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Assessing Risk-Return Dynamics in China's Tech Sector: A CAPM Analysis of Hikvision, Haier, and ZTE

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Abstract: *This paper employs the Capital Asset Pricing Model (CAPM) to evaluate the risk-return profiles of three prominent Chinese tech firms—Hikvision, Haier, and ZTE, utilizing data from 2021 to 2023 from the WIND database. Our analysis reveals that all three companies demonstrate significantly positive alphas, indicating returns that exceed CAPM predictions, and betas greater than one, suggesting higher market volatility and sensitivity. These results affirm CAPM's applicability in dynamic markets like China's tech sector, offering crucial insights for investors and policymakers in understanding the balance between potential gains and inherent risks. The study highlights the importance of continuous assessment in adapting investment strategies to the rapidly evolving technological landscape.*

Keywords: *CAPM, risk-return trade-off, Hikvision, Haier, ZTE, market efficiency, technological innovation, Chinese stock market*

1. Introduction

The examination of the risk-return trade-off for prominent Chinese companies such as Hikvision, Haier, and ZTE is essential for investors, policymakers, and academics to navigate and make informed decisions in the complex landscape of the global market. This study focuses on these three companies, each a leader in technology-driven sectors, to understand the intricacies of their market behaviors and investment potentials.

Firstly, investigating the risk and return dynamics of these companies provides insights into their operational efficiency and market positioning. By assessing how well they manage the balance between potential gains and inherent risks, stakeholders can gauge the companies' ability to sustain profitability amidst technological advancements and competitive pressures. Secondly, this analysis is crucial for investors aiming to optimize their portfolios by incorporating stocks that align with their risk tolerance and return expectations. It offers a detailed understanding of how investment in these high-tech companies might behave under various market conditions, helping in constructing a diversified and resilient investment portfolio. Furthermore, for policymakers, understanding these relationships assists in crafting regulations that support innovation while ensuring market stability. It also aids in maintaining financial stability by preempting market disruptions that could arise from these sectors. Lastly, this research enriches the academic field by applying financial theories to the specific context of China's rapidly growing technology sector, offering a comparative analysis with global standards. This contributes to a broader comprehension of how different market environments influence corporate performance and risk management strategies. Such insights are invaluable for fostering international collaborations and enhancing the global financial market's understanding.

This paper is structured as follows. Section 2 delves into the literature review, where an extensive array of academic sources is explored to establish the theoretical and empirical context of the study. In

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Section 3, the paper articulates the methodology adopted for the empirical investigation. Finally, Section 4 concludes.

2. Literature Review

The Capital Asset Pricing Model (CAPM), a pivotal construct in the realm of financial economics, offers a systematic approach for estimating the inherent risk and expected returns of investments. Established on the foundational principles of Modern Portfolio Theory by Markowitz, CAPM's core thesis was refined and popularized in the 1960s through the works of Treynor, Sharpe, Lintner, and Mossin. This theoretical framework remains central to understanding the risk-return dynamics of investments, especially in evaluating companies like Hikvision, Haier, and ZTE, which stand at the forefront of China's high-tech industrial vanguard.

In the extensive body of literature on CAPM, Ang and Chen (2007)[1] present a nuanced exploration of the model's efficacy across an extensive historical spectrum, from 1926 to 2001. Their analysis reveals that a conditional one-factor model that incorporates time-varying betas and market risk premia provides a more accurate account of the variance in returns, particularly for portfolios stratified by their book-to-market ratios. This insight into time-varying betas is crucial for a contemporary understanding of the risk profiles of firms such as Hikvision, Haier, and ZTE, whose stock performance is inevitably tied to the fluctuating dynamics of the technological sector.

Levy (2007)[2] enters the discourse with a defense of CAPM against the backdrop of behavioral economics and psychology, reinforcing the model's empirical fortitude even when traditional economic assumptions, such as expected utility, are contested. This endorsement of CAPM's robustness underlines the model's relevance in the context of these firms, whose innovative operations may not always align with conventional market behavior, thereby necessitating a robust, theoretically grounded method for risk-return assessment.

Complementing these theoretical insights, Ding (2019)[3] advances a discrete grey multivariable model, critically enhancing the precision of output forecasts within high-tech industries—a category to which Hikvision, Haier, and ZTE belong. The model's incorporation of the cumulative effects of R&D expenditure on output growth equips investors with a predictive tool that is particularly attuned to the risk-return calculus of innovation-centric enterprises.

The interplay of firm ownership and R&D efficacy is dissected by Zhang et al. (2003)[4], whose findings suggest that private ownership correlates with heightened R&D efficiency in Chinese industrial firms. For Hikvision, Haier, and ZTE, understanding the nuances of ownership structure becomes indispensable, as it could significantly influence their capacity for innovation and, consequently, their risk-return equilibrium.

Further enriching this discussion, Lin et al. (2017)[5] examine the strategic interplay between exploitative and explorative innovation within China's high-tech parks, uncovering that a harmonious blend of organizational, human, and social capital is fundamental for achieving innovation ambidexterity. For the companies under study, this balance is directly consequential to their strategic risk positioning and expected returns, as per the CAPM framework.

Yam et al. (2004)[6] scrutinize the technological innovation capacities of Chinese firms, highlighting the crucial role of effective R&D and resource allocation in fostering innovation, competitiveness, and growth. This insight is particularly salient for companies operating in the fast-paced technological sector, such as Hikvision, Haier, and ZTE, which consistently seek to optimize their innovation capabilities to enhance returns, albeit with the understanding that such endeavors carry inherent risks.

Finally, the broad strokes of China's financial architecture are deftly captured by Allen et al. (2017)[7], who provide a comprehensive analysis of the nation's financial system, delineating the intricacies of its banking sector and the burgeoning significance of its stock and bond markets. This macroeconomic canvas is fundamental for situating the financial strategies and market engagements of Hikvision, Haier, and ZTE, as it provides a backdrop against which systemic risks and market-aligned returns can be evaluated through the CAPM lens.

Collectively, these scholarly contributions weave a dense tapestry of insights and analytical tools, each reinforcing the pertinence of the CAPM in dissecting the risk-return profile of Hikvision, Haier, and ZTE. They afford a robust framework for investors and analysts endeavoring to navigate the complexities of China's high-tech investment landscape.

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3. Method, Data and Empirical Analysis

3.1. Method

The core idea of CAPM is that the expected return of any asset can be determined through the risk-free rate, the asset's systematic risk (also known as the market risk or undiversifiable risk) and the expected return of the market.

The CAPM formula is expressed as:

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

where $E(R_i)$ is the expected return rate of asset i, R_f is the risk free rate, which is the return expected by the investors for a risk-free investment, $E(R_m)$ is the expected return of the market portfolio, $E(R_m) - R_f$ is the market risk premium (the part of the expected return that exceeds the risk-free return), β_i is the beta coefficient of asset i, indicating the sensitivity of asset i to overall market volatility. If β_i is greater than 1, it means that the price volatility of the asset is greater than the average of the market; if less than 1, then the volatility is less than the average of the market. Noticeably, the CAPM model assumes that investors hold highly diversified portfolios, hence they are only concerned with systematic risk of the assets, not the unsystematic risk specific to individual assets, which can be eliminated by diversification.

With this model, investors can determine whether an asset offers a reasonable expected return for the risk undertaken, or decide on the weight of different assets in an investment portfolio. CAPM is widely applied in the field of finance, including asset pricing, the calculation of the cost of capital, and portfolio management.

Equation (1) is the theoretical equation of the CAPM model, to transform the CAPM model into econometric model, we need to introduce the time series structure, viz.

$$R_{it} - R_{ft} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \epsilon_{it} \quad (2)$$

where R_{it} is the actual return rate of asset i at time t, R_{ft} is the risk-free rate at time t, R_{mt} is the actual return rate of the market portfolio at time t, α_i is the alpha coefficient of asset i, β_i is the beta coefficient of asset i, representing the ratio of covariance of asset i's return with the market portfolio return to the variance of the market portfolio return; finally, ϵ_{it} is the error term, representing the unobservable factors.

3.2. Data

Hikvision, Haier, and ZTE are prominent companies that can be seen as representatives of China's technology industry due to their significant roles in their respective sectors, global reach, and technological innovations.

Hikvision (Hangzhou Hikvision Digital Technology Co., Ltd.) is known globally as a leading provider of video surveillance products and solutions. It has a strong focus on R&D, with significant investment in this area, which has helped it to advance core technologies in audio and video encoding, video image processing, and data storage. Hikvision has also ventured into cloud computing, big data, and deep learning. The company caters to a wide range of vertical markets and has a substantial international presence with products used in more than 100 countries. Despite controversies regarding its role in surveillance and the subsequent sanctions by several countries, Hikvision has maintained its position as a significant player in the IT and security sectors.[1]

Haier is a multinational home appliances and consumer electronics company that has grown to be one of the largest white goods manufacturers worldwide. Known for its innovative approach to home appliances, Haier has been a pioneer in integrating smart home technology into its products, allowing it to stand out in the competitive global market.[2]

ZTE Corporation is a major international provider of telecommunications, enterprise, and consumer technology solutions for the Mobile Internet. With a comprehensive range of products that include mobile phones, telecommunications infrastructure, and enterprise technology solutions, ZTE is a key player in the global telecoms market, contributing to the sector with its innovations in 5G technology and network

[1] https://www.hikvision.co.zw/company_profile.php and https://craft.co/hikvision.
[2] https://www.haier.com/choose-country-region.html and https://craft.co/haier.

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solutions.[3]

The dataset for this study consists of stock performance data for ZTE, Haier, and Hikvision spanning from January 4, 2021, to December 29, 2023. This data was sourced from the WIND database, a premier financial data provider known for its comprehensive coverage of the Chinese financial markets. To approximate the market portfolio, rates of return from the Shanghai Stock Exchange (SSE) were employed, which serves as a benchmark for market movements within the Chinese equity market. For the risk-free rate, the Weighted Average Rate of Interbank Pledged Repo was utilized. This particular measure is recognized for reflecting the short-term borrowing costs between banks and serves as a reliable proxy for the risk-free rate in financial analyses. The incorporation of these specific datasets ensures a robust foundation for the CAPM analysis. The analysis of the data is carried using R, utilizing a suite of specialized packages—ggplot2 for advanced plotting, zoo and xts for time-series data management, and fBasics for robust financial analytics.

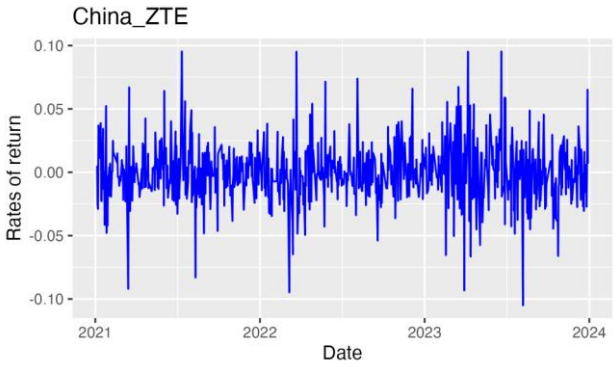
Note that we cover the stock prices and index values into logarithmic rates of return, using logarithmic rates of return is particularly advantageous in financial analyses of volatile markets, such as those often seen in the technology sector. Logarithmic returns, or continuously compounded returns, provide a measure that is symmetric and additive across time, allowing for the integration and comparison of returns over different periods seamlessly. The descriptive statistics of logarithmic rates of returns for SSE, Hikvision, Haier and ZTE are summarized in Table 1.

Table 1: Summary Statistics and ADF Test Results

Variable	Min	Median	Mean	Max	ADF Test Statistic	Critical Value (59)
SSE_RR	-0.05077	-0.00006	-0.00022	0.03424	-18.802	-2.86
Hikvision_RR	-0.10538	-0.00119	-0.00040	0.09531	-19.798	-2.86
Haier_RR	-0.06569	-0.00167	-0.00040	0.07458	-19.626	-2.86
China ZTE_RR	-0.10504	-0.00143	-0.00031	0.09541	-20.052	-2.86

The results summarized in Table 1 indicate that the daily rates of return for SSE, Hikvision, Haier, and China ZTE exhibit stationary behavior, as evidenced by the Augmented Dickey-Fuller (ADF) test statistics. For each variable, the ADF Test Statistic is significantly lower than the Critical Value at the 5% level (-2.86), strongly suggesting the rejection of the null hypothesis of a unit root. This absence of a unit root implies that the time series of returns does not depend on time, and thus, it is stationary. Stationarity is a crucial assumption in time series analysis because it means that the statistical properties of the series—such as mean, variance, and autocorrelation—are constant over time, making the historical data reliable for forecasting and modeling financial risk and return.

We also visualize the logarithmic rates of return in Figure 1.



(a) China ZTE

[3] https://www.zte.com.cn/china/ and https://craft.co/zte.

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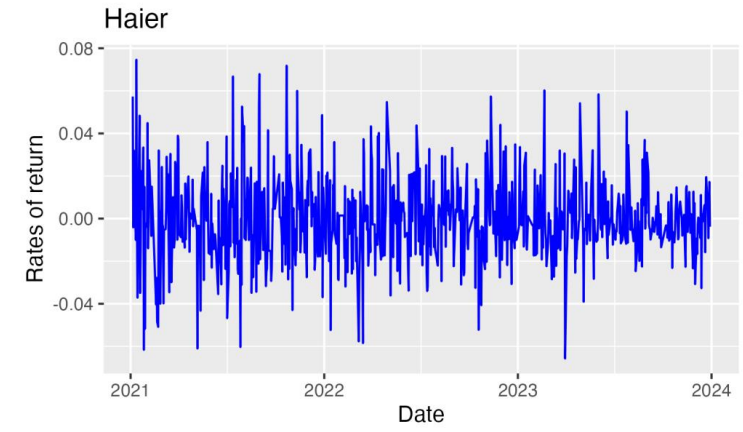
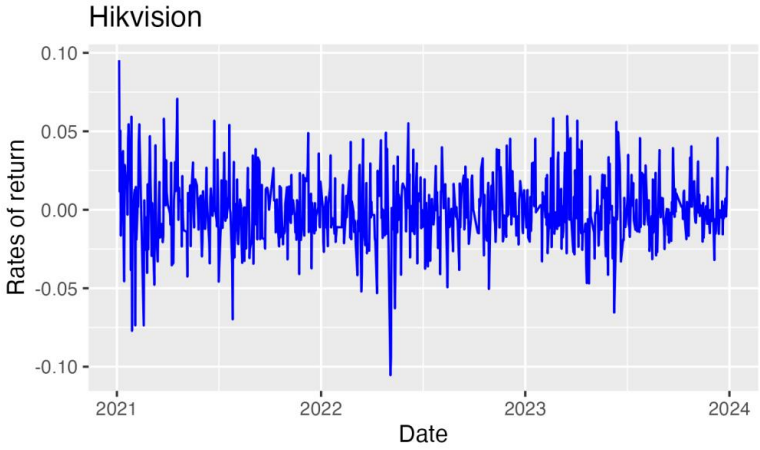


(b) Haier



(c) Hikvision

Figure 1: Rates of return for Hair, China ZTE and Hikvision.

Figure 1 presents the rates of return for Hair, China ZTE and Hikvision. Clearly, the fluctuations are centered around a consistent mean, indicating no clear long-term upward or downward trend, which exhibit a stationary behavior.

3.3. Empirical Analysis

Table 2 provides a succinct summary of the regression results for the rates of return on three significant Chinese companies—China ZTE, Haier, and Hikvision—each analyzed in relation to the excess returns on the Shanghai Stock Exchange (SSE). For each company, the table lists the estimated intercept and beta coefficient, along with their respective t-values, which measure the statistical significance of these estimates. The beta coefficient represents the sensitivity of the company's returns to the market, commonly referred to as the stock's systemic risk.

Table 2: Regression Results for China ZTE, Haier, and Hikvision

Variable	Intercept	T-value (Intercept)	Beta	T-value (Beta)	R^2	F-statistic
China_ZTE_RR	0.0058022	6.636***	1.2007666	14.278***	0.2149	203.9
Haier_RR	0.0055364	7.803***	1.1672553	17.105***	0.282	292.6
Hikvision_RR	0.0059695	7.431***	1.2525919	16.213***	0.2608	262.9

Note: *** indicates that significance at 1% significance level.

From Table 2, we can see that the intercepts (alpha) are significantly greater than zero and the betas are larger than one for all three companies. A significantly positive alpha suggests that the firms have been able to generate returns that exceed what could be predicted by the CAPM alone, which implies the

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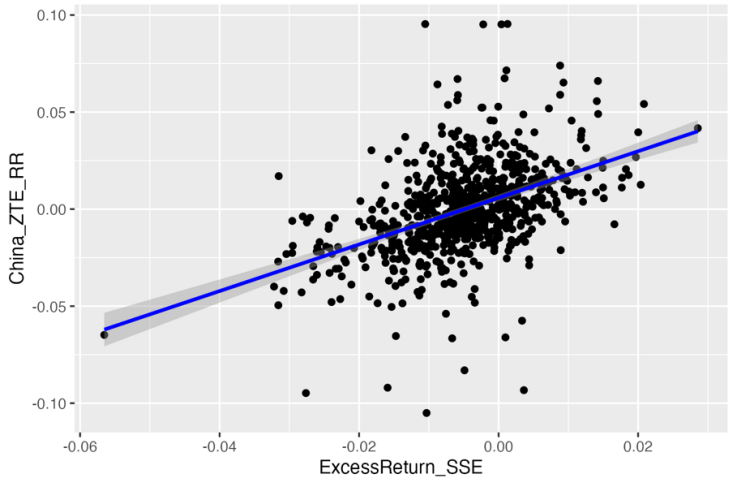
possibility of superior stock selection or market timing, or other firm-specific factors that have contributed positively to the returns beyond the systematic risk captured by the market index.

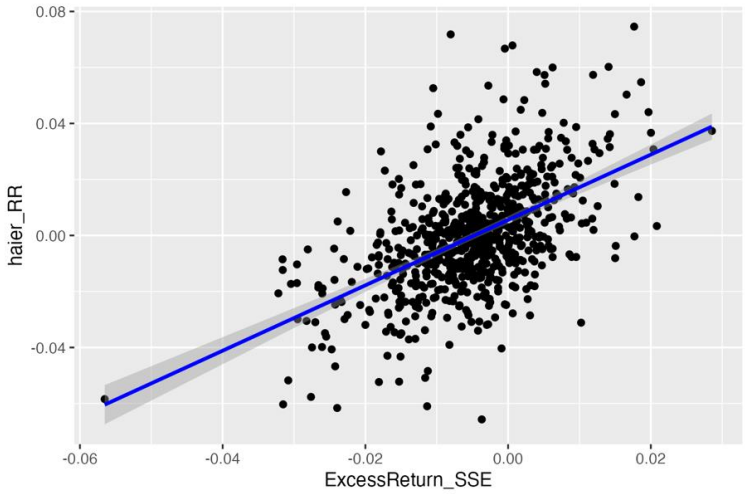
Moreover, the beta values greater than one indicate that the stocks of China ZTE, Haier, and Hikvision have a higher volatility compared to the broader market. Essentially, this means that these stocks are expected to outperform the market during upward movements but may also decline more than the market during downturns. The fact that all three companies have betas significantly larger than one may reflect their positions in high-growth, high-tech industries, which are often characterized by higher volatility and greater sensitivity to market swings. This can be attributed to the dynamic nature of the tech sector, which includes rapid innovation cycles, competitive market entries, evolving regulatory environments, and changing consumer preferences, all contributing to higher systematic risk as measured by beta.

The R-squared values indicate the proportion of the variability in the company's returns that can be explained by the market's returns. A higher R^2 value denotes a greater explanatory power of the market's influence on the stock's returns. The F-statistic tests the overall significance of the regression model, with higher values suggesting a more statistically significant fit. All t-values for the intercepts and betas are marked with three asterisks, denoting statistical significance at the 1% level. This high level of significance suggests that the relationships between the excess returns on the SSE and the rates of return for these companies are statistically robust. The results imply that the market's performance is a strong predictor of the performance of these stocks, which is crucial for investors considering these stocks for their portfolios.

Figure 2 visualizes the relationship between stock returns and excess returns of the SEE. Each point presents a paired observation of both returns at a specific time. The blue line indicates the CAPM fitted equation, which shows the general trend or the beta of the stock, indicating all the stock's excess returns move with the market. Clearly, Figure 2 helps us to assess a stock's systematic risk as compared to the broader market.



(a) China ZTE



(b) Hairer

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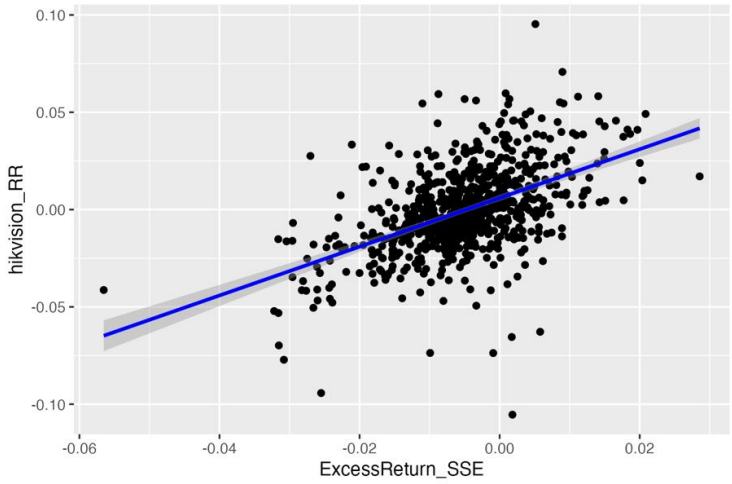

(c) Hikvision

Figure 2: CAPM analysis of ZTE China, Hair and Hikvision Excess rates vs. SSE Market Returns.

Figure 2 illustrates the CAPM analysis for ZTE China, Hair and Hikvision Excess rates. Each scatter plot maps individual stock excess returns against the excess returns of the Shanghai Stock Exchange (SSE) market. The excess returns for each company are the returns in excess of a risk-free rate, which is a standard approach in finance to isolate the performance attributable to the market itself.

The plotted points cluster around an ascending line, indicating a positive relationship between the stock excess returns and the market excess returns. This suggests that as the market performs better, so do these stocks, consistent with the principles of CAPM. The slope of the line, often referred to as beta, measures the responsiveness of a company's stock return to changes in the market return. A steeper slope would imply a higher beta, suggesting a greater level of systematic risk and a stronger linkage with market movements.

4. Conclusion

In concluding this study, the empirical analysis has corroborated the CAPM's efficacy in explicating the risk-return dynamics for Hikvision, Haier, and ZTE. Significant alpha values suggest that these companies have managed to surpass market expectations, potentially indicating successful strategies or unique market advantages. The beta values greater than one across all three firms point to higher-than-average market volatility, a characteristic inherent to the rapidly evolving high-tech sector.

Investors can interpret these findings as a beacon for potentially higher returns, albeit coupled with increased risks. This nuanced understanding is crucial for portfolio diversification and for policymakers aiming to navigate the delicate balance between fostering innovation and maintaining market stability.

Academically, the study enriches CAPM literature by integrating it with the particularities of the Chinese market, reaffirming the model's relevance and inviting further investigation into its applicability amid the fast-paced changes in technology.

Ultimately, this research underscores the imperative for ongoing scrutiny as the interplay between technological growth and market behavior continues to evolve. The insights gleaned from Hikvision, Haier, and ZTE not only illuminate current investment potentials but also pave the way for future studies to unravel the complexities of financial markets in the tech era.

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