]. From this perspective, cryptocurrency is a relatively environmentally friendly industry. While causing a small emission burden on the environment, the growing market value provides a steady stream of impetus for economic development. According to a research report by Stonberg, crypto mining plays an important role in saving energy by using excess electricity to prevent wastage of energy [28]. However, because crypto mining is working all day, this can put a lot of pressure on the local grid during peak electricity consumption. At the same time, after the excess electricity is used up, crypto mining still needs electricity to keep running, it will consume the extra electricity.

Cryptocurrencies are consuming a lot of energy. Cryptocurrencies do not appear to be contributing enough in terms of environmental protection, even though the vast majority of crypto mining uses renewable energy. However, there is still a part of crypto mining that still uses non-renewable energy, which has a certain impact on the environment, which may also become a bottleneck for the development of cryptocurrencies. More carbon emissions accelerate the rate of global warming, which largely goes against the idea of sustainable development. Egiyi and Ofoegbu stated that if the massive consumption of electricity by cryptocurrency cannot be reduced in the future, it may face the risk of global warming of 2 degrees Celsius [29]. From the perspective of energy consumption, many countries are skeptical of cryptocurrencies, and the high energy consumption characteristics of cryptocurrencies are out of tune with the current theme of green development. In a study on the

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environmental impact of cryptocurrencies, Mohsin stated that the energy consumption of cryptocurrencies will even exceed the energy consumption of entire countries like Sweden and Malaysia [30]. In the future, if the market value of cryptocurrencies continues to grow rapidly, more energy will be used for cryptocurrencies. According to data, in just a few years, Bitcoin mining consumes 1% of global energy consumption, which is about 5 billion watts [30]. Excessive energy consumption will only make environmental problems worse.

In the short term, the development of cryptocurrencies may put considerable pressure on the environment. However, in the long run, cryptocurrencies may support sustainable development under high market enthusiasm. This has contributed to the growth of the economy in part as more and more people invest in cryptocurrencies. Economic benefits translate into environmental sustainability, while also driving social development [31]. Whether cryptocurrencies can bring greater help to the development of society is still an issue that most researchers are currently debating. The advantages of Bitcoin in energy consumption and environmental protection are obviously insufficient, whether Bitcoin can make up for these deficiencies in other aspects. Whether cryptocurrencies have the ability to create more value far beyond the cost of energy consumption is quite difficult to judge, and still needs more time to prove.

The impact of cryptocurrencies on the environment seems to be very worrying at present, which may not be in line with the concept of green development. How to maintain the sustainable development of cryptocurrencies is an issue that needs to be seriously considered. However, having a larger market and mature users is the future trend of cryptocurrencies, and more economic benefits will be transformed into a driving force for sustainable development.

5. Conclusion

To conclusion, the rapid growth in the value of the cryptocurrency market and the new decentralized transaction model have made people gradually realize that this is likely to be the next more efficient economic model. In the research of this paper, it is found that cryptocurrencies stimulate the development of the economy to varying degrees, bring additional taxes to the government and have the advantage of rational use of excess electricity. This shows that cryptocurrencies have great potential for development. However, the emergence of cryptocurrencies has also brought more new challenges. For example, issues such as transaction security, investment risk, excessive energy consumption, and even challenges to the traditional financial system. Evidence shows that there is still a lot of uncertainty in cryptocurrencies, and a lot of research is still needed. In this paper, the research on the operation mechanism of cryptocurrency is very limited, and more research processes are presented in the way of its impact. This article argues that the increasing use of cryptocurrencies means that more and more people are beginning to recognize its value. Since it is impossible to completely deny the value that cryptocurrencies provide, what can be done is to make them better regulated. What is uncertain is whether people will continue to use cryptocurrencies if they start to be regulated in the future. The correct use of cryptocurrencies enables them to promote economic development and even human development.

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Integrating Advanced Technologies in Financial Risk Management: A Comprehensive Analysis

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Abstract: This paper delves into the pivotal role of advanced technologies in enhancing financial risk management across various domains, including credit risk, market risk, operational risk, and liquidity risk. It meticulously explores the application of machine learning (ML) algorithms and artificial intelligence (AI) in developing sophisticated risk assessment models, portfolio diversification strategies, and regulatory compliance mechanisms, which collectively surpass traditional methodologies in accuracy, efficiency, and predictive power. Through a detailed examination of enhanced Value at Risk (VaR) models, dynamic hedging strategies, and the impact of geopolitical events on market risk, alongside innovative approaches to operational risk mitigation and liquidity planning, this study underscores the transformative potential of technological advancements in financial risk management. It highlights how these technologies facilitate real-time analysis, predictive modeling, and strategic planning, significantly contributing to the resilience and stability of financial institutions in the face of evolving risks and regulatory requirements.

Keywords: Financial Risk Management, Machine Learning, Artificial Intelligence, Credit Risk, Market Risk

1. Introduction

In the rapidly evolving landscape of global finance, the management of financial risk remains a critical concern for institutions aiming to maintain stability, compliance, and competitive advantage. Traditional approaches to risk management, while foundational, increasingly fall short in addressing the complexity and dynamism of modern financial markets. This shortfall has paved the way for the integration of advanced technologies such as artificial intelligence (AI) and machine learning (ML), heralding a new era in financial risk management. This paper aims to critically analyze the transformative impact of these technologies across key domains of financial risk management, including credit risk, market risk, operational risk, and liquidity risk. The advent of AI and ML has enabled the development of more sophisticated risk assessment models, which are capable of analyzing vast datasets to uncover complex, nonlinear relationships that elude traditional statistical methods. These models enhance the accuracy of credit scoring, facilitate dynamic portfolio diversification, and improve regulatory compliance reporting [1]. Furthermore, the application of advanced quantitative analysis techniques and hedging strategies has significantly bolstered market risk management, allowing for a nuanced understanding of risk exposures and the formulation of robust mitigation strategies. Operational risk management, too, has benefited from technological

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innovations, with blockchain technology and AI-driven process automation enhancing transaction security and efficiency. Meanwhile, in the realm of liquidity risk management, AI and ML models offer unprecedented precision in cash flow forecasting and the development of contingent funding strategies, ensuring that financial institutions can adeptly navigate liquidity crises. As financial institutions grapple with the challenges posed by complex financial products, volatile markets, and stringent regulatory demands, the adoption of advanced technologies in risk management practices becomes not just advantageous but essential. This paper provides a comprehensive overview of current applications and explores the potential for future innovations, arguing that the strategic integration of technology is indispensable for the effective management of financial risk in today's digital age.

2. Credit Risk Management

2.1. Risk Assessment Models

Modern risk assessment models in credit risk management incorporate machine learning algorithms that significantly outperform traditional statistical methods by analyzing complex, nonlinear relationships within large datasets. For example, Gradient Boosting Machines (GBM) have emerged as a powerful tool for credit scoring, offering high accuracy by iteratively correcting errors of weak prediction models to strengthen the overall prediction capability. These models utilize features like payment history, credit utilization, length of credit history, new credit accounts, and types of credit in use from credit report data, incorporating non-traditional data sources such as mobile phone usage and social media activity to enhance predictive power [2]. Neural Networks, especially Deep Learning models, are employed to capture complex interactions between variables that are not apparent to simpler models. These networks, through their layered structure, can model intricate patterns in data, learning from vast amounts of unstructured data, which traditional models cannot process effectively. The adoption of these advanced models enables credit institutions to dynamically assess and update the risk associated with potential borrowers, factoring in real-time changes in economic conditions, borrower behavior, and market trends [3].

2.2. Portfolio Diversification Strategies

The application of cluster analysis in portfolio diversification involves grouping assets based on similarity in returns, volatility, and other market behaviors, identifying clusters of assets that provide the best diversification benefits. This method helps in understanding the complex structure of financial markets and in constructing portfolios that are more resilient to market shocks. Principal Component Analysis (PCA), another sophisticated technique, reduces the dimensionality of the dataset by identifying the principal components that explain the most variance in the data, aiding in the understanding of key risk factors that affect portfolio performance. Dynamic portfolio optimization models use these insights to adjust portfolio allocations in real time [4]. By incorporating predictive analytics, these models can forecast market movements and adjust the portfolio composition to optimize for the highest risk-adjusted returns. This proactive approach to portfolio management enables institutions to navigate market volatilities more effectively, securing optimal performance across different market conditions.

2.3. Regulatory Compliance and Reporting

The integration of RegTech solutions for regulatory compliance leverages technologies such as big data analytics, AI, and blockchain to streamline the compliance process. Big data analytics facilitate the rapid processing and analysis of vast volumes of transaction data, identifying potential areas of

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risk that require attention [5]. AI algorithms enhance the efficiency of compliance by automating the detection of patterns indicative of fraudulent activities or breaches of regulatory limits. Blockchain technology offers a decentralized ledger that provides a transparent and immutable record of transactions, enhancing the auditability of financial operations and ensuring the integrity of the data used in compliance reporting. This technology facilitates real-time monitoring and reporting, reducing the time and cost associated with regulatory compliance. Moreover, NLP is used to stay abreast of regulatory changes, automatically updating compliance systems and documentation to reflect the latest regulatory requirements, thus ensuring that institutions remain compliant in a dynamically changing regulatory landscape [6].

3. Market Risk Management

3.1. Quantitative Analysis Techniques

Enhanced Value at Risk (VaR) models using Monte Carlo simulations powered by AI not only predict potential losses over various time horizons but also incorporate scenario analysis to account for extreme market events. These simulations, by generating a wide range of possible outcomes based on historical market data, allow institutions to visualize potential risk exposures under a variety of market conditions. This comprehensive approach to risk modeling enables better-informed decision-making regarding asset allocation, hedging strategies, and capital reserves [7]. AI-enhanced stress testing goes beyond traditional models by incorporating complex, multi-factor scenarios that simulate the impact of various market conditions on portfolio performance. These models analyze the portfolio's sensitivity to changes in interest rates, exchange rates, commodity prices, and other key market variables. By assessing the impact of these variables under adverse conditions, financial institutions can better prepare for potential market downturns, ensuring they maintain adequate capital buffers and risk mitigation strategies to safeguard against significant losses. These advanced quantitative analysis techniques represent a significant evolution in market risk management, offering a more dynamic and nuanced approach to understanding and mitigating market risks [8]. Through the application of sophisticated modeling and simulation tools, financial institutions can navigate the complexities of the market with greater confidence, ensuring stability and resilience in the face of market volatilities.

3.2. Hedging Strategies

Hedging, a critical strategy in market risk management, involves the use of derivatives and other financial instruments to safeguard against potential losses. The sophistication of hedging strategies has evolved, driven by advancements in simulation and backtesting tools. High-performance computing has enabled the development of complex models that simulate various market conditions and the performance of hedging strategies against those conditions. Options, futures, forwards, and swaps are among the derivatives commonly used in hedging. The choice of instrument and strategy—whether it's delta hedging with options or employing interest rate swaps to manage rate risk—depends on the specific market exposure and risk appetite of the entity [9]. Simulation tools, powered by high-performance computing, allow for extensive backtesting of these strategies under historical market conditions, providing valuable insights into their effectiveness and potential pitfalls. Moreover, the use of algorithmic trading in executing hedging strategies has increased, allowing for the automatic adjustment of positions in response to market movements. This real-time risk management capability, underpinned by sophisticated models and computing power, significantly enhances the ability to mitigate market risk effectively.

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4. Operational Risk Management

4.1. Technology and Process Innovations

The mitigation of operational risk is increasingly reliant on technological innovations, which serve as a cornerstone for enhancing transaction security and efficiency. Among these innovations, blockchain technology and smart contracts have emerged as transformative tools in the financial sector. Blockchain's decentralized ledger provides an immutable record of transactions, significantly reducing the risk of fraud and errors [10]. This technology facilitates transparent and secure peer-to-peer transactions without the need for traditional intermediaries, thereby streamlining operations and reducing costs. Smart contracts, self-executing contracts with the terms of the agreement directly written into code, further enhance transaction security and efficiency. They automatically enforce and execute contract terms, reducing the reliance on manual processes and the potential for human error. AI-driven process automation represents another significant leap forward in operational risk management. Through the application of artificial intelligence and machine learning algorithms, financial institutions are able to automate complex, time-consuming processes such as compliance checks, risk assessments, and customer service operations [11]. This not only boosts operational efficiency but also reduces the scope for human error, a major component of operational risk. Moreover, AI and ML enable the analysis of vast datasets to identify risk patterns and predict potential operational issues before they arise, allowing for proactive risk management.

4.2. Cybersecurity Measures

As financial institutions increasingly digitize their operations, the threat landscape expands, making cybersecurity a critical pillar of operational risk management. Cybersecurity measures in financial institutions are comprehensive, encompassing both technological solutions and organizational strategies to protect sensitive information and systems from cyber threats. Real-time threat detection systems, employing advanced algorithms and machine learning, continuously monitor for suspicious activities, enabling swift identification and mitigation of potential security breaches. These systems are complemented by robust encryption methods, secure access controls, and regular security audits to ensure the integrity and confidentiality of data. Furthermore, cybersecurity frameworks within financial institutions are designed to be adaptive, evolving in response to the dynamic nature of cyber threats [12]. They incorporate incident response plans that outline procedures for addressing security breaches, minimizing their impact and restoring normal operations as quickly as possible. Employee training programs are also a critical component, equipping staff with the knowledge to recognize phishing attempts and other cyber threats, thereby strengthening the human element of cybersecurity defenses.

4.3. Business Continuity Planning

Business continuity planning (BCP) is essential for financial institutions to maintain operations in the face of disruptions, whether they arise from natural disasters, technological failures, or cyber incidents. Advanced planning tools and simulations play a pivotal role in preparing for such events, allowing institutions to model various disruption scenarios and assess their potential impact on operations. These tools help in identifying critical functions and processes that are vital for maintaining operations and in developing strategies to ensure their continuity or rapid recovery. Effective business continuity planning involves a comprehensive approach, encompassing not just IT infrastructure but also human resources, facilities, and communication channels. Recovery strategies may include redundant systems, backup data centers, and alternative work arrangements, such as remote work capabilities [13]. Regular testing and drills are crucial to ensure that plans are effective

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and that staff are familiar with emergency procedures. Moreover, BCP is not static; it requires ongoing review and adaptation to reflect changes in the operational environment and emerging threats. This dynamic approach ensures that financial institutions can respond flexibly and resiliently to disruptions, minimizing downtime and financial impact. The ultimate goal of business continuity planning is to ensure that financial institutions can continue to provide essential services to their customers, even in the face of unforeseen challenges, thereby maintaining trust and stability in the financial system.

5. Liquidity Risk Management

5.1. Cash Flow Forecasting

In the domain of liquidity risk management, the accuracy of cash flow forecasting emerges as a paramount concern. The traditional methodologies, while providing a foundational approach, often fall short in capturing the dynamic intricacies of modern financial markets. Enter Artificial Intelligence (AI) and Machine Learning (ML) models, which mark a significant departure from these conventional techniques. By leveraging vast datasets encompassing historical transactions, market trends, and economic indicators, these models apply complex algorithms to predict future cash flows with a high degree of precision. The implementation of AI in cash flow forecasting involves the utilization of neural networks and deep learning techniques, capable of recognizing patterns and anomalies in data that are not immediately apparent. These technologies enable financial analysts to forecast cash inflows and outflows with enhanced accuracy, facilitating more informed decision-making regarding asset-liability management. For instance, by accurately predicting periods of cash shortfall or surplus, institutions can optimize their investment strategies, maintain adequate liquidity buffers, and avoid costly emergency funding. Furthermore, ML models continuously refine their predictions through feedback loops, adapting to new financial conditions and market events. This adaptive learning capability ensures that liquidity planning remains robust against the backdrop of an ever-evolving financial landscape. As such, AI and ML do not merely enhance the precision of cash flow forecasts; they transform liquidity risk management into a more proactive and strategic function within financial institutions.

5.2. Contingent Funding Strategies

The development of contingent funding strategies stands as a critical pillar in safeguarding against liquidity crises. Given the unpredictable nature of financial markets, institutions must prepare for scenarios in which access to regular funding sources becomes constrained. Sophisticated models, harnessing the power of simulation and stress testing, play a pivotal role in this preparation. These models enable financial institutions to anticipate the impact of various stress scenarios, ranging from market downturns to sudden withdrawals of deposits, and assess the resilience of their funding strategies under such conditions. Utilizing Monte Carlo simulations or scenario-based analysis, institutions can explore a wide array of adverse conditions, evaluating how different funding sources — such as central bank facilities, secured borrowings, or asset sales — would perform. The objective is to identify potential funding gaps and develop strategies that are both feasible and effective in bridging these gaps during periods of financial stress. This approach not only aids in the formulation of robust contingent funding plans but also supports the strategic allocation of assets and liabilities to ensure liquidity under stress conditions. Moreover, these models facilitate a deeper understanding of the cost implications associated with various funding sources under stress conditions. Financial institutions can thereby strategically plan their capital allocation to minimize costs while ensuring liquidity.

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6. Conclusion

The integration of advanced technologies such as AI and ML into financial risk management represents a significant paradigm shift, offering enhanced capabilities in risk identification, assessment, and mitigation. As demonstrated in this paper, these technologies have profound implications across various domains of financial risk, including credit, market, operational, and liquidity risk management. Through the adoption of sophisticated risk assessment models, dynamic portfolio diversification strategies, and efficient regulatory compliance mechanisms, financial institutions are not only able to achieve greater accuracy and efficiency but also to foster resilience and adaptability in an ever-changing financial landscape. The findings of this study underscore the importance of embracing technological advancements for future-proofing risk management strategies. As financial markets continue to evolve, marked by increasing complexity and regulatory scrutiny, the role of technology in enabling proactive and predictive risk management will undoubtedly become more pronounced. It is imperative for financial institutions to invest in these technologies, cultivate expertise, and foster innovation to navigate the risks and opportunities of the digital era. This exploration into the integration of advanced technologies within financial risk management highlights a promising pathway towards achieving enhanced operational efficiency, regulatory compliance, and strategic foresight. As the financial sector progresses, continued research and development in these technological applications will be essential in shaping resilient and forward-looking risk management frameworks.

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Organizational Strategic Navigation in a Dynamic Environment: Insights into Market Competition, Technological Change, and Policy Dynamics

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Abstract: In today's rapidly evolving business landscape, organizations encounter a myriad of challenges that stem from intense market competition, swift technological advancements, and the intricate web of regulatory complexities. This article delves deep into the strategic approaches employed by firms to navigate these hurdles, with a special focus on essential areas such as market positioning, brand development, technological innovation, digital transformation, legal compliance, and policy adaptability. Through a detailed investigation and analysis, this study uncovers the profound effects of market dynamics, technological disruptions, and policy uncertainties on the practices of strategic management. It meticulously examines how organizations adapt to the fast-paced changes in the environment, leverage technology for competitive advantage, and ensure compliance with evolving regulations. Furthermore, the article discusses the importance of strategic flexibility and the ability to swiftly respond to market and technological shifts. By shedding light on these critical aspects, the study aims to enrich the understanding of strategic management in the modern business era, providing valuable insights for academics, practitioners, and policymakers alike. This comprehensive exploration underscores the need for an agile, forward-thinking approach in formulating strategies that can withstand the pressures of today's dynamic business environment.

Keywords: strategic management, market competition, technological change, policy dynamics, organizational strategy

1. Introduction

In the ever-evolving seas of contemporary commerce, organizations are perpetually caught in a maelstrom of challenges and opportunities. The current landscape, characterized by its ferocious market competition, rapid technological progress, and constantly changing regulatory frameworks, demands a robust and dynamic approach to strategic management. This vital discipline serves not just as a navigational tool but as a beacon of resilience and adaptability, guiding organizations through the unpredictable waters of global business. The essence of today's economic environment is uncertainty, propelled by the fast-paced evolution of market trends, consumer behaviors, and technological advancements. This paper seeks to shed light on the complex web of factors that organizations must navigate to secure their position and advance in such a fluid context. It delves into

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the crucial aspects of strategic decision-making, which include but are not limited to, discerning market dynamics, leveraging technological disruptions, understanding policy and regulatory requirements, and crafting a sustainable competitive advantage. Through a meticulous exploration of these themes, this study aims to dissect the nuances of strategic management, highlighting its indispensable role in enabling organizations to not only survive but flourish. By examining the processes through which companies identify opportunities, mitigate risks, and harness innovation, the paper endeavors to offer profound insights into the strategic maneuvers that define success in the modern business era [1]. The focus extends beyond mere survival tactics to emphasize the importance of proactive growth strategies such as market positioning, brand development, technological advancement, and regulatory compliance. This comprehensive analysis aims to equip business leaders, strategists, and policymakers with the knowledge and tools necessary to chart a course toward enduring success. In doing so, it contributes to the broader discourse on how organizations can transform challenges into stepping stones for growth, thereby turning the tide in their favor in an age marked by relentless change and boundless possibilities.

2. The impact of market competition on strategic management

2.1. the importance of market positioning

In the competitive market environment, market positioning is one of the keys to organizational success. Market positioning is not simply about bringing a product or service to market, but about understanding the needs, preferences, and behavior patterns of the target audience through in-depth market research and analysis. First, the organization needs to segment the market into different segments in order to better understand the characteristics and needs of each market. Second, for different market segments, the organization needs to determine their target market, and clearly target customer groups. This includes key information such as their age, gender, income level and buying habits. Through market positioning, an organization can accurately position its own products or services to meet the specific needs of customers, thereby gaining a competitive advantage. For example, a high-end fashion brand may choose to target high-income groups to provide high-quality, high-value products and services [2]. On the other hand, a mass-market company may choose to offer affordable, functional products to attract a broader customer base. In developing a market positioning strategy, an organization should consider its own resources and capabilities, as well as the behavior and market trends of its competitors. At the same time, to pay attention to establish good communication and relationship with the target customer groups, in order to timely understand customer demand changes, and flexible adjustment of market positioning strategy. Most importantly, market positioning is not static, but needs to be adjusted and optimized as the market environment changes and the organization develops [3].

2.2. brand building and competition for market share

Brand building is the key to win the trust and recognition of customers in the market. A strong brand can not only raise awareness of a product or service, but also add value to the product or service, making it stand out in a competitive market. Brand building needs the organization to invest a lot of resources and energy, through marketing, advertising, public relations activities and other means, shape and brand image in line with the corporate image and product image.

In the process of brand building, organizations need to pay attention to brand consistency and stability, to ensure that brand image and corporate culture and core values consistent [4]. At the same time, we should pay attention to the feedback and evaluation of consumers, constantly improve and optimize products or services, improve brand quality and reputation. Through brand building, the

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organization can set up a good brand image in the market, attract more customers and consumers, thus increasing market share and achieving sustained growth and development.

3. Challenges of technological change to strategic management

3.1. promotion of Technological Innovation

Technological innovation is not only a simple means of business competition, but also leads the entire industrial chain of change and progress. With the continuous development of science and technology, the emergence of new technologies continue to subvert the traditional business model and market rules. For organizations, faced with such a fast-changing technological environment, not only need to keep up with the pace of technological innovation, but also need to have a forward-looking thinking and layout. First of all, technological innovation brings about the replacement of products and services, making the original products or services are quickly eliminated or replaced. Therefore, organizations need to continue to carry out technological research and development and innovation to ensure their competitiveness in the market. Secondly, technological innovation also intensifies the intensity of market competition, because the introduction of new technologies often break the existing market pattern, to traditional enterprises bring great challenges [5]. Therefore, the organization needs to have flexible strategic adaptability, Timely Adjustment of strategy to meet the new market needs and competitive environment. In addition, technological innovation also brings more opportunities for cooperation and openness, such as open innovation model, cooperation in the upper and lower reaches of the industrial chain, etc. , work with external partners to promote technological innovation and industrial upgrading.

3.2. the importance of digital transformation

With the wide application of digital technology, digital transformation has become an inevitable choice for the development of organizations. Digital transformation is not only the application of technology, but also a comprehensive change, which involves the change of organizational structure, process, culture and other aspects. First, digital transformation can improve the business efficiency and productivity of the organization. By introducing advanced information technologies, such as cloud computing and big data analytics, organizations can automate and optimize business processes and improve productivity and quality. Second, digital transformation can promote organizational innovation. Digital technology brings new business opportunities and models for organizations, such as the Internet of things, blockchain, etc. . Organizations can achieve product and service innovation through these new technologies, thus winning market competitive advantage. In addition, digital transformation can also change the culture and management of the organization. The traditional organization structure and management mode are often limited to the vertical flow and centralized management of information, and the digital transformation can break this traditional limitation, and realize the platform and network management of information, promote information sharing and collaboration, improve organizational flexibility and adaptability. Therefore, digital transformation has become one of the key paths for organizations to achieve sustainable development and long-term competitive advantage [6]. These delve into the specific aspects of the challenges of technological innovation and digital transformation to strategic management, from strategy formulation to implementation, from organizational culture to management models, and explore the complexity and impact of these challenges in a holistic manner, for the strategic management of theoretical research and practice to provide more in-depth thinking and guidance [7].

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4. The impact of policies and regulations on strategic management

4.1. the importance of legal compliance

In the changing environment, organizations need to strictly abide by relevant laws and regulations, which is not only a moral responsibility, but also an important means to protect the long-term interests of enterprises. First, legal compliance helps reduce the legal risks faced by organizations. As regulations are updated and changed, organizations must keep abreast of and adapt to them to avoid possible fines, lawsuits or other legal consequences. For example, for a multinational enterprise, the laws and regulations of different countries may differ and serious liability issues may arise if the organization is negligent in the legal requirements of a particular country. Therefore, strict compliance with laws and regulations is an important means to protect enterprises from legal risks. Second, legal compliance helps to establish a good corporate image. In today's society, a growing sense of social responsibility, the public on the moral and legal conduct of enterprises more attention. As part of corporate citizenship, businesses must therefore operate in an honest and transparent manner and ensure compliance with all relevant laws and regulations. Such behaviour not only helps to build trust and reputation, but also to attract more customers, investors and partners, thus promoting the sustainable development of the enterprise. For example, some enterprises have established a good corporate image by actively participating in public welfare activities or complying with environmental laws and regulations. In addition, legal compliance also helps to improve the efficiency of enterprise management and operational stability. Through the establishment of a sound legal compliance system and processes, the organization can regulate internal behavior, to prevent violations of the law and regulations [8]. This will not only help to protect the interests of enterprises, but also improve the efficiency of enterprise management and reduce the risk of internal disputes and legal proceedings. At the same time, compliance with laws and regulations can also create a stable business environment for enterprises, conducive to long-term development and sustainable profits.
To sum up, the importance of legal compliance to the organization is self-evident. As the foundation and premise of Enterprise Management, legal compliance is not only the foundation of enterprise legal operation, but also the embodiment of enterprise sustainable development and social responsibility [9]. Therefore, the organization must attach great importance to the legal compliance work, establish a sound legal compliance mechanism to ensure that enterprises in the legal compliance on the basis of sound development.

4.2. uncertainty in the policy environment

The uncertainty of the policy environment brings great challenges to the organization's strategy-making. Policy changes may lead to changes in market rules, affecting the organization's operating environment and profit space. Therefore, organizations need to pay close attention to the dynamics of policy changes, and timely adjustment of strategies to adapt to the new policy environment.

The uncertainty of policy environment brings unpredictable factors to enterprise strategy making. The policy change may lead to the invalidation or restriction of the original strategy of the enterprise, thus affecting the market position and profitability of the enterprise. For example, new regulatory policies or restrictions imposed by governments on certain industries may result in increased production costs, reduced market share or restricted market access for enterprises, and then affect the enterprise's profitability and development prospects. Therefore, enterprises must pay close attention to the dynamics of policy changes, timely adjustment of strategies to reduce the impact of policy risks. The uncertainty of policy environment may also lead to more decision-making dilemma in the process of strategy-making [10]. Because of the uncertainty of policy change, it is difficult for enterprises to accurately predict the future policy trend and impact, thus increasing the uncertainty and risk of

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decision-making. For example, in an uncertain policy environment, an enterprise may face major decisions in the areas of product pricing, marketing, investment expansion, etc. , but because the impact of policy changes can not be accurately predicted, these decisions may bring more risk and uncertainty. Therefore, enterprises must strengthen strategic planning and decision-making management, timely adjustment of strategy, reduce the impact of policy risks. In addition, the uncertainty of policy environment also provides certain development and innovation opportunities for enterprises. Because the change of policy may lead to the change of market pattern and industry competition pattern, enterprises can grasp the market opportunity and realize rapid development through flexible strategy adjustment. For example, the introduction of new industrial policies or support policies may provide enterprises with more development opportunities and resource support, thus achieving rapid expansion and development of enterprises.

To sum up, the uncertainty of the policy environment brings great challenges to the enterprise strategy making, but it also provides certain development and innovation opportunities for the enterprise. Enterprises must pay close attention to the dynamics of policy changes, strengthen strategic planning and decision-making management to reduce the impact of policy risks, and seize market opportunities to achieve sustained development and innovation.

5. Future research directions

5.1. strengthen strategic implementation capacity

Future research can explore how to improve the strategic implementation capacity of organizations to ensure the smooth implementation of strategic objectives and achieve the expected results. This includes establishing effective performance management mechanisms to ensure that strategic objectives are clearly communicated to each department and individual, and to motivate employee performance through performance evaluations and rewards and punishments. At the same time, the research can also focus on how to establish an effective communication mechanism to ensure that the strategic objectives can be understood and accepted by all employees, thus improving the overall implementation efficiency of the organization. In addition, strengthening the organizational culture is also key, because culture can have a profound impact on the behavior of employees, and thus affect the implementation of the strategy [11]. Future research can further explore how to promote employees' recognition and implementation of strategic goals through the shaping of organizational culture, and how to deal with the challenges brought by cultural differences.

5.2. in-depth study on digital transformation

With the continuous development of digital technology, digital transformation has become an important trend of organizational development. Future research can explore the impact of digital transformation on organizational strategic management. Specifically, research can focus on how the digital transformation is changing the way organizations do business, mode of production, and interact with customers and suppliers [12]. At the same time, we also need to study how to effectively address the challenges of the digital transition, such as data security and privacy protection, and how to take full advantage of the opportunities presented by the digital transition, for example, through big data analysis and artificial intelligence technology to improve organizational decision-making efficiency and innovation. In addition, the study can also explore the impact of digital transformation on organizational structure and culture, and how to adjust organizational management model to meet the needs of digital transformation [13].

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6. Conclusion

In conclusion, the journey through the turbulent seas of contemporary commerce reveals the indispensable role of strategic management as the linchpin of organizational success and sustainability. This exploration has illuminated the multifaceted challenges that today's organizations face, from fierce market competition and rapid technological evolution to complex regulatory landscapes. Strategic management stands as the cornerstone of navigating these challenges, offering a framework for decision-making that is both agile and foresighted. The comprehensive examination of market dynamics, technological disruptions, policy intricacies, and competitive strategies underscores the breadth and depth of strategic management. It highlights how effective positioning, brand strengthening, innovation, and compliance are not merely elements of organizational strategy but are the very fabric of sustainable success in today's volatile business environment. This study has endeavored to provide a panoramic view of the strategic imperatives that drive organizational resilience and growth. By dissecting the strategies that enable businesses to adapt, innovate, and lead, it offers valuable insights for leaders aiming to steer their organizations toward a prosperous future. In an era defined by constant flux, the ability to anticipate change, embrace innovation, and remain steadfast in the face of adversity is more than a strategic advantage—it is the hallmark of enduring excellence. Ultimately, this paper contributes to the ongoing dialogue on strategic management in the modern era, inviting further exploration and discussion among scholars, practitioners, and policymakers. As organizations continue to navigate the complexities of the global market, the principles and practices of strategic management will remain their most trusted compass, guiding them through uncertainty and change toward success and sustainability.

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Enhancing Energy Management in New Energy Vehicles and Energy Storage Systems Through Advanced Data Analysis and Machine Learning

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Abstract: This paper explores the pivotal role of data analysis and machine learning in advancing energy management strategies for New Energy Vehicles (NEVs) and Energy Storage Systems (ESS). Focused on the comprehensive journey from data collection and preprocessing to the application of dynamic programming, reinforcement learning, and genetic algorithms, our study underscores the transformational impact of these technologies on optimizing energy utilization and prolonging battery life. Initial stages involve meticulous data gathering and preprocessing to ensure the quality and usability of information derived from operational parameters. Subsequently, feature selection and engineering refine this data into meaningful insights, laying the groundwork for predictive modeling. These models forecast energy demands and system behavior, facilitating proactive maintenance and system efficiency improvements. We delve into optimization strategies, highlighting dynamic programming's role in decision-making, reinforcement learning's adaptability to environmental changes, and genetic algorithms' exploration of optimal charging/discharging strategies. These methodologies collectively contribute to sustainable energy practices and resource conservation, marking significant advancements in the field. The integration of machine learning not only enhances predictive maintenance and charging protocol optimization but also addresses challenges related to data scarcity, model generalizability, and interpretability. This paper provides a comprehensive analysis of current methodologies and future prospects, advocating for a multidisciplinary approach to further enrich the research landscape in energy management for NEVs and ESS.

Keywords: New Energy Vehicles, Energy Storage Systems, Data Analysis, Machine Learning, Predictive Modeling

1. Introduction

The transition to sustainable energy sources and the optimization of energy consumption have become paramount in the face of escalating environmental concerns and the finite nature of fossil fuels. Particularly, the automotive sector and energy storage industries are under increasing pressure to enhance efficiency and adopt green technologies. New Energy Vehicles (NEVs) and Energy Storage Systems (ESS) represent critical advancements in this quest, yet their widespread adoption hinges on overcoming significant challenges in energy management. This paper investigates the application of

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advanced data analysis and machine learning techniques as transformative tools for addressing these challenges. Beginning with the critical task of data collection and preprocessing, we explore the multifaceted process of gathering and refining operational data from NEVs and ESS. This foundation enables the subsequent stages of feature selection and engineering, which are essential for transforming raw data into actionable insights. The core of our analysis focuses on predictive modeling techniques, including regression, time series analysis, and machine learning algorithms, that forecast future energy demands and system behavior. These predictions are crucial for implementing proactive maintenance strategies and enhancing system efficiency. Furthermore, we examine optimization strategies that leverage dynamic programming, reinforcement learning, and genetic algorithms to fine-tune energy consumption and charging protocols. These approaches not only aim to maximize the operational lifespan of batteries but also to ensure the sustainable utilization of resources. Through a comprehensive review of current methodologies and an exploration of future prospects, this paper contributes to the academic and practical discussions on improving energy management in NEVs and ESS [1]. By highlighting the importance of interdisciplinary collaboration and the integration of machine learning with physics-based modeling, we underscore the potential for significant advancements in the field.

2. Data Analysis for Energy Management

2.1. Data Collection and Preprocessing

Data collection for energy management in New Energy Vehicles (NEVs) and Energy Storage Systems (ESS) encompasses the acquisition of multivariate data streams capturing various operational parameters. These parameters include real-time measurements of battery status, such as voltage, current, temperature, and State of Charge (SoC), alongside environmental conditions and driving behaviors. The process involves the integration of sensor data from onboard systems and external sources, generating extensive datasets for analysis. Preprocessing techniques play a pivotal role in ensuring data quality and usability. Approaches such as data cleaning, normalization, and outlier detection are employed to rectify inconsistencies, handle missing values, and mitigate noise inherent in sensor data. Furthermore, feature extraction methods are applied to derive informative features from raw data, enhancing the predictive capability of subsequent modeling algorithms [2]. Table 1 illustrates how data from various sensors are collected at different frequencies depending on their nature and importance.

Table 1: Data Collection and Preprocessing Framework for NEVs and ESS Operational Parameters

Parameter	Sensor Type	Data Type	Frequency	Preprocessing Steps
Voltage	Voltage sensor	Continuous	1 Hz	Normalization, Outlier detection
Current	Current sensor	Continuous	1 Hz	Normalization, Outlier detection
Temperature	Temperature sensor	Continuous	0.5 Hz	Normalization, Outlier detection, Smoothing
State of Charge (SoC)	SoC sensor	Continuous	0.2 Hz	Normalization, Outlier detection
Environmental Conditions	Environmental sensor	Discrete	On event	Data cleaning, Missing value handling
Driving Behaviors	Behavioral sensor	Discrete	On event	Data cleaning, Feature extraction

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2.2. Feature Selection and Engineering

Feature selection and engineering involve identifying and crafting relevant features that capture the underlying dynamics of energy consumption and system behavior. In NEVs, features such as battery charge/discharge rates, energy consumption patterns, and driving profiles are pivotal for characterizing vehicle performance and energy usage. Similarly, for ESS, features encompass parameters such as charging/discharging rates, energy capacity, and efficiency metrics, which provide insights into system operation and effectiveness. Feature engineering techniques, including time-series decomposition, Fourier analysis, and principal component analysis (PCA), are employed to extract salient features and reduce dimensionality while preserving essential information. These engineered features serve as input variables for predictive models, facilitating accurate forecasting and decision-making in energy management [3].

2.3. Predictive Modeling

Predictive modeling forms the cornerstone of machine learning-based energy management systems, enabling the anticipation of future energy demands and system behavior. Leveraging historical data, predictive models are trained using regression, time series analysis, and machine learning algorithms to capture temporal dependencies and patterns in energy consumption. Time series forecasting techniques, such as autoregressive integrated moving average (ARIMA) and long short-term memory (LSTM) networks, are utilized to predict future energy requirements and optimize resource allocation, as shown in Figure 1 [4]. Classification algorithms are employed to identify anomalous events and predict system failures, enabling proactive maintenance and mitigation strategies. By harnessing predictive models, energy management systems can optimize energy utilization, extend battery lifespan, and enhance overall system efficiency, contributing to sustainable energy practices and resource conservation.

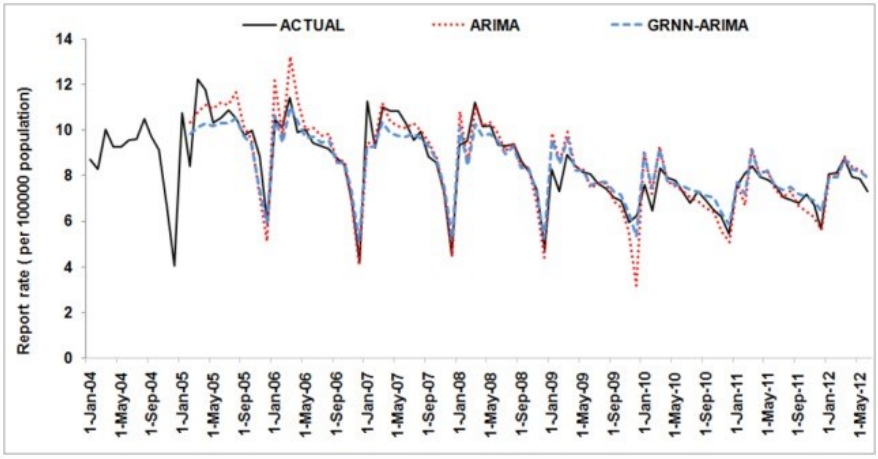

Figure 1: ARIMA=the autoregressive integrated moving average

3. Optimization Strategies for Energy Utilization

3.1. Dynamic Programming

Dynamic programming is a powerful optimization technique that involves breaking down a complex problem into smaller subproblems and solving each subproblem optimally. In the context of energy management for NEVs, dynamic programming algorithms can be applied to determine the most efficient driving routes, speeds, and energy management strategies. By considering the long-term

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consequences of different decision paths, dynamic programming seeks to minimize energy consumption while meeting performance constraints such as arrival time or battery range [5].

For instance, in electric vehicles (EVs), dynamic programming algorithms can optimize route planning by considering factors such as traffic conditions, road gradients, and charging station locations. By analyzing historical traffic data and real-time traffic updates, the algorithm can identify the most fuel-efficient route to reach the destination within the specified time frame. Additionally, dynamic programming can adjust driving speeds and energy usage based on terrain profiles, optimizing energy efficiency during uphill climbs and regenerative braking during downhill descents. Similarly, in energy storage systems (ESS), dynamic programming can optimize charging and discharging schedules to balance energy supply and demand while maximizing system efficiency and reliability, as shown in Figure 2. By considering factors such as electricity prices, grid conditions, and system constraints, dynamic programming algorithms can determine the optimal timing and duration of charging/discharging cycles to minimize operating costs and ensure grid stability. Dynamic programming approaches are particularly well-suited for problems with overlapping substructures and optimal substructure properties, allowing for efficient computation of optimal solutions. However, the main drawback of dynamic programming is its computational complexity, which may limit its scalability to large-scale systems or real-time applications [6]. Nevertheless, with advancements in computing technology and algorithmic optimizations, dynamic programming remains a valuable tool for energy optimization in NEVs and ESS.

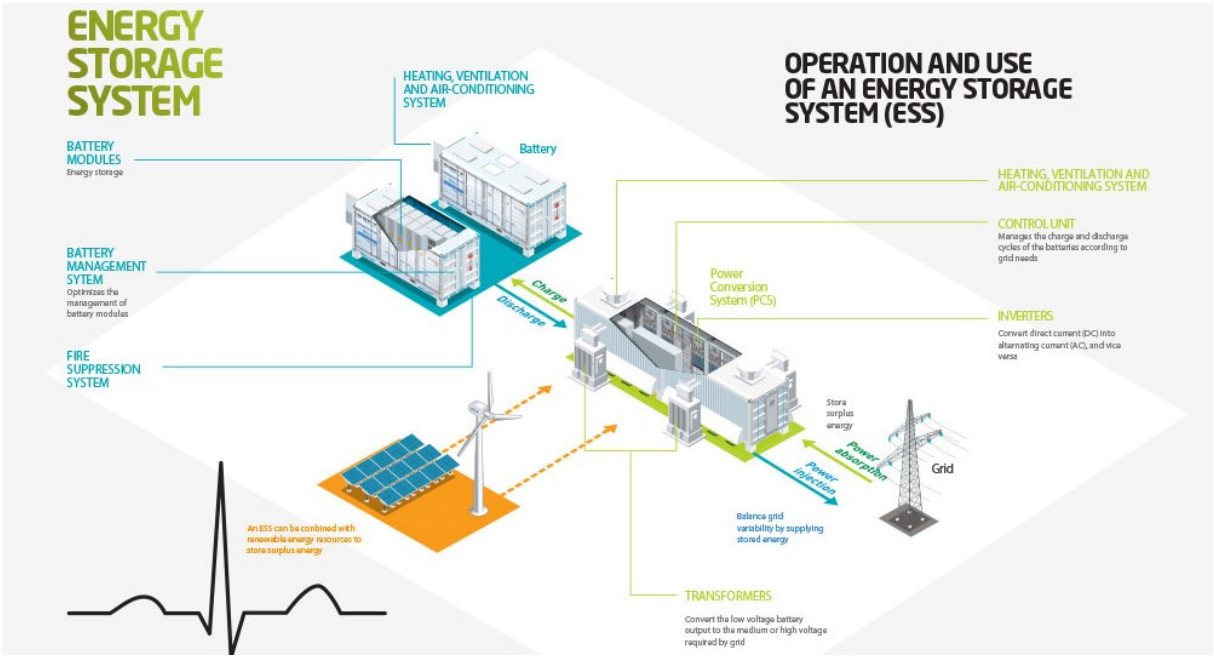

Figure 2: Operation and use of an Energy Storage System (ESS) (Source: Saft Batteries)

3.2. Reinforcement Learning

Reinforcement learning is a machine learning paradigm that enables agents to learn optimal decision-making policies through trial and error interactions with the environment. In the context of energy management, reinforcement learning algorithms can be employed to adaptively adjust driving behaviors and energy consumption patterns in response to changing environmental conditions and user preferences.

For NEVs, reinforcement learning algorithms can optimize driving strategies by continuously learning from feedback received during driving experiences. By rewarding energy-efficient driving

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behaviors and penalizing wasteful practices, such as aggressive acceleration or sudden braking, reinforcement learning agents can adapt their driving styles to minimize energy consumption while maintaining comfort and safety levels for passengers. Moreover, reinforcement learning can facilitate personalized energy management solutions by adapting to individual driving habits and preferences. By analyzing driving patterns and user feedback, reinforcement learning agents can tailor energy management strategies to suit the unique needs and preferences of each driver, optimizing energy utilization and enhancing user satisfaction. In the context of ESS, reinforcement learning can optimize energy storage and release strategies to maximize revenue in energy markets while ensuring system stability and reliability [7]. By learning from market dynamics, grid conditions, and historical data, reinforcement learning agents can adaptively adjust charging/discharging schedules to exploit market opportunities and mitigate risks, such as price fluctuations or supply shortages. However, the effectiveness of reinforcement learning approaches in energy management relies heavily on the quality of feedback received from the environment and the design of reward mechanisms. Moreover, reinforcement learning algorithms may require significant computational resources and training data to achieve satisfactory performance levels, limiting their applicability in real-time applications or resource-constrained environments.

4. Predictive Modeling for Remaining Useful Life (RUL) Estimation

4.1. Style and spacing

The precise estimation of the Remaining Useful Life (RUL) of batteries in New Energy Vehicles (NEVs) and Energy Storage Systems (ESS) is pivotal for optimizing operational strategies and preemptive maintenance scheduling. Leveraging Gaussian process regression (GPR) and Long Short-Term Memory (LSTM) networks, predictive models can infer the degradation trajectory of batteries from complex, nonlinear operational data. GPR, with its probabilistic approach, offers insights into the uncertainty of RUL predictions, enabling a risk-informed maintenance strategy. This model is particularly adept at handling the noisy and sparse data typically associated with battery operations, providing a robust framework for RUL estimation under uncertain conditions. LSTM networks, characterized by their ability to remember long-term dependencies, are effectively used to model the sequential and temporal dynamics of battery usage patterns [8]. By analyzing sequences of charging and discharging cycles, ambient temperatures, and load variations, LSTM models can accurately predict when a battery will reach its end-of-life based on its current and past states. This capability is invaluable for implementing dynamic maintenance schedules and optimizing battery replacement strategies, ensuring the continuous reliability and efficiency of NEVs and ESS. The integration of these advanced machine learning techniques into battery health monitoring systems marks a significant step forward in predictive maintenance. By accurately estimating RUL, stakeholders can make informed decisions about battery management, reducing unexpected downtimes and extending the operational lifespan of battery systems. Leveraging the strengths of Gaussian Process Regression (GPR) and Long Short-Term Memory (LSTM) networks, the predictive estimation of a battery's Remaining Useful Life (RUL) can be succinctly represented by the following conceptual formula, encapsulating the sophisticated process of analyzing operational data to inform maintenance and replacement strategies:

$$RUL = f(GPR(LSTM(Operational\ Data))) \tag{1}$$

Where: RUL is the Remaining Useful Life of the battery. f represents the predictive modeling function that estimates RUL [9]. GPR denotes the Gaussian Process Regression model that provides a probabilistic approach to handling uncertainties in RUL predictions. $LSTM$ indicates the Long

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Short-Term Memory network used to process and analyze sequential and temporal dynamics in the operational data. Operational Data includes sequences of charging and discharging cycles, ambient temperatures, and load variations, which are key factors influencing battery degradation and RUL [10].

4.2. Optimization of Charging Protocols Using Reinforcement Learning

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Reinforcement Learning (RL) offers a paradigm shift in the optimization of charging protocols for NEVs and ESS, focusing on the dynamic adaptation of strategies to maximize battery lifespan while minimizing charging time and energy costs. In this context, Q-learning, a popular RL algorithm, excels by learning optimal actions (charging rates and modes) in various states (battery's current SoC, temperature, etc.) through the evaluation of rewards and penalties [11]. The algorithm iteratively updates its strategy to reflect the most energy-efficient charging paths with the least wear on the battery. This RL-based approach facilitates the development of intelligent charging systems capable of adjusting parameters in real-time based on the battery's condition and the grid's demand-response signals. For instance, during periods of low energy demand or high renewable generation, the system might opt for slower charging rates to optimize energy costs and reduce stress on the battery. Conversely, in scenarios requiring rapid charging, the system could implement fast charging at the least detrimental times, considering battery health indicators and historical performance data [12]. Such adaptive charging strategies not only enhance the operational efficiency of battery systems but also contribute significantly to the integration of renewable energy sources by aligning charging times with periods of high renewable energy availability, thereby supporting the transition to a more sustainable energy ecosystem.

5. Conclusion

The exploration of data analysis and machine learning within the context of New Energy Vehicles (NEVs) and Energy Storage Systems (ESS) underscores a transformative era in energy management. Through meticulous data collection and preprocessing, feature selection and engineering, and predictive modeling, this study has illuminated the pathways through which advanced technologies can enhance system efficiency, prolong battery life, and optimize energy utilization. The application of dynamic programming, reinforcement learning, and genetic algorithms further demonstrates the potential for innovative optimization strategies that respond adaptively to the complex dynamics of energy systems. This paper not only provides a comprehensive analysis of current methodologies but also projects a vision for the future, highlighting the importance of interdisciplinary research and the fusion of machine learning with traditional modeling techniques. As the field evolves, the integration of these approaches promises to overcome existing challenges and pave the way for more sustainable, efficient, and reliable energy management in NEVs and ESS, contributing to the broader goals of environmental sustainability and resource conservation.

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Ethical IT Decision Making and Data Governance

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Abstract: This paper explores the importance of data governance in influencing ethical decision-making in the context of information technology (IT). Data governance is used as a management technique to ensure the quality of organisational data by establishing and implementing policies, procedures and standards. Three main types of data governance are discussed: silo-oriented data governance, functional data governance, and platform data governance. The impact of each type on ethical IT decision-making is analysed, highlighting the challenges and benefits associated with each approach.

Ethical IT decision-making hinges on robust data governance. Silo-oriented governance fosters fragmentation, conflicting standards, and security vulnerabilities. Functional Data Governance tailors policies to departments, enhancing accountability and risk mitigation but may lack unified ethics. Platform Data Governance builds on this, ensuring clearer accountability, data privacy, and unified ethical standards. To foster ethical IT decision-making, prioritize Platform Data Governance, establish a data platform for security, cultivate a unified ethical culture, and enforce organizational standards. These steps promote accountability, mitigate risks, and safeguard data integrity, crucial for ethically sound IT decisions in today's complex landscape.

Keywords: Data governance, Ethical decision-making, IT

1. Introduction

1.1. What is ethical decision-making (EDM)

When people or organizations are presented with morally significant circumstances or dilemmas, they use ethical principles and values to guide their decision-making. This process is known as ethical decision-making.

An individual's ethical decision-making is significantly influenced by his or her feelings, experiences, and intuitions, according to research in moral psychology. An individual's intuition will first provide a preliminary judgment while making a decision, indicating whether it is moral, immoral, or in the middle. [1]

Human emotions are also a significant predictor of moral decision-making at the same time. Emotion is a direct feeling state, whereas intuition is a hazy, hard-to-express feeling.

The following categories of emotions are regarded to be more closely associated with EDM: 1. "Prosocial" emotions—like empathy, sympathy, concern, or sympathy—that encourage morally

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righteous behavior; 2. "Reproach" emotions—like shame and remorse; 3. or "other blame" feelings of revulsion, rage, and contempt.[2]

At the same time, consideration of environmental and human concerns is necessary when determining if an action complies with ethical norms. Environmental considerations include the moral severity of the issue (i.e., whether it violates the law or infringes on the rights of others), the issue's complexity and relevance, and the moral character and moral propensity of the decision-maker.

1.2. Ethical decision-making in IT

Decision-making is the behavior of human beings when faced with choices. In order to make the right decision, people usually need to have a deeper understanding of the problem, collect information related to the problem, and finally take actions they believe are feasible. Believe it will meet their expectations.[3]

The decisions humans make are often a combination of logic and experience. People often make initial judgments based on past experience or "gut feeling" and then make logical judgments by collecting and analyzing data or other information.

Today, as IT develops more and more rapidly, ethical IT decision-making has become a new topic. What actions and decisions are unethical? Under what circumstances is AI not allowed to be used? In the IT field, these must be discussed.[4]

For example, today with the continuous development of digital technology, the combination of IT technology and business has brought huge changes to modern business decision-making models. Through the training of IT models, the model can predict future development through past data and make decisions. IT models are more logical than human thinking and are not affected by subjective emotions, so they may not be consistent with ethical decision-making.[5]

1.3. The importance of ethical IT decision-making

IT ethical decision-making plays an important role in many aspects. For society, as an important achievement of technological development, IT also leads to various problems, such as data leakage, network security, etc. Therefore, IT ethical decision-making can ensure the stability of society. It is also necessary for organizations to reduce the occurrence of these accidents, which ensures the interests of the organization. At the same time, ensuring that organizations that implement ethical IT decisions can win a good social reputation is also very important for the long-term operation of the organization.[6]

For individuals, ethical IT decisions can ensure that their interests are not harmed, such as preventing the proliferation of pirated software and the leakage of private data.

2. Data governance

Data governance is a technique for managing IT data that, via the creation and application of organizational policies, procedures, and standards, guarantees the quality of the organization's data, including data availability, security, integrity, etc. For IT companies, data governance is a crucial management tool. The value of data inside the company can rise with the implementation of a data governance structure. Data governance influences results based on data, from more complicated automated projects to more straightforward daily business decisions, by enhancing overall data accuracy. [7]

Data governance activities are mostly driven by efforts related to big data and digital transformation. Organizations require more effective data governance procedures as the volumes of data from new data sources, such Internet of Things (IoT) technology, expand.

Three different types of data governance:

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2.1. Silo-oriented data governance

Silo-oriented data governance tends to store different data in different departments.As a result, various departments may create unique policies, frameworks, or methods for handling data. To a certain extent, this data management technique can provide flexibility, but if different departments don't work together, there may be job duplication, low productivity, biased decision-making, and other issues.

2.2. Functional Data Governance

This method bases the organization and execution of data governance operations on the functional requirements and demands of various departments or business units. Within each functional domain, functional data governance clearly delineates who owns and is responsible for data management. This guarantees that the quality, integrity, and security of the data that each department's teams or individuals use and administer remain their responsibility. A dedicated data administrator is in charge of managing the uniform storage of data inside a data set. The organization owns the data; it is not dispersed among many divisions.

2.3. Platform Data Governance

Platform data governance creates a framework for processing and storing data. On this platform, members of organizations may exchange and access data. Additionally, by putting in place strong governance procedures, these organizations can make sure that their data assets are managed sensibly and efficiently to support business goals while lowering risk.[8]

3. What does it mean for ethical IT decision-making

3.1. If data governance is mature and executed well?

Let’s discuss it in different situations.

3.1.1. Silo-oriented data governance

Dispersed data makes it more difficult to collect and analyze information, and it prevents organizations from developing a consistent strategy for making ethical IT decisions. Because of this, several corporate divisions or departments may have ethical standards that differ from one another or even contradict.

It is also challenging for organizations to create strong ethical accountability systems because of data fragmentation.It can be challenging for organizations to identify the root cause of ethical IT concerns and to hold people accountable. In addition, the possibility of a recurrence of the issue increases with the incapacity to effectively seek accountability.

Data security threats are also brought on by the scattered nature of data across departments. There is a higher chance of data theft when organizations are unable to establish a centralized, trustworthy database.

Information leakage issues, ambiguous accountability frameworks, and conflicting ethical norms might result from silo-oriented data governance. Therefore, silo-oriented data governance might not be the best option for morally sound IT decision-making.

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3.1.2. Functional Data Governance

Functional Data Governance rules and processes to each business function's ethical aims and concerns is made possible by functional data governance. This consistency promotes a culture of ethical IT decision-making by guaranteeing that ethical considerations are included into each department's fundamental data governance policies.
Simultaneously, there is a defined ownership and responsibility for data in functional data governance, which makes it possible to effectively pursue accountability in the event of ethical difficulties to stop them from happening again.

Depending on the particular data requirements and hazards connected to each business function, Functional Data Governance can establish tailored ethical safeguards and controls. Through customization, organizations can mitigate possible harm by addressing ethical concerns including prejudice, security, and data privacy in a targeted manner.

Similar to Silo-oriented data governance, Functional Data Governance may also have unified ethical standards and a lack of communication between departments, resulting in different ethical standards.

Therefore, if the organisation has a mature Functional Data Governance, it will greatly help the organisation to achieve ETHICAL IT decision-making, including the formation of a good culture of ethical IT decision-making, a clear system of accountability, and the protection of data privacy, etc., but it may not be possible to form a unified code of ethics. There is a certain amount of ethical risk.

3.1.3. Platform Data Governance

Platform data governance further improves Functional Data Governance, with a clearer accountability system for effective recourse in organisations that practice Platform data governance. At the same time, data privacy is better protected as data is stored, managed, and recalled in a unified manner on a well-built platform, and only those with permissions can access the data.

At the same time, platform data governance establishes clear ethical guidelines and policies for data management within a given technology platform. Therefore, organisations can establish unified ethical standards that are well suited for ethical IT decision-making.

4. Advice

From the above points, we can see that ethical IT decision-making can be guaranteed by implementing Platform Data Governance. At the same time, building a data platform can also ensure the organization’s data security.

In addition, establishing unified ethical standards for the organization and cultivating an organizational ethical decision-making culture can also promote ethical IT decision-making.

5. Conclusion

Moral decision-making is a decision involving principles and values that a person makes when faced with a moral issue. Factors influencing ethical decision-making include personal ethical factors (intuition and emotion) and ethical situational factors.

Because it safeguards human interests, lowers data-related incidents, improves an organization's social reputation, and upholds social stability, ethical IT decision-making is extremely important to people, organizations, and society as a whole. In order to achieve ethical IT decision-making, data governance is essential for guaranteeing the accuracy, safety, and compliance of data. To fulfill various data management demands and give companies and individuals assurance to support the

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attainment of business objectives, reduce risk, and promote long-term sustainable development, it is split into three types: silo-oriented, functional, and platform-oriented.

Different types of data governance have different impacts on ethical decision-making. Platform data governance, which establishes unified ethical standards for the organization, is the best data governance for ethical IT decision-making.

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Forecasting Gold Futures Prices: An Empirical Analysis Using the Vector Autoregression Model

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Abstract: This study presents an empirical examination of the Vector Autoregression (VAR) model's efficacy in predicting gold futures prices, a critical analysis for investors and financial analysts amidst global economic fluctuations. The research leverages a dataset spanning from January 4, 2010, to June 7, 2024, derived from Investing.com, encompassing a multitude of financial indicators such as gold and silver futures, the US Dollar Index, and Brent Crude Oil futures.The methodology includes a comprehensive data preparation phase, ensuring the stationarity of time series data through Augmented Dickey-Fuller (ADF) testing and cointegration analysis. The VAR model is meticulously estimated, identifying the lag order that optimizes model performance while mitigating overfitting risks.The empirical findings underscore the VAR model's high accuracy in forecasting gold futures prices, with significant influences attributed to silver futures prices, the US Dollar Index, and Brent Crude Oil futures. Despite minor discrepancies in capturing short-term price volatility, the model adeptly reflects overall market trends.The study acknowledges limitations, such as the potential exclusion of influential variables and the scope of data timeframe, suggesting future research should expand variable inclusion and integrate advanced prediction techniques. The paper concludes that the VAR model is a robust analytical instrument for predicting gold futures prices, offering substantial support for strategic financial decision-making.

Keywords: Vector Autoregression, Gold Futures Prediction, Economic Indicators, Financial Modeling, Time Series Analysis.

1. Introduction

With the continuous development of the global economy, international financial markets have become the main platform for economic interdependence and interaction among countries. As an important component of the international financial market, the gold market has always been highly regarded. Gold, as an important safe haven asset and investment tool, has profound impacts on the global economy due to its price fluctuations and changes. Owing to the influence of the gold market can be extended to the gold futures market, gold futures have emerged as a star product in the financial futures market, occupying a substantial trading volume and proportion in numerous exchanges. They serve as the primary choice for many market participants to hedge and avoid risks [1]. Therefore, the price fluctuations of gold futures are an essential basis for investors to make judgments before making investment decisions. It is imperative to construct a reasonable and

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effective futures prediction model to reveal the trend of gold futures prices and provide investors with a reliable reference for investment directions.

2. Literature Review

The Vector Autoregression (VAR) model is a commonly used econometric model for analyzing the dynamic relationships between multiple time series. Since its introduction by Sims [2], the VAR model has found widespread application in economics and finance. By considering the relationships between multiple variables simultaneously, the VAR model is able to better capture the complexities of economic and financial markets.

numerous studies have explored the factors influencing gold prices. For instance, Blose [3]investigated the relationship between gold and inflation and found a positive correlation between gold prices and inflation. Nikiforos[4]'s study on the relationship between gold and money supply, discovered that an increase in money supply leads to a rise in gold prices. Additionally, Ghosh [5]analyzed the relationship between gold and the stock market and found a negative correlation. Furthermore, Koosup[6] studied the relationship between gold and the oil market and found a positive correlation.

In terms of the application of VAR models, many studies have successfully applied VAR models to forecast financial markets. For example, Caporale[7] used a VAR model to analyze the dynamics of European stock markets and to predict their trends. Their findings indicated that the VAR model was able to capture the volatility and trends of the stock market quite well. Additionally, Wang [8]employed a VAR model to analyze the international financial markets during the Asian financial crisis and to forecast their movements. Their research results showed that the VAR model had high accuracy and reliability in forecasting international financial markets.

In conclusion, the literature review suggests that the VAR model is an effective tool for analyzing the key variables influencing gold futures prices and forecasting the closing prices of gold futures. By considering the dynamic relationships between multiple variables, the VAR model can provide more comprehensive and accurate market forecasts. Therefore, this study will be based on the VAR model to analyze and predict the trends in the gold futures market.

3. Data and Methods

3.1. Data Selection and Source

The data for this study were sourced from the Investing.com website (https://cn.investing.com/), covering the period from January 4, 2010, to June 7, 2024. To simplify the model, the closing prices of each variable were ultimately chosen as the values for model construction. The specific variables included:

Gold futures closing prices
Silver futures closing prices
US Dollar Index
Euro to US Dollar exchange rate
S&P 500 Index
Brent Crude Oil futures closing prices
EGO company stock prices
US 10-year Treasury bond yields

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3.2. Methods

3.2.1. Data Processing Methods

In data processing, Missing values were first checked, and outlier detection was conducted using quartile methods. There are no missing values or outliers in the data.

3.2.2. Time Series Analysis Methods

In the process of establishing the VAR model, Augmented Dickey-Fuller (ADF) tests were conducted to ascertain the stationarity of the time series variables. For variables that exhibited non-stationarity, first differences of the data were computed to conform to the necessary requirements for constructing the VAR model. The selection of the lag order was based on the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Final Prediction Error (FPE), and Hannan-Quinn Information Criterion (HQIC). Causality matrices were constructed via Granger causality tests, and Johansen cointegration tests along with Durbin-Watson statistics tests were performed prior to the finalization of the VAR model.

4. Empirical Analysis

4.1. Descriptive Statistics of Data

In the preliminary phase of data exploration, a comprehensive quality assessment of the dataset was conducted, with a primary focus on the integrity and accuracy of the data. The implementation of a missing value test confirmed the absence of missing values within the dataset, ensuring the completeness of all records. Subsequently, outlier detection was performed on the data using the quartile method, specifically [Q1-1.5*(Q3-Q1), Q3+1.5*(Q3-Q1)]. Any values falling outside this range are considered outliers. Fortunately, a meticulous review revealed no outliers, indicating the dataset's high level of accuracy.

To gain a deeper understanding of the relationships among the variables within the dataset, various visualization techniques were employed. Initially, line charts were generated to depict the closing prices of gold futures in relation to the closing prices of Brent crude oil in London and silver futures over time. These visual representations effectively illustrate the trend variations and potential correlations between the distinct variables.

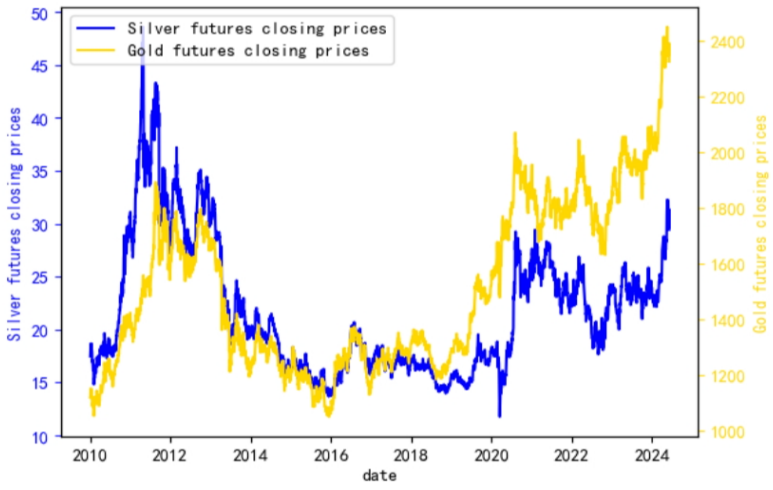

Figure 1: Line Chart of Gold and Silver Futures Closing Prices Over Time.

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In summary, through preliminary exploration and visual analysis of the dataset, a preliminary understanding of the overall characteristics of the data and the relationships between variables was obtained.

4.2. Unit Root Test and Cointegration Analysis

In the initial stages of data processing and analysis, it is crucial to ensure that the data are stable and reliable. A common problem with time series data is that the data may contain unit roots, i.e., the data may not be smooth, which may lead to pseudo-regression problems when constructing economic models. Therefore, we first perform the ADF (Augmented Dickey-Fuller) test on the data to check the smoothness of the data.

The results of the Augmented Dickey-Fuller (ADF) test indicate that the variables of interest exhibit non-stationarity at their original levels. This implies that the statistical properties of these variables, including mean, variance, and autocovariance, change over time, which is incompatible with the data stationarity requirements of numerous economic models.

To address the issue of non-stationarity, the difference method was employed. First-order differences of the data were computed, and the ADF test was subsequently conducted on the differenced data. Fortunately, the results of the test indicated that all variables had been transformed into stationary time series after differencing. This step is crucial as it ensures that the data used in constructing the VAR (Vector Autoregression) model meets the stationarity requirement, thereby mitigating the risk of spurious regression.

Following the confirmation of data stationarity, the Johansen cointegration test was performed to investigate the presence of a long-run equilibrium relationship among the variables. The outcomes of the Johansen cointegration test indicate the existence of a long-run equilibrium relationship among the variables of interest. This implies that while these variables may exhibit short-term deviations from equilibrium, they will tend toward a stable equilibrium in the long term. This discovery serves as a significant foundation for the establishment of the VAR model.

4.3. Estimation Results of the VAR Model

In analyzing the dynamic relationships within financial markets, Vector Autoregression (VAR) models prove to be a valuable instrument. Once the stability and cointegration relationship of the data have been ascertained, the estimation phase of the VAR model commences, which is a pivotal step in the analysis.

4.3.1. Determination of Lag Order

To optimize the model's performance, an information criterion method was employed, which included the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Final Prediction Error (FPE), and Hannan-Quinn Information Criterion (HQIC), to determine the lag order of the VAR model. Following a meticulous comparison and analysis, a lag order of 2 was selected for the model. This selection was based on striking a balance among the values of the information criteria, with the objective of identifying a equilibrium point that ensures the model's fitting performance while mitigating the risk of overfitting.

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	AIC	BIC	FPE	HQIC
0	-8.648	-8.634	0.0001755	-8.643
1	-8.783	-8.656*	0.0001534	-8.737*
2	-8.788*	-8.549	0.0001525*	-8.703
3	-8.772	-8.420	0.0001549	-8.647

Figure 2: Determination of minimum lag order (partial)

4.3.2. Parameter Estimation

After determining the lag order, we used the Ordinary Least Squares (OLS) method to estimate the parameters of the VAR model. This model contains 8 equations that collectively capture the dynamic relationships between different variables in the system. Our dataset has a total of 3507 observations, which provides rich information for model parameter estimation.

Table 1: OLS estimation results (Summary).

Summary of Regression Results			
Model:		VAR	
Method:		OLS	
Date:		Sat, 06, Jul, 2024	
Time:		11:41:05	
No. of Equations:	8.00000	BIC:	-8.54754
Nobs:	3507.00	HQIC:	-8.70124
Log likelihood:	-24266.6	FPE:	0.000152779
AIC:	-8.78652	Det(Omega_mle):	0.000146982

Taking the closing price model of gold futures as an example, its BIC, HQIC, and FPE values are -8.54754, -8.70124, and 0.000152779, respectively. These values are all at a low level, indicating that the model has a good fitting effect on the data and can accurately describe the dynamic changes in gold futures prices.

4.3.3. Evaluation of Model Stability and Predictive Ability

To ascertain the stability and predictive capability of the VAR model, Durbin-Watson (DW) statistical tests were performed on the model's residuals. DW statistics are utilized to assess the presence of first-order autocorrelation in sequences. In the model under consideration, the DW statistics for all variables are approximately 2.0, suggesting the absence of significant autocorrelation in the model residuals. This outcome further validates the stability of the VAR model and justifies the reliability of the predictions derived therefrom.

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Gold futures closing prices : 2.0
Silver futures closing prices : 2.0
US Dollar Index : 2.0
Euro to US Dollar exchange rate : 2.0
S&P 500 Index : 2.0
Brent Crude Oil futures closing prices : 2.0
EGO company stock prices : 2.0
US 10-year Treasury bond yields : 2.0
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Figure 3: Durbin-Watson (DW) statistical test results.

5. Prediction and Analysis

5.1. VAR Model Prediction Results

Following the inversion of differencing on the model data, the predicted data were successfully derived. On this basis, a graphical representation of the predicted and true values of the closing price of gold futures over time was constructed.

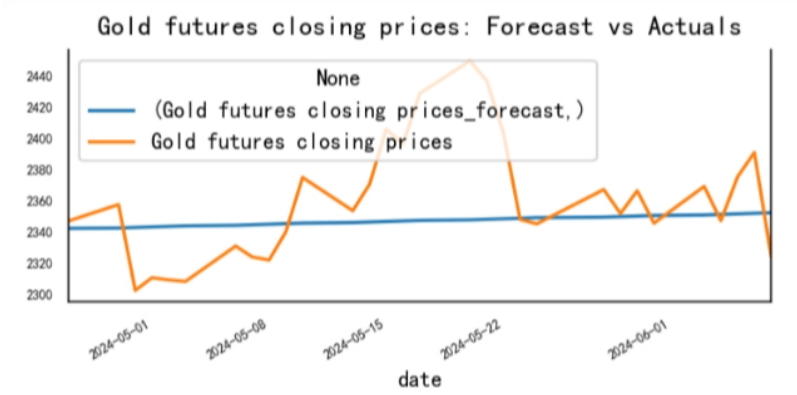

Figure 4: Line graph of projected and real values over time

From the predicted image of the closing price of gold futures drawn, it can be clearly observed that although there is a certain difference between the predicted values obtained by the VAR model and the true values, overall, the predicted values still remain within a relatively reasonable range. The image shows that the phased predicted values given by the model tend to show a steady growth straight line, while the true values show more severe fluctuations and significant trend changes, and their volatility is obvious. From an intuitive perspective, the difference between the two does exist and is quite obvious. However, if viewed from the overall trend of change, the trend of predicted values is consistent with the trend of actual values.

In summary, the model exhibits some discrepancies in capturing minor price fluctuations; however, it is effective in reflecting the overall trend of changes over a given time period.

5.1.1. The Impact of Various Variables on Gold Prices

Through an in-depth analysis of the parameter estimates of the VAR model, insights can be gained into the specific impacts of various variables on gold futures prices. The results indicate that the closing price of silver futures, the closing price of the dollar index, the closing price of London Brent crude oil futures, and the closing yield of the U.S. 10-year Treasury bonds exert a particularly

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significant influence on gold futures prices. Conversely, the impact of EGO's stock prices and the euro-to-dollar exchange rate is found to be relatively minor.

5.2. Model Prediction Performance Evaluation

To comprehensively and rigorously evaluate the performance of the VAR model in predicting the closing price of gold futures, multiple quantitative evaluation indicators were adopted for integrated analysis. Specifically, the mean absolute percentage error (MAPE) is 0.0123, indicating that the average error predicted by the model is relatively small, demonstrating high prediction accuracy. However, the mean error (ME) was -12.8635, revealing a slight negative bias in the model's prediction. The mean absolute error (MAE) is 29.2201, which reflects that the average absolute difference between the predicted and actual values is within a reasonable range. The negative percentage error (MPE) is -0.0052, further confirming the existence of slight negative bias in the model. The root mean square error (RMSE) is 38.9047, which suggests that in some cases, the prediction error may be large and the stability of the model needs to be improved. The minimum maximum error (minmax) is 0.0122, indicating that the range of prediction error is relatively compact and the model's prediction results are relatively stable.

Based on these data, we can conclude that the model performs well overall in predicting the closing price of gold futures, but there is a slight negative bias, and in some cases, the prediction error is large. The model still has room for optimization.

6. Conclusion

The paper demonstrates the effectiveness of the VAR model in forecasting the general trend of gold futures prices over a one-month period. The high accuracy of the model is attributed to its proficient ability to capture the intricate relationships among variables and to analyze market dynamics. The study identifies key factors such as silver futures, the dollar index, Brent crude oil, and U.S. 10-year treasury yields, which significantly impact gold prices.

The study's limitations include the use of limited data (2010-2024) and the potential oversight of influential variables like other precious metals and crude oil types. To improve, future research should consider a broader range of variables and longer time series data. Additionally, integrating advanced prediction methods like machine learning algorithms could enhance accuracy. Furthermore, improving the model's sensitivity to small price changes is crucial.

Future research should focus on expanding the variable scope to include more influencing factors, utilizing longer time series data, and employing a combination of prediction methods. The goal is to improve the model's accuracy, sensitivity, and ability to capture market nuances, ultimately providing more robust predictions for investors and policymakers.

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A Study of Stock Returns in China's A-share Market Based on the Fama-French Three-factor Model

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Abstract: In recent years, the world's financial boom, all kinds of financial products are emerging, how to rationalize the pricing of financial assets, is a new test of asset pricing theory. The capital asset pricing model of the 1970s, although set up rigorously, many studies have shown that it is unable to fully explain the stock returns. In view of this, academics began to explore other variables affecting stock returns and gradually focused on multifactor models. In this regard, the Fama-French three-factor model stands out. In addition to focusing on the impact of the market premium factor on stock returns, it also simultaneously takes into account that the market capitalization factor and the book-to-market ratio factor also have a significant impact on stock returns. Although the explanatory power of the Fama-French three-factor model on stock returns has been verified in major developed capital markets abroad. However, when applying the three-factor model to the Chinese market, the views of various scholars are different. This paper examines the data of SSE A-shares for the past 10 years and tests the adaptability of the three-factor model in the Chinese market with monthly data, and finds that the market premium factor and the market capitalization factor are significantly effective in explaining stock returns, in contrast, the book-to-market ratio factor is relatively weak in its ability to explain stock returns.

Keywords: Three-factor model, A-share stock returns, Newey-West adjustment.

1. Introduction

Since the establishment of the Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) in the 1990s, China's securities market has developed for more than a decade, and now has more than 5,000 listed companies, including Shanghai and Shenzhen A-shares, B-shares, Growth Enterprise Markets (GEM) boards, and the new three boards, and other multilevel capital market modules. Currently, the Fama-French three-factor model is widely used in foreign countries for risk management, yield prediction, and fund performance evaluation. However, whether this model, which is extremely effective in the Western securities market, can be equally applicable to the Chinese stock or bond market is a question that requires in-depth research. This study applies the Fama-French three-factor model to provide a detailed empirical analysis of the key factors affecting stock returns. On the one hand, this study tests the applicability of the model; on the other hand, it analyzes the factors affecting stock returns. Specifically, this study conducts a regression analysis with a sample of Chinese A-share data for the past 10 years to assess the validity of the Fama-French three-factor model in the Chinese A-share market, especially the explanatory power of the market premium factor,

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the firm size factor, and the book-to-market ratio factor in explaining stock returns. In addition, by revealing the factors that can explain the changes in stock returns in China's stock market, and by using them to provide a practical basis for portfolio selection, risk management, and performance evaluation, this paper can also provide some guidance for China's securities market and offer a direction for future reforms.

2. Theoretical Analysis and Research Preparation

2.1. Model Preparation

2.1.1. Modeling

Systematic risk beta plays a central role in the financial asset pricing process. However, Fama and French's study proposes that in addition to β, the size of the firm and its book-to-market ratio are also determinants, and these two parameters can profoundly reflect differences in firms' profitability and their persistence. Therefore, in addition to the consideration of systematic risk, it is important to include two factors that are highly sensitive to risk, namely the size factor (Size) and the book-to-market ratio (B/M).

The Fama-French model consisting of the three key factors is formulated as follows:

$$R_{pt} - R_{ft} = \alpha_{pt} + S_{pt}SMB + h_{pt}HML + \beta_{pt}(R_{mt} - R_{ft}) + \varepsilon_{pt} \quad (1)$$

In this model, Rpt represents the return of portfolio p in month t; while Rft represents the risk-free rate in month t; and small minus big (SMB) and high minus low (HML) represent the size and book-to-market factors. The former is "small minus large", calculated as the difference between the returns of a small-cap portfolio and a large-cap portfolio, a factor designed to compensate for the so-called small-company effect. Similarly, HML, or "high minus low," is calculated as the difference in returns between a portfolio of "value" stocks and a portfolio of "growth" stocks; Rmt identifies the market return in month t; α month market return; αpt is the intercept term in the model; Spt, hpt, and βpt are the sensitivity coefficients to SMB, HML, and market excess return, respectively, and εpt is the error term in the model.

The constant term α is used to assess whether a portfolio has the ability to generate excess returns, similar to the Jenson index derived from a one-factor CAPM (Capital Asset Pricing model) where if α is greater than 0, the asset earns a return greater than it should at its level of risk, and vice versa. This measure is known as "Jason's alpha" and is a widely used tool for assessing the profitability of a portfolio.

2.1.2. Characterization of Each Sensitivity Factor

In general, the difference between the returns of a small-cap portfolio and a large-cap portfolio is positive because small-cap stocks are not liquid enough, only some closed-end funds are willing to hold small-cap stocks, and large institutions are unlikely to hold small-cap stocks that are less liquid and have poorer performance, which creates the small-cap premium phenomenon. This means that the return on a portfolio of small-cap stocks will exceed that of large-cap stocks, and Rpt (the return on asset p at time t) is positively correlated with SMB, so Spt is positive.

For the return difference between the "value" and "growth" portfolios, since the "value" portfolio is more likely to earn higher returns, Spt is positive. Rpt (the return on asset p at time t) is positively correlated with HML, so hpt is positive.

In the long run, the average market return is higher than the average risk-free rate of return, and the risk premium is likely to be positive, so it can be assumed that the expected return is positively correlated with the risk premium, so βpt is positive.

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2.1.3. Jensen's Alpha

Jensen's Alpha is a risk-adjusted performance evaluation metric used to measure the performance effect of a fund manager or portfolio. It measures the difference between the actual return of the portfolio and the return expected based on the Capital Asset Pricing Model (CAMP). The single factor model is given below:

$$\alpha = R_i - [R_f + \beta \times (R_m - R_f)] \quad (2)$$

where Ri is the actual return of the portfolio or fund, Rf is the risk-free return, Rm is the market portfolio return, and the beta coefficient of the portfolio indicates the sensitivity of the portfolio to market returns.

Under the efficient market hypothesis, the expected α should be zero. This is because in an efficient market, all available information is fully reflected in asset prices and investors are unable to achieve sustained excess returns through any systematic method. Therefore, if the market is efficient, the expected alpha should be close to zero.

2.2. Sample Selection

The sample data involved in the discussion of this paper includes all the stocks in A-share (after excluding the stocks that do not fulfill the conditions), and the time distribution of the sample is from December 2010 to December 2020, and the relevant data in this paper comes from databases such as Cathay Pacific.

This paper selects the data of these 10 years for empirical analysis for the following reasons: this paper selects the time from December 2011 to December 2020, in this decade, China's stock market has experienced a bull market, bear market and sideways oscillation, the stock index fluctuation of the interval is larger, and at the same time, the completion of the reform of the equity distribution, by the development of these 10 years, China's stock market is gradually becoming more mature, and the same in the circumvention of the After avoiding the impact of black swan events on stock returns, such as the Xin Guan epidemic, it can be expected that the empirical analysis using the data of this decade will be fully representative. At the same time, due to the large amount of data, the possibility of significant random errors in the analysis results is small [1].

2.3. Sample Classification

First, stocks are sorted based on their total market capitalization, where the top 50% in terms of market capitalization are classified as the small-sized stock group (s) and the remaining are categorized as the large-sized stock group (b). Subsequently, the stocks are sorted based on their book-to-market ratio, with the top 30% as the low book-to-market ratio group (l), the bottom 30% as the high book-to-market ratio group (h), and the remaining 40% as the medium book-to-market ratio group (m).

The stocks after the two forms of grouping according to the above methodology are cross-grouped between the groups so that it gets 6 stock portfolios. The stocks within these six portfolios are used to calculate the average monthly return of each portfolio according to the total market capitalization weighting method within the group.

Based on the calculated monthly average return of each portfolio, the risk factor can be calculated:

$$SMB = \frac{1}{3}(SH + SM + SL) - \frac{1}{3}(BH + BM + BL) \quad (3)$$

$$HML = \frac{1}{2}(BH + SH) - \frac{1}{2}(BL + SL) \quad (4)$$

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As for the selection of the dependent variable, most of the literature directly adopts the data for calculating the combination of independent variables, but considering the small number of groups, it is not appropriate to make comparisons. In this paper, all eligible stocks are categorized into 5 groups according to market capitalization, and similarly, all eligible stocks are categorized into 5 groups according to book-to-market ratio, and then by cross-grouping between the groups this will result in 25 stock portfolios.

2.4. Data Preprocessing

When performing stock screening, it is first necessary to exclude all stocks in the financial sector, as they usually have high financial leverage and large enterprise size due to the special valuation mechanism and China's specific conditions; if not eliminated, most of these stocks would be categorized into a large-scale and high book-to-market ratio portfolio, which would lead to a large market capitalization share of the portfolio and a more significant impact on the average rate of return. It is also necessary to eliminate stocks that have had ST status in the past year, are still in ST status, or have a history of trading suspensions, as these stocks tend to have dramatic fluctuations in market capitalization and book value, and analysis using this type of data may introduce errors that affect the accuracy of the results [2].

3. Analysis of Empirical Results

3.1. Descriptive Stats

3.1.1. Newey-west t-statistics

First, this article verified the validity of the grouping as follows: it first constructed a gap variable using the difference between the weighted portfolio returns of the fifth group and the first group. Then, in order to find the order of the lag term and at the same time to ensure the simplicity of the model and the smoothness of the time series, this artical chose to consider the use of empirical functions and finally chose the order of the lag term to be 4 [3]. Then, let each group and gap value do t-test, observe whether its value is significant to judge whether the score is valid or not, and get the t-value and significant level of each group as follows (see Table 1):

Table 1: Newey-West t-test results

	(1)	(2)	(3)	(4)	(5)
	gap	gap	gap	gap	gap
_cons	-0.442	-0.768**	-0.718**	-0.770**	-0.527
	(-1.101)	(-2.191)	(-2.050)	(-2.070)	(-1.251)
N	252	252	252	252	252
t statistics in parentheses			* p < 0.1, ** p < 0.05, *** p < 0.01		

From the table, it shows that the difference between the returns of the weighted portfolios of groups II, III and IV and the returns of the weighted portfolios of groups I and V is significant at the 95% level of significance, which also implies that our grouping is valid.

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3.1.2. Risk Factor (Dependent Variable) Descriptive Statistics

Table 2: Three-factor descriptive statistics

	N	mean	sd	min	max
MKT	252	0.79	7.97	-26.83	29.6
SMB	252	0.395	3.772	-16.68	19.36
HML	252	0.187	3.392	-15.52	16.38

As can be seen from Table 2, the average of the monthly data of the three factors in the past ten years is positive, and since both SMB and HML can represent the difference in returns between the required portfolios, there is a significant market capitalization effect and book-to-market ratio effect in China's A-share market in the long run. The standard deviations of all three factors are small, indicating that the three factors have some stability.

3.1.3. Correlation Analysis of Independent Variables

Table 3: Three-factor Pearson correlation coefficient table

	MKT	SMB	HML
MKT	1	0.2238	-0.00021
SMB	0.2238	1	-0.2525
HML	-0.0002	-0.2525	1

Pearson's correlation analysis of the three factors using Matlab yielded the results as above (see Table 3), as seen from the data provided, the correlation coefficient between the market capitalization factor and the market premium factor is 0.2238, while the correlation coefficient between the book-to-market ratio factor and the market premium factor is almost unaffected and recorded as -0.0002; and the correlation coefficient between the book-to-market ratio factor and the market capitalization factor is correlation coefficient is -0.2525. These low correlation coefficients indicate the lack of a strong linear relationship between these three factors [4]. Therefore, there is no need to be overly concerned about possible multicollinearity issues arising from these three explanatory factors in future regression analyses.

3.1.4. Analysis of Excess Returns on Dependent Variables

Table 4: Mean rate of return (25 groups)

	BM_group5				
BM_group5	1	2	3	4	5
1	1.151	1.430	1.501	1.537	1.225
2	0.755	1.149	1.345	1.323	1.186
3	0.623	0.989	1.004	1.089	1.146
4	0.726	0.944	0.989	1.147	0.985
5	0.709	0.662	0.783	0.767	0.698

As shown in Table 4, this research analyzes the average monthly excess returns of 25 portfolios, all of which exhibit positive returns, where the fluctuations in returns range from 0 to 2%. It is found that there is a significant negative correlation between the size of a portfolio and its return, i.e., smaller portfolios tend to realize higher returns [5]. However, the relationship between the book-to-market

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ratio and the rate of return is unclear due to common anomalies within each industry, and further in-depth research is needed to validate its specific impact on the rate of return.

3.2. Regression Analysis

Table 5: Regression results (intercept and dependent variable regression coefficients)

Book-to-market ratio					
scales	1	2	3	4	5
	α				
1	0.005	0.270**	0.303***	0.335**	-0.029
2	-0.362**	0.055	0.252*	0.080	-0.007
3	-0.338**	-0.061	-0.091	-0.063	0.013
4	-0.076	-0.045	-0.039	0.044	-0.092
5	0.254**	0.002	-0.071	-0.053	-0.008
	β				
1	0.987***	0.979***	0.994***	1.000***	1.010***
2	0.997***	1.000***	0.994***	1.025***	1.010***
3	0.976***	0.989***	1.028***	1.041***	1.028***
4	0.967***	1.055***	1.050***	1.083***	1.062***
5	0.989***	1.028***	1.066***	1.009***	0.944***
	s				
1	1.066***	1.090***	1.116***	1.067***	1.038***
2	1.006***	0.897***	0.856***	1.054***	0.844***
3	0.757***	0.826***	0.765***	0.813***	0.638***
4	0.443***	0.547***	0.538***	0.538***	0.390***
5	-0.365***	-0.204***	-0.032	-0.101***	-0.377***
	h				
1	-0.300***	-0.237 ***	-0.153***	-0.051	0.244***
2	-0.366***	-0.278***	-0.165**	0.089*	0.324***
3	-0.587***	-0.310***	-0.105**	0.042	0.368***
4	-0.738***	-0.327***	-0.075	0.185***	0.451***
5	-0.975***	-0.382***	0.130	0.336***	0.585***
	Adj-R^2				
1	0.922	0.959	0.967	0.962	0.950
2	0.944	0.955	0.953	0.964	0.961
3	0.947	0.957	0.956	0.958	0.950
4	0.932	0.939	0.942	0.948	0.951
5	0.940	0.929	0.914	0.911	0.936

Considering that the sample belongs to time series data, and in time series analysis, the temporal autocorrelation will make the standard error of OLS (ordinary least squares) estimation increase, which makes the estimation result inaccurate, so this paper adopts the new Harvey-West estimator (Newey-West estimator), the Newey -West method adjusts the standardized weights by introducing the autocorrelation term weight matrix, so as to obtain more accurate estimation results. At the same time, the Newey-West method also takes into account the problem of heteroskedasticity, and further improves the correctness and robustness of the estimation by weighting the covariance matrix.

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As shown in Table 5, the three-factor model shows good results in fitting these 25 portfolios (dependent variables), and its adjusted R-squared value (Adj-R^2) proves the applicability and accuracy of the model, all of which reach 0.9, which shows that the three-factor model has a low degree of overfitting and an excellent ability to explain the excess return.

Setting the significance level at 0.05, the seven portfolios of Main Board and SMB stocks show a high significance of t-value of their intercept α, while the other portfolios have an intercept value close to zero and their t-values do not show significance. This result indicates that the Fama-French three-factor model shows better results in explaining the cross-sectional differences in the returns of our main board and SME stocks.

When analyzing the beta coefficient of market risk premium, this artical notice that its t-value shows high significance, with t-values of all portfolios exceeding 30 while the beta coefficients are generally greater than 0.9. These results emphasize the importance and strong explanatory power of market risk premium in explaining the cross-sectional differences in stock returns.

Based on the regression analysis, it is found that the coefficient s of the size factor SMB is significantly positive for all four portfolios except for the largest firms' portfolio where the coefficient s of the size factor SMB is less significant, suggesting that stocks of smaller firms typically earn higher returns than those of larger firms. In addition, the coefficient s of the size factor shows a gradual decline as the size of the firm increases, which further reveals that in the Chinese stock market, the excess returns of stocks of small firms often exceed those of large firms, and that there is an obvious inverse relationship between stock returns and firm size [6]. This phenomenon not only reconfirms the negative correlation between stock returns and firm size, but also emphasizes the existence of an obvious scale effect in the market. Taken together, smaller firms face greater market uncertainty and greater volatility in returns, so investors tend to seek higher returns to compensate for these risks, resulting in relatively higher expected returns for these firms [7]. Relatively speaking, the returns of large firms are more stable, resulting in lower expected returns for investors. Therefore, the firm size factor plays a key explanatory role in explaining the cross-sectional difference between the returns of main board and small and medium-sized board stocks in China's A-share market.

According to the results of the regression analysis, the indicator of book-to-market ratio (BE/ME) shows different characteristics: in the first three groups with low BE/ME, the regression coefficient h is mostly negative and significant. The significance of the coefficient h decreases when in the fourth group with moderate BE/ME. In the fifth group with the highest BE/ME, the coefficient h is significant and significantly greater than 0. In addition, the coefficient h gradually increases as the firm's BE/ME increases, indicating that the excess stock returns of firms with high BE/ME are significantly higher than those of firms with low BE/ME, which further suggests that there exists a positive correlation between stock returns and firms' book-to-market ratios [8]. In short, when a company has a low book-to-market ratio, this usually indicates that the market has overvalued the stock over the past period of time. Once investors reassess, the overvaluation is corrected, leading to a decrease in the price of the stock and thus a lower expected rate of return. Conversely, a higher book-to-market ratio indicates that investors hold a pessimistic view of unfavorable news about the company and perceive it as risky, thus requiring a higher expected return to compensate for this risk [9]. Through regression analysis, it can be observed the effectiveness of book-to-market ratio in explaining the cross-sectional difference between the returns of main board and SME stocks in China's A-share market.

4. Conclusion

The application of the Fama-French three-factor model in China's A-share market shows excellent performance in explaining stock returns compared to the CAPM model. The market risk premium effectively explains the variation of stock returns whether in the main board, SME or GEM of A-

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share. In particular, among companies listed on the Main Board and SMB, this articul find that stock returns are significantly negatively correlated with firm size, a phenomenon that is more pronounced among smaller companies. In addition, stock returns are positively related to the book-to-market ratio of the firm, and this positive correlation is especially significant among firms with higher book-to-market ratios. These analytical results further validate the broad applicability and explanatory power of the Fama-French model in diverse market environments.

In addition, this thesis does not consider the robustness test of the three-factor model, but it can give a more appropriate test method: it can firstly select the first 60 months of time series data, and then each time backward one month in order to obtain a new 60 time series data for the regression, so by using the 120 time series data to regress cyclically, it can get the model regression coefficients of 60 time series data, so as to analyze the stability of the regression coefficients. The stability of the regression coefficients can be investigated in this way. On the other hand, higher frequency data such as weekly or daily data can be considered to explore the robustness and adaptability of the model under different time scales, in addition, other factors can be considered, such as the turnover rate, etc., but researchers need to pay attention to the problem of multicollinearity between the factors. Finally, in future research, scholars can continue to verify the adaptability of the Fama-French model in specific areas. At present, some scholars in China have tried to use the Fama-French model in the field of real estate, and researchers can continue to apply it to other fields, such as medicine, green economy and even funds to verify and expand.

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The Role of AI and ML in Transforming Marketing Strategies: Insights from Recent Studies

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Abstract: With the development of digital information technology, the application of AI and ML in marketing has always been a key research direction. In this paper, this review focuses on the applications of Predictive Analytics (P), Personalization (P), Advertising Optimization (A), and Customer Experience Enhancement (C) in the marketing mix, explores the latest applications and research results published in various journals in recent years, and summarizes the progress made in this field of machine learning. It is easy to understand that machine learning can help enterprise decision-makers to help determine decision-making guidelines, but it is controversial in terms of privacy due to the large amount of customer data it requires, and as the algorithm deepens, transparency and fairness agnosticism is also a major concern. Finally, this paper will provide research directions and suggestions for future research based on the overall advantages and disadvantages, which can be combined with human insight and multidisciplinary cooperation to further optimize the problem.

Keywords: Artificial Intelligence, Machine Learning, Marketing Strategies.

1. Introduction

In the wave of digital transformation, Artificial Intelligence (AI) and Machine Learning (ML) technologies are playing an important role in various domains, especially in marketing decision making. The integration of AI and M intelligence has shifted traditional marketing decisions towards a more data-driven approach, enabling decision makers to gain deeper insights into market data and improve their strategies [1]. As a result, AI and M intelligence have received increasing attention in recent years. The combination of AI and ML facilitates the extraction and analysis of large amounts of data, helping marketers to better understand customer needs and provide more personalized interactions. By applying AI and ML, marketers can enhance the customer experience and improve their decision-making process, which not only improves operational efficiency but also increases market competitiveness, creating a win-win situation for both customers and organizations. The purpose of this paper is to explore how AI and ML can enhance customer experience and help marketers make decisions. The main objective is to analyze the current applications of AI and Machine Learning in the market and identify the existing gaps.

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2. Methods

2.1. Literature Review

2.1.1. Selection Criteria for Relevant Studies

In order to ensure the relevance and quality of the selected studies, this paper sets the following inclusion criteria: first of all, select the studies published in recent years (for example, in the past five years) to ensure that the articles are up-to-date, and the publication time is more than five years, unless it is a classic literature, which is an important basic contribution to the current study. Primarily, academic journal articles, conference papers, systematic reviews and empirical studies were included, and it was ensured that the subject matter was hugely and highly relevant: the studies had to explicitly deal with the application of AI and ML in marketing, with preference given to studies with a rigorous methodology as well as to quantitative studies consisting of a clear methodology for data analysis.

2.1.2. Purpose of The Study

This paper intends to identify the main purpose and research questions of the study, describe the methodology and data analysis techniques used in the study, summarize the main findings and conclusions of the study, identify the limitations and potential biases mentioned in the study, and finally, through a comprehensive analysis of the extracted information, identify the main areas of application of AI and ML in marketing, the effects, the challenges faced, and the future research directions.

2.2. Data Collection

Based on the results of the literature review and the nature of the ML techniques studied, and according to the classification of ML specific algorithms as well as the scenarios of practical applications, they are categorized into two classes from the architectural level in order to better show the applications of ML. The first category of this classification shows the application of ML technology in the PPAC portfolio at this stage, i.e., predictive analytics (P), personalization (P), ad optimization (A), and customer experience enhancement (C) in the marketing portfolio. In the second half, the algorithms (e.g., supervised learning, unsupervised learning, deep learning) used by ML in this process are fully demonstrated. In this paper, this architecture is used to determine whether the selected article is relevant to its topic or not. The articles that satisfy the PPAC marketing mix and to which ML is applied are then analyzed and classified in the figure 1and table 1.

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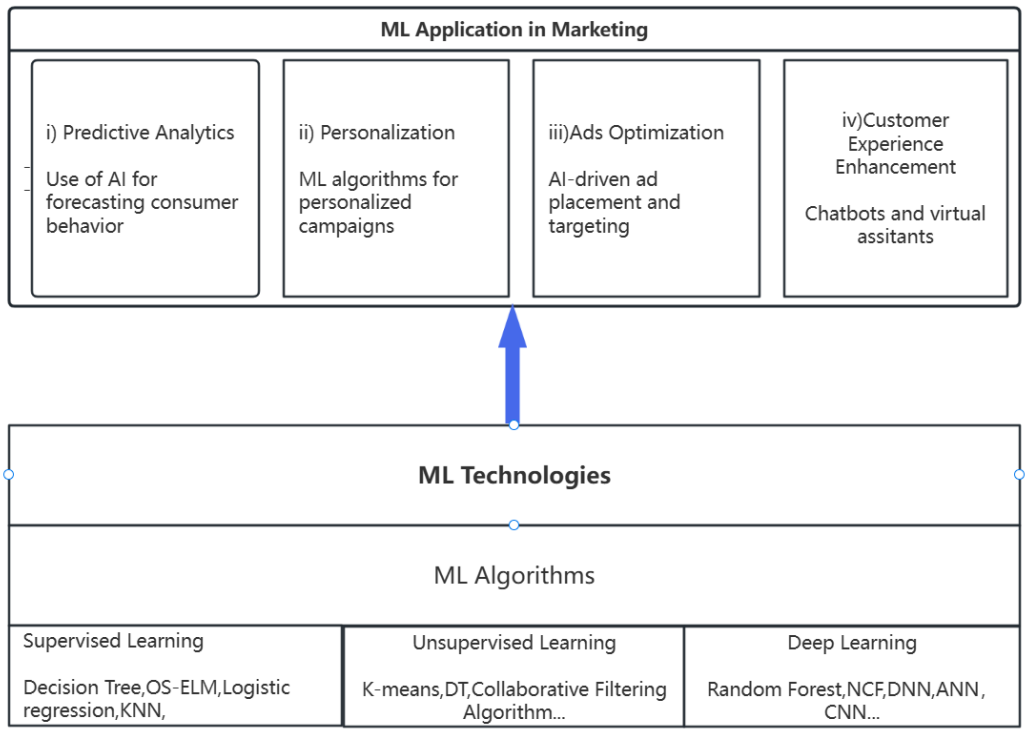

Figure 1: ML in PPAC marketing mix.

Table 1: ML applications in marketing based on PPAC marketing mix.

PPAC Marketing mix	ML Algorithm
Predictive Analytics (Use of AI for forecasting consumer behavior)	Supervised Learning Unsupervised learning Deep Learning
Personalization (ML algorithms for personalized marketing campaigns)	Supervised Learning Unsupervised Learning Deep Learning
Advertising Optimization (AI-driven ad placement and targeting) Customer Experience Enhancement (chatbots and virtual assistants)	Unsupervised learning Deep Learning

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3. Applications of Artificial Intelligence in Marketing

Continuing from the previous section, this section divides the application of AI and ML in marketing into four segments. In this section, we will continue to detail the specific definitions and scope of application of these four segments and will analyze the advantages and enhancements of ML in marketing with case studies.

3.1. Predictive Analysis

3.1.1. Defining Analytics

Predictive analytics is a process that utilizes statistical techniques, mining data, machine learning, and other methods to obtain information from historical information, build models, and predict future outcomes [2]. Eckerson et al. found that although the process applies a lot of cutting-edge knowledge in statistics and advanced mathematics is intimidating. But its role can make decision makers more instinctive and intuitive to react to customers and business, improve marketing efficiency and increase the competitiveness of enterprises [2].

3.1.2. Case Study on Predictive Modeling

In Cheng's article, a machine learning classification algorithm is used to build a purchase prediction model to grasp customers' purchase intentions for coupons on the Palm Life App [3]. Zhou, on the other hand, first classified customers using their historical data with the K-means algorithm and finally predicted customer churn with the Random Forest algorithm [4].Weirong Wang et al., in their article, similarly first used the k-nearest neighbor algorithm to categorize the customers and applied an online extreme learning machine to predict the customer electricity load forecast [5]. These cases have shown that machine learning can make good use of historical customer data and segment customers to predict future customer behavior, so that decision makers can take into account the weight of the impact of changes in customer behavior on the development of the company to formulate appropriate countermeasures to ensure that the company's interests can be maximized in this prediction model.

3.2. Personalization

3.2.1. Definitional Analysis

Personalization in this review specifically refers to the use of machine learning algorithms in personalized marketing, which can help companies provide customized services and recommendations based on customers' historical behaviors and preferences, effectively improving customer satisfaction and conversion rates.

3.2.2. Examples of Improving Customer Engagement

Vinay Pitchika et al. in their article used ANN and CNN models to diagnose periodontal cases after and help decision makers to integrate personalized cases [6].Yaghtin et al. for the specific case of a B2B company with the help of the fusion of machine learning and ML, used CRISP-DM and SEMMA to perform data mining followed by LASSO logistic regression to classify customer preferences and create a PIS system of customers to provide personalized services [7].Messaoudi Fayça et al. in their article built a deep learning DNCF model and found that it was effective in increasing the recall rate to a certain extent reflecting an increase in the probability of recommending content of interest to customers after content filtering [8]. Alabdulrahman, R., & Viktor, H. in 2021 distinguished a single

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classifier (DT) for grey sheep users and designed personalized recommendations for them [9]. It can be seen that in recent years, the application of machine learning in marketing has greatly improved the development of customer personalization, which can lead to a better e-commerce experience for the customer while increasing the customer conversion rate on the business side and increasing revenue.

3.3. Advertising Optimization

3.3.1. Definition Analysis

Advertising optimization refers to optimizing the effect of advertising through various technical means and strategies to maximize the return on investment (ROI) of advertising. This process includes the adjustment and improvement of various aspects such as ad content, audience, delivery time and delivery channels. In this review, we focus on ad optimization after incorporating machine learning.

3.3.2. Results from Recent Implementations

Ava Hajian, Russell Sadeghi, Victor R. Prybutok & Chang E. Koh. in their article Improving the Accuracy of Topics for Ad Push with Topic Modeling in NLP [10].Qin Wu. found that collaborative filtering algorithms can be utilized to improve ads by augmenting the modeling of user preference precision and quality, which greatly improves the yield of advertisements [11].Li Chunhui., on the other hand, well improves the recall and return of the advertisement recommendation algorithm by dividing the customers and advertisements into two networks for learning, and then finally utilizes CNNs to capture the higher-order interaction information [12]. From the above case, it is easy to see that the use of machine learning can well mine the historical preferences and likes of customers, so as to push the corresponding types of advertisements for the target customers thus improving the return rate of advertisements and increasing the revenue.

3.4. Customer Experience Enhancement

3.4.1. Definition Analysis

The core objective of customer experience is to ensure that customers are delighted and satisfied at every touch point throughout the consumption process. This includes every step of the process from initial brand awareness, through the purchase process to after-sales service. A good customer experience improves customer loyalty, increases customer lifetime value, and promotes positive word-of-mouth. In the digital era, companies are increasingly focusing on optimizing customer experience through data analytics and technology. In this paper, we focus on techniques such as virtual robots that utilize ML and AI technologies to achieve user experience enhancement.

3.4.2. Impact on Customer Satisfaction and Customer Retention

Manju, Aman Jatain & Deepti Singh. In the article it was found that existing chatbots have been able to apply large language models to accomplish basic communication with customers with precise needs and good enhancement of user experience [13]. Samadrita Ghosh, Stephanie Ness & Shruti Salunkhe. et al. found that it is possible to make good use of ML for the mining of historical data to predict the customer needs combined with NLP techniques for multi-channel interaction with customers to add consumer satisfaction and loyalty [14].

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4. Discussion

4.1. Challenges and Limitations

Personalized marketing requires large amounts of customer data, which raises serious privacy and security concerns. Customers are increasingly concerned about their data rights and demand transparency and control [7,8]. At the same time, complex machine learning models, especially deep learning models, often lack transparency and are seen as "black boxes". This can make the decision-making process difficult to understand and trust, especially in business decisions. Integrating new AI and ML solutions with existing marketing systems can be technically challenging and resource intensive.

4.2. Applications in Practice

4.2.1. Best Practices for Implementing AI and ML in Marketing

Currently, as pointed out in Vinay Pitchika, Martha Büttner & Falk Schwendicke, combining the techniques of AI and ML with human insight and leveraging the cooperation of multiple disciplinary fields and requiring a large number of customers can minimize human bias against AI algorithms and improve the fairness of AI algorithms. algorithms' fairness [6].

4.2.2. Strategies to Overcome Current Challenges

Education and training: invest in training marketing teams to understand the concepts of AI and ML and to be able to utilize these technologies effectively. Ethical AI practices: develop and follow ethical guidelines for AI use, focusing on transparency, fairness, and accountability.

Interpretability and Transparency: investigate how to improve the interpretability and transparency of complex AI and ML models and develop new interpretive techniques.

Bias and fairness: research on how to detect, quantify and eliminate bias in machine learning models to ensure that all user groups are treated fairly.

4.3. Research Limitations and Future Directions

4.3.1. Potential Interdisciplinary Collaborations

Behavioral Economics and AI: Combining insights from behavioral economics with AI technology to develop more psychologically informed marketing strategies [15].

Ethics and AI: Collaborate with ethicists and legal experts to address ethical and regulatory challenges of AI in marketing.

Emerging trends and technologies

Edge computing: with the proliferation of IoT devices, edge computing enables real-time data processing and personalized marketing at the point of interaction.

AI-driven content creation: advances in natural language generation (NLG) and computer vision can automate and personalize content creation, making marketing campaigns more dynamic and engaging.

Future research needs to focus more on multi-dimensional data integration, real-time, and user experience in real-world applications to enable the full application and optimization of machine learning techniques in marketing. These studies not only promote the progress of academia, but also provide practical application references for the industry to promote innovation and development in the field of marketing.

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5. Conclusion

5.1. Research Summary

With AI and ML technologies, marketers are able to segment customer groups more accurately and use this to provide personalized services to increase customer engagement and conversion rates. Using models to predict market trends and customer needs helps companies develop more effective marketing strategies and maximize the return on investment (ROI) of advertising. Enriched marketing theory by studying the application of AI and ML in marketing, especially in the areas of customer behavior analysis, personalized marketing and ad optimization. Introduced and promoted new data analysis methods and machine learning algorithms to improve the accuracy and practicality of marketing research. The integration and cooperation between marketing and multiple disciplines such as data science, artificial intelligence, and behavioral economics have been promoted, and the development of comprehensive research has been advanced.

5.2. Future Outlook

As AI and ML technologies continue to advance, personalized marketing will become more accurate and efficient, providing dynamic personalized experiences based on real-time data. Encourage interdisciplinary collaboration across disciplines such as marketing, data science, AI, and ethics to solve complex marketing problems. Further research to improve the interpretability and fairness of AI and ML models to ensure that their use in marketing is widely trusted and accepted. Through these researches and applications, AI and ML will play an increasingly important role in marketing, promoting the continuous improvement of marketing efficiency and effectiveness, and at the same time providing rich materials and directions for academic research.

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Adolescent Cosmetic Consumption: Exploring Societal Influences, Safety Concerns, and Post-Pandemic Market Shifts

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Abstract: Adolescence is a formative period where identity and consumer behaviors are significantly influenced by societal norms and media portrayals. This research delves deeply into the engagement of adolescents with cosmetics, meticulously scrutinizing the persuasive power of advertisements and the profound implications of societal beauty standards on teenagers. By applying a critical lens, the study examines the presence of harmful substances in cosmetics that lack regulatory approval, uncovering potential threats to skin health and underscoring the necessity for stringent regulatory oversight and comprehensive consumer education. Furthermore, the study explores the disruptive effect of the COVID-19 pandemic on consumer patterns within the cosmetics sector. It illustrates a discernible pivot towards skincare and wellness-oriented products, reflecting a shift in adolescent preferences. The research concludes with evidence-based recommendations for the cosmetics industry to effectively navigate post-pandemic challenges. It advocates for a focus on safety, transparency, and alignment with the evolving preferences of a health-conscious adolescent demographic, emphasizing the importance of meeting the demands for safe and effective cosmetic products in a rapidly changing market landscape.

Keywords: adolescent consumption, cosmetic safety, societal influences, COVID-19 pandemic, cosmetics industry strategies.

1. Introduction

Adolescence, a critical juncture in the developmental trajectory, is characterized by a confluence of identity formation and heightened vulnerability to societal influences [1, 2]. This period is particularly salient in the context of cosmetic consumption, where media portrayals, peer pressure, and the desire for self-expression significantly intersect [3]. The choices adolescents make regarding cosmetic products are not only a reflection of their burgeoning sense of self, but are also heavily influenced by external narratives that shape their perceptions of beauty and attractiveness [4].

A study presents a critical examination of adolescent consumption behaviors, focusing on the impact of cosmetic advertisements and societal beauty standards on teenagers in Medan City [5]. This research is particularly timely given the widespread use of cosmetics among adolescents and the potential health risks associated with certain ingredients, such as hydroquinone and mercury. These substances, often found in non-Badan Pengawas Obat dan Makanan (BPOM, which is the National

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Agency of Drug and Food Control in Indonesia) labeled cosmetics, pose significant threats to skin health and overall well-being, necessitating a robust understanding of the factors that drive adolescents' cosmetic choices.

The COVID-19 pandemic has further complicated this landscape, leading to a pronounced shift in consumer behavior and market dynamics within the cosmetics sector. The pandemic's imposition of mask-wearing and increased time spent at home has catalyzed a reorientation towards skincare, with a concomitant decline in traditional makeup demand. This pivot has prompted the industry to recalibrate its strategies, focusing on the development of products that cater to the evolving needs and preferences of consumers.

This paper aims to provide an extensive exploration of the intricate interplay between adolescent consumption attitudes, societal influences, cosmetic safety, and the pandemic's impact on the cosmetics market. By examining the findings of research alongside the broader societal and market adaptations, this research offers a nuanced understanding of the factors that influence adolescent cosmetic consumption [5]. Furthermore, it presents strategic recommendations for the cosmetics industry to navigate the complexities of the post-pandemic landscape, ensuring the safety and satisfaction of its adolescent consumer base.

Through a meticulous analysis of the existing literature, empirical research, and market trends, this paper endeavors to contribute to the discourse on adolescent cosmetic consumption, advocating for a more informed, discerning approach to cosmetic product selection. It emphasizes the need for educational interventions, regulatory oversight, and industry responsiveness to promote the health and well-being of adolescents in their cosmetic choices.

2. Adolescent Consumption Attitudes and Behaviors

Adolescence represents a pivotal phase in the developmental trajectory of individuals, marked by the interplay of identity formation and heightened susceptibility to societal influences. Within this context, cosmetic consumption emerges as a significant area where media portrayals, peer pressure, and the pursuit of self-expression converge. Adolescents' choices regarding cosmetic products reflect not only their burgeoning sense of self but are also significantly shaped by external narratives that influence their perceptions of beauty and attractiveness.

A study offers a critical examination of adolescent consumption behaviors, with a particular emphasis on the impact of cosmetic advertisements and societal beauty standards on teenagers in Medan City [5]. This research is timely, considering the widespread use of cosmetics among adolescents and the potential health risks associated with certain ingredients, such as hydroquinone and mercury. These substances, often present in cosmetics lacking BPOM labeling, pose significant threats to skin health and overall well-being, thereby underscoring the necessity for a robust understanding of the factors that drive adolescents' cosmetic choices.

The study conducted a cross-sectional investigation involving a diverse sample of 385 adolescents [5]. Through rigorous statistical analyses, the study aimed to elucidate the influence of cosmetic advertisements on the cosmetic choices of teenagers. The findings highlight the substantial impact of pervasive beauty narratives, frequently perpetuated by media, peer groups, and cosmetic advertisements, on the cosmetic selection decisions of teenagers. The study posits that "attitudes and cosmetics advertisements play a crucial role in the decisions of cosmetic selection among teenagers", underscoring the importance of educational interventions that encourage a discerning approach to cosmetic advertisements [5].

The pervasive influence of societal beauty standards, as portrayed by media and advertising, can significantly shape the self-perception and consumption behaviors of adolescents. This influence can lead to a range of outcomes, from the pursuit of unrealistic beauty ideals to the potential misuse of cosmetics. The study underscores the importance of understanding the underlying factors that drive

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these consumption behaviors, enabling the development of effective educational strategies to guide informed decision-making regarding cosmetic choices [5].

Moreover, the study's findings suggest a need for a more critical examination of the role those cosmetic advertisements play in shaping the perceptions and choices of teenagers [6, 7]. The influence of these advertisements can have far-reaching effects, impacting not only immediate cosmetic choices but also the long-term health and well-being of adolescents. Therefore, it is essential to consider the broader implications of these findings and to develop strategies that can mitigate the potential negative impacts of cosmetic advertisements on teenagers.

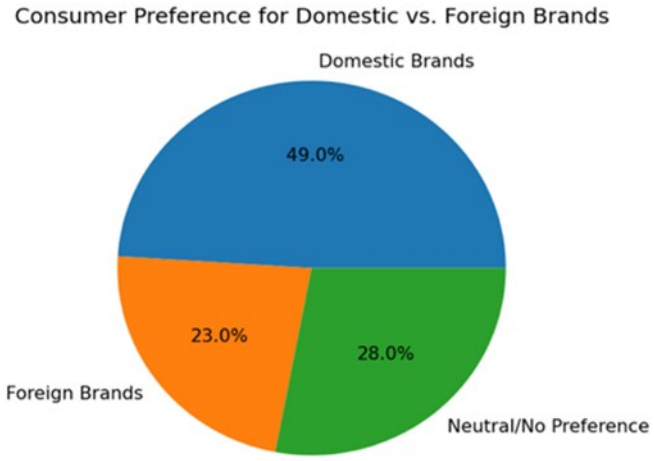

Figure 1: Consumer preference for domestic vs. foreign brands.

Adolescents represent a significant segment of the consumer market, whose preferences and purchasing behaviors significantly influence market trends. Recent market research data reveals distinct preferences among adolescents when choosing between domestic and foreign brands. In a survey targeting this demographic, as shown in Figure 1 above, 49.0% of respondents indicated a preference for domestic brands, likely due to their competitive quality, innovation, and pricing. Conversely, 23.0% showed a higher inclination towards foreign brands, possibly due to their technological edge and brand image in certain sectors. Additionally, 28.0% of the respondents expressed neutrality or no particular preference for brand origin, suggesting that some adolescents prioritize the product itself over the brand's background.

Delving deeper into the decision-making factors for adolescents, it is evident that product categories significantly influence purchasing behavior. In the non-food category, as shown in Figure 2 below, quality and functionality are the most critical factors for adolescents, with 60% of the respondents citing these as their primary considerations. This indicates that adolescents value the actual performance and user experience of a product. In the food category, while quality and functionality remain important, price also holds a considerable weight, likely due to the daily consumable nature of food products, where adolescents consider cost-effectiveness in their purchases.

Online resources further supplement these data points. For instance, some studies suggest that adolescents are increasingly concerned with the sustainability and social responsibility of products, which may influence their brand choices. Moreover, social media and online word-of-mouth play an increasingly vital role in adolescents' purchasing decisions, as they tend to use online platforms to gather product information and user reviews to inform their buying choices.

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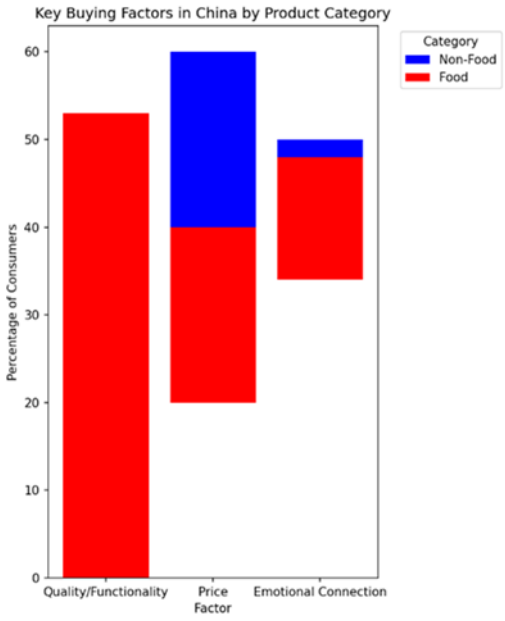

Figure 2: Key buying factors in China by product category.

In summary, the consumption attitudes and behaviors of adolescents are diverse and complex, influenced by a multitude of factors. Brands aiming to attract this demographic need to deeply understand their needs and preferences and make strategic adjustments in product quality, pricing, brand image, and social responsibility.

3. Cosmetic Safety Issues

The safety of cosmetics, particularly for adolescents, is a multifaceted issue that warrants careful consideration. The study reports on the use of non-BPOM labeled cosmetics among teenagers, raising significant concerns due to the presence of harmful substances in these products [5]. The prevalence of such cosmetics among the younger demographic may stem from a lack of awareness or understanding of the potential health hazards associated with their use.

Hydroquinone and mercury are substances often found in cosmetics that are not regulated by the National Agency of Drug and Food Control, and both can have harmful effects on skin health. Hydroquinone, which is frequently used in products intended to lighten skin, can cause skin irritation, allergic reactions, and may sometimes result in a condition known as exogenous ochronotic, which leads to a blue-black discoloration of the skin. Mercury, a powerful neurotoxin, can result in various health problems, including neurological disorders and damage to the kidneys.

The study underscores the imperative for robust regulatory frameworks within the cosmetics industry [8]. It advocates for stringent measures to ensure the safety of cosmetic products, such as comprehensive safety assessments and the enforcement of bans on harmful ingredients. Transparent labeling is also recommended, enabling consumers to make informed decisions about the products they use.

Furthermore, the study calls for public health initiatives aimed at educating adolescents about the potential risks associated with the use of cosmetics containing harmful ingredients. Education is a vital tool in empowering young consumers to prioritize their health and well-being over the immediate aesthetic benefits offered by certain cosmetic products.

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4. The Societal and Pandemic Impacts on Adolescent Cosmetic Consumption and Market Adaptations

The adolescent phase is instrumental in shaping consumer attitudes and behaviors, with media and peer pressures exerting a substantial influence on their choices, particularly in cosmetics. The COVID-19 pandemic has further complicated this landscape, leading to a pronounced shift in consumer behavior and market dynamics within the cosmetics sector. The pandemic's imposition of mask-wearing and increased time spent at home has catalyzed a reorientation towards skincare, with a concomitant decline in traditional makeup demand. This pivot has prompted the industry to recalibrate its strategies, focusing on the development of products that cater to the evolving needs and preferences of consumers.

The profound impact of the pandemic on perceptions of beauty and the demand for cosmetic products was exposed through an in-depth analysis [9, 10]. As the global population spent more time at home and faced the realities of mask-wearing, a notable pivot towards skincare products addressing these new concerns emerged. The mandatory mask-wearing imposed by the pandemic has diminished the traditional demand for makeup products, as the opportunities to wear makeup have been limited. However, this has not resulted in a universal decline across cosmetic categories. Instead, eye makeup products have seen a significant surge in interest, as the eyes become the primary medium for facial expression when other features are concealed. This behavioral shift has led cosmetic companies to reevaluate their product development and marketing strategies, aligning with the new consumer priorities shaped by the pandemic.

5. Market Strategy Recommendations

In response to the pandemic-induced changes in consumer behavior, the cosmetics industry must recalibrate its strategies to align with the evolving preferences and priorities of consumers. The development of safe and efficacious skincare products is paramount, as consumers are increasingly seeking solutions for at-home self-care routines. By accentuating the safety and efficacy of their ingredients, companies can cultivate trust among health-conscious consumers.

The digital realm presents a fertile ground for engagement and education. Virtual consultations, online tutorials, and social media campaigns can serve as effective platforms to educate consumers on the safe use of cosmetics, addressing their concerns and promoting product benefits in a relatable and accessible manner.

Sustainability has emerged as a key consumer preference, with an increasing number of consumers gravitating towards eco-friendly products. The cosmetics industry would do well to assess the environmental impact of their packaging and production processes, adopting sustainable practices that resonate with the values of the younger generation.

Lastly, agility and responsiveness are pivotal in navigating the dynamic landscape of consumer behavior. By keeping a finger on the pulse of market trends, actively soliciting customer feedback, and being willing to iterate and innovate, companies can maintain a competitive edge and stay relevant in the eyes of consumers.

Therefore, the cosmetics industry must evolve its strategies to align with the changing dynamics of consumer behavior, with a focus on safety, digital engagement, sustainability, and agility. By doing so, the industry can continue to meet the needs of consumers and maintain its relevance in a post-pandemic world. This includes a continuous assessment of consumer feedback, market trends, and the integration of innovative technologies to enhance product offerings and consumer experiences.

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6. Conclusion

The adolescent journey through the cosmetics landscape is a complex voyage, significantly sculpted by societal narratives and peer influences, with the media playing a formidable role in shaping perceptions of beauty and attractiveness. This paper has underscored the profound impact of these factors on adolescent consumption behaviors, highlighting the critical need for educational interventions that foster a discerning approach towards cosmetic advertisements. The COVID-19 pandemic has further recalibrated the dynamics of the cosmetics market, steering focus towards skincare and propelling the industry to innovate and adapt. The paper's analysis of adolescent consumption patterns, cosmetic safety, societal influences, and market adaptations offers a holistic view of the current landscape, advocating for strategies that prioritize consumer health, digital engagement, sustainability, and market agility. It concludes that while the cosmetics industry faces the challenge of evolving consumer needs and societal expectations, it also has the opportunity to lead with safety, transparency, and innovation.

Despite the comprehensive exploration presented in this paper, there are inherent limitations that warrant acknowledgment. The study's focus on English-language data and the specific context of Medan City may not fully encapsulate the global adolescent experience with cosmetics. Furthermore, the rapid evolution of consumer behavior in response to the pandemic suggests that ongoing research is essential to capture emerging trends and consumer sentiments. Future studies should expand the scope to include diverse linguistic and cultural perspectives and consider the long-term implications of the pandemic on cosmetic consumption. Additionally, as the cosmetics industry continues to evolve, research should investigate the effectiveness of new marketing strategies, the role of technology in consumer engagement, and the impact of regulatory changes on product safety and innovation. This will ensure a continuous, relevant discourse that supports the well-being of adolescents and the sustainability of the cosmetics industry in an ever-changing world.

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Analysis of Financial Performances for Honeywell Based on Comparison with 3M, Emerson, and Johnson Controls

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Abstract: Contemporarily, the advanced techniques of Iot has been widely implemented. Hence, this paper presents a comparative financial analysis for relevant industry of Honeywell International Inc., 3M Company, Emerson Electric Co., and Johnson Controls Inc., focusing on key financial metrics such as TTM P/E ratio, NTM P/E ratio, revenue growth rate, EPS growth rate, PEG, GP/A, gross profit margin, and net profit margin. The analysis reveals that Honeywell exhibits strong financial health with high profitability, stable growth, and efficient asset utilization, making it a favorable investment option. Johnson Controls, despite lower margins, shows potential for high returns, particularly due to its lower PEG ratio. Conversely, 3M and Emerson face financial challenges, with 3M showing negative growth rates and Emerson displaying a higher PEG ratio, indicating overvaluation relative to earnings growth. The study highlights the importance of leveraging IoT, AI, and machine learning technologies to drive future growth and efficiency in industrial automation. By providing a nuanced understanding of the financial health and growth prospects of these companies, these results offer valuable insights for investors and stakeholders in the industrial automation sector.

Keywords: Financial analysis, Honeywell international Inc., investment insights, comparative study.

1. Introduction

Early developments in industrial automation can be traced back to the early twentieth century, beginning with simple automated processes through mechanical controls and relays. With the further development of electronics, automation systems were significantly enhanced in the 1950s [1]. The introduction of the Programmable Logic Controller (PLC) in the 1960s marked an important turning point in industrial automation, as Dick Morley and his team developed the first PLC, which greatly improved the flexibility of programming as well as the efficiency of plant operations [2]. In the 1970s, the emergence of the Distributed Control System (DCS) gave further impetus to industrial automation, particularly in complex industrial processes such as chemical and pharmaceutical industries. in complex industries such as chemicals and pharmaceuticals [3]. These systems provided finer process control and higher reliability and became standard for large-scale industrial applications.

Entering the 21st century, industrial automation has experienced a revolution in digitalization and intelligence, with the integration of Internet of Things (IoT), Artificial Intelligence (AI), and Machine Learning technologies enabling automation systems not only to perform tasks, but also to anticipate

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maintenance needs and optimize operations [1]. Typical applications of this intelligent automation include the use of AI for troubleshooting and the remote monitoring and control of equipment via IoT [4]. The transition from automation to digitalization and then to intelligence involves not only upgrades at the technical level, but also innovations in communication technologies. For example, the reference of Ethernet has become the mainstream technology for industrial automation communication and supports real-time, secure, and efficient data transport [5]. Overall, industrial automation has become an indispensable part of modern manufacturing and production from the early mechanical and electrical control to today's intelligent and network integration.

The research company selected for this paper is Honeywell International, Inc. Honeywell has been a key player in a variety of high-tech and industrial markets, demonstrating adaptability and leadership in areas such as aerospace, building technology and high-performance materials. This versatility has been driven by strategic mergers, innovation, and global market expansion, particularly in regions such as China, which has been identified as a key market in Honeywell's growth and innovation strategy [6]. Honeywell's investment in research and development and technology integration reflects its market dominance, especially in the highly competitive field of industrial automation. This focus on technology supports the company's long-term strategic goals and improves productivity and operational efficiency [7].

Financial analyses show that Honeywell maintains a solid growth profile supported by effective management strategies that are in the interest of shareholders. The use of advanced financial models, such as the Hanke-Guttridge discounted cash flow model, helps to forecast future earnings and assess the financial position, enhancing potential for growth and investment. Honeywell's dynamic market management strategy and strong financial foundation suggest that Honeywell is an attractive investment option with a positive outlook [8]. 3M Company is a multinational conglomerate that excels in innovation and technology commercialization across a wide range of industries. 3M is known for its creativity-promoting "15 per cent rule", which requires 30 per cent of revenues to come from new products, ensuring steady growth [9]. Its decentralized structure enhances flexibility and responsiveness in a rapidly evolving market. Its innovative advantages have attracted significant investor investment. Emerson Electric Co specializes in advanced control systems for complex industrial processes. Their Delta VDCS systems play a key role in polyvinyl chloride production, ensuring safe and efficient operation. Emerson continually upgrades its systems to maintain high performance and reliability in demanding industrial environments [10]. Johnson Controls, Inc. specializes in creating intelligent building solutions that emphasize safety, efficiency, and sustainability. Their innovations include OpenBlue, a platform that integrates existing IT systems with artificial intelligence to enhance building operations and ensure a dynamic and adaptive environment for occupants [11].

Companies such as Honeywell, 3M, Emerson, and Johnson Controls are leaders in diversified technology and manufacturing, with unique strengths in different industrial sectors such as aerospace, building technology and automation systems. A financial comparison of these giants provides a greater understanding of how they leverage innovation, manage operational efficiencies, and address financial challenges. The purpose of this paper is to take a closer look at the financial analysis of Honeywell compared to the other three companies, analyzing the financials, and providing investment insights by examining and analyzing financial data in terms of profitability, P/E ratio, PEG and more. In the following article, this study will firstly explain the source of data and the scope selected, the reason for selecting the comparison companies and the timeframe of selection, and explain the formulae of the metrics used in the comparison and their meanings, followed by the comparative analysis of the data and the analysis of the financial position, explain the results and the investment insights, and explain the limitations and outlook of this article.

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2. Data and Method

The anchor company selected for this paper is Honeywell International Inc. The comparison companies selected are 3M Company, Emerson Electric Co, and Johnson Controls, Inc. The reason for conducting a comparative financial analysis of Honeywell, 3M, Emerson, and Johnson Controls is that each of these companies operates in different, yet overlapping, business segments. Each company has carved out large market segments in industries such as industrial automation and specialty materials, which provides a unique opportunity to uncover unique financial models and strategic outcomes from their operating methods. The data selected for this paper are stock price as well as annual and quarterly total revenue, annual and quarterly cost of revenue, annual and quarterly gross profit, annual and quarterly total assets, and annual and quarterly net income for each company found on the Nasdaq website, and TTM EPS, NTM EPS and Revenue for each company found on the Estimize website. The stock price data selected is the US closing price of each company on 16 July 2024. Honeywell and 3M have selected annual total revenue, annual cost of revenue, annual gross profit, annual total assets and annual net income for the period from 31 December 2020 to 31 December 2023. Emerson and Johnson Controls have selected annual total revenue, annual cost of revenue, annual gross profit, annual total assets and annual net income for the period from 30 September 2020 to 30 September 2023. The selected quarterly total revenue, quarterly cost of revenue, quarterly gross profit, quarterly total assets and quarterly net income data are for the period from 30 June 2023 to 31 March 2024. The selected TTM EPS and NTM EPS data are for the most recent four quarters, with Honeywell, 3M, and Emerson selected for a timeframe from the second quarter of 2023 to the first quarter of 2024, and Johnson Controls selected for a timeframe from the third quarter of 2023 to the second quarter of 2024.

The comparison metrics selected for this paper are TTM P/E ratio, NTM P/E ratio, revenue growth rate, EPS growth rate, PEG, GP/A, gross profit margin, net profit margin. The following are their calculation formulae:

$$\text{TTM P/E ratio} = \frac{\text{Current Stock Price}}{\text{TTM EPS}} \tag{1}$$

$$\text{NTM P/E ratio} = \frac{\text{Current Stock Price}}{\text{NTM EPS}} \tag{2}$$

$$\text{Revenue growth rate} = \frac{\text{NTM Revenue}}{\text{TTM Revenue}} - 1 \tag{3}$$

$$\text{EPS growth rate} = \frac{\text{NTM EPS}}{\text{TTM EPS}} - 1 \tag{4}$$

$$\text{PEG} = \frac{\text{TTM P/E}}{100 * \text{EPS growth rate}} \tag{5}$$

$$\text{GP/A} = \frac{\text{Gross Profit}}{\text{Total Assets}} \tag{6}$$

$$\text{Gross profit margin} = \frac{\text{Gross Profit}}{\text{Total Revenue}} \tag{7}$$

$$\text{Net profit margin} = \frac{\text{Net Income}}{\text{Total Revenue}} \tag{8}$$

Each of these metrics has its own meaning. Both TTM P/E ratio and NTM P/E ratio help investors assess whether a stock is overvalued or undervalued relative to its earnings. A higher P/E ratio might indicate that the stock is overvalued, or investors expect high growth in the future. A lower P/E ratio could suggest that the stock is undervalued or that the company is facing challenges. TTM P/E is more useful for analyzing companies with stable earnings and established track records. By contrast, NTM P/E is more relevant for growth companies where future earnings potential is a key driver of stock price. Revenue growth rate is an important financial indicator that reflects the percentage increase in a company's sales over a specific period. It is an indicator of the health of a business that helps investors make informed decisions, aids in company valuation, and facilitates benchmarking against competitors and industry trends. EPS growth rate measures the percentage increase in a

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company's earnings per share over a specific period. Like revenue growth rate, it also shows earnings trends, guides investment decisions, helps with company valuation, and provides benchmarking against competitors and industry standards. PEG ratios round out the P/E ratio by factoring in earnings growth, providing a more nuanced view of valuation. A low PEG indicates that a stock may be undervalued relative to its growth. In contrast, GP/A measures how efficiently a company uses its assets to generate gross profit. A higher GP/A indicates that a company is better able to utilize its assets to generate profits, reflecting the efficiency of its operations. Together, these metrics provide insight into valuation, growth prospects and asset efficiency, helping investors make more informed investment decisions and comparative analyses. Gross profit margin measures the percentage of revenue remaining after deducting cost of goods sold (COGS) and reflects the efficiency of production and pricing strategies. The higher the gross profit margin, the better the company's cost control and profitability. On the other hand, net profit margin reflects the percentage of revenue remaining after deducting all expenses, taxes, and interest and reflects overall profitability. Comparing these margins helps investors assess a company's financial health, operational efficiency, and profitability.

3. Results and Discussion

3.1. Comparison Analysis

Firstly, this paper compiles the calculations of each financial data of each company for subsequent analysis. The calculation results are all displayed in the Table 1. The datas show that Honeywell's financial position is more prominent among these four companies, with a high stock price, TTM EPS, NTM EPS and P/E ratio, and its revenue and EPS growth rates are also very good. 3M's TTM EPS, NTM EPS and GP/A are relatively high, but its revenue growth rate and EPS growth rate are low, and its revenue growth rate, in particular, is negative, which shows that its company. Emerson has higher revenue and EPS growth rates, but its PEG is higher, indicating a slightly higher stock price relative to expected earnings growth. Johnson Controls performs better in terms of EPS growth rate and PEG, indicating stronger growth potential, but its stock price and EPS are lower. This comparison shows that Honeywell and Johnson Controls are performing better, while 3M and Emerson have some financial pressures and challenges in some areas. However, Emerson has a higher PEG than Johnson Controls, and lower GP/A than both Honeywell and Johnson Controls. 3M has the greatest GP/A, and its stock price is lower than Honeywell. It does have negative growth rates, which is the major red flag. So here, 3M and Emerson will be dropped the consideration.

Table 1: The important financial data of each company

	Honeywell	3M	Emerson	Johnson Controls
Stock Price	$218.47	$103.31	$118.87	$72.18
TTM EPS	9.49	9.66	5.16	3.37
NTM EPS	10.47	7.29	5.71	3.81
TTM P/E ratio	23.02	10.69	23.04	21.42
NTM P/E ratio	20.87	14.17	20.82	18.94
Revenue Growth Rate	6.9%	-24.7%	8.7%	5.7%
EPS Growth Rate	10.3%	-24.5%	10.7%	13.1%
PEG	2.23	N/A	2.16	1.64
GP/A	22.2%	28.1%	17.4%	21.2%

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Next, this paper will analyze the gross margin and net margin. The Table 2 and Table 3 is the calculated relevant data. Based on the trends shown in the Fig. 1 and Fig. 2, it can be concluded that quarterly numbers are driven by seasonal factors, so less weight will be put on them. By analyzing the gross margin data, it can be concluded that Honeywell's annual gross margin has been increasing year on year, from 32.1% in 2020 to 37.7% in 2023, which shows the company's significant ability in cost control. Johnson Controls, on the other hand, has a relatively stable annual gross margin that fluctuates around 33%, with a higher gross margin in 2021 but declining to 33.5% in 2023. In terms of net margin, Honeywell's performance remains strong, with the overall stability and high level of its net margin demonstrating Honeywell's greater ability to improve net profitability. Johnson Controls' annual net margin is gradually improving but remains volatile and at a lower level.

Table 2: The important annual and quarterly margin of Honeywell

Period Ending:	12/31/2023	12/31/2022	12/31/2021	12/31/2020
Gross Margin	37.3%	37.0%	35.9%	32.1%
Net Margin	15.4%	14.0%	16.1%	14.6%
Quarterly Ending:	3/31/2024	12/31/2023	9/30/2023	6/30/2023
Gross Margin	38.7%	34.3%	38.4%	38.5%
Net Margin	16.1%	13.4%	16.4%	16.3%

Table 3: The important annual and quarterly margin of Johnson Controls

Period Ending:	9/30/2023	9/30/2022	9/30/2021	9/30/2020
Gross Margin	33.5%	33.0%	34.1%	33.2%
Net Margin	6.9%	6.1%	6.9%	2.8%
Quarterly Ending:	3/31/2024	12/31/2023	9/30/2023	6/30/2023
Gross Margin	32.6%	32.7%	32.0%	34.1%
Net Margin	-4.1%	6.1%	7.9%	14.7%

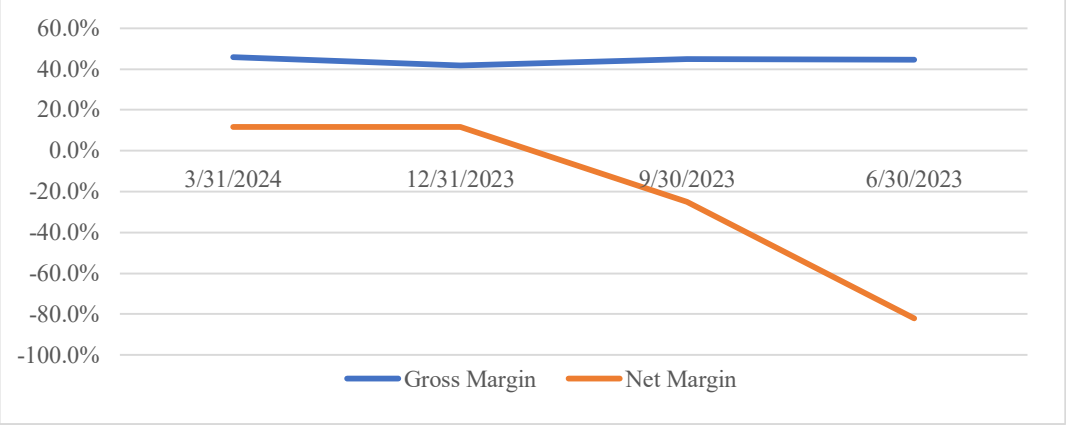

Figure 1: The important quarterly margin trend of Honeywell.

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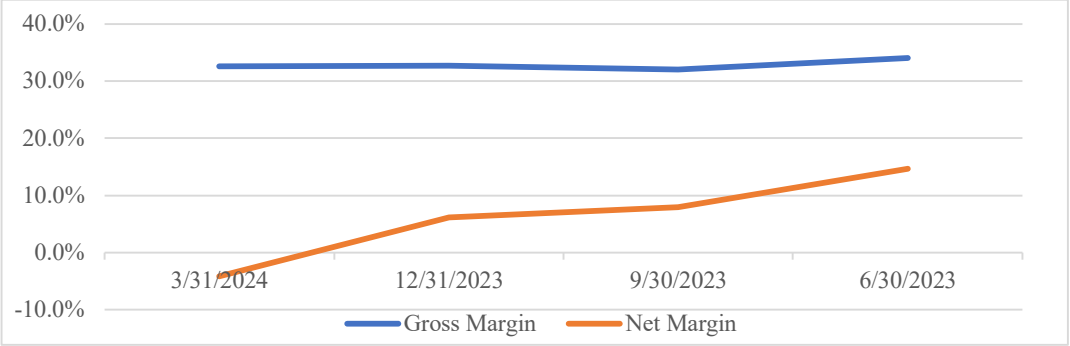

Figure 2: The important quarterly margin trend of Johnson Controls.

3.2. Explanation and Implications

On a consolidated basis, Honeywell's gross margin is higher than that of Johnson Controls in both annual and quarterly figures and has shown to be more stable and is gradually increasing. At the same time, its net margin is also significantly higher than that of Johnson Controls, showing stronger and more stable profitability. That's why the paper argues that Honeywell is a better candidate to be invested in.

Meanwhile, based on the analysis, this paper will give some investment insights. Honeywell has excellent performance in terms of gross and net profit margins, and has been growing steadily year by year, which shows its strong profitability and cost control ability, from which investors can expect its financial performance to remain strong in the future. Honeywell's revenue and EPS growth rates are high, and its GP/A and PEG are within reasonable ranges, which indicates that the market is optimistic about its future growth. For investors looking for a stable stock with growth potential, Honeywell is an option worth considering. And while Johnson Controls' gross and net margins are lower than Honeywell's, its revenue and EPS growth rates show some growth potential, especially with its lower PEG, which suggests it may have better returns in the future. However, its net margin is subject to some fluctuations and losses, which suggests investors need to be aware of the volatility of its profitability. For investors with higher risk tolerance, they may consider buying low during market correction.

3.3. Limitations and Prospects

The financial data used in this paper is limited to a specific time horizon (2020-2024 for Honeywell and 2020-2023 for other companies). Shorter time horizons, however, may not reflect long-term trends or the impact of economic cycles, which may affect the robustness of the conclusions. At the same time, this analysis does not consider macroeconomic factors, geopolitical events or industry-specific disruptions, which may have a significant impact on the financial performance and stock prices of the companies analyzed. In addition, while the selected financial metrics (TTM P/E ratio, NTM P/E ratio, revenue growth rate, EPS growth rate, PEG, GP/A, gross margins, and net margins) provide valuable insights, they may not fully reflect a company's financial health or investment potential. Other metrics such as cash flow, debt levels and R&D spending can provide additional perspective. Contemporarily, the ongoing convergence of IoT, AI and machine learning technologies with industrial automation will drive significant growth and efficiency improvements. Companies that effectively utilize these technologies will reap considerable long-term benefits. As emerging markets continue to industrialize, the demand for advanced automation solutions will continue to grow. Companies like Honeywell, with a strong global presence and strategic market entry plans, are well positioned to capitalize on these opportunities. By addressing these limitations and considering

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the outlook, investors and stakeholders can gain a more nuanced understanding of the financial health and growth potential of companies in the industrial automation space.

4. Conclusion

To sum up, this paper provides an in-depth financial analysis of Honeywell International Inc. compared to 3M Company, Emerson Electric Co., and Johnson Controls Inc. The comparative study focuses on various financial metrics including TTM P/E ratio, NTM P/E ratio, revenue growth rate, EPS growth rate, PEG, GP/A, gross profit margin, and net profit margin. Honeywell stands out with its high stock price, robust TTM and NTM EPS, and favourable P/E ratios. Its revenue and EPS growth rates are commendable, indicating strong financial health and growth potential. The company's gross and net profit margins have shown consistent improvement, demonstrating its efficiency in cost control and profitability enhancement. On the other hand, Johnson Controls exhibits lower gross and net margins compared to Honeywell but shows promise with its revenue and EPS growth rates, suggesting potential for high returns, especially with its lower PEG ratio. However, its net margins fluctuate significantly, highlighting the need for caution among investors. 3M and Emerson face more pronounced financial challenges. 3M, despite having high TTM EPS and GP/A, suffers from negative revenue and EPS growth rates, marking it as a less favourable investment. Emerson, although showing higher growth rates, has a higher PEG ratio, indicating its stock price may be overvalued relative to its earnings growth. The analysis reveals that Honeywell and Johnson Controls are more attractive investment options compared to 3M and Emerson. Honeywell's strong profitability, steady growth, and efficient asset utilization make it a reliable choice for investors seeking stable and growth-oriented stocks. Meanwhile, Johnson Controls could appeal to those with higher risk tolerance, given its potential for better returns during market corrections. Looking to the future, the ongoing convergence of IoT, AI, and machine learning technologies with industrial automation is expected to drive significant growth and efficiency improvements. Companies that effectively leverage these technologies, like Honeywell, are well-positioned to reap substantial long-term benefits. As emerging markets continue to industrialize, the demand for advanced automation solutions will increase, presenting further growth opportunities for these companies. This paper underscores the importance of using comprehensive financial metrics to assess a company's investment potential. By providing a nuanced understanding of the financial health and growth prospects of Honeywell and its competitors, this study offers valuable insights for investors and stakeholders in the industrial automation sector.

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Comparison of CAPM and DVM: Evidence from Costco and Walm

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Abstract: In the financial field, asset pricing models are crucial for investment decisions and enterprise value assessment. This article compares and studies two common asset pricing models, CAPM and DVM. There are differences in parameter estimation and assumptions between the two models. The CAPM offers a theoretical derivation of the relationship between required returns and systemic risk by precisely accounting for a firm's level of systemic risk relative to the entire stock market. However, the assumptions of this model are unrealistic, and the accuracy of variable values cannot be accurately grasped. The calculation process for DVM's conclusion is concise and applicable to most companies. Nevertheless, the input data used in the calculation process may not be accurate. At the same time, it ignores the growth of future returns, ignoring explicitly include risks, and is not applicable to companies that distribute zero dividends. This study is beneficial for providing investors and enterprises with a more comprehensive basis for selecting pricing models, and promoting the development of financial theory and practice.

Keywords: WACC, DVM, CAPM, Beta.

1. Introduction

The cost of capital is an important determinant in the financing decision of a company. Gordon popularized the idea that the cost of capital is the same as the property discount rate [1]. He emphasized that the profitability of a particular investment above (or below) this discount rate will increase (or decrease) the value of that vendor. It can be viewed as the necessary rate of return from the perspective of the investor. The performance of a corporation is usually assessed using the return on invested capital. Thus, an investor-owner (shareholder) assesses the company performance considering the gain of the invested capital value [2].

Shareholders require a paramount rate of return. The cost of equity capital serves as a crucial foundation for decisions about financing and investments [3]. This research study examines and contrasts the Dividend Valuation Model (DVM) and the Capital Asset Pricing Model (CAPM). The roles that the DVM and CAPM models play in the computation of WACC are distinct. The primary use of the CAPM model is to estimate the cost of capital. This cost, in turn, is used to establish the expected rate of return for investors, taking into account market risk premiums and asset beta coefficients. The DVM model offers a cash flow-based approach to valuation that makes it easier for investors to comprehend a company's profitability and room for expansion. Consequently, acquiring a more accurate approximation of the rate of return that equity investors require.

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Comparing dividend valuation models and asset capital pricing models can help investors evaluate asset value and optimize investment portfolio allocation in investment decision-making. In terms of corporate financial management, DVM helps with company valuation and provides a basis for decision-making by enterprise managers such as mergers and acquisitions financing. CAPM helps determine the capital cost of the enterprise, which is crucial for project investment decisions, capital structure optimization, and so on. DVM and CAPM are both important components of asset pricing theory. Comparative research is beneficial for deepening the understanding of the mechanism of asset price formation in financial markets, promoting theoretical progress and effective operation of financial markets.

2. Data and Method

2.1. Methodologies

One important metric that businesses use to evaluate the feasibility of investment plans is the cost of capital. Before choosing to raise funds through the issuance of shares or retained earnings, an organization must be aware of the cost of capital. Thus, the company may select the most advantageous financing package to reduce its overall cost. It is also necessary for valuing businesses. When evaluating the target company's value in a merger or acquisition, the acquirer must take the cost of equity capital into account. Investors find it noteworthy as well. Investors acquire the ability to evaluate the risk and expected return of a stock investment. Based on more precise cost estimations, market participants can make more logical financing and investment decisions, encouraging the effective use of already available resources.

The DVM uses a discounted formula to calculate the cost of capital, assuming the market stock price is true and accurate, neither undervalued nor overvalued. The only cash flow investors receive from a company is dividends. The value of a stock is determined by its expected future dividend flow, discounted to its present value. It is important to understand the frameworks that support the link between an investment's risk and return. Diversification cannot eliminate systematic risk, but it can minimize unsystematic risk if a portfolio is kept well-diversified.

In a project, the cost of capital can be computed by using the CAPM. This figure is contingent on the project's systematic risk and may differ from the firm's overall cost of capital [4]. The systemic risk of any asset reflects the correlation between the returns of that asset and the overall welfare of investors, or more specifically, how little an asset yields during periods of low investor wellbeing [5]. The company's equity beta is used to measure it. The strength of the CAPM's forecasts regarding risk measurement and the relationship between projected return and risk make it appealing [6]. The Weighted Average Cost of Capital (WACC) is one of the important parameters of finance and it helps the firm valuation, capital budgeting analysis, and several other applications.

One of the key financial metrics, the WACC, is used for capital budgeting research, corporate valuation, and many other purposes [7]. WACC determines a weighted average based on the various weightings of the capital structure's costs of capital, accounting for the cost of capital from various sources such as debt and equity. By calculating WACC, companies can determine the feasibility of a project and ensure that the project's rate of return meets their expectations.

For DDM model, it can be described as:

$$P_0 = \frac{Do(1+g)}{r_e - g}, K_e = r_e = \frac{D_0(1+g)}{P_0} + g \quad (1)$$

where, $K_e = r_e = Cost\ of\ equity$; g=Dividend growth rate; D_0 =Dividend to be paid at the conclusion of year 0; P_0=Share price =Ex-dividend share price. Most companies expect dividends to

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increase from year to year. A logical model would assume constant growth. The g, for the given period can be computed as follows:

$$g = \sqrt[n]{\frac{last\ dividend}{first\ dividend}} - 1 \quad (2)$$

Here, N=the number of years of dividend growth. As for Gordon's growth model [8]:

$$g = br_e \quad (3)$$

where r_e =Return on equity (ROE); b=Retention rate=1-dividend pay-out ratio. This model is formulated under following assumptions:

- Retained earnings are the only source of growth in earnings;
- For every future year, the historic return on equity capital will persist;
- The retention rate is constant.

As for Capital Asset Pricing Model [9]:

$$E(r)j = R(f) + \beta\big(E(rm) - R(f)\big) \quad (4)$$

where E(r)j=Required return from the investment; R(f)=Risk-free rate of return; β=beta value of the investment; E(rm)=Average return from market portfolio; E(rm)-R(f)=Equity risk premium. The validity of CAPM's conclusion depends on whether the following assumptions are true:

- Investors utilize the mean variance efficient portfolio in a single period model to gauge the quality of the portfolio;
- Investors consistently anticipate the market's expected return, variance, and covariance;
- Investors are price receivers and have a strong aversion to risk;
- The market is free of taxes, transaction costs, or information barriers, all assets can be market-oriented, and investors can borrow at risk-free rates [10].

2.2. Data

Costco and Walmart were selected to study the comparison of DVM and CAPM. Costco and Walmart are globally renowned retail companies with significant positions and influence in the industry. Their business model, financial condition, and market performance can all reflect the overall characteristics and trends of the retail industry. There is a competitive relationship between the two in the market, and a deep understanding of how companies use different strategies to create value and control risks in a fiercely competitive dynamic environment is of great significance for the validation and application of DVM and CAPM models. As listed companies, both have accumulated a large amount of rich and reliable financial data in their years of operation, and both follow strict financial data disclosure standards, with high information transparency, providing sufficient materials for model parameters and analysis, and reducing the uncertainty and error of research data. Costco focuses on membership based warehousing retail, emphasizing high cost-effectiveness and large packaging sales; Walmart adopts various retail formats, including supermarkets, hypermarkets, etc. The differences in this business model can lead to differences in cost structure, profit sources, and market positioning, thereby affecting its risk and return characteristics, providing rich comparative samples for the analysis of risk factors in the CAPM model. This study adopts Gordon's growth model to calculate dividend growth rate. The data of the two companies is summarized in Table 1, Table 2, Table 3, Table 4, Table 5, Table 6 and Table 7.

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Table 1: Annual data of Walmart and Costco dividend pay-out ratio

Walmart date	2021-01	2022-01	2023-01	2024-01
dividend pay-out ratio	0.46	0.45	0.53	0.40
Costco date	2020-08	2021-08	2022-08	2023-08
dividend pay-out ratio	0.30	0.26	0.26	0.27

Table 2: Walmart and Costco Retention rate

Walmart date	2021-01	2022-01	2023-01	2024-01
Retention rate	0.54	0.55	0.47	0.60
average	0.54			
Costco date	2020-08	2021-08	2022-08	2023-08
Retention rate	0.70	0.74	0.74	0.73
average	0.73			

Table 3: Return on equity Annual Data

Walmart	2021-01	2022-01	2023-01	2024-01
ROE	17.37%	16.66%	14.61%	19.32%
Costco	2020-08	2021-08	2022-08	2023-08
ROE	23.87%	27.94%	30.59%	27.54%

Table 4: Share price

Costco	$845.085 Jul 12, 2024
Walmart	$69.755 Jul 12, 2024

Table 5: Dividend for Walmart

Cash Amount	Declaration Date	Payment Date
$0.56	02/17/2022	09/06/2022
$0.56	02/17/2022	05/31/2022
$0.56	02/17/2022	04/04/2022
$0.55	02/18/2021	01/03/2022

Table 6: Dividend for Costco

Cash Amount	Declaration Date	Payment Date
$0.79	10/13/2021	11/12/2021
$0.79	07/13/2021	08/13/2021
$0.79	04/14/2021	05/14/2021
$0.70	01/21/2021	02/19/2021

Table 7: Annual data of beta coefficient for Walmart and Costco

Date for Walmart	2021-01	2022-01	2023-01	2024-01
β	0.42	0.48	0.53	0.56
Date for Costco	2020-08	2021-08	2022-08	2023-08
β	0.60	0.59	0.63	0.99

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Treasury bonds are often thought to be risk-free, at least from the perspective of credit. Some people also choose short-term banks for 3-5 years. The bond market interest rate is treated as a risk-free rate, which is taken as 4.187% for the US 10-year Treasury bond. Compared with short-term treasury bond interest rate, the term of long-term treasury bond is more consistent with the term of equity investment to be discounted [11]. For average return from market portfolio, this study utilized approximation the Average Return from Market Portfolio as Return on Equity.

3. Results and Discussion

To simplify the analysis, the impact of taxes and inflation is not considered in the calculation. Based on the assumption of the formula, Walmart's retention rate is taken as the average of 0.54 over the past four years, while Costco's retention rate is 0.73. For return on equity, select the most recent data, which is 19.32% for Walmart and 27.54% for Costco. Using the formula □ = □□□ and the data provided above, it is feasible to compute the dividend growth rate: Walmart's dividend growth rate is 10.43%, while Costco's dividend growth rate is 20.10%. Dividend to be paid at the conclusion of year one is the sum of quarterly dividends as shown in Table 8. The cost of equity of two companies can be obtained using the DVM model given in Table 9. By using the CAPM model, the required return from the investment of two companies can be calculated as presented in Table 10.

Table 8: Dividend to be paid for the two companies.

	Walmart	Costco
D1	$2.23	$3.07

Table 9: The cost of equity of two companies

	Walmart	Costco
ke	13.54%	20.46%

Table 10: The required return from the investment of two companies

Walmart	2021-01	2022-01	2023-01	2024-01
	9.72%	10.17%	9.71%	12.66%
Costco	2020-08	2021-08	2022-08	2023-08
	16.00%	18.20%	20.82%	27.31%

The WACC calculated using the DVM model is slightly larger compared to the CAPM model. The WACC calculated by CAPM model and DVM model may differ. This is because the two models are based on different assumptions and constraints, and they have different ways of considering risks. At the same time, the capital market is complex and volatile, full of uncertainty and volatility, and calculations based on historical data may have significant deviations.

In actual investment, how to choose CAPM model and DVM model to calculate WACC depends on multiple factors. Firstly, the stability and growth rate of the company. If the company's cash flow is stable and its growth rate is predictable, the DVM model may be more applicable. In cases where a firm's growth rate exhibits instability or is ill-defined, the CAPM model might be a better fit due to its emphasis on the correlation between market returns and risk. Secondly, specific industries use specific models. The DVM model is more suitable for stable companies in mature industries, while for high-risk or emerging industries, the CAPM model can better reflect risk factors. Data availability must also be considered. It may be simple to estimate the CAPM model's parameters, such as the β, market risk premium, and risk-free rate. The DVM model requires the company's dividend data,

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which may be difficult for some companies to obtain or accurately predict. It is necessary to consider the limitations of both models. The market may behave irrationally and have information asymmetry, despite the CAPM model's assumption that it is efficient. The DVM model relies on predicting dividends, and dividend policies may be influenced by multiple factors.

4. Conclusion

To sum up, this study conducted an in-depth comparison between CAPM and DVM and found that CAPM has an advantage in measuring the impact of systemic risk on asset pricing, while DVM is more accurate in evaluating the value of stable dividend paying enterprises. Meanwhile, there are differences in the applicability of the two under different market conditions and stages of enterprise development, and the rationality of data acquisition and model assumptions also affects their application effectiveness. In the future, it is expected to further optimize these two models or explore new pricing methods that integrate their advantages to more accurately reflect asset value. These results provide a reference for investors and enterprises in asset pricing choices, which helps to enhance the scientific nature of financial decision-making and promote the healthy development of financial markets.

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Analysis of Financial Performances for Monster Beverage: Comparison with KO, PEP and KDP

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Abstract: The soft drink market is a growth market with diverse products including carbonated drinks, energy drinks, sports drinks, ready-to-drink tea, etc., in which demand shifts by consumer behaviours, market innovations, as well as macro environment policies. This study analyzes the financial performance of Monster Beverage Corporation (MNST) in comparison with Coca-Cola (KO), PepsiCo (PEP), and Keurig Dr Pepper (KDP) by calculating financial metrics and making comparison analysis, and the aim is to find one stock which is worth value investing. Consequently, MNST is worth investing in on account of its outstanding financial metrics including its lower PEG ratio, higher revenue growth rate, and EPS growth rate, meanwhile, MNST stands out with its external factors such as innovation in flavour. The research fills the vacancy of value investing, especially for comparison analysis in the specific four soft drink companies, i.e., MNST, KO, PEP, and KDP. Though the research needs more predicting models, these results still can help investors make decisions in value investing.

Keywords: Value investing, financial performance, soft drink industry.

1. Introduction

The soft drink industry is a routine market that many people spend in. According to Statista, the average volume consumed per person is projected to reach 37.66 liters in 2024 in the soft drink industry [1]. The revenue contribution percentage shows the structure of the soft drink industry. According to the industry report, carbonated soft drinks account for 45% of the soft drink industry revenue, and the following industry revenue from high to low is fruit beverages, bottled waters, functional beverages, and sports drinks [2]. Research shows the soft drink industry's revenue is expected to reach USD 169920 million by 2031 with a high compound annual growth rate, meanwhile, USA, China, and Europe are the leading regions in the soft drink market [3]. To emphasize, soft drink consumption has grown fast over the past 50 years, and the demand is caused by consumer behavior and the industry's constant evolution and innovation [4]. Furthermore, Raihan and his colleagues found that the soft drink industry is facing high competition with rapid growth, on the other hand, its supply chain is prone to be challenged by consumer preference changes and new environmental policies [5]. Promotional tactics, including social media advertising, educational approach, emotional evoking, and sports team sponsoring, can help relieve the challenges [2].

Monster Beverage Corporation (MNST) in comparison with Coca-Cola (KO), PepsiCo (PEP), and Keurig Dr Pepper (KDP) are 4 of the top 10 soft drink companies in the world [6]. To begin with,

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Monster Beverage Corporation sold its products in 158 countries. The company has profitability growth, outstanding cost and risk management, and brand expansion with high consumer demand for energy drinks, which make it a strong potential stock [7]. Additionally, Madrid made a comparison analysis by the balance sheet and income statement of PEP and KO, and then focuses on several financial ratios such as activity ratios, profitability ratios, solvency ratios, etc. PEP and KO have decreasing revenue and face decreasing market volume, and each company has different advantages and disadvantages after analyzing the financial ratios [8]. KO has better overall financial indicators than PEP. For example, though KO has higher revenue, it is not better than PEP since KO is difficult to convert free cash flow [9]. Furthermore, Coca-Cola performed better than Keurig Dr Pepper is a better stock, in the fact of KO's higher revenue growth and net profit though both underperformed the S&P 500 over the last three years [10].

Most present papers are about the single analysis of one company or a comparison analysis of two companies in the soft drink industry, but there is no comparison for the four companies, i.e., MNST, KO, PEP, and KDP. However, comparing analysis for these four companies of the top 10 soft drink companies by adopting calculations and concluding suggestions is important for value investing. Thus, this paper that helps compare the financial performances of MNST, KO, PEP, and KDP will fill in the gaps in existing research. The paper is structured as follows. The next section is to present the sources of data, competition, and methodology. Section 3 is for results and discussions based on the comparison analysis, explanations, and limitations. Section 4 concludes this research paper.

2. Data and Method

This study used data from financial websites (Nasdaq and Estimize) and companies' annual reports. All data are obtained by June 26th, 2024. To begin with, the best way to characterize the soft drink market is as an oligopoly with multiproduct companies [11]. The Coca-Cola Company (KO), PepsiCo, Inc. (PEP), Monster Beverage Corporation (MNST), and Keurig Dr Pepper, Inc. (KDP) are the leading soft drink companies in the US. Coca-Cola, PepsiCo and Keurig Dr Pepper have carbonated soft drinks; Coca-Cola, PepsiCo and Monster have energy drinks; and each of them has ready-to-drink teas and coffees.

Main products are the main competition from those four companies, and meanwhile, strong brand recognition, diverse products, health initiatives etc. are other competing factors. To be more specific, the Coca-Cola Company (KO) is a long-established company with strong brand influence even in the global market, which also shows its leading position in the soft drink industry. Moreover, PepsiCo's extensive coverage in the worldwide market presents a direct challenge to Coca-Cola's dominance. PepsiCo's ability to innovate and diversify its products ensures its competitive edge, making it a formidable rival. Furthermore, for Monster Beverage Corporation, the high growth rate shows it's expanding rapidly in the global market, especially in North America, Europe and Asia. Monster focuses on the energy drink segment, an area of increasing consumer interest, especially for people who pursue health and wellness ideas. Similarly, Keurig Dr Pepper also has strong brand recognition and a diverse product range.

This paper is based on the calculation of several financial metrics. The stock price is the company's current price for trading, showing the market value of the company. Then, stock price times outstanding shares is market capitalization. The market capitalization reflects the company's value with its outstanding shares. EPS has two types, NTM and TTM, and is the indicator meaning earnings per share. TTM EPS is the net income (past 12 months) divided by outstanding shares, while NTM EPS is the projected net income (next 12 months) divided by outstanding shares. Hence, each of them is for the profitability for the traditional 12 months and the future profitability. Similarly, the TTM P/E ratio and NTM P/E ratio are current stock prices divided by TTM EPS or NTM EPS, indicating

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the market expectation for past and future periods. Revenue growth rate indicates the increase in a company's sales over a specific period and EPS growth rate is the increase rate in EPS during a period.

One of the most important financial indicators is the PEG ratio, which is a prospect to evaluate the company by comparing P/E with growth rates usually expressed as a percentage. The PEG ratio is lower the better since a lower PEG ratio (typically below 1) means the stock might be undervalued considering its expected growth. GP/A ratio is gross profit to total assets. It measures the efficiency of a company's assets in generating gross profit. Annual gross margin and annual net profit margin are gross profit to revenue and net profit to income respectively. Annual gross margin displays the proportion of income that is higher than the cost of products sold, which is a measure of production efficiency, whereas annual net profit represents the portion of income left over after all costs are paid. The above metrics can help evaluate the healthiness of companies, growth competencies, and profitability, which can provide effective insights to assess companies' investing value more accurately.

3. Results and Discussion

3.1. Comparison Analysis

According to the Table 1, there are several observations. Firstly, all four companies' forward P/E ratios are slightly lower than the current P/E ratios, suggesting an increase in earnings over the next year. Furthermore, Monster Beverage Corporation has the lowest PEG ratio, which indicates it might be undervalued relative to its growth, that is, high quality of earnings growth. Moreover, Monster Beverage Corporation's wedge between revenue growth rate and EPS growth rate is much larger than the others. The main reason for the wedge is the optimized cost control, which means the company's net income, and then EPS, might increase more quickly than revenue. On the other hand, there might be the high leverage, caused by using debt to grow, and at the same time, EPS growth rates are amplified and financial risk emerges. In addition, Keurig Dr. Pepper, Inc. has the lowest GP/A ratio, which means the efficiency for converting assets to gross profit is low.

Table 1: Key financial ratios for KO, PEP, MNST, and KDP in June 2024.

	Coca-Cola Company	PepsiCo, Inc	Monster Beverage Corporation	Keurig Dr Pepper, Inc.
Stock price	$63.84	$167.35	$50.14	$34.41
TTM EPS	2.73	7.73	1.59	1.83
NTM EPS	2.86	8.31	1.84	1.95
TTM P/E	23.38	21.65	31.53	18.80
NTM P/E	22.32	20.14	27.25	17.65
Revenue growth rate	0.01%	3.87%	9.22%	4.49%
EPS growth rate	4.76%	7.50%	15.72%	6.56%
PEG	4.91	2.89	2.01	2.87
GP/A	27.87%	49.35%	39.17%	15.50%
Number of shares outstanding	4,310,000,000	1,375,000,000	1,041,081,000	1,380,700,000
Market Capitalization (in billion)	275150400000	230106250000	52199801340	47509887000

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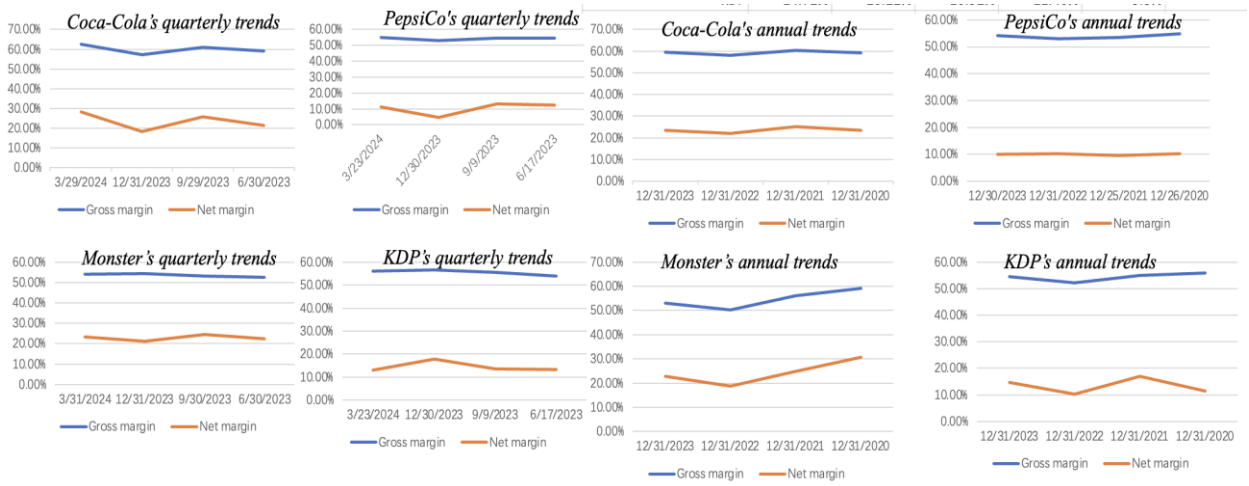

Figure 1: Annual gross margin and annual net profit margin trends for KO, PEP, MNST, and KDP.

Table 2: Annual gross margin and annual net profit margin for KO, PEP, MNST, and KDP.

Annual gross margin	2024	2023	2022	2021	Diff between 2024 & 2021
KO	59.5%	58.1%	60.3%	59.3%	0.2%
PEP	54.2%	53.0%	53.3%	54.8%	-0.6%
MNST	53.14%	50.30%	56.10%	59.23%	-6.1%
KDP	54.54%	52.10%	55.01%	55.83%	-1.3%
Annual net profit margin	2024	2023	2022	2021	Diff between 2024 & 2021
KO	23.4%	22.2%	25.3%	23.5%	0.0%
PEP	9.9%	10.3%	9.6%	10.1%	-0.2%
MNST	22.84%	18.88%	24.86%	30.65%	-7.8%
KDP	14.72%	10.22%	16.92%	11.40%	3.3%

According to Table 2 and Fig. 1, over the last 4 years, Monster Beverage Corporation experienced a significant decline in annual gross margin and annual net profit margin, while the other three companies are relatively at the same level during the four years. Besides, annual and quarterly trends are almost consistent, but quarterly data show more short-term volatility and seasonal changes. Thus, analysts' expectation that Monster Beverage Corporation's EPS will grow at 15.72% might be overly optimistic.

3.2. Explanation and Implications

Investing in Monster Beverage Corporation is a wise choice for the following reasons. Firstly, for financial factors, MNST has the lowest PEG ratio and high growth rates, which is good for long-term investment. Secondly, external factors including the innovation of new flavors, market expansion, and market demand, prove MNST's sustainability and are conducive to investors.

There are several risks to investing in MNST. Firstly, seen from the results, investing in Monster Beverage Corporation might take on a financial risk caused by the declining annual net profit margin.

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However, MNST has a high growth potential which shows the long-term investment value. Additionally, operational risks including the dependency on relationships with TCCC and the increasing competition emerge. However, according to MNST's annual report, they have independent companies that are not aligned with TCCC's interest and have robust brand positions and market shares in the soft drink market [12]. Besides, industry risks, such as the change in consumer preferences in the future, might be a consideration. To solve this problem, the company will develop new innovative beverages based on new trends to appeal to consumers continuously. Therefore, though investing in MNST has risks, investors are worth trying and taking on the risk since MNST will bring more benefits over risks and the risks can be managed.

3.3. Limitations and Prospects

The paper may not consider the market conditions, including inflation, global economic trends, consumer preferences change etc. Moreover, for the comparison analysis, different companies have different geographic scopes which may influence the profitability metrics. To improve, future research should use more predicting tools such as machine learning and large-language model to identify trends more accurately. In addition, the paper should consider long-term trends including tracing data for a longer period and considering sustainability competency. By addressing the limitations and exploring the prospects, future research can be more accurate and comprehensive for gaining insights into both financial and macro aspects.

4. Conclusion

To sum up, this study discussed the financial performance between MNST, KO, PEP and KDP. Monster Beverage Corporation stands out in the four companies because of its great financial metrics including its lower PEG ratio and higher revenue growth rate and EPS growth rate. Additionally, external factors such as innovation in flavor in MNST make it a sustainable competency. This paper fills out the vacancy for investment suggestions based on the four companies in the soft drink industry, which helps investors make decisions in value investing. However, the paper analyzed data based on the present data and industry status without predicting the future market condition by using model tools. Future studies should build more models for predicting market development, so as to make the investment suggestion more reliable.

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Influence and Inspiration of Asymmetric Information on Individual Investor Behavior

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Abstract: Information asymmetry is a pervasive phenomenon in the financial market. For individual investors, this imbalance usually results in making them vulnerable in the investment decision-making processes, thus raising the challenges as well as risks that characterize their participation in the market. Unlike financial institutions that have access to extensive resources and research capabilities, the lack of reliable sources of data and knowledge about how to interpret and analyze available information add layer of complexity for individual investors to acquire full and sufficiently accurate information, which increases risks for them during investment activities compared with financial institutions. Without proper understanding of financial concepts and analysis techniques, they may struggle to make informed decisions in an environment characterized by asymmetric information. Thus, according to the current literature on information asymmetry and individual investor behavior, this paper sorts out and summarizes the viewpoints and conclusions of each paper. On this basis, this paper provides a series of suggestions for individual investors to have better insight of this financial phenomenon and make reasonable investment in the financial market environment with asymmetric information.

Keywords: asymmetric information, individual investor behavior, determinants of financing decisions.

1. Introduction

In financial markets, information asymmetry denotes unequal access and interpretation capabilities among participants, rooted in information acquisition costs, analytical capacity, disclosure clarity, and market structures [1]. Aldo and Siconolfi define this as entities holding private information about economic variables, such as personal statuses and actions, leading to market inefficiencies like adverse selection and moral hazard[2]. Adverse selection arises pre-transaction when one party's superior knowledge leads the less informed to make suboptimal decisions.

Ngoc's study identifies behavioral traits in individual investors, including herd behavior, overconfidence, gambler's fallacy, anchoring, and ability bias [3]. Investors mimic peers' decisions, overestimate their expertise, misjudge past outcomes' influence on future events, and rely heavily on initial or recent data. These behaviors intertwine with information asymmetry, yet remain understudied.

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While academia extensively examines information asymmetry in major players—corporations, financial institutions, governments—there's a dearth of research on how these dynamics affect everyday individual investors, offering fertile ground for further investigation into practical applications of financial theory.

2. Literature Review

2.1. The impact of information asymmetry on individual risk

Rustichini and Siconolfi explored equilibrium in economies marked by asymmetric information, categorizing aspects like private information, moral hazard, and adverse selection [4]. They found that competitive equilibrium can be achieved in economies with private information and moral hazard via proper mechanism design. However, in adverse selection economies, non-convexity from free type declaration complicates existence and optimality, potentially thwarting efficient allocation through competitive markets. To counter manipulation from private information, planning should limit consumption sets to incentive-compatible distributions, possibly solved with lotteries. Personalized pricing is efficient in individual risk economies, but challenging in adverse selection ones due to market choice and type concealment. Adverse selection economies often lack equilibrium, unlike other economies where it always exists, due to uncoercible private type information.

The authors propose an incomplete market model with multiple budget constraints and currency transfers. Here, any efficient configuration under these constraints represents a competitive equilibrium, acknowledging heterogeneous data misalignment. Efficiency demands differentiated pricing akin to Malinvaud's concept, where various states facing different data misalignments have varying validity probabilities that shift by class.

The paper concludes that in asymmetric information economies, especially adverse selection settings, the coexistence of equilibrium existence and optimality is inconsistent with the smoothness of constrained optimality conditions, stemming from traders' market freedom.

2.2. Analysis of individual investor behavior pattern

Luu’s quantitative study in the International Journal of Business and Management surveyed 188 Vietnamese investors, revealing five key behavioral factors impacting investment decisions: Herd Behavior, Market Control Factors, Prospect Theory, Overconfidence-Gambling Fallacy, and Anchoring-Ability Bias [5]. These factors significantly affect stock price accuracy and capital raising.

Pahlevi and Oktaviani employed SEM and PLS software to assess factors shaping individual investor behavior among Indonesian student traders. Their results showed that attitudes, subjective norms, behavioral control, overconfidence, overoptimism, and herding positively influence investment intentions, whereas risk attitudes do not [6].

Lodhi’s empirical research in Karachi highlighted the role of financial knowledge, accounting information, and experience in personal investment decisions [7]. The results showed that the knowledge of the financial sector and the availability of accounting information reduce the asymmetric information, allowing for riskier investments.

Døskeland and Hvide analysed the trading patterns of Norway's private investors and discovered that the unusual returns were generally negative in spite of the preference for industry related shares [8]. This indicates that over-confidence might encourage over-trading of known stocks.

Together, they highlight the importance of behavior characteristics and asymmetric information in investment decisions, providing insights that are useful for advisers and policy makers.

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3. Theoretical Underpinnings of Information Asymmetry

Asymmetric information, classified as private, moral hazard, and negative selective economics, is the basis of all kinds of market inefficiencies. Confidential information means that the inside person does not have access to the general public, which makes it unfair for some people. Moral hazard arises when actions after a transaction are concealed from the other party, which may result in riskier behaviour. Adverse selection happens pre-transaction, where one party's superior knowledge can cause market inefficiencies.

Such an asymmetry has a negative impact on the effectiveness of the market because the prices are not always representative of all the important data. This may result in bad investment decisions, inappropriate allocation of resources, and increased capital costs as investors require a larger return on the additional risk. This imbalance results in market failures such as negative choice and moral hazard. Ngoc's research indicates that there is a shortage of information among investors, leading to sub-optimal shares [3]. The results of Døskeland and Hvide indicate that over-investment in well-known industrial equities leads to a negative return, indicating over-confidence in the market[8].

4. Behavioral Patterns of Individual Investors

Behavioral finance theory, drawing upon psychological insights, illuminates irrational investor behaviors in financial markets. Critical biases like herding, over-confidence, the gambler's fallacy, and anchoring play a significant part in individual decision making. This bias may cause investors to go along with the flow of people, which will influence the share price and stabilize the market. Too much confidence can encourage investors to move to more risky assets, whereas a bias can increase the volatility of the market [5][6].

In particular, investors frequently copy other people's purchase and sale decisions, which may aggravate a market bubble or collapse. Often, they overestimate their predictive power and think they can outperform the market average. The Gambler's Fallacy may result in a wrong judgment about the independent nature of past and future events. Additionally, anchoring on initial or recent data can skew forecasts, overlooking broader market trends.

5. Impact of Information Asymmetry on Individual Investment Decisions

5.1. Cost of Information Acquisition and Processing Capacity

The cost of obtaining information and one's processing ability affect investment choices. Because of the restricted approach of private investors relative to the financial institutions, they are exposed to increased risk when investing.

5.2. Information transparency and market structure

The transparency of the market and the structure of the market have a direct impact on the information of the private investors. Greater transparency in the market makes it more likely for investors to make better informed decisions.

5.3. Information Asymmetry and Investment Strategy Choice

The asymmetric information may result in the bad investment decision of the individual investors. Missing information, for instance, may make it difficult for them to identify high risk situations or investment traps.

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5.4. Case Analysis of Information Asymmetry

Rustichini and Siconolfi looked at decisions made in privately owned, moral hazard and negative choices [4]. In an unfavourable selective economy, when each class is private, it is not possible for the market to impose disclosure, which may lead to an ineffective allocation of resources by competing markets.

6. Information Asymmetry and Market Mechanisms

6.1. The Role of Market Mechanism Design

Asymmetric information is greatly reduced by market structures. Interventions such as publication rules and fair commercial practices may mitigate the underlying problems. The government may require a public company to present a comprehensive and timely financial statement, which will give the key information to the investors so that they can make informed choices.

6.2. Non-convex problems and market manipulation risks

Market manipulation is likely to occur in asymmetric information situations, in particular where private data owners are operating in opposition to the interests of other market players. For instance, insiders may make a deal before a public announcement, taking advantage of profits that are not widely known.

6.3. Application of Lottery Mechanism

Lottery technologies offer promise in addressing information asymmetry. By means of lotteries, participants in uncertain situations may be encouraged to deal in accordance with the sharing mechanism. This method can assist in reducing the inefficiencies that arise from privacy concerns.

7. Empirical Studies on Individual Investor Behavior

7.1. Quantitative Analysis of Behavioral Patterns

Empirical research frequently uses quantitative methods, including exploratory factor analysis, to identify behavioral drivers of investor decisions. Ngoc's research, for instance, utilized factor analysis to uncover five critical behavioral factors: herd behavior, market factors, prospect theory, the over-trusting-gambling fallacy, and anchoring-attribute bias [3].

7.2. The Impact of Information Asymmetry on Investment Performance

Empirical evidence shows a significant impact of information asymmetry on individual investment performance. Lodhi demonstrated that enhanced financial literacy and accounting information mitigate asymmetry, enabling more confident investment in riskier assets [7].

7.3. Empirical Studies on Policy Formulation and Investment Advice

Empirical studies provide a theoretical foundation for policymakers and investment advisors regarding investor behavior, notably under information asymmetry. Pahlevi and Oktaviani's research using structural equation modeling confirmed a positive link between investor behavior and investment intentions [6].

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8. Research Gaps and Future Directions

8.1. Limitations of existing studies

Research stresses that information asymmetry significantly impacts market efficiency and investor decisions. Enhanced financial education reduces this asymmetry, enabling bolder investment strategies. Yet, industry professionals don't always gain higher returns from stock trading, possibly due to overconfidence.

Academic gaps exist in understanding optimal market balance under incomplete information and the long-term effects on investor behavior. Comparative studies across different markets and cultures are scarce, limiting insights. Future research should focus on translating asymmetry dynamics into practical investment strategies.

8.2. Potential areas for future research

Future research should deeply probe information asymmetry's cross-market and cross-cultural impacts on investor decisions, enhancing tailored advice and risk strategies. Temporal analysis of asymmetry changes is vital, shaping market dynamics and guiding sound investor decisions over time. Concrete policy recommendations and investment advice require additional empirical studies, identifying asymmetry effects and proposing regulatory improvements to promote better disclosure and informed investing.

9. Methodology

This paper offers a comprehensive literature review, integrating and evaluating existing research to highlight key insights and suggest future research avenues. It applies various methodologies for a thorough exploration of the topic, providing a solid theoretical foundation for upcoming studies. The primary methods employed are:

Literature Collection: Collects related documents from a wide range of sources, such as libraries, databases, and Internet platforms.

Literature Analysis: Systematically synthesises previous research with the methods of Content Analysis, Meta-Analyses, and Case Research.

Comparative Analysis: Reviews ideas, approaches, and results from a wide range of sources to highlight the different and similar aspects of this area.

It is essentially a multi-angle analysis of the field of study, identifying important discoveries and new paths. This structured review will not only consolidate current knowledge, but also prepare the ground for further research.

10. Conclusion

10.1. Influence of financial market information asymmetry on individual investors

10.1.1. Information asymmetry and investment decisions of individual investors

Individual investors have an important part to play in the financial markets, but the lack of information tends to hamper their decision-making capacity. The fact that corporate executives can manipulate the information is detrimental to the investor, which is beneficial to the insider but damages the fair value of the market. This results in an inaccurate evaluation of the risk, in which investors may assume too much risk on the basis of imperfect information or rumours about the market. The false positive or pessimistic outlook that it produces may increase the risk of risky assets, thus jeopardizing the profitability of investors and the stabilization of the market.

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It is essential to improve the information disclosure system to solve this problem. The legal and timely disclosure of the relevant information is required by the public, and more stringent regulatory controls and sanctions for improper conduct will guarantee fair treatment. Training investors improves their information-processing and risk-management skills, backed up with expert advice to help them make better choices.

The asymmetric information influences both the short term investment decision and the long term benefit. It is difficult to design reliable investment strategies in markets where there is significant asymmetric information. Short term biases or mental defects result in more frequent transactions, higher costs and lower returns. The persistence of asymmetric information can undermine the trust of investors, discouraging long term investments and loss of opportunities.

10.2. Strategies and suggestions for dealing with information asymmetry

In finance, there are some strategies that can be used to improve the ability to obtain information, to develop a good investment idea, and to maintain finance education. The investor must be adept at collecting and assessing the information in order to identify the direction of the market. In addition to the maintenance of a patient long term perspective, the adoption of an appropriate investment strategy adapted to individual risk-tolerant and risk-tolerant goals is essential. Consultation with finance professionals can compensate for asymmetric information and make use of their expertise to analyze the market. Continuing education is crucial for adjusting to a constantly changing financial environment and empowering investors with effective risk management.

In order to create an equitable, transparent and effective market, the research encourages investors to take a cautious, long term view of investing, constantly renewing their sense of finance to foster the development of individual wealth and promote the healthy development of the market.

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Analysis of Wal-Mart Stock Trend Based on CAPM Model

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Abstract: The Capital Asset Pricing Model (CAPM) model is an important theoretical model in finance. This theory can be used to estimate the price of the target asset and predict its future development trend. As a famous brand, Wal-Mart is an indispensable backbone in the stock consumption sector and has attracted much attention from investors. This paper uses direct data and the CAPM model to conduct a case study on Wal-Mart's US stocks. The historical data of the S&P 500 is used as a sample to calculate the market return rate R(M), the one-year US Treasury bond rate is used as the risk-free rate R(f), and the historical rate of change of Wal-Mart's stock is used as R(i) to calculate its sensitivity to systematic risk β. The author uses Excel to perform regression analysis on the relevant data. The results show that the model passes the F test and T test, and the model is established; the model R 2 is 0.9676, which proves that the model fits well. The β of Wal-Mart stock is 0.9676. This data can prove that the stock is positively correlated with the changes in the S&P 500 market, that is, the stock is close to the market systematic risk. The greater the risk, the better the stock performs. When investors predict that the US stock market is on an upward trend, they can hold the stock.

Keywords: case analysis, regression model, empirical analysis.

1. Introduction

In recent years, CAPM has been widely used in the financial field. Due to its accurate measurement of asset prices, many investment banks like to use it to predict target assets. Since securities trading is a prediction of the future value of assets, investors will face certain risks when investing [1]. In this regard, the CAPM model is a good helper.

CAPM model is the cornerstone of classical financial theory. It was proposed by William Sharpe and other scholars in 1960 and is widely used in the field of corporate finance [2]. In the face of unknown risks, CAPM provides a simple and effective model that only requires the beta value to represent the impact of factors on the model. The CAPM model solves the relationship between investors and risks and confirms the relationship between risk and profitability.

The core of CAPM is Markowitz Portfolio Theorem, which aims to maximize expected returns and minimize risks by analyzing the trade-off between investment returns and risks, thereby helping investors choose the best financial investment products. The CAPM model is developed based on this theory. CAPM describes the investment situation of the market after all investors in a completely efficient market follow the Markowitz theorem, assuming that investors are rational and make diversified investments according to Markowitz's principles [3].

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Nowadays, CAPM has been developed for a long time and is very popular in theory and practice. CAPM was the first to determine the price and quantity of capital assets in equilibrium, using the neoclassical risk decision paradigm. It has become one of the main frameworks in financial economics for analyzing investor behavior under risk conditions [4].

This article will use the CAPM model to analyze the relationship between Walmart stock and the S&P 500, use relevant historical data to calculate the model's beta value, and use it to predict the future development of the asset.

2. Case Description

Walmart was incorporated in 1969 and has grown to become the world's largest retail company since its founding [5]. Its stock was established in the last century and has maintained steady growth since its founding. It has seen several sharp rises since the beginning of the 21st century and is currently one of the stocks included in the S&P 500. Although it still lags the S&P 500 index, Walmart is gradually catching up in recent years. Walmart's stock has risen an average of 6% per year between 2020 and 2024. Despite the impact of covid-19, Walmart has maintained good development during this period, thanks to the company's excellent business strategy, which also shows its hidden investment potential.

Walmart has an excellent supply chain system. They applied IT and other high technologies to the supply chain in the last century and effectively increased sales [6]. The company's continuous technological innovation has brought them huge profits, making them a leading company in the consumer industry and a very representative consumer stock. Therefore, this article selects the company's stock for case analysis.

3. Analysis on the Problems

3.1. Model Analysis

The CAPM model expression is $E(r_i) = r_f + \beta_{im}(E(r_m) - r_f)$: In this article, the U.S. one-year Treasury bond is used to represent the risk-free interest rate r_f; the rate of change of the closing index of the S&P 500, including 50 sets of data from April 2020 to June 2024, is $r_m$used as the yield of the market portfolio M; the rate of change of the closing price of Walmart U.S. stocks, including 50 sets of data from April 2020 to June 2024, is used as the yield of the target stock i r_i.

The core of this model is the calculation of β, which represents the increased risk of the portfolio after investing in assets [7]. According to the standard formula, we know that $\beta = \frac{cov(R_m,R_i)}{var(R_m)} = \frac{\rho\sigma_i}{\sigma_m}$. For the convenience of calculation, we can further deduce from the formula that $\beta_{im} = \frac{r_i - r_f}{r_m - r_f}$.

Therefore, we use the regression function of Excel to analyze and get the following results:

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Table 1: Regression results for Walmart stock data.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.983975
R Square	0.968206
Adjusted R Square	0.967557
Standard Error	0.048372
Observations	51

ANOVA

	df	SS	MS	F	Significance F
Regression	1	3.491518	3.491518	1492.174	2.34E-38
Residual	49	0.114654	0.00234		
Total	50	3.606173			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.00636	0.007193	-0.88433	0.380835	-0.02082	0.008094	-0.02082	0.008094
X Variable 1	0.967603	0.025049	38.62867	2.34E-38	0.917266	1.017941	0.917266	1.017941

As show in Table 1, we can know that 1. significance F < 0.05, T Stat < 0.05, the model is established; 2. R Square is 0.968, close to 1, proving that the model fits well; 3. X Variable is 0.9676, indicating that when the Nasdaq index rises by 1, the target stock rises by 0.9676, and the changes in the two are positively correlated.

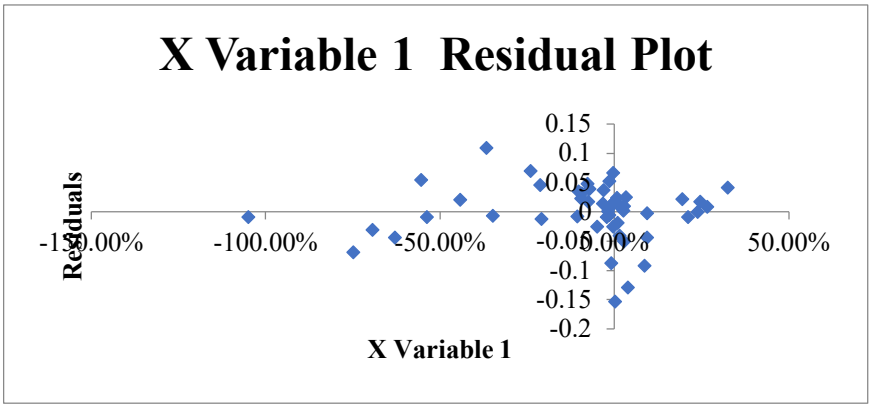

Figure 1: Residual Plot.

As show in Figure 1, it can be found that most of the points represented by the relevant data are randomly distributed above and below the straight line with 0 as the horizontal axis, and the regression

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line fits each observation well. This graph can prove that there is a linear relationship between the data variables x and y, the residual variance is uniform, and there are no outliers.

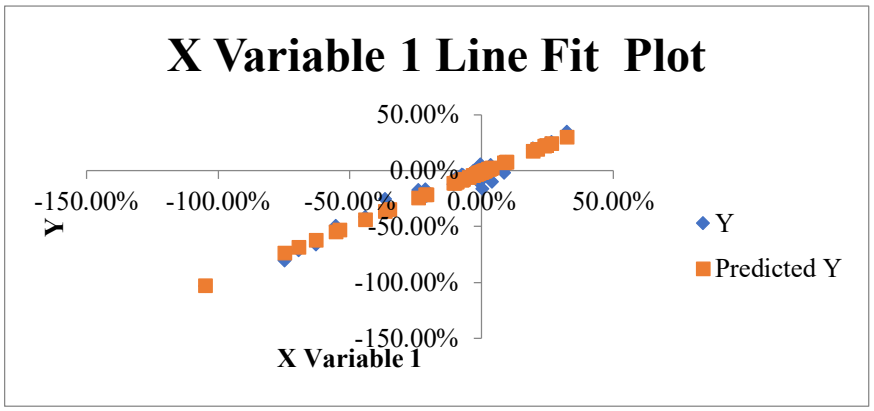

Figure 2: Line Fit Plot.

As show in Figure 2, we can find that the observed point Y and Predicted Y have a high degree of fit, indicating that the actual total price is close to the expected price. Combined with the icon R^2 of 0.9682, it shows that the model can explain 96.82% of the total price change, proving that the model has strong predictive ability.

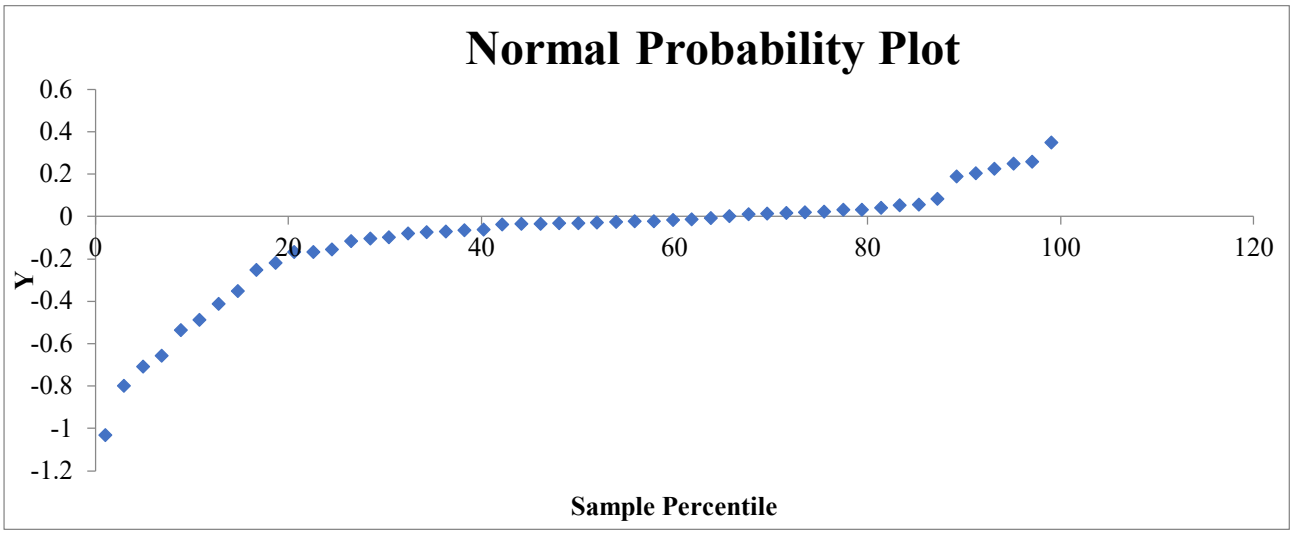

Figure 3: Normal Probability Plot.

As show in Figure 3, we can find that the overall trend of Y is rising, and when the Percentile is 65.6863, it is greater than 0, indicating that the model shows an overall upward trend.

Summary: 1. The model has a high degree of fit and is successfully constructed; 2. There is a high correlation between variables X and Y; 3. There is a positive correlation between their changing trends.

3.2. Macroeconomic Analysis

According to the data from the U.S. Department of Labor, the growth rates of the U.S. Consumer Price Index (CPI) and the core CPI slowed down in June 2024. The CPI grew by 3% year-on-year in that month, lower than 3.3% in May, and it was the first negative CPI growth since May 2020. This shows that the U.S. economy is gradually cooling down, but it also indicates that the Fed's future

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interest rate hikes will also slow down. The market has already responded to this. In fact, the S&P 500 index stopped growing, and technology-related stocks such as Microsoft and Nvidia fell. However, there are still about 400 stocks that have risen, including Walmart.

In the short term, the decline in CPI is a negative news for the stock market. Generally speaking, it indicates a slowdown in economic growth in the future. However, this economic slowdown is the result of the Fed's interest rate hike to fight inflation. So far, the effect is good.

The central bank may stop raising interest rates because in the long run this decline in CPI is actually good for the economy and the stock market.

3.3. Enterprise Analysis

Wal-Mart's business model is based on many aspects, the core of which is its innovative supply chain system. In the early stages of its development, the company vigorously developed its supply chain and used its own supply chain system to save a lot of transportation costs [8]. This is the reason for Wal-Mart's low cost and the basis of its competitiveness. Supply chain management has enabled Wal-Mart to develop rapidly and not just stick to the retail industry but has helped Wal-Mart expand its business scope.

As the industry leader, Walmart has always encouraged innovation [9]. Due to the high inflation in recent years, the consumption capacity of the American people has declined. Therefore, Walmart is planning to create a new operating model in the near future. This model will abandon the idea of using fresh food as the main category to attract customers to operate supermarkets and will complement membership stores such as Sam's Club. In addition, Walmart is also investing in green supply chains [10]. These investments prove that Walmart has development potential and prove that the company has investment potential.

4. Suggestions

For investors, since the long-term trend of the stock market is optimistic, investing in Walmart stocks with a positive beta will bring investors stable and good returns. At the same time, beta is close to 1, proving that the stock has been very stable for a long time, in line with the overall development of the US economy, and is a very stable stock. By observing the Normal Probability Plot, we can find that the overall trend of Y is rising, which indicates that this stock has the potential to rise in the future. In general, this stock is worth investing in.

From a macro perspective, the current inflation in the United States has gradually decreased, so the Federal Reserve is likely to reduce deposit rates in the short term to encourage money circulation and promote the rise of the stock market, which is a major positive for the US stock market. As for Walmart stock, since the beta is 0.9, it indicates that the stock is likely to rise in the future. In addition, the reduction in inflation is also positive for the retail industry, which means that people can have more ability to consume. In short, in view of the overall environment of the gradual easing of inflation in the United States, this stock is worth investing in.

From the company's perspective, Walmart has an advanced supply chain system, which gives it a great advantage in market competition. Moreover, the company encourages innovation and encourages the creation of new management and business models, which makes its long-term development dynamic and will not decline due to outdated management or business models. In general, the company has a good long-term development momentum and is worth investing in.

5. Conclusion

In general, this paper uses the CAPM model to conduct a regression analysis on Walmart's stock to draw conclusions. According to the regression model, it can be seen that the stock is generally on an

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upward trend, and the increase is very close to the increase of the S&P 500. According to the analysis of the macro economy, the overall development trend of the US economy in the future is positive, which is good news for the development of the market and companies such as Walmart. Regarding the analysis of the company, the company has innovation capabilities and a good supply chain foundation and has great potential for growth.

In general, Wal-Mart stock has a strong potential for growth. The regression model proves that the stock has been rising well in the past period. With the help of the overall economic environment and the company's own advantages in management and operation, the stock's future development trend will also be positive. Therefore, for investors, this stock has good development potential and has performed very steadily in the past, making it a very good investment option.

As a case study, this study helps the market fill the gap in the stock analysis of retail companies such as Walmart, and at the same time provides relevant investors with a reference for investment in the consumer sector. This study is helpful to professional investors, investment companies, relevant researchers, and companies in the consumer sector.

The model still has some problems. For future research, more professional data analysis software such as stata can be used to replace excel, and more charts can be used to describe the problem in more detail.

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Empirical Study on BYD Stock Price Prediction Based on LSTM Model

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Abstract: This study employs Long Short-Term Memory (LSTM) neural network models for stock price prediction. LSTM models excel in managing nonlinearities and time-series dependencies in data, thereby enhancing the accuracy of stock price forecasts, reducing investment risks, and increasing returns. Investors can reasonably use the LSTM model to predict stock prices and obtain greater returns. The research utilizes eight years of historical data from BYD, including opening prices, closing prices, highest prices, lowest prices, and trading volumes, as training data. By adjusting various hyperparameters such as epochs, learning rates, and training-test ratios, the study analyzes their impact on the predictive accuracy of the model and identifies optimal configurations through comparative experimental methods. We found that the best parameters were when epoch number was 25, training ratio was 90:10 (minimum mean square error was 0.00175572) and 4 years of training data was selected as the training set (minimum mean square error was 0.00146477).

Keywords: LSTM, stock price prediction, RNN, neural networks.

1. Introduction

With the rapid development of China's financial market, stocks have become a "barometer" of the market economy, attracting significant attention from investors and researchers. The volatility of stock prices makes accurate predictions challenging, and traditional statistical models have limitations. In recent years, with advances in artificial intelligence and machine learning, neural network models have emerged as a prominent research focus in the financial sector. This study aims to explore the application of the Long Short-Term Memory (LSTM) neural network model for stock price prediction.

The LSTM model excels in processing time series data and can achieve higher accuracy in handling nonlinear and serial correlation problems. This addresses the limitations of traditional machine learning algorithms in dealing with the time series correlations of stock data, making LSTM particularly advantageous for stock price prediction. By building and training LSTM models, we can accurately predict stock prices and provide valuable insights for investors, aiding them in making informed investment decisions, reducing risks, and enhancing returns.

The main body of this paper is divided into six parts. The first part outlines the background of stock price prediction, emphasizing the unique value and significance of the LSTM model for this task. The second part reviews various studies on stock price forecasting using the LSTM model, detailing their methodologies, subjects, and conclusions. The third part describes the experimental

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design, including data sources, preprocessing, model evaluation criteria, and LSTM structural analysis. The fourth part presents the experimental results using tables and figures. The fifth part discusses the experimental results and the conclusions drawn from the study. The final part summarizes the overall conclusions, addresses the limitations of the research, and proposes potential solutions.

2. Literature review

In recent years, the application of the Long Short-Term Memory (LSTM) network in predicting stock prices has garnered considerable attention. In 2018, Wang Jun et al. introduced an attention mechanism integrated into the traditional Seq2Seq model and conducted a 5-day prediction experiment using data from 50 constituent stocks of the Shanghai Stock Exchange spanning 2015 to 2017 [1]. The experimental findings demonstrated that this method enhances prediction accuracy by at least 3 percentage points compared to alternative approaches, particularly for predicting uncertain long-term series.

Subsequently, in 2021, Huang Yucheng et al. further refined the traditional Seq2Seq model by varying time series lengths and utilized the dataset of stocks from the Shanghai Stock Exchange, code-named 002, covering January 5, 1998, to June 2, 2020 [2]. Their investigation identified optimal prediction outcomes when the time series length parameter approached i = 0.01n, highlighting the LSTM model's superior predictive capabilities in their experimentation.

In 2022, Lin Xin et al. integrated an Attention mechanism into the LSTM model, employing the Shanghai Stock Exchange Industrial Index and the Shanghai Stock Exchange Environmental Protection Index as representative datasets. They conducted daily predictions from January 2, 2014, to September 22, 2020, and compared the performance against MLP, RNN, and traditional LSTM models, affirming that the AM-LSTM model achieved the highest prediction accuracy [3].

Shortly thereafter, Tao Yongkang et al. proposed an LSTM model incorporating an attention mechanism in 2023, focusing on stock forecasting within the banking sector. Through their research, they determined an optimal time step of 10 and verified through comparative analysis with standard LSTM models that LSTM-ATT exhibited superior predictive accuracy [4].

Huang Chaobin et al. utilized the LSTM neural network to predict the Shanghai Composite Index, benchmarking results against BP neural networks, CNN models, RNN models, and GRU neural networks. Their study, based on over 7,000 sample data points from specific stocks within the Shanghai Composite Index spanning 1990 to 2019, and utilizing 11 feature dimensions, split the dataset into a training set and a test set at a ratio of 7:3. Their findings underscored LSTM's robust predictive performance [5].

Additionally, Li Liping et al. compared LSTM, BP, and Elman models, examining the influence of neural network hidden layers. Their experimental outcomes demonstrated that LSTM neural networks achieved smaller MAE and RMSE values compared to the other models, affirming superior prediction accuracy [6].

Zhu Wenchao's comparison of RNN, LSTM, and GRU models utilized data from Changjiang Securities spanning January 1, 2008, to December 31, 2021, across 9 variables. Their study, under conditions of 3 hidden layers and 1 fully connected layer, revealed that the GRU model exhibited the most favorable fitting effects [7].

Exploring the combination of breadth learning (BLS) and deep learning, Han Ying et al. introduced complementary ensemble empirical mode decomposition (CEEMD) for noise reduction, addressing the volatility inherent in stock sequences. Their study focused on agricultural, forestry, animal husbandry, and fishery stock prices, demonstrating substantial improvements over baseline and existing models in multiple accuracy metrics [8]. Specifically, their model effectively mitigated issues such as poor fitting and time lag during periods of significant data fluctuation.

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3. Methods

3.1. Study Design

This study employs the Long Short-Term Memory (LSTM) network model to predict stock price changes. By adjusting various hyperparameters such as epochs, learning rate, and training ratio, the study evaluates their impact on the model's prediction accuracy. An experimental comparison method is used to assess model performance under different configurations and identify the optimal setup.

3.2. Data Collection

The dataset comprises historical trading data for BYD (002594) stocks on the Chinese mainland stock exchange, spanning from November 2016 to November 2023. This includes daily opening price, closing price, highest price, lowest price, and trading volume, covering an eight-year period.

3.3. Data Preprocessing and Fundamental Settings

Data preprocessing involves several key steps:

3.3.1. Handling Missing Values

Missing values are filled using interpolation methods.

3.3.2. Feature Selection

Features with high correlation, such as opening price, closing price, and trading volume, are selected.

3.3.3. Data Normalization

Data is normalized to the range [0, 1] to expedite model convergence.

Fundamental settings include:

Loss Function: Mean square error (MSE) is used as the loss function.

Optimizer: The Adam optimizer is employed.

Hyperparameter tuning includes:

Epochs: Set to 20, 25, 30, 40, and 50 for experimental comparison.

Learning Rate: Fixed at 0.001.

Training Ratio: Varied at 75:25, 80:20, 85:15, and 90:10 for experimental comparison.

3.4. Model Evaluation

Root mean square error (RMSE) is used as the evaluation metric.

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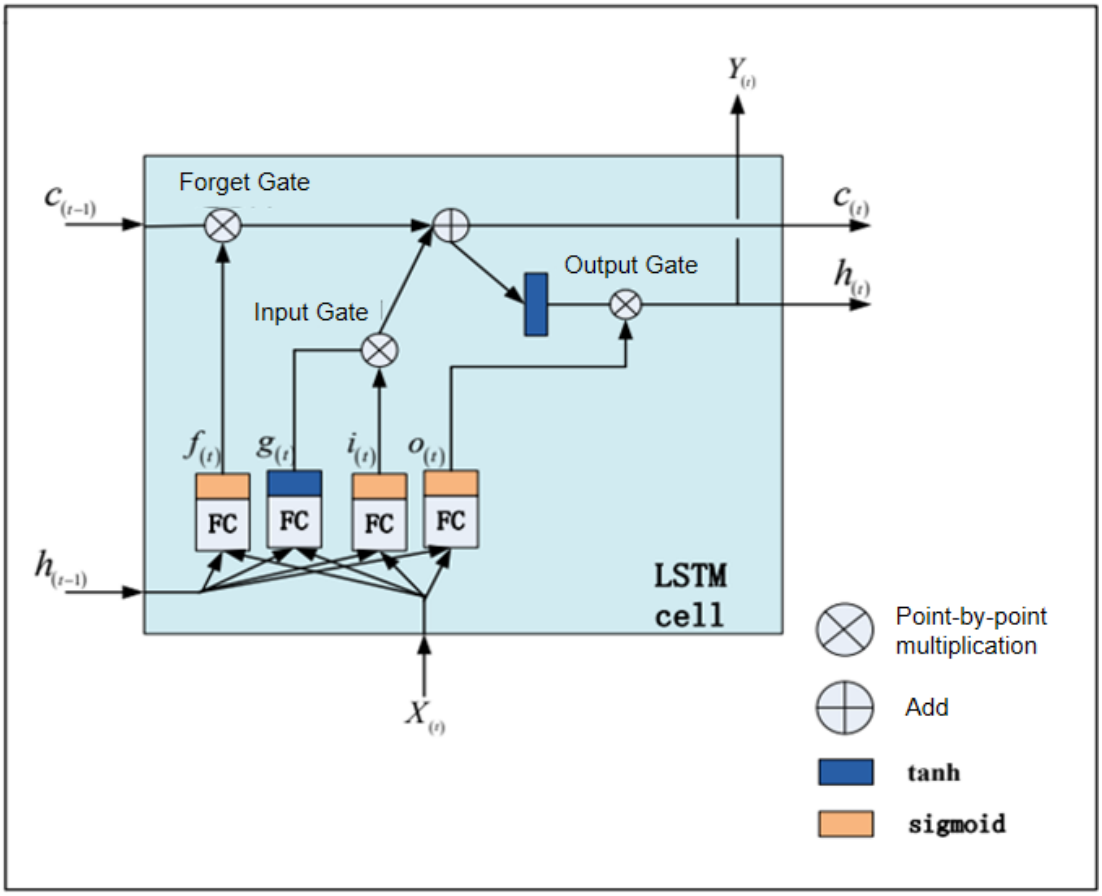

Figure 1: Memory cell of LSTM

3.5. LSTM structure analysis

3.5.1. Input data

The input to the LSTM unit includes the current time step's input data and the previous time step's output value.

3.5.2. Forget Gate

The forget gate determines the proportion of information from the previous time step's memory unit state that needs to be forgotten. It calculates a forget ratio based on the current time step's input data and the previous time step's output value. This ratio is applied to the previous time step's memory unit state to decide which information to retain and discard.

3.5.3. Input Gate

The input gate determines the amount of new information from the current time step to be stored in the memory unit. It calculates an input ratio using the current time step's input data and the previous time step's output value. Additionally, the LSTM unit generates a new candidate memory state, which, together with the input gate's output, determines the new information to be added to the memory unit.

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3.5.4. Cell State Update

The current time step's cell state comprises two parts: information from the previous time step's cell state adjusted by the forget gate, and new information from the current time step adjusted by the input gate. These parts combine to form the current time step's cell state.

3.5.5. Output Gate

The output gate determines the amount of information from the current time step's cell state to be output. It calculates an output ratio based on the current time step's input data and the previous time step's output value. This ratio is applied to the current time step's cell state to decide which information will be passed to the output value.

3.5.6. Output Value

The current time step's output value is derived from the output gate and the current time step's cell state. The output gate adjusts the cell state information to ensure that the final output value includes the necessary information for the current time step.

4. Results

Based on the aforementioned experimental conditions, this study designed and executed three sets of control experiments.

Firstly, utilizing the LSTM model, adjustments were made to the number of training epochs to determine the point at which the model achieves saturation in sample detection. For this experiment, epoch numbers were tested within the range of 20 to 40. It was determined that the optimal training effect occurred at 25 epochs.

Table 1: presents the Mean Squared Error (MSE) of the model across various epochs.

Epoch	MSE
20	0.00173421
25	0.00164962
30	0.00168809
40	0.00167847

Secondly, adjustments were made to the training-test sample ratio, and prediction experiments were conducted under four conditions: 75:25, 80:20, 85:15, and 90:10. The results are illustrated in the subsequent figure.

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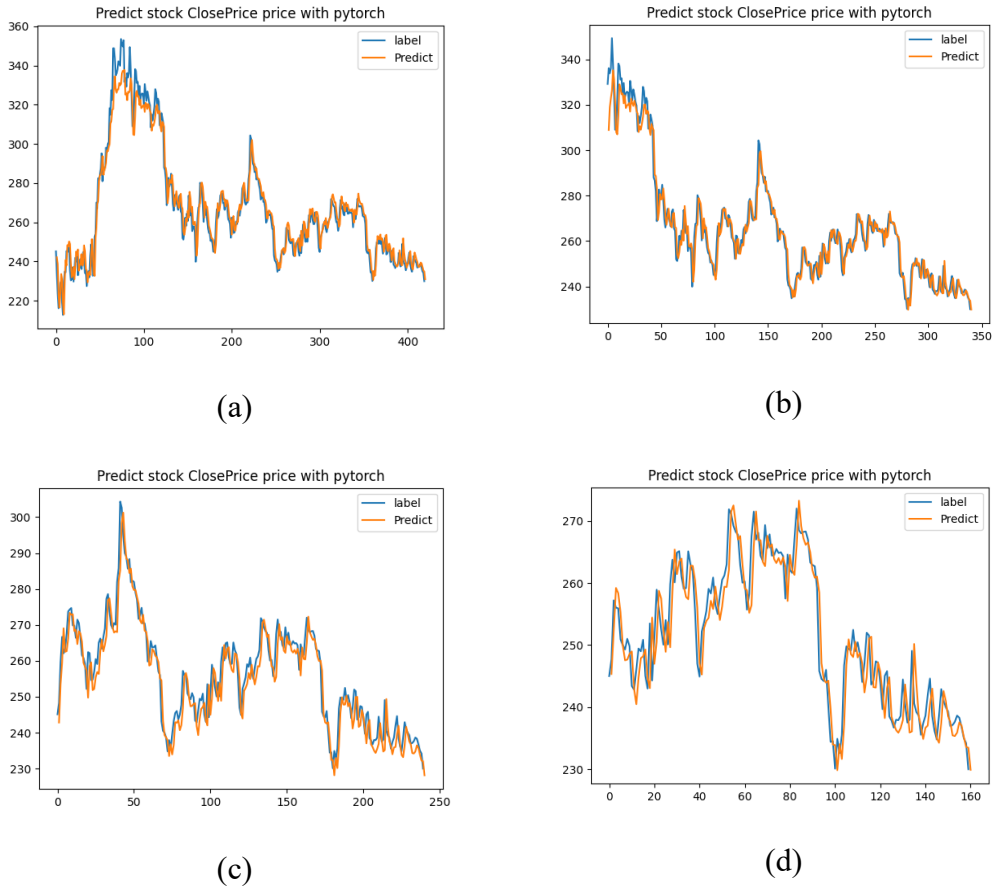

Figure 2: Comparison of model predictions for different training-test sample ratios 75:25; (b)80:20; (c)85:15; (d)90:10.

The errors of the four control experiments were recorded as shown in the following table

Table 2: The MSE size of the model for different training-test sample ratios

Train-test ratio	75:25	80:20	85:15	90:10
RMSE	0.00447932	0.0033114	0.00215872	0.00175572

Finally, using the last quarter of the control sample set as the test set, several past years were used as training sets in eight control experiments. The numerical results are presented in the following table.

Table 3: MSE size of the model when the training set span is different

Training set span (unit: year)	1	2	3	4	5	6	7	8
RMSE	0.0176122	0.00368225	0.00148657	0.00146477	0.0015021	0.00158986	0.0015021	0.00153486

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5. Discussion

Observing the results from the initial group of control experiments reveals that the predictive performance of the model varies significantly with the number of training epochs, peaking at 25 epochs. This phenomenon arises because insufficient training samples prevent model saturation, thereby limiting its effectiveness. Conversely, an excess of training samples may lead to overfitting, thereby diminishing performance. Thus, it is crucial during research to meticulously adjust both training samples and epochs to optimize model performance before proceeding with subsequent experiments.

Examining the second set of control experiments demonstrates that the model's predictive efficacy varies with the training-test ratio. Across ratios tested from 75:25 to 90:10, superior performance is consistently observed with higher training ratios, reaching optimal effectiveness at 90:10.

Analysis of the outcomes from the third set of control experiments highlights the impact of training data age on model performance. Older training data compromises sample reliability, thereby diminishing predictive accuracy. Optimal results are achieved when utilizing a training dataset spanning four years.

6. Conclusion

Through systematic adjustments of influential variables such as epochs, training-test ratios, and training dataset spans, this study employed comparative experimental methods to identify optimal configurations that maximize model predictive accuracy. Specifically, 25 epochs, a training ratio of 90:10 yielding a minimal Mean Squared Error (MSE) of 0.00175572, and a training dataset spanning four years resulting in the lowest MSE of 0.00146477 were determined as optimal parameters.

However, the experimental design of this study reveals limitations in the granularity of control group division, particularly highlighted in the third experiment where smaller training samples hindered short-term predictive capabilities. Addressing these limitations, future enhancements could include integrating dynamic adaptive training models and augmenting data using reinforcement learning techniques for improved short-term predictions. Additionally, broader investigations into market behavior dynamics could provide further insights into optimizing model performance across diverse scenarios.

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