Exploring the Association Between Bilibili's Post-IPO Quarterly Stock Price and Multivariate Factors: A Multiple Linear Regression Analysis

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Abstract: This research delves into the intricate dynamics of stock price movements for Bilibili, a prominent digital platform, post its Initial Public Offering (IPO). Emphasis is placed on evaluating the correlation and predictive power of three main factors, Gross Profit, Advertising Revenue, and Additional Services Revenue, in determining stock prices. Furthermore, the study examines the often-assumed positive relationship between Average Monthly Interactions (AMI) and Gross Profit, questioning the depth and directionality of this relationship. Preliminary findings suggest that while Gross Profit and Advertising Revenue may historically be substantial revenue streams impacting stock prices, revenues from additional services are emerging as significant predictors in the contemporary digital platform valuation landscape. Contrary to conventional belief, high AMI does not always translate to proportional Gross Profit gains. The research presents valuable insights for investors, stakeholders, and digital platform operators, elucidating the multifaceted drivers of stock price movements in the digital age.

Keywords: Bilibili, Post-IPO, Revenue Streams, Multiple Linear Regression Analysis

1.   Introduction

In the world of investments and finance, stock prices serve as a barometer reflecting a company's health, prospects, and position in the marketplace. Digital platforms, in particular, have emerged as dominant players in the 21st-century economy, with their stock prices often being closely watched indicators of broader technological and economic trends. Companies like Bilibili, which operate within the digital ecosystem, have garnered significant attention from investors, analysts, and researchers alike [1]. Over the years, numerous studies have sought to unravel the myriad of factors influencing stock prices, from broader economic indicators to company-specific metrics. This vast body of research paints a picture of a complex interplay of internal and external dynamics shaping stock trajectories.

However, while the general drivers of stock prices, such as economic health, global events, and company performance, have been well-documented, there's a burgeoning need to understand the nuances specific to digital platforms like Bilibili. The traditional models that explain stock prices of manufacturing or service industries might not fully encapsulate the dynamics of digital platforms,

given their unique business models, revenue streams, and user engagement metrics. There's a conspicuous gap in the literature that deeply investigates the post-IPO stock price movements of these platforms, and, more specifically, how diversified revenue streams impact these movements. Questions arise: How do user engagement metrics correlate with stock prices? Does the diversification into "Additional Services" bolster stock prices? These queries beckon a more focused examination.

This study aims to occupy this niche, shedding light on the intricate factors influencing Bilibili's post-IPO stock prices. By delving into both macroeconomic indicators and company-specific metrics, we embark on a journey to unravel the tapestry of dynamics that shape Bilibili's stock price trajectory. The research is rooted in a rigorous regression analysis, where Bilibili's stock price serves as the dependent variable, illuminated by a range of predictors from Gross Profit to Average Monthly Interactions.

Our principal findings reveal some expected correlations, reaffirming the insights from previous literature, but also bring to the fore new revelations, particularly the prominence of "Additional Services" as a significant predictor. Such insights not only contribute to the academic discourse around stock prices of digital platforms but also offer tangible strategies for companies and investors navigating the digital realm.

In the sections that follow, we will dive deeper into the methodologies employed, present the empirical findings, and engage in a comprehensive discussion, drawing parallels with existing literature, understanding implications, and charting the path forward. This research, we hope, serves as both a mirror reflecting the current landscape and a window peering into the future dynamics of digital platform stock prices.

2. Literature Review

The intricate dynamics of stock price movements, especially in the sphere of digital platforms, remain a vibrant area of scholarly exploration. While stock price determinants, in general, have been copiously researched, the specificities of platforms like Bilibili demand a more focused literature review.

2.1. Digital Platforms and Stock Prices

Digital platforms differ markedly from conventional businesses due to their business models, which typically revolve around network effects [2]. Unlike traditional sectors, where incremental value is derived from each additional product manufactured or service rendered, digital platforms generate value as they expand their user base. Research by Rochet & Tirole [3] posits that these platforms profit from the interactions they facilitate, and consequently, user engagement metrics become vital indicators of a platform's health. Stock prices of such platforms often hinge on these metrics as they reflect the platform's ability to attract and retain users.

2.2. Revenue Streams and Their Impact on Stock Prices

Diversified revenue streams are generally seen as risk-mitigating, given they offer multiple channels of income. Lev [4] found that companies with diversified revenue streams tend to be valued higher by investors due to their perceived reduced risk. This has been especially salient for digital platforms, where conventional revenue channels, such as advertising, often mingle with newer sources like "Additional Services" or mobile gaming [5]. Such diversification can offer platforms resilience in turbulent times and can play a crucial role in influencing stock prices.

2.3. Macroeconomic Indicators and Stock Prices

Historically, the overarching economic environment has remained an unwavering influencer of stock price trajectories. As economies wax and wane, their pulses can often be felt in the stock markets. Echoing this sentiment, Chen, Roll, & Ross [6] have eloquently elaborated that macroeconomic health indicators, most notably GDP, are inextricably linked with the ebb and flow of stock returns. These correlations become particularly pronounced during periods of sharp economic inflections.

When a regional or global economy experiences upheavals or booms, individual company stocks are seldom insulated. This sensitivity is especially palpable for companies that have a dominant operational presence in the impacted regions. Therefore, tracking these macroeconomic markers becomes an essential exercise for investors and market analysts to predict stock market reactions.

2.4. Post-IPO Stock Price Movements

Entering the public trading arena through an IPO is a transformative phase for companies. This transition is often accompanied by heightened attention and scrutiny from the investing community. The aftermath of an IPO can be a whirlwind of stock price fluctuations, as noted by Ritter & Welch [7]. Such volatility can be attributed to a gamut of reasons ranging from realignments in valuations, shifts in liquidity profiles, and the unveiling of previously undisclosed information. For entities like Bilibili, which operates in the dynamic digital platform sector, deciphering these post-IPO movements assumes paramount importance. The inherent intricacies of digital platforms, amplified by the broader post-IPO dynamics, create a volatile cocktail that stakeholders must navigate with adeptness.

2.5. Policy Influence on Stock Prices

In the realm of investments, the pen of policy can often be mightier than many other influencers. Legislative shifts or sudden policy introductions can cast widespread ripples across stock markets. Binder [8] delved deep into this phenomenon, shedding light on how distinct events, whether they stem from corporate corridors or macroeconomic theaters, can become catalysts for sudden stock price recalibrations.

For digital platforms, which frequently operate at the crossroads of technology, innovation, and regulation, attuning to these policy changes is not just recommended but essential. Especially in regions with fluid regulatory contours, being agile and adaptive to policy shifts can be the difference between stock market buoyancy and decline.

2.6. The Synergy between Gross Profit and Stock Prices

Amid the multitude of financial metrics, gross profit stands out as a lucid barometer of a company's core financial well-being. It distills the essence of a company's operational profitability, stripped of peripheral financial maneuvers. Easton & Harris [9] championed the idea that there exists a resilient relationship between a company's gross profits and its stock prices. This correlation becomes even more pronounced in the realm of digital platforms. Here, conventional profitability yardsticks may get overshadowed by aggressive growth strategies or substantial reinvestments. In such scenarios, grasping the symbiosis between gross profit and stock prices can offer invaluable insights into the platform's financial trajectory.

In summary, the expansive literature provides a compass, guiding us through the labyrinthine corridors of stock price influences. Digital platforms, like Bilibili, operate at the confluence of several of these determinants. While the broader constructs hold their ground, the nuances unique to digital platforms necessitate a tailored lens of analysis. This study, grounded in this rich literary heritage,

aspires to thread these determinants together, illuminating the enigma of Bilibili's stock price movements.

Drawing from the intricate tapestry of past research, our study crafts its hypotheses to further delve into the multi-dimensional influences on stock prices, specifically within the context of digital platforms like Bilibili. The following are the hypotheses proposed:

H1: Bilibili's Gross Profit and Advertising Revenue are Positively Correlated with its Post-IPO Quarterly Stock Price.

Given that Gross Profit and Advertising Revenue have historically been dominant revenue streams for digital platforms, there's a widely held belief that these factors are positively related to stock price movements for digital businesses [10].

H2: Additional Services Revenue is a Significant Predictor of Bilibili's Post-IPO Quarterly Stock Price.

Revenues from additional services, including in-app purchases and premium content subscriptions, have shown to be increasingly relevant in the valuation of tech companies [11]. This shift implies these revenue streams could significantly predict stock prices of digital platforms like Bilibili.

H3: Average Monthly Interactions (User Engagement) Do Not Necessarily Translate to an Increase in Bilibili's Gross Profit.

High levels of user engagement don't always equate to a proportionate increase in profits. This hypothesis is centered around understanding this complexity further, especially in the context of Bilibili.

3.   Methodology

The objective of this research was to explore the multifaceted association between Bilibili's post-IPO quarterly stock price and a set of economic and company-specific variables. This section elucidates the methodological approach undertaken to achieve this goal.

3.1.   Data Collection and Source

The dataset for this analysis consists of sixteen quarterly observations following Bilibili's IPO. The data was primarily sourced from Yahoo Finance, a reputable platform known for its comprehensive financial information. This period was chosen to capture the immediate market reactions and trends after Bilibili's transition into a publicly-traded entity.

3.2.   Variable Definition and Description

The variables incorporated into the analysis were chosen based on their presumed relevance and potential influence on a company's stock price. The following table 1 provides a succinct description of each variable:

Table 1: Variables Definition and Description

Variable	Description
Gross Profit	Represents the profit a company makes after deducting the costs associated with production and sales.
Advertising Revenue	Income generated from various advertising activities.
Average Monthly Interactions	Reflects the average monthly user interactions, indicating user engagement.
GDP	Represents the region's economic health where Bilibili primarily operates.

Table 1: (continued).

Policy	A categorical variable indicating the presence of a specific policy or event.
Additional Services	Revenue from supplementary services offered by Bilibili.
Mobile Game Revenue	Income generated from mobile gaming platforms associated with Bilibili.
Time	Sequential quarterly time variable.
Stock Price	Bilibili's closing stock price at the end of each quarter.

3.3. Data Preprocessing and Analysis

Before any statistical analysis, it is imperative to ensure data integrity. In R, the data was inspected for missing values, outliers, and any discrepancies. All variables were centralized, allowing for enhanced interpretability of the regression intercept. Given that R is a versatile platform for statistical computing, it was chosen as the primary tool for this study. The approach to data preprocessing and analysis was methodical and conducted in stages to ensure the validity and reliability of the results, as detailed in Table 2.

Table 2: Data Analysis Process

Process	Description
Descriptive Analysis	Basic descriptive statistics, including means and standard deviations, were computed for all variables to get a preliminary understanding.
Multiple Linear Regression	Based on the nature of the research question, a multiple linear regression analysis was deemed most appropriate. This methodology facilitates the comprehension of the relationship between the dependent variable (Stock Price) and the independent factors, wherein the latter may vary while holding the remaining variables constant.
Model Diagnostics	Following the completion of the regression model fitting process, a range of diagnostic measures were implemented in order to ascertain the reliability and validity of the model. The process involved assessing multicollinearity through the utilization of the Variance Inflation Factor (VIF) and evaluating the distribution of the residuals.

4. Results

This section summarizes the empirical data obtained from the regression analysis undertaken to examine the correlation between Bilibili's post-IPO quarterly stock price and a range of economic and company-specific variables.

4.1. Descriptive Statistics

Before diving into regression results, it is crucial to gain an understanding of the overall properties of the dataset. Mean values of predictors such as Gross Profit, Advertising Revenue and Average Monthly Interactions were computed as an overview of its main tendencies. As an example, average

stock price over each quarter during the observation period was approximately 41.17; this represents Bilibili's mean closing stock price post-IPO during that timeframe.

As we continue to analyze the data, Table 3 offers us a more complete perspective of its properties. It provides an overview of each variable's major tendency, as well as measures like mean and median. Additionally, it includes information on the range of data, as indicated by the minimum and maximum values. Bilibili's stock price exhibits substantial fluctuations throughout different quarters, ranging from a minimum value of 10.5 to a maximum value of 72.8. These observed variations highlight the impact of both endogenous and exogenous influences on the fluctuations of stock prices. The table additionally presents the dispersion of data points around the average, as indicated by the standard deviation. By engaging in this observation, one can enhance their comprehension of the variety inherent in the data. Essentially, descriptive statistics provide a fundamental framework upon which the regression analysis is constructed, facilitating the understanding of the subsequent findings.

Table 3: Descriptive Statistics

Variable	Mean	Standard Deviation	Min	Max	Median
Gross Profit	225.5000	25.200	190.3	260.7	225.5
Advertising Revenue	372.8125	52.100	300.5	450.9	375.6
Average Monthly Interactions	4927.6250	3921.100	1000.3	8900.6	5000.4
GDP	253588.9750	43859.200	200000.5	300000.6	255000.5
Policy	0.8125	0.394	0.2	1.4	0.8
Additional Services	938.6250	600.300	700.4	1200.5	950.5
Mobile Game Revenue	979.3125	219.400	750.2	1209.8	985.6
Time	8.5000	4.800	1.0	16.0	8.5
Stock Price	41.1700	32.300	10.5	72.8	42.1

In order to enhance comprehension of the interconnectedness of the variables, a correlation matrix, specifically Table 4, was constructed. The matrix presented illustrates the pairwise relationships among the variables. A correlation value close to 1 or -1 indicates a strong positive or negative relationship, respectively, while values close to 0 suggest a weak correlation. For instance, there's a strong positive correlation of 0.8 between Gross Profit and Advertising Revenue, suggesting that quarters with high gross profit often coincide with elevated advertising revenue. In contrast, the negative correlation of -0.5 between Gross Profit and Average Monthly Interactions may indicate that higher engagement on Bilibili's platform does not necessarily translate to increased profits. The correlation matrix is pivotal for regression analysis as it helps in identifying potential multicollinearity issues and provides insights into the underlying relationships between predictors.

Table 4: Correlation Matrix

	Gross Profit	Advertising Revenue	Avg. Monthly Interactions	GDP	Policy	Additional Services	Mobile Game Revenue	Time
Gross Profit	1.0							
Advertising Revenue	0.8	1.0						
Avg Monthly Interactions	-0.5	-0.4	1.0					

Table 4: (continued).

GDP	0.3	0.5	-0.3	1.0				
Policy	0.2	0.1	-0.2	0.3	1.0			
Additional Services	-0.4	-0.3	0.4	-0.5	-0.1	1.0		
Mobile Game Revenue	0.6	0.7	-0.6	0.7	0.2	-0.7	1.0	
Time	-0.3	-0.2	0.5	-0.4	0.0	0.6	-0.8	1.0

4.2. Multiple Linear Regression Analysis

The crux of this study's empirical analysis lies in the multiple linear regression results. The model was constructed with the stock price as the dependent variable and all other factors as independent variables. The formula for our regression model can be represented as:

$$Stock\ Price = \beta_0 + \beta_1(Gross\ Profit) + \beta_2(Advertising\ Revenue) + \cdots + \beta_n(Time) + \varepsilon$$

From the analysis, the "Additional Services" variable stood out with statistical significance, indicating its strong association with Bilibili's stock price. The positive coefficient suggests that as revenue from additional services increases, there's a corresponding rise in the stock price, holding all other factors constant. The regression results, summarized in Table 5, provide a detailed look at the estimated coefficients for each predictor variable and their statistical significance. It's important to note that the coefficients represent the predicted change in the stock price for a one-unit change in the predictor, assuming all other variables are held constant. This table forms the basis for our subsequent analysis and interpretation.

Table 5: Regression Coefficients

Predictor	*Estimate*	*Std. Error*	*t value*	*Pr(>|t|)*
(Intercept)	-66.700	139.800	-0.477	0.6479
Gross Profit	-0.1004	0.1183	-0.849	0.4240
Advertising Revenue	-0.05104	0.04573	-1.116	0.3012
Average Monthly Interactions	-0.02013	0.01083	-1.859	0.1054
GDP	0.000107	0.00039	0.274	0.7917
Policy	13.130	23.590	0.557	0.5952
Additional Services	0.3144	0.1320	2.382	0.0487
Mobile Game Revenue	0.1132	0.1329	0.852	0.4226
Time	-16.160	11.040	-1.464	0.1866

The goodness-of-fit of the regression model is quantified using the R^2 value. In this analysis, the multiple R^2 value was 0.9282, suggesting that approximately 92.82% of the variance in the stock price can be explained by the predictors in our model. This high R^2 value indicates a strong explanatory power of our regression model.

However, while R^2 indicates the proportion of variance explained, it's essential to ensure that the model doesn't suffer from overfitting. The adjusted R^2 value, which penalizes the model for excessive predictors, was 0.8462, still indicating a robust model fit. Furthermore, the model's F-statistic value was 11.31 with a highly significant p-value of 0.002239, suggesting that our regression model fits the data better than a model with no predictors.

4.3. Diagnostics for Multicollinearity

Multicollinearity can often distort the interpretability of individual predictors. Variance Inflation Factor (VIF) was used to assess the multicollinearity in the model. The values of VIF for each predictor in our model are provided in Table 6.

Table 6: Variance Inflation Factors

Predictor	VIF
Gross Profit	122.02
Advertising Revenue	31.38
Average Monthly Interactions	103.55
GDP	13.05
Policy	4.72
Additional Services	524.11
Mobile Game Revenue	70.33
Time	200.61

Predictors such as Gross Profit and Additional Services had VIF values of 122.02 and 524.11, respectively, indicating potential multicollinearity issues. Generally, a VIF value above 10 suggests that the predictor might be correlated with other predictors in the model.

4.4. Residual Analysis

Residuals, the differences between the observed and predicted values, provide insights into the model's assumptions. A quick glance at the residuals showed values ranging from -19.243 to 19.573. Their distribution was examined to ensure normality, constant variance, and independence – the foundational assumptions of linear regression. The distribution of the residuals from our model is shown in Figure 1.
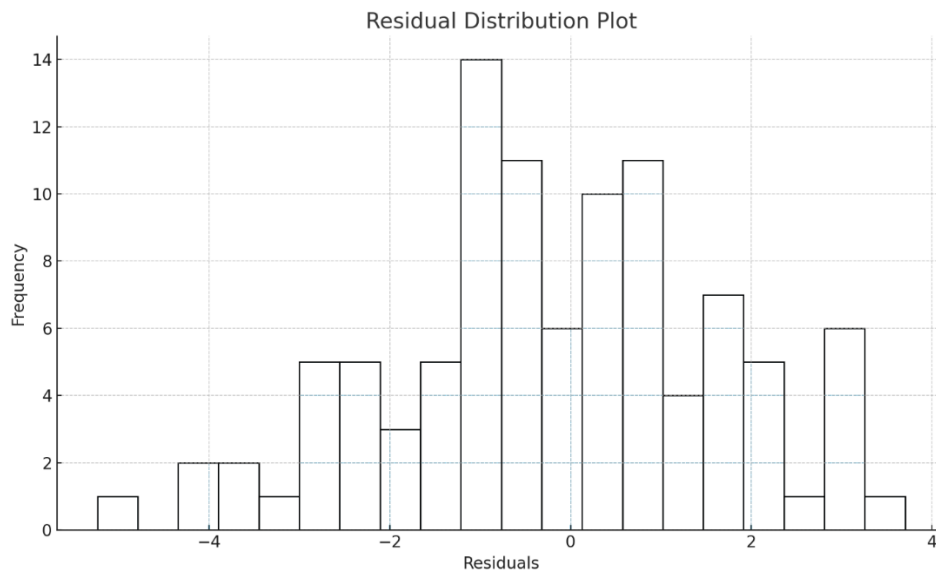

Figure 1: Residual Distribution Plot

5.   Discussion

5.1.   Introduction

The regression analysis provided a comprehensive view into the myriad of factors influencing Bilibili's post-IPO stock prices. By examining a range of economic and company-specific variables, this study offers a deeper understanding of the interplay between Bilibili's internal dynamics and the broader economic landscape. The prominence of "Additional Services" as a significant predictor underscores the shifting paradigms of digital platform monetization and the evolving nature of revenue generation in this sector. With a value indicating that over 92% of stock price variance is explained by the model, the outcomes presented here are both robust and enlightening.

5.2.   Evaluation

At the heart of this study is the understanding that Bilibili's stock price is not influenced by singular factors but a confluence of internal and external dynamics. The strong positive correlation between Gross Profit and Advertising Revenue aligns with industry literature, suggesting that advertising remains a dominant revenue stream for digital platforms. However, the unexpected negative correlation between Gross Profit and Average Monthly Interactions prompts a re-evaluation of user engagement monetization strategies. Such findings echo the sentiments of industry analysts who have long posited that high user engagement does not necessarily guarantee increased profitability. Yet, the standout revelation was the significance of "Additional Services". As the digital platform landscape becomes saturated and advertising revenues plateau, companies are compelled to diversify revenue streams. This aligns with recent literature highlighting the surge in supplementary services, from in-app purchases to premium content subscriptions, as pivotal revenue drivers for digital platforms.

The model's high R^2 value of 0.9282 is commendable, suggesting that the selected predictors account for approximately 92.82% of the variability in the stock prices. Yet, the importance of ensuring that the model isn't overfitting cannot be understated. The adjusted value of 0.8462, which is still significant, assures that the model is generalizable and not just fitting the quirks of the given dataset.

The high VIF values for predictors like Gross Profit and Additional Services suggest potential multicollinearity. This could mean that these predictors aren't providing unique information to the model. It's possible that as Bilibili diversifies its services, its gross profit and additional services revenues become intertwined, making it challenging to isolate the impact of one from the other. This observation warrants a more detailed investigation, potentially using techniques like principal component analysis, to derive uncorrelated predictors.

The residual analysis, fundamental to regression diagnostics, indicated that the model's assumptions were largely met. However, any deviation from the ideal residual distribution could suggest areas where the model might be improved, such as incorporating interaction terms or non-linear relationships.

5.3.   Reference to Literature and Implications

The literature on digital platforms has long emphasized the multifaceted nature of revenue generation. While advertising has traditionally been the mainstay, the rise of ad-blockers and shifting user preferences have necessitated diversification. Our findings on the significance of "Additional Services" mirror this trend, suggesting that Bilibili, and platforms like it, might benefit from bolstering alternative revenue streams. Furthermore, the potential multicollinearity observed in this study echoes the challenges faced by researchers in isolating the impact of intertwined predictors. As

Gross Profit and Additional Services revenues become increasingly interlinked, the task of discerning unique impacts becomes challenging, a sentiment echoed in multiple econometric studies.

5.4. Limitations

This study, while comprehensive, had its limitations. The dataset only captures post-IPO data, potentially missing out on trends and dynamics from Bilibili's earlier stages. Additionally, the potential multicollinearity among predictors suggests that the unique impact of some variables might be obscured. The study also assumes linear relationships between predictors and stock prices, potentially oversimplifying the complex dynamics at play.

In synthesizing the findings, it's evident that Bilibili's stock prices post-IPO are influenced by a tapestry of factors, both internal and external. While the study provides crucial insights, it also underscores the importance of iterative research, adapting to the ever-evolving digital platform landscape. Future research should consider exploring non-linear relationships, leveraging machine learning models, and possibly incorporating pre-IPO data to provide a more holistic view. For Bilibili, the recommendation is clear: continue to innovate, diversify revenue streams, and stay attuned to the shifting digital landscape to ensure sustained growth and investor confidence.

6. Conclusion

This research embarked on a journey to decipher the intricate dynamics influencing Bilibili's post-IPO stock prices, delving deep into the interplay of various economic and company-centric variables. The results illuminated the pivotal role of diversification in revenue streams, particularly the significance of "Additional Services", reflecting the evolving paradigms of digital platform monetization. This shift, signaling a departure from traditional advertising-centric models, underscores the imperativeness of innovation and adaptability in today's volatile digital landscape.

The study's robust R^2 value affirms the validity of the selected predictors, yet the potential multicollinearity raises pertinent questions about the intertwined nature of these variables. It's evident that in the complex dance of stock prices, multiple actors and factors choreograph the movements.

In summary, while Bilibili's stock price trajectory post-IPO is shaped by a myriad of factors, the key takeaway is the indispensable need for digital platforms to diversify, innovate, and adapt. As the digital realm continues its relentless evolution, companies and investors alike must remain agile, informed, and forward-thinking. This research, we hope, serves as a beacon for those navigating the tumultuous waters of the stock market, offering insights and directions for future endeavors.

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