The Role of Chinese State-Owned Enterprises in Portfolio Beta Hedging

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Abstract

The thesis investigates the government ownership effect on the dynamic behavior of publicly listed Chinese state-owned enterprises (SOEs) compared to private firms in terms of their systematic risk exposure (beta) across different economic cycles. By estimating rolling betas using the time-varying Capital Asset Pricing Model (CAPM), the study examines whether Chinese A-shares of SOEs offer hedging opportunities against market volatility, particularly during recessions and expansions. Using firm-level panel data from 2012 to 2025 and classifying economic cycles phases through the Li Keqiang Index, the analysis concludes that state ownership does not explain a statistically significant effect on beta over time, while sector fixed effects explain a larger portion of beta variation across firms. Furthermore, regressions results show that economic cycles impact beta within sectors, further reinforcing the importance of sector membership. These findings highlight the limitations of applying the CAPM model in the still immature Chinese stock market and present the complex role of SOEs as both stabilizing agents and structurally inefficient companies controlled by the government. Future research is encouraged to explore improved models with a larger sample to better capture the small impact of state ownership on market risk.

Keywords: State-Owned Enterprises, China, Time-Varying Beta, Asset Pricing

JEL Classification: G12, G11, G14, G15, G32

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1 Introduction

In recent decades, China has grown exponentially and emerged as the world's second-largest economy, and with it, its capital markets have grown in significance for global investors. Among emerging markets, China is characterized by its rapid economic growth, scale, and government involvement, which make its stock market particularly attractive and challenging at the same time. One significant feature that distinguishes China's capital markets from other global economies is the important role played by State-Owned Enterprises (SOEs). Defined broadly as enterprises where the state retains majority ownership, commonly 50% and above, SOEs dominate the Chinese stock market in vital sectors, including financial services, infrastructure, and energy. This pervasive government influence implies unique dynamics for investors' portfolios, as investment returns and volatility from SOEs may be more closely bound to the current political situation, policies, government credit support, and macroeconomic interventions than market-driven dynamics.

Historically, the outlook of the Chinese stock market has undergone significant paradigm shifts, such as the Split-Share Structure Reform in 2005-2006[1], which transformed non-tradable state-owned shares into tradable shares. This reform, associated with increased financial market openness to foreign investors and broader capital market liberalization through initiatives like the Hong Kong Stock Connect schemes[2], has significantly reshaped Chinese financial markets. Such structural changes raise concerns for the future evolution of risk-return profiles of SOEs, their market responsiveness, and their potential diversification benefits.

[1] The Split-Share Structure Reform was initiated in 2005 to resolve the problem of non-tradable shares (NTS) that made up a large portion of listed companies' equity and were largely held by the state. The reform converted NTS into tradable ones, which in turn aligned the interests of all shareholders and improved market efficiency (Inoue, 2005).

[2] The Hong Kong Stock Connect schemes, launched in 2014 and 2016 by the Chinese Premier Li Keqiang, allow cross border stock market access between mainland China stock exchanges (Shanghai and Shenzhen) and Hong Kong, which make investors in each market able to trade shares on the other market (Hong Kong Exchanges and Clearing Limited (HKEX), 2024).

Related studies regarding SOEs have highlighted their specific characteristic of relative resilience during economic downturns due to implicit government guarantees. For instance, the study by Cong et al. (2019) demonstrated that during the economic stimulus program in China (2009-2010)[3], SOEs disproportionately benefited from government credit allocations. In a more recent study, Geng and Pan (2024) observed a persistent "SOE premium" in the bond market, especially during liquidity crises, attributable to investor confidence in implicit government guarantees. Moreover, government support to SOEs helps them to operate under soft budget constraints, further weakening competition (Lin et al., 1998). Regarding their performance, since 1998, Chinese SOEs have been performing worse than private firms, with over 40% of SOEs operating at a loss. This inefficiency is largely attributed to the separation of ownership and control, which in turn provokes an agency problem between the state that faces challenges in monitoring SOEs' managers and has to align their incentives (Lin et al., 1998).

Despite their inefficiencies, Chinese SOEs have been essential in promoting economic growth and providing resilience during adverse economic cycles. However, given their dual nature as both market participants and policy instruments, they present a paradox: while they may offer stability and resilience during economic downturns, they also raise concerns among investors about efficiency and market alignment. Thus, it becomes essential to understand whether and under what conditions SOEs can contribute to portfolio diversification and stability, particularly regarding their systematic risk exposure (beta) during different economic cycles.

While the literature has documented the effect of government implicit guarantees on SOEs, their inefficiencies, agency problems, and their reaction to political uncertainty, relatively few studies have assessed the contribution of Chinese listed SOEs to portfolio diversification in a dynamic, business-cycle sensitive framework. This paper aims to fill this gap by analyzing the CAPM estimates time-varying betas behavior of Chinese-listed

[3]The Chinese economic stimulus program in 2008-2009 was a RMB¥ 4 trillion (US$586 billion) stimulus package in response to minimize the impact of the global financial crisis of 2008 (Fardoust et al., 2012).

SOEs versus listed non-SOEs during economic downturns, linking resilience in financial markets to state ownership structure. Specifically, this paper aims to answer two main questions. Firstly, do Chinese SOEs provide higher diversification benefits compared to private firms across different economic cycles? Secondly, to what extent do Chinese SOEs contribute to portfolio risk reduction and performance enhancement during recessions and booms? In addressing these questions, this paper tests two hypotheses: first, that during economic downturns, SOEs may exhibit lower systematic risk (beta), providing stability to the portfolio, and second, that during economic expansions, SOEs may present lower beta due to higher competition pressure, showing their structural inefficiencies.

The remainder of the paper proceeds as follows. An overview of the unique features of the Chinese stock market to better comprehend the underlying dynamics that characterize it. A literature review that summarizes the main findings of empirical and theoretical research relevant to publicly listed Chinese SOEs and their characteristics. A detailed methodology outlining the econometric approach involving CAPM rolling-beta estimations. Empirical results presenting key findings on the effects of sector membership and different economic phases on betas, with scarce effect for the government ownership factor. Lastly, a discussion of these findings, including limitations of the current research, and possibilities for future investigations.

1.1 An Overview of the Chinese Capital Market

Characteristics of the Chinese Stock Market

The Chinese capital market has emerged as one of the most dynamic and complex systems in the global financial landscape. Often linked as a “casino”, it is perceived as a highly volatile and speculative environment, reflecting the predominant investor behavior that favors short term gains over long term holding strategies (Bradsher, 2024). Chinese investors often view their stock market as a controlled way of gambling with a high risk and high reward environment, where short-term gains overshadow long-term stability. This casino reputation is pronounced by external factors such as government interventions and economic fluctuations, which in turn contribute to the unpredictable nature of the market, making it a challenging but exciting arena for investors seeking to capitalize on transitory opportunities. As a result, in recent decades the Chinese stock market has exhibited a significant high stock turnover ratio[4], reaching approximately 280% in 2022 (see Figure 1.1). With a turnover ratio of 280%, the Chinese stock market ranked as the highest globally, indicating a particular active environment characterized by frequent buying and selling of domestic shares. This ratio implies that the total value of shares traded during a year is approximately 2.8 times the total market capitalization, which is around 12 trillion USD circa as of 2025. Consequently, the volume of domestic shares that have been traded in a year amounts to approximately 34 trillion USD, a figure nearly double China's current GDP in US dollars.

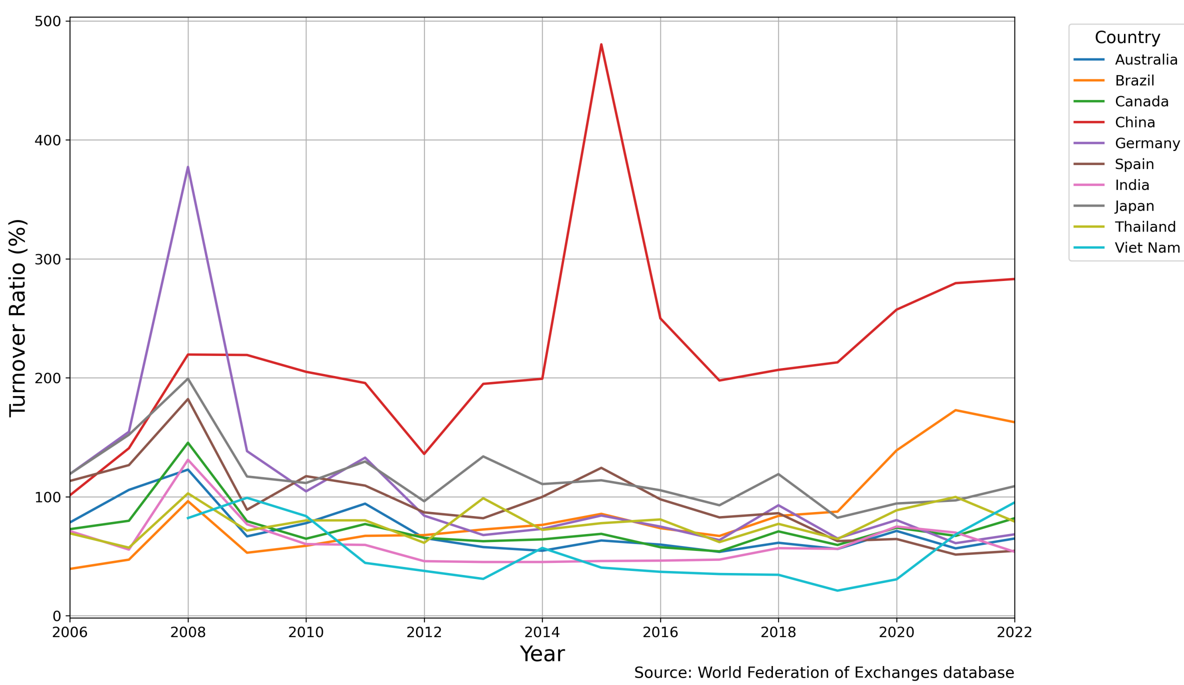

Figure 1.1: Top 10 countries by stock turnover ratio (2006-2022)

[4]The stocks turnover ratio is measured as the total value of domestic shares traded in a year divided by their market capitalization and tells how frequently shares are traded (World Bank, 2024).

History of the stock market and reforms

Established in the early 1990s, mainly as a form to privatize SOEs, the Chinese stock market is the result of the economic plans by the government of shifting from state-controlled enterprises to a more market-driven economy (Carpenter and Whitelaw, 2017). Among the numerous rounds of privatization, a crucial milestone in this evolution was the Split-Share Structure Reform (2005-2006), which aimed to resolve the inefficiencies caused by the coexistence of tradable and non-tradable shares. Empirical evidence shows that the expectations of privatization from the SSSR have increased rapidly SOEs' output, profits and employment more than in non-SOEs and this difference was reflected in higher stock returns for SOEs (Liao et al., 2014). In support of this, Boubakri and Cosset (1998) provide broader evidence across developing economies that privatization is beneficial for enhancing profits, increase in output and employment, improved efficiency and profitability, obtained by the alignment of managerial incentives with market performance.

Despite several rounds of privatizations and reforms, SOEs continue to dominate the Chinese stock market, especially in vital sectors, reflecting the enduring influence of the government in capital markets. This persistent government presence became especially relevant during the 2015-2016 Chinese stock market turbulence[5], when over half of the listed companies halted trading in an attempt to prevent further losses and the China Securities Regulatory Commission (CSRC) intervened to reduce the fall by banning shareholders with stakes of more than 5% from selling shares for the next six months (Kuo, 2015). The crisis revealed deeper structural problems: unlike many other capital markets around the world, China's stock trading is mainly driven by retail investors, who accounted for almost 70% of activity and many are inexperienced investors and vulnerable to herd behavior caused by market rumors (Reuters, 2025).

[5]The 2015–2016 Chinese stock market turbulence was a stock market in the A-share market, with the Shanghai Stock Exchange falling over 30% within weeks (Daly, 2016).

The role of the government and credit misallocation that favors SOEs

The central role of the Chinese government in shaping the country's capital market extends from ownership and regulatory policies to active participation in credit allocation and macroeconomic policy transmission. Chen et al. (2023) investigate how monetary policy and fiscal stimulus interact to shape credit allocation and capital investment decisions in China, particularly during the economic stimulus following the 2008 global financial crisis. They reveal that infrastructure-oriented fiscal expansion notably altered monetary policy transmission, significantly amplifying the positive effects on bank lending to SOEs while diminishing the effects for non-SOEs. This asymmetric credit allocation arose predominantly due to implicit and explicit government guarantees enjoyed by SOEs, which facilitated their preferential access to loans and subsequently investment capital. Importantly, the study identifies a crowding-out effect where fiscal stimulus, coupled with monetary expansion, limited non-SOE investment opportunities, effectively reversing a long-term trend of capital reallocation toward the more productive private firms. This credit misallocation towards SOEs instead of more productive counterparts has been demonstrated to potentially undermine China's long term growth potential (Huang and Qiu, 2023).

The role of SOEs in China

The continued dominance of SOEs in China reflects their double role as companies essential for the economy and policy instruments in a state-capitalist environment. While SOEs are frequently criticized for operating with low production efficiency (Lin et al., 1998) (Chen et al., 2006), their strategic importance extends beyond firm performance.

The literature identifies three main reasons that justify the high presence of SOEs in the Chinese economy. First, government interventions in the market improve efficiency by maximizing resource mobility to create capital-intensive industries. These industries are essential, but investing in them requires long gestation, imported equipment, and large lump-sum investments that can not be achieved by the market alone (Lin et al., 1998)

(Lin and Tan, 1999). Second, SOEs are used as employment instruments to maintain social stability, often used to absorb excess labor and support social welfare benefits during times of economic stress (Bai et al., 2000) (Shleifer and Vishny, 1994). Thirdly, the government uses SOEs to maintain control over critical sectors, often referred as "the commanding heights"[6] of the economy, advocated by Vladimir Lenin.

Although China started the marketization process under the rule of Deng Xiaoping 1978 that shifted China from a centrally planned economy to a more market oriented one, SOEs have remained dominant in the stock market (Naughton, 2007). In 1993, the CPC Congress approved the "Decision of the CCP Central Committee on Issues Concerning the Establishment of a Socialist Market Economic Structure" which emphasized the reform of SOEs to restructure their ownership and guarantee their autonomy (Beijing Review, 1993). In the 1990s, SOEs listed their stocks on the stock market through initial public offerings (IPOs) under a quota-based system. Moreover, SOEs receive preferential access to loans from state-owned banks, facilitated by ideological alignment, better information channels to assess SOEs and the perception of government bailouts in times of crisis makes them look less risky (Brandt and Li, 2003) (Liu et al., 2018). This diverse treatment creates misallocation of capital, as resources are channeled towards politically aligned companies instead of efficient firms, potentially lowering China's long-term productivity (Huang and Qiu, 2023).

Despite persistent concerns over their operational inefficiencies, SOEs have been essential for China's economic development (Lin et al., 2020). This enigma as been framed as the "Chinese Puzzle", by Lin et al. (2020), which refers to an economy largely characterized by inefficient SOEs that has nonetheless achieved significant growth rates over the past forty years. While SOEs are characterized by agency problems, soft budget constraints, policy

[6]The commanding heights of the economy are strategic sectors that governments should retain control such as heavy industries and transport because they are considered vital to national interest. The phrase originates from Vladimir Lenin, who used it to describe the key industries that the state should dominate in a socialist economy to foster development and maintain control over the broader economic system (Yergin and Stanislaw, 1998).

burdens and internal power asymmetries (Lin and Tan, 1999) (Huang and Qiu, 2023), their dominance in the economy and in the stock market is still persistent.

The stock market nowadays and the three shares classes

In recent years, China has taken important steps towards capital markets liberalization to attract foreign investments. A landmark in this process occurred in 2020 when China removed all quota limits of the Qualified Foreign Institutional Investor (QFII)[7] and the Renminbi Qualified Foreign Institutional Investor (RQFII)[8] and merged the programs to simplify access. This reform has further increased China's A-share openness for global investors.

The Chinese stock market is currently divided into three shares classes: A-shares, traded in Chinese Yuan on China mainland exchanges and primarily accessible to domestic investors and qualified foreign institutions; B-shares, listed on mainland exchanges but are traded in foreign currencies (such as US dollars and Hong Kong dollars) and open to both domestic and international investors; and H-shares, mainland Chinese companies traded in Hong Kong dollars on the Hong Kong Stock Exchange, with no trading restrictions (Peng et al., 2024).

Despite this trading openness, structural inefficiencies still persist within the A-shares market, driven largely by the high concentration of SOEs. In the paper by Allen et al. (2024), the authors explained that the Chinese A-shares underperformed the Chinese shares listed internationally, a trend attributed to the high presence of SOEs in China's A-share market as their inclusion influences market inefficiencies, governance challenges and investment inefficiencies. The paper finds that SOEs firms from government-supported industries and those

[7] Qualified Foreign Institutional Investor (QFII): A program launched by the Chinese government in 2002 allowing approved foreign institutional investors to invest in China's domestic stock and bond markets using foreign currency, subject to investment quotas and regulatory oversight (State Administration of Foreign Exchange (SAFE), 2020).

[8] Renminbi Qualified Foreign Institutional Investor (RQFII): Introduced in 2011, this program extended QFII access to include investments made in offshore renminbi (RMB), aiming to promote the internationalization of the RMB and provide more flexible access for foreign investors to China's onshore financial markets (State Administration of Foreign Exchange (SAFE), 2020).

with connections to the regulators are more likely to be listed, whereas privately owned firms, especially those in new growth industries without high current profitability, face much higher impediments. Although the findings report no significant difference in accounting performance between SOEs and non-SOEs, SOEs still underperform non-SOEs in terms of stock returns, particularly among large firms. While many stock exchanges have a high presence of government owned companies that are publicly traded, as shown in Figure 1.2 , China's government reaches one of the highest government participation globally, with a ownership of 47% share of the total stock market cap (OECD, 2024).

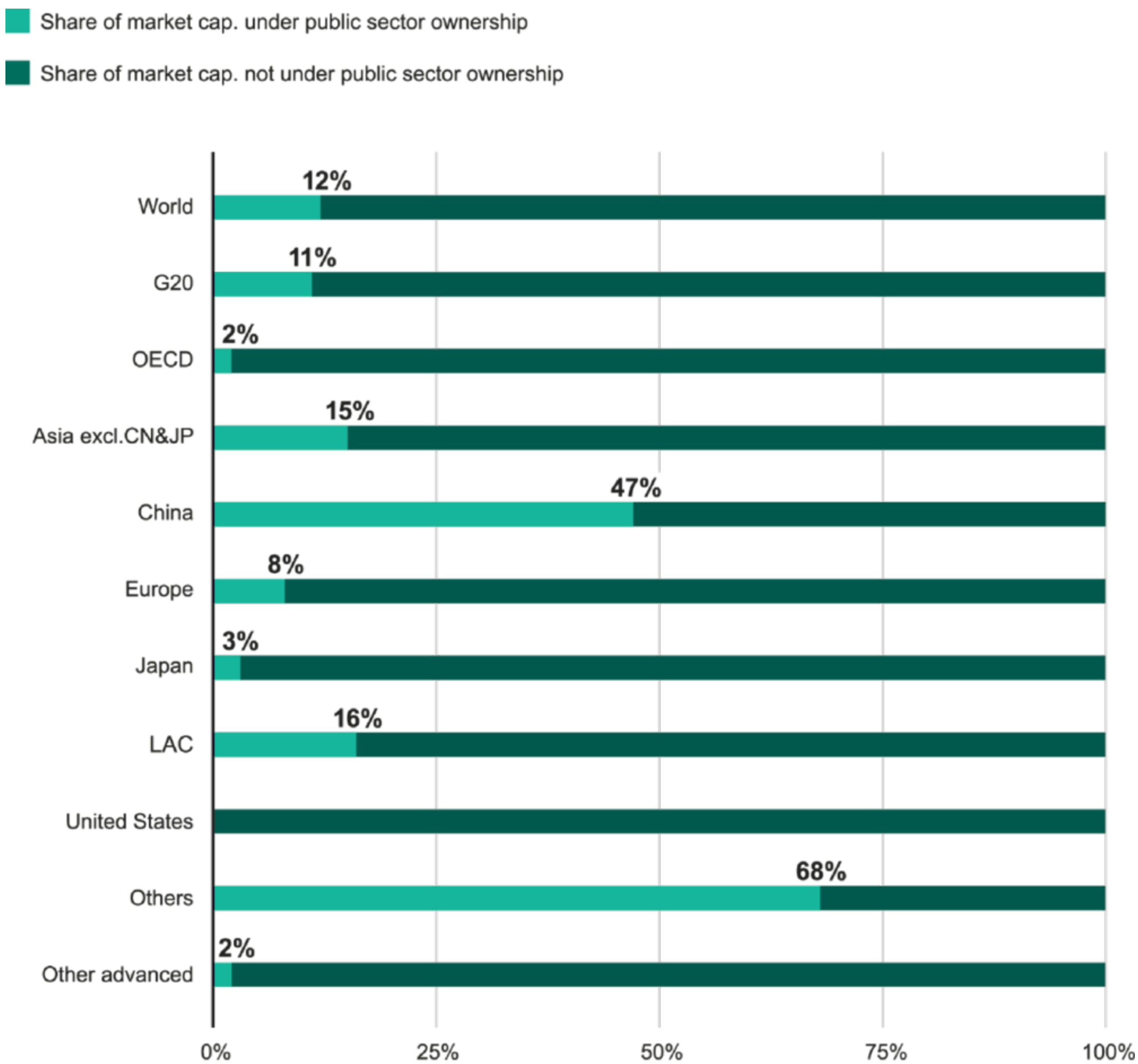

Figure 1.2: Public sector ownership in listed companies, end of 2023

Note: Asia excl. CN&JP = Asia excluding China and Japan. LAC = Latin America and the Caribbean. The public sector refers to direct ownership by central governments, local governments, public pension funds, SOEs, and sovereign wealth funds (SWFs), hence the data presented do not strictly correspond to the definition of SOEs in the SOE Guidelines. *Source:* OECD Capital Market Series dataset, FactSet, LSEG, Bloomberg.

While government ownership in listed companies has been dominant in China, recent trends illustrate a marked decline in state holdings among China's top 100 publicly listed companies while still remaining a significant portion, as highlighted by Figure 1.3.

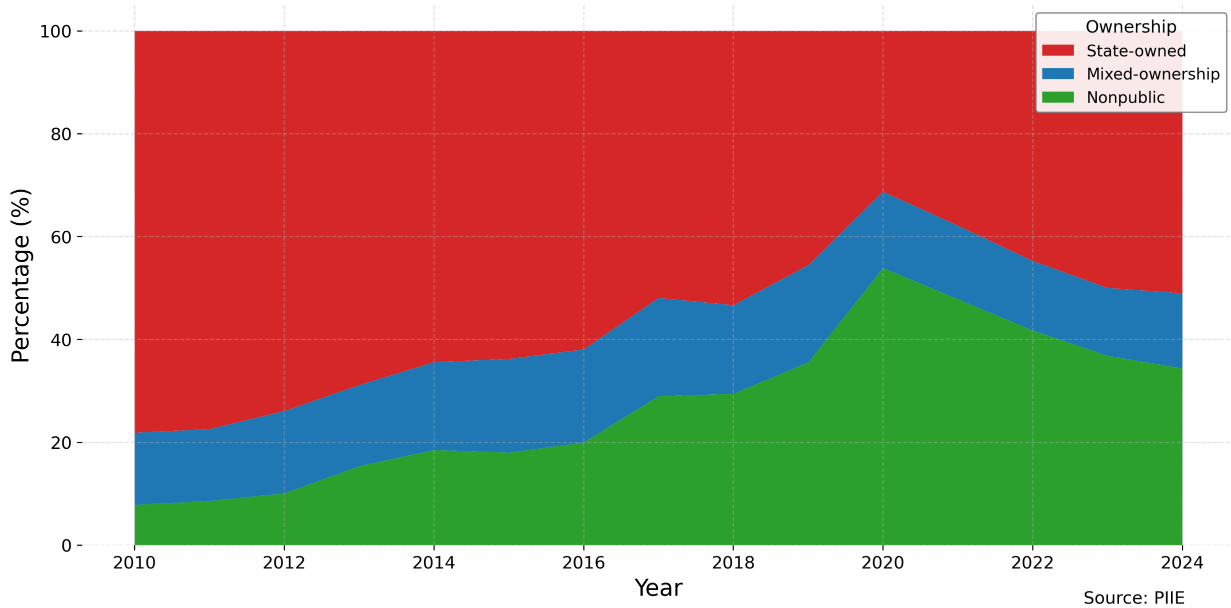

Figure 1.3: Share of aggregate market capitalization of China's top 100 listed firms by ownership (2010–2024)

Given the magnitude of state ownership in Chinese publicly listed companies, domestic investors and foreigners should carefully consider whether they should or should not include SOEs compared to non-SOEs in their portfolios.

1.2 Relevant Literature

The research literature regarding Chinese State-Owned Enterprises (SOEs) can be divided into two interrelated themes: the effect of government ownership in financial markets and the role of government guarantees in mitigating financial risk, especially during economic downturns.

Given the close relationship between government and SOEs, they may provide stability during turbulence in the financial market, particularly in response to political and economic uncertainty. Zhou (2017) finds that Chinese firms' exposure to political uncertainty and political risks varies with government ownership. The stock performance of private firms declines more on politically sensitive event days, while SOEs exhibit greater resilience, implying that government ownership can act as a shock absorber against political risk and economic uncertainty.

The close ties between SOEs and the government provide benefits not only in times of uncertainty but also under normal market conditions. Ding and Suardi (2019) document that government ownership significantly increases Chinese stock liquidity, especially for smaller SOEs. This effect is more pronounced when the state holds a controlling stake, and when the benefits of government ownership are most needed, such as for smaller firms, for financially constrained firms, and especially during the financial crisis period. In support of this, the paper found that SOEs during the 2008 global financial crisis, particularly those with high leverage, benefited disproportionately from increased liquidity. These conclusions support the soft-budget constraint view of government ownership according to which investors that highly value the additional financial benefits granted through implicit government guarantees, the preferential treatment in competition for government resources and investment opportunities, would view such stocks as value-enhancing and trade in them.

A second part of literature investigates how government guarantees affect the performance and stability of SOEs, particularly during downturns. Cong et al. (2019) show that Chinese SOEs received a disproportionately high share of stimulus credit during China's 2009–2010 economic stimulus program, despite being less productive than their private counterparts. This preferential treatment focuses on how implicit guarantees protect SOEs from financial stress and how this could potentially be reflected in SOEs stock prices. However, these findings are not persistent only in the stock market. Geng and Pan (2024) investigate this thesis in the Chinese bond market, identifying a persistent "SOE premium". Compared to non-SOEs, SOEs exhibit lower credit spreads, a discrepancy that becomes more pronounced during liquidity crises. This finding suggests that investors rely on implicit state backing, which in turn enhances SOE resilience in times of financial instability.

Government ownership may also provide diversification benefits for the stock market due to lower price synchronicity. The study by Gul et al. (2010) explore how Chinese ownership concentration affects stock price synchronicity. Higher synchronicity, indicating that the idiosyncratic information is not fully priced, reduces a stock's diversification benefits. Their results reveal a concave relationship between ownership concentration and synchronicity, with government-owned firms displaying significantly higher synchronicity than privately owned ones. This hints that Chinese SOEs with excessive government ownership may have reduced effects on portfolio diversification, due to potential increasing in market co-movement. Shan et al. (2022) provide supporting evidence, observing that Chinese A-shares offer substantial diversification benefits due to their low correlation with global markets. However, these benefits come with greater sensitivity to domestic policy interventions. Because of the QFII reform, which increased foreign access to Chinese equities, the Chinese stock market has reduced over time its diversification advantages for international investors.

2 Data

This study uses financial data for different stages of the empirical analysis. Specifically, data of firm-level stock prices, Chinese ten-year bond yield and Shanghai Composite index return are employed to estimate time-varying betas within the CAPM. In contrast, additional macroeconomic and firm-level variables, such as economic cycles indicators and state ownership status, are used in subsequent regression to explain the variation in the estimated beta over time.

2.1 Historical stock prices

The firm-level stock price data from publicly listed Chinese companies on the Shanghai and Shenzhen stock exchanges are retrieved over a 13 year period, from January 1, 2012 to January 1, 2025, with monthly frequency. A monthly interval is employed to mitigate the influence of daily market volatility. The dataset of Chinese A-shares prices was collected from the LSEG Refinitiv database (formerly Thomson Reuters). The original dataset includes historical stock prices for a total of 1,117 firms, of which 483 were identified as State-Owned Enterprises (SOEs) and 634 as non-SOEs. A firm is classified as an SOE if it is "an entity owned or controlled by the government or any governmental body, if the latter has more than 50% of votes or has a golden share in the company, which gives it veto power", as defined by Refinitiv. Accordingly, the binary variable SOE is defined as TRUE if the firm's state ownership is greater than or equal to 50%, and FALSE otherwise. It is important to note that these ownership classifications reflect the status at the time of data retrieval and it is available at a single point in time, while in practice it may evolve over time due to changes in shareholder structure. After data cleaning to exclude firms with non-continuous or insufficient data coverage over the study period, the final sample consists of a a total of

312 firms historical stock prices data, including 171 SOEs, where 121 of these are listed on the Shanghai Stock Exchange and 50 on the Shenzhen Stock Exchange, and 141 non-SOEs, where 59 companies are listed on the Shanghai Stock Exchange and 82 on the Shenzhen Stock Exchange. Stock prices are denominated in Chinese Yuan (CNY) and are transformed into log monthly returns for empirical analysis, using the following formula:

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right) = \ln(P_t) - \ln(P_{t-1})$$

The firms included in the final time series financial dataset used for the analysis exhibit the characteristics illustrated in the following graphs. Figure 2.1 displays the distribution of State-Owned Enterprises (SOEs) by market capitalization, measured in billions of Chinese Yuan (CNY). The 171 SOEs are heavily right-skewed, indicating that most of them have relatively lower market capitalization, representing small to mid-sized firms.

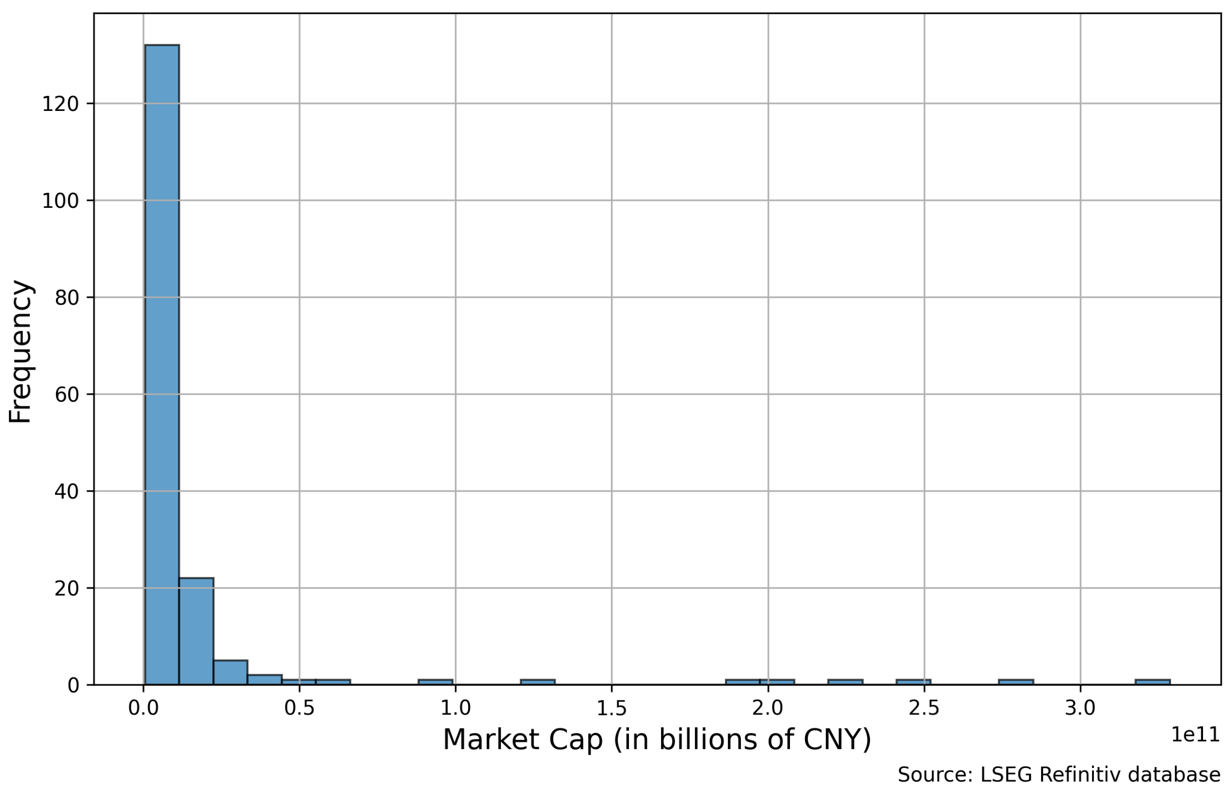

Figure 2.1: Distribution of Market Capitalization for SOEs

Figure 2.2 illustrates the distribution of non-SOEs by market capitalization and shows that the 141 non-SOEs are right-skewed distributed, with small to medium-sized firms. Both the distributions present some outliers, with very fewer large companies, indicating heterogeneity in both groups.

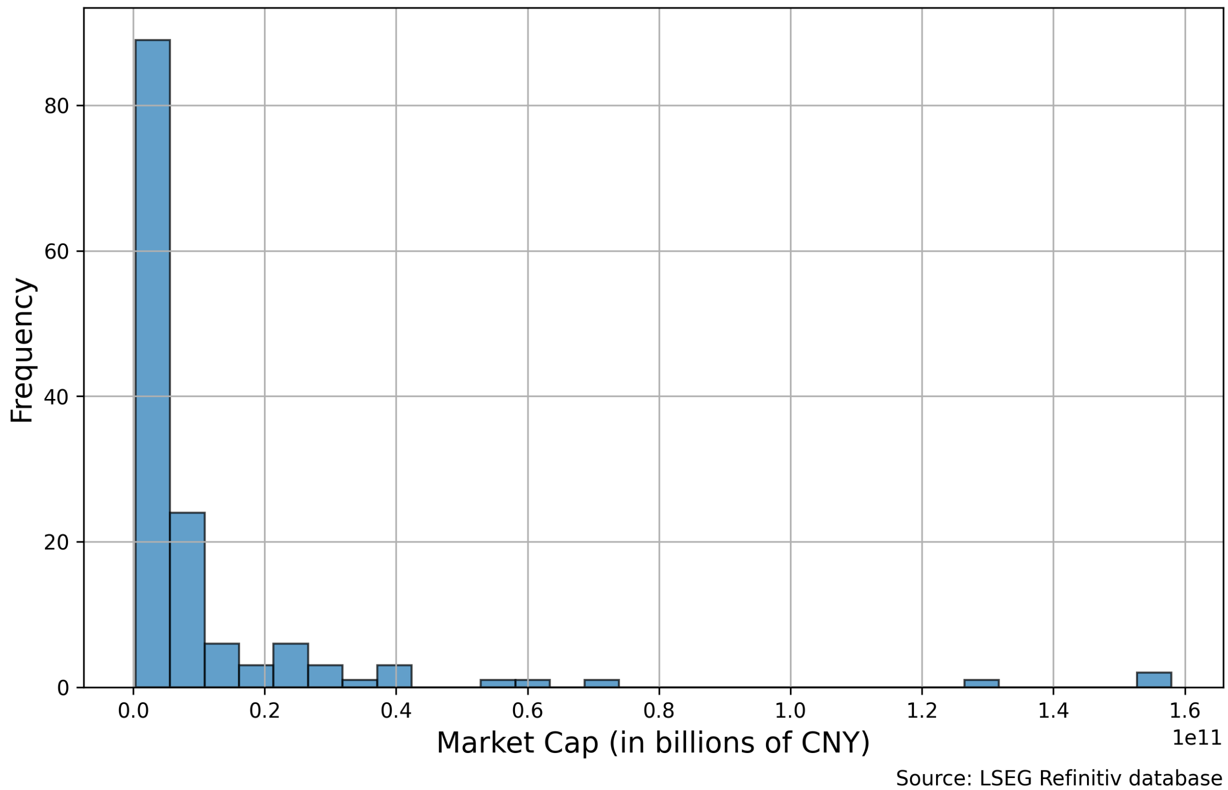

Figure 2.2: Distribution of Market Capitalization for Non-SOEs

Figure 2.3 shows SOEs and non-SOEs by the GICS Sector[1]. Due to missing data, some sectors are significantly unbalanced in terms of state ownership, such as Industrials, Materials, and Utilities. In some sectors SOEs firms are fewer, for instance in Communication Services. However, this large unbalance may be caused by the high presence of SOEs in sectors that are considered vital for the Chinese government.

[1]The Global Industry Classification Standard (GICS) organizes industries into 11 sectors: Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Real Estate, Communication Services, and Utilities. This classification system, developed by S&P Global and MSCI, is widely used in the financial industry for investment analysis and portfolio management (MSCI).

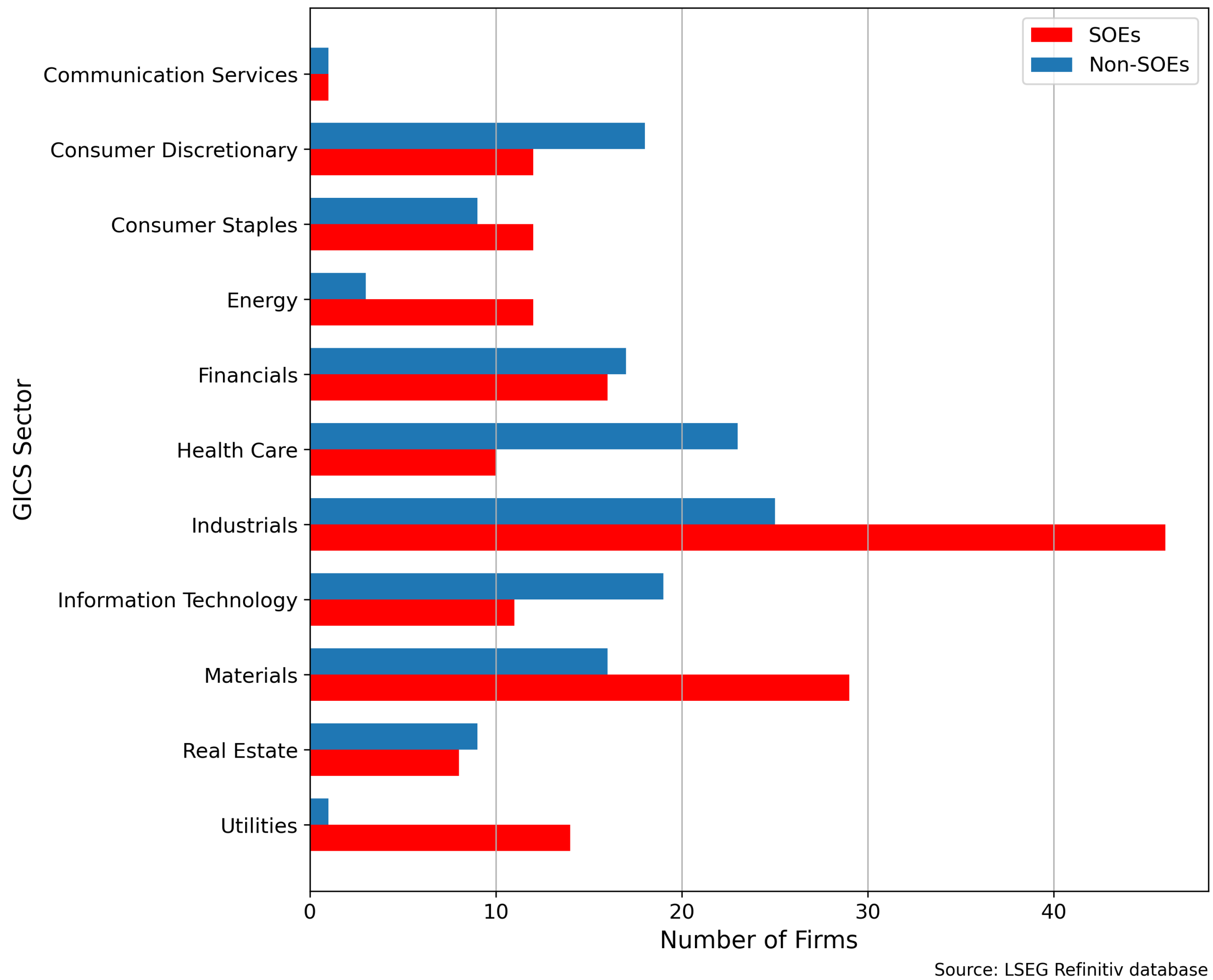

Figure 2.3: Number of Firms by GICS Sector

2.2 Variables for the Capital Asset Pricing Model

As a proxy for market return, this paper uses the Shanghai Stock Exchange Composite Index (ticker 000001.SS) which is a stock market index of all stocks A-shares and B-shares that are traded at the Shanghai Stock Exchange. The Shanghai Composite Index meets the structural requirements of the CAPM for the market, accurately reflecting market trends and exhibiting good market representation. The monthly data of the SSE Composite Index are retrieved from Yahoo Finance over the period that goes from the 1st of January 2012 to the 1st of January 2025 and the respectively monthly log-returns are calculated as before.

The 10 year government bond yield is employed as a proxy the risk-free rate in the CAPM framework. Monthly data covering the period that goes from the 1st of January 2012 to the 1st of January 2025 are retrieved from the LSEG Refinitiv database and monthly log-returns of the risk-free rate are calculated as mentioned before.

2.3 Economic cycle indicators

Selecting an appropriate indicator that differentiates periods of economic expansion and recession in China entails several challenges. Traditional macroeconomic indicators, such as quarterly real GDP growth rates, widely used to determine expansion and recession, face potential concerns regarding data accuracy and reliability, due to the lack of transparency associated with official Chinese statistics (Shalal and Ljunggren, 2023) (Kennedy and Mei, 2023).

Additionally, another measure used is the OECD based recession indicators for China (CHNRECM), measured from the peak through the trough which employs a systematic cross-country comparable methodology to define recession periods. Despite the international benchmarking advantages, this indicator may inadequately reflect structural changes specific to the Chinese economy, due to uniformity in cross-country methodology that does not take into account China's economy structural differences.

Alternatively, the Li Keqiang Index is a measure based on three different indicators: electricity consumption, railway cargo volume, and bank lending. This indicator has an interesting story: since China's GDP data are over-reported, Li Keqiang, the seventh Premier of the People's Republic of China from 2013 to 2023 revealed in a leaked U.S. embassy memo (later published by WikiLeaks), his remarks to a U.S. diplomat a decade ago, describing the official GDP figures as “man-made”, which inspired The Economist to create an index of his three preferred measures of economic growth in China that now bears his name: the Li Keqiang index (The Economist, 2010). Therefore, this indicator offers a more accurate measure of China's real economic activity, but, as an indirect measure, it may not fully capture the different nature of economic downturns, thereby producing measurement errors.

Given that there are no defined thresholds that indicate periods of recession and expansion for the Li Keqiang Index, I have decided to consider the values below the 25th percentile as recession and the values above the 75th percentile as expansion, as shown in Figure 2.4. The quarterly data measure the percentage change from the same quarter in the previous year (i.e. Y/Y change) with constant prices (the data are not seasonally adjusted). The Li Keqiang Index data are retrieved from the LSEG Refinitiv Database.

In conclusion, the Li Keqiang index results to be less prone to political influence than official GDP and can accurately capture real economic activity changes and thus, it is used in the analysis.

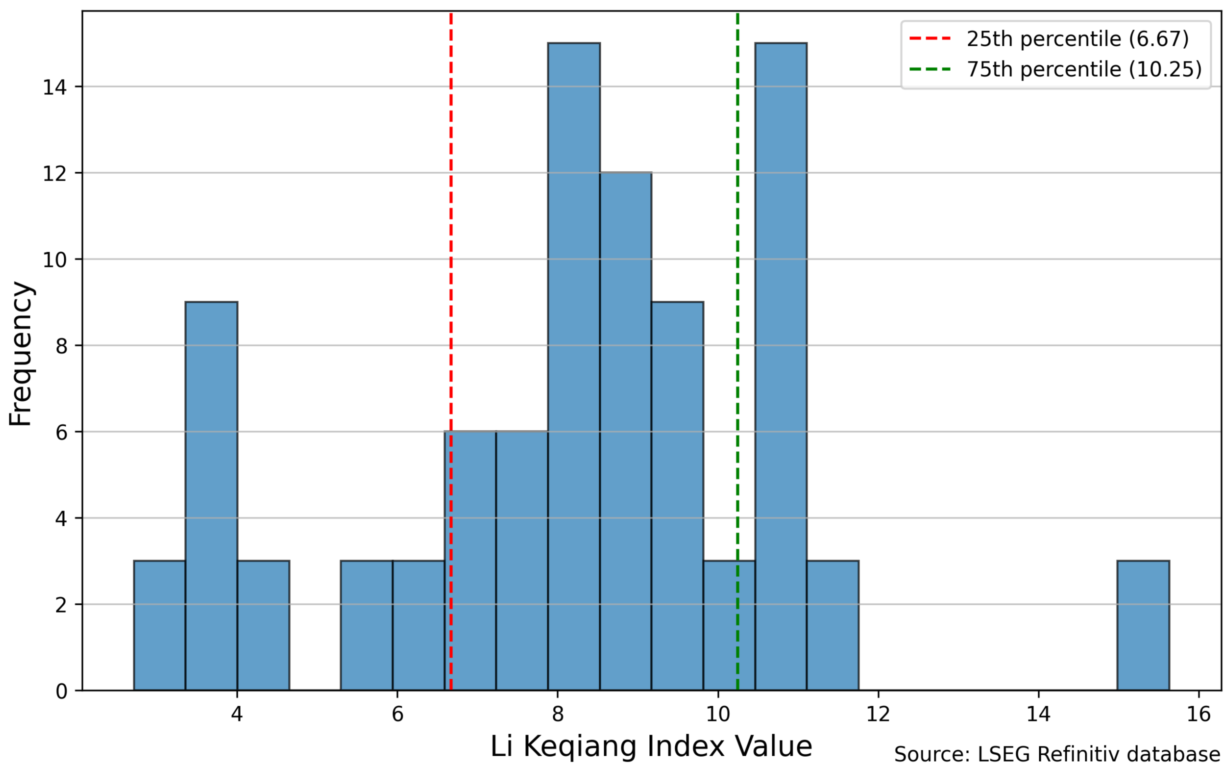

Figure 2.4: Distribution of the Li Keqiang Index

3 Methodology

The portfolio theory conceived by Markowitz (1952) answers the question of how to find an optimal distribution of wealth among various assets. In his paper, he measured the investment risks by the variance and proposed the mean-variance formulation which laid the foundation of the modern portfolio theory. Built on this, the Capital Asset Pricing Model (CAPM) initially introduced by Sharpe in 1964, is a quantitative technique to assess systematic risk exposure in equity markets Sharpe (1964). From then on, Lintner (1965) and Mossin (1966) further developed and defined the famous CAPM, which states that the systematic difference in security returns can be explained by beta, which measures the asset's systematic risk. According to CAPM, the expected return on any security can be measured by adding the risk-free rate and the market risk premium multiplied by the beta coefficient.

The traditional CAPM follows four assumptions. First, investors are risk averse and evaluate their investment portfolios solely on expected return and standard deviation of return, measured in the same holding period. Second, capital markets have assets infinitely divisible, with no transaction costs and no taxes. Third, all investors have access to the same investment opportunities and can borrow and lend money at a risk-free rate. Fourth, investors have homogeneous expectations about means, variances, and correlations of returns of securities.

The standard CAPM equation is mathematically expressed as follows:

$$\mathbb{E}(R_i) = R_f + \beta_i \left[\mathbb{E}(R_m) - R_f\right]$$

Where $E(R_i)$ indicates the expected return of asset i; R_f is the risk-free rate of return (e.g., the rate on a U.S. Treasury bond); β_i is the beta of the asset i, which measures its volatility relative to the market (a measure of systematic risk); $E(R_m)$ is the expected return of the market portfolio and $E(R_m) - R_f$ is the market risk premium, which is the difference between the expected market return and the risk-free rate.

However, the CAPM presents some limitations. The study by Fama and French (2004) revealed that many of the empirical applications of the model are invalid. Their findings suggest that value stocks earn higher returns despite having lower betas, contradicting CAPM predictions that higher beta stocks should be rewarded with higher returns. Similarly, low-beta stocks often outperform high-beta ones, further challenging the model's risk-return trade-off. The model assumes that returns are normally distributed, while in reality risk is asymmetric. CAPM also presumes investors have homogeneous expectations and rational beliefs, while in reality investors may prefer positive skewness (e.g., lottery-like payoffs). Another fundamental issue is that the theoretical market portfolio includes all investable assets (e.g., real estate, human capital), but in fact this is unobservable. In practice, using a stock index as a proxy introduces significant measurement errors, a critique raised by Roll (1977). Moreover, the model assumes a frictionless world with no taxes or transaction costs, infinitely divisible assets, and short-term optimization by investors. Furthermore, CAPM assumes one unified portfolio, while real investors often manage multiple portfolios to meet different necessities or goals. Additional models have been developed to address for documented anomalies such as size and value effects which remained unexplained by CAPM, formulated by models like the Fama-French three-factor model (Fama and French, 1993). Lastly, the static CAPM relies on a single-period framework, assuming beta to be constant over time and estimated over ordinary least squares (OLS), limiting its applicability to the real dynamic nature of investment decisions and the differences in the behavior of an asset during different economic periods. To address this issue, several studies have been conducted, arguing that the systematic risk beta depends on microeconomics and macroeconomics factors, rejecting the hypothesis that beta is stable over time (Fabozzi and Francis, 1978) (Sunder, 1980) (Bos and Newbold, 1984) (Collins et al., 1987).

Developed on this criticism, the paper by Bollerslev et al. (1988) introduces time-varying CAPM, which implies that the beta and covariances are allowed to change over time, specifically as functions of the conditional covariance matrix of returns. Their study aims to address the problem that investors may have common expectations on the moments of future returns but that these are conditional expectations and therefore random variables rather than constants. Following this line, the studies by Ferson (1989), Ferson and Harvey (1991), Ferson and Harvey (1993), Ferson and Korajczyk (1995), argued that beta and market risk premium may vary over time and CAPM should be improved by including time-varying beta. Build on this, Jagannathan and Wang (1996) advanced the conditional CAPM where betas and the market risk premium vary over time with business cycles, including

While the literature relate to empirical asset pricing in China remains scarce, regarding time-varying beta in the Chinese stock market, Ye (2017) examines how CAPM betas for Chinese A-shares vary with estimation window length from 6 to 72 months. Contrary to developed markets in which a longer window usually increases beta stability, in the Chinese stock market a 12-months window has been found optimal. Moreover, beta has been found to be procyclical, confirming time-varying systematic risk.

3.1 Model

This research focuses on the evolution of time-varying beta for SOEs listed in China's A-share market across economic cycles. The aim of this paper is to assess whether SOEs, often perceived as more stable due to government backing, exhibit lower systematic risk during economic downturns and higher risk during expansions. To estimate time-varying beta, the first regression represents the CAPM with a monthly rolling window over data from 2012 to 2025 period. The excess return of SOEs is regressed against the market risk premium over a rolling five-year (60-months) window and given this window length, the estimated beta are from 2017 to 2025.

The standard CAPM time-varying model is designed as follow:

$$R_{\mathrm{i},t} = R_{f,t} + \beta_{\mathrm{i},t}(R_{m,t} - R_{f,t}) + \varepsilon_t$$

By subtracting $R_{f,t}$ on both sides of the expression, we obtain the econometric model used to estimate time-varying beta:

$$(R_{\mathrm{i},t} - R_{f,t}) = \alpha_t + \beta_{\mathrm{i},t}(R_{m,t} - R_{f,t}) + \varepsilon_t \tag{3.1}$$

Where $R_{i,t} - R_{f,t}$ is the excess log return of firm i over the risk-free rate, represented as the China 10-year government bond yield at time t, α_t is the Jensen's alpha, measuring the excess return that cannot be explained by the market, $\beta_{\mathrm{i},t}$ is the time-varying beta measuring firm's i sensitivity to market risk at time t, $R_{m,t} - R_{f,t}$ is the market risk premium (excess market return over the risk-free rate) where $R_{m,t}$ is the return of the Shanghai Composite Index, and ε_t is the error term (idiosyncratic risk).

Rolling windows are utilized to estimate beta since they allow a smoother continuous estimate of time-varying betas, which are useful for studying economic shifts over time and mimic investor behavior of using recent data to assess risk in financial markets. However, rolling windows estimation present several drawbacks. Firstly, the choice of the optimal window is arbitrary since there is no universal correct window and so, results will be different with different windows lengths. Secondly, since rolling windows have overlapping time frames, the estimates present artificial serial correlation, showing bias standard errors. To address this issue, the Regression 3.1 uses time-series OLS with the Newey-West HAC (Heteroskedasticity and Autocorrelation Consistent) standard errors which correct for autocorrelation in residuals up to four lags (Newey and West, 1987).

Once the time-varying beta estimates are obtained, they are regressed on macroeconomic variables:

$$\hat{\beta}_{i,t} = \gamma_0 + \gamma_1 \,\text{Recession}_t + \gamma_2 \,\text{Expansion}_t + \gamma_3 \,\text{SOE}_i$$
$$+ \gamma_4 \,(\text{Recession}_t \times \text{SOE}_i) + \gamma_5 \,(\text{Expansion}_t \times \text{SOE}_i) + \nu_t \qquad (3.2)$$

Where $\hat{\beta}_{i,t}$ is the estimated beta from Regression 3.1 and the independent variables are: Recession_t is a dummy variable (1 if the economy is in a recession, 0 otherwise), Expansion_t is a dummy variable (1 if the economy is in an expansion, 0 otherwise), SOE_i is a dummy variable (1 if firm i is state-owned, 0 otherwise) and ν_t is the regression error term. Here, Neutral_t is the omitted baseline and is a dummy variable (1 if the economy is in a neutral economic condition, 0 otherwise). Periods of recession and expansion are determined by the Li Keqiang Index, developed by The Economist (2010). Moreover, two interaction terms are introduced to measure the additional effect of interaction between state ownership and economic conditions.

Furthermore, the coefficients are: γ_0 is the average beta for a non-SOE during a normal economic period (omitted baseline), γ_1 is the additional effect on beta for a non-SOE during a recession (compared to a period with normal economic conditions), γ_2 is the additional effect on beta for a non-SOE during an expansion (compared to normal period), γ_3 is the additional effect on beta when firm i is a SOE (during a "normal" period, compared to a non-SOE), γ_4 is the additional effect on beta for an SOE during a recession, above the effect of recession for non-SOEs and the total effect of Recession_t on SOE beta is expressed by $\gamma_1 + \gamma_4$, γ_5 is the additional effect on beta for a SOE during an expansion, above the effect of expansion for non-SOEs and the total effect of Expansion_t on SOE beta is determined by $\gamma_2 + \gamma_5$.

In addition to Regression 3.2, in the following Regression 3.3 the GICS sectors[1] fixed

[1] The GICS Sectors are the followings: Communication Services, Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Real Estate, and Utilities.

effects are introduced, capturing how firms beta differ if firm i is classified in a different sector. The decision to implement sectors fixed effects is introduced given that some sectors naturally have higher betas and betas are different across sectors according to different economic cycles (e.g. sector rotation). The classification of firm i in sector s is assumed to be constant over time (time-invariant), as the re-classification of firm i into another sector is rare.

$$\begin{aligned}\hat{\beta}_{i,t} &= \gamma_0 + \gamma_1 \,\text{Recession}_t + \gamma_2 \,\text{Expansion}_t + \gamma_3 \,\text{SOE}_i + \gamma_4 \,(\text{Recession}_t \times \text{SOE}_i) \\ &\quad + \gamma_5 \,(\text{Expansion}_t \times \text{SOE}_i) + \sum_{s=1}^{S-1} \delta_s \,\text{Sector}_{i,s} + \nu_{i,t} \end{aligned} \tag{3.3}$$

The $\text{Sector}_{i,s}$ is a dummy variable that equals 1 if firm i belongs to sector s, and 0 otherwise. The summation $\sum_{s=1}^{S-1}$ includes all sectors, except one baseline. Here, the Communication Services sector is used as a baseline (omitted from the dummy variables), to avoid perfect multicollinearity.

Each δ_s captures the additional effect of firm i belonging to sector s (e.g., Financials, Energy, etc.) on the firm's systematic risk ($\hat{\beta}_{i,t}$), relative to average beta of a firm in the baseline sector, both for non-SOEs and SOEs from another sector s. For instance, if $\delta_4 = 0.12$ and it is statistically significant, it means that a firm i classified in the Energy sector has on average a 0.12 higher beta than a firm in the Communication Services sector. Thus, the coefficient interpretation in Regression 3.3 remains the same as in Regression 3.2, apart from the fact that every effect is now compared to the baseline sector Communication Services.

Since data for the same firm over time is not independent and thus violates the second Gauss-Markov assumption which states that the draws from the population distribution should be independent and identical distributed (IID), the regression type used for the second regression is a pooled Ordinary Least Squares (OLS) with clustered standard errors at firm-level. This address the issue that standard errors for a given firm are likely to be correlated over time across different firms, given that if a firm exhibit a high beta in a specific month, it will probably have a high beta for the next month. This in turn will correct for serial dependence making standard errors robust to autocorrelation and heteroskedasticity within firms, as defined by Liang and Zeger (1986) and suggested by Abadie et al. (2022).

Hypothesis Testing

The main hypothesis of this paper is that γ_4, the coefficient of the interaction term $\text{Recession}_t \times \text{SOE}_i$ in Regression 3.3, has a negative effect on the estimated beta $\hat{\beta}_{i,t}$. This would be explained by the fact that the government backing effect on SOEs betas lowers the sensitivity to the market during recession compared to private firms in the same baseline sector. Apart from the main hypothesis, the following effects are expected from Regression 3.3:

- $\gamma_0 > 0$: reflects a baseline positive sensitivity of non-SOEs in the baseline sector to market returns under neutral economic conditions;

- $\gamma_1 < 0$: recessions lower the market beta of firms in the Communication Services sector, suggesting that they become less sensitive to the overall market and are perceived as more resilient during hard times;

- $\gamma_2 > 0$: expansions increase the market beta of stocks in the Communication Services sector, suggesting that they become more volatile compared to the overall market;

- $\gamma_3 < 0$: state ownership for Chinese stocks in the Communication Services sector is associated with lower volatility compared to the overall market under neutral economic conditions;

- $\gamma_5 < 0$: SOEs generally suffer from inefficiencies, lower profitability, and losses compared to their private counterparts and so, during expansion periods, they may receive more competition pressures, making SOEs in the baseline sector less market-sensitive than private firms;

- $\delta_s \neq 0$: belonging to a specific sector s has a significant effect on a firm's beta, as some sectors are naturally characterized by higher or lower average beta. These coefficients capture systematic risk differences across sectors relative to the baseline industry.

4 Results

Figure 4.1 and Figure 4.2 illustrate the dynamic behavior of SOEs and non-SOEs beta, respectively, estimated as in Regression 3.1 using a five-year monthly rolling window, and plotted over time from 2017 to 2025. The shaded regions correspond to different economic phases identified using the Li Keqiang Index, where red areas correspond to economic recession periods while green areas correspond to economic expansion periods.

Comparing the two graphs, a clear divergence in beta dynamics is observable between SOEs and non-SOEs. SOEs in Figure 4.1 exhibit relatively more volatile betas over time, with more responsiveness to shifts in macroeconomic conditions. In contrast, non-SOEs in Figure 4.2 display considerably less volatility, with betas generally stable during recessions and expansions.

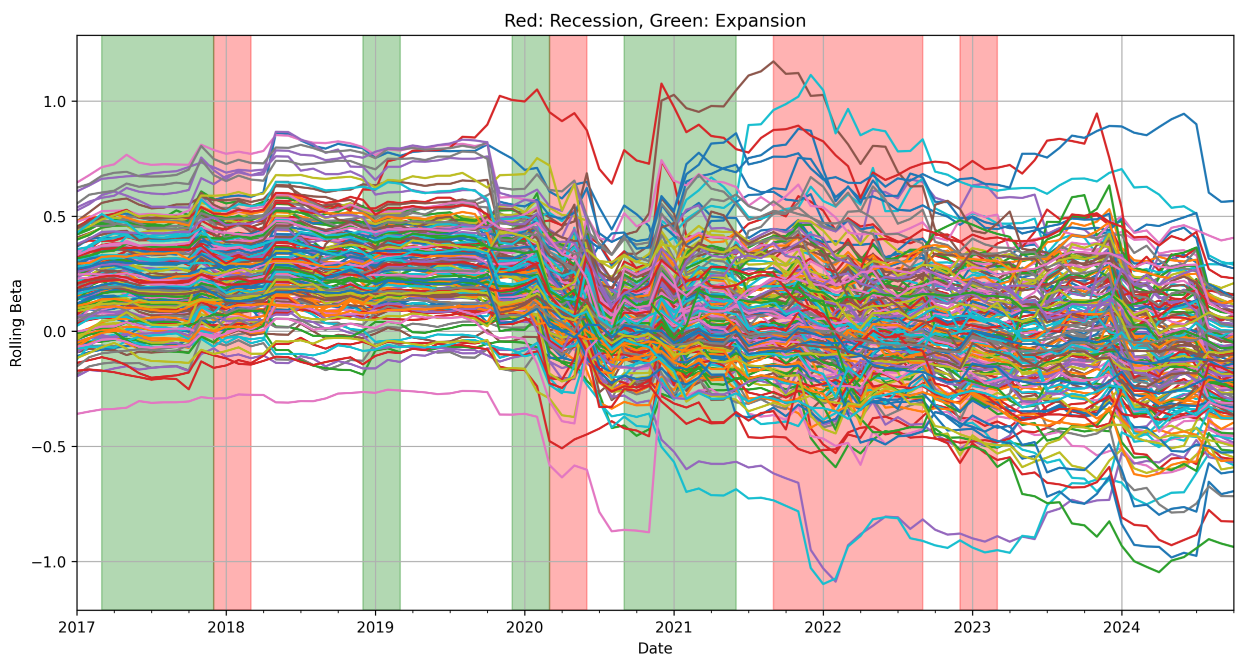

Figure 4.1: 5-Year Monthly Rolling Estimated Betas of SOEs during Recession and Expansion, measured by the Li Keqiang Index

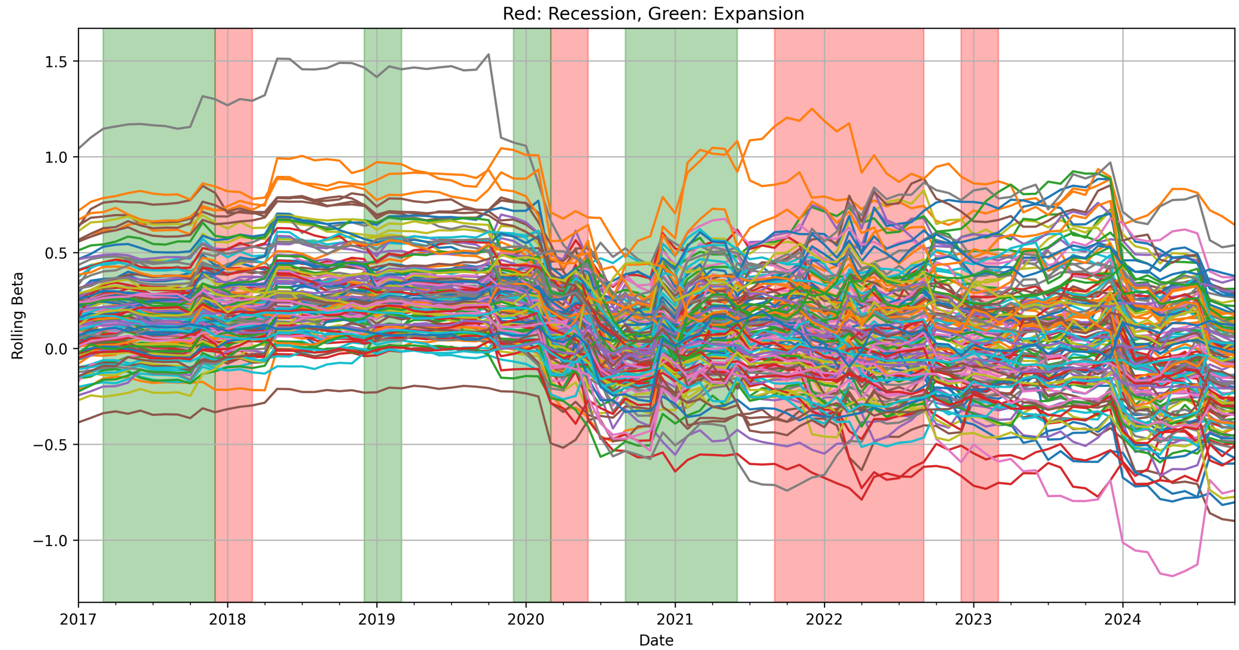

Figure 4.2: 5-Year Monthly Rolling Estimated Betas of non-SOEs during Recession and Expansion, measured by the Li Keqiang Index

Table 4.1 reports the results of the pooled OLS with firm-level clustered standard errors of the regression which follows the specification outlined in Equation 3.2 and Equation 3.3, regressing the time varying beta $\hat{\beta}_{i,t}$ estimated with a five-years monthly rolling window, obtained from Regression 3.1, on recession, expansions, state ownership dummies, interaction terms between state ownership and macroeconomic conditions, and sector fixed effects.

As shown in Table 4.1, sector fixed effects in Model 4 increased largely the explanatory power from $R^2 = 0.019$ in Model 3 to $R^2 = 0.183$ in Model 4, indicating an overall improvement of the model fitting. This suggests that sector classification explains a large portion of the variation in firm-level beta. In comparison, Model 2 presents a lower explanatory power than Model 4 and thus, the following interpretation focuses on the latter, which includes the full set of explanatory variables, offering the most comprehensive specification. The intercept γ_0 being statistically significant at the 1% level means that private firm from the reference sector Communication services during neutral economic periods exhibit a positive systemic risk, with an average beta of 0.219. The coefficient γ_1 of the recession dummy is -0.027, and is statistically significant at the 5% level. This indicates that on average the beta of a non-SOE firm in the baseline sector tend to slightly decrease during downturns compared to periods of neutral economic conditions. The γ_2 coefficient of the expansion dummy is 0.061 and is statistically significant at the 1% level, meaning that during expansion firms in the baseline sector experience on average an increase in beta of 0.061. The γ_3 coefficient on SOE_i is not significant at any confidence level. This indicates that there is no strong evidence that SOEs in the baseline sector differ from non-SOEs in the same sector in terms of market sensitivity in neutral periods. The two interaction terms with state ownership, γ_4 for recession and γ_5 for expansion, are not statistically significant and have a low magnitude, meaning that state owned firms in the baseline sector do no significantly differ from non-SOEs in the same sector in how their beta responds to recession and expansion periods. The inclusion of sector fixed effects reveal significant variation in firm-level beta and the coefficient δ_s measures the average difference in a firm beta in that sector relative to a firm beta in the baseline sector. For instance, firms in Consumer Staples, Energy, Health Care, Real Estate and Utilities have significantly lower betas than those in Communication Services, statistically significant, reflecting their defensive nature during period of neutral economic conditions.

Table 4.1: Regression Results: Pooled OLS with Firm-Level Clustered Standard Errors, using Beta Estimated with a 5-Year Rolling Window

	Dependent variable: beta			
	Model 1	Model 2	Model 3	Model 4
	(1)	(2)	(3)	(4)
Intercept	0.150***	0.228***	0.140***	0.219***
	(0.028)	(0.058)	(0.028)	(0.058)
SOE	-0.041	-0.034	-0.036	-0.030
	(0.034)	(0.027)	(0.034)	(0.027)
recession			-0.027**	-0.027**
			(0.012)	(0.012)
expansion			0.061***	0.061***
			(0.016)	(0.016)
recession x SOE			-0.009	-0.009
			(0.016)	(0.016)
expansion x SOE			-0.010	-0.010
			(0.021)	(0.021)
Consumer Staples		-0.240***		-0.240***
		(0.059)		(0.059)
Energy		-0.107**		-0.107**
		(0.054)		(0.054)
Financials		-0.057		-0.057
		(0.064)		(0.064)
Health Care		-0.251***		-0.251***
		(0.077)		(0.078)
Industrials		-0.086		-0.086
		(0.055)		(0.055)
Information Technology		0.078		0.078
		(0.065)		(0.065)
Materials		0.033		0.033
		(0.062)		(0.062)
Real Estate		-0.207***		-0.207***
		(0.059)		(0.059)
Utilities		-0.225***		-0.225***
		(0.078)		(0.078)
Observations	3720	3720	3720	3720
R^2	0.005	0.169	0.019	0.183
Adjusted R^2	0.005	0.167	0.018	0.180
Residual Std. Error	0.267 (df=3718)	0.244 (df=3709)	0.265 (df=3714)	0.242 (df=3705)
F Statistic	1.465 (df=1; 3718)	8.330*** (df=10; 3709)	9.870*** (df=5; 3714)	10.633*** (df=14; 3705)
Note:				*p<0.1; **p<0.05; ***p<0.01

4.1 Robustness checks

To ensure reliability and consistency of the main results, robustness checks were conducted using two different lengths for beta estimation windows.

Figure A.1 and Figure A.2 present the evolution of firm betas estimated using a one-year monthly rolling window for SOEs and non-SOEs, respectively, with periods of recession and expansions detected by the Li Keqiang Index. Compared to the earlier betas estimated with a five-year rolling window, these estimates display a large short-term volatility, capturing high-frequency fluctuations in systematic risk. The narrower window increase the sensitivity of beta estimates to market shocks, highlighting that SOEs beta volatility is slightly more confined compared to the private counterparts.

Table A.1 shows the results for the pooled OLS with firm-level clustered standard errors, obtained regressing $\hat{\beta}_{i,t}$ estimated with a one-year monthly rolling window on the independent variables of interests and sectors fixed effects outlined in Equation 3.2 and Equation 3.3. Compared to the five-year window results, the model fit is substantially lower, with the adjusted R^2 increasing only marginally from 0.002 in Model 3 to 0.038 in Model 4. This suggests that the explanatory power of economic conditions and sector classification is significantly reduced when betas are estimated using a shorter horizon, which introduces more noise into the dependent variable beta that in turns makes more difficult to detect statistically significant relationships. Indeed, most of the estimated coefficients are not significant at conventional levels. Only some sector fixed effects (e.g., Consumer Staples, Energy, Financials, Health Care, Industrials, Real Estate and Utilities) show statistical significance, highlighting the limited ability of the model to detect economic conditions effects. These results accentuate the challenges of explaining high-frequency fluctuations in systematic risk and suggest that short-term beta movements may be driven more by sector specific characteristics and firm-specific shocks than by macroeconomic conditions.

Figure A.3 and Figure A.4 display the three-year rolling beta estimates for SOEs and non-SOEs respectively, revealing smoother dynamics than the one-year but with more fluctuations than the five-year estimates. Non-SOEs exhibit a severe decline during periods of recession compared to SOEs, consistent with the previous results. The associated regression in Table A.2 shows the results for the pooled OLS with firm-level clustered standard errors, indicating an improved explanatory power over the one-year model, with an adjusted R^2 of 0.149 for Model 4, although still below the Model 2 in Table A.2 and the five-year Model 4 with an adjusted R^2 of 0.180 in Table 4.1. Several coefficients are statistically significant, including macroeconomic dummies and sector fixed effects. This suggest that the three-year Model 4 balances the inclusion of beta dynamics and model stability, offering stronger inference than the one-year Model 2, while remaining less robust than the five-year baseline.

4.2 Discussion

The results of this study offer some significant insights into beta dynamics in the context of state ownership and economic conditions. The large portion of beta dynamics is explained by firm classification into a specific sector and by how beta from that sector evolves on average during different economic cycles. In contrast, state ownership display lower and statistically insignificant effect, implying a possible buffering role attributable to government implicit support or reduced exposure to pressure of market competitiveness. The inclusion of sector fixed effects highlights the importance of sectoral heterogeneity in explaining variation in beta. For instance, sectors such as Consumer Staples and Utilities, which are considered traditionally to be defensive sectors, consistently display lower betas relative to the baseline sector. Furthermore, the comparison across different rolling window lengths reveals a trade-off between responsiveness and statistical power: shorter windows (i.e., one-year) capture more short-term fluctuations in beta but result in weaker model fitting, while longer windows (i.e. five-year) provide smoother and more robust estimates. These findings underline the challenge of identifying consistent patterns in a high-volatile environment such as the Chinese stock market.

4.3 Limitations

This research presents several limitations concerning data availability, variable definitions, CAPM model assumptions, research assumptions, and the model employed.

Firstly, data availability poses the main constraint of this study, as incomplete datasets have limited the extension of the analysis, reduce the robustness and reliability of the empirical results. In particular, several firms exhibit incomplete historical stock prices data, with only a limited subset providing consistent and continuous records over longer periods. This results in a trade-off between using a smaller sample of firms with longer time series and a larger sample of firms for a shorter time horizon. After removing missing values, the resulting firm sample obtained may no longer reflect the characteristics of the broader population, potentially leading to selection bias. Furthermore, main firm-level independent variables such as state ownership, market capitalization and GICS sector classification were only available trough the LSEG Refinitiv database at the time of the data retrieval, rather than as a time series. For instance, the SOE independent variable retrieved only reflects the ownership status at the time of data collection, although ownership classification can change over time, potentially weakening the SOE factor effect. Similarly, firm market capitalization historical values were unavailable, which hindered their inclusion in the analysis, since market capitalization is inherently time variant. This issue extends also to GICS sector classification, but they were includec in the analysis as fixed effects, as firm reclassifications are relatively uncommon.

Secondly, variable definition poses additional challenges. The definition of an SOE in this study is a firm with a government ownership majority (i.e., over 50%). However, different definitions exist in the literature and in different databases[1]. Such different definitions can

[1] For instance, FTSE Russell defines an SOE as a firm under the control of a Chinese state entity, including

lead to inconsistent classifications and hamper cross-studies comparisons. Another key issue concern the selection of economic indicators that truly depict the overall condition of the Chinese economy. Given China's status as a developing economy, its real GDP growth rate is rarely negative, making it a limited measure of economic cycles. Furthermore, official Chinese statistics have been criticized for lack of data transparency and revision practices. To address this, the study adopts the Li Keqiang Index as a proxy for economic activity, where recession and expansion periods are identified as values below the 25th percentile and the 75th percentile of the index, respectively, with the remainder classified as neutral. However, this threshold-based identification is arbitrarily executed and lacks of formal validation, potentially weakening the explanatory power of this analysis by misclassifying economic conditions.

Thirdly, the application of the CAPM model introduces theoretical limitations. The CAPM is based on strict assumptions, including absence of barriers to capital flow, perfect information, risk-free borrowing, and the nonexistence of transactions costs and taxes. These conditions are unlikely to hold in the Chinese stock market, where structural inefficiencies, government interventions, information asymmetry and limited investor access, are prevalent, which in turns undermine the model's assumptions, potentially obtaining bias results.

Lastly, several simplifying research assumptions affect the validity of the findings. The study assumes that sector fixed effects are time invariant, meaning that each firm remains in the same sector throughout the sample period. In practice, firms may be reclassified into a different sector over time, leading to a misrepresented sector membership effect. Similarly, state ownership is assumed to be time-invariant, based solely on its status at the time of data retrieval. These two assumptions may reduce the explanatory of the SOE and sector fixed effects variable, limiting the model's ability to capture dynamic firm characteristics.

To summarize, these limitations underline the necessity for cautious interpretation of the results and directions of future research, including the data collection of firm char-

indirect control through aggregate holdings exceeding 30%.

acteristics over time and the application of models that include evolving firm specific and economic factors, are suggested below.

Future research

To address the issue of data availability, I recommend for future research to use databases that are more specific to China, if they are available, such as the Wind Information database, which contains financial data specific for Chinese A-shares. By doing so, a larger sample of stocks could be retrieved and with a larger data availability, the sample may represent the characteristics of the true population.

The analysis could be improved by introducing other firm specific fixed effects, such as stock liquidity and debt level and a Weighted Least Squares (WLS) regression could be implemented with firm market capitalization as weights, to give more importance to bigger firms. In addition, another regression of beta with a sample of stocks with the same debt level and in the same sector could be used to capture state ownership and macroeconomic conditions effects, controlling for those two characteristics.

Finally, the proxy used as a risk-free rate in this study is the China ten-year government bond yield while CAPM is considered as a short-horizon asset pricing estimate and thus, a three-year government bond yield could reflect better the real risk-free rate in the economy.

5 Conclusion

The study investigates how state ownership affect systematic risk (beta) compared to private firms across economic cycles. Utilizing historical stock prices from 2012 to 2025 and rolling CAPM regression, estimated betas were obtained and were regressed on state ownership, macroeconomic cycles and sectors fixed effects. Empirical findings show that economic cycles significantly affect beta of a firm within a sector, while state ownership factor remains statistically insignificant after controlling for sector effects. A key limitation of the study lies in data availability, as several firm-level variables were only accessible at a single point in time, lowering the explanatory power of the analysis. The CAPM assumptions suggest that the Chinese stock market is still in an immature stage and does not fully follow the theory and assumptios of the model, highlighting stock market inefficiencies. In conclusion, the effect of state ownership on systematic risk (beta) remains an open question, requiring further exploration.

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A Appendix

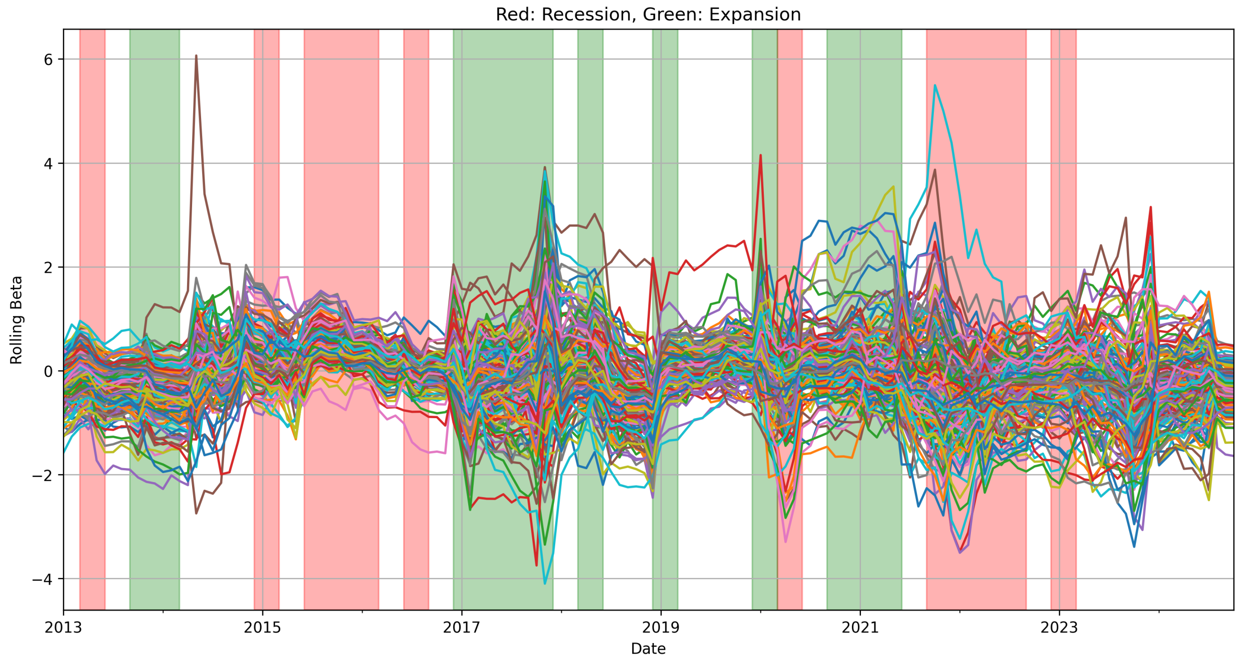

Figure A.1: 1-Year Monthly Rolling Estimated Betas of SOEs during Recession and Expansion, measured by the Li Keqiang Index

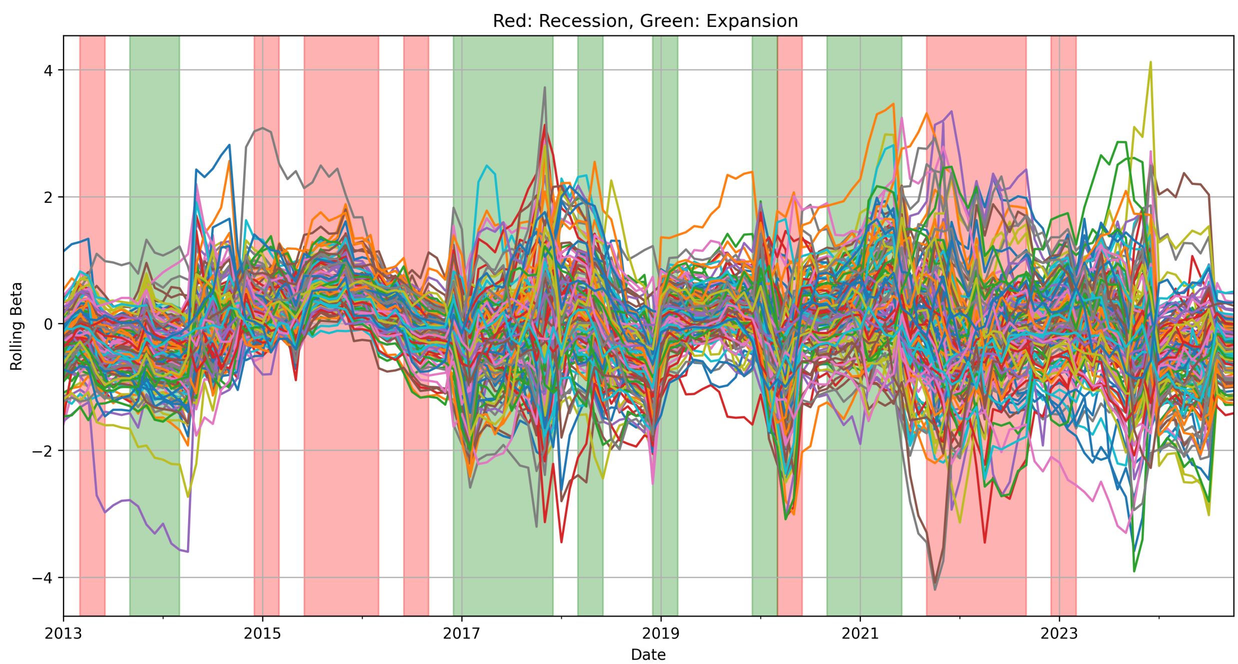

Figure A.2: 1-Year Monthly Rolling Estimated Betas of non-SOEs during Recession and Expansion, measured by the Li Keqiang Index

Table A.1: Regression Results: Pooled OLS with Firm-Level Clustered Standard Errors, using Beta Estimated with a 1-Year Rolling Window

	Dependent variable: beta			
	Model 1	Model 2	Model 3	Model 4
	(1)	(2)	(3)	(4)
Intercept	-0.020	0.061	-0.043	0.039
	(0.030)	(0.041)	(0.035)	(0.044)
SOE	-0.034	-0.022	-0.010	0.002
	(0.037)	(0.027)	(0.040)	(0.032)
recession			0.055	0.055
			(0.034)	(0.034)
expansion			0.031	0.031
			(0.039)	(0.039)
recession x SOE			-0.013	-0.013
			(0.043)	(0.043)
expansion x SOE			-0.079	-0.079
			(0.049)	(0.049)
Consumer Staples		-0.220***		-0.220***
		(0.047)		(0.047)
Energy		-0.139***		-0.139***
		(0.048)		(0.048)
Financials		-0.152**		-0.152**
		(0.063)		(0.063)
Health Care		-0.232***		-0.232***
		(0.059)		(0.059)
Industrials		-0.092**		-0.092**
		(0.042)		(0.042)
Information Technology		0.078		0.078
		(0.053)		(0.053)
Materials		0.068		0.068
		(0.056)		(0.056)
Real Estate		-0.341***		-0.341***
		(0.058)		(0.058)
Utilities		-0.249***		-0.249***
		(0.060)		(0.060)
Observations	5704	5704	5704	5704
R^2	0.001	0.038	0.003	0.040
Adjusted R^2	0.000	0.036	0.002	0.038
Residual Std. Error	0.661 (df=5702)	0.649 (df=5693)	0.660 (df=5698)	0.648 (df=5689)
F Statistic	0.869 (df=1; 5702)	10.805*** (df=10; 5693)	2.144* (df=5; 5698)	8.868*** (df=14; 5689)

Note: *p<0.1; **p<0.05; ***p<0.01

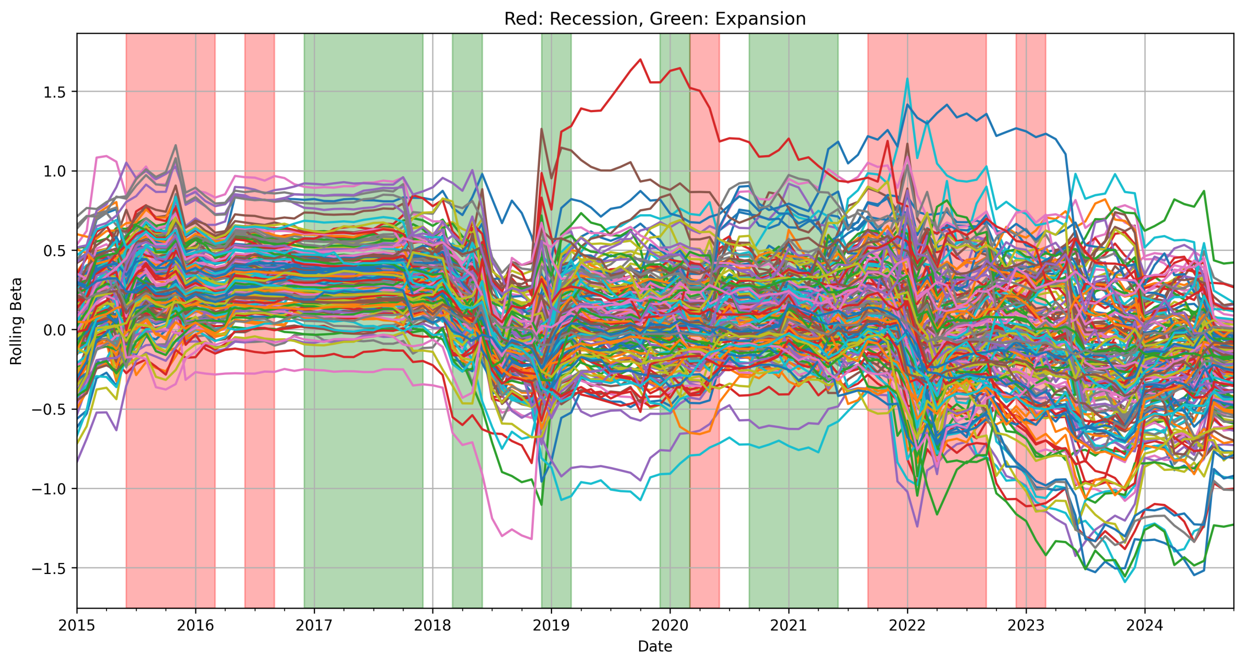

Figure A.3: 3-Year Monthly Rolling Estimated Betas of SOEs during Recession and Expansion, measured by the Li Keqiang Index

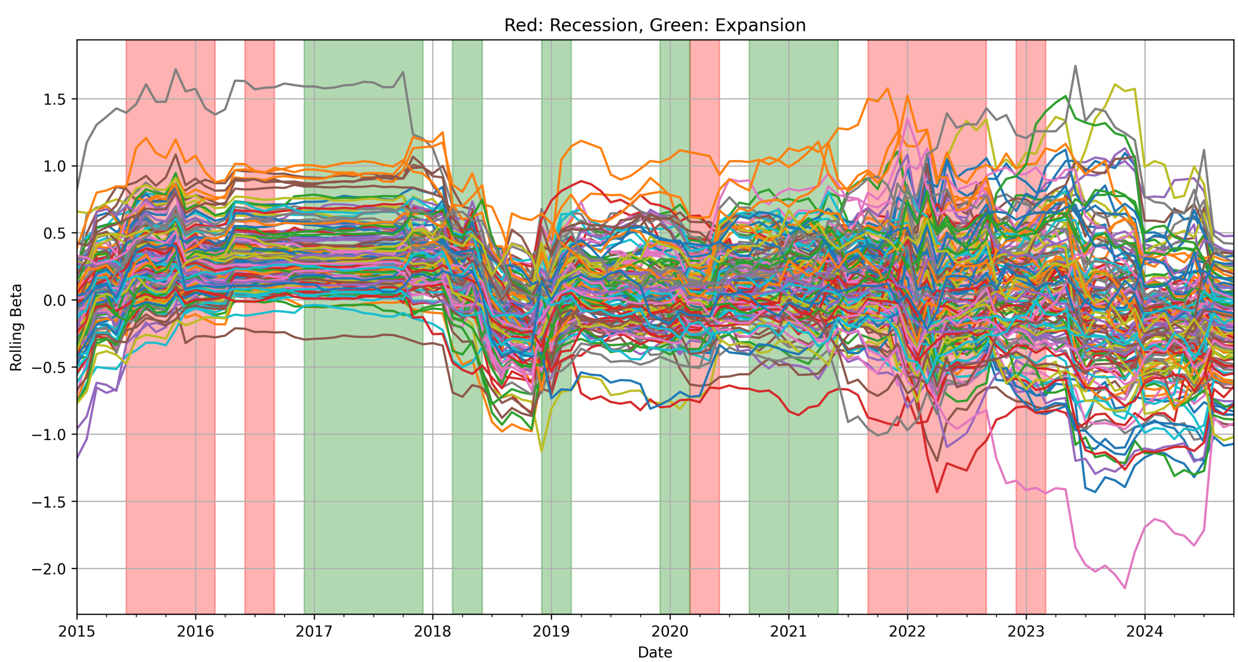

Figure A.4: 3-Year Monthly Rolling Estimated Betas of non-SOEs during Recession and Expansion, measured by the Li Keqiang Index

Table A.2: Regression Results: Pooled OLS with Firm-Level Clustered Standard Errors, using Beta Estimated with a 3-Year Rolling Window

	Dependent variable: beta			
	Model 1	Model 2	Model 3	Model 4
	(1)	(2)	(3)	(4)
Intercept	0.119***	0.214***	0.055*	0.149***
	(0.029)	(0.052)	(0.031)	(0.050)
SOE	-0.039	-0.031	-0.035	-0.026
	(0.035)	(0.027)	(0.038)	(0.028)
recession			0.090***	0.090***
			(0.023)	(0.023)
expansion			0.156***	0.156***
			(0.023)	(0.023)
recession x SOE			0.003	0.003
			(0.028)	(0.028)
expansion x SOE			-0.020	-0.020
			(0.030)	(0.030)
Consumer Staples		-0.256***		-0.256***
		(0.054)		(0.054)
Energy		-0.157***		-0.157***
		(0.049)		(0.049)
Financials		-0.091		-0.091
		(0.058)		(0.058)
Health Care		-0.263***		-0.263***
		(0.071)		(0.071)
Industrials		-0.097*		-0.097*
		(0.050)		(0.050)
Information Technology		0.078		0.078
		(0.060)		(0.060)
Materials		0.026		0.026
		(0.057)		(0.057)
Real Estate		-0.272***		-0.272***
		(0.056)		(0.056)
Utilities		-0.268***		-0.268***
		(0.079)		(0.079)
Observations	4712	4712	4712	4712
R^2	0.003	0.121	0.034	0.152
Adjusted R^2	0.003	0.119	0.033	0.149
Residual Std. Error	0.350 (df=4710)	0.329 (df=4701)	0.344 (df=4706)	0.323 (df=4697)
F Statistic	1.261 (df=1; 4710)	11.246*** (df=10; 4701)	21.603*** (df=5; 4706)	14.713*** (df=14; 4697)

Note: *p<0.1; **p<0.05; ***p<0.01

A.1 GitHub

The following link gives access to the Python code used in the analysis, including graphs and datasets used:

https://github.com/marcotancrediclerici/Thesis-BSc-in-Economics-Tilburg-University-Marco-Tancredi-Clerici