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# **The Impact of Real Estate Prices on China's Financial System Risk**

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## Abstract

This thesis examines the impact mechanism of real estate price fluctuations on China's financial system risk based on the current situation of China's real estate capital market. Against the backdrop of the policy that "housing is for living in, not for speculation," as China's macroeconomic growth gradually decelerates, the supply and demand dynamics in the real estate market have shifted from supply shortages to overall balance or even oversupply in certain regions, making the issue of real estate price bubbles increasingly prominent.

At the theoretical level, this thesis analyzes the relationship between real estate price fluctuations and systemic risk, identifying the transmission channels through which real estate price fluctuations trigger systemic risk. It finds that in the primary real estate capital market, system risk is mainly transmitted through the collateral channel, liquidity channel, and capitalization channel, while in the secondary real estate capital market, transmission occurs primarily through asset securitization. Moreover, under China's institutional conditions, episodes of rising real estate prices are often accompanied by oversupply of new housing, excessive credit expansion into real estate related activities, and speculative purchases, which together magnify the build-up of vulnerabilities. Conversely, when real estate prices decline, these accumulated exposures may trigger loss propagation across the real estate market, the financial system, and multiple sectors of the macroeconomy.

In terms of empirical analysis, this study focuses on the impact of real estate price fluctuations on system risk through the real estate enterprise channel. Based on data from China's listed real estate enterprises, the study analyzes the effects of real estate price fluctuations on corporate solvency, financing capacity, and default probability. The research finds that real estate price fluctuations have a significant asymmetric impact on corporate financing capacity, with the negative impact of declining real estate prices on financing capacity being significantly stronger than the positive impact of rising prices.

The empirical results indicate that system risk exists in China's current real estate capital market, primarily transmitted through the real estate enterprise channel. A substantial decline in real estate prices would cause real estate enterprises to face liquidity risk, which would then be transmitted to the banking sector and adversely

affect the stock market. Specifically: real estate price fluctuations generate liquidity risk for real estate enterprises, and while the impact on long-term solvency is relatively small, it significantly weakens enterprises' short-term solvency; real estate price fluctuations expose banks to liquidity risk through the real estate enterprise channel; an increase in real estate prices followed by a sharp decline creates negative shocks to the stock market.

This thesis provides theoretical foundations and policy recommendations for preventing system risk in China's financial market and promoting stable and healthy development of the real estate market. The research suggests constructing a system risk prevention system from multiple perspectives including real estate enterprises, banks, capital markets, and livelihood security, with particular focus on enterprise liquidity risk management, bank credit risk control, and market information transparency enhancement.

Keywords: Real estate price fluctuations, System risk, China's real estate market, Real estate enterprises

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# **Chapter 1 Introduction**

## **1.1 Background, Significance and Objectives of the Study**

Since the 19th National Congress of the Communist Party of China (CPC) in 2017, the Chinese government has set a core development tone for the country's real estate industry. The Communist Party of China's Report on the 19th National Congress, presented by President Xi Jinping (2017), "We must not forget that housing is for living in, not for speculation. With this in mind, we will move faster to put in place a housing system that ensures supply through multiple sources, provides housing support through multiple channels, and encourages both housing purchase and renting. This will make us better placed to meet the housing needs of all of our people." In 2019, Chinese Premier Li Keqiang (2019) reiterated the importance of addressing housing issues in the Report on the Work of the Government. He emphasized the need for cities to take responsibility for resolving housing problems and for improving the real estate market system and protection mechanisms to promote stable and healthy development of the real estate market. It is well known that the real estate industry and the financial sector have a highly symbiotic relationship, and that the fluctuations of real estate prices have been closely linked to financial instability and economic crises in world history.

With the development of China's capital markets and the deeper integration of Chinese finance into the globalized system, the stability of China's financial system is increasingly under scrutiny. Research on whether systemic financial risks can occur in the Chinese financial system has become a focus of scholarly attention in various countries. Traditionally, asset price fluctuations have been considered one of the key triggers of system risk, and previous studies have focused on system risk arising from fluctuations of general financial assets such as stocks and bonds. In the context of China, "real estate" represents one of the primary assets held by most households throughout their lives. As a result, research on the potential for system risk arising from fluctuations in real estate prices has gradually become an emerging and important perspective for Chinese scholars.

### **1.1.1 Background of the Study**

It is unquestionable that real estate is an essential item for people's productive lives and that its price and economic fundamentals are deeply intertwined in the long

run (Shen, 2004). Real estate is often regarded as a low-risk investment due to its value preservation and appreciation attributes. However, such characteristics can result in blind optimism and over-investment, leading to price bubbles in the real estate market. Given the close connection between the real estate market and the financial market, real estate serves as a significant investment, with fluctuations in real estate prices that can substantially impact the financial market. When real estate price bubbles burst, the financial market can be hugely affected, leading to system risks. In past global financial crises, China's financial system was less affected due to the country's limited capital market openness and underdeveloped domestic financial derivatives and hedging markets relative to Western countries. Nevertheless, China needs to strengthen its financial market system continually, given its relatively underdeveloped financial system and limited capital market openness, to improve its capability to withstand system risks. The banking sector, as the backbone and fundamental safeguard of the financial system, must sustain the financial system's smooth operation. Therefore, preventing system risks in the banking sector is critical to maintaining financial stability.

In 2014, the concept of "system risk" was first mentioned in a Chinese government report. As China's economic development shifts from a stage of high growth to a stage of high-quality development, there is no time to waste in transforming the mode of development, optimizing the economic structure, and shifting growth drivers. In any economy, economic transformation is a difficult stage in the evolution of economic development towards a more advanced form, a more complex division of labor, and a more rational structure. In the process of transformation and upgrading, various types of risks are prone to occur and may be concentrated and released. Therefore, it is the direction of the Chinese government's work to prevent and resolve major risks and to guard the bottom line of no systemic financial risks (Li, 2014). System risk, a hot topic since the global financial crisis in 2008, has received widespread attention in the literature. The Financial Stability Board (FSB), an international organization, has defined "contagiousness" as an important criterion for determining financial system risk (BIS, 2009). Xie Zhigang (2016) likens system risk to a "large-scale contagious disease", i.e., a dynamic process in which the actual operation of the system deviates significantly from its intended operational objectives due to a combination of external and internal causes, and the negative effects are transmitted to a wider area.

According to data from the National Bureau of Statistics of China (2023), over the fifteen-year period from 2000 to 2015, investment in the Chinese real estate market grew at an annual rate of approximately 20%. The total demand for real estate in various cities was huge, providing sufficient momentum for real estate prices to rise and leading to high overall growth rates. As a pillar industry of China's national economy, the real estate sector has driven the growth of consumption and investment among Chinese residents. Over the following five years, from 2015 to 2020, the real estate market remained an important pillar industry in China, although the average growth rate slowed to 7%. The development of China's real estate industry has gone through four main phases. The first stage was the initial development stage from 1978 to 1991, when the formulation and implementation of the Land Law provided the legal basis for real estate development; subsequently, the national housing system reform implemented at the Third Plenary Session of the Eleventh Central Committee laid the foundation for the marketisation of real estate. The second phase was the stable development phase from 1995 to 2003, characterized by rapid development of the real estate industry in China, accompanied by steady growth in market prices and sales volumes, and the termination of the previous welfare housing system further promoted the development of the private residential market. The third phase was the rapid development phase from 2003 to 2014, when the real estate market in a large number of regions became overheated thanks to the appreciation of the RMB, the inflow of international hot money, and speculation by real estate groups. The fourth phase is the gradual cooling phase from 2015 to 2021.

The Chinese real estate market is constantly evolving and displaying risky characteristics such as soaring prices, excessive inventory, substantial leverage, and pronounced financialization. Pronounced financialization refers to a market condition where real estate is increasingly treated as a financial asset for investment and speculation, rather than for its utility as a dwelling. This is characterized by a widespread belief that real estate prices will continue to rise, driving purchasing decisions based on expected capital gains rather than fundamental housing needs. In response, the Chinese government is determined to eliminate the prevalent high-risk practices within the real estate sector, which pose a significant threat to the stability of the country's financial system. To achieve this objective, the government has implemented a series of regulatory policies to exert control over the real estate market. The aim is to systematically mitigate the risks associated with the real estate sector by

adopting firm and stable policies that address broader macro-financial system risks. In addition, the government is attempting to prevent the use of administrative measures to regulate the rise and fall of real estate prices in the future, thereby using the real estate market as a short-term economic stimulus measure. In other words, the Chinese government will no longer stimulate the real estate market to gain more attention through short-term measures such as increasing land supply and lowering real estate loan interest rates. The method often used by the government to intentionally guide real estate prices to rise and drive macroeconomic data growth in the real estate industry will no longer exist. Instead, the real estate market is seen as a stabilizing force that promotes long-term stability and fosters healthy economic development.

Given the Chinese government's commitment to promoting the healthy and stable development of the real estate market, research on the system risks that may arise from fluctuations in real estate prices has become a crucial consideration for Chinese scholars, think tanks, and policymakers. Historical data indicates that the rapid macroeconomic growth witnessed in recent years has provided strong backing for the expansion of China's real estate market. The persistent shortage of supply in the real estate market has contributed to a sustained high level of real estate prices, which experienced continuous and rapid growth until 2010.

Figure 1.1 presents a comparison between the China's 100-City real estate price index and per capita disposable income in China since 2006. The comparison reveals that the trend of real estate price inflation in China corresponds to some extent with the growth of income. Prior to 2010, real estate prices grew significantly faster than disposable income, which to some extent reflected the trend of real estate price bubbles in China. However, since 2010, China's macroeconomic growth has slowed down, resulting in changes in the supply and demand dynamics of the real estate market. Consequently, consumers are becoming increasingly reserved about purchasing real estate, and real estate price growth has also decelerated significantly. This shift in market focus highlights concerns over the real estate market losing its economic fundamentals, leading more and more residents and investors to worry about the presence of a real estate bubble and the likelihood of its bursting.

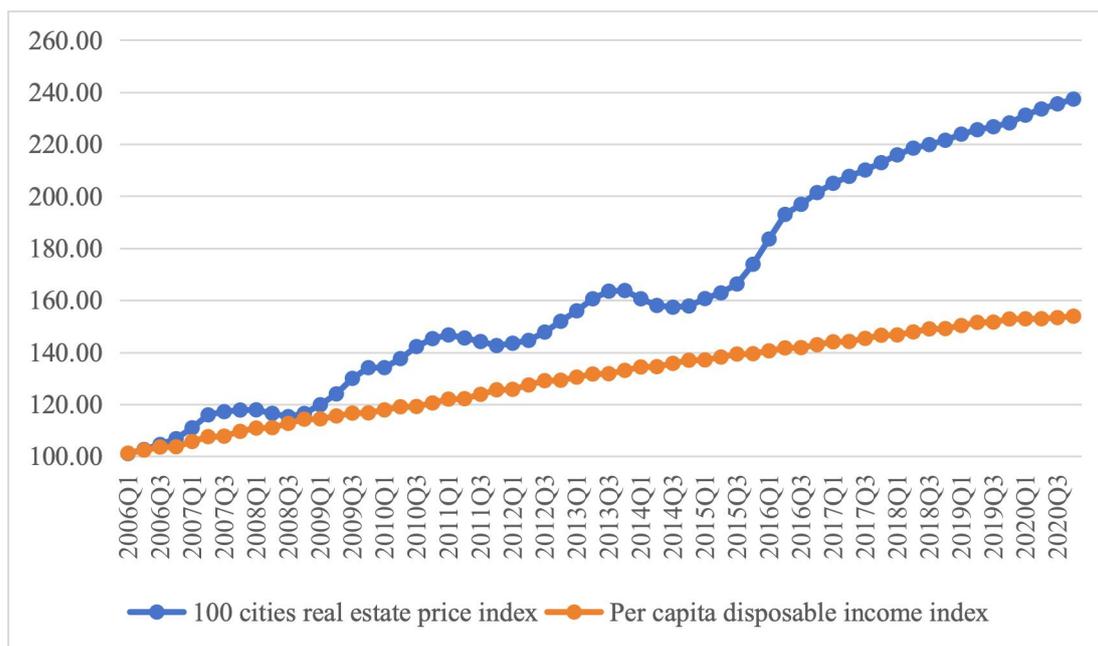


Figure 1.1: China's 100-City real estate price index and China's per capita disposable income index

Data source: Development Research Center of the State Council & Wind Information

Figure 1.2 presents the national house price to annual income ratio in China since 2006. The house price to annual income ratio is a crucial indicator used to assess the state of the Chinese real estate market's affordability. A higher house price to annual income ratio indicates relatively higher real estate prices, making it challenging for residents to afford the cost of ownership in relation to their income levels. This scenario could result in the residents spending more from their income on housing. Conversely, a lower house price to annual income ratio suggests relatively lower real estate prices, enabling residents to afford purchasing homes, thereby lowering the cost of housing. Globally, the house price to annual income ratio ranging from 3-6 is deemed reasonable (Kang, 2018). In China's unique circumstances, scholars consider the range of 6.5-7 to be a reasonable house price to annual income ratio for China (Kuang, 2021). However, despite the temporary decline in the national house price to annual income ratio after 2010, it has remained persistently higher than the reasonable range, indirectly indicating the possibility of a housing bubble in the Chinese real estate market.

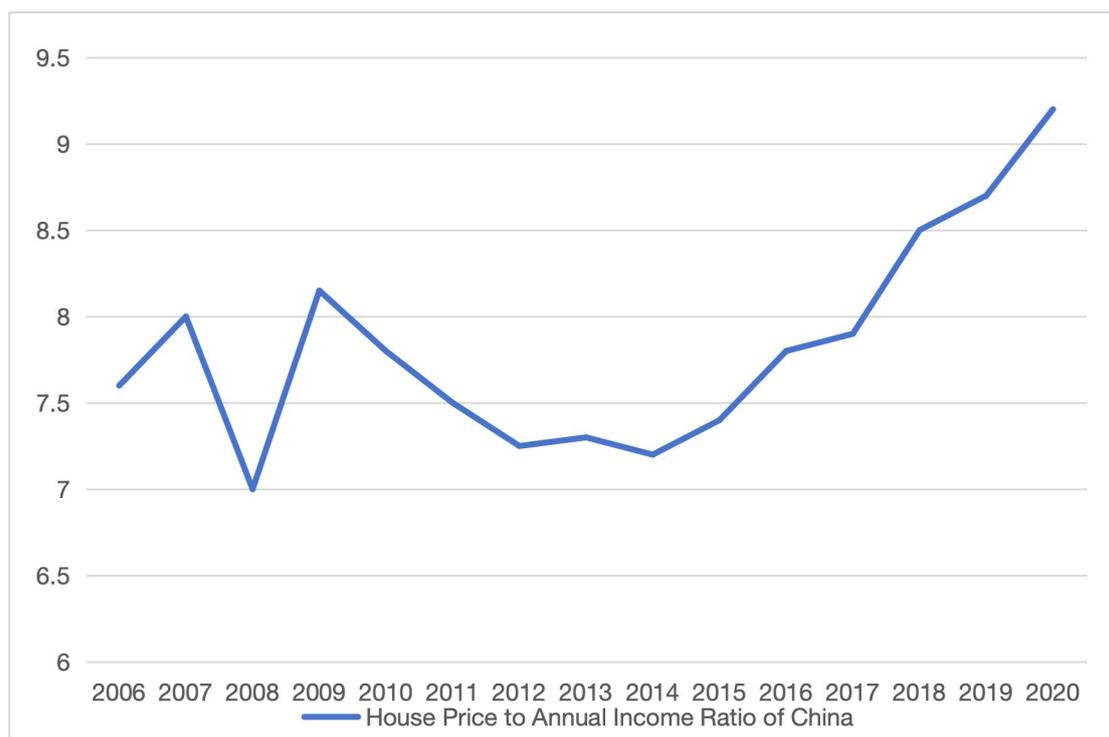


Figure 1.2: 2006-2020 House Price to Annual Income Ratio of China

Data source: China Real Estate Association & Wind Information

The global financial crisis, including the subprime mortgage crisis in the United States since 2008, caused by the problems in the real estate market, particularly the collapse of the real estate bubble, remains vivid and thought-provoking. The bursting of the real estate price bubble will inevitably cause a chain of losses to real estate enterprises, financial institutions, governments, investors, and other participants in the real estate market, including the market for financing real estate. This is one of the main reasons why there is concern about whether fluctuations of real estate prices in China will trigger system risks.

Real estate enterprises are major players in the Chinese real estate and real estate capital markets. However, they are generally characterized by high indebtedness and high inventories, which raises concerns about their solvency and the system risks they might pose if real estate prices were to decline (Liu et al., 2013). In the real estate market, developers are the main suppliers of real estate in China, and their activities are closely tied to the revenues earned from land concessions, which in turn are an important source of fiscal revenue for the Chinese government. In the real estate capital market, developers typically rely on bank loans to finance their operations, and they also receive funds from both homebuyers and lenders. The financial soundness of real estate enterprises is therefore essential for ensuring the safety of bank loans

and the funds invested by mortgage borrowers. Moreover, listed real estate enterprises have a total market capitalization of RMB 1.75 trillion, which accounts for 1.95% of China's A-share stock market and ranks the real estate industry among the top ten industries of China's A-share stock market (Intelligence Research Group, 2022). Real estate enterprises play a crucial role in the linkages between real estate buyers, market participants such as the government, and financial market participants such as banks. For example, among the 116 listed real estate enterprises in Shanghai and Shenzhen, the average book asset-liability ratio in Q3 2021 was as high as 0.68, and the average book value inventory ratio was 0.49 (Zhang et al., 2021). In the face of a market shock, such as falling real estate prices, real estate companies are likely to face solvency issues due to their large inventories. On the one hand, these inventories may lead to direct asset losses, reducing the long-term solvency of the companies. On the other hand, the liquidity of the inventory may pose short-term solvency challenges. Real estate companies in China are well aware of the risks associated with high debt and inventories, and de-inventorying has become the primary business strategy for most real estate firms. However, as the inventory ratio continues to climb, the pressure to reduce inventory and prevent liquidity risk remains high in a changing market environment. Under such circumstances, real estate enterprises may face serious financial crises, and debt and equity investors may suffer significant losses in the event of a significant decline in real estate prices. The community is concerned about the potential system risks that may arise from the solvency issues facing real estate enterprises.

The sound development of real estate enterprises is closely linked with the stability of both the real estate market and the capital market. The relationship between real estate prices and system risks is increasingly gaining attention as an important perspective in academic research on system risks worldwide. Scholars have primarily concentrated on the issue of mortgage defaults by individuals or households that stem from fluctuations in real estate prices, while research on risks associated with development enterprises has been comparatively less developed.

According to traditional research, fluctuations in asset values are considered the most critical triggering event for system risks, and asset prices mainly refer to general financial assets such as stocks (Wei, Chen, & Zhang, 2018). However, the subprime mortgage crisis in the United States made people realize the criticality of fluctuations in real estate prices as a factor triggering system risks. This realization was due to the

inseparable relationship between the financial market and the real estate market. Furthermore, the impact of system risks extends beyond the banking system since it also affects participants in the broader financial market and even the actual economy. In contrast, countries like the United States and other Western nations, primarily focusing on existing properties' transactions, have rapid and mature development of their real estate markets. In such markets, real estate enterprises are not the principal suppliers. Moreover, their advanced financial systems, such as mortgage-backed securities, contribute directly to potential system risks through individual or household mortgage defaults caused by real estate price fluctuations (Geng, 2020).

In contrast to developed Western countries, China's real estate market primarily focuses on new real estate transactions, and real estate enterprises remain significant market suppliers. However, further research is necessary to examine the impact of real estate price fluctuations on real estate enterprises and their potential transmission to the banking sector, which can lead to potential system risks.

### **1.1.2 Research Significance**

Theoretical and practical implications resulting from the possible findings of this study fall primarily into the following areas.

Theoretical significance:

1. This research thesis examines real estate price fluctuations and system risk to measure the presence of a housing bubble in China. It also proposes a risk identification and prediction system specific to Chinese real estate capital markets and examines the transmission channels of system risk that could result from real estate price fluctuations. As a hybrid financial market linking the real estate market and the financial market, system risks stemming from real estate price fluctuations will impact not only financial market participants (such as listed companies, banks, secondary market investors or investment institutions) but also real estate enterprises, the household sector, and government agencies within the real estate market.

2. This thesis has contributed to the research on the relationship between real estate markets and system risk. While previous research focused on the default of loans to the household sector due to real estate price fluctuations and the resulting spread of risk to individual bank loans, this thesis examines the impact of real estate price fluctuations on the banking sector and stock market through the lens of real estate enterprises. Specifically, the thesis explores the effect of real estate enterprise risks that arise from real estate price fluctuations on the banking sector and stock

market.

Practical Significance:

1. The Chinese government recognizes the system risks that come with fluctuations in real estate prices. Conducting research on potential system risks in the current macro-financial system and identifying factors that contribute to these risks will assist the government in promoting stable and healthy economic development, as well as maintaining social stability. This can help government decision-makers gain a better understanding of risk points in the real estate capital market that could trigger system risks, and enable the use of macroeconomic policy tools to implement reasonable regulation and control, ultimately reducing the likelihood of system risks.

2. The research thesis aims to enhance the understanding of real estate enterprises, the banking industry, and the stock market regarding various shocks arising from changes in real estate prices. This study will assist real estate enterprises in improving their scientific approach towards corporate management, while also promoting stability in their bank credit services and the stock market. With China's ongoing efforts to reduce over-reliance on real estate for economic growth and the global macroeconomic slowdown caused by the COVID-19 pandemic, coupled with China's comparatively backward macroeconomic system and relatively unstable financial system, analyzing the impact of price fluctuations on financial institutions in China's real estate market is vital. Such study can provide insights into the relationship between Chinese financial institutions and the stability of the Chinese financial system, and help understand the actual system risks that may arise, which are crucial for deepening the reform of China's macro-financial system and strengthening its stability.

An empirical study on real estate price fluctuations and financial institution risks in China, based on real data, can help clarify the actual impact of price fluctuations on financial institutions in China's real estate market. The findings can aid government departments in optimizing real estate regulation and control policies, as well as enabling more precise regulation of regional real estate prices, in line with the Chinese government's top-level design for real estate policy outlined in "precise policies, one policy for each city" (State Council, 2018). From the perspective of financial system stability, this thesis seeks to refine its policy recommendations, so as to provide more practical ideas for top-level design of financial system reform and supervision. On this basis, policymakers/regulatory authorities can gradually improve

real-estate market price regulation and risk-control measures for financial institutions in a reasonable and targeted manner, so as to promote the stability of China's financial system and to meet the government's top-level design of "holding the bottom line of no systemic financial risk" (Zhou, 2017).

### **1.1.3 Research Objectives**

This study begins with a description of the system risks that can arise from fluctuations in real estate prices and the risk transmission mechanisms and channels in the real estate capital market based on theoretical analysis, taking into account the current macro-political and economic situation in China, as well as the actual situation of the real estate market and the real estate capital market. Subsequently, empirical analysis is conducted to examine the risks faced by real estate enterprises due to fluctuations in real estate prices, and the potential system risks transmitted through the channels of real estate enterprises to financial institutions and the stock market. The ultimate goal is to provide support for participants in the real estate capital market to gain a better understanding of the market laws and make informed investment decisions. Furthermore, this study aims to provide effective suggestions for government regulators to implement policy regulation and risk prevention.

Specific research objectives include:

1. To identify the transmission mechanism of system risk in the real estate capital market, with particular attention given to the system risk characteristics in the real estate capital market.
2. To establish a theoretical model with Chinese characteristics that illustrates the relationship between real estate price fluctuations and system risk, as well as to summarise the transmission channels of system risk that may arise from such fluctuations.
3. To analyze the risks that real estate enterprises face due to real estate price fluctuations, as well as the resulting risks to financial institutions and the potential impact on the stock market. This will serve to determine the possibility of transmitting system risk through these enterprises.
4. Based on the findings derived from both theoretical and empirical analyzes, this study will provide effective recommendations for government regulators on policy regulation and risk prevention, taking into account the government's macro regulatory objective of "safeguarding the bottom line of no systemic financial risk".

### **1.1.4 Research Road Map**

The core research question of this thesis is understanding how fluctuations in real estate prices impact system risk within China's financial system. Specifically, the study aims to explore the potential system risks that may arise from real estate price fluctuations and how these risks can be transmitted through various channels in the financial market, with a particular focus on real estate enterprises.

The research question is closely related to the research objectives in three main aspects: First, identifying transmission mechanisms. This initial objective aims to pinpoint the mechanisms through which system risk is propagated within the real estate capital market, paying special attention to the characteristics of system risks in this sector. This is directly linked to the research question as it seeks to understand how fluctuations in real estate prices can lead to broader financial implications.

Second, establishing a theoretical model. The next goal involves constructing a theoretical model that demonstrates the relationship between real estate price fluctuations and system risk, while also summarizing the channels through which system risk is transmitted. This objective supports the research question by providing a conceptual framework that explains the interactions and impacts observed in the market.

Third, analyzing risks and impacts. The final objective is to analyze the risks posed to real estate enterprises by price fluctuations and the subsequent risks to financial institutions and the potential impacts on the stock market. This is intended to evaluate the practical implications of the theoretical constructs through empirical evidence, thereby addressing the research question.

The research design to achieve these objectives and answer the research question includes: Theoretical Analysis, where the study first conducts a comprehensive theoretical analysis focused on the actual situation of China's real estate and financial markets. This analysis aids in clarifying the transmission mechanisms of system risk within the real estate finance industry, setting the groundwork for identifying potential risk pathways and constructing a theoretical model. This is followed by empirical analysis, which uses empirical research methodologies to examine the effects of real estate price fluctuations on real estate enterprises and, by extension, the financial market. This includes testing the theoretical frameworks and models developed earlier using real data, and analyzing the impact of these fluctuations on the solvency and liquidity of real estate firms and their effects on the banking sector and stock market

through specific channels such as the real estate enterprise channel.

Moreover, the study integrates findings from both theoretical and empirical analyzes to provide comprehensive insights into how real estate price fluctuations impact system risk. This integration is instrumental in making informed recommendations for policy and practice aimed at mitigating the identified risks. Based on the conclusions drawn from the theoretical and empirical analyzes, the study offers policy recommendations. These are designed to assist regulators and policymakers in implementing measures to prevent or reduce the occurrence of system risks identified in the study. By following this structured approach, the thesis aims to comprehensively address the research question, providing both theoretical insight and empirical evidence to understand the complex dynamics at play in China's real estate capital market.

## **1.2 Key Concepts and Scope of Research**

### **1.2.1 Key Concepts**

To facilitate readers' accurate understanding of the concepts expressed in this thesis and to avoid potential misinterpretations, this paper will begin by providing definitions of key concepts that may be used throughout the text.

**Real Estate Finance:** A comprehensive term that encompasses all financing activities related to real estate, including money and credit circulation, mortgages, loans, and other economic activities that involve real estate development, consumption, and market transactions. This includes fundraising, financing, trusts, insurance, and the issuance and circulation of securities. According to Zhang and Yin (2007), modern real estate finance not only includes real estate mortgages in development and consumption, but also extends to supply chain finance, financial leasing, mortgage-backed securities, real estate investment trusts, and other financial instruments that are used in the real estate sector.

**Real Estate Capital Market:** Serves as the platform for real estate finance operation, comprising both primary and secondary markets for real estate finance. This market is composed of market participants, financial intermediaries, and financial instruments. The primary real estate capital market involves borrowers raising funds indirectly via real estate finance intermediaries or directly from the capital market. The secondary market, on the other hand, deals with real estate finance intermediaries securitizing mortgages and selling them to secondary market

institutions or individual investors.

**Real Estate Price Fluctuation:** Refers to changes in the level of real estate prices, which are transaction prices generated by the buying and selling of real estate in the market. Real estate price fluctuation refers to both increases and decreases in real estate asset prices, such as a house selling for \$10,000 per square meter rising to \$11,000 or dropping to \$9,000. The level of real estate prices is often measured through real estate price indices or transaction unit prices. Real estate price fluctuation describes changes in the upward and downward direction of real estate prices. In research, this phenomenon is typically presented as a rate of change in the real estate price index or transaction unit price, or as logarithmic differencing depending on the research objectives (Wu et al., 2007, 2009).

**System risk:** Refers to the potential occurrence of a series of severe adverse shocks to financial institutions, market participants, and financial markets as a whole, triggered by destabilizing events such as adverse market news, the failure of a financial institution, or a sudden market collapse (Kaufman & Scott, 2003). In the context of this study, irrational fluctuations in real estate prices are regarded as such a triggering event. Irrational fluctuations of real estate prices can be understood as a significant deviation of real estate prices from their equilibrium value in the short or medium term, driven by non-fundamental economic factors such as speculation, biased psychological expectations, misinterpretation of policy signals, or institutional deficiencies, which may manifest as either price bubbles or excessive declines (Shiller, 2015). When such fluctuations occur, they may initially cause losses to participants in the real estate capital market; however, their impact can spread beyond this sector, extending to the broader financial system and the macroeconomy.

### **1.2.2 Scope of Research**

This thesis explores the relationship between real estate price fluctuations and system risk, which encompasses two aspects: determining the nature of the risk and discussing its existence. The first aspect involves analyzing whether real estate price fluctuations generate adverse shocks to the real estate capital market and whether such adverse shocks exhibit the basic characteristics of system risk, that is, whether they can be defined as system risk. If it can be defined as system risk, then its transmission mechanism and channels are consistent with its operation. The second aspect involves assessing whether system risk exists in China's current real estate capital market based on the transmission mechanisms and channels of system risk. The first aspect requires

theoretical analysis, while empirical analysis is necessary for examining the second aspect.

The scope of this thesis is not to build a fully specified, mathematically formal theoretical model of the transmission mechanism of system risk caused by real estate price fluctuations. By “formal theoretical model” this thesis refers to a model that explicitly specifies agents, equations and parameters and is able to simulate the dynamic evolution of different transmission channels and compare their relative importance, which is beyond the scope of the present study. Instead, this thesis seeks to establish a conceptual, China-specific analytical framework that links real estate price fluctuations to system risk, with an emphasis on empirical identification of the transmission channels through real estate enterprises. The core objective is to derive testable hypotheses on how fluctuations in real estate prices affect market participants connected to these enterprises, and to use the subsequent empirical analysis to assess whether system risk exists in China’s real estate market and to explore its underlying economic and policy implications.

Although this study's conceptual scope includes both primary and secondary real estate capital markets, the secondary market will only be analyzed in the theoretical analysis section. This decision comes as the secondary market is still in an initial stage of exploration in China and has a relatively small market size.<sup>1</sup> To ensure representative and reliable data, this thesis uses primarily newly constructed commercial real estate prices (China’s 100-City real estate price index). First is that commercial housing is the main trading commodity in the Chinese real estate market, second is newly built commercial housing is highly representative in both value and transaction volume. The empirical study involves analysis across both macro (national) and micro (enterprise) levels. Various authoritative institutions' data, including the National Bureau of Statistics of China, will be used to ensure the availability and reliability of data at the macro-level. As for the micro level, commercial banks listed on the Shanghai and Shenzhen Stock Exchanges and listed companies whose primary business is real estate development (as of 2006) will form the sample of the present

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<sup>1</sup> One of the significant assets in the secondary real estate capital market is mortgage-backed securities products. Since China initiated the pilot program for mortgage-backed securities products in 2005, it successfully issued two mortgage-backed securities products in 2005 and 2007, respectively. However, due to the financial crisis and other reasons, it was not until 2014 that China issued its third mortgage-backed security product. In 2015, China issued 10 such products, followed by 20 in 2016, 19 in 2017, and 54 in 2018 (amounting to only 572.959 billion yuan). In contrast, considering just the new real estate loans in 2018, the amount exceeded 5 trillion yuan. This indicates that China's real estate finance secondary market is still in its early stages of development. As the current regulatory authorities have not yet encouraged the vigorous development of the secondary real estate capital market, it can be referred to as the "initial development stage."

research. In total, 16 listed commercial banks and 106 listed real estate development enterprises are included.

## **1.3 Literature Review**

The core issue of this research is to explore how, in China's unique institutional and market environment, severe fluctuations in real estate prices lead to and transmit systemic financial risk through the key financial node of real estate enterprises. This chapter aims to systematically review, critically evaluate, and logically reconstruct the existing academic literature to clearly outline the current research landscape, identify key knowledge gaps, and, based on this, precisely position the research value and academic contribution of this dissertation.

### **1.3.1 Panoramic View of Existing Research**

#### **1.3.1.1 The Theoretical Cornerstone of Systemic Financial Risk**

System risk is not a new concept, but its connotation and extension have received unprecedented attention and deepening since the 2008 global financial crisis. Although a completely unified definition has not yet been formed in the global academic community, its core idea has been condensed into a consensus. Early research, such as the "Systematic Risk" proposed by Sharpe (1964) in the Capital Asset Pricing Model (CAPM), emphasizes a type of macro risk that cannot be diversified away through asset portfolio diversification and originates from common market factors. This is a "static" risk attribute inherent in the system. However, "system risk" in the modern sense focuses more on its "dynamic" and "contagious" characteristics. De Bandt & Hartmann (2000) and later scholars such as Schwarcz (2008) define it as a risk triggered by an event (such as the collapse of a large institution or violent market turmoil) that is transmitted and amplified through various internal channels of the financial system, and may eventually lead to severe damage to the entire financial service function and have a huge negative impact on the real economy. This concept emphasizes the "domino effect" of risk, that is, how the predicament of a single institution or market evolves into a crisis that affects the entire system.

To understand system risk, we must grasp its sources and transmission mechanisms. The existing literature usually attributes the initial sources of risk to two major categories: one is macro-level shocks, such as sudden changes in interest rates, severe economic cycle fluctuations, or major policy adjustments; the other is

individual-level events, such as the sudden failure of a systemically important financial institution (SIFI) (Bullard et al., 2009). Once the risk is triggered, its transmission path is intricate. The pioneering research of Allen & Gale (2000) revealed that the direct risk exposure (Real/Exposure Channel) formed by the interbank market through the payment and settlement system is a key path for risk contagion. In addition, the informational channel also plays a vital role. The spread of negative news may cause investor panic, leading to bank runs or asset sell-offs, forming a self-fulfilling crisis (Saunders, 1986). Wagner (2010) further systematically summarized a variety of risk transmission mechanisms in the financial system, including direct counterparty risk, interdependence due to common liquidity needs, price spirals caused by asset "fire sales" to cope with liquidity pressure, panic withdrawals caused by information asymmetry (Information Externalities), and the reduction of investors' wealth caused by falling asset prices, which in turn reduces their risk tolerance and triggers a wider range of risk aversion behaviors (Wealth Effect Externalities). These theories together form the cornerstone for our understanding of why the financial system has inherent financial fragility, and also provide a basic analytical framework for us to identify and measure system risk.

#### **1.3.1.2 Asset Price Fluctuations: The Key Trigger of System Risk**

Among the many triggers of system risk, violent fluctuations in asset prices, especially the irrational boom and bust of real estate prices, have been repeatedly proven by theory and history to be the core fuse for igniting large-scale financial crises. Unlike general commodities, assets such as real estate not only have use value, but also carry strong financial attributes. Most notably the fact that housing units frequently serve as collateral for mortgage loans. Because of this collateral role, their price fluctuations are disproportionately amplified through a variety of mechanisms, posing a serious threat to the stability of the financial system.

The "borrowing constraint" or "financial accelerator" mechanism is the core theory for understanding the linkage between asset prices and system risk. The pioneering research of Bernanke & Gertler (1990) and Kiyotaki & Moore (1995) pointed out that the borrowing capacity of enterprises is highly dependent on the value of their collateral. When asset prices such as real estate rise, the net worth of enterprises increases, their collateral capacity is enhanced, and credit constraints are relaxed, so that they can obtain more financing for investment and expansion, which in turn further pushes up asset prices, forming a positive feedback loop of "credit

expansion-asset price rise". However, once asset prices reverse, this process will proceed in the opposite direction at a faster speed. Falling asset prices erode corporate net worth, tighten credit constraints, and force companies to "deleverage" and even sell assets cheaply to repay debts. This collective asset sell-off will further depress market prices, forming a vicious spiral of "credit tightening-asset price decline", amplifying the initial asset price shock into a full-blown credit crisis and economic recession. Korinek's (2011) research further explains this theory, pointing out that during economic booms, due to general optimistic expectations, enterprises tend to over-borrow (Inefficient Credit Boom), accumulating huge financial fragility, which makes the economy extremely sensitive to negative shocks.

The "information and panic contagion" mechanism plays a key role in the system risk caused by asset price fluctuations. The research of Cifuentes et al. (2005) shows that the collapse of real estate prices itself is one of the strongest pieces of negative information in the financial market. It not only directly leads to huge losses in the book wealth of investors holding the asset, but more importantly, it will shake market confidence and trigger general concerns about the solvency of financial institutions holding related assets. Once this concern forms an "information cascade", it may trigger a run on financial institutions, whether it is a run on bank deposits or a request for redemption of funds. This panic behavior is highly contagious, and even healthy institutions may collapse due to liquidity depletion, eventually leading to the collapse of the entire system. The classic model of Diamond & Dybvig (1983) has long revealed the internal logic of bank runs, and the collapse of the real estate market provides the most realistic and violent "trigger" for this panic.

The "agency problem" also exacerbates the risks brought about by asset price fluctuations. Due to the widespread information asymmetry in the financial market, it is often difficult for investors to fully assess the true risks of the assets held by financial institutions. The research of Morris & Shin (2004) found that financial traders face a so-called "loss threshold". Once the loss of the investment portfolio reaches a certain point, they may face the risk of being fired. Therefore, when asset prices begin to fall, in order to avoid touching the "red line" of their personal careers, traders have a strong incentive to sell off risky assets in advance, even if this selling behavior itself is not in the long-term interests of the institution. When traders in the market generally adopt this strategy, the collective selling behavior will artificially create a "liquidity black hole", leading to an excessive decline in asset prices and

disproportionately amplifying the initial shock. Vayanos' (2004) research also shows that a similar logic applies to fund investors. They evaluate the short-term performance of fund managers, which forces fund managers to follow the trend and sell assets when the market is down, thus exacerbating the pro-cyclicality of the market.

The global financial crises have lent empirical support for the aforementioned mechanisms. Whether it was the 1997 Asian financial crisis or the 2008 US subprime mortgage crisis that swept the globe, its roots can be traced back to the irrational boom in the real estate market and the subsequent bubble burst. Demyanyk & Van Hemert (2011) and Pezzuto (2012) among others have clearly depicted the risk transmission chain: starting from the price decline in the US real estate market, it first punctured the bubble of low-quality subprime mortgage loans, leading to large-scale personal defaults; these defaults were transmitted through complex financial derivatives - mortgage-backed securities (MBS) and collateralized debt obligations (CDOs) - spreading the losses from a few lending institutions to global investors, including commercial banks, investment banks, insurance companies, and even pension funds, and ultimately detonating the most serious global financial tsunami since the Great Depression. These painful historical lessons have made "monitoring real estate price fluctuations" a core task for financial regulatory authorities in all countries to prevent system risks.

Recent evidence shows that macroeconomic stimulus not only amplifies asset-price swings via the "financial accelerator," but also significantly distorts credit allocation and reshapes how risk is distributed across sectors. Using China's 2009–2010 stimulus as a quasi-natural experiment, Cong, Gao, Ponticelli, and Yang (2019) find that stimulus-driven credit expansion disproportionately flowed to state-owned enterprises and borrowers with a lower marginal product of capital, reversing the pre-crisis tendency to reallocate credit toward more efficient private firms. This expansion further tilted toward collateral-intensive infrastructure and real estate, pushing up land and housing prices in booms and, in downturns, inducing more fragile balance-sheet contractions and "crowding-out," thereby strengthening the negative feedback from falling prices to financing constraints (Cong et al., 2019). At the same time, structural mapping of China's shadow banking indicates that commercial banks sit at the core of shadow credit intermediation, revealing tight linkages between stimulus, on-balance-sheet bank expansion, and off-balance-sheet

arbitrage—linkages that reinforce the procyclicality of real-estate-related assets (Ehlers, Kong, & Zhu, 2018).

### **1.3.1.3 The Traditional Research Perspective of Real Estate Financial Risk**

Based on the consensus that real estate price fluctuations are a key trigger for system risk, the academic community has conducted a great deal of in-depth research on the transmission mechanism of real estate financial risk. In these studies, a dominant analytical perspective is to focus on the personal housing mortgage loan channel. The logical starting point of this research path is clear and direct: the decline in real estate prices directly affects the balance sheets of every family with a mortgage. When the market price of a property is lower than the remaining loan principal (the so-called "negative equity"), the borrower's motivation and risk of default will increase significantly. This large-scale personal default constitutes the first huge wave of impact on the banking system.

Under this research framework, scholars have conducted detailed distinctions and modeling of personal default behavior. One category is passive default, that is, the borrower is forced to suspend repayment due to loss of repayment ability due to external shocks such as unemployment and sharp income reduction. The other category is strategic default, that is, although the borrower still has the ability to repay, he chooses to actively give up the property and stop repayment from a purely economic and rational point of view, because the economic loss of continuing to repay has exceeded the cost of default. Option theory is widely used to explain strategic default behavior (Titman & Torous, 1989). This theory regards a home mortgage as a put option held by the borrower: when the value of the property is higher than the loan balance, the borrower will choose to continue to "hold" the property (that is, repay on time); and when the value of the property falls below the loan balance, default is equivalent to "exercising" the right to sell the property at the exercise price of the loan balance, thereby limiting the loss to the down payment and partial repayment already paid. Therefore, the decline in real estate prices will directly increase the intrinsic value of this "option", thereby increasing the probability of strategic default.

A large number of empirical studies have provided strong support for this theory. From Wilson's (1995) analysis of California credit data, to Deng et al. (1996) and Downing et al. (2005) based on Freddie Mac's million-level borrower sample research, and then to Bajari et al. (2008) and Capozza & Van Order (2011) on the analysis of

loan data on the eve of the subprime mortgage crisis, these studies have consistently found that there is a significant and robust negative correlation between the decline in real estate prices and the default rate of personal housing loans. Building on this line of evidence, Damianov, Wang, and Yan (2025) show for U.S. metropolitan areas that house price shocks translate more strongly into mortgage defaults in non-recourse markets, where strategic default is easier, thereby confirming that the “price-default” link is robust but institutionally heterogeneous. Campbell & Cocco's (2011) research also found that the design of floating-rate loans will further amplify the impact of falling housing prices on default risk. These studies have clearly revealed the risk transmission chain from "falling housing prices" to "personal default" and then to "bank credit losses".

When the risk is transmitted to the banking system, its impact is not limited to direct credit losses. The surge in personal defaults will force banks to tighten the approval standards for new mortgage loans and increase loan interest rates, thereby inhibiting new housing demand, which in turn will bring further downward pressure on the real estate market, forming a negative feedback. At the same time, the deterioration of the bank's balance sheet will weaken its overall credit supply capacity, affecting financing for other sectors of the real economy, thereby spreading the local crisis in the real estate market into a comprehensive credit crunch.

In addition, in economies with more developed financial markets, the transmission of risk will not stop at the bank's balance sheet. Personal housing mortgage loans are packaged into financial products such as MBS through securitization and sold to a wider range of investors. This process can theoretically disperse risks, but the lesson of the subprime mortgage crisis is that when the underlying assets (that is, housing loans) have systemic and large-scale defaults, securitization has instead become a "super amplifier" and "super highway" for risks. The research of Hellwig (2009) and Sornette & Woodard (2010) and other scholars has profoundly revealed how complex derivatives such as MBS and CDOs, in the context of information asymmetry and the dereliction of duty of rating agencies, package, hide, and transfer the risks of underlying loans layer by layer, and finally detonate the entire financial system when the real estate bubble bursts. Therefore, the research on the secondary market of real estate finance constitutes another important component of understanding risk transmission from a traditional perspective.

Chinese scholars have also made active explorations in this field. Although for a

long time in the past, the continuous rise of real estate prices in China has made strategic default cases relatively rare, researchers have still identified a variety of factors affecting personal mortgage default through the analysis of bank micro-data, such as income-to-mortgage ratio, job stability, borrower characteristics, etc. (Qian et al., 2010; Ma, 2009). In recent years, with the adjustment of the real estate market in some cities, the research of scholars such as Kuang (2014) has begun to confirm that even in China, the expectation of falling real estate prices and the actual callback that has occurred have begun to have a significant impact on the default rate of personal housing loans, and the risk of strategic default is gradually emerging. These research results together constitute the traditional cognitive basis for our understanding of China's real estate financial risks.

#### **1.3.1.4 Updated Evidence on System Risk Channels**

Recent China-specific evidence shows a tight co-movement between asset-price bubbles and system risk across financial institutions. Using institution-level data, systemic contributions and comovements increase when bubble indicators rise, directly linking asset-price misalignments to system-level externalities in the Chinese context and reinforcing the “financial accelerator—asset prices—credit constraints” channel discussed earlier (Zhang, Wei, Lee, & Tian, 2023).

Complementing this, new research articles pronounced pro-cyclicality of leverage within China’s financial system: complementing this, new research articles have documented the pro-cyclicality of leverage within China’s financial system: during real-estate upswings, bank credit tends to expand, and this pro-cyclical credit behavior pushes up institutional leverage and system risk; during downturns, deleveraging and asset fire sales generate negative feedback loops (Cincinelli, Pellini, & Urga, 2021). This dovetails with the mechanism of “price declines—tightening financing—further contraction” and bridges micro-institutional behavior with system-wide amplification.

On the industry side, potential structural turning points in housing supply/production may alter cycle features and exposure paths. Evidence suggests China’s residential starts and completions may be near a plateau/peak, undermining the old equilibrium of “high growth—high turnover—high leverage” and stress-testing the tight links among developers, local public finance, and bank credit under a low-growth/de-inventory regime (Rogoff & Yang, 2021). This aligns with China-specific view that developers are pivotal nodes: when sales cash flows slow

and inventories compress margins, developers' cash-flow and refinancing capacity become key amplifiers.

Evidence from the banking system is consistent: shocks in the real estate market spill over into banking system risk, with effects that are stronger during downturns (Fang, Jin, & Ma, 2021). Combined with leverage pro-cyclicality and bubble dynamics, this implies a developer-centered transmission chain in which declines in housing prices and sales reduce developers' cash flows, which in turn tighten credit supply and increase system risk in the banking sector. This is fully consistent with the multi-channel contagion and amplification perspective outlined in Section 1.3.2 (Fang et al., 2021).

### **1.3.2 The Limitations of Existing Research and the Research Gaps in the Chinese Context**

Although the rich literature mentioned above provides a solid theoretical cornerstone and valuable empirical evidence for our understanding of the relationship between real estate price fluctuations and systemic financial risk, its limitations become immediately apparent when we try to directly apply these classic analytical frameworks to contemporary China. The vast majority of existing research, whether theoretical models or empirical paradigms, is rooted in the mature market economies of the West, represented by the United States. In these markets, the real estate industry is dominated by existing home sales, and the financial system is characterized by developed capital markets and a complete securitization chain. However, China's real estate market and financial system present completely different "Chinese characteristics" in terms of development stage, structural features, institutional environment, and the relationship between the government and the market (Herring & Wachter, 1999; Hilbers, Lei, & Stausholm Zacho, 2001; Ehlers, Kong, & Zhu, 2018; Fang, Jin, & Ma, 2021). Therefore, the existing research paradigm inevitably has systematic "cognitive blind spots" and "explanatory gaps" when explaining Chinese problems. This study believes that these research gaps are mainly reflected in the following three interrelated aspects:

#### **1.3.2.1 The Systemic Neglect of the Core Node of Real Estate Development Enterprises**

The focus of the existing literature on real-estate financial risk is almost entirely on the credit chain of "homebuyers – personal mortgage loans – banks". This research

preference is rational in Western housing markets, because in those markets second-hand (existing) homes account for the overwhelming majority of transactions—typically around 80–90% in the United States, while new homes represent only about 10–15% (National Association of Realtors, 2025; U.S. Census Bureau & U.S. Department of Housing and Urban Development, 2025). In parts of Europe the dominance of the secondary market is even clearer; for example, Finland reports only a very small share of transactions in newly built dwellings compared with old dwellings (Statistics Finland, 2025). By contrast, China’s residential market has long been led by primary/new-home sales; even after the recent downturn, national and industry data indicate that new homes still make up roughly two-thirds of transactions, with the secondary market catching up mainly in large cities (Cushman & Wakefield, 2025; S&P Global Ratings, 2025; Yicai Global, 2025). Therefore, transplanting the Western “mortgage-to-banks” perspective to China without adaptation will seriously underestimate, or even ignore, the more critical and systemically important node in China’s risk-transmission mechanism—real estate enterprises.

Unlike Western markets, China's real estate market has been a typical "increment-led" or "new-home-driven" market in the past two decades. Under this structure, real estate enterprises (hereinafter referred to as "real estate enterprises") are far from simple house producers; they actually play the role of a "financial hub" for the entire real estate financial ecosystem. First, in terms of scale, real estate enterprises are one of the largest credit demanders in the real estate economy. According to the latest data from the People's Bank of China and the National Bureau of Statistics, as of the end of 2023, China's real estate loan balance was as high as 52.3 trillion yuan, of which the real estate development loan balance was 12.9 trillion yuan. Real estate enterprises not only obtain huge development loans from commercial banks, but are also the most important fund clients of the "shadow banking" system such as trust companies and securities companies' asset management plans. (Allen, Gu, Li, Qian, & Qian, 2023) Second, real estate enterprises are the key point connecting the financial system and land finance. They obtain land from local governments through the "bidding, auction, and listing" market, and the huge land transfer fees they pay are an important source of local government fiscal revenue and infrastructure construction investment, forming a tight bundle of "land-credit-investment". Third, real estate enterprises have also deeply involved

downstream homebuyers in their financing cycle through the pre-sale system. A considerable part of the down payment and personal mortgage loans paid by homebuyers become the cash flow for real estate enterprises to maintain their high-turnover model before the houses are completed and delivered. Finally, real estate enterprises have formed intricate connections with the capital market and a wide range of investors by issuing stocks, bonds, and complex equity and debt financing structures.

This unique "central-radial" structure means that the financial health of real estate enterprises has a "pull one hair and move the whole body" effect on the stability of the entire financial system. The fluctuation of real estate prices first impacts not the thousands of scattered individual homebuyers, but the balance sheets of a few but large-scale real estate enterprises. The decline in housing prices directly leads to the shrinkage of the value of real estate enterprises' inventory (unsold houses and projects under construction) and a sharp decrease in sales collections, which will quickly trigger a liquidity crisis and solvency crisis under their high-leverage operating model. Once a large real estate enterprise defaults on its debt, its risks will be systematically and explosively transmitted to the entire financial system and social wealth through the above-mentioned multiple channels - bank development loans, non-standard financing, supply chain arrears, pre-sale fund chains, and capital market cross-defaults. Therefore, any research that attempts to comprehensively assess China's real estate financial risks will be putting the cart before the horse if it cannot place real estate enterprises at the core of the analysis and only stays at the analysis of personal mortgage loan risks, and its conclusions will inevitably be one-sided and incomplete.

#### **1.3.2.2 Insufficient Characterization of the Risk Transmission Mechanism with Chinese Characteristics**

Closely related to the systematic neglect of real estate enterprises, the existing literature's characterization of the risk transmission mechanism has also failed to fully reflect China's institutional and market realities. The transmission models based on the experience of Western markets, such as the classic interbank contagion model or the MBS risk diffusion model, cannot effectively capture and explain how risks are transmitted and amplified through a series of unique channels with strong institutional imprints in the "real estate enterprise-centric" model in China (Saunders, 1986; Freixas, Parigi, & Rochet, 2000; Gai, Kapadia, Millard, & Perez, 2008; Schwarcz, 2008; Wagner, 2010; Tao & Zhu, 2018). Specifically, these neglected transmission channels with "Chinese characteristics" include:

(1) Land Finance and the Implicit Guarantee of Local Governments: Real estate enterprises have formed a deep interest bundle with local governments through high-priced land acquisition. In the boom period of the market, this model supported the rapid growth of the local economy; but in the downturn of the market, the difficulties of real estate enterprises will directly impact the fiscal revenue of local governments, weaken their debt repayment ability, and may even trigger local government debt risks. Conversely, the market's expectation of local government bailouts of real estate enterprises may distort risk pricing for a certain period of time, leading to the accumulation of moral hazard (Gu & Zhu, 2023; Guo, 2013; State Council, 2018; Zhu & Xu, 2011; Zou, Yuan, & Tong, 2015).

(2) The Complex Network of Shadow Banking and Non-standard Financing: In order to circumvent traditional credit scale and regulatory constraints, a large amount of funds has flowed into the real estate industry through trust plans, asset management products, and other forms. These non-standard financing chains are long, structurally complex, and have low transparency, making it difficult to accurately identify the true scale of the risk and the ultimate bearer. When a real estate enterprise has problems, the risk will be transmitted along these hidden pipelines in an unexpected way, impacting the off-balance-sheet assets of banks, high-net-worth individual investors, and even the entire wealth management industry (Ehlers, Kong, & Zhu, 2018; Guo & Zhao, 2017; Niu, 2014; Shen, Cao, & Li, 2018).

Recent causal studies identify deposit competition triggered by fiscal stimulus as an important starting point for the expansion of shadow banking: large state-owned banks, tasked with rapidly scaling credit in support of stimulus, faced loan-to-deposit ratio constraints and regulated deposit-rate ceilings and thus competed more aggressively for deposits; banks with greater branch-network overlap found it harder to retain funding and turned to issuing short-maturity, deposit-like wealth management products (WMPs) to ease funding pressures (Acharya, Qian, Su, & Yang, 2024). This mechanism, on the one hand, circumvents on-balance-sheet regulation through WMP–trust nesting and levered allocations into long-duration infrastructure and real-estate projects; on the other hand, its short-maturity rollover structure accumulates refinancing risk, which manifests under liquidity stress as rising new-issue WMP yields, higher interbank funding costs, and stock-price pressure for WMP-issuing banks (Acharya et al., 2020). Complementary evidence on trust products shows that “implicit guarantees” are a key institutional underpinning that

allowed shadow banking to scale up risky asset allocations (including property projects) to retail and institutional investors, weakening investor discipline and, under stress, amplifying par-redemption expectations and moral hazard (Allen et al., 2023). This “stimulus → deposit competition → shadow banking → property financing → rollover risk” chain is a China-specific cross-market risk transmission channel with property developers as core nodes.

(3) Risk Transfer in Supply Chain Finance: Real estate enterprises generally adopt a high-leverage, high-turnover model, transferring a large amount of construction costs and risks to upstream suppliers such as construction and building materials through commercial acceptance bills, accounts payable, and other forms. Many of these suppliers are small and medium-sized enterprises, and their dependence on real estate enterprises is extremely high. Once the capital chain of a real estate enterprise breaks, it will trigger a large-scale supply chain "chain debt" crisis, and the risk will spill over from the financial field to the production end of the real economy (Liu, Jiang, & Wu, 2013; Zhang, Zhang, Xu, & Cheng, 2021; Qi, 2012).

(4) The Game of the Pre-sale Fund Supervision System: China's commercial housing pre-sale system allows real estate enterprises to obtain sales funds before the completion of the house, which also contains huge risks while accelerating the construction cycle. Although pre-sale fund supervision accounts are set up in various places, in actual implementation, the effectiveness of supervision, the risk of misappropriation of funds, and the ultimate responsibility for "guaranteeing the delivery of buildings" have all become the focus of a complex game among real estate enterprises, banks, governments, and homebuyers. Once a real estate enterprise fails to deliver on time, it will cause serious social problems and pose a direct threat to the credit quality of banks' personal mortgage loans (Geng, 2020; Qi, 2012; State Council, 2018; Zhou, 2017).

These unique transmission mechanisms are intertwined, forming a more complex and closely related risk network than in Western markets. The existing literature lacks a systematic theoretical summary and empirical test of this, which makes our understanding of the true picture and evolution path of China's real estate financial risks still at a relatively superficial and scattered state (Tao & Zhu, 2018; Zhao, Li, & Feng, 2019; Zhang, Wei, Lee, & Tian, 2023).

### **1.3.2.3 Lack of Unified Empirical Evaluation Framework Integrating Multiple Participants**

At the empirical research level, the existing literature also presents obvious

"fragmentation" characteristics. Some studies focus on the banking system, assessing system risk by constructing a risk contagion network among banks or conducting macro-stress tests, but their characterization of the initial impact of the risk - that is, the risk status of real estate enterprises - is often oversimplified. Another part of the research focuses on the corporate level, analyzing the impact of housing price fluctuations on the financial indicators of real estate enterprises (such as default probability, profitability), but rarely directly linking it to the system risk of the financial system in a quantitative way. There are also some studies from the perspective of macro-prudential, but their models are often highly aggregated and difficult to reveal the micro-level risk interaction and transmission path between different market participants (Tao & Zhu, 2018; Zhao, Li, & Feng, 2019; Rodríguez-Moreno & Peña, 2013; Wagner, 2010).

This division in research has led to the fact that we still lack an empirical evaluation system that can endogenously include multiple key subjects such as real estate enterprises, commercial banks, shadow banks, homebuyers, investors, and regulatory policies and their interactions in a unified framework. We may know the "average" impact of falling housing prices on the non-performing loan ratio of banks, or the "average" impact on the default risk of real estate enterprises, but we do not know how the risk is transmitted from "a certain" systemically important real estate enterprise, through "several" specific transmission channels, and ultimately affects the stability of "several other" systemically important banks and the entire financial market. We cannot accurately compare the relative importance of different transmission channels, nor can we dynamically simulate the evolution path of the entire risk network under different policy interventions (Freixas, Parigi, & Rochet, 2000; Gai et al., 2008; Guo & Zhao, 2017; Liang & Guo, 2017).

This lack of an evaluation framework has greatly limited the policy relevance of the research. Regulators need to know precisely where the concentration of risk is (which institutions are systemically important nodes), what the most vulnerable link is (which channels are the main paths for risk transmission), and what kind of "scalpel-style" intervention measures should be taken in a crisis to block the contagion chain, rather than just getting a vague early warning at the macro level. Therefore, constructing a unified empirical evaluation framework that integrates multiple participants and characterizes multiple transmission channels is a bottleneck that current research urgently needs to break through (Schinasi, 2004; State Council,

2018; Zhou, 2017).

Notably, recent China-based evidence begins to ease the above fragmentation. The documented links between asset-price bubbles and system risk (Zhang et al., 2023) and the pro-cyclicality of leverage (Cincinelli et al., 2021) supply operational dimensions for unifying real-estate prices, developer balance sheets, and intermediary risk within a single evaluation framework. Meanwhile, the spillover from real estate to bank system risk (Fang et al., 2021) motivates a joint empirical design that models developers, banks, and market prices together (Zhang, Wei, Lee, & Tian, 2023; Gu & Zhu, 2023; Qi, 2012; Zhao, Li, & Feng, 2019).

### **1.3.3 Research Contributions and Innovations**

Facing the aforementioned research gaps, the core mission of this dissertation is to construct a more realistic and explanatory analytical framework through the close integration of theory and empirics, in order to systematically reveal the internal mechanism and evolution path of how real estate price fluctuations trigger and transmit systemic financial risk through the core node of real estate enterprises in China's unique market and institutional environment. The contributions and innovations of this research will be clearly presented through the following two levels of progressive exploration:

(1) Theoretical Contribution: Constructing and elaborating a theoretical framework for system risk transmission with real estate enterprises as the core node. The primary innovation of this research lies in fundamentally reconstructing the theoretical perspective of risk transmission, pushing the long-neglected "real estate enterprises" from the periphery of analysis to the center. We no longer regard real estate enterprises merely as passive price takers or simple credit demanders, but precisely position them as a "Risk Hub" connecting the real estate market, credit market, capital market, and the upstream and downstream of the real economy. Based on this positioning, this dissertation constructs a new theoretical framework for system risk transmission. This framework clearly identifies and elaborates on how, in China's specific institutional context, the shock wave of real estate prices first acts on the balance sheets of real estate enterprises, and then radiates outward through a series of interrelated channels. These channels primarily include: Balance Sheet Channel: The decline in housing prices directly erodes the inventory value and net asset value of real estate developers, triggering the "financial accelerator" effect and leading to a sharp deterioration in their financing capacity. Cash Flow Channel: The sharp decline

in sales collections and the depletion of external financing form a "double kill", directly impacting the operating cash flow of real estate enterprises and triggering a liquidity crisis. Bank Credit Channel: The difficulties of real estate enterprises are directly transformed into bank credit losses and an increase in risk-weighted assets through corporate businesses such as development loans and M&A loans, weakening the capital adequacy ratio and credit expansion capacity of banks.

Through the systematic integration of these core channels, this research aims to provide a fundamental supplement and correction to the existing transmission theory centered on individual loans, and to construct a "Chinese version" of the transmission theory that can better explain the full picture of China's real estate financial risks.

(2) Empirical Contribution: Empirical testing based on Chinese data, quantifying the impact of key transmission channels. The vitality of a theory lies in its being tested empirically. The second major contribution of this research is to subject the above theoretical framework to rigorous empirical testing and to quantitatively evaluate the relative importance of key transmission channels. We refuse to stay at the level of qualitative description and logical deduction, but are committed to providing empirical evidence that "speaks with data".

To this end, this research constructs a large panel database covering listed real estate enterprises, listed commercial banks, and related macro and market variables in China. On this basis, we comprehensively employ diversified econometric models, particularly static and dynamic panel data models, and introduce asymmetric effect models to capture the differences in impact during periods of price increases and decreases. These empirical findings based on Chinese local data will provide unprecedented micro-insights for understanding the generation and diffusion paths of risks, providing solid evidence support for macro-prudential supervision.

Based on theoretical reconstruction and empirical findings, the ultimate focus of this research, and also its most policy-valuable contribution, lies in providing solid micro-evidence and more targeted operational recommendations for China's real estate financial risk macro-prudential supervision system. This research no longer pursues the construction of a comprehensive but potentially impractical macro-assessment model, but instead focuses on how to transform empirical conclusions into feasible regulatory wisdom. The core policy implications of the research are reflected in:

(1) Identifying systemically important key nodes. The research clearly

demonstrates that real estate enterprises, particularly those large-scale, highly leveraged enterprises with deep connections to the financial system, are amplifiers and core transmission nodes of system risk. This provides clear identification criteria for regulatory authorities to implement differentiated, key-focused macro-prudential management, namely that regulatory resources should be primarily directed toward these systemically important real estate enterprises.

(2) Clarifying key risk monitoring indicators. The research quantifies the asymmetric impact of housing price fluctuations on developers' core financial indicators (such as short-term debt-paying capacity and financing ability). This suggests that regulatory authorities, when constructing risk early warning systems, should more proactively incorporate developers' inventory value ratios, quick ratios, and long-short term debt structures into core monitoring ranges beyond traditional lagging indicators such as banks' non-performing loan ratios, and closely monitor their marginal changes during housing price downward cycles.

(3) Providing decision support for precise policy implementation. The research reveals the heterogeneity of risk exposure among enterprises of different scales and ownership types when responding to housing price shocks. For example, non-state-owned enterprises have greater risk exposure during market downturns. These findings provide micro-level decision-making basis for the central government's proposed "city-specific policies" and "enterprise-specific policies" and other precise regulation guidelines. The design of regulatory policies should fully consider such structural differences to avoid potential collateral damage from "one-size-fits-all" regulation.

### **1.3.4 Summary of literature Review**

In summary, by focusing research attention at the enterprise level and conducting quantitative testing of key risk transmission channels, the ultimate outcome of this dissertation is not a comprehensive predictive model, but rather providing regulators with a more refined and operational set of "diagnostic tools" and "policy dashboards", thereby contributing solid academic research strength to the core policy objective of "maintaining the bottom line of preventing systemic financial risks".

Building on recent Chinese and China-related empirical studies that identify asset-price bubbles, leverage pro-cyclicality, and real-estate-to-bank spillovers as key channels of system risk transmission (Zhang et al., 2023; Cincinelli et al., 2021; Fang et al., 2021), this thesis extends their analysis by foregrounding real estate enterprises

as the pivotal nodes through which these channels interact and amplify. At the same time, structural signals that housing production in China may be peaking (Rogoff & Yang, 2021) imply that these risks could become more persistent under a low-growth or deleveraging regime, which further reinforces the need for targeted, differentiated oversight of developers.

## **1.4 Research Methodology and Implementation Pathway**

### **1.4.1 Research Methodology & Empirical Analysis Data**

The methodology of this thesis is designed to investigate how fluctuations in real estate prices may generate system risk through three key channels: real estate enterprises, the banking system, and the capital market. To ensure both rigor and coherence, the research design proceeds step by step from data construction and indicator adjustment to channel-specific econometric analysis. The methodological framework introduced here is further elaborated in detail in Chapters 3–5. The empirical analysis draws on a multi-source dataset covering the period from the third quarter of 2006 to the fourth quarter of 2020. Three categories of data are employed. First, firm-level data are collected for 106 A-share listed real estate enterprises, including indicators such as total assets, total liabilities, inventories, pre-sales, operating income, asset-liability ratio, quick ratio, long-term debt ratio, and net leverage ratio. These data are primarily obtained from annual reports and financial statements disclosed by listed companies, and cross-checked with the Wind Information database to ensure reliability.

Second, institution-level data are drawn from 16 A-share listed commercial banks, covering indicators such as total assets, asset–liability ratio, operating expenses, balances of total loans, real-estate-development loans and mortgage loans, multi-period loan rates, capital-adequacy ratio, and deposit-to-loan ratio. The data are obtained from the CBIRC and the Wind database. In all subsequent chapters, whenever “bank-level” or “panel” regressions are reported, the unit of observation is these 16 listed banks, observed at quarterly frequency from 2006Q3 to 2020Q4. They are used because they disclose standardized, audited, and comparable statements, and they represent the most systemically important and data-transparent part of China’s banking sector. By contrast, when the thesis reports “national-level” results for the banking sector, the observations are quarterly aggregates for the whole industry, not individual banks. This distinction ensures that the enterprise–bank transmission

channel can be examined on a consistent micro panel, while the macro risk implications are evaluated on aggregate data.

Third, macroeconomic and market-level indicators are included, with housing price indices obtained from the National Bureau of Statistics of China and the China Index Academy's 100-City Residential Price Index (REPI)<sup>2</sup>, which serves as the primary measure of housing price dynamics. This index, updated monthly, covers a wide range of property types and cities, ensuring representativeness and timeliness. In addition, capital market data such as stock returns, bond yields, and excess return indicators are drawn from the Wind and CSMAR databases. These "head-institution" samples, represented by listed enterprises and listed banks, are chosen for their representativeness, disclosure quality, and broad coverage, enabling the analysis to capture systemic linkages between real estate price fluctuations, real estate developers, financial institutions, and capital markets. In other words, listed entities are adopted because their disclosures are standardized, audited, and comparable, enabling consistent construction of firm and bank-level panels; moreover, these "head-institution" samples command large market shares and broad coverage, enhancing the representativeness and external validity of our findings.

Before conducting empirical estimation, essential adjustments are applied to firm-level financial indicators to address distortions caused by accounting standards, such as the principle of lower of cost or net realizable value, and the widespread pre-sale policy in China's housing market. Specifically, inventories are adjusted by excluding pre-sold properties and revalued according to the housing price index to reflect changes in fair value during the holding period. Total assets are then recalculated by replacing book inventories with these adjusted values. Based on these corrections, new measures of actual asset-liability ratio, inventory ratio, and quick ratio are constructed. These refinements ensure that the empirical models capture firms' real exposure to housing price fluctuations rather than accounting artifacts.

The empirical strategy proceeds in three stages, corresponding to the three transmission channels of system risk. Chapter 3 focuses on the real estate enterprise channel, where panel data models are estimated to examine firms' long-term solvency (proxied by the adjusted asset-liability ratio), short-term solvency (proxied by the

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<sup>2</sup> The thesis adopts the China's 100-City real estate price index instead of indicators from NBSC, MSCI, or OECD because this index best reflects the actual market environment faced by Chinese real estate developers, while maintaining stable statistical standards and good data availability. The index is nominal and not adjusted for inflation; the thesis accounts for real effects by correcting firms' financial data into "real values," rather than adjusting at the housing price index level. (Shen et al., 2018)

quick ratio net of illiquid inventories), and financing capacity (measured by the long-term debt ratio). Both static and dynamic panel estimations are employed, with further tests conducted for asymmetry and heterogeneity by firm size and ownership structure. Chapter 4 then turns to the banking channel, investigating how housing price fluctuations affect banks' loan exposures, credit quality, and capital adequacy, using both national-level aggregate data and bank-level panel data. Chapter 5 addresses the capital market channel, examining how price shocks in the real estate sector transmit to system risk in capital markets, focusing on stock returns, bond spreads, and market volatility of listed real estate firms.

The implementation pathway of this thesis can be characterized as a three-step process: the construction of corrected financial indicators and a multi-source dataset; channel-specific econometric analysis of solvency, liquidity, financing, and market risk transmission; and the integration of results across the enterprise, banking, and capital market channels to provide a comprehensive understanding of how real estate price fluctuations generate system risk in the Chinese financial system.

## 1.4.2 Research Implementation Pathway

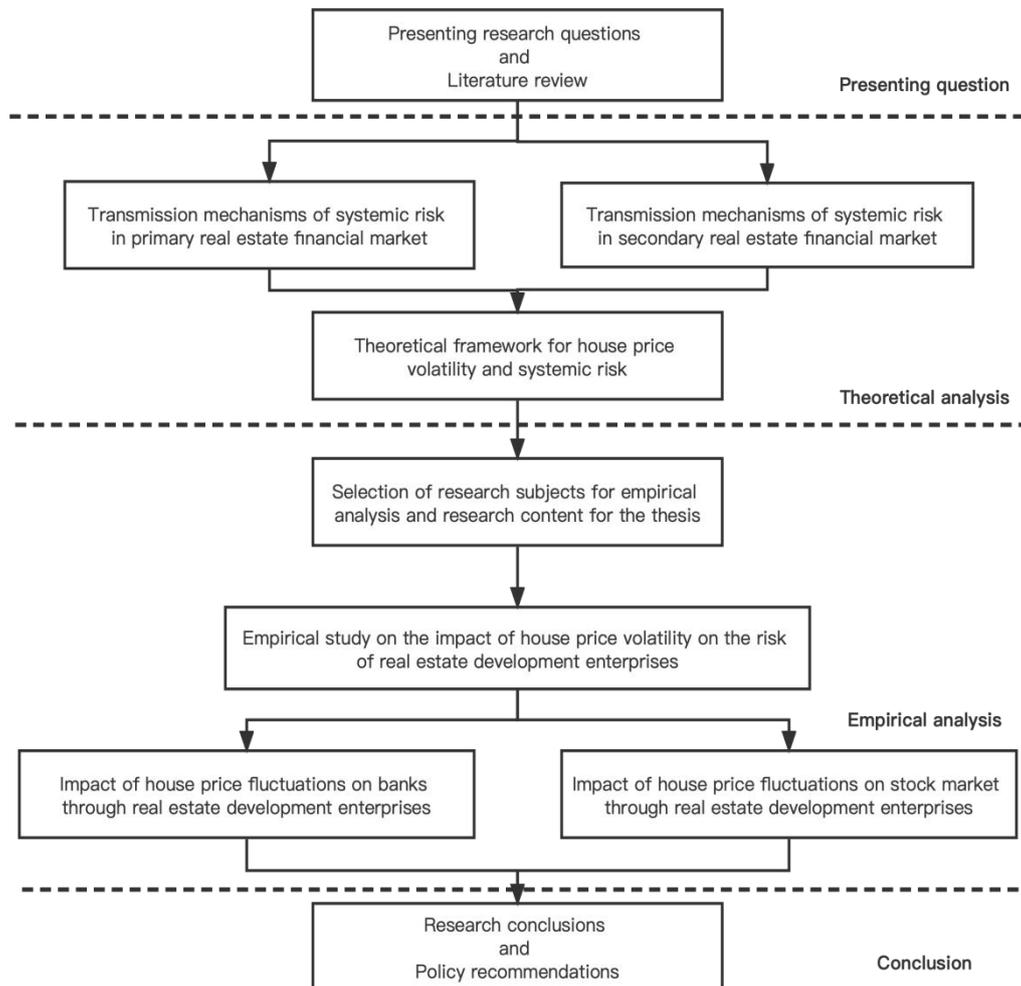


Figure 1.3: Literature review illustration

Note: Self-constructed

## 1.5 Thesis Structure

The thesis is divided into six chapters in total.

Chapter 1: Introduction. This chapter elucidates the research background, research objectives, and the significance of the thesis. It defines the research object, identifies key concepts, and narrows down the scope of the research. Additionally, it compares relevant literature and research progress based on the research ideas. Finally, the chapter introduces the research methodology and technical route of the thesis.

Chapter 2: Theoretical framework of the relationship between real estate price fluctuations and system risk. This chapter introduces the concepts of real estate finance and the real estate capital market, followed by an exploration of the current

state of China's real estate capital market. Building upon this foundation, the chapter delves into the specific meaning and characteristics of system risk in the real estate capital market. In light of the actual situation of China's real estate market and real estate capital market, the transmission mechanism of system risk in the real estate capital market is analyzed at the theoretical level. Finally, the chapter summarizes the conceptual framework of the relationship between real estate price fluctuations and system risk, and identifies the development enterprise channel as the focus of this thesis's empirical analysis.

Chapter 3: The Impact of Real Estate Price Fluctuations on the Risk of Real Estate Development Enterprises. The chapter begins by correcting financial indicators such as inventory value, asset-liability ratio, and inventory value ratio of real estate enterprises, which are crucial for understanding their risk profile. The chapter then analyzes the solvency of real estate enterprises when faced with fluctuating real estate prices. Long-term solvency pertains to an enterprise's ability to manage solvency risk, while short-term solvency pertains to an enterprise's ability to manage liquidity risk. The chapter assesses the impact of real estate price fluctuations on the financing capacity and the probability of default of development enterprises. Finally, the chapter concludes by presenting empirical evidence that allows for a judgment on the solvency risk and liquidity risk of real estate enterprises when real estate prices fluctuate.

Chapter 4: The Impact of Real Estate Price Fluctuations on Banks through the real estate enterprise channel. This chapter begins with a theoretical analysis of the impact of real estate price fluctuations on the scale of real estate development loans and the credit risk and liquidity of banks that provide such loans. Secondly, the chapter estimates the size of bank loans related to the development enterprise channel based on the characteristics of the Chinese real estate market. Thirdly, the chapter examines the impact of real estate price fluctuations on the size of loans related to the development enterprise channel to assess the potential for system risk transmission through this channel. Subsequently, the chapter examines separately the impact of real estate price fluctuations on banks' credit risk and liquidity through development firm channel-related lending. Finally, the chapter concludes by determining whether real estate price fluctuations trigger system risk for banks through the development enterprise channel.

Chapter 5: The Impact of Real Estate Price Fluctuations on Equity Markets

through the Development Enterprises Channel. Firstly, this chapter analyzes the theoretical factors that influence corporate stock prices, and evaluates whether real estate price fluctuations are a factor that affects the stock prices of development enterprises. Secondly, this chapter empirically analyzes the impact of real estate price fluctuations on the share price of development enterprises. Thirdly, the chapter examines real estate price fluctuations as a significant event factor to determine its impact on the excess returns of development firms' share prices and to validate the conclusions on the impact of real estate price fluctuations on development enterprises' share prices. Finally, the chapter concludes by evaluating whether real estate price fluctuations can lead to detrimental shocks to the stock market through the development enterprises channel.

Chapter 6: Research Conclusions and Policy Recommendations. This chapter summarizes the research findings of the thesis, outlines its academic contributions and proposes future research directions. In light of the thesis findings and the current situation, this chapter presents relevant policy recommendations. These recommendations are based on the basic logic of "no speculation in housing" and "defending the bottom line of no system risk", thus providing administrative departments with guidance on the regulation of the real estate market and promoting the stable and healthy development of China's real estate market. This chapter also offers advice to the administration on how to regulate the real estate market effectively.

## **Chapter 2 Conceptual Framework of the Relationship Between Real Estate Price Fluctuations and System Risk**

This chapter introduces the core concepts of real estate finance and the real estate capital market. It provides an overview of the current state of China's real estate capital market and then elaborates on the meaning and characteristics of system risk in the real estate capital market. Based on an analysis of China's real estate market and financial sector, the theoretical transmission mechanism of system risk in the real estate capital market is delineated, and the conceptual framework for the relationship between real estate price fluctuations and system risk is summarized. The channels for system risk triggered by fluctuations in real estate prices are then discussed, with a focus on the development enterprise channel, which is the key object of research in this thesis's empirical analysis.

### **2.1 Meaning and Characteristics of System Risk in Real Estate Capital Markets**

#### **2.1.1 Concept of Real Estate Finance and Real Estate Capital Markets**

The study of system risk in the real estate capital market involves understanding real estate finance and the real estate capital market. Real estate finance is a branch of finance that encompasses all capital financing activities related to real estate. This includes economic activities related to money circulation, credit, mortgage, and lending in the production, consumption, and circulation of real estate. Real estate finance also includes financing, trust, insurance, and issuance of marketable securities. The real estate capital market is the vehicle for carrying out these activities (Zhang & Yin, 2007).

However, this is a broad, and arguably, less strict definition. In fact, the meaning of real estate finance can vary depending on the country, region, social system, and stage of economic development. There is currently no widely accepted international definition or standard. Real estate finance shares many features with other types of finance such as corporate finance, personal financial insurance and risk management, and investment portfolio theory. Its basic theory, operational rules, market

participants, and product design are based on general financial theory. However, because of its close relationship with the real estate market, it is also affected by external environments such as the stage of economic development, government policy objectives, legal systems, cultural traditions, and more (Williams, 1999).

The concept of real estate finance has evolved along with the economy. In the mid-1980s, the term primarily referred to real estate mortgages within the US. However, with the continuous development of financial markets, and growth in financial products and instruments, the meaning of real estate finance has broadened. Presently, real estate finance encompasses not only real estate mortgages for traditional real estate development and consumption, but also all forms of financing related to the real estate industry. This includes financing for developers, financial institutions, financial leasing, and the use of financial instruments in the real estate sector, such as mortgage-backed securities and real estate investment trusts. (Baig & Choudhry, 2013; Lemke et al., 2013; Clark, 2021)

The real estate capital market facilitates the operations of real estate finance and is composed of both the primary and secondary markets. It involves market participants, financial intermediaries, and various financial instruments. In the primary real estate capital market, borrowers can obtain financing indirectly through real estate intermediaries or directly from the capital market. The market participants include individual or family-based land development enterprises, government-based development enterprises, construction enterprises, and non-real estate enterprises. Some of the lenders include financial intermediaries, commercial banks, leasing banks, savings banks, mortgage banks, insurance companies, financial institutions such as real estate investment trusts, and institutional or individual investors. The primary financial instruments utilized are mortgages and credit facilities provided by the financial institutions themselves, as well as shares and bonds incorporated in the capital market.

The primary financing activities in the real estate market include individual housing mortgages taken out from financial institutions by individuals or households for the purposes of buying, constructing or renovating their homes. Real estate enterprises may apply for mortgage or credit loans from financial institutions to finance their operations, while also issuing equity shares or bonds through the capital market. Construction companies may obtain fixed asset mortgages or credit facilities from banks and finance from the capital market. Non-real estate enterprises may

apply for fixed asset mortgages to invest and seek loans from banks.

The secondary real estate capital market is the process through which financial intermediaries in the real estate sector securitize mortgage loans and sell them to individual or institutional investors in the secondary market. Market participants include financial institutions and individual or institutional investors, while mortgage-backed securities are among the main financial instruments. Thus, the secondary real estate capital market is also known as the loan securitization market or the secondary mortgage market (Clauret & Sirmans, 1999).

The concepts of real estate finance and real estate capital markets used in this study are based on the existing consensus among scholars that real estate finance encompasses all financing activities related to real estate, while real estate capital markets include both primary and secondary markets.

### 2.1.2 China's Real Estate Capital Market

The complete real estate capital market is a financial market that includes primary and secondary real estate markets, real estate capital market participants, and real estate financial instruments. Figure 2.1 presents a schematic diagram of the overall operation mechanism of the real estate capital market (Ye, 2017). In particular, the primary real estate capital market, as shown in Figure 2.1, constitutes the main part of China's real estate capital market, while the secondary market is still in its early stages of development.

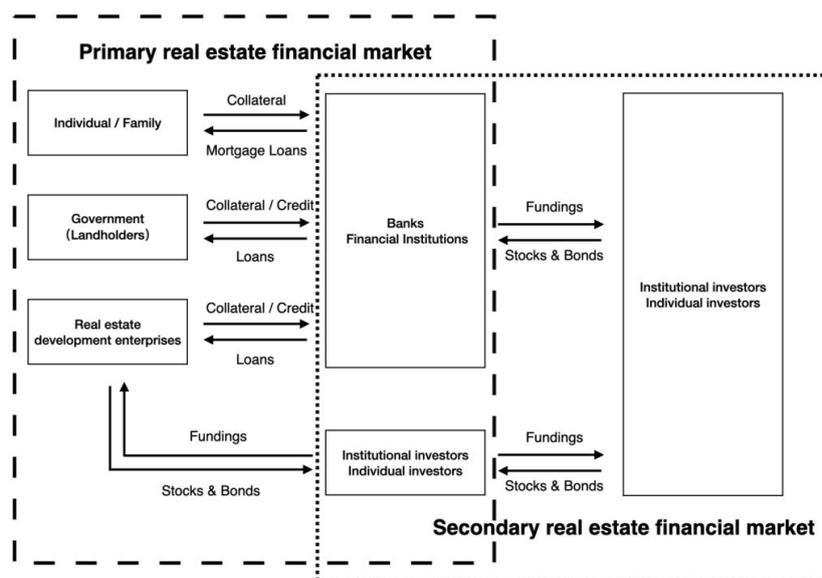


Figure 2.1: China's real estate capital market operation mechanism

Note: Self-constructed, derived from the article of Ye, 2017.

As China's real estate and financial markets are still less mature than their Western counterparts, they are roughly equivalent to the stage of development seen in the US during the 1980s and 1990s. Therefore, both companies and individuals tend to choose indirect financing, such as bank loans, especially mortgages, as their preferred method of financing for real estate activities (Yin, 2021). This has led to some people in China mistakenly believing that real estate loans represent the entirety of real estate finance, and even using the two concepts interchangeably. Additionally, the fact that China's secondary real estate capital market is still in its infancy and that China's real estate capital market is predominantly dominated by the primary market leads to the misconception that the real estate capital market only includes the primary market.

The real estate capital market in China has several characteristics at this stage. Firstly, there are fewer financial instruments available compared to developed countries. China's secondary real estate capital market is still in the exploratory stage, and the primary market is dominated by personal housing mortgages and real estate development loans. This makes the overall capital financing less efficient, and as a result, the market has limited dynamism (Hu, 2021). For example, on the demand side of the real estate market, apart from informal channels such as private lending, there are only two major financial instruments available: personal housing mortgages and real estate funds. These instruments require full equity as collateral, and flexible financial instruments such as mortgage refinancing and partial equity re-mortgaging are yet to be introduced. From the perspective of financial intermediaries, mortgage securitisation and real estate investment trusts, which are undergoing theoretical research and initial practical exploration in China, are seen as new breakthroughs to enhance the dynamism of both the real estate and financial markets. However, it is still unclear when these two financial instruments will actually come to market.

The second characteristic of China's real estate capital market is the relative homogeneity of financial institutions and financial intermediaries. Banks are the main financial institutions and intermediaries in the market. From the perspective of the supply side of the market, over 85% of real estate development funding sources in China from 2010 to 2020 came from banks (Forward Industrial Research Institute, 2020). On the demand side of the real estate market, residential mortgage loans provided by banks remain the main financing tool for households. The individual mortgage balance of the Housing Provident Fund, which is one of the important

policy financial tools, is only about one-fourth of the individual housing mortgage balance of banks. In other words, around 80% of individual housing mortgages are financed by banks. Moreover, due to China's relatively traditional and conservative financial system, the balance of real estate development loans and personal housing mortgage loans are highly concentrated in the head financial institutions, including the four state-owned banks and a few large commercial banks. This is significantly different from the situation in developed countries in Europe and the United States, where nearly 10,000 financial institutions, including commercial banks, mortgage banks, and savings associations, are involved in issuing housing loans (Herring & Wachter, 1999).

Finally, unlike the US government, which has established special purpose companies and regulatory authorities specifically for the real estate capital market, China does not have a dedicated regulator for the real estate capital market. Instead, the People's Bank of China, the CBRC, and other relevant departments, such as the Ministry of Housing and Construction, the Ministry of Land, the Ministry of Finance, and the Development and Reform Commission, are unified in practice. However, this also reflects an important flaw in China's real estate capital market, as the prevention of system risks has not been given sufficient attention at the national-level. In other words, the fact that China's real estate capital market lacks a dedicated regulator indicates that it is not yet fully developed.

### **2.1.3 Meaning and Characteristics of System Risk in Real Estate Capital Markets**

Real estate finance falls under the larger umbrella of finance, and the real estate capital market is an integral part of the overall financial market. Thus, in order to study the system risk in the real estate capital market, it is essential to first comprehend the concept of system risk, and then to analyze its distinct implications and features in connection with finance, real estate, and financial markets.

Expounding on the previous section's definition of system risk, this phenomenon can be succinctly characterized as the likelihood of a cascade of severe shocks impacting financial institutions and other market players, and in some cases, affecting the entire financial market. These shocks are triggered by adverse events such as negative market news, the failure of a financial institution, and sudden market downturns. The gravity of the matter could lead to a financial crisis, or even an

economic crisis, which makes it a crucial area of study.

By integrating the definition and analysis from the previous section, several key characteristics of system risk are identifiable. Firstly, the systemic nature and likelihood of losses arising from adverse shocks triggered by the triggering event is the essential attribute of system risk. System risk is characterized by its temporal continuity and spatial extensiveness, with the emphasis on the "series" and "cascading" nature of losses once triggered. The continuity in time refers to the processes from the formation of system risk to the generation of losses, including government intervention and market adjustments, until the market stabilizes. These processes occur over an extended period and are widely distributed in time. Spatial extensiveness implies that system risk transmission affects every participant in financial markets and may extend to commodity markets and the overall macroeconomy, placing all participants at risk of losses. The term "likelihood" highlights the possibility of losses instead of the realization of losses. In other words, system risk refers to the likelihood and transmission of losses resulting from adverse shocks, rather than the liquidation of losses that have actually occurred. Consequently, the study of system risk can only estimate the losses market participants will face when an adverse shock occurs. It is impossible to calculate the exact size of the losses, and at best, an expectation and probability distribution of losses can be provided (Jiang, Liu, & Cheng, 2019; Wen & Tang, 2018).

Secondly, the transmission of system risk is dependent on financial instruments. In a modern economy, individuals and companies rely on financial markets to finance their economic activities. For companies, internal financing is often insufficient to meet their funding needs, and they have to obtain additional funds through external financing. The use of financial instruments in external financing offers a channel for the transmission of system risk. MBS, for instance, facilitates the transmission of risk from financial intermediaries to capital markets and is, therefore, a crucial channel for the transmission of system risk. While the emergence of financial instruments provides access to capital and diversifies risk, it can also turn limited and manageable risk into unpredictable system risk, which is particularly problematic. Scholars use the "leverage effect" to describe the amplifying role of financial instruments, as the size of the leverage effect depends on the design of the instrument. If leverage is significant, it can amplify risk. The design and application of financial instruments are crucial concerns for financial market regulators.

Thirdly, the transmission of system risk is driven by positive feedback and is asymmetric. Examples such as the financial crisis in the US since 2007 and the land price bubble in Japan in the 1980s show that once system risks are triggered, the effects that follow their transmission tend to be positive and asymmetric. Positive feedback means that the effects of a certain systemic operation, once created, pass through the system again to form a new effect, and the new effect becomes stronger in terms of impact. This effect is often present in the transmission of system risk. After system risk is triggered by a trigger event, it is transmitted and spread to financial markets and the macroeconomy, with its effects feeding back to further affect financial markets and the macroeconomy, causing even stronger shocks (Qi, 2012). Due to the existence of positive feedback effects, system risk often presents a long-term follow-on impact, and the cycle of financial market downturn it causes will far exceed the boom cycle of the market. In other words, market cycles exhibit asymmetric characteristics due to the presence of positive feedback effects (Allen et al., 2009).

Finally, system risks often arise spontaneously within the system and require external intervention to diversify, weaken, and defuse. In reality, ideal markets may not exist or may be difficult to achieve, and information asymmetries become a significant feature of financial markets. The emergence of speculators and noise traders also contributes to the creation of asset price bubbles. Therefore, system risks often cannot be resolved on their own without external intervention (De Long et al., 1990; De Long et al., 1991).

Compared to the general financial market, the real estate capital market is distinctive in its utilization of credit facilities for both short-term and long-term purposes, as well as its reliance on collateral (particularly real estate collateral). The system risk within the real estate capital market, in addition to the aforementioned characteristics, also exhibits the following traits: first, the long-term nature of credit usage in the real estate capital market can lead to an accumulation of system risk. Given the unique nature of the real estate sector, both the supply and demand sides require extended access to credit facilities. As the economy develops, the public's demand for real estate typically results in a gradual escalation of real estate credit scale, which perpetuates the tendency for system risk to accumulate within the real estate capital market.

Secondly, the heavy reliance on collateral, particularly real estate-based

mortgages, makes credit funding risks highly susceptible to fluctuations in real estate prices. Fluctuations in real estate prices directly cause variations in the value of underlying collateral. When the value of the collateral significantly decreases, it can result in events such as defaults, runs, and liquidity shortages. Therefore, significant drops in real estate prices tend to act as triggers for system risks in the real estate capital market.

In summary, combining system risk with the particularity of real estate finance, we can give a relatively comprehensive explanation of the meaning of system risk in the real estate finance market. Firstly, system risk in the real estate capital market refers to the risk of a series of losses incurred by participants in the market due to a triggering event. The impact of this event can extend beyond the real estate capital market to the entire financial market and even the macroeconomy. Secondly, the triggering event could be a market default, negative news, macroeconomic fluctuations, or policy implications. However, as financial markets mature, sharp drops in real estate prices and the bursting of bubbles are increasingly becoming the main sources of risk generation. Thirdly, the potential losses from such risks include losses to market participants from the triggering event and losses transmitted from one participant to another. Fourthly, once triggered, system risks may lead to grave financial and economic crises, and often, reliance on market self-regulation may not suffice. Government intervention is usually necessary to restore stability.

The following section of this thesis provides a conceptual framework for understanding the transmission mechanisms of system risk in the real estate capital market. Additionally, it summarizes the channels through which system risk is transmitted in the Chinese context, considering the characteristics of the country's real estate capital market.

## **2.2 Transmission Mechanisms of System Risk in Real Estate Capital Markets**

The previous literature has extensively summarized the transmission mechanisms of system risk in financial markets in general. Therefore, this section does not provide a repetition of that literature. Instead, this chapter will discuss the transmission mechanisms of system risk in China's primary and secondary real estate capital markets, taking into account the operational rules of China's real estate market and real estate capital market.

## **2.2.1 Transmission Mechanisms of Systemic Risk in Primary Real Estate Capital Market**

### **2.2.1.1 Systemic Risk Transmission Through Collateral**

Mortgages are considered one of the most traditional and predominant ways of raising finance in financial markets. Due to information asymmetry and incomplete information, lenders are compelled to examine the balance sheet and cash flow situation to determine whether to lend to borrowers. To minimize risks related to information asymmetry and incomplete information, lenders frequently require borrowers to utilize collateralized assets as a means of lending. The use of collateralized assets creates a pathway for system risk transmission. Houses, as one of the most crucial and commonly perceived assets are often utilized as collateral in mortgage lending, and thus there is a high risk of system risk transmission through these assets.

When a borrower uses a house as collateral for a mortgage, their borrowing ability depends on the mortgage value of the house, which subsequently relies on the closely related market price. Generally, lenders grant a loan amount smaller than the collateral to mitigate their risk, but there exists a defined ratio, such as the loan-to-value ratio (LTV ratio) which ranges around 60-70% in China. For borrowers, a rise in real estate prices increases their borrowing capacity while also amplifying their level of indebtedness and enlarging the lender's risk. Conversely, a cycle of rising and falling real estate prices causes the value of the borrower's collateral to fluctuate accordingly. If the LTV ratio is set too high, the borrower may decide to default on the loan if the real estate prices fall too far, leaving the lender susceptible to considerable direct losses. (Duca et al., 2012)

In the Chinese real estate market, real estate mortgages are categorized into several types, including real estate development mortgages, land development mortgages, commercial mortgages, and personal housing (residential) mortgages. Despite having different names and involving diverse borrowers and lenders, all of these mortgage types in China operate under a broadly similar collateral and repayment framework (The People's Bank of China, 2021; National Bureau of Statistics of China, 2023). The borrower pledges their housing, commercial premises, or land as collateral in exchange for funds, which are redeemed through repayment, including interest, to the lender using methods such as equal principal and interest or

equal principal repayment.

Collateral is the primary and most common form of financing in the real estate market, and is therefore a major source of potential losses. Additionally, it serves as the foundation for other system risk transmission mechanisms. Lenders face the following risks associated with collateral.

**Borrower Credit Risk:** Borrower credit risk is the primary risk that can result in losses on mortgages, and lenders (predominantly banks and other financial institutions) must focus on mitigating this risk by carefully evaluating the borrower's creditworthiness and income before approving loan disbursements to ensure that the borrower has the capacity and willingness to repay the loan.

**Collateral Risk:** Collateral risk can include both collateral price risk and legal risk. A decline in real estate prices causing a depreciation in the collateral's value may result in a credit default, while potential uncertainty surrounding the borrower's legal rights to the collateral may pose a risk to the lender's ability to dispose of the collateral. To mitigate collateral risk effectively, lenders must accurately assess the value of the collateral and manage it within a reasonable range, as well as examine the title and legal status of the collateral prior to making the loan.

**Liquidity Risk:** Liquidity risk is a significant issue for lenders who provide funds to borrowers on a long-term basis. There are two main types of liquidity risk. Firstly, by lending out funds, mortgage claims become illiquid, which can result in a loss of short-term investment opportunities and put the lender at risk of short-term earnings loss. Secondly, for banks and financial institutions, granting mortgages can reduce liquid assets and cause short-term liquidity problems in response to unfavorable news or macroeconomic fluctuations. If real estate prices fall and investors have negative expectations about the bank or financial institution's operations, this can lead to a run on the bank. Moreover, given that a significant portion of a bank's liabilities are short-term loans (such as savings deposits) while real estate mortgages are long-term assets, this "short deposit and long loan" situation makes liquidity risk the most prevalent and severe risk faced by banks.

**Operational Risks:** Operational risks refer to risks associated with the operational aspects of a mortgage. These risks include mortgage-to-value risk, repayment method risk, repayment term risk, and interest rate risk. The higher the mortgage-to-value ratio, the higher the risk involved in the mortgage. Similarly, longer repayment terms also increase the risk associated with a mortgage. Repayment

method risk and interest rate risk, on the other hand, are difficult to determine and require a case-by-case judgement.

When real estate prices decrease, lenders face the risk of borrower credit risk. In case of a default by the borrower, the lender faces the risk of depreciation in the value of the collateral. Further, a significant depreciation in the value of the collateral exposes the lender to liquidity risk and may lead to adverse market expectations. All these risks are transmitted via the collateral and may result in significant direct losses for financial institutions in case of large fluctuations in real estate prices or a bursting real estate price bubble. Real estate mortgages are available to various participants in the Chinese real estate market and macroeconomy, and this exposes banks and other financial institutions to collateral transmission risk. Individuals and households can obtain mortgages for real estate or commercial premises, while real estate enterprises and non-real estate companies can use their real estate holdings for mortgage financing. Alternatively, governments or companies that own land use rights may choose to mortgage their land use rights for financing (The People's Republic of China, 1990).

#### **2.2.1.2 Systemic Risk Transmission Through Liquidity**

Allen and Gale (2000) developed a theoretical model which describes a bank run triggered by depositors' expectation of a fall in the price of illiquid risky assets with risky returns and low returns. When the bank sells the risky assets to meet the liquidity needs of depositors, it causes asset prices to fall further, increasing system risk in the process. This model extends Diamond and Dybvig's (1983) work on bank runs from the perspective of asset price fluctuations and liquidity risk, and it complements the earlier work by providing the transmission mechanism of system risk through liquidity.

In the real estate capital market, liquidity problems are not unique to banks and other financial institutions but also affect development enterprises. This complexity gives rise to a real estate capital market where system risk is transmitted through liquidity mechanisms, which is more intricate than the traditional financial market.

A decline in real estate prices can have a direct impact on the sales of real estate enterprises, leading to a shortage of liquidity and credit defaults, resulting in losses to lenders. Due to the Chinese real estate market being in a phase of development, with expectations of instability, as well as serious problems relating to informational asymmetry and imbalances in structural supply and demand (Zhang & Wen, 2013),

prices and transaction volumes in China's real estate market tend to exhibit a positive correlation (Insight & Info Consulting Ltd, 2020). Therefore, when real estate prices decline, transaction volumes also tend to decrease sharply. At this point, real estate enterprises may face two challenges - the first being a decrease in real-time sales growth due to a drop in inventory transactions, and the second being the difficulty of realizing their inventory, which may result in longer capital turnover cycles and liquidity problems, thereby affecting their short-term solvency despite a strong long-term solvency position (Liu et al., 2013). When faced with liquidity issues, the only viable option is to sell inventory at a discounted price to recover cash.

The purpose of disposing of inventory at discounted prices is to acquire immediate funding and resolve liquidity issues. However, two potential consequences must be considered. Firstly, the influx of inventory disposed of at discounted prices may lead to a reduction in prices due to increased supply elasticity (Shim & Von Peter, 2007). Secondly, the disposal of inventory at reduced prices may trigger a shift in market expectations, further deteriorating expectations for prices and causing sustained declines in prices and trading volumes. Either outcome renders the transaction less liquid, with the most immediate result being a deterioration in the company's own financial circumstances, or even liquidation. In the case of lenders, whether it be in the form of credit or mortgage loans, the loss will be passed on from the real estate development company to the lender, resulting in a loss of credit (Shim & Von Peter, 2007).

On the other hand, a fall in house prices may also lead to a decrease in the value of available collateral. This is particularly problematic when financial institutions are unwilling to accept new mortgages, which can reduce their credit capacity. In addition, developers may have difficulty obtaining new financing to alleviate their liquidity problems. For banks and other financial institutions, there are three main sources of liquidity problems that arise from falling property prices: credit defaults, liquidity tied up in collateral, and adverse expectations. The first source of liquidity problems is credit defaults. Banks and financial institutions often provide funding for a variety of real estate loans, including personal, corporate, and land-use rights, in addition to real estate mortgages. (The People's Bank of China, 2021) Unlike real estate loan mortgages, these loans tend to be credit or secured loans, which are more risky. These loans are also subject to greater losses when a fall in real estate prices triggers liquidity or solvency problems for developers, and the bank is directly liable for credit

default losses. Proper risk assessment and management can help mitigate these losses. (Yin, 2021; Zhang, 2010)



Figure 2.2: Types of Real Estate Loans

Note: Self-constructed. Adapted from Zhang's (2019) article.

Secondly, there is the issue of liquidity tied up in collateral. Banks, who serves as the conduit for holding collateral, predominantly hold real estate assets. When real estate prices decline, the decrease in collateral prices will lead to a decrease in the lending ability of banks, which means that banks are unwilling to lend funds to borrowers. This may lead to a decrease in the trading volume of the real estate market, which in turn will generate market liquidity risks. In order to mitigate the risk of mortgage default losses, banks hold collateral to issue loans. However, in doing so, banks are faced with the trade off between risk management and liquidity and may opt to make impairment disposals of collateral in exchange for liquidity when there is a risk of loan defaults or illiquidity. Nevertheless, the sale of such impaired collateral could potentially lead to direct losses for the bank and trigger further degradation in the asset's value, causing significant losses to the entire market.

Finally, there is the issue of potential panic caused by adverse expectations. When property prices fall, banks are likely to experience significant losses,

particularly if the bank has issued a large number of real estate mortgages, exposing the bank to high levels of liquidity risk. These adverse expectations could trigger panic among depositors who attempt to withdraw their funds to avoid losses. This transfer of panic can be highly contagious and may result in a bank run. According to Diamond and Dybvig (1983), if banks are not equipped to handle such a liquidity shock, they may even face a crisis of insolvency.

The transmission mechanism of system risk through liquidity is visually illustrated in Figure 2.3. It is important to note that a lack of liquidity in banks and other financial institutions leads to a significant decline in their credit capacity, exacerbating the liquidity crisis in the financial markets as a whole. For both real estate and non-real estate companies, this results in tighter financing constraints, making it more challenging to resolve liquidity issues through financing channels. Moreover, even when no liquidity problems arise, financing difficulties can lead to a decrease in investment and a slowdown in business development.

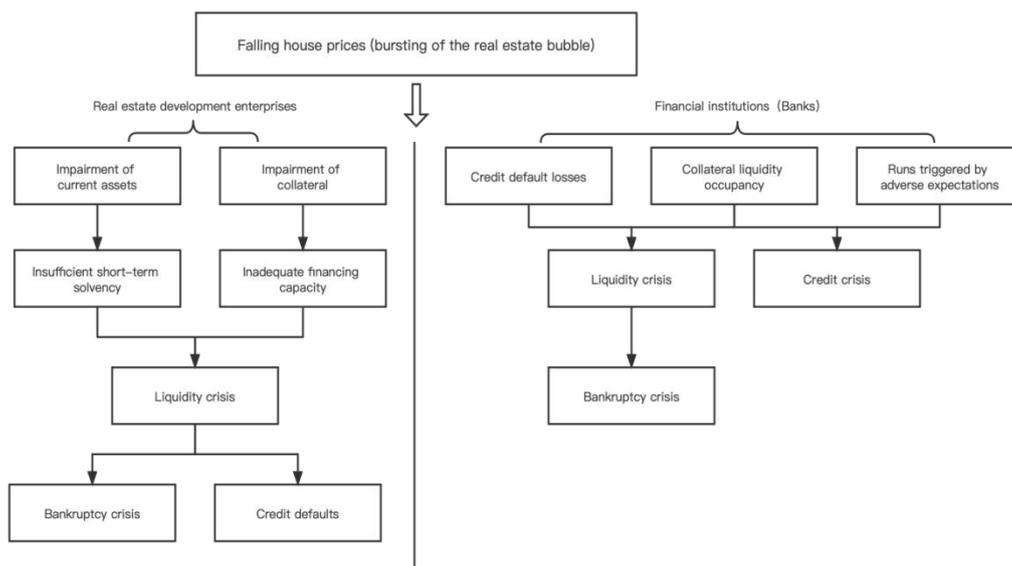


Figure 2.3: The Transmission Mechanisms of Systemic Risks in Real Estate Capital Markets via Liquidity

Note: Self-constructed. Adapted from Zhao, Li, & Feng (2019).

### 2.2.1.3 Transmission of Systemic Risk Through Capitalization

In real estate capital markets, system risk can be transmitted through not only bank capital, as is the case in general financial markets, but also through the capital of real estate enterprises, due to real estate price fluctuations.

Fluctuations in real estate prices can lead to liquidity risk for real estate enterprises due to fluctuations in the value of inventories and fixed assets. Additionally, this can also cause an immediate increase in the asset-liability ratio,

which results in a reduction in the capital of the real estate enterprise. As a consequence, this could lead to potential losses in two areas: equity losses and debt losses.

The impact of equity loss for real estate enterprises stems from two primary sources. Firstly, there is a direct loss to owners' equity as capital is reduced, while liabilities remain unchanged. Secondly, the stock price of the enterprise may decrease, leading to stock market losses for individual or institutional investors. According to Feltham-Ohlson's equity valuation model, the equity value is equivalent to the sum of the net book assets of the carrying business and the discounted value of the expectations of the operating earnings of the business (Feltham & Ohlson, 1995; Ohlson, 1995). In the case of real estate enterprises, a decrease in real estate prices can lead to a decline in the discounted value of both the enterprise's net book assets, as well as the expected operating earnings. An impairment of inventories and fixed assets can also cause a reduction in book assets, while poor expectations of inventory sales will reduce the discounted value of anticipated operating earnings. Thus, reduced real estate prices typically lead to declines in corporate stock prices and losses for individual or institutional investors in the stock market.

Losses on claims refer to solvency problems caused by excessive asset impairment when a fall in property prices may trigger insolvency of a property development enterprise, resulting in a long-term solvency deficit. When the capital has been depleted and assets in liquidation cannot cover all debts, similar to the liquidity problems of short-term insolvency, creditors of a real estate enterprise will face direct loss of claims.

For banks, capital is the foundation of their operations, and insufficient capital means that they are exposed to significant liquidity and solvency risks. The core capital adequacy ratio is a crucial index of a bank's capital adequacy. The Basel III Accord, formally agreed upon on 12th September 2010, requires the core capital adequacy ratio of commercial banks to be increased from 4% to 6%, with a protective buffer capital of 2.5% and a countercyclical reserve capital of no more than 2.5% to be accrued. As a result, the combined core capital adequacy requirement will be 8.5% to 11%, whereas the total capital adequacy requirement remains steady at 8%. These regulations aim to prevent excessive speculative behavior by commercial banks, reduce system risk in the banking industry, and prevent the recurrence of financial crises (The Bank for International Settlements, 2022). The movement of bank capital

is closely tied to fluctuations of asset prices. Deposits tend to be short-term, whereas loans are long-term due to the fact that corporations have "short deposits and long loans." On a bank's balance sheet, deposits are on the liability side, while loans are on the asset side. When asset prices rise, the accounting statements indicate that the asset side will grow, whereas the liability side will not significantly change, resulting in an increase in the net assets of the bank's ledger, i.e. more capital. Assuming banks operate independently, this scenario stimulates them to lend more, which, in turn, pours a significant amount of money into the capital market that further drives up asset prices, a phenomenon known as the financial accelerator (Cui, 2006). Shin developed a theoretical model illustrating that when real estate is used as collateral, the value of the mortgage also rises when the real estate price increases (in this case, the mortgage is considered a tradable financial asset). This increase in mortgage value leads to an increase in the bank's net worth, allowing the bank to continue making loans. This behaviour repeats during the period of inflated property prices until a bubble emerges. Once the bubble bursts, the net worth of both the borrower and the bank significantly decrease, and a default on the loan will result in a loss of bank capital. If a bank's capital falls below the minimum requirements of Basel III, it faces a higher risk of severe losses, causing the entire banking system to be exposed to system risk (Shin, 2008). The process outlined above appears similar to liquidity channel transmission, but there are fundamental differences. The capitalisation channel focuses on solvency issues rather than liquidity issues that are commonly referred to as insolvency. A quick drop in asset prices, including real estate prices, results in a loss in capital for asset banks. Once this loss is severe, banks face long-term solvency problems in addition to short-term liquidity problems, which is a more severe crisis than liquidity problems and can ultimately lead to bankruptcy (Wang, 2012a).

In the modern financial system, banks not only hold a significant amount of assets, but also often raise capital themselves by issuing shares. In China, for example, all of the country's large state-owned commercial banks are listed as public companies. A bank's capital is a financial asset that is dynamic. Real estate prices and equity prices are closely related, and therefore, fluctuations in real estate prices can produce more significant shocks through the capitalization channel. This vulnerability to asset price fluctuations through the capitalization channel is the fundamental reason why Basel III requires higher core capital adequacy ratios for banks in the modern

financial system (Quan & Titman, 1999).

## **2.2.2 Transmission Mechanism of Systemic Risk in Secondary Real Estate Capital Market**

In Western countries like the United States, where financial markets are more developed, system risk is transmitted through the secondary real estate capital market, resulting in widespread losses. However, in China, the secondary financial real estate market is still in its early stages, and its size is almost negligible compared to the primary market. Therefore, this thesis presents a theoretical analysis of the transmission of system risk in the secondary real estate capital market to illustrate the transmission mechanism of this channel. No subsequent empirical analysis is conducted. In the secondary real estate capital market, system risk is primarily transmitted through asset securitization. Asset securitization involves issuing securities in the capital market that transfer the flow of income rights of an asset to investors. The basic requirement for asset securitization is that the asset is capable of generating stable and sustainable returns in the future. The demand for asset securitization comes from the liquidity needs of investors. Assets that can generate stable and sustainable returns in the future tend to be less liquid, which can pose a liquidity problem for investors who choose to hold them for a long period of time. Asset securitization can address this liquidity issue for investors while diversifying risk. For instance, real estate mortgages are risky assets but, at the same time, provide stable and sustainable returns in the future, which makes them suitable assets for securitization. In fact, the issuance of the first home mortgage securities by the US Government National Mortgage Association in the 1960s is regarded as the beginning of the global asset securitization process (Zhang & Yin, 2007).

Residential mortgage-backed securities (RMBS), collateralized mortgage-backed securities (CMBS), and commercial real estate mortgage-backed securities (CMBS) are the most significant products in the secondary market for securitizing real estate loans. In developed Western countries, such as the US, these products have become as common as equities and bonds for asset securitization and are collectively referred to as loan-backed securities in the broadest sense. Before the US subprime crisis in 2007, the size of the US MBS market had reached \$9.14 trillion, accounting for 28.77% of all marketable loan balances, which was 2.02 times the total size of the US Treasury at the time and 3.07 times the size of other asset-backed securities (ABS). It is evident

how such significant losses and global implications can arise when there is a massive default (China International Capital Corporation Limited, 2020).

The basic operational model of MBS is depicted in Figure 2.4. Financial institutions, such as commercial banks, that hold the original mortgage loans, sell their mortgage portfolios to Special Purpose Vehicles (SPVs) to facilitate asset securitization. The SPVs then repackage and rate these mortgage loans before issuing MBS and selling them to investors.

In this process, various professional institutions, such as delegated management agencies, credit guarantee agencies, securities rating agencies, and securities underwriting agencies, play essential roles by providing their respective services and fulfilling their functions. The issuance of MBS brings about several benefits: Enhanced liquidity: It increases the liquidity of banks and other financial institutions that issue mortgages, effectively alleviating the problem of institutional liquidity constraints. Risk diversification: MBS helps diversify mortgage risks, thereby improving the overall operational efficiency of the financial system and promoting efficient capital utilization. Lower financing costs: Real estate mortgages are considered assets capable of generating stable and sustainable future returns. MBS issuers can benefit from lower financing costs and even achieve higher credit ratings by utilizing credit enhancement services provided by credit guarantee agencies. Expanded operational scope and increased income: MBS issuance enables financial institutions to expand their operational scope, leading to increased operating income. Promoted real estate consumption and improved real estate financial services: MBS issuance plays a role in promoting real estate consumption and effectively improving financial services related to real estate.

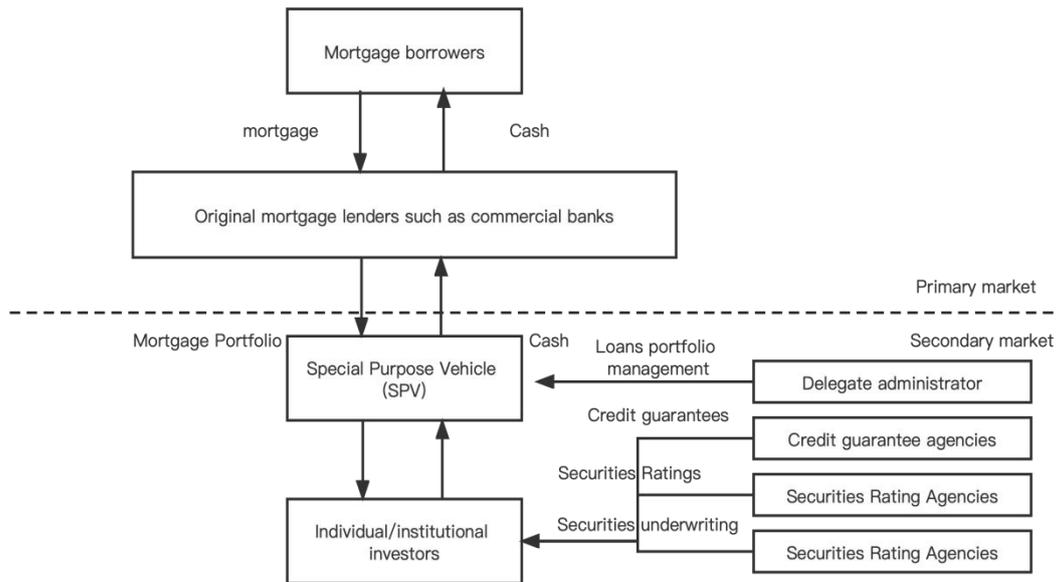


Figure 2.4: Basic MBS Operating Model

Note: Adapted from Zhang and Yin (2007). The original analysis focuses on the U.S. real estate market; the figure is cited here only to illustrate the transmission logic, which is applied to the Chinese context in the subsequent discussion.

However, the issuance and management of mortgage-backed securities (MBS) require strict regulation to avoid the accumulation and proliferation of system risks, as illustrated by the sub-prime mortgage crisis that occurred in the United States in 2007. Figure 2.4 presents a comprehensive view of the MBS securitization process, highlighting the numerous interconnected stages involved. Within each stage, the pursuit of short-term gains and information asymmetries give rise to potential agency problems. During periods of rising property prices, enthusiasm for investing in MBS tends to surge. Under such circumstances, the mortgages underlying the increasing house prices are often deemed creditworthy, resulting in a low likelihood of default by lenders. This perception of low risk contributes to the market-wide expansion of MBS. In addition, investors at this time often overestimate the value of MBS investments. Information asymmetries often hinder the identification of corresponding risks associated with MBS, leading to significant undervaluation of credit risks for subprime lenders (Demyanyk & Van Hemert, 2011; Sornette & Woodard, 2010). When a burst in the real estate price bubble occurs, triggering a high number of defaults (particularly among subprime lenders), investors either seek cash flow from their MBS holdings or liquidate them. This results in a severe depreciation of MBS and exposes financial institutions, such as Fannie Mae and Freddie Mac, to a liquidity

crisis. In some cases, this crisis culminates in bankruptcy (e.g., New Century Financial in the US), acquisition (e.g., Bear Stearns Investment Bank in the US), or a need for government liquidity injections (e.g., Fannie Mae and Freddie Mac) (Yu, 2009). Consequently, relevant financial institutions, along with institutional and individual investors in the secondary market of real estate finance, suffer significant losses, ultimately triggering system risk.

In practical terms, the need for the securitization of real estate mortgages in China has gradually become apparent. As of 2013, individual housing mortgages accounted for 19.98% of the mortgage balance of all financial institutions, a level almost comparable to that of the United States as a percentage of all loan balances in 1991 (The People's Bank of China, 2021). At the same time, the numerous money shortages in China's financial markets over the past decade, especially since the outbreak of COVID-19 in 2020, coupled with the Chinese government's top-level real estate design policy of "housing without speculation," which strictly controls the flow of all types of capital into the real estate market, have created a deep sense in the financial markets that the Chinese financial system, particularly the banking sector, is facing the problem of "short deposits and long loans" due to the high proportion of long-term bonds held (especially a large number of property-backed bonds), resulting in a liquidity crunch in the Chinese financial sector. Accordingly, scholars have pointed out that asset securitization, especially the securitization of home mortgages, would be an important solution to address this issue (Xu & Tang, 2014; Niu, 2014).

However, some scholars have also pointed out that the securitization of housing mortgage loans in China is still at a very early stage and therefore faces a series of problems. These include the weak construction of the credit system, the small scale of the primary real estate capital market, the single and low standardization of housing mortgage loans, the absence of special purpose companies and unclear legal status, and an unclear guarantee system (Qu & Chunfeng, 2014). Because the MBS market is not yet sufficiently developed, this thesis does not take mortgage securitization as a central transmission channel for system risk in China; instead, it concentrates on the better-established developer–bank–shadow-banking linkages. Therefore, despite the demand for securitization of real estate mortgages in the financial system and the government's desire to promote asset securitization, both commercial banks as originators and individual and institutional investors as investors are still mostly adopting a wait-and-see attitude towards MBS products, and this channel is discussed

here only as a potential, future amplifying mechanism, not as a main object of empirical testing, as the risks and returns associated with them remain insufficiently transparent at this stage.

The system risks that may be caused by MBS deserve attention. When constructing a secondary real estate capital market, China should learn from the lessons of the US subprime crisis, improve relevant laws, regulations, and regulatory systems from the outset, establish a standardized, safe, and risk-controlled market transaction system, and implement rigorous financial supervision and risk control. However, achieving these goals will undoubtedly be a long-term process. Specifically, regarding the system risks analyzed in this thesis, no further discussion will be provided.

## **2.3 Conceptual Framework for the Relationship Between Real Estate Price Fluctuations and Systemic Risk**

Building on the general discussion of system risk in Section 1.3.1.2, this section moves from what system risk is to how real estate price fluctuations can generate it in the Chinese context. In other words, the aim here is not to redefine system risk, but to develop an analytical framework that links price shocks in the real estate market to concrete transmission channels — especially those centered on real estate enterprises and their financing relationships with banks and non-bank institutions — which will later be tested in the empirical chapters.

### **2.3.1 Real Estate Price Rise and the Formation of Systemic Risk**

While Section 1.3.1.2 outlined the general features of systemic risk (contagion, amplification, and system-wide impact), this subsection specifies how an upward phase of real estate prices contributes to the build-up of such risk under China's institutional setting. It does so by tracing how rising prices relax collateral constraints, encourage pro-cyclical credit expansion to developers and households, and raise the exposure of banks and shadow-banking products to real-estate-related assets, thereby laying the groundwork for vulnerabilities that may materialize when prices reverse.

The term "risk" in system risk refers to the potential for financial loss. When real estate prices increase, real estate enterprises, banks, and investors all stand to gain profits, and there would be no systemic losses in the financial markets. From this perspective, it may appear that there is no system risk. However, if real estate prices continue to rise without effective constraints and signs of a speculative price bubble begin to appear, real estate development enterprises, banks, and investors may, under

overly optimistic market expectations, engage in irrational or over-leveraged investment behavior. This type of irrational investment behavior actually contributes to the formation and growth of the house price bubble (Case & Shiller, 2003; Shiller, 2006). The consequence of this excessive investment is that if real estate prices eventually plummet and the bubble bursts, the entire financial system is likely to experience significant and sustained losses. The belief that real estate prices will continue to rise fuels high levels of unrealized credit, and once the bubble bursts, the losses tied to this credit will likely spread throughout the real estate capital market, impacting various market participants including real estate enterprises, households, governments, banks, and investors (Sornette & Woodard, 2010). Therefore, it can be concluded that rising real estate prices alone do not imply system risk; instead, it is the excessive investment behavior or speculation triggered by rising real estate prices that creates system risk.

"Excessive" optimistic expectations and "excessive" investment behavior are the primary drivers of system risk. In fact, measuring the degree of "excess" is a central focus of academic research. Previous studies have utilized mathematical models to demonstrate that the larger the real estate price bubble or the higher the real estate prices, the greater the systemic losses in the event of a market downturn or bubble burst (Wen, 2010). However, the functioning of the economic and financial system is highly intricate, and determining the level of investment that is deemed "excessive" often necessitates empirical analysis or ongoing examination of financial practices. Therefore, this thesis aims to analyze the effects of increasing real estate prices on the behavior of various market participants and identify those behaviors that may give rise to system risk.

### **2.3.1.1 Impact of Rising Real Estate Prices on the Investment and Financing Decisions of Real Estate Development Enterprises**

Rising real estate prices can significantly impact investment and financing decisions made by real estate enterprises. During periods of rising real estate prices, these companies often opt to expand their production and increase the scale of their financing in order to maximize their profits. This phenomenon aligns with the primary mechanism observed in the real estate capital market, as discussed in the previous section. With regard to collateral, the increase in real estate prices leads to a rise in the value of the collateral available to firms. This, in turn, enhances their capacity to secure financing. Furthermore, as real estate prices rise, they create a sense of market buoyancy, favorable business conditions for real estate enterprises, and an increased

capability for credit-based financing. However, it is essential to consider that the liquidity of assets may be overestimated amid these circumstances. In terms of capitalization, rising real estate prices contribute to an increase in a firm's net worth and provide long-term solvency. Additionally, a positive expected earnings profile will correspondingly drive up a firm's share price.

Overall, rising house prices significantly enhance the capacity of real estate enterprises to secure both debt and equity financing. The favorable earnings profile of these firms not only grants them the ability but also incentivizes them to expand their production. This expansion is reflected in the financial markets through increased share prices, higher inventory levels, and an improved capacity to service long-term debt obligations.

### **2.3.1.2 Impact of Rising House Prices on Banks' Credit Behaviour**

Rising real estate prices have a threefold impact on banks' credit behavior: on the demand side, the supply side, and on the real estate assets held by banks. Firstly, increasing real estate prices influence banks' credit behavior on the demand side of the real estate market. As real estate prices climb, the appraised value of real estate mortgages also rises, prompting banks to expand their mortgage lending. If the loan-to-value ratio (LTV) remains constant, this expansion leads to an overall increase in lending. Conversely, if the total lending remains unchanged, the LTV will decrease, making mortgages appear less risky to banks and thereby encouraging them to issue more loans (Zhang, 2008). Secondly, rising real estate prices impact banks' credit behavior on the supply side of the real estate market. With increasing property values, property development companies witness improved business prospects, prompting banks to perceive their credit risks more favorably. Consequently, banks become more inclined to extend larger loans for property development projects (Herring & Wachter, 1999). Lastly, rising real estate prices affect banks' credit behavior through influencing their holdings of real estate assets. As real estate prices rise, the value of banks' real estate holdings increases, contributing to a rise in their capital. This, in turn, improves the credit capacity of banks, leading them to continue extending loans during this period.

Overall, rising real estate prices will lead to an increase in banks' credit capacity and lower risk expectations. This will directly result in an expansion in the scale of bank credit, especially in the areas of home mortgages and real estate development loans.

### **2.3.1.3 Impact of Rising Real Estate Prices on Individual and Institutional Investors' Decisions**

Rising real estate prices can influence investors' investment decisions in two ways. Firstly, it can stimulate investment in the real estate market as debtors. Secondly, it can encourage investment in the real estate capital market as creditors or shareholders. On one hand, increasing real estate prices result in higher property values, making real estate an attractive investment asset with greater potential for profits. This leads to an influx of investors, including speculators, into the real estate market (De Long et al., 1990). Speculation, in turn, can further drive up real estate prices in the short term. However, the combination of rising prices and speculation may also contribute to the formation of a house price bubble (Zhao & Tu, 2008). The increase in investors' investment in the real estate market can be observed through the growth of their debt in the real estate capital market. As real estate prices rise, banks and other investors become more willing to provide loans. Additionally, the profitability of real estate development firms increases, attracting investments from investors. They may choose to invest in real estate development companies, financial institutions, funds, or trusts that operate in the real estate market. This expansion of investment is reflected in their role as creditors or shareholders in the real estate capital market. Consequently, their equity holdings in real estate enterprises or financial institutions that invest in real estate or bonds also increase.

### **2.3.1.4 Impact of Rising House Prices on Systemic Risk**

To summarize the aforementioned analysis, the impact of rising real estate prices on the investment behavior of real estate enterprises, banks, and investors can be outlined as follows. Firstly, for real estate enterprises, it may lead to the development of overly optimistic market expectations, resulting in increased debt ratios, expanded investment scales, and the accumulation of large inventories. Consequently, the enterprises may underestimate liquidity risk. Secondly, banks may issue substantial quantities of real estate loans, either on the supply side (development loans) or on the demand side (mortgages) of the real estate market, thus exposing themselves to credit default risk and liquidity risk. Thirdly, investors may engage in significant speculative behavior, obtaining substantial amounts of credit to enlarge their investments in both the real estate market and the real estate capital market. In doing so, they risk losses in both debt and equity investments.

It is worth noting that there is another key player in the Chinese real estate market: local governments. Local governments hold a monopoly in the land market,

and the surge in real estate prices is directly linked to the increase in land prices. This, in turn, leads to a significant rise in demand for land (Guo, 2013). Consequently, local governments can generate higher revenue from land concessions, thereby experiencing an overall increase in government income. However, Chinese local governments often face a substantial funding gap for urban construction and public services, resulting in a reliance on issuing debts to finance these needs. One crucial source of financing for local governments is the revenue generated from land concessions. As a result, if real estate prices decline, causing a drop in land prices and land transactions, local governments may encounter difficulties in servicing their debts. This, in turn, exposes investors in local governments' debts to the risk of default.

Next, this thesis will analyze the potential losses that market participants face when real estate prices fall and how these losses are transmitted between market participants. To describe the transmission of system risk resulting from a decline in house prices, we will examine the interactions between participants in the real estate market, financial markets, and the macroeconomy.

### **2.3.2 Real Estate Price Falls and the Transmission of Systemic Risk**

To illustrate the losses incurred by participants in the real estate capital market when real estate prices fall or bubbles burst, the thesis constructed a conceptual framework for the transmission of system risk in such scenarios (see Figure 2.5). This framework visually depicts the transmission of losses to individual market participants in the real estate market, the real estate capital market, and the macroeconomy when there is a decline in real estate prices or the bursting of a housing bubble.

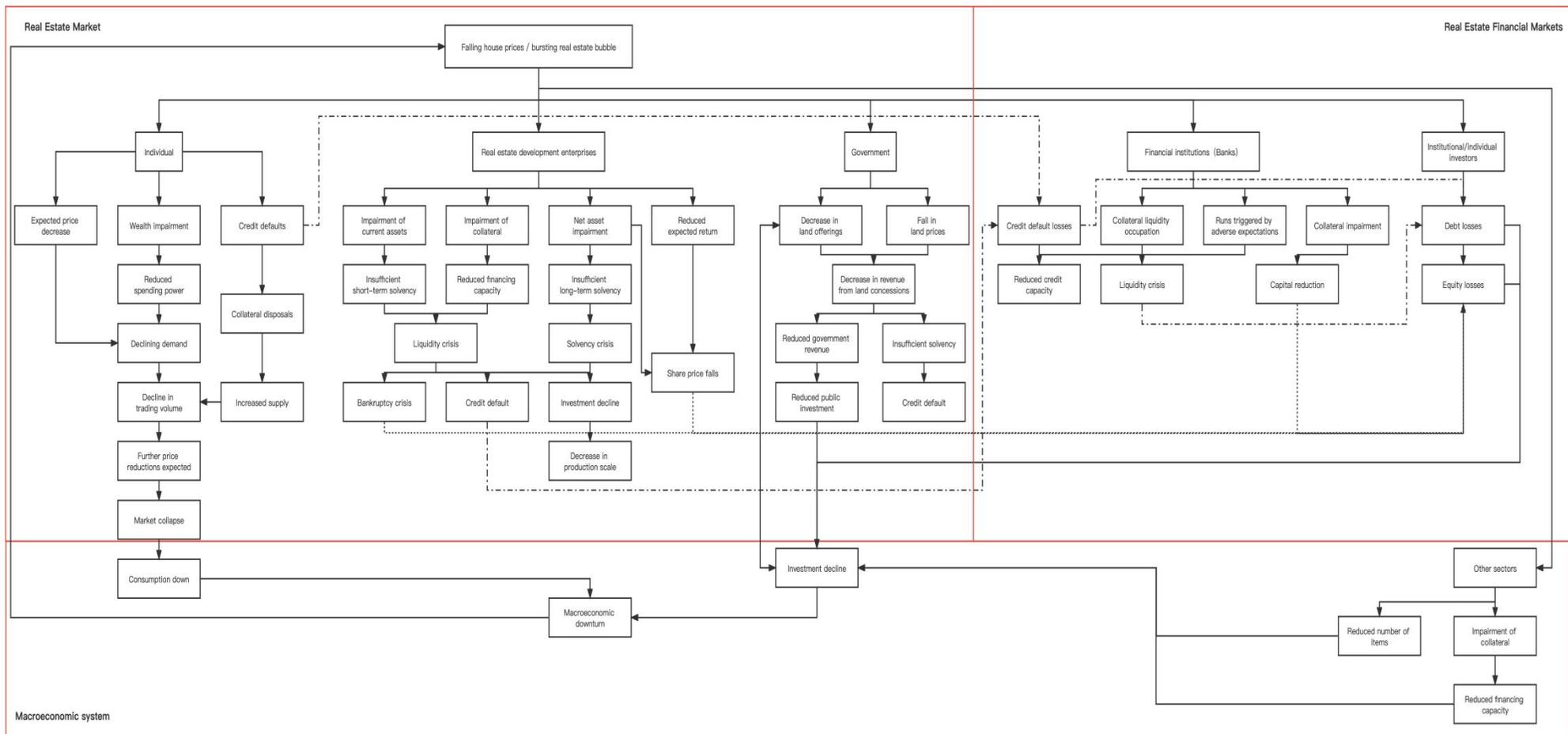


Figure 2.5: System risk transmission mechanisms in the event of fall in house prices

Note: Self-constructed. Derived from articles of Bai et al., 2020 and Cai, 2018

### **2.3.2.1 Real Estate Market**

Direct market participants in the real estate market include real estate demanders (individuals or households), real estate suppliers (real estate enterprises), and land suppliers (government). When real estate prices decrease, individuals or households adjust their price expectations and experience a loss in wealth. Moreover, the value of real estate collateral rises and falls during the cycle of rising and falling real estate prices. If the loan-to-value ratio (LTV) is too high, borrowers may choose to abandon the collateral and intentionally default when real estate prices drop significantly. The disposal of defaulted collateral increases the market supply. Given the market's anticipation of falling real estate prices and the impaired wealth of demanders, these factors may collectively contribute to a decrease in market activity and expectations of further price drops, ultimately resulting in a demand slump in the real estate market (Lu, 2010).

For real estate enterprises, a decrease in real estate prices will have implications for both liquidity and capitalization. In terms of liquidity, falling real estate prices will result in impairments of current assets like inventory, as well as impairments of collateral such as fixed assets. The impairment of inventory will expose real estate enterprises to short-term solvency issues, while the impairment of collateral will hinder their ability to raise capital. Capitalization will be affected as well, with lower real estate prices leading to a reduction in net assets and lower expected earnings. Consequently, this will result in direct losses in the owner's equity of the company, as well as long-term solvency challenges. In the case of listed enterprises, falling real estate prices also lead to a decline in share prices, which affects short-term and long-term solvency, as well as financing capacity. Such circumstances potentially subject the enterprise to liquidity or solvency crises stemming from credit defaults, loss of shareholder equity, and even bankruptcy. Even if the company manages to avoid bankruptcy, its investment, production, and operational capacity will be weakened. The decline in production and operational capacity of real estate enterprises will lead to reduced supply in the real estate market, which in turn impacts the government's offerings of land, resulting in a reduction in land supply. Simultaneously, lower real estate prices will also drive down land prices. Consequently, the decrease in real estate and land prices will lead to a decline in government revenue from land concessions. This reduction in revenue may trigger a government debt crisis, thereby exposing investors in financial markets to further

losses.

### **2.3.2.2 Real Estate Capital Market**

The main providers of funds in the real estate capital market are financial institutions, including banks, as well as individual and institutional investors. These individuals and institutions may choose to invest their funds directly in the real estate capital market or indirectly through intermediaries such as banks and other financial institutions.

The immediate impact of falling real estate prices on banks and other financial institutions is a decrease in the value of collateral. Simultaneously, potential credit losses arising from defaults on real estate mortgages, credit defaults by real estate development companies and governments, will impair banks' assets. At this stage, there is a high likelihood of a run on collateral due to liquidity constraints and investor panic triggered by unfavorable market expectations. This, in turn, can lead to a liquidity crisis for the banks, exposing them to bankruptcy. Even if a bank manages to avoid bankruptcy, its investors and depositors may still suffer substantial losses. The market's liquidity problem would be further compounded by the banks' own lack of liquidity, resulting in a decrease in their lending capacity. Moreover, individual and institutional investors who have debt investments will also face losses resulting from credit defaults by property development companies, governments, and banks. Furthermore, investments in equity capital will experience losses due to declining share prices of real estate enterprises and diminished capital of both real estate enterprises and banks (Demyanyk & Van Hemert, 2011; Gai, Kapadia, Millard, & Perez, 2008).

### **2.3.2.3 Macroeconomy**

The impact of falling real estate prices on the macroeconomy manifests through a decline in consumption and investment (Bernanke & Gertler, 1990; Kiyotaki & Moore, 1995). The property market downturn has led to reduced consumption and diminished productive capacity of real estate enterprises. Lower fiscal revenues have resulted in decreased public investment by the government, while the financial sector experiencing reduced credit capacity and non-real estate firms facing diminished investment capacity have further contributed to the decline in overall investment (Rogoff & Yang, 2021). Such declines in investment and consumption can trigger a macroeconomic recession. Furthermore, if the shock to the macroeconomy is particularly severe, it can further impact real estate prices. This creates a feedback

mechanism where falling real estate prices and financial crises reinforce each other, leading to a vicious cycle (Schinasi, 2004; Wagner, 2010). Consequently, financial crises resulting from system risks have the potential to evolve into all-encompassing financial crises.

## **2.4 Selection of Research Subjects and Content for Empirical Analysis**

The previous section presented the conceptual framework outlining the transmission mechanism of system risk in the real estate capital market, as well as the relationship between real estate price fluctuations and system risk. This framework explains how system risk is theoretically transmitted among participants in a system that comprises the real estate market, the real estate capital market, and the macroeconomy. In this section, the thesis will further analyze the conceptual framework by discussing three channels through which real estate price fluctuations trigger the transmission of system risk. Additionally, the thesis will specify the objective and research content of the empirical analysis section, which aims to examine the presence of system risk transmitted through the channels involving real estate enterprises in the real estate capital market.

### **2.4.1 Channels of Transmission of Systemic Risk Arising From Real Estate Price Fluctuations**

According to the conceptual framework outlined in the preceding section, it is evident that the effect of real estate price fluctuations on the real estate capital market is directly felt by households, the government, and real estate enterprises. Subsequently, this impact is transmitted through these entities to financial institutions such as banks and investors. Consequently, the transmission of system risk resulting from real estate price fluctuations in the real estate capital market can be classified into three channels: the household channel, the government channel, and the real estate enterprise channel.

### **2.4.2 Confirmation of the Choice of Subjects and Content of the Study for Empirical Analysis**

Based on the conceptual framework, the empirical analysis can be conducted through two alternative methods. Firstly, it can explore the impact of real estate price

fluctuations on different market participants and the transmission of such impact among individuals within a particular market participant. For instance, one can study the influence of real estate price fluctuations on banks and the transmission of risks between different banks. Secondly, it is essential to investigate the transmission of shocks caused by real estate price fluctuations across various market participants, starting with the channels described earlier. For instance, it is necessary to examine the risks faced by real estate enterprises due to real estate price fluctuations and the resulting impact on banks and the stock market. In line with the research objectives of this thesis, it becomes evident that an empirical analysis of the transmission channels is a more meaningful approach to validate the existence of system risk in the Chinese real estate capital market. This analysis will also shed light on the efficacy of the transmission channels and provide policy recommendations to the Chinese government's real estate regulators for risk prevention.

This study places particular emphasis on the role of real estate enterprises in the empirical analysis for several reasons. Firstly, the Chinese real estate market is largely dominated by new homes (commonly referred to as primary homes), and real estate enterprises, being the primary suppliers in the market, play a central role in the functioning of both the real estate market and the real estate capital market. As discussed in the previous section, the risks associated with real estate enterprises have garnered significant attention, including from government regulators. However, there is relatively limited research on the transmission of system risks through these enterprises, which deserves greater scrutiny from scholars. Secondly, the household channel has emerged as a prominent area of focus in the existing literature on system risk, particularly with regard to household loan defaults. Scholars have dedicated considerable efforts to researching this topic, both theoretically and empirically. Therefore, investigating the real estate enterprise channel can provide a comprehensive understanding of system risk in the real estate capital market. Finally, in the empirical analysis of the government channel, there is a lack of a corresponding database due to the unavailability of government land grant and debt-related data. As a result, it is not possible to accurately quantify the risk of real estate price fluctuations transmitted through the government channel.

For these reasons, the thesis identifies the empirical analysis component of the study as system risk transmitted through the real estate enterprise channel, consisting of three specific components.

The first component is the direct impact of real estate price fluctuations on the risk of real estate enterprises. The second component focuses on the bank risk that arises from real estate price fluctuations through the real estate enterprise channel. Specifically, it examines how the loss of bank-related claims resulting from real estate price fluctuations on real estate enterprises will further impact the credit risk and liquidity risk of banks. The third component investigates the impact of real estate price fluctuations on the stock market through the real estate enterprise channel. Its main objective is to analyze how real estate price fluctuations affects the share price of real estate enterprises.

If the empirical analysis yields the finding that a decline in house prices will negatively affect real estate enterprises and that this shock will subsequently transmit through these enterprises to financial institutions like banks and the stock market, it implies that a drop in real estate prices or the bursting of a housing bubble would trigger system risk transmitted through the real estate enterprise channel.

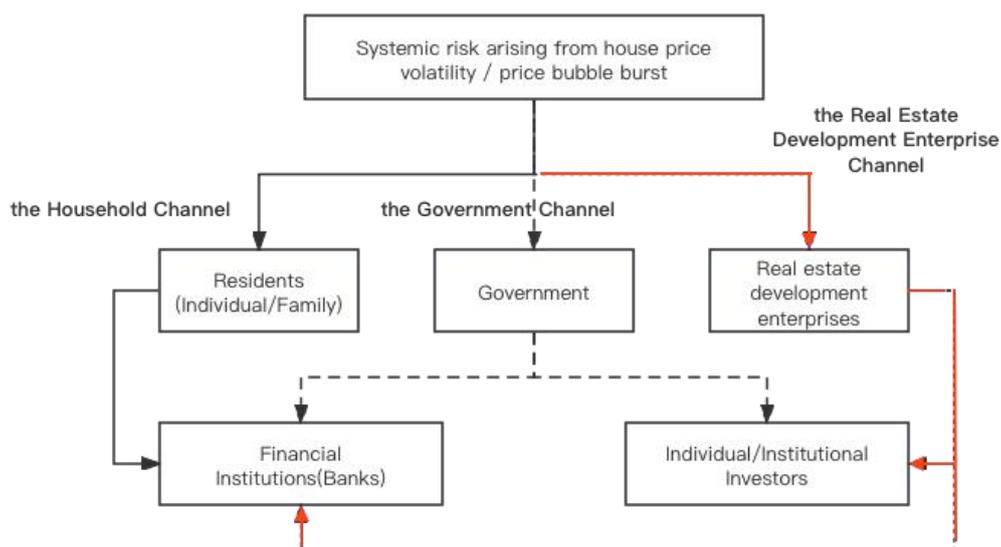


Figure 2.6: Three channels for the transmission of system risk arising from real estate price fluctuations

Note: Self-constructed.

In more detail, the empirical analysis should commence with an examination of the direct impact of fluctuations in real estate prices on the risk faced by real estate enterprises during the attribution process. The impact of real estate price fluctuations on these enterprises primarily manifests in their liquidity and solvency, which ultimately affects their credit default probability. Specifically, changes in real estate prices can influence the short-term and long-term solvency of real estate enterprises. According to theory, there should be a positive correlation between house prices and a

firm's capacity to service short-term and long-term debts. However, if a decline in real estate prices leads to a significant reduction in the firm's ability to service its debts in both the short and long term, it could result in a liquidity or solvency crisis for the company. Additionally, it is crucial to examine how fluctuations in real estate prices affect a firm's financing capacity. If a decrease in real estate prices significantly diminishes a firm's ability to raise capital, it may struggle to secure funds to navigate through a liquidity crisis, thereby increasing the likelihood of triggering system risk. Lastly, scrutinizing the impact of real estate price fluctuations on the probability of default serves as a more direct indicator of the risk posed to property development companies as a result of such price fluctuations.

Finally, the thesis analyzes the influence of real estate price fluctuations on the stock market through the real estate enterprise channel. Changes in real estate prices can directly affect the stock prices of real estate enterprises. A prolonged increase in real estate prices may mask the associated risks, and when real estate prices eventually decline, it can lead to a significant decrease in the stock prices of real estate enterprises, causing substantial losses for investors and reducing the enterprises' capacity to raise funds through the capital market. This, in turn, can have a detrimental effect on the overall stock market.

The key issues to focus on in the empirical analysis can be summarized as follows: For real estate enterprises, it is important to examine the impact of real estate price fluctuations on their long-term and short-term solvency, financing capacity, and default risk. Banks should be mindful of the effects of real estate price fluctuations on their credit risk and liquidity due to loans extended to developers. In the context of stock markets, it is crucial to consider the impact of real estate price fluctuations on firm share prices. An essential aspect in analyzing whether real estate price fluctuations trigger system risk is to assess the differential impact on market participants during periods of rising and falling real estate prices. Specifically, if there is a significant discrepancy in the impact on these participants during these periods, particularly with a greater impact during falling real estate prices than during rising ones, it suggests the presence of system risk.

## **2.5 Chapter Summary**

Based on an elaboration of the meaning and characteristics of systemic risk in the real estate capital market, this chapter compared the transmission mechanisms of systemic risk in the real estate capital market with the current situation of China's real

estate and real estate capital markets. It also summarized the conceptual framework for the relationship between real estate price fluctuations and systemic risk, and clarified the purpose of the subsequent empirical analysis.

#### (1) Characteristics of systemic risk

Systemic risk refers to the possibility that a series of severe adverse shocks, once triggered, can spread across financial institutions, market participants and even the entire financial system, and eventually evolve into a financial or even economic crisis. Its main characteristics are system risk is system-wide in nature, arising from events with the potential to generate large adverse shocks; its transmission depends on financial instruments and the structure of financial linkages, through which disturbances can spread across institutions and markets; it is characterized by asymmetric positive feedback, in the sense that negative shocks are more easily and more strongly amplified than positive ones; and it tends to emerge endogenously within the system, often requiring external intervention to diversify, attenuate, or stabilize its effects.

#### (2) Factors specific to systemic risk in China's real estate capital market

Compared with the general financial market, systemic risk in China's real estate capital market has several distinctive sources: In China's real estate sector, the long duration of credit use in real estate projects makes the accumulation and amplification of risk more time-persistent; at the same time, the heavy reliance on collateral especially property collateral magnifies the impact of price fluctuations on credit risk; moreover, the tight coupling between real estate financing, local-government land finance, and bank balance sheets allows shocks in the real estate market to cross more easily into the public sector and the broader financial system.

#### (3) Transmission mechanisms.

Systemic risk in the primary real estate capital market is mainly transmitted through the collateral, liquidity, and capital channels, while in the secondary real estate capital market it is transmitted primarily through asset securitization. When real estate prices fall, the collateral channel operates as lower property values weaken collateral, increase borrowers' default probability, and expose lenders to collateral devaluation risk; the liquidity channel operates as falling prices impair developers' cash positions, slow inventory turnover, and tighten external financing, while banks simultaneously confront tied-up collateral, credit losses, and panic-driven withdrawals, together generating liquidity stress; the capital channel operates as both banks and real

estate development enterprises incur capital losses, which may trigger solvency concerns and investor losses. By contrast, in mature markets such as the United States, systemic risk can spread widely through the asset-securitization channel via MBS and related products, whereas in China this channel remains at an early and relatively small scale, and is therefore documented in the literature but not treated as the core transmission path.

#### (4) Reasons for overoptimistic expectations

Over-optimistic expectations formed during the rising phase of real estate prices can become a key behavioural trigger of systemic risk: real estate development enterprises may extrapolate high prices, raise leverage, expand investment, and hold large inventories, thereby underestimating liquidity and refinancing risks; banks may extend large amounts of real-estate-related credit on both the supply side (development loans) and the demand side (mortgages), increasing their exposure to credit-default and liquidity risk; individual and institutional investors may engage in speculative purchases and use leverage to enlarge positions in real-estate-linked assets, leaving themselves vulnerable to both debt-default and equity-price losses once prices reverse; and local governments may experience falling land prices and shrinking land-transfer revenues in a downturn, weakening their debt-servicing capacity and transmitting losses to investors in local-government-related products. Taken together, these overoptimistic behaviours explain why, once house prices fall, losses can emerge simultaneously on the balance sheets of developers, banks, investors, and local governments.

#### (5) Loss transmission and macro feedback

A fall in house prices can cause losses in multiple segments of the real estate market, the real estate capital market and the macroeconomy, and these losses can be transmitted across sectors. For households, falling prices reduce wealth, alter price expectations and may induce mortgage defaults. For real estate enterprises, both long-term and short-term solvency and financing capacity deteriorate, which may lead to credit default, equity erosion or even bankruptcy. For governments, shrinking land-transfer revenues raise the risk of default. For financial institutions, lower collateral values, mortgage defaults and credit losses can trigger liquidity problems and even runs. At the macro level, lower prices depress consumption and investment; if the macro shock is strong enough, it can further push real estate prices down, forming a vicious feedback loop between house-price declines and financial stress.

(6) Empirical focus of this thesis

Against this background, this thesis will empirically analyse the transmission of systemic risk primarily through the real estate development enterprise channel, proceeding in three closely connected steps: first, it examines the direct impact on real estate development enterprises, assessing how real estate price fluctuations affect their solvency, financing capacity, and probability of default; second, it investigates the impact on banks via the enterprise channel, identifying how stress originating from developers is transmitted to banks' credit risk and liquidity conditions; and third, it analyses the impact on equity markets through the same channel, testing how real estate price fluctuations are reflected in developers' stock prices and in the market pricing of real-estate-related risks

## Chapter 3 The Impact of Real Estate Price Fluctuations on the Risk of Real Estate Development Enterprises

Starting from this chapter, the thesis will analyze whether fluctuations in real estate prices transmit system risk through the channel of real estate enterprises, banks, and the stock market. This analysis will be based on the empirical research ideas presented in Chapter 2. As discussed in the theoretical analysis in Chapter 2, fluctuations in real estate prices can directly expose real estate enterprises to risks, especially in terms of solvency and liquidity risks. This chapter will primarily examine the impact of real estate price fluctuations on the risk profiles of real estate enterprises. Specifically, it will investigate whether such fluctuations lead to solvency or liquidity risks for these enterprises, as well as whether they affect the probability of default.

This chapter is organized as follows: First, the financial indicators such as the actual inventory value, total assets, asset liability ratio, and inventory value ratio of real estate enterprises will be adjusted according to the characteristics of these enterprises. Second, the analysis will focus on the solvency of real estate enterprises under fluctuating house prices. Long-term solvency reflects an enterprise's ability to cope with solvency risk, while short-term solvency reflects its ability to handle liquidity risk. Third, the chapter will examine the impact of real estate price fluctuations on the financing capacity of real estate enterprises, as well as the probability of default for these enterprises. Finally, the chapter will provide a summary of its contents.

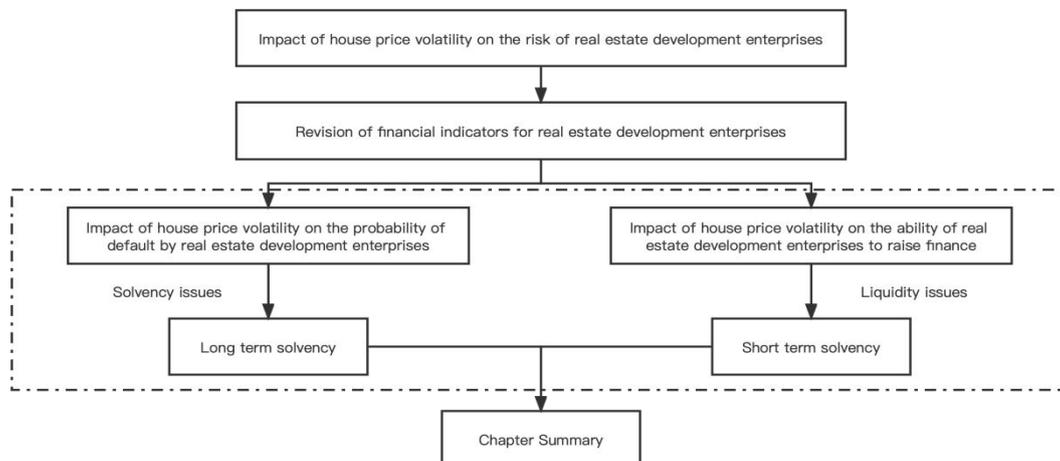


Figure 3.1: Structure of this chapter

Against this backdrop, this chapter consolidates the motivation into a clear agenda. It first situates developers' sensitivity to housing-price movements within China's pre-sale, high-leverage, high-inventory setting, then asks whether such movements systematically translate into changes in liquidity and longer-horizon solvency, and whether the strength of transmission differs across firm types. A panel design based on listed developers and accounting measures aligned with pre-sale practices is employed, alongside standard estimation and extensive robustness checks. The aim is to identify the direction and magnitude of the price-to-fundamentals link under China's institutional features. The contribution is a China-consistent measurement framework and enterprise-level evidence that inform risk monitoring and policy design.

### **3.1 Revision of Financial Indicators for Real Estate Development**

#### **Enterprises**

As the annual report data published by real estate enterprises employs the principle of the lower of cost or net realizable value to calculate the value of inventories and total assets, the cost usually tends to be lower than the net realizable value, assuming that real estate market prices generally remain elevated. Consequently, the book value of inventory, as accounted for by the accounting valuation principle, tends to represent the acquisition cost of inventory, essentially disregarding the characteristics of the enterprise's operating activities and failing to reflect the increase in fair value of inventory according to market changes during the inventory holding phase. Additionally, due to the existence of a pre-sale system in the real estate market, a portion of the inventory value recorded in an enterprise's books is already pre-sold to real estate purchasers and therefore does not actually count as an enterprise asset in practice. Nevertheless, accounting standards require this portion of inventory to be accounted for in the corporate books. Previous analyzes and studies reveal that the adverse impacts of real estate price fluctuations on real estate enterprises are mainly through the liquidity and capitalization channels. Therefore, directly examining liquidity and solvency issues arising from real estate price fluctuations using the book value of enterprise financial indicators is likely to yield inaccurate conclusions. Hence, it is imperative to first adjust the book value of the real estate enterprise's financial indicators to obtain the actual value, and subsequently use this actual value for further analysis.

### 3.1.1 Calculation of Actual Values of Financial Indicators

#### 3.1.1.1 Adjustments to the Value of Inventories in Real Estate Development Enterprises

The core of the adjustment of enterprise financial indicators is the adjustment of inventory value. Due to problems arising from pre-sale policies and accounting valuation principles in China's local real estate sales policy, the actual inventory value of enterprises is often higher than the book value, so this thesis makes adjustments to the book inventory value of enterprises in order to calculate the actual inventory value. Firstly, adjusting for problems arising from pre-sale policies. The inventory calculated in the accounting includes the part that has been pre-sold to the purchaser, which is in fact no longer an asset of the enterprise, but an asset of the purchaser. The corresponding pre-receipts of the enterprise include both the value of this inventory and the profit made by the enterprise from the sale of this inventory. Therefore, an adjustment needs to be made to the inventory held by the business. The value of the inventory of the purchaser that is already pre-sold is separated from the book inventory value and can be calculated using Equation 3.1.

$$IV_c^e = IV_a^e - AR^e \times (1 - OPR^e)$$

[Equation 3.1]

$IV_c^e$  is the corrected value of inventory owned by enterprise e,  $IV_a^e$  is the book value of inventory owned by enterprise e,  $AR^e$  is the deposit received of enterprise e,  $OPR^e$  is the operating margin of enterprise e.

Secondly, adjust the change in the actual inventory value due to real estate price changes. The value of inventories calculated in accordance with accounting standards is measured based on the lower of cost and net realisable value. In the context of rising house prices, although the realisable value of inventories is increasing, the carrying value of inventories does not change. Therefore the actual value of inventory held by an enterprise with an underestimated inventory carrying value in this situation can be calculated using Equation 3.2.

$$IV_r^e = IV_c^e \prod_{j=0}^q REPI_{t-j}^e$$

[Equation 3.2]

$IV_r^e$  is the actual value of inventory held by enterprise e, q is the length of time enterprise e has held inventory (in quarters),  $REPI_{t-j}^e$  is the chain index of the 100-city real estate price index for enterprise e in period t (the index was 100 in the previous period).

Above equations allow for a relatively accurate estimate of the change in the actual inventory value of a firm's inventory holdings during q quarters as house prices change.

### 3.1.1.2 Adjustments to Total Assets, Inventory Value Ratios and Asset-Liability Ratios of Enterprises

By calculating the actual inventory value of the enterprise and calculating the actual total assets of the enterprise (Equation 3.3), the actual inventory value ratio (Equation 3.4) and the actual asset-liability ratio (Equation 3.5) can be further calculated.

$$ATA_r^e = ATA_a^e - IV_a^e + IV_r^e$$

[Equation 3.3]

$$AIVR^e = IV_r^e / ATA_r^e$$

[Equation 3.4]

$ATA_r^e$  is the actual total assets of enterprise e,  $ATA_a^e$  is the total book assets of enterprise e.  $AIVR^e$  is the actual inventory value ratio of enterprise e.

$$RALR^e = TL^e / ATA_r^e$$

[Equation 3.5]

$RALR^e$  is the actual asset-liability ratio of enterprise e,  $TL^e$  is the total liabilities of enterprise e.

## 3.1.2 Analysis of Financial Indicators of Real Estate Development Enterprises

Through the preliminary processing of enterprise financial data, the actual inventory value, actual total assets, actual inventory value ratio and actual asset-liability ratio of sample real estate enterprises can be obtained. Figure 3.2 shows the average book asset liability ratio and actual Asset Liability Ratio of Sample enterprises and the China's 100-City real estate price index from the third quarter of 2006 to the fourth quarter of 2020.<sup>3</sup>

<sup>3</sup> Although the sampling window (2006Q3–2020Q4) spans the 2007–2008 global financial crisis and the initial phase of COVID-19, the empirical specification does not include event dummies for these episodes. This choice reflects the study's focus on how fluctuations in China's housing prices map into China's financial system risk. During 2007–2008, the transmission from the U.S. subprime crisis to China's real-estate finance was dampened by

The four phases below are not read off Figure 3.2, but are defined according to policy and market turning points identified in earlier studies on China’s housing cycle (Kuang, 2010; Insight & Info Consulting Ltd., 2020; Forward Industrial Research Institute, 2020; Xu, Wang, Wu et al., 2020). Following this literature, and consistent with the sequence “tightening - stimulus - destocking - ‘housing is for living in,’” the market is divided into four phases: (1) 2006–2009 pre-crisis expansion under gradual tightening; (2) 2009–2012 stimulus-driven surge; (3) 2013–2015 adjustment and destocking under differentiated control; and (4) 2015–2020 stabilization and financial deleveraging under the “housing is for living in, not for speculation” principle (see also National Bureau of Statistics of China, 2023; Geng, 2020).

As shown in Figure 3.2, Chinese real estate prices have experienced four distinct phases from 2006 to 2020. The first phase occurred from 2006 to early 2009. During this period, Chinese real estate prices exhibited an upward trend, with a minor decline starting in mid-2008. This decline was primarily attributed to the global financial crisis that impacted the Chinese economy, resulting in reduced demand for real estate and subsequent price decreases.

The second phase extended from mid-2009 to the end of 2012. During this time, Chinese real estate prices began a continuous upward trajectory, accompanied by growing enthusiasm in the real estate market. However, by mid-2011, China’s macroeconomic growth slowed, prompting the Chinese State Council to implement corresponding policies and regulations. These measures aimed to strengthen macroeconomic control and suppress the excessive increase in real estate prices, leading to a modest price correction.

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the relative segmentation of domestic financial markets and contemporaneous macroeconomic policy regimes; imposing a common crisis shock could therefore blur identification centered on within-China price dynamics. In addition, the available firm and bank level data through 2020Q4 capture only the early stage of the pandemic, before its macro-financial effects were fully observable in accounting data. For transparency, this chapter interprets results through the lens of domestic price movements rather than parametrizing these events. Future research can extend the specification—with crisis-period dummies, interactions, or sub-sample analyzes—to isolate the incremental impact of the global financial crisis and COVID-19 on China’s real-estate–financial nexus.

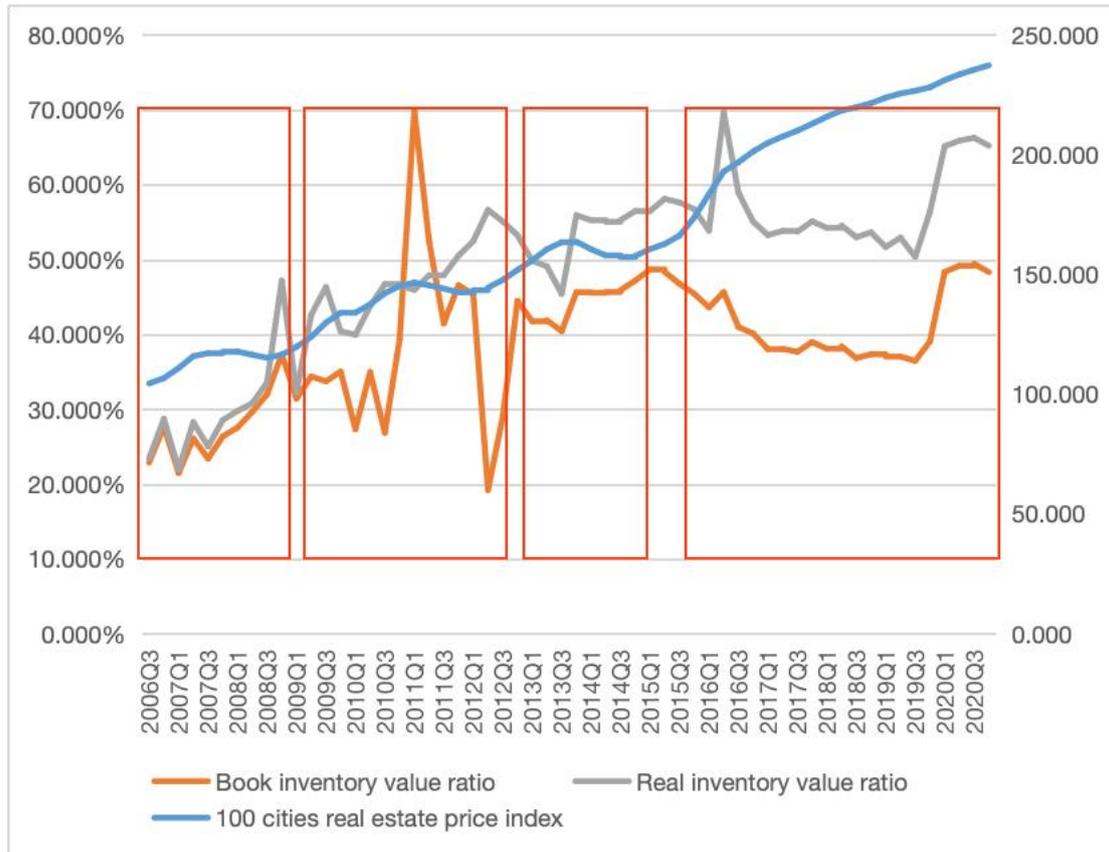


Figure 3.2: The Average Book Inventory Value Ratio, Average Actual Inventory Value Ratio, and China's 100-City real estate price index of Sample Enterprises

Data source: National Bureau of Statistics of China & Wind Information

The third phase spanned from early 2013 to early 2015. During this time, China's real estate market experienced a rebound, as numerous cities began to loosen their regulation policies, leading to a continuous increase in real estate prices. The viewpoints of the central government and local governments regarding real estate market regulation exhibited a polarized trend. In practice, while the central government bore the primary responsibility for regulation and control, local governments were tasked with implementation. However, due to varying policy objectives between the two levels of government, some local governments deliberately weakened their regulation efforts and failed to fully enforce relevant policies. In the latter half of 2014, as the central government intensified its regulation measures and pressed for stricter implementation by local governments, the real estate market witnessed a certain level of price correction.

The fourth phase began in the third quarter of 2015 and continues to the present. During this period, the Chinese real estate market has witnessed a sustained and rapid increase in prices. Between 2015 and 2016, there was a new wave of price surges in

the real estate sector, primarily driven by the ongoing relaxation of China's macroeconomic policies and a significant easing of monetary and credit policies in that year. Additionally, the real estate destocking policy, spearheaded by the central government and implemented in collaboration with local governments, further contributed to the continuous rise in real estate prices. However, despite the central government's emphasis on "housing for living, not for speculation", the overall real estate market in China continued to rise, although at a slower pace compared to 2015 and 2016.

Figure 3.2 illustrates the inventory value ratios of real estate development firms, revealing a certain time lag between changes in these ratios and the corresponding changes in real estate prices. Notably, the fluctuations in the inventory value ratios of real estate enterprises are considerably more pronounced compared to those in real estate prices.

Over the past 15 years, there have been four significant fluctuations in the actual inventory value ratios of the sample companies, indicating that these firms have taken precautionary measures to mitigate potential risks associated with property price fluctuations. They have done so by reducing their inventories, thus releasing funds and managing liquidity risks. Since the fourth quarter of 2011, the actual inventory value ratios of the sample companies consistently surpassed the 50% threshold and remained at that level, peaking at 70%. This highlights that while the sample companies have been adjusting their inventories in response to the risks posed by real estate price fluctuations, changes in the macroeconomic environment and the persistent implementation of government regulatory measures have altered the supply-demand dynamics in the real estate market. Therefore, despite the efforts of the sample real estate companies to mitigate their liquidity risks by reducing inventories, the overall inventory value ratio remains high, indicating a persistent weakness in their risk prevention capabilities.

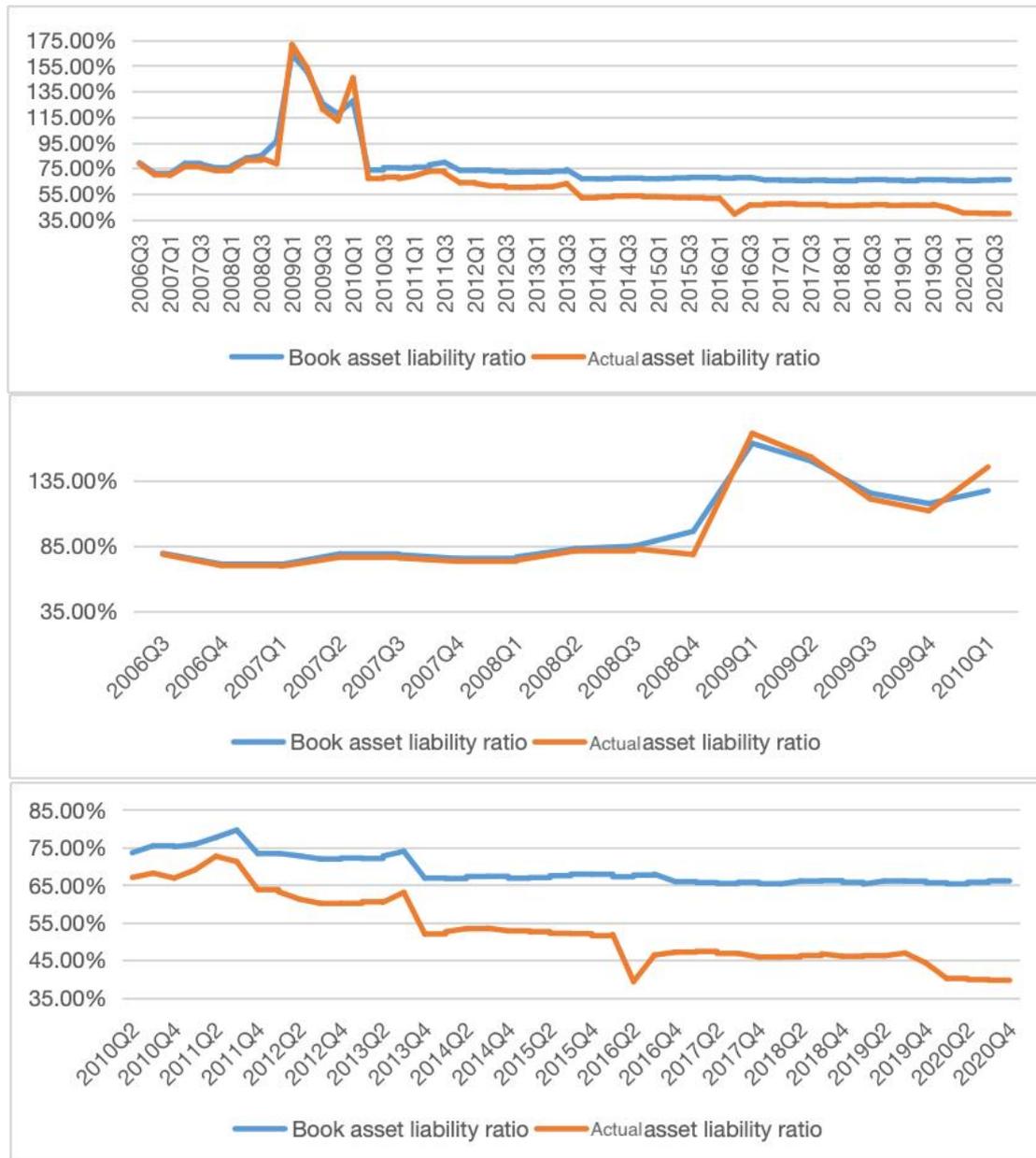


Figure 3.3: Average Book Asset-Liability Ratio and Actual Asset-Liability Ratio of Sample Enterprises

Data source: National Bureau of Statistics of China & Wind Information

Figure 3.3 shows that the average asset-liability ratio of real estate enterprises has remained between 60% and 80% since the third quarter of 2006. Specifically, from the second quarter of 2008 to the first quarter of 2010, both the actual and book asset-liability ratios experienced significant fluctuations due to the global financial crisis, resulting in internal macroeconomic volatility in China's real estate market. This led to various issues such as declining real estate prices and cash flow shortages for real estate enterprises. To prevent their business situation from deteriorating further and avoid bankruptcy, these companies had to rely on significant financing methods to raise funds from various financial institutions. The decline in real estate

prices caused the actual asset-liability ratio of real estate development companies to increase continuously, as shown in the figure. However, as the macroeconomic situation improved and the Chinese government implemented more relaxed real estate policies, the prices of ready-to-sell real estate assets held by these companies started to rise. This led to an increase in housing sales volume and a downward trend in both actual and book asset-liability ratios. Since the first quarter of 2010, both the book asset-liability ratio and actual asset-liability ratio of Chinese real estate enterprises have shown a sustained downward trend. The book asset-liability ratio has remained between 60% and 80%, while the actual asset-liability ratio has continuously declined, reaching a low of about 40%.

By analyzing the aforementioned situation, it can be argued that when a company faces high real estate prices, it will proactively choose to upgrade its inventory to maximize profits and enhance its interests. However, in a market characterized by risk and pessimistic real estate sales, a slowdown or decline in real estate prices can trigger a crisis for real estate enterprises. High inventory levels and a high debt ratio exert significant pressure on the company's short-term solvency and give rise to liquidity risk. To mitigate liquidity risk, companies should actively reduce their inventory levels. In practice, the fact that the actual inventory value ratio of Chinese real estate enterprises remained above 60% at the end of 2020 is worrisome (see Figure 3.2). A decline in real estate prices in China or further deterioration in real estate sales would directly lead to a rapid increase in companies' actual asset-liability ratio. Consequently, companies would face short-term liquidity risk as well as long-term solvency risk. These risks could propagate through the financial system to the macro-financial system, resulting in systemic financial risks. Consequently, such risks could trigger a ripple effect among financial market participants, leading to uncontrolled shocks and disruptions in both financial markets and the macroeconomy.

In order to provide a more comprehensive analysis of different types of real estate enterprises that better reflects the actual situation in Chinese society, this study takes into consideration the equity structure and scale of domestic enterprises in China. It is worth noting that most Chinese real estate enterprises operate nationwide, regardless of their registered address. Therefore, the sample of real estate enterprises in this thesis is divided into two categories: large enterprises and small enterprises. Following the guidelines outlined in the Notice on Printing and Distributing the Standards for Classifying Small and Medium-sized Enterprises issued by the Ministry

of Industry and Information Technology of China, large enterprises are defined as those with an annual income exceeding RMB 2 billion. On the other hand, small enterprises are defined as those with an annual income of less than RMB 2 billion or total assets of less than RMB 100 million. The second category includes state-owned enterprises and non-state-owned enterprises. State-owned enterprises are defined as companies whose actual controllers are either the local government or the central government's State-owned Assets Supervision and Administration Commission, in accordance with relevant regulations. All other enterprises are classified as non-state-owned.

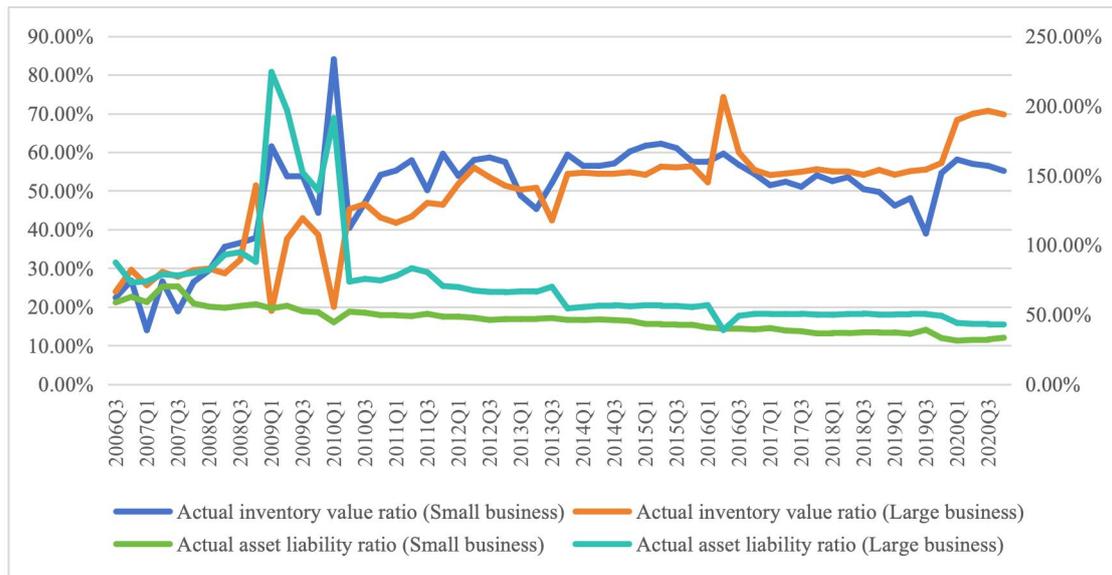


Figure 3.4: Average Inventory Value Ratio and Asset-Liability Ratio by Company Size

Data source: National Bureau of Statistics of China & Wind Information

Figure 3.4 presents the average actual asset-liability ratio and the average actual inventory value ratio for large firms and small firms when the sample firms in this study are categorized by firm size. As illustrated in Figure 3.4, the actual asset-liability ratios of large firms have consistently exceeded those of small firms throughout the sample period from 2006 to 2020. It is worth noting that, in the earlier period, the actual inventory value ratios of small firms were higher than those of large firms. This can be attributed to the fact that, during this time, the Chinese real estate industry was experiencing significant growth and the government was actively encouraging investment by real estate enterprises. Consequently, small firms, being subject to less regulatory oversight, displayed greater aggressiveness compared to their larger counterparts, leading to higher actual inventory value ratios. However, in recent years, the real estate market has slowed down and the Chinese government has

implemented stricter measures to control the real estate sector. As a result, the viability of small real estate enterprises has been compromised, leading to a decrease in their actual inventory value ratios, which has surpassed the decline observed in large real estate enterprises. Overall, large firms, with their high inventory and asset-liability ratios, are exposed to solvency risk in the event of rapidly declining real estate prices and liquidity risk due to challenges in liquidating their inventories. On the other hand, smaller firms face comparatively lower solvency and liquidity risks owing to their lower inventory and asset-liability ratios.

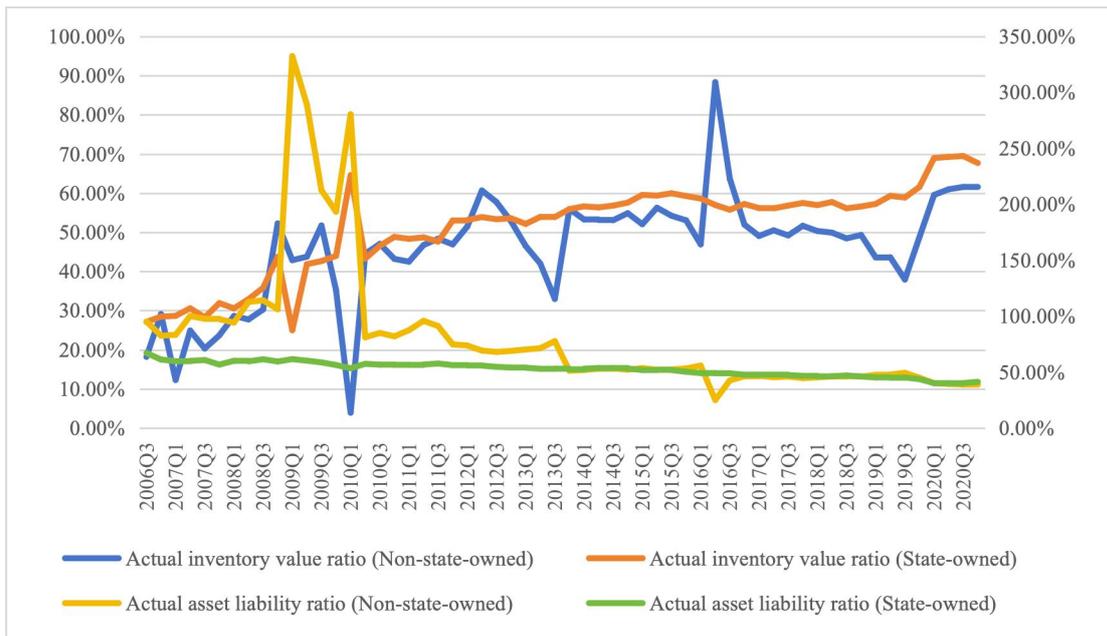


Figure 3.5: Average Inventory Value Ratio and Actual Asset-Liability Ratio by Company Type

Data source: National Bureau of Statistics of China & Wind Information

Figure 3.5 displays the average actual asset-liability ratio in comparison to the average actual inventory value ratio for state-owned enterprises and non-state-owned enterprises after categorizing the sample companies by enterprise type. As depicted in Figure 3.5, the actual asset-liability ratios of state-owned enterprises and non-state-owned enterprises exhibited significant disparities prior to 2014. State-owned enterprises maintained relatively stable actual asset-liability ratios, whereas non-state-owned enterprises experienced exceptionally high and volatile ratios. However, in recent years, with the implementation of stricter regulations by the Chinese government in the real estate market, the actual asset-liability ratios of non-state-owned enterprises have gradually declined, bringing them closer to the actual asset-liability ratios of state-owned enterprises. Simultaneously, there exists a notable discrepancy in the actual inventory value ratios between state-owned

enterprises and non-state-owned enterprises, with the former surpassing the latter. Theoretically, should there be a rapid decline in real estate prices, state-owned enterprises would be more vulnerable than their non-state-owned counterparts.

Generally speaking, based on the analysis of the current situation presented in Figure 3.2 to Figure 3.5, the impact of declining real estate prices is more pronounced on large enterprises compared to small enterprises, and especially on state-owned enterprises compared to non-state-owned enterprises. This could be attributed to the risk associated with the elevated inventory value ratio of enterprises, which will be further explored in subsequent studies within this thesis.

## **3.2 The Impact of Real Estate Price Fluctuations on Corporate Solvency**

If there is a significant decline in real estate prices and a substantial reduction in the market value of corporate inventories, it is likely to result in a solvency shortfall for businesses. This, in turn, can lead to widespread debt defaults and ultimately trigger system risk in the real estate capital market. The solvency of an enterprise is typically assessed in both the long-term and short-term perspectives, reflecting its ability to withstand asset impairment risks over these respective time frames. In the long-term, insolvency may emerge as a manifestation of solvency issues for the enterprise. In the short-term, it may lead to liquidity problems when current assets, particularly short-term liquid assets, prove insufficient to meet current debts. Considering these two aspects, the impact of real estate price fluctuations on enterprise solvency is multi-faceted and warrants differentiated examination in specific studies.

### **3.2.1 Long Term Solvency**

The study utilizes the actual asset-liability ratio of the sample companies as a data indicator to reflect the long-term solvency of enterprises. By analyzing the impact of house price fluctuations on the actual asset-liability ratio, this research establishes whether these fluctuations trigger solvency risk for enterprises. Previously, the author had assessed the adjusted actual inventory value of real estate development firms against the actual asset-liability ratio to examine changes caused by potential inventory impairment from declining house prices. This assessment serves to gauge the enterprises' ability to withstand price risk. In order to provide a more comprehensive understanding of the current risk landscape in China's real estate

market, this study selects data spanning from the third quarter of 2006 to the fourth quarter of 2020. Utilizing this dataset, the relationship between changes in corporate inventory value, inventory value ratio, and asset-liability ratio is analyzed. It is widely acknowledged in academic circles that when an enterprise's asset-liability ratio surpasses 80%, concerns may arise regarding its long-term solvency, potentially leading to a higher risk of debt default (Zhang, 2008; Huang et al., 2011).

**Table 3.1 Sensitivity analysis of the decline of enterprise inventory value and the change in business asset-liability ratio (All sample companies)**

Actual asset-liability ratios at different rates of decline in inventory value ratio							Percentage of companies with real asset liability ratio $\geq 80\%$ for different declining inventory value ratios						
Period	0% OFF	10% OFF	20% OFF	30% OFF	40% OFF	50% OFF	Period	0% OFF	10% OFF	20% OFF	30% OFF	40% OFF	50% OFF
2006	74.21%	76.04%	78.04%	80.24%	82.68%	85.41%	2006	15.09%	16.04%	21.70%	26.89%	33.49%	37.74%
2007	73.64%	75.20%	76.97%	78.96%	81.22%	83.79%	2007	13.92%	14.86%	18.87%	24.06%	31.84%	39.62%
2008	79.11%	79.17%	83.77%	85.74%	88.42%	91.69%	2008	15.09%	16.27%	17.92%	26.42%	36.56%	45.28%
2009	139.40%	138.34%	138.31%	138.90%	140.15%	142.15%	2009	10.85%	12.26%	13.68%	18.63%	28.07%	43.87%
2010	86.90%	85.08%	85.27%	87.98%	90.82%	94.43%	2010	5.19%	7.31%	9.20%	13.21%	23.58%	35.85%
2011	69.18%	70.85%	73.19%	76.29%	79.55%	84.49%	2011	6.84%	7.31%	9.43%	12.74%	27.12%	42.45%
2012	61.17%	64.09%	67.36%	72.10%	76.03%	81.36%	2012	3.77%	4.01%	7.78%	13.68%	28.07%	44.81%
2013	59.00%	61.45%	64.49%	68.09%	72.38%	77.53%	2013	3.77%	3.54%	6.13%	11.32%	25.71%	39.15%
2014	53.07%	56.16%	59.70%	63.81%	68.65%	74.43%	2014	1.65%	2.12%	5.19%	12.03%	31.37%	42.45%
2015	52.08%	55.15%	58.69%	62.82%	67.76%	74.00%	2015	0.71%	1.18%	1.65%	8.25%	24.29%	40.33%
2016	46.15%	58.16%	53.96%	61.01%	63.26%	68.11%	2016	0.47%	0.47%	0.71%	1.18%	8.73%	25.47%
2017	46.69%	49.32%	52.31%	55.73%	59.72%	64.42%	2017	0.24%	0.24%	0.24%	0.71%	5.19%	23.58%
2018	46.20%	48.74%	51.65%	54.99%	58.89%	63.52%	2018	1.42%	1.65%	1.65%	2.36%	5.90%	19.58%
2019	45.87%	48.24%	51.00%	54.24%	58.06%	62.65%	2019	1.42%	1.65%	2.59%	3.07%	5.42%	11.79%
2020	39.95%	42.77%	46.07%	49.99%	54.72%	60.60%	2020	0.24%	0.24%	0.24%	0.24%	1.18%	5.90%

Data source: Wind Informaton & Self Calculated

Note: For each listed real estate enterprise and for each quarter in the sample, first compute the actual inventory value and the actual asset–liability ratio according to Equations (3.4)–(3.5). Then impose hypothetical inventory-value shocks of 0%, 10%, 20%, 30%, 40%, and 50%, which stand for different magnitudes of housing-price declines. For every shock level, re-compute the firms’ actual asset–liability ratios, and we finally calculate (i) the cross-sectional average of the actual asset–liability ratio and (ii) the share of firms whose actual asset–liability ratio is  $\geq 80\%$ . When the sample is split by size (large/small) or by ownership (SOE/non-SOE), the same calculation is repeated for each subsample.

As depicted in Table 3.1, China's real estate enterprises have exhibited a significant improvement in their ability to withstand the risk of declining house prices since 2013. Even when the value of inventories dropped by 50%, the average asset-liability ratio remained below 80%. Throughout the sample period, there were instances where the inventory value witnessed a 50% decrease, leading to nearly 50% of the sample enterprises' asset-liability ratio surpassing the 80% cautionary threshold. However, starting from 2013, when the inventory value fell by 50%, only 45% of the sample enterprises had an asset-liability ratio exceeding the 80% warning line. Furthermore, the data reflected a downward trend year by year. In 2020, when the value of inventories experienced a 50% decline, only a mere 6% of the sample enterprises exceeded the 80% warning line, supporting two key observations:

1. As house prices continue to rise in China, enterprises are accumulating large inventories in order to maximize profit. However, although there has been a slowdown in the growth of inventory sales, the overall market is still expanding.

2. Since the end of 2012, when the Communist Party of China and the government emphasized the principle that "housing is for living, not for speculation," real estate enterprises in China have indeed adhered to the industry development strategy outlined by the central government. They have gradually reduced their own risk and enhanced their ability to withstand uncertainties.

To provide a more detailed analysis of the long-term solvency of different types of real estate enterprises, this thesis categorized the sample enterprises into two groups: large and small enterprises, and state-owned and non-state-owned enterprises. This categorization allows for a more in-depth examination of the long-term solvency of various types of enterprises.

The key findings from the disaggregated simulations (now reported in the Appendix as Tables 3.2–3.5) are summarized below. Tables 3.2 and 3.3 present the impact of inventory impairment on the actual asset-liability ratio when the sample firms are categorized into large and small firms based on their size, respectively. As shown in Table 3.2, large enterprises exhibit significantly higher actual asset-liability ratios compared to small enterprises, regardless of whether the value of inventories remains relatively stable or continues to decline. Similarly, Table 3.3 reveals that the proportion of large enterprises with an effective asset-liability ratio above 80% is also higher than that of small enterprises, regardless of whether the inventory values are relatively stable or persistently declining. These findings indicate that the long-term

solvency of large enterprises is weaker than that of small enterprises, and this weakness becomes more pronounced when the decline in real estate prices triggers inventory impairments.

At the same time, due to the high proportion of inventory value in large enterprises, the continuous rise in the asset-liability ratio of these enterprises weakens their ability to withstand price risk. In the event of a significant decrease in house prices, the inventories of these enterprises will face substantial impairment risk, leading to a reduction in their long-term solvency and, consequently, an increased solvency risk. While larger enterprises can more easily secure external financing to mitigate their liquidity risk, the substantial reliance on external financing and borrowing, along with the continued impairment of their own inventory, poses a greater solvency risk in the long run. On the other hand, smaller companies have limited access to external financing compared to their larger counterparts. As a result, they tend to swiftly deplete their inventories or reduce inventory levels to maintain a reasonable level of liquidity, thereby diminishing their own solvency risk.

Table 3.4 and Table 3.5 display the changes in the actual asset-liability ratio due to inventory impairment after categorizing all sample enterprises into state-owned and non-state-owned enterprises based on their types. As depicted in Table 3.4, before the fourth quarter of 2012, there is a notable disparity in the actual asset-liability ratios between state-owned and non-state-owned enterprises, with the latter exhibiting significantly higher ratios. However, post the fourth quarter of 2012, there is a gradual convergence in the actual asset-liability ratios of both types of enterprises. In particular, the actual asset-liability ratio of non-state-owned enterprises demonstrates a rapid decline, eventually reaching a level on par with that of state-owned enterprises. Additionally, the proportion of enterprises with actual asset-liability ratios above 80% remains constant across state-owned and non-state-owned enterprises in the event of inventory impairment. These findings suggest that the distinction in long-term corporate solvency between state-owned and non-state-owned enterprises is not distinctly apparent.

Overall, the actual asset-liability ratios of enterprises have maintained a better level and demonstrated stronger long-term solvency in the face of a significant decline in inventory value caused by falling real estate prices. However, a closer examination reveals that large enterprises, with their higher asset-liability ratios and larger inventory value ratios, may be less resilient to price risks compared to small

enterprises. Consequently, they could face greater solvency risks in the event of a substantial drop in asset prices, such as house prices. On the other hand, small enterprises continue to exhibit a robust long-term solvency. Additionally, there is no notable disparity in the long-term solvency between state-owned and non-state-owned enterprises. As mentioned earlier, the preceding section discussed the higher actual inventory value ratio of state-owned enterprises compared to that of non-state-owned enterprises, implying that the inefficiency of inventory liquidation during a real estate price decline may result in weaker short-term solvency for state-owned enterprises than for non-state-owned enterprises. This point will be further examined in subsequent discussions.

Judging from the current state of China's real estate market, it is evident that when Chinese real estate enterprises encounter challenges in inventory management due to declining house prices, their actual asset-liability ratios remain at a reasonable level. This indicates a relatively strong long-term solvency and low risk for these companies. However, when we categorize the sample enterprises, it becomes apparent that large enterprises are less equipped to withstand price risks compared to their smaller counterparts. This is primarily due to their higher actual asset liability ratios and larger inventory value ratios. In the event of a substantial decline in real estate prices, large enterprises may face a higher solvency risk, whereas small enterprises employ a high liquidity strategy that mitigates solvency risks. Furthermore, when we compare state-owned and non-state-owned enterprises, we find that both types exhibit a similar level of long-term solvency, with no significant difference.

### **3.2.1.1 Model Setting and Variable Selection**

Actual asset-liability ratio as a data indicator reflecting the long-term solvency of enterprises, by examining the impact of fluctuations in real estate prices and inventory value ratios on the long-term solvency indicator of enterprises, which is represented by the actual asset-liability ratio, changes in the long-term solvency of the enterprises can be reflected, enabling an evaluation of the relationship between fluctuations in real estate prices and the risks of real estate enterprises.

The relationship between real estate price fluctuations, inventory value ratio and actual asset-liability ratio is analyzed by panel data measurement model. The equation is as follows:

$$RALR_{i,t} = \alpha_i + \beta_1 \text{dlog}(REPI_{i,t-1}) + \beta_2 AIVR_{i,t-1} + \text{Controls}_{i,t} + \varepsilon_{i,t}$$

[Equation 3.6]

Unless otherwise stated, period defines quarter.  $RALR_{i,t}$  is the actual asset-liability ratio of company  $i$  in period  $t$ .  $d\log(REPI_{i,t-1})$  is the log-differential value of house prices lagged by one period.  $AIVR_{i,t-1}$  is the actual inventory value ratio of the previous period.  $Controls_{i,t}$  is the control variable. In the equation, the variables chosen include  $\log(TA_{i,t-1})$  and  $(OR_{i,t-1}/TA_{i,t-1})$ .  $TA_{i,t-1}$  is total assets lagged one period and  $OR_{i,t-1}$  is operating income lagged one period. The main reason for choosing one-period lagged data is that in business operations, current period operating decisions are made from the previous period's corporate financial data and the market macro environment.

$\alpha_i$  represents firm fixed effects.  $\beta_1$  measures the marginal effect of lagged real estate price changes on firms' long-term solvency, proxied by the actual asset-liability ratio, while  $\beta_2$  reflects the impact of the lagged inventory-to-asset ratio on long-term solvency.

Considering the characteristics of real estate enterprises, the expected sign of  $\beta_1$  is negative: although rising real estate prices may increase firms' operating revenues, they also tend to stimulate greater land acquisition and debt-financed expansion, thereby exerting a negative effect on the actual asset-liability ratio. The expected sign of  $\beta_2$  is likewise negative, as a high inventory-to-asset ratio implies large amounts of capital being tied up in assets that are not easily liquidated in the short term, which ultimately weakens firms' long-term solvency.

### **3.2.1.2 Empirical Analysis Results**

By performing a panel data cointegration test on the Equation 3.6 model data, the results of the test in Table 3.6 indicate the existence of a cointegration relationship. If the time series within panel data are found to be unit root processes, panel cointegration tests should be conducted to examine whether there exists a long-term equilibrium cointegration relationship among variables (Chen, 2015). As the data in this study was found to be unit root processes, panel cointegration tests must be performed. By conducting the Hausman test, the  $W$  statistic was 30.06, indicating that the fixed effect model is preferred to the random effect model. The regression results obtained are shown in Table 3.7.

Table 3.6: Cointegration test results of panel model variables of actual asset-liability ratio

Test methods	Hypothesis testing	Statistical quantity name	Statistical value	p-value
Kao test	$H_0:\rho=1$ (No co-integration relationship)	ADF	-15.79***	0.00
Pedroni test		Panel v-Statistic	-0.35	0.36
	$H_0:\rho=1$	Panel rho-Statistic	-2.03***	0.02
	$H_1:(\rho_i=\rho)<1$	Panel PP-Statistic	-5.31***	0.00
		Panel ADF-Statistic	-5.27***	0.00
		Group rho-Statistic	-2.30***	0.01
	$H_0:\rho=1$	Group PP-Statistic	-11.49***	0.00
	$H_1:\rho_i<1$	Group ADF-Statistic	-12.02***	0.000

Annotation: Lag orders are determined by the AIC criterion; \*\*\* indicates significant at 99% confidence level.

Table 3.7: Regression analysis of sensitivity of long-term solvency to real estate price fluctuations of real estate enterprises

Explanatory variables	Model 1	Model 2	Model 3 (Large)	Model 4 (Small)	Model 5 (S-O)	Model 6 (Non-S-O)
Constants	0.74*** (114.31)	1.13*** (21.55)	0.87*** (8.96)	0.41*** (10.70)	0.52*** (29.88)	0.70*** (4.65)
$d\log(\text{REPI}_{i,t-1})$	-0.15* (-1.22)	-0.13* (-0.54)	-0.11*** (-3.26)	0.12*** (3.64)	-0.11*** (-3.22)	0.22* (1.29)
$\text{AIVR}_{i,t-1}$	-0.32*** (-30.94)	-0.26*** (-14.36)	0.18*** (-5.08)	-0.19*** (-15.54)	-0.20*** (-27.84)	-0.18*** (-3.79)
$\log(\text{TA}_{i,t-1})$		-0.03*** (-8.19)	-0.02** (-2.34)	-0.95*** (-3.22)	0.78*** (6.48)	-0.74 (-0.68)
$\text{OR}_{i,t-1}/\text{TA}_{i,t-1}$		0.58 (0.19)	0.08 (1.31)	0.59 (0.38)	0.05*** (3.08)	0.14** (2.01)
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect		Yes				
Adjusted R <sup>2</sup>	0.41	0.45	0.48	0.38	0.52	0.42
F-Statistics	9.77***	42.14***	30.45***	104.46***	305.40***	26.42***
Sample size	5916	5916	4130	1786	3526	2390

Notes: (1) Explained variable is actual asset-liability ratio. (2) The estimation method is panel generalized least squares estimation. Using cross-sectional residual variance as estimation weights. To eliminate cross-sectional heteroskedasticity and contemporaneous correlation, the standard deviation of the coefficients is calculated using a robust estimation method (White cross-sectional weighting method). (3) Yes indicates the inclusion of enterprise fixed effects. (4) The t-statistics are in parentheses, \*\*\*, \*\*, \* indicates significant at 1 %, 5 % and 10 % significance level, respectively. (5) Firms with annual operating revenue above RMB 2 billion are classified as Large, while firms with annual operating revenue below RMB 2 billion or total assets below RMB 100 million are classified as Small. “S-O” denotes state-owned enterprises (actual controller is the central or local government); “Non-S-O” denotes non-state-owned enterprises.

Table 3.7 reports sensitivity regressions for real estate enterprises’ long-term solvency. Model 1 indicates that the aggregate effect is weak at the pooled level, suggesting underlying heterogeneity across firms; Model 2 adds time fixed effects and robust cross-section weights yields the same qualitative reading, confirming

specification robustness. In the subsamples, the patterns align with the mechanisms in 3.2.1: Model 3 is consistent with balance-sheet valuation support when prices strengthen, implying an improvement in long-term solvency; Model 4 is consistent with pro-cyclical leverage expansion during upturns, implying a deterioration in long-term solvency; Model 5 mirrors the large enterprise pattern, whereas Model 6 mirrors the small enterprise pattern. Across specifications, the adjusted inventory to asset ratio behaves as expected under 3.2.1: heavier inventories are associated with tighter long-term solvency and the scenario evidence in Tables 3.1–3.5 is coherent with these subgroup results (threshold effects are more apparent for small enterprise and non-state owned enterprise groups).

### 3.2.2 Short Term Solvency

#### 3.2.2.1 Model Setting and Variable Selection

Generally speaking, current ratio and quick ratio are important indicators to reflect short-term solvency. However, for real estate enterprises, the proportion of inventory in their current assets is usually large, and based on the special characteristics of property, it is difficult to liquidate quickly in the short term, so the current ratio does not reflect the short-term solvency of the enterprise well. In contrast, the quick ratio can eliminate the influence of inventory and more fully reflect the actual situation of short-term solvency of the enterprise. By studying the short-term solvency indicators of enterprises: the quick ratio is affected by fluctuations of real estate price and the ratio of inventory value, which can reflect the change of short-term solvency of enterprises, and can more comprehensively evaluate the relationship between fluctuations of real estate price and enterprise risk.

The relationship between real estate price fluctuations, inventory value ratio and quick ratio is analyzed by panel data model. The equation is as follows:

$$QR_{i,t} = \alpha_i + \beta_1 d\log(REPI_{i,t-1}) + \beta_2 AIVR_{i,t-1} + Controls_{i,t} + \varepsilon_{i,t}$$

[Equation 3.7]

Unless otherwise stated, period defines quarter.  $QR_{i,t}$  is the quick ratio of company  $i$  in period  $t$ .  $d\log(REPI_{i,t-1})$  is the log-differential value of house prices lagged by one period.  $AIVR_{i,t-1}$  is the inventory value ratio of the previous period.  $Controls_{i,t}$  is the control variable. In the equation, the variables chosen include  $\log(TA_{i,t-1})$  and  $(OR_{i,t-1}/TA_{i,t-1})$ .  $TA_{i,t-1}$  is total assets lagged one period and  $OR_{i,t-1}$  is operating income lagged one period. The main reason for choosing one-period lagged data is that in business operations, current period operating decisions are made

from the previous period's corporate financial data and the market macro environment.

Considering the characteristics of real estate enterprises, the expected sign of  $\beta_1$  is positive: rising real estate prices typically lead to higher sales revenues and stronger cash inflows, thereby improving firms' liquidity and enhancing their quick ratio, which reflects short-term solvency. The expected sign of  $\beta_2$  is negative, since a higher inventory-to-asset ratio indicates that a large share of resources is tied up in assets that are not easily converted into cash, ultimately weakening firms' short-term solvency.

### 3.2.2.2 Empirical Analysis Results

By performing a panel data cointegration test on the Equation 3.7 model data, the results of the test in Table 3.8 indicate the existence of a cointegration relationship. If the time series within panel data are found to be unit root processes, panel cointegration tests should be conducted to examine whether there exists a long-term equilibrium cointegration relationship among variables (Chen, 2015). As the data in this study was found to be unit root processes, panel cointegration tests must be performed. By conducting the Hausman test, the W statistic was 3.97, indicating that the fixed effect model is preferred to the random effect model. The regression results obtained are shown in Table 3.9.

Table 3.8: Cointegration test results of panel model variables of quick ratio

Test methods	Hypothesis testing	Statistical quantity name	Statistical value	p-value
Kao test	$H_0:\rho=1$ (No co-integration relationship)	ADF	-16.23***	0.00
Pedroni test		Panel v-Statistic	-3.02	1.00
	$H_0:\rho=1$	Panel rho-Statistic	-3.92***	0.00
	$H_1:(\rho_i=\rho)<1$	Panel PP-Statistic	-10.94***	0.00
		Panel ADF-Statistic	-11.87***	0.00
		Group rho-Statistic	-4.50***	0.00
	$H_0:\rho=1$	Group PP-Statistic	-11.50***	0.00
	$H_1:\rho_i<1$	Group ADF-Statistic	-12.20***	0.00

Annotation: Lag orders are determined by the AIC criterion; \*\*\* indicates significant at 99% confidence level.

Table 3.9: Results of quick ratio panel model regression

Explanatory variables	Model 1	Model 2	Model 3 (Large)	Model 4 (Small)	Model 5 (S-O)	Model 6 (Non-S-O)
Constants	0.70*** (52.50)	3.67*** (16.53)	4.299*** (13.77)	2.55*** (8.08)	2.03*** (8.79)	5.01*** (11.86)
$d\log(\text{REPI}_{i,t-1})$	1.87*** (6.11)	3.94** (2.52)	4.83** (2.27)	0.95 (0.58)	3.28*** (3.43)	5.32** (1.50)
$\text{AIVR}_{i,t-1}$	-0.003*** (-12.41)	-0.002*** (-3.69)	-0.001 (-1.22)	-0.007*** (-8.39)	-0.002*** (-3.73)	-0.002 (-1.82)
$\log(\text{TA}_{i,t-1})$		-0.196*** (-12.27)	-0.24*** (-11.99)	-0.096*** (-3.36)	-0.09*** (-5.34)	-0.28*** (-9.23)
$\text{OR}_{i,t-1}/\text{TA}_{i,t-1}$		-0.66 (-4.41)	-1.18 (-4.74)	-0.27 (-2.27)	-0.35** (-2.31)	-0.71** (-2.79)
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R <sup>2</sup>	0.52	0.43	0.49	0.47	0.54	0.52
F-Statistics	197.18***	72.44***	62.71***	12.80***	22.93***	43.40***
Sample size	5916	5916	4310	1786	3526	2390

Notes: (1) Explained variable is Quick ratio. (2) The estimation method is panel generalized least squares estimation. Using cross-sectional residual variance as estimation weights. To eliminate cross-sectional heteroskedasticity and contemporaneous correlation, the standard deviation of the coefficients is calculated using a robust estimation method (White cross-sectional weighting method). (3) Yes indicates the inclusion of enterprise fixed effects. (4) The t-statistics are in parentheses, \*\*\*, \*\*, \* indicates significant at 1 %, 5 % and 10% significance level, respectively. (5) Firms with annual operating revenue above RMB 2 billion are classified as Large, while firms with annual operating revenue below RMB 2 billion or total assets below RMB 100 million are classified as Small. "S-O" denotes state-owned enterprises (actual controller is the central or local government); "Non-S-O" denotes non-state-owned enterprises.

According to the estimates in Table 3.9, the signs of the coefficients of the relational variables conform to expectations. The short-term solvency of enterprises shows a significant positive relationship to fluctuations of house price. A decrease of house price will lead to the decrease of short-term solvency of enterprises, while the

coefficient of inventory value ratio of enterprises is significantly negative, which indicates that the increase of inventory value ratio has a negative impact on short-term solvency. At the same time, the short-term liquidity of enterprises is weak due to the special nature of their inventories. Combined with the traditional Chinese real estate market's consumer psychology of "buying up but not buying down", consumers will choose to conservatively wait and see in the process of falling house prices, which will further promote the decline of real estate prices. (Kuang, 2010) As a result, falling prices are often accompanied by a decline in transaction volumes, making it more difficult to liquidate inventory. In the case of falling prices, a larger inventory ratio does not enhance short-term solvency, but instead ties up a large amount of capital, which may lead to insufficient short-term solvency of the enterprise.

To further examine whether the impact of real estate price volatility on firms' short-term solvency is asymmetric—that is, whether the effects differ between periods of rising and falling real estate prices—an interaction term  $dum \cdot dlog(REPI_{i,t-1})$  is introduced into the model. Here, *dum* is a dummy variable indicating whether real estate prices are in an upward phase or a downward phase. If firms respond differently to changes in real estate prices depending on the direction of the change, it implies the existence of asymmetry in the impact.

Table 3.10 presents the regression results of the asymmetric model, with Models 2 through 6 covering the full sample, large firms, small firms, state-owned enterprises, and non-state-owned enterprises, respectively. The results show that the interaction term  $dum \cdot dlog(REPI_{i,t-1})$  is significantly positive across all models (except Model IV, which is still significant at the 10% level), suggesting that the improvement in short-term solvency during real estate price increases is significantly greater than the deterioration during price declines. This confirms the presence of an asymmetric effect of real estate price fluctuations on firms' short-term debt-paying capacity.

The effect is particularly pronounced among large firms (Model 3) and non-state-owned enterprises (Model 6), indicating that these firms benefit more during real estate price upturns and are less adversely affected during downturns. This asymmetry may reflect that, in the face of falling real estate prices, firms experience weakened financing ability, asset devaluation, and lower expected returns, thereby exacerbating liquidity risks. Conversely, during housing booms, firms are able to leverage asset appreciation for stronger financing capacity and cash flow support, thereby enhancing their short-term solvency.

Table 3.10: Results of quick ratio panel model regression (Asymmetric model)

Explanatory variables	Model 2 (ALL)	Model 3 (Large)	Model 4 (Small)	Model 5 (S-O)	Model 6 (Non-S-O)
Constants	5.56*** (18.50)	6.65*** (17.13)	0.58** (1.28)	2.05*** (8.48)	8.19*** (14.57)
$dlog(REPI_{i,t-1})$	15.04*** (3.73)	20.86*** (3.80)	4.35** (1.09)	2.77** (1.04)	31.02*** (3.40)
$dum*dlog(REPI_{i,t-1})$	13.50*** (3.03)	19.83*** (3.27)	3.28* (0.74)	-0.64* (-0.22)	31.67*** (3.15)
$AIVR_{i,t-1}$	-0.001* (-0.91)	0.0002* (0.27)	-0.006*** (-6.60)	-0.002*** (-3.70)	0.0002* (0.15)
$log(TA_{i,t-1})$	-0.33*** (-15.40)	-3.99*** (-14.96)	0.05** (1.33)	-0.09*** (-5.23)	-0.51*** (-12.56)
$OR_{i,t-1}/TA_{i,t-1}$	-0.69*** (-4.47)	-1.50*** (-5.55)	-0.01* (-0.09)	-0.38** (-2.43)	-0.80*** (-3.10)
Enterprise fixed effect	Y	Y	Y	Y	Y
Adjusted R <sup>2</sup>	0.38	0.40	0.471	0.42	0.50
F-Statistics	62.39***	54.86***	10.15***	17.43***	39.05***
Sample size	5804	4052	1752	3462	2343

Notes: (1) Explained variable is Quick ratio. (2) The estimation method is panel generalized least squares estimation. Using cross-sectional residual variance as estimation weights. To eliminate cross-sectional heteroskedasticity and contemporaneous correlation, the standard deviation of the coefficients is calculated using a robust estimation method (White cross-sectional weighting method). (3) Dum is a dummy variable distinguishing real estate price cycles: If  $dlog(REPI_{i,t-1}) \leq 0$  (prices falling or flat)  $dum=1$ ; If  $dlog(REPI_{i,t-1}) > 0$  (prices rising)  $dum=0$ . (4) Yes indicates enterprise fixed effects are included; No indicates they are not. (5) The t-statistics are in parentheses, \*\*\*, \*\*, \* indicates significant at 99%, 95% and 90% confidence levels. (6) Firms with annual operating revenue above RMB 2 billion are classified as Large, while firms with annual operating revenue below RMB 2 billion or total assets below RMB 100 million are classified as Small. "S-O" denotes state-owned enterprises (actual controller is the central or local government); "Non-S-O" denotes non-state-owned enterprises.

### 3.2.2.3 Prediction and Analysis Based on Asymmetric Model Results

According to the estimates in Table 3.11, we can roughly assess the impact of real estate prices on firms' short-term solvency, specifically by examining how changes in real estate prices affect the quick ratio. Assuming a significant decline in the real estate price index of cities where firms conduct their main business in the third quarter of 2014, we can use the estimated model results in Table 3.11 to calculate the potential changes in firms' quick ratios (see Table 3.11).

Table 3.11: Effect of falling house prices on quick ratio

	Price Down	0%	10%	20%	30%	40%	50%
All Sample	Average	0.58	0.56	0.55	0.53	0.52	0.50
	Relative benchmark change (%)		2.59	2.66	2.74	2.81	2.89
	Percentage of companies with QR<0.5 (%)	60.34	65.48	68.90	72.56	82.01	87.27
Large Business	Average	0.45	0.43	0.42	0.40	0.39	0.37
	Relative benchmark change (%)		3.35	3.47	3.59	3.72	3.87
	Percentage of companies with QR<0.5 (%)	70.23	73.42	76.83	80.31	89.45	97.72
Small Business	Average	0.846	0.842	0.837	0.833	0.829	0.824
	Relative benchmark change (%)		0.51	0.52	0.52	0.52	0.53
	Percentage of companies with QR<0.5 (%)	72.23	77.29	84.21	87.37	90.17	98.54
State-Owned Business	Average	0.612	0.609	0.606	0.604	0.601	0.598
	Relative benchmark change (%)		0.45	0.46	0.46	0.46	0.46
	Percentage of companies with QR<0.5 (%)	52.21	62.31	69.12	75.21	78.19	82.14
Non-State-Owned Business	Average	0.582	0.551	0.520	0.489	0.458	0.427
	Relative benchmark change (%)		5.33	5.63	5.97	6.35	6.78
	Percentage of companies with QR<0.5 (%)	34.21	37.56	44.56	53.93	70.64	74.28

Notes: (1) The benchmark value in the table is 0%. (2) Based on Equation 3.7 in Section 3.2.2, it is possible to analyze the quick ratio and examine the proportion of all sample enterprises (classified according to their size and type) with a quick ratio of less than or equal to 0.5 due to the decline in real estate prices.

The results in Table 3.11 show that firms' quick ratios are highly sensitive to changes in real estate prices. When real estate prices drop sharply in the short term, quick ratios also decline considerably. In particular, the proportion of firms with quick ratios below 0.5 reveals this trend most strikingly. As the magnitude of the price decline increases, the nationwide real estate price index in major cities shows a clear slowdown or even decline. According to the forecast in Table 3.11, if real estate prices fall by 50%, the proportion of firms with quick ratios below 0.5 will rise from 60.34% under the baseline to 87.27%, indicating a significant increase in liquidity risk under a scenario of steep price declines.

A comparison between large and small enterprises shows that large enterprises face more severe consequences under the assumption of rapidly declining real estate prices. If real estate prices fall by 50%, the proportion of large enterprises with a quick ratio below 0.5 is expected to reach 97.72%, far higher than the baseline level of 70.23%. For small enterprises, although the average quick ratio only decreases slightly from 0.846 to 0.824, the proportion of firms below the 0.5 threshold still increases significantly—from 72.23% to 98.54%—suggesting that marginal small firms also face severe liquidity risks.

From the perspective of ownership structure, state-owned enterprises generally have a higher inventory value ratio than non-state-owned firms. As a result, in the context of falling real estate prices, the quick ratios of state-owned enterprises decline more slowly. Specifically, the proportion of state-owned firms with quick ratios below 0.5 increases from 52.21% to 82.14%. In contrast, non-state-owned firms see this proportion rise from 34.21% to 74.28%. Although their initial risk level is lower, the degree of fluctuations is greater, indicating that the asset structures of non-state-owned enterprises are more susceptible to shocks from real estate price changes.

The empirical findings further confirm the conclusions drawn in Section 3.1.2 through qualitative analysis: if a sharp decline in real estate prices occurs when enterprises have both high inventory and high debt levels, real estate enterprises will not only suffer inventory devaluation but also face increasing difficulties in liquidation. Developers may then face both liquidity and solvency risks, meaning that

real estate price volatility may trigger system risks that transmit to creditors and equity investors, leading to broader chain losses across participants in the real estate capital market.

### **3.3 The Impact of Real Estate Price Fluctuations on the Financing Ability of Real Estate Development Enterprises**

The ability to raise capital is a crucial factor in determining a company's liquidity risk. If a company possesses strong financing capabilities, it can address liquidity issues by securing funds through financing. Conversely, if both an enterprise's short-term solvency and financing ability experience significant declines following an external shock, it indicates that the enterprise will encounter more severe liquidity risk in such circumstances. Hence, by assessing the impact of real estate price fluctuations on enterprise financing capabilities in conjunction with the aforementioned examination of short-term solvency, we can ascertain whether such fluctuations may trigger liquidity risk for enterprises.

#### **3.3.1 Model Setting and Variable Selection**

The long-term debt ratio is the proportion of long-term liabilities in the enterprise's debt, which can reflect the financing ability of the enterprise. The more long-term liabilities in the enterprise's debt, the better the creditors think the enterprise's investment prospect, business credit, profitability and other aspects, and worthy of long-term investment by investors, reflecting that the enterprise has strong financing ability. The impact of real estate price fluctuations on the financing ability of enterprises is reflected in two aspects: firstly, fluctuations of real estate price will affect the profitability of enterprises and thus their financing ability. Secondly, enterprises can obtain financing by pledging assets. For enterprises, inventory is the key to obtain financing through the collateral channel, and fluctuations of real estate price will have an impact on the value of inventory, which will affect the financing ability of enterprises. The impact of fluctuations in real estate prices on financing capacity can thus be examined by establishing the following model.

$$LTDR_{i,t} = \gamma_i + \varphi_1 \text{dlog}(\text{REPI}_{i,t-1}) + \varphi_2 \text{AIVR}_{i,t-1} + \text{controls}_{i,t} + \mu_{i,t}$$

[Equation 3.8]

Unless otherwise stated, period defines quarter.  $LTDR_{i,t}$  is the proportion of long-term liabilities of company  $i$  in period  $t$ . In the equation, the variables chosen include  $\log(TA_{i,t-1})$ ,  $(OR_{i,t-1}/TA_{i,t-1})$ ,  $Q_{i,t-1}$  and  $Z_{i,t-1}$ .  $Q_{i,t-1}$  is the one-period

lagged firm Tobin  $q$ , which is the ratio of the firm's market capitalisation to the firm's total assets, and  $Z_{i,t-1}$  is the one-period lagged firm Z-value warning indicator, which represents the likelihood of the firm's financial failure.

According to the business characteristics of real estate enterprises, the sign of both  $\varphi_1$  and  $\varphi_2$  should theoretically be positive. The increase in real estate prices will increase the profitability of enterprises and therefore should have a positive impact on their financing ability. As the increase in inventory value ratio indicates that the enterprise has more collateral, it also has a positive impact on the enterprise's financing ability.

As non-stationary data were employed in this study, performing a panel data cointegration test is required in order to avoid spurious regression and prevent potential errors in the results. By performing a panel data cointegration test on the data in the model of Equation 3.8, the ADF statistic of the Kao test was -2.14, indicating the existence of cointegration. The Hausman test was performed on the static panel, and the W statistic was 4.02, there was no random effect and the enterprise effect was determined to be a fixed effect. Due to the possible autocorrelation of the long-term debt share, in order to control for self-shocks, a static panel is added to conduct the estimation of the dynamic panel model, and the estimation method uses the First Difference Generalized Method of Moments based on robust standard errors. (Hall, 2005) To examine the asymmetric impact of rising and falling real estate prices on financing capacity, the model also incorporates interaction terms for the dummy variable  $dum$  of real estate price fluctuations.  $dum$  indicates a dummy variable to determine whether real estate prices are in an upward or downward period. The regression results for the static and dynamic panel models are shown in Table 3.12.

The results in Table 3.12 show that the signs of the coefficients of the key variables in the static and dynamic panel models are as expected. Enterprise financing capacity shows a significant positive relationship with real estate price fluctuations and inventory value ratio. The estimation results of the asymmetric model indicate that the enterprise financing capacity will be hit more strongly when real estate prices fall, which means that a fall in real estate prices will have a greater impact on financing capacity than a rise in real estate prices. This also implies that a rise in real estate prices will increase the financing capacity of enterprises, but a fall in real estate prices of the same magnitude will cause a stronger reduction in financing capacity.

Table 3.12: Financing ability panel model regression results

Explanatory variables	Static panel		Dynamic panel	
	General	Asymmetrical	General	Asymmetrical
Constants	-25.53*** (-11.89)	-25.61*** (-11.93)		
LTDR <sub>i,t-1</sub>			0.54*** (22.60)	0.54*** (78.04)
dlog(REPI <sub>i,t-1</sub> )	44.82*** (4.31)	18.92* (1.26)	35.50*** (4.16)	28.60*** (15.61)
dum*dlog(REPI <sub>i,t-1</sub> )		39.42** (2.40)		8.79*** (4.30)
AIVR <sub>i,t-1</sub>	0.03*** (6.37)	0.03*** (6.39)	0.01*** (7.95)	0.01*** (8.50)
log(TA <sub>i,t-1</sub> )	3.70*** (23.81)	3.69*** (23.81)	-2.04*** (-14.69)	-2.04*** (-11.83)
OR <sub>i,t-1</sub> /TA <sub>i,t-1</sub>	-9.11*** (-8.29)	-9.28*** (-8.43)	0.71 (1.59)	1.01* (1.95)
Q <sub>i,t-1</sub>	0.04*** (3.23)	0.04*** (3.23)	0.03*** (3.91)	0.03** (2.76)
Z <sub>i,t-1</sub>	0.0008* (0.45)	0.0007* (0.41)	0.001*** (7.29)	0.001*** (4.23)
Enterprise fixed effect	Yes	Yes	No	No
Adjusted R <sup>2</sup>	0.64	0.59		
F-Statistics	190.83***	164.53***		
Hansen			101.52***	101.17***
AR(2)			2.85***	2.78***
Sample size	5817	5817	5704	5704

Notes: (1) Explained variable is long-term liability ratio. (2) The estimation method is panel generalized least squares estimation. Using cross-sectional residual variance as estimation weights. To eliminate cross-sectional heteroskedasticity and contemporaneous correlation, the standard deviation of the coefficients is calculated using a robust estimation method (White cross-sectional weighting method). (3) Dum is a dummy variable distinguishing real estate price cycles: If  $dlog(REPI_{i,t-1}) \leq 0$  (prices falling or flat)  $dum=1$ ; If  $dlog(REPI_{i,t-1}) > 0$  (prices rising)  $dum=0$ . (4) Yes indicates enterprise fixed effects are included; No indicates they are not. (5) Dynamic panel

analysis using a robust standard deviation-based differential GMM analysis. Hansen is the robust Hansen test statistic for over-identification of instrumental variables. AR(2) is the Arellano-Bond test statistic for the presence of second-order serial correlation in the model. (6) The t-statistics are in parentheses, \*\*\*, \*\*, \* indicates significant at 99%, 95% and 90% confidence levels. (7) Firms with annual operating revenue above RMB 2 billion are classified as Large, while firms with annual operating revenue below RMB 2 billion or total assets below RMB 100 million are classified as Small. “S-O” denotes state-owned enterprises (actual controller is the central or local government); “Non-S-O” denotes non-state-owned enterprises.

### **3.3.3 Robustness of Asymmetric Model and Difference Analysis of Financing Ability of Different Enterprises**

To further examine the robustness of the asymmetric-model estimates reported in Section 3.3.2 and to explore heterogeneity in firms’ financing capacity across different size and ownership structures, we conduct robustness checks based on the static-panel and dynamic-panel asymmetric model results presented in Table 3.12.

The estimation results reported in Tables 3.13 and 3.14 indicate that the static-panel specifications exhibit overall robustness, while the dynamic-panel models largely reproduce the same qualitative patterns. In the majority of static-panel regressions, the coefficients on the key explanatory variables  $dlog(REPI_{i,t-1})$ ,  $dum*dlog(REPI_{i,t-1})$ , and  $AIVR_{i,t-1}$  are all significantly positive, confirming the asymmetric impact of housing-price fluctuations on corporate financing capacity. In particular,  $dum*dlog(REPI_{i,t-1})$  is significantly positive in Models 1, 2, and 4 of Table 3.13, indicating that the adverse effect of a housing-price decline on firms’ access to finance is materially stronger than the positive effect associated with a price increase—thereby supporting the existence of an asymmetric relationship. In the dynamic-panel estimations reported in Table 3.14, these coefficients also remain positive and significant in most specifications—albeit with somewhat lower levels of statistical significance in a few cases—demonstrating the robustness of our findings.

Table 3.13: Robustness tests for static panel asymmetric models of financing capacity

Explanatory variables	Model 1 (ALL)	Model 2 (Large)	Model 3 (Small)	Model 4 (S-O)	Model 5 (Non-S-O)
Constants	-25.61*** (-11.93)	-21.51*** (-9.77)	-64.93*** (-9.32)	-32.05*** (-9.04)	-17.90*** (-6.55)
$d\log(\text{REPI}_{i,t-1})$	18.92** (2.26)	18.22** (2.12)	29.57** (2.93)	28.71** (2.47)	-4.53* (-0.20)
$\text{dum} \cdot d\log(\text{REPI}_{i,t-1})$	39.42** (2.40)	30.88** (1.73)	43.06* (1.24)	55.19** (2.57)	34.09** (2.36)
$\text{AINAA}_{i,t-1}$	0.03*** (6.39)	0.03*** (6.97)	-0.009 (-0.63)	0.04*** (4.79)	0.03*** (4.46)
$\log(\text{AA}_{i,t-1})$	3.69*** (23.81)	3.38*** (22.24)	6.85*** (12.43)	4.25*** (16.73)	3.02*** (15.24)
$\text{QOR}_{i,t-1}/\text{AA}_{i,t-1}$	-9.28*** (-8.43)	-6.90*** (-4.53)	-9.97*** (-5.80)	-11.32*** (-5.19)	-8.50*** (-6.83)
$Q_{i,t-1}$	0.04*** (3.23)	0.004 (0.33)	0.26*** (6.48)	0.01 (0.40)	0.14*** (5.78)
$Z_{i,t-1}$	0.0007 (0.41)	0.0005 (0.30)	-0.02 (-0.39)	-0.31*** (-4.19)	0.0003 (0.22)
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes
Adjusted R <sup>2</sup>	0.48	0.46	0.42	0.47	0.48
F-Statistics	164.53***	139.02***	47.45***	108.97***	71.35***
Sample size	5817	4061	1756	3464	2353

Notes: (1) Explained variable is long-term liability ratio. (2) The estimation method is panel generalized least squares estimation. Using cross-sectional residual variance as estimation weights. To eliminate cross-sectional heteroskedasticity and contemporaneous correlation, the standard deviation of the coefficients is calculated using a robust estimation method (White cross-sectional weighting method). (3) Dum is a dummy variable distinguishing real estate price cycles: If  $d\log(\text{REPI}_{i,t-1}) \leq 0$  (prices falling or flat)  $\text{dum}=1$ ; If  $d\log(\text{REPI}_{i,t-1}) > 0$  (prices rising)  $\text{dum}=0$ . (4) Yes indicates enterprise fixed effects are included; No indicates they are not. (5) The t-statistics are in parentheses, \*\*\*, \*\*, \* indicates significant at 99%, 95% and 90% confidence levels. (6) Firms with annual operating revenue above RMB 2 billion are classified as Large, while firms with annual operating revenue below RMB 2 billion or total assets below RMB 100 million are classified as Small. "S-O" denotes state-owned enterprises (actual controller is the central or local government); "Non-S-O" denotes non-state-owned enterprises.

Table 3.14: Robustness tests for dynamic panel asymmetric models of financing capacity

Explanatory variables	Model 1 (ALL)	Model 2 (Large)	Model 3 (Small)	Model 4 (S-O)	Model 5 (Non-S-O)
LTDR <sub>i,t-1</sub>	0.54*** (78.04)	0.57*** (33.35)	0.66*** (12.95)	0.62*** (29.57)	0.68*** (25.21)
dlog(REPI <sub>i,t-1</sub> )	28.60*** (15.61)	23.31*** (6.80)	72.37* (1.71)	38.38*** (6.81)	14.84 (1.48)
dum*dlog(REPI <sub>i,t-1</sub> )	8.79*** (4.30)	14.41** (2.74)	-9.72** (-2.31)	-1.35* (-1.24)	-1.49* (-1.15)
AINAA <sub>i,t-1</sub>	0.01*** (8.50)	0.006** (3.20)	0.01 (0.29)	0.01 (1.55)	0.01*** (4.13)
log(AA <sub>i,t-1</sub> )	-2.04*** (-11.83)	-1.46*** (-5.75)	-0.19 (-0.02)	-1.59*** (-3.84)	-1.68* (-1.82)
QOR <sub>i,t-1</sub> /AA <sub>i,t-1</sub>	1.01* (1.95)	1.89** (3.41)	0.07 (0.02)	3.20** (2.60)	1.20 (0.73)
Q <sub>i,t-1</sub>	0.03** (2.76)	0.01* (1.79)	0.06* (1.82)	0.02* (1.94)	0.03** (2.09)
Z <sub>i,t-1</sub>	0.001*** (4.23)	0.001*** (6.87)	0.76 (0.85)	-0.18 (-0.51)	0.001** (2.22)
Hansen	101.17***	69.95***	26.07***	57.62***	36.87***
AR(2)	2.78***	2.58**	1.65*	2.11**	1.85*
Sample size	5704	3982	1772	3400	2304

Notes: (1) Explained variable is long-term liability ratio. (2) Dynamic panel analysis using a robust standard deviation-based differential GMM analysis. Hansen is the robust Hansen test statistic for over-identification of instrumental variables. (3) Dum is a dummy variable distinguishing real estate price cycles: If  $dlog(REPI_{i,t-1}) \leq 0$  (prices falling or flat)  $dum=1$ ; If  $dlog(REPI_{i,t-1}) > 0$  (prices rising)  $dum=0$ . (4) The t-statistics are in parentheses, \*\*\*, \*\*, \* indicates significant at 99%, 95% and 90% confidence levels. (5) Firms with annual operating revenue above RMB 2 billion are classified as Large, while firms with annual operating revenue below RMB 2 billion or total assets below RMB 100 million are classified as Small. "S-O" denotes state-owned enterprises (actual controller is the central or local government); "Non-S-O" denotes non-state-owned enterprises.

Further examination of Models 2 and 3 in Tables 3.13 and 3.14 reveals pronounced heterogeneity by firm size in the impact of housing-price fluctuations on financing capacity. When real estate prices rise, large firms experience a more substantial increase in financing capacity, whereas small firms exhibit only modest

gains; conversely, in periods of price decline, small firms suffer larger reductions in financing capacity and are more severely affected. This suggests that small firms are at a distinct disadvantage in coping with housing-price volatility, with their financing vulnerability particularly acute during market downturns.

Likewise, a comparison of Models 4 and 5 indicates that ownership structure also conditions sensitivity to housing-price movements. State-owned enterprises enjoy more rapid improvements in financing capacity during price upturns and demonstrate stronger resilience during downturns, whereas non-state-owned firms display more pronounced cyclical fluctuations. These results further highlight the structural differentiation in financing behavior among Chinese real estate enterprises, with large and state-owned firms holding clear advantages in financing capacity.

Overall, housing-price declines exert a materially adverse effect on developers' financing capacity. Relative to the financing gains associated with price increases, downturns not only significantly curtail access to finance but do so most acutely for small and non-state-owned firms. When combined with the empirical findings of Section 3.2.2, it becomes evident that housing-price declines can precipitate concurrent sharp deteriorations in both short-term solvency and financing capacity. Moreover, with inventories rendered illiquid during such periods, developers confront elevated liquidity risk—thereby amplifying systemic vulnerabilities within the broader real-estate finance system.

### **3.4 Impact of Real Estate Price Fluctuations on Default Probability of Real Estate Development Enterprises**

In the real estate market, price fluctuations indirectly influence the credit risk level of real estate enterprises by affecting the structure of corporate credit ratings. Empirical data show that during periods of high or rapidly rising real estate prices (such as in 2007 and 2016–2018), the number and proportion of highly rated real estate companies (e.g., AAA, AA+) increased, while the proportion of lower-rated firms declined. This reflects an overall improvement in corporate creditworthiness and indirectly indicates a relatively lower probability of default. In contrast, during periods of real estate price slowdown or correction (such as in 2014 and 2020), the proportion of low-rated firms increased and the number of highly rated companies declined, suggesting a deterioration in credit structure, tighter financing conditions, and a potentially higher probability of default.

These changes indicate a clear correlation between fluctuations in real estate

prices and shifts in corporate default probabilities: when real estate prices are high, firms tend to have higher credit ratings and lower default risks; during market downturns, the credit structure worsens and default risks rise. Overall, real estate prices serve not only as a barometer of real estate market conditions but also significantly impact firms' credit risk exposure, playing a crucial role in financial institutions' risk assessment and the formulation of regulatory policies.

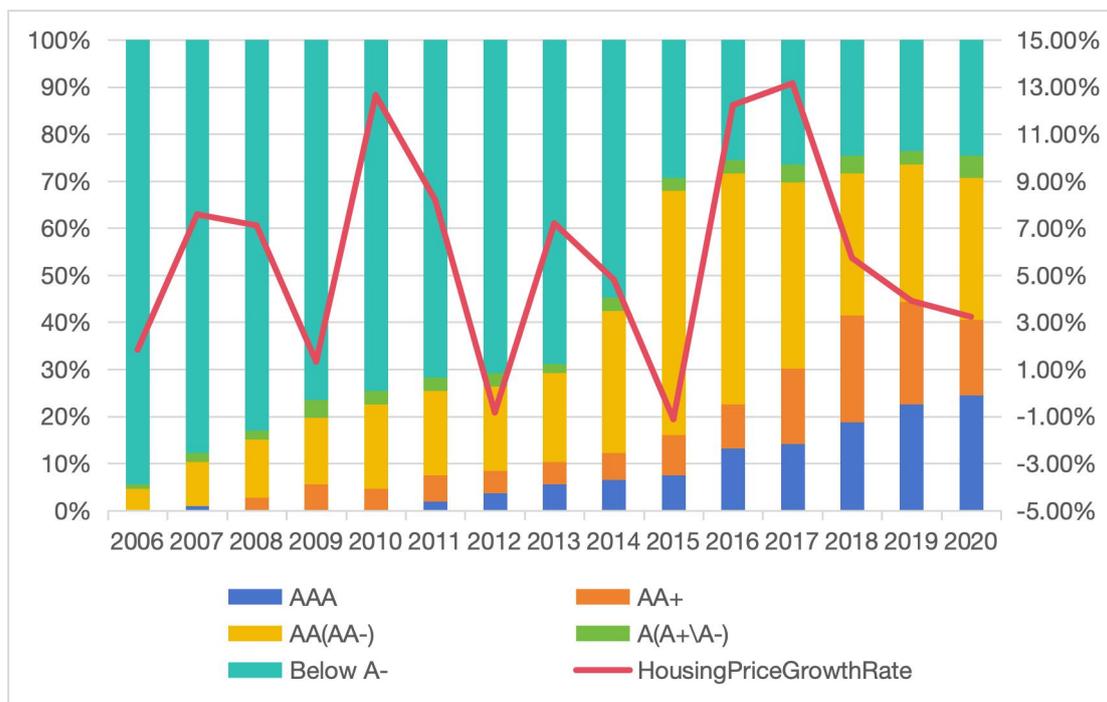


Figure 3.6: Credit distribution of sample companies

Data source: Compiled based on data from Wind Information

### 3.5 Chapter Summary

This section investigates the influence of real estate price fluctuations on the risk faced by real estate enterprises. Specifically, it explores the effects of these fluctuations on the solvency, financing capacity, and default likelihood of enterprises. The key findings are as follows:

At the firm level, the inventory ratio of China's real estate enterprises remains high, with an actual inventory ratio exceeding 70%. In the presence of this high inventory, fluctuations in real estate prices can have both short-term and long-term implications for the solvency of the sample companies. While the sample companies, in general, exhibit strong long-term solvency despite the decline in inventory value caused by the decrease in real estate prices, a substantial number of enterprises are likely to face short-term solvency issues. The real estate industry operates cyclically,

characterized by fluctuations in real estate prices. When real estate prices enter a downward trend, there is usually a significant reduction in transaction volume. As a result, the decline in inventory value weakens inventory liquidity and significantly impairs the short-term solvency of enterprises with high inventory levels. Facing liquidity difficulties, enterprises holding large inventories find themselves particularly vulnerable.

Real estate price fluctuations will significantly affect the financing capacity of the sample enterprises. The impact on financing capacity is more pronounced when real estate prices decline, indicating that a decrease in real estate prices exerts a stronger effect on financing ability compared to an increase in real estate prices. While an increase in real estate prices enhances the financing capacity of enterprises, an equivalent decrease in real estate prices leads to a more significant decline in financing ability. Moreover, large enterprises and state-owned enterprises display a greater financing capacity when real estate prices rise, and experience a relatively smaller decline in financing capacity when real estate prices fall, as compared to small enterprises and non-state-owned enterprises.

The change in enterprise default probability is significantly correlated with real estate price fluctuations. When real estate prices are high, firms have a relatively low default probability and a high credit rating. Conversely, when real estate prices are low, firms have a relatively high default probability and a low credit rating.

On the whole, the high debt and high inventory characteristics of China's real estate enterprises make them vulnerable to liquidity risk when there is a significant decline in real estate prices, although the solvency risk is relatively low. A decrease in real estate prices not only impairs the short-term solvency and financing ability of these enterprises but also reduces their long-term solvency, thereby increasing the likelihood of default. However, it is the liquidity problem that poses a more severe challenge for these enterprises compared to solvency.

## Chapter 4 The Impact of Real Estate Price Fluctuations on Banks Through the Real Estate Enterprise Channel

This chapter will analyze the impact of fluctuations in real estate prices on banks through the channel of real estate enterprises. As stated in the theoretical analysis of this article, the system risk originating from fluctuations in real estate prices can be transmitted to the banking sector through real estate enterprises, and the banking sector's risk mostly stems from loans associated with real estate enterprises. The research in this chapter aims to address the following questions:

1. Does fluctuations in real estate prices affect banks' lending decisions towards real estate development firms? (Does it impact the size of bank loans?) This serves as a prerequisite for the ability of real estate price fluctuations to incur losses in the banking sector through real estate enterprises.

Is it possible for fluctuations in real estate prices to affect the credit risk and liquidity risk of banks through loans associated with real estate enterprises? If such an impact exists, does it expose banks to solvency or liquidity risk?

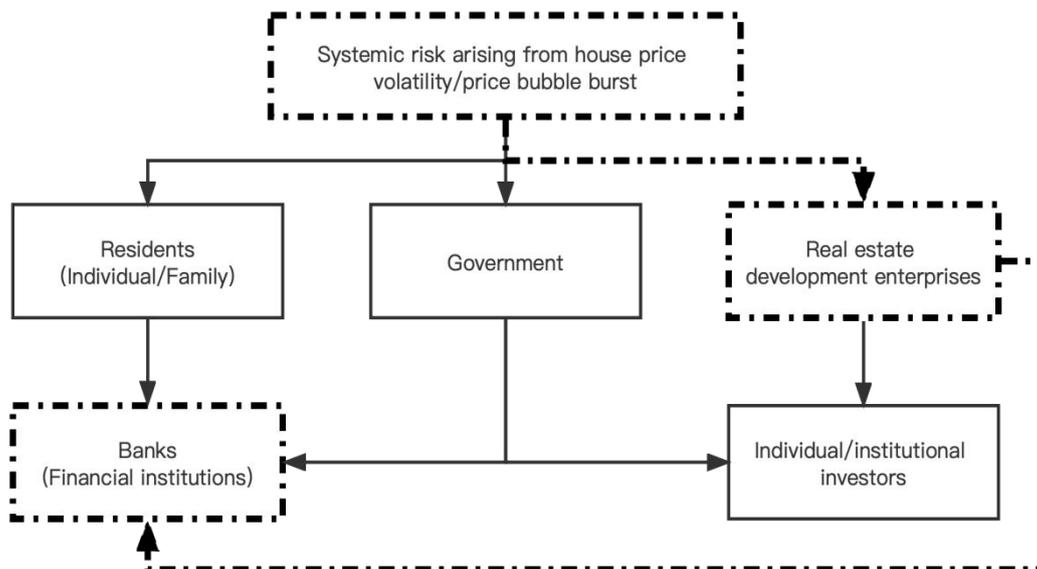


Figure 4.1: The research object of this chapter

Note: The dashed boxes are the objects of study in this chapter.

As previously discussed regarding the transmission mechanism of system risk in the real estate capital market, the effect of fluctuations in real estate prices on banks relies on the presence of risky short-sighted behavior exhibited by banks. This

behavior entails investing a substantial amount of credit in the real estate capital market, driven by the pursuit of short-term gains. Consequently, it results in credit risk and liquidity issues arising from credit defaults, compromised collateral, reduced capital, and negative market expectations, thereby leading to system risk. Building upon this notion, this chapter aims to analyze the impact of real estate price fluctuations on banks. The specific arguments are outlined below:

Firstly, this chapter will provide a theoretical analysis of the impact of real estate price fluctuations on the scale of real estate development loans, as well as on banks' credit risk and liquidity. Secondly, an empirical analysis will investigate the influence of real estate price fluctuations on the scale associated with the real estate enterprise channel, and will test the foundation for system risk transmission through this channel. Thirdly, we will separately examine the impact of real estate price fluctuations on banks' credit risk and liquidity risk through loans related to the real estate enterprise channel. Finally, the chapter will conclude by synthesizing the evidence to establish the existence of bank risk resulting from real estate price fluctuations through the real estate enterprise channel.

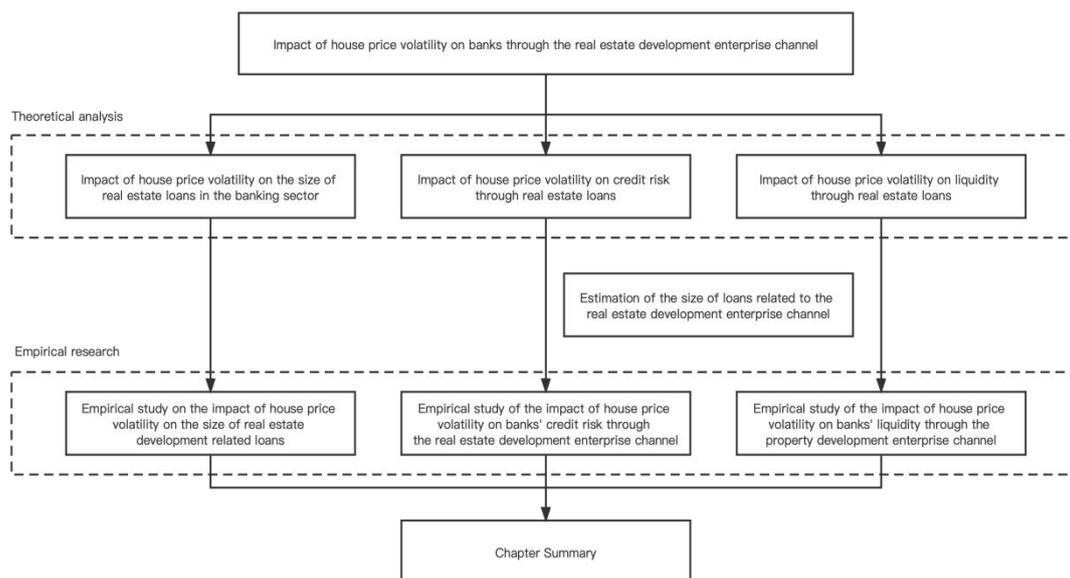


Figure 4.2: The structural composition of this chapter

Building on the institutional setting in which pre-sales effectively front-load household mortgages as de facto developer financing, this chapter focuses on how credit linkages carry housing shocks from developers to banks. Specifically, it asks whether exposures tied to developers are associated with shifts in bank risk and liquidity, and whether such transmission varies with bank characteristics. A bank-level panel is assembled with exposure measures constructed to reflect pre-sale

practices, and findings are cross-checked through alternative specifications and subgroup analyses. The objective is to quantify the developer-to-bank channel in a manner consistent with China's institutional realities. The main contribution is an operational exposure metric and evidence of transmission to the banking system with direct relevance for prudential supervision.

Before turning to the bank-level estimates, it is useful to clarify the banking sample used in this chapter. Consistent with the sample design in Chapter 3, the bank-level empirical analysis is based on 16 commercial banks listed on the Shanghai and Shenzhen Stock Exchanges as of 2006, which together represent the most data-transparent and systemically important segment of China's commercial banking sector. These listed banks disclose comparable quarterly/annual financial statements, which makes it possible to measure real-estate-related credit exposure, liquidity conditions, and capital positions in a consistent manner over time. This fixed sample of 16 banks is also chosen to be fully comparable with the 116 listed real estate development enterprises analysed earlier, so that the developer–bank transmission channel can be examined within one unified panel. By contrast, the national-level results reported in this chapter are constructed from aggregated quarterly banking data for the whole sector and should not be interpreted as the number of individual banks.

## **4.1 Theoretical Analysis of the Impact of Real Estate Price Fluctuations on Banks**

### **4.1.1 The Impact of Real Estate Price Fluctuations on the Size of Bank Loans Related to Real Estate**

Rising real estate prices lead to an expansion in the scale of bank credit and an influx of credit funds into the real estate capital market, further driving up real estate prices. Scholars refer to this phenomenon of real estate prices and total credit funds mutually reinforcing each other as the "financial accelerator" effect (Cui, 2006). The source of this effect can be observed from both the supply and demand sides. On the supply side, banks tend to have a "short deposit and long loan" composition. When real estate prices increase, the value of assets on their accounting statements also rises, resulting in an increase in the net assets recorded on banks' books. In other words, their capital increases, boosting their credit capacity and enabling them to issue more loans. From the demand side, when real estate prices rise, the appraised value of house mortgages increases, prompting banks to expand mortgage credit (Hilbers et al., 2001). If the loan-to-value ratio remains the same, the total volume of loans will

increase. Alternatively, if the total amount of loans remains unchanged, the loan-to-value ratio will decrease. Banks perceive mortgages as less risky in this scenario and are more inclined to extend loans. Additionally, a rise in real estate prices indicates improved business performance for enterprises, leading banks to view them as less credit-risky (Herring & Wachter, 1999). Consequently, the size of real estate development loans expands. In summary, it becomes evident that a rise in real estate prices benefits the banking industry regardless of whether the loans are directed towards real estate development or personal house mortgages.

Assuming that the bank makes a loan portfolio to obtain returns and that the bank is required to have a probability of insolvency due to loan default risk no greater than  $\gamma$ , the loan portfolio constraint of the bank is given as:

$$\Pr(A \leq M) \leq \gamma$$

[Equation 4.1]

A denotes bank assets, M denotes the minimum assets required by the bank and M is determined by elements such as the bank's internal risk control department and the financial regulator's minimum capital adequacy ratio.

Use Chebyshev's inequality to rewrite Equation 4.1 as below:

$$\Pr(A - E(A) \leq E(A) - M) \leq \sigma_p^2 / (E(A) - M)^2$$

[Equation 4.2]

$\sigma_p^2$  is the variance of the expected return on the bank's loan portfolio.

If Equation 4.3 and Equation 4.4 hold, Equation 4.1 will also hold.

$$\sigma_p^2 / (E(A) - M)^2 \leq \gamma$$

[Equation 4.3]

$$\gamma (E(A) - M)^2 - \sigma_p^2 \geq 0$$

[Equation 4.4]

In order to be able to find the relationship between real estate price fluctuations and loan size, assume that there are n loans in the bank's loan portfolio, with loan volume  $L_j$  and expected return  $r_j$ :

$$E(A) = \sum_{j=1}^n L_j r_j$$

[Equation 4.5]

Assuming that the bank seeks to maximize the expected return, and therefore maximizing Equation 4.5 under the constraint of Equation 4.4, the Lagrangian expression for the maximum value of Equation 4.5 can be obtained as follows:

$$G(L_j, V) = \sum_{j=1}^n L_j (r_j - r_0) + V(\gamma(E(A) - M)^2 - \sigma_p^2)$$

[Equation 4.6]

$r_0$  is the opportunity cost of bank loans,  $V$  is the Lagrange multiplier, i.e. the shadow price.

To be able to easily illustrate the impact of real estate price fluctuations on real estate loans, assume that banks allocate only two types of loans as assets: real estate loan  $L_1$  and other types of loans  $L_2$ .

$$\max_{L_1, L_2} G(L_1, L_2) = L_1(r_1 - r_0) + L_2(r_2 - r_0) + V(\gamma(L_1(r_1 - r_0) + L_2(r_2 - r_0) - M)^2 - \sigma_p^2)$$

[Equation 4.7]

Its first-order maximization condition is:

$$\begin{cases} \frac{\partial G}{\partial L_1} = (r_1 - r_0) + 2V\gamma(E(A) - M)(r_1 - r_0) - (L_1\sigma_1^2 + L_2\sigma_2^2) = 0 \\ \frac{\partial G}{\partial V} = \gamma(E(A) - M)^2 - \sigma_p^2 = 0 \end{cases}$$

[Equation 4.8]

$\sigma_1^2$  and  $\sigma_2^2$  are the variances of the expected yields of the two types of loans respectively.

The first-order maximization condition is given by the equation:

$$L_1 = \left[ \frac{1 + 2V\gamma^{1/2}\sigma_p}{2V\sigma_1^2} \right] (r_1 - r_0) - \frac{L_2\sigma_{12}}{\sigma_1^2} = \left[ \frac{1 + 2V\gamma(E(A) - M)}{2V\sigma_1^2} \right] (r_1 - r_0) - \frac{L_2\sigma_{12}}{\sigma_1^2}$$

[Equation 4.9]

$\sigma_{12}$  is the covariance of the expected return on the two loans. Equation 4.9 shows that loan volume is related to the difference between expected rate of return and opportunity cost is positively correlated. The larger the difference between expected rate of return and opportunity cost, the more real estate loans are issued, and by further rewriting Equation 4.5 and we could get:

$$L_1(r_1-r_0)+L_2(r_2-r_0)-M=\frac{L_1\sigma_1^2+L_2\sigma_2^2+2L_1L_2\sigma_{12})^2}{\gamma^{1/2}}$$

[Equation 4.10]

Equation 4.10 is the equation that banks follow when making loan allocations. According to Equation 4.10 will find the partial derivative with respect to  $r_1$ , it is obtained that:

$$\frac{\partial L_1}{\partial r_1}=\frac{\gamma(E(A)-M)L_1}{\gamma(E(A)-M)(r_1-r_0)-(L_1\sigma_1^2+L_2\sigma_{12})}$$

[Equation 4.11]

Combining the first-order maximization condition of Equation 4.8, could get  $\partial L_1/\partial r_1 > 0$ . Which means that the volume of real estate loans will increase as the expected yield on real estate loans increases.

On the other hand, assume that the probability of default on a real estate loan is  $\pi_1$  and the contractual yield is  $R_1$ :

$$r_1=(1-\pi_1)R_1$$

[Equation 4.12]

Substituting Equation 4.12 into Equation 4.11:

$$L_1((1-\pi_1)R_1-r_0)+L_2(r_2-r_0)-M=\frac{L_1\sigma_1^2+L_2\sigma_2^2+2L_1L_2\sigma_{12})^2}{\gamma^{1/2}}$$

[Equation 4.13]

Further taking the partial derivative of  $L_1$  with respect to  $\pi_1$ :

$$\left\{ \begin{array}{l} \frac{\partial L_1}{\partial \pi_1}=L_1\left[R_1+\frac{(L_1\sigma_1^2+L_2\sigma_{12})^2}{\gamma^{1/2}\sigma_p}\frac{\partial \sigma_1}{\partial \pi_1}\right]/\left[(r_1-r_0)-\frac{L_1\sigma_1^2+L_2\sigma_{12}}{\gamma^{1/2}\sigma_p}\right] \\ \frac{\partial \sigma_1}{\partial \pi_1}=\frac{R_1(1-2\pi_1)}{2(\pi_1(1-\pi_1))^{1/2}} \end{array} \right.$$

[Equation 4.14]

In general,  $\pi_1 < 0.5$  and therefore have  $\partial L_1/\partial \pi_1$  with a numerator greater than 0. Also:

$$\frac{\partial L_1}{\partial M}=\frac{1}{L_1}\frac{\partial L_1}{\partial r_1}=\frac{\gamma(E(A)-M)}{\gamma(E(A)-M)(r_1-r_0)-(L_1\sigma_1^2+L_2\sigma_{12})}<0$$

[Equation 4.15]

It is known that the denominator of  $\partial L_1/\partial \pi_1$  is less than 0. This leads to  $\partial L_1/\partial \pi_1 < 0$ . Which means the volume of real estate loans increases as the probability of default on real estate loans decreases.

The above analysis shows that the total amount of bank real estate loans placed increases as the expected return on loans increases ( $\partial L_1/\partial r_1 > 0$ ) and increases as the probability of default decreases ( $\partial L_1/\partial \pi_1 < 0$ ). For the Chinese real estate capital market, the impact of real estate price fluctuations on the scale of real estate credit funding is reflected by these two aspects. Increased real estate prices have a two-fold effect: First, they increase the expected returns on real estate loans, as predicted by the theory of equilibrium price change. An expected increase in future real estate prices will lead to an increase in the assessed value of a mortgage loan for a given house. Second, higher real estate prices reduce the probability of default on real estate loans overall. When these two factors act in unison, rational banks are inclined to increase the total amount of real estate loans issued in order to maximize their returns, while disregarding the potential system risks. This phenomenon is known as the financial accelerator effect. Consequently, rising real estate prices result in an expansion of both real estate development loans and individual home mortgages.

#### **4.1.2 Impact of Real Estate Price Fluctuations on Banks' Credit Risk and Liquidity**

Assume that the bank's real estate loans as a percentage of all loans are  $REMShare = L_1/(L_1 + L_2)$ :

$$\frac{\partial (REMShare)}{\partial (L_1)} = \frac{\partial (L_1/(L_1 + L_2))}{\partial (L_1)} > 0$$

[Equation 4.16]

As a result, when banks allocate loans, they will change the total amount of credit funds invested in the real estate capital market and its share in the total loans according to the changes in house prices. If real estate prices rise, not only will the total amount of real estate credit funds increase, but also the proportion of total credit funds will increase. Since the impact of real estate price fluctuations on banks' credit risk and liquidity will be realized through real estate loans, the share of real estate loans (REMShare) also needs to be focused on.

If banks have myopic expectations when allocating real estate loans, that is, they

decide the change in the share of real estate loans in the current period based on the change in real estate prices in the previous period. Then:

$$\frac{\partial(\text{REMSHare}_t)}{\partial(\Delta\text{REP}_{t-1})}=\lambda$$

[Equation 4.17]

$\lambda$  is the bank's loan preference coefficient. The larger  $\lambda$  is, the better the bank's expectations of the real estate market. Banks will perceive the expected return on real estate loans to be higher relative to other assets. Therefore banks will be more willing to hold real estate loans .

According to Randall (Randall, 1993), Murto (Murto, 1994) and Domowitz and Sartain (Domowitz & Sartain, 1999) the asset portfolio of banks is a direct influence on the credit risk and liquidity of banks. Therefore, the share of real estate loans will have a significant impact on banks' credit risk and liquidity, and this impact varies with real estate price fluctuations. Thus, for the bank at time t:

$$\frac{\partial(\text{Risk}_t)}{\partial(\text{REMSHare}_t)}=\alpha_1+\alpha_2\cdot\Delta\text{REP}_{t-1}$$

[Equation 4.18]

$$\frac{\partial(\text{BL}_t)}{\partial(\text{REMSHare}_t)}=\beta_1+\beta_2\cdot\Delta\text{REP}_{t-1}$$

[Equation 4.19]

$\text{Risk}_t$  is credit risk,  $\text{BL}_t$  is Liquidity.

Equation 4.18 reflects the impact of the proportion of real estate loans on credit risk.  $\alpha_2$  represents the effect of real estate price fluctuations on the impact of real estate loan proportion on credit risk.

Equation 4.19 reflects the impact of the proportion of real estate loans on liquidity.  $\beta_2$  represents the effect of real estate price fluctuations on the impact of real estate loan proportion on liquidity.

From [Equation 4.17][Equation 4.18][Equation 4.19] could obtain:

$$\frac{\partial(\text{Risk}_t)}{\partial(\Delta\text{REP}_{t-1})}=(\alpha_1+\alpha_2\cdot\Delta\text{REP}_{t-1})\lambda, \frac{x^2\text{Risk}_t}{\partial(\Delta\text{REP}_{t-1})^2}=\alpha_2\lambda$$

[Equation 4.20]

$$\frac{\partial(\text{BL}_t)}{\partial(\Delta\text{REP}_{t-1})}=(\beta_1+\beta_2\cdot\Delta\text{REP}_{t-1})\lambda, \frac{\partial^2\text{BL}_t}{\partial(\Delta\text{REP}_{t-1})^2}=\beta_2\lambda$$

[Equation 4.21]

Considering from the perspective of system risk, different combinations of  $\alpha_1$  and  $\alpha_2$ ,  $\beta_1$  and  $\beta_2$  can make the effect of real estate price fluctuations on credit risk and liquidity through real estate loans appear in different states. Considering the effect of rising house prices, the credit risk and liquidity changes caused by rising house prices can be classified as "accelerating up", "decelerating up-accelerating down", "decelerating down-accelerating up" and "accelerating down". The different combinations of  $\alpha_1$  and  $\alpha_2$ ,  $\beta_1$  and  $\beta_2$  corresponding to the four states are shown in Figure 4.3 and Figure 4.4. (Randall, 1993; Domowitz & Sartain, 1999)

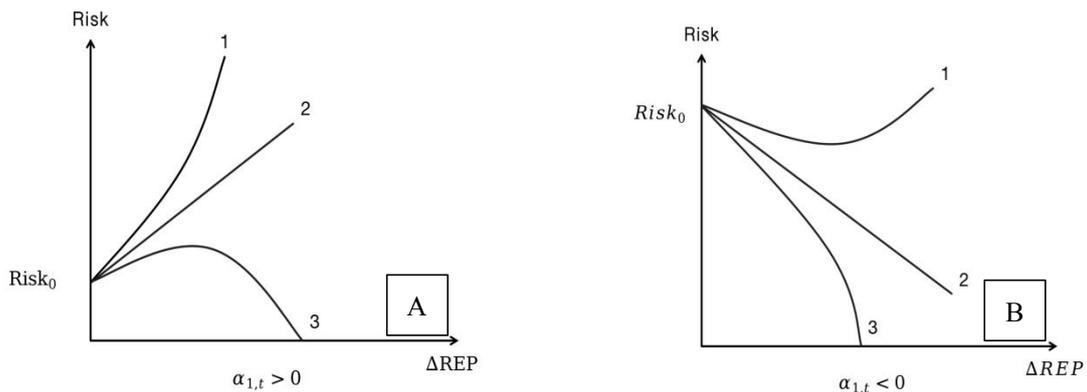


Figure 4.3: The effect of real estate price fluctuations on banks' credit risk

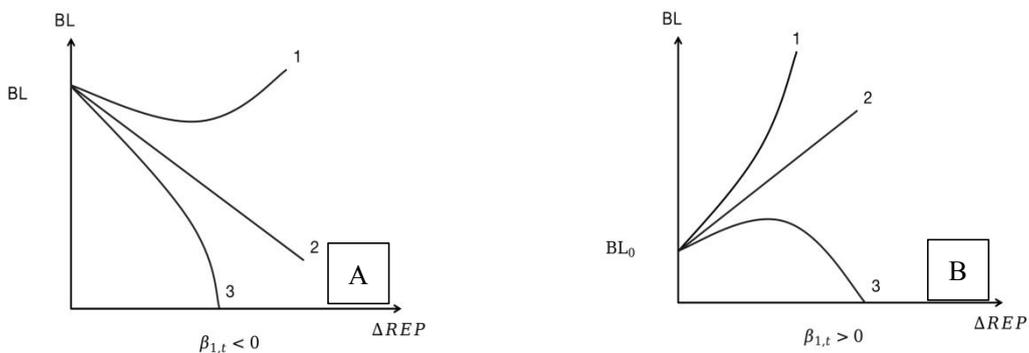


Figure 4.4: The effect of real estate price fluctuations on banks' liquidity

The meaning of Table 4.1 can be better understood by combining the four scenarios in Figures 4.3 and 4.4. Take the effect on bank credit risk when real estate

prices rise in Figure 4.3-A as an example. When  $\alpha_1 > 0$  and  $\alpha_2 > 0$ , the relationship between credit risk and real estate price fluctuations is quadratic curve (Figure 4.3-A-Curve1). At this point,  $\partial^2 (\text{Risk}_t) / \partial (\Delta \text{REP}_{t-1})^2 = \alpha_2 \lambda > 0$ , the impact of rising real estate prices on credit risk is "accelerating", which means that the slope of the tangent line of the curve is increasing with the acceleration of rising real estate prices. When  $\alpha_1 > 0$  and  $\alpha_2 = 0$ , the relationship between credit risk and real estate price fluctuations is straight (Figure 4.3-A-Curve2), and the impact of real estate price increase on credit risk is in a state of "uniform increase", which is a special case. When  $\alpha_1 > 0$  and  $\alpha_2 < 0$ , the relationship between credit risk and real estate price fluctuations is quadratic curve (Figure 4.3-A-Curve3). At this point,  $\partial^2 (\text{Risk}_t) / \partial (\Delta \text{REP}_{t-1})^2 = \alpha_2 \lambda < 0$ , The impact of rising real estate prices on credit risk is in a state of "deceleration up - extreme value - acceleration down". This means that as the slope of the tangent line of the acceleration curve becomes smaller, it goes from positive to zero and then becomes negative, and then the absolute value becomes larger.

Table 4.1: Types of effects of rising house prices on credit risk and liquidity

Variables	Types	$\alpha_{1,t}$	$\alpha_{2,t}$	$\beta_{1,t}$	$\beta_{2,t}$	Curve No.
Credit risk	Accelerating up	>0	>0	/	/	F4.3-A-1
	Uniform up	>0	=0	/	/	F4.3-A-2
	Decelerating up - Accelerating down	>0	<0	/	/	F4.3-A-3
	Accelerating down	<0	<0	/	/	F4.3-B-3
	Uniform down	<0	=0	/	/	F4.3-B-2
	Decelerating down - Accelerating up	<0	>0	/	/	F4.3-B-1
Liquidity	Accelerating up	/	/	>0	>0	F4.4-A-1
	Uniform up	/	/	>0	=0	F4.4-A-2
	Decelerating up - Accelerating down	/	/	>0	<0	F4.4-A-3
	Accelerating down	/	/	<0	<0	F4.4-B-3
	Uniform down	/	/	<0	=0	F4.4-B-2
	Decelerating down - Accelerating up	/	/	<0	>0	F4.4-B-1

Note: "/" denotes items that are not applicable or not evaluated in the corresponding scenario.

It is important to note that  $\text{Risk}_0$  in the figure 4.3 is the credit risk when the real estate price growth rate is 0. At that moment, although real estate prices do not fluctuate and real estate loans do not pose credit risk, banks also make other loans and investments, and the credit risk from these other loans allocation behaviors is  $\text{Risk}_0$ .

Approximately, in the liquidity research, point  $BL_0$  in the figure 4.4 can be defined as inherent liquidity.

During the phase of rising real estate prices, the credit risk and liquidity of banks vary with fluctuations of real estate prices. According to the previous theoretical analysis, when there is a decline in real estate prices, banks' credit risk may trigger direct risk losses. At the same time, banks' liquidity faces a continuous decline due to credit losses, liquidity traps and panic caused by bad expectations. Therefore, the impact of real estate price fluctuations on credit risk and liquidity during a rising real estate price cycle can be considered to be directly realized during a falling real estate price period. At that moment, determining four states of the effect of real estate price fluctuations on banks' credit risk and liquidity plays a key role in determining whether banks have system risk.

Analyzing the effect of real estate price fluctuations on banks' credit risk, there are four states:

1. "Accelerating up" state: when  $\alpha_1 > 0$  and  $\alpha_2 > 0$  (Figure 4.3-A-Curve1), credit risk increases with the increase in real estate prices, which means that banks are facing a large credit risk at this time, which may be due to the poor quality of real estate loans issued by banks or factors such as high LTV. Once real estate prices fall at this time, borrowers have a higher probability of credit default, which can easily lead to system risk.

2. "Decelerating up-accelerating down" state: When  $\alpha_1 > 0$  and  $\alpha_2 < 0$  (Figure 4.3-A-Curve3), the credit risk decelerating up and then accelerating down with the increase of real estate price. At this time, the bank's credit risk may rise with a small increase in real estate prices. The reason may be due to lower LTV, lower interest rates on loans or the presence of some speculators among borrowers. However, there are two possible reasons for the reduced credit risk when real estate prices rise significantly. On the one hand, the quality of other bank assets is worse and the probability of default is higher. On the other hand is that the vast majority of borrowers for real estate loans are better credit and have a lower probability of default. In either case, real estate loans are a lower credit risk asset at this time for bank.

3. "Decelerating down-accelerating up" state. When  $\alpha_1 < 0$  and  $\alpha_2 > 0$  (Figure 4.3-B-Curve1)), credit risk is decelerating down with the increase of real estate price, and then accelerating up. This indicates that there may be a considerable number of speculators in the bank's borrowers at this time, and these borrowers will not choose

to default when the real estate price rises modestly. However, once the trend reverses after the real estate price rises sharply, they may choose to default and bring a lot of losses to the bank. The credit risk at this point is not easily detectable at the initial stage, and the brief reduction in risk may also give banks the wrong impression and thus neglect to prevent system risk.

4. "Accelerating down" state: when  $\alpha_1 < 0$  and  $\alpha_2 < 0$  (Figure 4.3-B-Curve3), credit risk accelerating down with the increase of real estate price, similar to the "decelerating up-accelerating down" state, real estate loans are low credit risk assets at this time.

Analyzing the effect of real estate price fluctuations on banks' liquidity, there are four states:

1. "accelerating up" state: when  $\beta_1 > 0$  and  $\beta_2 > 0$  (Figure 4.4-A-Curve1), liquidity increases with the increase in real estate prices. This indicates that real estate loans are highly liquid assets. This situation is not easy to occur in China, where the secondary real estate capital market is not well developed, but more likely to occur in western countries such as the United States, where the secondary real estate capital market is more developed. At this point, there is a need to simultaneously supervise the credit risk of banks to prevent the risky and short-sighted behavior of banks from causing a decline in loan quality, which could lead to another subprime crisis. This is precisely why liquidity and credit risk must be examined at the same time to be able to determine whether system risk exists.

2. "Decelerating up-accelerating down" state: when  $\beta_1 > 0$  and  $\beta_2 < 0$  (Figure 4.4-A-Curve3), liquidity decelerating up and then accelerating down with the increase of real estate price. When real estate prices rise slightly, banks' liquidity may rise due to the stimulation of good market news. However, with a significant rise in real estate prices triggering the expansion of real estate loans, liquidity appropriation will still trigger an accelerating down in banks' liquidity, and it is important to note at this point that a fall in real estate prices is likely to cause a shortage of liquidity for banks.

3. "Decelerating down-accelerating up" state: when  $\beta_1 < 0$  and  $\beta_2 > 0$  (Figure 4.4-B-Curve1), liquidity is decelerating down with the increase of real estate price, and then accelerating up. The first half of the "decelerating down" curve indicates that the liquidity of banks is affected by the liquidity of real estate loans, but the liquidity does not accelerate due to the good control of banks in the scale of loans. The second half of the "accelerating up" curve is similar to the first half, which is not

easy to occur in China where the secondary real estate capital market is not developed. In the empirical analysis, if banks are found to have  $\beta_1 < 0$  and  $\beta_2 > 0$  and are judged to be in the first half of the curve, it means that they have better liquidity management.

4. "Accelerated decline" state: when  $\beta_1 < 0$  and  $\beta_2 < 0$  (Figure 4.4-B-Curve3), liquidity accelerating down with the increase of real estate price, indicating that there are considerable problems in banks' liquidity management. At this point, the banks should reduce their real estate lending and reallocate their assets to achieve a reasonable level of liquidity.

Overall, the sign of  $\alpha_2$  and  $\beta_2$  is more critical: In the empirical analysis of credit risk, if there is a bank  $\alpha_2 < 0$ , it indicates that real estate loans are low risk asset for the bank, and a decline in real estate prices is less likely to trigger large credit loss. If there is a bank  $\alpha_2 > 0$ , it means that the possibility of large credit loss due to the fall of real estate price is higher and banks should control the issuance of real estate loans when the real estate price rises. In the empirical analysis of liquidity, If there is a bank  $\beta_2 < 0$ , it means that banks' liquidity decreases faster with the rise of real estate prices and the fall of real estate prices may trigger the problem of liquidity shortage. If bank  $\beta_2 > 0$  is present, it indicates that banks' liquidity management is good and a fall in real estate prices is less likely to trigger a liquidity shortage problem.

The results of the empirical analysis show that the fall in real estate prices will lead to a massive shortage of short-term solvency of enterprises, which may result in the default of real estate development loans. Therefore, the study will focus on the state of the impact of real estate development loans on banks' credit risk and liquidity, so as to determine the possibility of system risk of banks in the event of enterprise defaults due to a decline in real estate prices, and then make targeted policy recommendations.

Due to the possibility that the decline in real estate prices may increase the probability of defaulting on personal mortgage loans, this paper intends to conduct empirical research on the impact of real estate price fluctuations through the channels of real estate enterprises (through real estate development loans and real estate enterprise channel-related loans) on bank credit risk and liquidity. Meanwhile, this paper will also compare and examine the impact of real estate price fluctuations on bank credit risk and liquidity through household channels (through personal mortgage loans and household channel-related loans) in order to make the empirical analysis more effective by comparing the impact of the two channels.

## **4.2 Estimation of the Size of Loans Related to Real Estate Development Enterprises**

Real estate loans in China's banking sector exhibit three key characteristics, commonly referred to as the "three highs": high industry concentration, high bank concentration, and high balance growth rate. These characteristics reflect the system risk associated with real estate loans in terms of their volume and structure. High industry concentration denotes that the combined share of real estate development loans and personal housing mortgage loans accounts for over 27% of all loans within the banking industry. Specifically, real estate development loans make up 6.2% of the total, while personal housing mortgage loans account for 19.89%. High bank concentration indicates that the loan balance of the five largest commercial banks constitutes 50.92% of the aggregate loan balance across all banks. Moreover, these banks hold a considerable proportion of real estate development loans and personal housing mortgage loans, accounting for 43.7% and 76.88% respectively, among all loans of the same category provided by these banks. The high balance growth rate emphasizes the substantial average quarterly growth rate of real estate development loan balances and personal housing mortgage loan balances, surpassing 6% during the period from 2006 to 2020 (Xu et al., 2020; People's Bank of China & Wind Information).

Upon examining the aforementioned data, it becomes evident that the majority of real estate loans provided by banks are personal mortgage loans, with only a small portion being real estate development loans. Based on this observation, when analyzing the impact of real estate price fluctuations on banks, it would seem that the household channel is more significant compared to the real estate enterprise channel. However, it should be noted that, due to the presence of the real estate pre-sale policy, a significant portion of the financing for real estate enterprises actually originates from personal home mortgage loans. During the real estate development stage, personal housing mortgages are effectively transferred from households to real estate enterprises. Therefore, the total personal housing mortgage loans held by banks can be divided into two distinct parts. The first part consists of personal housing mortgage loans corresponding to real estate assets that have already been developed by companies and are held by households. Fluctuations in real estate prices impact the probability of default for these households. Consequently, the impact of real estate

price fluctuations leading to default on this portion of individual home mortgages, as it relates to banks, operates through the household channel. The second part of personal housing mortgage loans corresponds to real estate assets that have yet to be developed by the enterprise, with funds having been transferred to the enterprise through the pre-sale policy. The impact of real estate price fluctuations on the default probability of this portion of the personal housing mortgage loans essentially depends on whether the enterprise defaults at that time. Thus, the impact of real estate price fluctuations leading to defaults on this segment of individual housing mortgage loans, in relation to the banking sector, occurs via the real estate enterprise channel

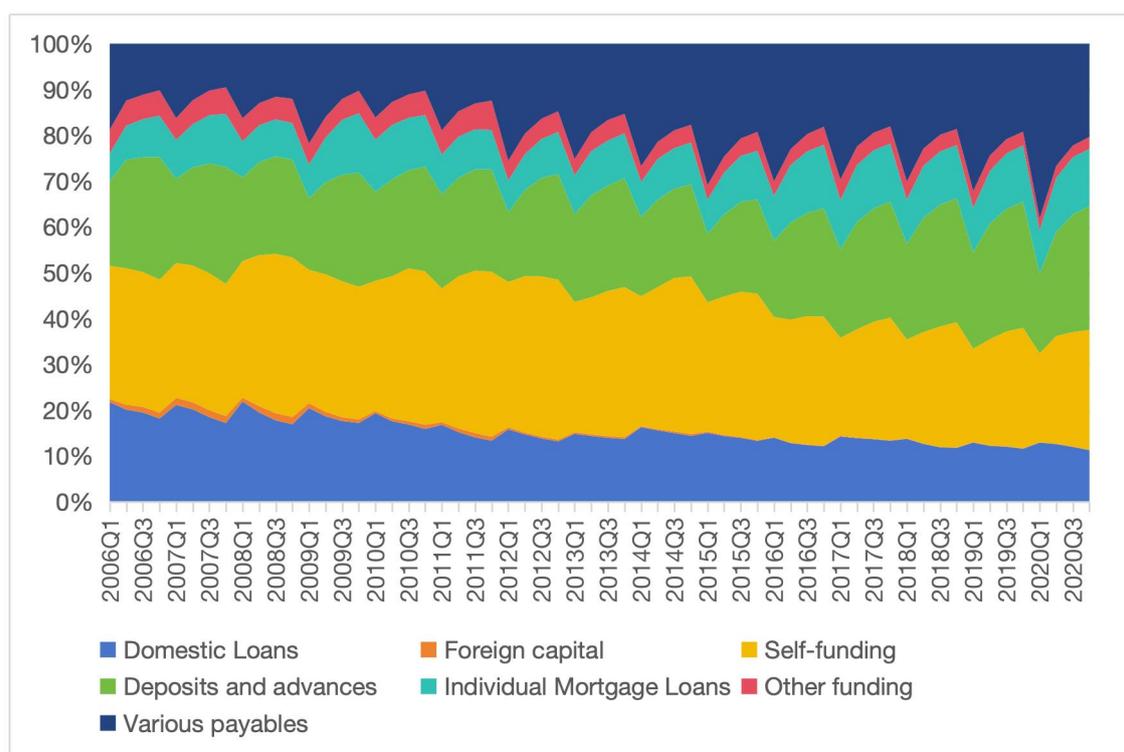


Figure 4.5: Percentage of real estate development funding

Source: Compiled from National Bureau of Statistics of China and Wind Information

Real estate enterprise channel-related loans include not only real estate development loans, but also the second part of personal housing mortgage loans. In order to more accurately examine the impact of real estate price fluctuations on banks through the real estate enterprise channel, estimates of real estate enterprise channel-related loans are needed. Directly using real estate development loans as real estate enterprise channel-related loans would result in low loan sizes and inaccurate examination of bank credit risk and liquidity issues.

The loans related to real estate enterprise channels are estimated by the data of

various sources of real estate development funds. Specific equations are as below:

$$\Delta AREDL_t = \gamma_t * \Delta REDL_t + \Delta AREDL_t$$

[Equation 4.22]

$$AREDL_t = AREDL_{t-1} + \Delta AREDL_t$$

[Equation 4.23]

$\Delta AREDL_t$  is the incremental volume of loans related to the real estate enterprise channel.  $\gamma_t$  is the ratio of individual housing mortgages to development loans as a source of financing for real estate development.  $\Delta REDL_t$  is for incremental development loans.  $\gamma_t * \Delta REDL_t$  is the portion of an individual housing mortgage loan that is invested in real estate development and the remainder of the individual housing mortgage loan after deducting this portion is a home channel related loan.  $AREDL_t$  is the balance of loans from the real estate enterprise channel. The portion  $\gamma_t * \Delta REDL_t$  deducted from personal housing mortgage loans is the household channel-related loan.

By looking at the proportion of real estate development loans, personal housing mortgage loans, the real estate enterprise channel-related loans and household channel-related loans as a percentage of total loans, it can be seen that while the scale of real estate development loans is relatively small compared to personal housing mortgage loans, the scale of personal housing mortgage loans is gradually approaching the scale of real estate development loans, and even vaguely surpassing it. This indicates that the system risk arising from fluctuations in house prices is equally important to be transmitted from the real estate enterprise channel and the household channel to banks.

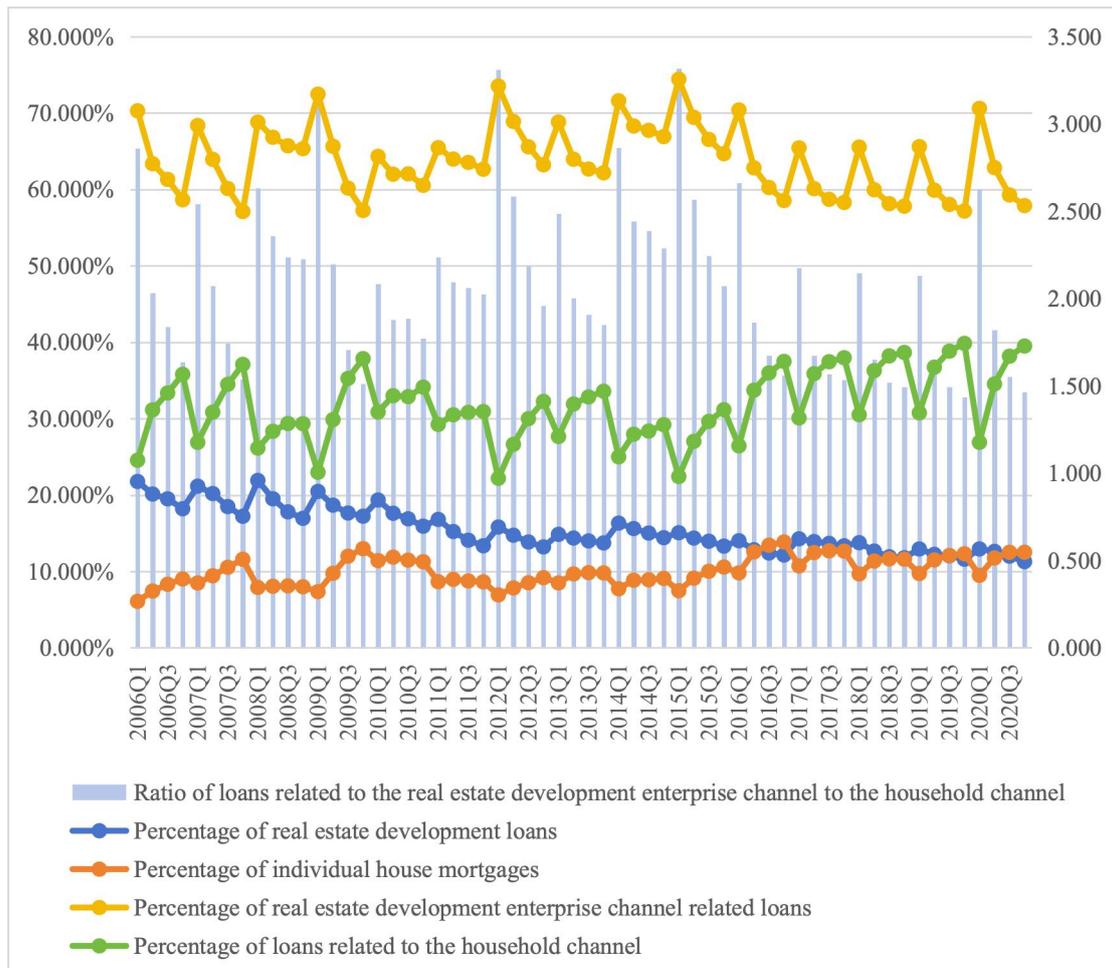


Figure 4.6: Change in the size of all types real estate loans

Data source: Compiled based on data from the People's Bank of China and Wind Information

Therefore, it would be inaccurate to analyze the impact of real estate price fluctuations on banks solely through the real estate enterprise channel, using data from real estate development loans, as it would only provide a partial reflection of such impact. Instead, a more scientific approach would involve utilizing loans data associated with the real estate enterprise channel. Thus, this section will primarily focus on the results obtained from the study using real estate enterprise-related loans data obtained from the People's Bank of China and Wind Information. Concurrently, the use of real estate development loans will serve as a means to test the reliability of these findings. Additionally, the study will conduct a comparative analysis by employing individual housing mortgage data and loans data from the household channel, aiming to ascertain any variations in the impact between the real estate enterprise channel and the household channel on banks.

### **4.3 Empirical Analysis of the Impact of Real Estate Price Fluctuations on the Size of Real Estate Development-Related Loans**

According to previous theoretical analysis, banks' lending decisions are influenced by fluctuations of real estate prices, indicating the presence of banks' risk myopia. In order to analyze the impact of real estate price fluctuations on banks through the real estate enterprise channel, it is crucial to first assess whether these fluctuations affect the magnitude of real estate development-related loans. This entails investigating whether real estate price fluctuations have a bearing on lending decisions within the real estate development sector. If such fluctuations do indeed impact the size of these loans, it becomes necessary to further analyze their effect on banks' credit risk and liquidity, thereby determining whether system risk is transmitted through the real estate enterprise channel. Conversely, if no impact is observed, it suggests that banks are not prone to risk myopia, making the existence of system risk less probable.

Furthermore, to examine the presence of this effect, Granger causality tests and impulse response function analysis will be employed.

#### **4.3.1 Analysis Based on Granger Causality Test**

Granger causality test based on Vector Auto-Regression Model (VAR model) is a common method used in time series analysis. It is used to test whether a change in one economic variable is the cause of a change in another economic variable. This scheme was proposed by scholar Granger in 1969 and improved by scholar Sims in 1972, and it is widely used in the field of economics and finance to test the existence of causality between time series variables. (Sims, 1972) The economic implication is that for economic variables  $X$  and  $Y$ , in order to examine whether a change in  $X$  is the problem that causes a change in  $Y$ , the main question is how far the present  $Y$  can be explained by the past  $X$ , i.e., whether the addition of the lagged term of  $X$  can make the explanation higher. If the addition of the lagged term of  $X$  can significantly improve the prediction accuracy or reduce the mean square error of prediction for  $Y$ , then  $X$  can be said to be the Granger cause of  $Y$  (or  $Y$  is caused by  $X$  Granger). (Granger, 1969)

It should be noted that the method proposed by Granger in 1969 is only

applicable to the smooth series, which requires unit root tests for the series, and the results are extremely sensitive to the choice of the lag term length  $p$ . The lag order of the VAR model needs to be determined. The specific determination method can be done by using the Akaike Information Criterion (AIC) or Bayes Information Criterion (BIC) criterion. It should also be noted that the results of the Granger causality test only represent the correlation between the economic variables  $X$  and  $Y$  in a statistical sense, and whether there is a reasonable causal relationship between the two in an economic sense needs to be analyzed and judged by theoretical analysis or other empirical analysis methods.

In this section, Granger causality tests are conducted at the national-level and bank level respectively based on Vector Auto-Regression Model established by Equation 4.22 and Equation 4.23. The logarithmic difference of the China's 100-City real estate price index ( $d\log(\text{REPI})$ ) is chosen to represent the house price change at the national-level. The percentage of real estate development loan balance to total loan balance (REDLR) and the percentage of real estate enterprises channel-related loan balance to total loan balance (AREDLR) are chosen to represent the change in the size of real estate development-related loans. At the bank level, the logarithmic difference of the China's 100-City real estate price index ( $d\log(\text{REPIB})$ ) is chosen to represent the change in house prices, and the percentage of real estate development loan balance to total loan balance ( $\text{REDLR}_b$ ) and the percentage of real estate enterprises channel-related loan balance to total loan balance ( $\text{AREDLR}_b$ ) are chosen to represent the change in the size of real estate development-related loans. The 3-year bank term deposit rates ( $\text{BDIR}$ ) are chosen as exogenous variables to control for changes in capitalization rates at both the national-level and the bank level. Since each series is a smooth series, the analysis can be performed by applying Granger causality tests.

#### **4.3.1.1 Results of the National-Level Empirical Analysis**

For the national-level analysis, the Granger causality test model can be applied directly to the VAR model. According to the AIC criterion, the optimal lag orders of the two model systems, REDLR and  $d\log(\text{REPI})$ , AREDLR and  $d\log(\text{REPI})$ , are determined to be 3rd and 4th order, respectively, which leads to the results of the Granger causality test.

Table 4.2: National-level Granger causality test results

Hypothesis	Chi-square value	degrees of freedom	p-value
REDLR is not Granger cause of dlog(REPI)	8.23	7	0.51
dlog(REPI) is not Granger cause of REDLR	15.57*	7	0.08
AREDLR is not Granger cause of dlog(REPI)	7.18	9	0.62
dlog(REPI) is not Granger cause of AREDLR	17.67**	9	0.04

Note: (1) BDIR is exogenous variable. (2)\*\*\*, \*\*, \* indicates significant at 99%, 95% and 90% confidence levels.

The findings presented in Table 4.2 reveal that in both sets of hypotheses, A is found to be a Granger cause of B and C respectively. This implies that fluctuations in real estate prices have the potential to impact the size of real estate development-related loans. Conversely, the changes in the size of these loans do not serve as Granger causes of real estate price fluctuations. This indicates that the allocation decisions regarding real estate development-related loans within China's banking industry are influenced by the factors of real estate price fluctuations. Furthermore, it suggests that banks' direct debt investments in the real estate capital market are characterized by both risk and myopia. Notably, the scale of real estate development-related loans does not exert influence on real estate price fluctuations. This implies that financial support on the supply side of the real estate market does not play a significant role in driving real estate price fluctuations.

#### 4.3.1.2 Results of the Bank Level Empirical Analysis

For the bank-level analysis, the time series-based VAR model Granger causality test method is no longer adequate. Therefore, a panel data Granger causality test method based on the Panel Vector Auto-Regression Model is needed. (Hurlin & Venet, 2001; Hurlin & Dumitrescu, 2008; Hurlin, 2004) According to the AIC criterion, the optimal lag order of both models REDLR<sub>b</sub> and dlog(REPI), AREDLR<sub>b</sub> and dlog(REPI) is determined to be 3rd order, and thus the results of the bank-level panel data Granger causality test are obtained.

Table 4.3: Bank level Granger causality test results

Hypothesis	Chi-square value	degrees of freedom	p-value
REDLR is not Granger cause of dlog(REPI)	19.48***	2	0.002
dlog(REPI) is not Granger cause of REDLR	21.47***	2	0.001
AREDLR is not Granger cause of dlog(REPI)	1.97	2	0.59
dlog(REPI) is not Granger cause of AREDLR	8.73*	2	0.06

Note: (1) BDIR is exogenous variable. (2)\*\*\*, \*\*, \* indicates significant at 99%, 95% and 90% confidence levels.

As can be seen from the findings in Table 4.3. In the above two sets of hypotheses, dlog(REPI) is the Granger cause of REDLR<sub>b</sub> and AREDLR<sub>b</sub> respectively. This result is consistent with the results at the national-level. It is also reflected at the bank-level that real estate price fluctuations can cause changes in the size of real estate development-related loans. Otherwise, the change in the size of real estate development-related loans is not a Granger cause of real estate price fluctuations. Thus, the national-level results reflect problems that are supported by the bank-level results. Which means that the allocation decisions of China's banking sector for real estate development-related loans are affected by real estate price fluctuations and that the China's banking sector is risky and myopic.

### 4.3.2 Impulse Response Function Analysis Based on VAR Model

The results of the Granger causality test reveal that real estate price fluctuations Granger cause changes in the size of real estate development-related loans. To further investigate this relationship, this section analyzes the impulse response functions formed by both the national-level VAR model and the bank-level Panel VAR model. These models provide a more direct test of the impact of real estate price fluctuations shocks on the size of real estate development-related loans.

In the utilization of the VAR model, it is important to note that the VAR model does not impose any a priori constraints on the variables and is considered a non-theoretical empirical model. Therefore, the analysis of its results focuses on understanding the dynamic effects on other variables in the system when there is a change in an error term or when the model system experiences a shock from a change in one variable. This analysis is commonly referred to as the impulse response function analysis (Koop et al., 1996; Pesaran & Shin, 1998). In subsequent studies, impulse response functions were also developed for Panel VAR systems (Love & Zicchino, 2006).

For both the national and bank-levels, VAR and Panel VAR models were employed. The choice of variables remains consistent with the ones utilized in the previous section's Granger causality test. Additionally, the same 3-year bank term deposit rates are chosen as exogenous control variables.

#### 4.3.2.1 Results of the National-Level Empirical Analysis

Two models at the national-level, REDLR and  $d\log(\text{REPI})$ , and AREDLR and  $d\log(\text{REPI})$ , are developed, and the optimal lag orders are 3rd and 4th order according to the AIC criterion; the modal inverse of all AR roots is less than 1, indicating that the estimated models meet the stability condition. The results of the autocorrelation LM test show that the residual series of the model system are not serially correlated; the results of the White heteroskedasticity test indicate that none of the models have heteroskedasticity. On the basis of the VAR model estimation, the impulse response function results can be obtained to derive the corresponding of real estate development loan size and real estate development-related loan size to real estate change shocks. The results are shown in Figure 4.7.

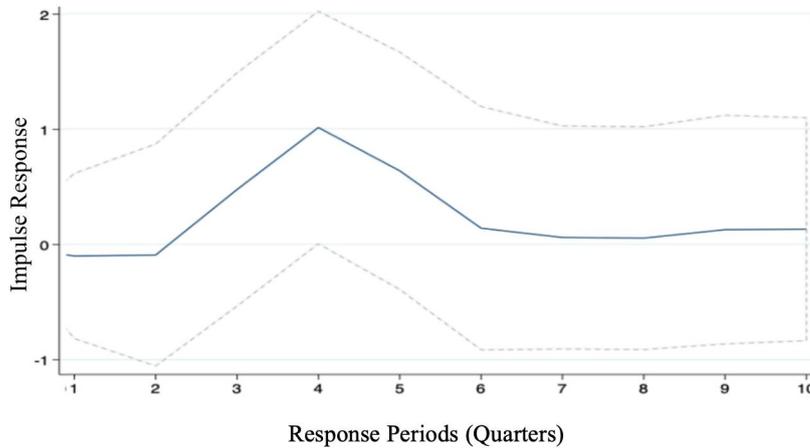


Figure 4.7: Impulse response functions for national-level VAR model

Figure 4.7-A: Response of the real estate development loan share to shocks in house price change

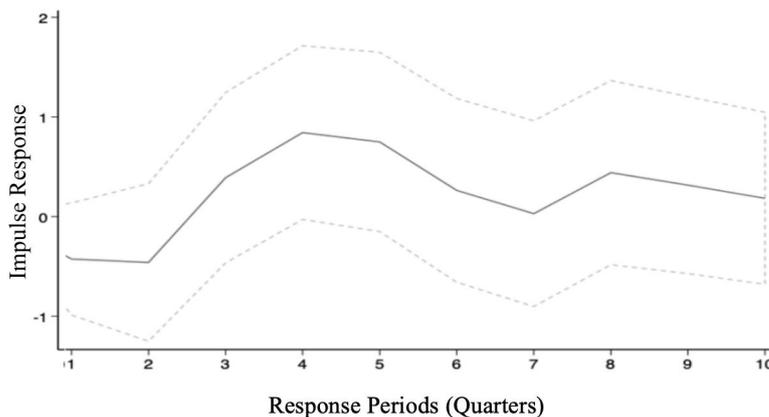


Figure 4.7: Impulse response functions for national-level VAR model

Figure 4.7-B: Response of the share of real estate development-related loans to shocks in house price change

Figure 4.7-A and Figure 4.7-B correspond to the impulse response functions of national-level real estate price fluctuations on variables REDLR and  $\text{dlog}(\text{REPI})$ , AREDLR and  $\text{dlog}(\text{REPI})$ , predicting lagged one period within the same sample. Figure A shows the impulse response function of an autoregressive model, while Figure B shows the impulse response function of a panel autoregressive model. It can be seen from the figures that the fluctuations in real estate prices have significant positive effects on variables REDLR and  $\text{dlog}(\text{REPI})$ , AREDLR and  $\text{dlog}(\text{REPI})$  predicting lagged one period within the same sample.

Overall, shocks from changes in real estate prices will cause a significant positive response in the size of loans related to the real estate enterprise channel.

#### 4.3.2.2 Results of the Bank-Level Empirical Analysis

Corresponding to the national-level models, bank-level models  $\text{REDLR}_b$  and  $\text{dlog}(\text{REPI})$ ,  $\text{AREDLR}_b$  and  $\text{dlog}(\text{REPI})$  are developed. The optimal lag order is determined as 3rd order according to the AIC criterion, and the Panel VAR model is estimated using the System Generalized Method of Moments estimation. The stability test results show that estimated models meet the stability condition. Further the impulse response function can be obtained from the estimation results to obtain the response of bank-level real estate development loans size and real estate development-related loans to shocks of house price changes. The results are shown in Figure 4.8.

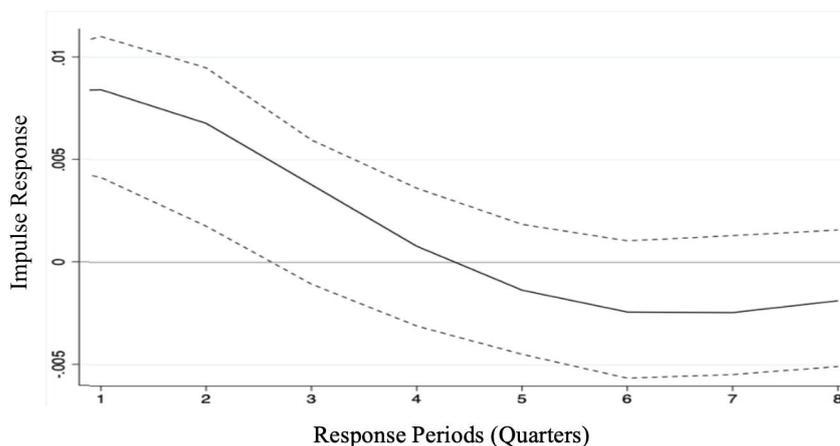


Figure 4.8: Impulse response functions for bank-level VAR model

Figure 4.8-A: Response of the real estate development loan share to shocks in house price change

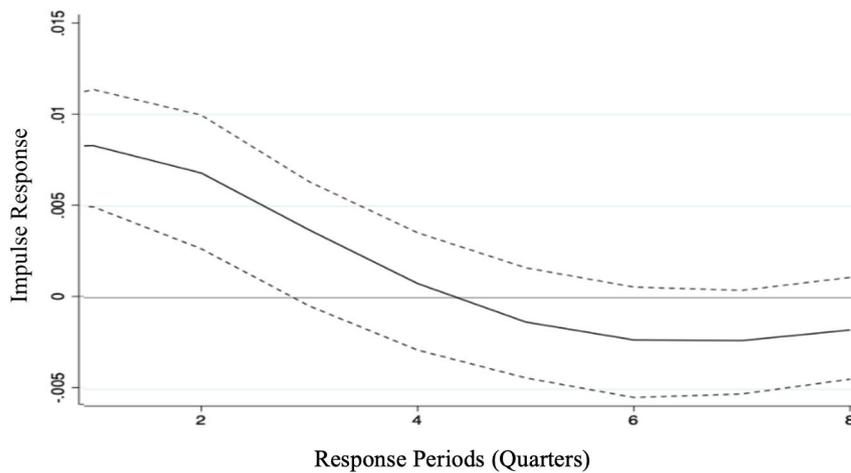


Figure 4.8: Impulse response functions for bank-level VAR model

Figure 4.8-B: Response of the share of real estate development-related loans to shocks in house price changes

The results in Figure 4.8 show that the impulse response results at the bank-level are similar to those at the national-level. Figure 4.8-A and Figure 4.8-B correspond to the impulse response functions of bank-level real estate price fluctuations on variables  $REDLR_b$  and  $dlog(REPI)$ ,  $AREDLR_b$  and  $dlog(REPI)$ , predicting lagged one period within the same sample. Figure A shows the impulse response function of an autoregressive model, while Figure B shows the impulse response function of a panel autoregressive model. It can be seen from the figures that the fluctuations in real estate prices have significant positive effects on variables  $REDLR$  and  $dlog(REPI)$ ,  $AREDLR$  and  $dlog(REPI)$  and predicting lagged one period within the same sample.

Both the size of real estate development loans and the size of real estate development-related loans respond positively under a shock of a change in house prices. Under the impact of a standard variance positive shock of real estate price change, both the size of real estate development loans and the size of real estate development-related loans will show a positive response and then start to decline.

Overall, at the bank-level, shocks to house price changes will significantly induce a significant positive response in the size of loans related to the real estate enterprise channel, consistent with the results of the national-level analysis.

### 4.3.3 Brief Summary

The results of the Granger causality test and impulse response function analysis indicate that changes in house prices have a significant impact on the size of loans related to the real estate enterprise channel. This finding is consistent at both the national and bank-levels.

Fluctuations in real estate prices can influence banks' decisions regarding the allocation of loans for real estate development. Banks may exhibit risk-taking behavior and short-sightedness when originating loans for real estate development. However, it is important to note that rational banks base their allocation decisions on the fluctuations in real estate prices, and it should not be assumed that system risk necessarily exists. If the allocation of loans related to real estate development allows banks to effectively manage their credit risk and maintain reasonable levels of liquidity, then system risk may not be present. The analysis in this section demonstrates the existence of preconditions for real estate price fluctuations to potentially trigger system risk through the real estate enterprise channel. However, further analysis of banks' credit risk and liquidity is needed to fully assess the presence of system risk.

## **4.4 Empirical Analysis of Real Estate Price Fluctuations on Bank's Credit Risk Through the Real Estate Development Enterprise Channel**

### **4.4.1 Model Setting and Variable Selection**

Based on the theoretical analysis in the previous section, designing the model for empirical research to determine the impact of real estate price fluctuations on banks' credit risk through the real estate enterprise channel. Next, the model setting at the national-level and the model setting at the bank-level will be explained separately.

The explained variables chosen for the national-level model is loan loss provision ratio ( $LLPR_t$ ) and the key explanatory variables are: loan to total loan ratio ( $LP_t$ ) and its cross-sectional term with prior period real estate price changes ( $LP_t * dlog(REPI_{t-1})$ ). The loan to total loan ratio is used to examine the impact of the real estate enterprise channel using the percentage of real estate development loan balance to total loan balance ( $REDLR_t$ ) and the percentage of real estate enterprises channel-related loan balance to total loan balance ( $AREDLR_t$ ). Meanwhile, the percentage of individual housing mortgage to total loan balance ( $PLPR_t$ ) and the percentage of loans related to household channel to total loan balance ( $FLPR_t$ ) are used to examine the impact of household channel for comparison, and the control variables are selected as banking sector asset-liability ratio ( $ALR_t$ ) and loan-to-deposit ratio ( $LTDR_t$ ). The model is set up with the following Equation:

$$LLPR_t = \alpha_0^N + \alpha_1^N * LP_t + \alpha_2^N * LP_t * d\log(REPI_{t-1}) + \theta' Controls_t + \varepsilon_t$$

[Equation 4.24]

$\alpha_1^N$  and  $\alpha_2^N$  correspond to the coefficients of  $\alpha_1$  and  $\alpha_2$  at the national-level,  $\theta$  is the corresponding coefficient vector,  $controls_t$  is the control variable,  $\varepsilon_t$  is the error term.

The explained variables chosen for the bank-level model is loan loss provision ratio ( $LLPR_{i,t}$ ) and the key explanatory variables are: loan to total loan ratio ( $LP_{i,t}$ ) and its cross-sectional term with prior period real estate price changes ( $LP_{i,t} * d\log(REPI_{i,t-1})$ ). The loan to total loan ratio is used to examine the impact of the real estate enterprise channel using the percentage of real estate development loan balance to total loan balance ( $REDLR_{i,t}$ ) and the percentage of real estate enterprises channel-related loan balance to total loan balance ( $AREDLR_{i,t}$ ). Meanwhile, the percentage of individual housing mortgage to total loan balance ( $PLPR_{i,t}$ ) and the percentage of loans related to household channel to total loan balance ( $FLPR_{i,t}$ ) are used to examine the impact of household channel for comparison, and the control variables are selected as banking sector's capital adequacy ratio ( $CAR_{i,t}$ ), loan-to-deposit ratio ( $LTDR_{i,t}$ ), Cash-generating ratio of main business ( $MICR_{i,t}$ ), net interest margin ( $NIM_{i,t}$ ), main business ratio ( $MPP_{i,t}$ ), return on net assets ( $ROE_{i,t}$ ), bank size ( $SIZE_{i,t}$ ). T

According to the theoretical assumptions in the previous section, banks have risky myopic expectations when allocating real estate loans. This means that the change in the percentage of real estate loans in the current period is determined by the change in house prices in the previous period. Individual fixed effects are also introduced into the model, which is set up with the following Equation:

$$LLPR_{i,t} = \alpha_0^B + \alpha_{0,i}^B + \alpha_1^B * LP_{i,t} + \alpha_2^B * LP_{i,t} * d\log(REPI_{i,t-1}) + \theta' Controls_{i,t} + \varepsilon_t$$

[Equation 4.25]

$\alpha_1^B$  and  $\alpha_2^B$  correspond to the coefficients of  $\alpha_1$  and  $\alpha_2$  at the bank-level,  $\theta$  is the corresponding coefficient vector,  $controls_{i,t}$  is the control variable,  $\varepsilon_t$  is the error term.

## 4.4.2 Estimation Results and Analysis

### 4.4.2.1 Estimated Results at National-Level

The estimation of equation 4.24 yields the national-level results reported in Table 4.4, where the loan to total loan ratio ( $LP_{i,t}$ ), the real estate development loan ratio ( $REDLR$ ), the real estate development loan ratio ( $AREDLR$ ), and individual housing

mortgage to total loan balance ( $PLPR_{i,t}$ ), loans related to household channel to total loan balance ( $FLPR_{i,t}$ ) correspond to Models 1-4, respectively. The ADF test results indicate that all variables are stationary within the sample period, allowing direct regression estimation. When using the ordinary least squares (OLS) method, the White test results show evidence of heteroskedasticity, while the D.W. statistic and LM test suggest possible residual autocorrelation. To improve the validity of the estimates, an AR(1) term is introduced to control for serial correlation in the residuals, and the weighted least squares (WLS) method is applied to address heteroskedasticity, thereby ensuring the robustness of parameter estimation and inference.

Table 4.4: Model estimation results on the impact of real estate price fluctuations on banks' credit risk (national-level)

	Model 1	Model 2	Model 3	Model 4
Constants	37.92*** (85.78)	37.46*** (69.21)	32.07*** (33.41)	31.67*** (35.01)
$LP_t$	-2.33*** (-15.21)	-2.12*** (-7.08)	4.85*** (12.91)	5.38*** (13.45)
$LP_{i,t} * d\log(REPI_{i,t-1})$	-11.10*** (-10.94)	-9.85*** (-6.09)	1.87* (1.60)	4.02*** (3.29)
Control variable	Yes	Yes	Yes	Yes
AR (1)	-0.99*** (-4.12)	-0.58* (-1.98)	-4.02*** (-7.37)	-4.00*** (-7.61)
Adjusted $R^2$	0.999	0.995	0.996	0.995
F-Statistics	9999***	5788.5	8066.16	5439.79
DW test value	1.01	1.00	0.92	0.94
Sample size	58	58	58	58

Notes: (1) The explained variable is loan loss provision ratio,  $LP_t$  in Model 1-4 are  $REDLR_t$ ,  $AREDLR_t$ ,  $PLPR_t$ ,  $FLPR_t$ . (2) To eliminate heteroskedasticity, a weighted least squares estimation method is used to calculate the standard deviation of coefficients using White heteroskedasticity consistent covariance to correct for serial correlation, an AR(1) model is used for estimation. (3) Yes indicates inclusion of control variables  $ALR_t$  and  $LTDR_t$ . (4) T-statistics in parentheses; \*\*\*, \*\*, \* denote significant at 99%, 95% and 90% confidence levels, respectively. (5)  $R^2$  is the adjusted value.

The results of the national-level model estimates show that: Model 1,  $\alpha_1^N < 0$  and  $\alpha_2^N < 0$ , shows that the impact of rising house prices on credit risk through real estate development loans is "accelerating down". Model 2,  $\alpha_1^N < 0$ ,  $\alpha_2^N < 0$ , shows that the

impact of rising house prices on credit risk through real estate development-related loans is "accelerating down". Model 3,  $\alpha_1^N > 0$ ,  $\alpha_2^N > 0$ , shows that the impact of rising house prices on credit risk through individual housing mortgages is "increasing but without acceleration". Model 4,  $\alpha_1^N > 0$  and  $\alpha_2^N > 0$ , shows that the impact of house price inflation on credit risk through household-related lending is "accelerating up".

Based on the results of Models 1 and 2 indicate that, for banks, development loans and development-related loans are generally assets with relatively low credit risk. Thus, the likelihood that rising real estate prices would trigger large-scale credit losses in the banking sector through the development enterprise channel is relatively small. At the same time, the results of Model 3 show that the effect of rising real estate prices transmitted through individual housing mortgage loans on large-scale credit losses in the banking sector is not significant, suggesting that its transmission effect is limited. In contrast, Model 4 indicates that real estate price increases accelerate the accumulation of credit risk through household-related lending. This finding aligns with the characteristics of the pre-sale system, where high leverage among homebuyers amplifies bank risk during real estate price upturns. Therefore, the results of Model 4 can be interpreted as evidence that, in periods of rising house prices, the household channel becomes the main source of system risk for the banking sector.

#### **4.4.2.2 Estimated Results at Bank-Level**

The estimation of equation 4.25 yields the national-level results reported in Table 4.5, where the loan to total loan ratio ( $LP_{i,t}$ ), the real estate development loan ratio (REDLR), the real estate development loan ratio (AREDLR), and individual housing mortgage to total loan balance ( $PLPR_{i,t}$ ), loans related to household channel to total loan balance ( $FLPR_{i,t}$ ) correspond to Models 1-4, respectively. The Kao test for panel data indicates the existence of cointegration relationships among the variables. In the estimation process, given the potential presence of heteroskedasticity and serial correlation in panel data, the panel weighted least squares method (Panel EGLS) is employed. Furthermore, the White cross-section robust method is applied to correct the standard errors, thereby ensuring the robustness and reliability of the coefficient estimates and statistical inference.

Table 4.5: Model estimation results on the impact of real estate price fluctuations on banks' credit risk (bank-level)

	Model 1	Model 2	Model 3	Model 4
Constants	-18.76*** (-4.44)	-18.25*** (-4.15)	-19.52** (-2.61)	-23.11** (-3.19)
$LP_{i,t}$	0.02*** (5.32)	0.03** (2.95)	-0.25 (-1.08)	0.01** (2.04)
$LP_{i,t} * \text{dlog}(\text{REPI}_{i,t-1})$	4.25*** (0.80)	0.28* (1.86)	2.77* (1.87)	8.10 (0.52)
$CAR_{i,t}$	0.09*** (5.79)	0.14*** (8.65)	0.12*** (5.74)	0.09** (3.12)
$LTDR_{i,t}$	-0.005** (-2.29)	-0.05** (-2.11)	-0.00 (-0.30)	-0.004 (-1.30)
$MICR_{i,t}$	-0.0001* (-1.76)	-0.00** (-2.21)	-0.0005** (-2.52)	-0.0005** (-2.41)
$NIM_{i,t}$	0.15*** (4.31)	0.12*** (3.51)	0.12** (1.42)	0.15* (1.71)
$MPP_{i,t}$	0.20*** (4.69)	0.19*** (4.28)	0.21*** (2.75)	0.25** (3.38)
$ROE_{i,t}$	-0.004 (-1.04)	-0.00 (-1.15)	-0.01 (-1.31)	-0.01 (-1.24)
$SIZE_{i,t}$	-6.25** (-3.37)	-0.72 (-0.38)	0.02 (0.01)	-3.84 (-1.49)
Enterprise fixed effect	Yes	Yes	Yes	Yes
Adjusted R <sup>2</sup>	0.50	0.51	0.49	0.52
F-Statistics	21.08***	17.58***	11.35***	12.65***
Sample size	606	606	324	324

Notes: (1) The explained variable is Loan loss accrual ratio,  $LP_t$  in Model 1-4 are  $REDLR_t$ ,  $AREDLR_t$ ,  $PLPR_t$ ,  $FLPR_t$ . (2) Using panel generalized least squares estimation method, using cross-section residual variance as the estimated weight. And use the robust estimation method ( White section weighting method ) to calculate the coefficient standard deviation. (3) Yes indicates the inclusion of individual fixed effects. (4) T-statistics in parentheses; \*\*\*, \*\*, \* denote significant at 99%, 95% and 90% confidence levels, respectively.

There are certain differences between the estimation results at the bank-level and the analysis results at the national-level. Model 1,  $\alpha_1^B > 0$  and  $\alpha_2^B > 0$ , shows that the

impact of rising real estate prices on bank credit risk through the proportion of development loans is "accelerating up". Model 2,  $\alpha_1^B > 0$ ,  $\alpha_2^B > 0$ , shows that the indicates that the impact of rising real estate prices on bank credit risk through real estate development-related loans is "accelerating up". Model 3,  $\alpha_1^B \approx 0$ ,  $\alpha_2^B \approx 0$  (insignificant), shows that the impact of rising real estate prices on credit risk through individual housing mortgages is insignificant. Model 4,  $\alpha_1^B > 0$  and  $\alpha_2^B \approx 0$  (the interaction term is insignificant), shows that the rising real estate prices increase credit risk through household-related loans, but without a clear accelerating effect.

The results of Models 1 and 2 indicate that during real estate price booms, banks exhibit strong procyclical behavior in allocating credit to development and development-related loans, leading to an "accelerating upward" trend in credit risk and raising the likelihood of large-scale credit losses via the real estate enterprise channel. The insignificant result of Model 3 shows that individual housing mortgages played a limited role in transmitting credit risk during the sample period. Model 4 shows that household-related loans experience rising risk when real estate prices increase, but without a significant amplification. Overall, the banking-level evidence indicates that rising real estate prices tend to accumulate and amplify credit risk mainly through the development enterprise channel, while the effects are limited in the individual mortgage channel and not significantly amplified in the broader household loan channel.

At the bank-level, the empirical analysis does not fully support this conclusion. Instead, it shows that real estate price increases have failed to effectively alleviate banks' credit risk and, in fact, demonstrate a "rapid accumulation" of credit risk. Even in the context of personal mortgage loans, the expected decline in credit risk does not materialize.

The discrepancy between theory and empirical evidence reflects a deviation of real-world banking behavior from rational expectations. First, during housing booms, banks do not proactively control risk exposure. Instead, driven by short-term profit maximization, they expand credit to the real estate sector—especially to real estate enterprises—exhibiting clear signs of risk myopia. Second, the presale system causes a large portion of mortgage loan funds to flow to developers during the construction phase, increasing banks' exposure to credit risk from unfinished projects. This mechanism is not adequately accounted for in existing theoretical models. Third, rapidly rising real estate prices attract a large number of marginal borrowers into the

market. As a result, development loans and associated financing may include a substantial share of low-quality borrowers, thereby worsening the actual credit risk rather than mitigating it.

Furthermore, the theoretical models' assumptions about borrower composition diverge from reality. Theoretical analysis often assumes that borrowers are generally creditworthy and that banks' risk control mechanisms are rational and effective. However, empirical results indicate that a portion of development loans and development-related loans may flow to enterprises with poor qualifications and high leverage. While these entities may profit in the short term during real estate price upswings, they are highly prone to default during credit cycle downturns. Therefore, the apparent real estate price increase masks the underlying risk contagion process, ultimately leading to a "rapid rise" in credit risk.

In conclusion, the divergence between theory and empirical results arises from several real-world distortions in the risk transmission path: banks' procyclical credit expansion behavior, financial institutional arrangements (such as the presale system), and borrower heterogeneity. These findings offer important insights into how systemic financial risks accumulate and underscore the need for regulatory policies in the real estate finance sector to focus more on risk accumulation during the boom cycle—not merely on reactive interventions during the downturn.

Moreover, when assessing system risk, it is not sufficient to rely solely on trends revealed by macro-level data. Greater attention must be paid to micro-level behavioral mechanisms. Regulatory frameworks should also better reflect structural differences among banks, especially by strengthening constraints and guidance on credit behavior in smaller and mid-sized banks during housing market fluctuations, in order to prevent system risks from silently growing beneath surface-level prosperity.

## **4.5 Empirical Analysis of Real Estate Price Fluctuations on Bank's Liquidity Through the Real Estate Development Enterprise Channel**

### **4.5.1 Model Setting and Variable Selection**

Based on the theoretical analysis in the previous section, designing the model for empirical research to determine the impact of house price fluctuations on banks' liquidity through the real estate enterprise channel. Next, the model setting at the

national-level and the model setting at the bank-level will be explained separately.

The explained variables chosen for the national-level model is liquidity ratio ( $LR_t$ ) and the key explanatory variables are: loan to total loan ratio ( $LP_{i,t}$ ) and its cross-sectional term with prior period real estate price changes ( $LP_{i,t} * d\log(REPI_{t-1})$ ). The loan to total loan ratio is used to examine the impact of the real estate enterprise channel using the percentage of real estate development loan balance to total loan balance ( $REDLR_t$ ) and the percentage of real estate enterprises channel-related loan balance to total loan balance ( $AEDLR_t$ ). Meanwhile, the percentage of individual housing mortgage to total loan balance ( $PLPR_t$ ) and the percentage of loans related to household channel to total loan balance ( $FLPR_t$ ) are used to examine the impact of household channel for comparison, and the control variables are selected as banking sector asset-liability ratio ( $ALR_t$ ) and non-performing loan ratio ( $NPLR_t$ ). The model is set up with the following equation:

$$LR_t = \beta_0^N + \beta_1^N * LP_t + \beta_2^N * LP_t * d\log(REPI_{t-1}) + \theta' Controls_t + \varepsilon_t$$

[Equation 4.26]

$\beta_1^N$  and  $\beta_2^N$  correspond to the coefficients of  $\beta_1$  and  $\beta_2$  at the national-level,  $X$  is regression coefficients of control variables,  $\theta$  is the corresponding coefficient vector,  $controls_t$  is the control variable,  $\varepsilon_t$  is the error term.

The explained variables chosen for the bank-level model is liquidity ratio ( $LR_{i,t}$ ) and the key explanatory variables are: loan to total loan ratio ( $LP_{i,t}$ ) and its cross-sectional term with prior period real estate price changes ( $LP_{i,t} * d\log(REPI_{i,t-1})$ ). The loan to total loan ratio is used to examine the impact of the real estate enterprise channel using the percentage of real estate development loan balance to total loan balance ( $REDLR_{i,t}$ ) and the percentage of real estate enterprises channel-related loan balance to total loan balance ( $AEDLR_{i,t}$ ). Meanwhile, the percentage of individual housing mortgage to total loan balance ( $PLPR_{i,t}$ ) and the percentage of loans related to household channel to total loan balance ( $FLPR_{i,t}$ ) are used to examine the impact of household channel for comparison, and the control variables are selected as banking sector's capital adequacy ratio ( $ALR_{i,t}$ ), loan-to-deposit ratio ( $LTDR_{i,t}$ ), Cash-generating ratio of main business ( $MICR_{i,t}$ ), net interest margin ( $NIM_{i,t}$ ), main business ratio ( $MPP_{i,t}$ ), return on net assets ( $ROE_{i,t}$ ), bank size ( $SIZE_{i,t}$ ).

According to the theoretical assumptions in the previous section, banks have risky myopic expectations when allocating real estate loans. This means that the

change in the percentage of real estate loans in the current period is determined by the change in house prices in the previous period. Enterprise fixed effects are also introduced into the model, which is set up with the following equation:

$$LR_{i,t} = \beta_0^B + \beta_{0,i}^B + \beta_1^B * LP_{i,t} + \beta_2^N * LP_{i,t} * dlog(REPI_{i,t-1}) + \theta' Controls_t + \varepsilon_t$$

[Equation 4.27]

$\beta_1^B$  and  $\beta_2^B$  correspond to the coefficients of  $\beta_1$  and  $\beta_2$  at the national-level,  $\theta$  is the corresponding coefficient vector,  $controls_t$  is the control variable,  $\varepsilon_t$  is the error term.

## 4.5.2 Estimation Results and Analysis

### 4.5.2.1 Estimated Results at National-Level

The estimation of equation 4.26 yields the national-level results reported in Table 4.6, where the loan to total loan ratio ( $LP_{i,t}$ ), the real estate development loan ratio (REDLR), the real estate development loan ratio (AREDLR), and individual housing mortgage to total loan balance ( $PLPR_{i,t}$ ), loans related to household channel to total loan balance ( $FLPR_{i,t}$ ) correspond to Models 1-4, respectively. The ADF test results indicate that all variables are stationary within the sample period, allowing direct regression estimation. When using the ordinary least squares (OLS) method, the White test results show evidence of heteroskedasticity, while the D.W. statistic and LM test suggest possible residual autocorrelation. To improve the validity of the estimates, an AR(p) term is introduced to control for serial correlation in the residuals, and the weighted least squares (WLS) method is applied to address heteroskedasticity, thereby ensuring the robustness of parameter estimation and inference.

Table 4.6: Model estimation results on the impact of real estate price fluctuations on banks' liquidity (national-level)

	Model 1	Model 2	Model 3	Model 4
Constants	-39.21*** (-19.15)	-38.31*** (-17.13)	-9.13*** (-3.19)	-8.91*** (-3.73)
$LP_t$	30.78*** (3.82)	39.09*** (4.43)	119.88*** (13.11)	127.31*** (14.49)
$LP_{i,t} * \text{dlog}(\text{REPI}_{i,t-1})$	-924.28*** (-16.69)	-838.66*** (-13.50)	-173.09*** (-4.92)	-163.47 (-6.48)
Control variables	Yes	Yes	Yes	Yes
AR (1)	11.40*** (5.51)	10.20*** (3.86)	-85.07*** (-11.01)	-80.54*** (-11.71)
Adjusted R <sup>2</sup>	0.98	0.99	0.98	0.99
F-Statistics	1557.01***	1773.80***	4327.02***	3513.95***
DW test value	0.82	0.82	0.91	0.90
Sample size	58	58	58	58

Notes: (1) The explained variable is Liquidity ratio,  $LP_t$  in Model 1-4 are  $REDLR_t$ ,  $AREDLR_t$ ,  $PLPR_t$ ,  $FLPR_t$ . (2) To eliminate heteroskedasticity, a weighted least squares estimation method is used to calculate the standard deviation of coefficients using White heteroskedasticity consistent covariance to correct for serial correlation, an AR(1) model is used for estimation. (3) Yes indicates inclusion of control variables  $ALR_t$  and  $NPLR_t$ . (4) The t-statistics are in parentheses, \*\*\*, \*\*, \* indicates significant at 99%, 95% and 90% confidence levels.

The results of the national-level model estimates show that: Model 1,  $\beta_1^N > 0$  and  $\beta_2^N < 0$ , shows that the impact of rising real estate prices on liquidity through real estate development loans is "decelerating up - accelerating down". Model 2,  $\beta_1^N > 0$  and  $\beta_2^N < 0$ , shows that the impact of rising real estate prices on liquidity through real estate development-related loans is "decelerating up - accelerating down". Model 3,  $\beta_1^N > 0$  and  $\beta_2^N < 0$ , shows that the impact of rising real estate prices on liquidity through individual housing mortgages is "decelerating up - accelerating down" through individual housing mortgages. Model 4,  $\beta_1^N > 0$  and  $\beta_2^N < 0$ , shows that the impact of real estate price inflation on liquidity through household-related loans is "decelerating up - accelerating down".

The empirical results indicate that, whether through the Real Estate Development Enterprise Channel (development loans and development-related loans) or the Household Channel (personal mortgage loans and household-related loans), bank

liquidity tends to increase in the short run, showing a positive effect. However, as real estate prices continue to rise, the credit allocation pattern heavily reliant on real estate begins to impose mounting pressure on bank liquidity, leading to an accelerated accumulation and exposure of liquidity risk. This demonstrates that the impact of real estate price fluctuations on bank liquidity risk exhibits a clear non-linear feature, with a dual effect of short-term “boost” and medium- to long-term “accelerated squeeze.”

Moreover, this result highlights the dynamic and phase-dependent nature of the impact of real estate price fluctuations on bank liquidity. Unlike a simple “accelerating decline” or “decelerating decline,” the findings of this study demonstrate that the influence of the real estate market on bank liquidity is not linear or unidirectional; instead, it undergoes a “positive first, then negative” turning process. This nonlinear relationship implies that if banks base their liquidity management solely on short-term observations, they are likely to overestimate the positive effects of rising real estate prices while overlooking potential medium- and long-term liquidity pressures .

#### **4.5.2.2 Estimated Results at Bank-Level**

Based on the estimation of Equation 4.27, the bank-level model estimation results are obtained in Table 4.7. The loan to total loan ratio ( $LP_{i,t}$ ) is used to examine the impact of banks’ liquidity by using the percentage of real estate development loan balance to total loan balance ( $REDLR_{i,t}$ ), the percentage of real estate enterprises channel-related loan balance to total loan balance ( $AREDLR_{i,t}$ ), the percentage of individual housing mortgage to total loan balance ( $PLPR_{i,t}$ ) and the percentage of loans related to household channel to total loan balance ( $FLPR_{i,t}$ ) to get model 1-4. The ADF statistic from the Kao test for panel data revealed the existence of cointegration relationships between the model variables. To eliminate cross-sectional heteroskedasticity and serial correlation, the model was estimated using the Panel Estimated Generalised Least Squares Method. The variance of cross-sectional residuals is used as the estimation weight and the robust estimation method ( White cross-sectional weighting method ) is used to calculate the standard deviation of the coefficients.

Table 4.7: Model estimation results on the impact of real estate price fluctuations on banks' liquidity (bank-level)

	Model 1	Model 2	Model 3	Model 4
Constants	12.02 (0.24)	19.81 (0.43)	13.70 (0.12)	-47.94 (-0.43)
$LP_{i,t}$	0.17** (2.70)	0.61** (2.75)	-0.07* (-1.66)	0.07* (1.48)
$LP_{i,t} * \text{dlog}(\text{REPI}_{i,t-1})$	-3.16** (-2.07)	-8.75* (-1.77)	-1.10* (-1.69)	-5.26* (-1.83)
$CAR_{i,t}$	1.47*** (4.71)	1.90*** (4.83)	1.53*** (4.25)	1.42*** (3.63)
$LTDR_{i,t}$	0.02 (0.43)	0.03 (0.70)	0.13** (2.15)	0.08 (1.23)
$MICR_{i,t}$	0.01** (2.71)	0.008** (2.63)	0.01 (1.51)	0.01 (1.53)
$NIM_{i,t}$	-5.76*** (-3.96)	-6.75*** (-4.30)	-3.24* (-1.93)	-2.69 (-1.54)
$MPP_{i,t}$	0.32 (0.64)	0.19 (0.42)	0.25 (0.22)	0.86 (0.77)
$ROE_{i,t}$	-0.25** (-2.23)	-0.26** (-2.26)	-0.50*** (-3.77)	-0.50*** (-3.75)
$SIZE_{i,t}$	-2.41*** (-4.31)	-2.09*** (-5.94)	-1.23** (-2.09)	-1.78** (-2.66)
Enterprise fixed effect	Yes	Yes	Yes	Yes
Adjusted R <sup>2</sup>	0.35	0.35	0.34	0.34
F-Statistics	10.93***	10.56***	9.64***	8.42***
Sample size	303	303	238	238

Notes: (1) The explained variable is liquidity ratio,  $LP_t$  in Model 1-4 are  $REDLR_t$ ,  $AREDLR_t$ ,  $PLPR_t$ ,  $FLPR_t$ . (2) Using panel generalized least squares estimation method, using cross-section residual variance as the estimated weight. And use the robust estimation method ( White section weighting method ) to calculate the coefficient standard deviation. (3) Yes indicates the inclusion of individual fixed effects. (4) T-statistics in parentheses; \*\*\*, \*\*, \* denote significant at 99%, 95% and 90% confidence levels, respectively.

The results of the bank-level model estimates show that: Model 1,  $\beta_1^B > 0$  and  $\beta_2^B < 0$ , shows that the impact of rising house prices on liquidity through real estate

development loans is "decelerating up - accelerating down". Model 2,  $\beta_1^B > 0$  and  $\beta_2^B < 0$ , shows that the impact of rising real estate prices on liquidity through real estate development-related loans is "decelerating up - accelerating down". Model 3,  $\beta_1^B < 0$  and  $\beta_2^B < 0$ , shows that the impact of rising real estate prices on liquidity is "accelerating down" through individual housing mortgages. Model 4,  $\beta_1^B > 0$  and  $\beta_2^B > 0$ , shows that the impact of real estate price inflation on liquidity through household-related lending is "decelerating up - accelerating down".

The bank-level results further corroborate the national-level findings: the impact of rising real estate prices on bank liquidity exhibits pronounced nonlinearity and phase-dependent characteristics. Across different lending channels, there is some degree of liquidity improvement in the initial stage; however, as real estate prices continue to rise, the effect of liquidity consumption becomes increasingly evident. In particular, the Household Channel, with its "accelerating decline" pattern, demonstrates that the expansion of household lending during periods of elevated real estate prices imposes a more direct and persistent drain on bank liquidity. This feature suggests that in the early stages of real estate price increases, banks may rely on the expansion of real estate loans to achieve short-term liquidity improvement—especially under conditions of rising collateral values and strong housing demand, when loan repayment expectations appear relatively optimistic and bank liquidity seems alleviated. Nevertheless, as real estate prices rise further, the sustained growth in loan demand leads to excessive locking of bank funds within the real estate sector, with liquidity consumption gradually becoming the dominant effect. This is particularly evident for personal mortgage loans, which, due to their large scale, long maturities, and the sensitivity of household repayment capacity to fluctuations in real estate prices and income expectations, ultimately expose banks to more acute liquidity strains in a high-price environment.

Taken together, the empirical results at both the national and bank-levels lead to the conclusion that the impact of rising real estate prices on bank liquidity is not a unidirectional process of either "improvement" or "deterioration," but rather a phase-dependent trajectory of "initial enhancement—subsequent depletion." At the onset of real estate price increases, bank liquidity may improve due to accelerated loan repayments and the rise in collateral values; yet as prices continue to climb, the excessive expansion of loan volume results in prolonged capital lock-up, and liquidity consumption effects come to dominate. Thus, real estate lending exerts differentiated

impacts on bank liquidity across different stages. This finding provides important implications for both banks and regulators: banks should place greater emphasis on the phase-dependent characteristics of real estate lending, rationally optimize credit structures, and establish forward-looking liquidity risk early-warning mechanisms to avoid overestimating liquidity improvements while neglecting potential risks during periods of rapid real estate price growth. On the regulatory side, countercyclical adjustments should be strengthened to guide banks in preventing the emergence of a “false prosperity” in liquidity conditions amid rising real estate prices, thereby avoiding the silent accumulation of system risks beneath surface-level stability.

In summary, the empirical evidence presented in this section suggests that rising real estate prices do not lead to a lasting improvement in bank liquidity. On the contrary, in the medium to later stages, they may aggravate liquidity pressures through different lending channels. This indicates that fluctuations in the real estate market not only have the potential to transmit credit risk to the banking system during price declines, but may also gradually embed liquidity risks during price upswings, thereby becoming a critical trigger of systemic financial risk .

## **4.6 Chapter Summary**

This chapter focuses on the impact of real estate price fluctuations on banks through the real estate enterprise channel, centering on two fundamental questions: (1) whether price fluctuations affect banks’ lending decisions toward development enterprises, thereby altering the scale of real estate credit, and (2) whether such fluctuations, through enterprise-related loans, influence banks’ Credit Risk and Liquidity Risk, ultimately generating Systemic Risk. By combining theoretical analysis with empirical testing, the chapter investigates the mechanism of risk formation, the characteristics of loan scale, and the transmission path of system risk, and finally derives a set of policy implications.

In the theoretical analysis, the chapter applies the bank loan decision-making model to demonstrate that rising real estate prices simultaneously increase the expected return on real estate loans and reduce their default probability. These dual effects encourage banks to expand their real estate lending, thereby triggering the Financial Accelerator Effect, in which credit expansion and price appreciation reinforce one another. Specifically, as real estate prices rise, banks’ balance sheets improve due to collateral revaluation, increasing capital and lending capacity. At the same time, developers’ profitability improves, risk assessments appear more favorable,

and banks are further motivated to increase development lending. The theoretical derivations confirm that loan scale is positively correlated with expected returns and negatively correlated with default probability. Thus, during periods of sustained price growth, banks pursue profit maximization while neglecting the accumulation of system risk, reflecting a clear pattern of myopic lending behavior.

In the analysis of risk mechanisms, the chapter develops the measure of the real estate loan share to examine how price fluctuations affect banks' credit risk and liquidity in a nonlinear fashion. Empirical results show that these effects can be categorized into four states: accelerating up, decelerating up–accelerating down, decelerating down–accelerating up, and accelerating down. Each state captures a different trajectory of risk exposure. During moderate price increases, risks may remain subdued, but once prices rise sharply and subsequently reverse, defaults, collateral devaluation, and liquidity tightening are released in an accelerated manner, producing significant shocks to the banking system. The transmission manifests itself both in Credit Risk, through higher default probabilities and declining collateral values, and in Liquidity Risk, through the concentration of lending in the real estate sector, which consumes liquidity and exposes banks to funding shortages once prices decline.

In the estimation of loan scale, the chapter broadens the measurement of enterprise-related lending by taking into account the particularities of China's pre-sale system. Under this system, a substantial portion of personal housing mortgages is effectively transferred to developers during the construction phase, functioning as de facto development financing. Thus, relying solely on development loans as a proxy variable significantly underestimates the exposure of banks through the enterprise channel. The incorporation of these "implicit development loans" into enterprise-related lending demonstrates that the risk exposure is far greater than suggested by traditional classifications, and that its influence on banking stability cannot be overlooked.

In the empirical analysis, the findings confirm that real estate price increases are associated with a significant expansion of bank credit and a relaxation of risk assessment toward development enterprises. However, when prices decline, developers' repayment capacity deteriorates, default probabilities rise, and banks face intensified credit risk and liquidity strain. A comparison with the household channel (personal mortgages) shows that the enterprise channel and the household channel are

equally important in transmitting system risk, jointly constituting the primary pathways through which real estate financial risks spread to the banking sector.

The conclusions and policy implications highlight that real estate price fluctuations not only determine the scale of real estate lending but also affect banks' credit and liquidity conditions through the enterprise channel, thereby validating the existence of system risk transmission. Accordingly, three policy recommendations emerge:

(1) Regulatory oversight should be strengthened on development lending and on the risks embedded in pre-sale financing;

(2) Dynamic monitoring of the Financial Accelerator Effect should be integrated into macroprudential frameworks, in order to avoid risk concealment during price upswings and concentrated exposure during downturns;

(3) Banks should optimize their loan structures and reduce excessive dependence on real estate lending, thereby diversifying away from potential systemic vulnerabilities.

In summary, this chapter confirms both theoretically and empirically that the real estate enterprise channel is a critical conduit for system risk transmission, comparable in importance to the household channel. Ignoring this channel would lead to a severe underestimation of the actual risks borne by the banking system.

## Chapter 5 The Impact of Real Estate Price Fluctuations on the Stock Market Through the Real Estate Enterprise Channel

This chapter aims to analyze the impact of real estate price fluctuations on the stock market, specifically focusing on the real estate enterprise channel. Building upon the previous theoretical analysis, it is evident that fluctuations in real estate prices can potentially affect the share prices of real estate enterprises, leading to losses that directly impact investors through the stock market. Thus, the objective of this chapter is to examine the impact of real estate price fluctuations on the stock market through the real estate enterprise channel. There are two main research questions that will be addressed: Does real estate price fluctuation indeed have an impact on the share prices of real estate enterprises? If so, what types of real estate price fluctuations have an adverse impact on the stock market?

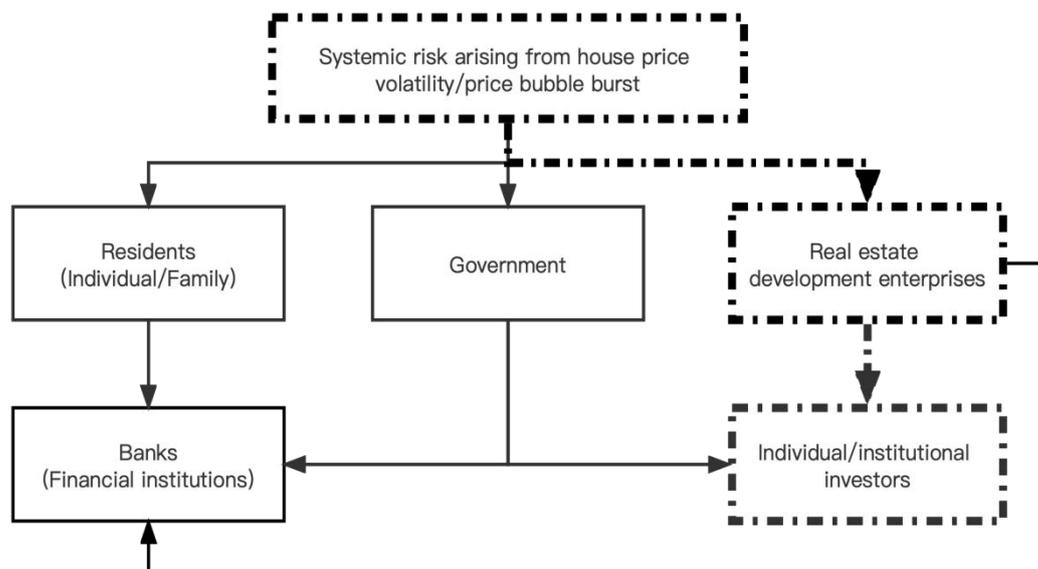


Figure 5.1: Objects of study in this chapter

Note: The dashed boxes are the objects of study in this chapter

The stock market has long been recognized as a reliable indicator of the macroeconomy, while real estate price fluctuations serve as crucial markers of macroeconomic fluctuations. Economists have extensively studied the impact of real estate price fluctuations on stock price movements. These studies consistently find that changes in real estate prices result in corresponding shifts in stock prices;

however, the effects tend to be asymmetric. In other words, the positive impact of rising real estate prices on stock prices is significantly weaker than the negative impact of falling real estate prices. This phenomenon can be attributed to two main factors. Firstly, long-term trends in real estate prices are closely intertwined with fundamental economic factors, and fluctuations in real estate prices often mirror shifts in the macroeconomy. Secondly, the stock market is a dynamic and highly speculative capital market, known for the prevalence of frequent trading. Consequently, macroeconomic changes indicated by shifts in real estate prices have a profound influence on investor expectations, exacerbating the potential for panic-driven reactions to negative news. This heightened susceptibility to "bad news" amplifies the risk of adverse shocks in equity markets resulting from real estate price fluctuations. The identification of these adverse shocks constitutes a pivotal aspect of this chapter's primary objective: assessing the existence of system risk associated with real estate price fluctuations. Understanding the occurrence of such shocks is pivotal not only for this specific analysis but also for discerning the broader presence of system risk in general.

This chapter comprehensively examines the effects of real estate price fluctuations on the stock prices of real estate enterprises. Initially, a theoretical analysis will be conducted to identify the factors that influence a firm's stock price, specifically examining whether real estate price fluctuations serve as a determining factor in the share price of real estate enterprises. Subsequently, an empirical analysis will be presented to assess the impact of real estate price fluctuations on the share prices of real estate development firms. Furthermore, leveraging the empirical findings, the study examines the event-driven element by analyzing the influence of real estate price fluctuations on the excess returns of share prices for real estate enterprises. This analysis will verify the accuracy of the conclusion regarding the influence of real estate price fluctuations on the stock prices of real estate enterprises. Finally, a comprehensive summary of the chapter will be provided to offer a conclusive assessment of whether real estate price fluctuations can result in adverse shocks to the stock market through the channel of real estate enterprises.

Extending the valuation logic that housing-price shocks work through profitability and asset values—and noting the likelihood of regime dependence in China's market—this chapter turns to equity outcomes. The questions are whether the price-stock relationship is nonlinear and regime-dependent, and whether developers'

equities exhibit regime-differentiated excess returns after accounting for market movements. The empirical strategy combines a pricing specification with a threshold-based panel approach and a standard market-model framework for returns, complemented by robustness analyses. The objective is to isolate economically meaningful regimes and quantify their implications for prices and returns. The contribution is to document regime-dependent transmission in the equity market and to provide thresholds with policy relevance.

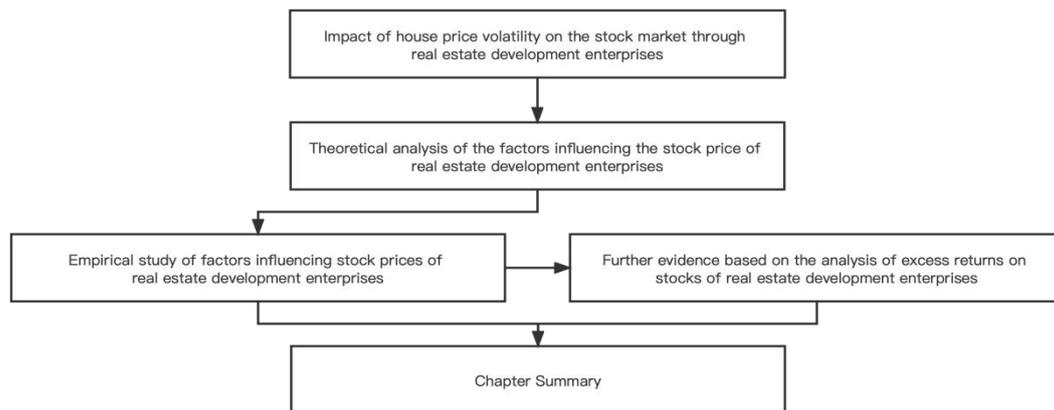


Figure 5.2: Structure of this chapter

## 5.1 Theoretical Analysis of Factors Influencing Stock Prices of Real Estate Development Enterprises

This section will theoretically analyze the factors influencing firm stock prices and determine whether fluctuations in real estate prices affect the share prices of real estate development firms. Feltham and Ohlson established the relationship between the market value of a firm's equity and book accounting data by studying the operations and investment activities of the firm, and proposed the famous Feltham-Ohlson equity value model (FO model). (Feltham & Ohlson, 1995) The FO model has been widely used in the study of the factors influencing the share price of a company. On the one hand, scholars have been refining the validity of the FO model in the practice of company equity valuation through the results of empirical analysis. (Bernard, 1995) On the other hand, they are also constantly using the results of empirical analysis to improve the choice of variables in the practical application of the FO model in order to more accurately analyze the factors influencing company share prices in different market environments. (Feltham & Pae, 2000)

The FO model directly establishes the link between a firm's stock price and its

accounting fundamentals, clearly capturing the mechanism through which real estate price fluctuations are transmitted to stock prices via fundamentals such as profitability, asset value, and leverage. This feature aligns closely with the research objective of this thesis, which focuses on the transmission path of “real estate prices - corporate fundamentals - stock prices.” Compared with other classical asset pricing models (such as the CAPM or Fama–French models), the FO model provides a more accurate framework for revealing how real estate price fluctuations are “priced” into corporate stock values by the capital market.

The FO model gives the following relationships between the basic accounting variables between a company's book accounting data:

$$\begin{aligned}
 bv_t &= oa_t + fa_t \\
 bv_t &= bv_{t-1} + x_t - d_t \\
 x_t &= ox_t + i_t \\
 i_t &= (R_f - 1)fa_{t-1} \\
 fa_t &= fa_{t-1} + i_t - (d_t - c_t) \\
 oa_t &= oa_{t-1} + ox_t - c_t \\
 d_t &= c_t + R_f fa_{t-1} - fa_t
 \end{aligned}$$

[Equation 5.1]

$bv_t$  is the company's net book assets at time  $t$ ,  $oa_t$  is operating assets,  $fa_t$  is financial assets,  $x_t$  is total earnings between time  $t-1$  and time  $t$ ,  $d_t$  is dividends or distributions,  $ox_t$  is earnings on operating assets,  $i_t$  is earnings on financial assets,  $R_f$  is gross risk-free rate of return,  $c_t$  is operating cash flow.

Assuming that the market value of a company's equity is obtained by discounting its future dividends by the risk-free rate of return:

$$P_t = \sum_{r=1}^{\infty} R_f^{-r} E_t[d_{t+r}]$$

[Equation 5.2]

$P_t$  is the market value of the company's equity,  $E_t[\cdot]$  is the conditional expectation of the contents of the brackets at moment  $t$ .

As  $d_t = c_t + R_f fa_{t-1} - fa_t$ , discount both sides of  $R_f$  and sum to  $(t, \infty)$ :

$$\sum_{r=1}^{\infty} R_f^{-r} E_t[d_{t+r}] = fa_t + \sum_{r=1}^{\infty} R_f^{-r} E_t[c_{t+r}]$$

[Equation 5.3]

Equation 5.3 shows two sources of the market value of a company's equity: one part is the value of the company's financial activities, measured by the value of the company's financial assets. The other part is the value of the company's productive operating activities, measured by the company's future operating cash flow profile.

Further, defined part of the company's operating income as "extraordinary operating income":

$$0x_t^a = ox_t - (R_f - 1)oa_{t-1}$$

[Equation 5.4]

Bring Equation 5.4 into Equation 5.1:

$$c_t = 0x_t^a + R_f oa_{t-1} - oa_t$$

[Equation 5.5]

$0x_t^a$  is abnormal operating income, this is defined as additional operating earnings over and above the expected risk-free earnings.

Equation 5.5 means that operating cash flows are equal to the sum of abnormal operating earnings and the risk-free return on operating assets. Summing over  $(t, \infty)$  after discounting both sides of it:

$$\sum_{t=1}^{\infty} R_F^{-t} E_t[c_{t+r}] = oa_t + \sum_{t=1}^{\infty} R_F^{-t} E_t[0x_{t+r}^a]$$

[Equation 5.6]

Since  $bv_t = oa_t + fa_t$ , therefore add C to both left and right sides of equation  $fa_t$ :

$$fa_t + \sum_{t=1}^{\infty} R_F^{-t} E_t[c_{t+r}] = (oa_t + fa_t) + \sum_{t=1}^{\infty} R_F^{-t} E_t[0x_{t+r}^a]$$

[Equation 5.7]

$$P_t = bv_t + \sum_{t=1}^{\infty} R_F^{-t} E_t[0x_{t+r}^a]$$

[Equation 5.8]

Equation 5.8 gives the general influences on the market value of a company's equity: the discounted net book assets of the company and the expected value of operating abnormal earnings. Therefore, the factors influencing a company's share price would include the factors that influence net book assets and operating abnormal earnings. As operating abnormal earnings are additional earnings in excess of risk-free earnings when a firm operates, they are not different in nature from the firm's operating earnings. Therefore, in the empirical analysis, it is sufficient to analyze the factors influencing the operating profitability of an enterprise. In the case of real

estate enterprises, fluctuations in real estate prices have a significant impact on the profitability of their operations (Yang, 2014). This has an impact on the equity value of real estate enterprises, which is reflected in the stock market as the stock price of real estate enterprises. Therefore, an empirical model can be developed to specifically examine the impact of real estate price fluctuations on the share price of real estate enterprises

## 5.2 Empirical Analysis of the Impact of Real Estate Price Fluctuations on the Stock Prices of Real Estate Development Enterprises

### 5.2.1 Model Setting and Variable Selection

Based on the theoretical model devised by Equation 5.8, the FO model can be rewritten as the following empirical model:

$$SP_{i,t} = \alpha_0 + \alpha_1 E_{i,t} + \alpha_2 BV_{i,t} + D_i + \theta' \text{Controls}_{i,t} + \varepsilon_t$$

[Equation 5.9]

For company  $i$  in period  $t$ ,  $SP_{i,t}$  is the company's share price,  $E_{i,t}$  is the factors influencing the company's expected earnings,  $BV_{i,t}$  is the company's net book assets,  $D_{it}$  is the enterprise's fixed effects,  $\theta$  is the corresponding coefficient vector,  $\text{controls}_{i,t}$  is the other control variables.

According to the findings of scholars, in addition to a company's net book assets and expected earnings, the growth of a company's profitability, the profitability of main business, capital structure, the proportion of shares outstanding and the size of the company can also have an impact on the company's share price. Therefore, in order to examine the impact of real estate price fluctuations, which is one of the influencing factors of a company's expected earnings on a company's share price, it is necessary to introduce the above factors into the model as control variables as well. (Li, 2005; Dang & Chu, 2004)

In the empirical model, the study will use the company's share price ( $SP_{i,t}$ ) as the explained variable, the lagged growth rate of real estate prices ( $\text{dlog}(\text{REPI}_{i,t-1})$ ) as the explanatory variable to indicate the influence of expected earnings, the company's net assets per share ( $\text{NAVPS}_{i,t}$ ) as the company's net book value, operating profit per share ( $\text{OPPS}_{i,t}$ ) and earnings per share ( $\text{EPS}_{i,t}$ ) as the company's profitability and growth, main business ratio ( $\text{MBR}_{i,t}$ ) as the main business profitability, net leverage

ratio ( $NL_{i,t}$ ) denotes capital structure, the percentage of shares outstanding ( $PSO_{i,t}$ ) and company size ( $CS_{i,t}$ ) will also be used as control variables.

By further writing Equation 5.9 as Equation 5.10:

$$SP_{i,t} = \alpha_0 + \alpha_1 \text{dlog}(\text{REPI}_{i,t-1}) + \alpha_2 \text{NAVPS}_{i,t} + D_i + \theta' \text{Controls}_{i,t} + \varepsilon_t$$

[Equation 5.10]

## 5.2.2 Results and Analysis of Panel Generalised Least Squares Model

The estimation of Equation 5.10 shows the estimation results in Table 5.1. In order to examine the differences between companies of different sizes and types, and also as a robustness check of the model structure, the study still groups the full sample of companies according to large and small, state-owned and non-state-owned companies like Chapter 3. The study estimates the data for the full sample of companies, large and small, state-owned and non-state-owned companies respectively to obtain the estimation results for models 1-5 in Table 5.1. The ADF statistic from the Kao test for panel data revealed the existence of cointegration relationships between the model variables. To eliminate cross-sectional heteroskedasticity and serial correlation, the model was estimated using the Panel Estimated Generalised Least Squares Method. The variance of cross-sectional residuals is used as the estimation weight and the robust estimation method ( White cross-sectional weighting method ) is used to calculate the standard deviation of the coefficients.

Table 5.1: Impact of real estate price fluctuations on stock prices of real estate enterprises (Panel EGLS Model)

	Model 2 (ALL)	Model 3 (Small)	Model 4 (Large)	Model 5 (Non-S-O)	Model 6 (S-O)
Constants	1.66*** (13.83)	1.66*** (11.07)	1.64*** (8.67)	4.07*** (21.16)	0.80*** (6.82)
dlog(REPI <sub>i,t-1</sub> )	24.32*** (12.92)	24.02*** (9.75)	24.68*** (8.67)	22.99*** (9.62)	24.53*** (9.25)
NAVPS <sub>i,t</sub>	0.09*** (6.03)	0.06** (2.86)	0.13*** (5.91)	0.04** (2.25)	0.06** (2.78)
OPPS <sub>i,t</sub>	-0.26* (-1.46)	-0.22* (-0.89)	-0.45* (-1.83)	-0.003* (-0.02)	-0.45* (-1.60)
EPS <sub>i,t</sub>	0.22** (2.83)	0.27** (2.78)	0.32** (2.83)	-0.33** (-2.98)	0.63* (1.72)

$MBR_{i,t}$	-0.00 (-0.95)	-0.00* (-1.80)	0.00 (0.47)	-0.00* (-1.80)	0.00 (0.78)
$NL_{i,t}$	0.00** (3.04)	0.00* (1.77)	0.00*** (3.59)	0.00** (2.07)	0.00 (1.54)
$PSO_{i,t}$	0.02*** (17.24)	0.02*** (14.57)	0.02*** (10.87)	0.00 (1.16)	0.03*** (22.20)
$CS_{i,t}$	0.32*** (12.81)	0.33*** (11.85)	0.35*** (5.85)	0.11*** (3.82)	0.60*** (14.43)
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes
Adjusted R <sup>2</sup>	0.44	0.48	0.46	0.45	0.44
F-Statistics	86.84***	62.72***	30.99***	16.15***	116.25***
Sample size	6254	3658	2596	3481	2773

Notes: Notes: (1) The dependent variable is stock price ; (2) The estimation method is panel EGLS (Estimated Generalized Least Squares), using cross-sectional residual variance as the weighting scheme. To correct for cross-sectional heteroskedasticity and contemporaneous correlation, robust standard errors are computed using the White cross-section weighting method; (3) “Yes” indicates the inclusion of firm fixed effects; (4) Model 1 is based on the full sample, Model 2 on large enterprises, Model 3 on small enterprises, Model 4 on state-owned enterprises, and Model 5 on non-state-owned enterprises; (5) Figures in parentheses are t-statistics. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% confidence levels, respectively. (6) Firms with annual operating revenue above RMB 2 billion are classified as Large, while firms with annual operating revenue below RMB 2 billion or total assets below RMB 100 million are classified as Small. “S-O” denotes state-owned enterprises (actual controller is the central or local government); “Non-S-O” denotes non-state-owned enterprises.

According to the empirical results in Table 5.1, the coefficients for  $d\log(REPI_{i,t-1})$  are significantly positive in all five models, but with some variation in magnitude. This suggests that fluctuations in real estate prices do indeed have a positive impact on the stock prices of real estate development companies. The significant positive coefficients for  $NAVPS_{i,t}$  indicate that the FO model is able to reflect the general pattern of factors that influence the stock prices of real estate development companies. The significant positive coefficients for  $CS_{i,t}$  in all models indicate that the impact of company size on the stock prices of Chinese real estate enterprises is worth noting. The size of the company affects investors' confidence in investing in the company's equity. Stronger confidence in equity investment can significantly enhance the value of the company's equity.

### 5.2.3 Existence Test of Panel Threshold Model and Threshold Effect

According to the existing literature, the pattern of change in the share prices of real estate enterprises under different conditions of real estate price fluctuations may show different states. This means that the model of Equation 5.10 may be non-linear in nature. In order to examine the change patterns of share prices of real estate enterprises under different conditions of real estate price fluctuations, this section uses a panel threshold model to examine whether there are non-linear characteristics of the impact of real estate price fluctuations on share prices of real estate enterprises and endogenously determine the threshold value (Chiang et al., 1995).

Panel threshold models are classified into static panel threshold models and dynamic panel threshold models (Hansen, 1999; Ho, 2006). According to the test results, the variables in models in Equation 5.10 are all smooth series, so there is no need to use dynamic panel threshold model. Rewriting Equation 5.10 into the form of a panel threshold model:

$$SP_{i,t} = \alpha_0 + \alpha_1^a \text{dlog}(\text{REPI}_{i,t-1}) \cdot I(g_{i,t} \leq \gamma) + \alpha_1^b \text{dlog}(\text{REPI}_{i,t-1}) \cdot I(g_{i,t} > \gamma) + \alpha_2 \text{NAVPS}_{i,t} + D_i + \theta' \text{Controls}_{i,t} + \varepsilon_t$$

[Equation 5.11]

$I(\cdot)$  is the threshold indicator function, if the condition in brackets is satisfied,  $I(\cdot) = 1$ , otherwise  $I(\cdot) = 0$ ,  $g_{i,t}$  is the threshold variable,  $\gamma$  is the threshold value,  $D_i$  is the enterprise's fixed effects,  $\varepsilon_t$  is the error term.

In the estimation of a panel threshold model, the coefficients of models are not difficult to estimate and can be estimated using methods such as the general OLS model or the Panel EGLS model. The selection of the threshold variable  $g_{i,t}$  and the determination of the threshold value  $\gamma$  are keys to the estimation of the model. In this study, the threshold search and test method proposed by Hansen (1999) is used:

1. Determining the threshold variable. In this study,  $\text{dlog}(\text{REPI}_{i,t-1})$  is chosen as the threshold variable in order to analyze the change pattern of share prices of real estate enterprises under different real estate price fluctuations conditions.

2. Threshold search was performed. All possible thresholds are ranked from smallest to largest and brought into the above equation as the threshold to be determined in order of certain quantile points for OLS estimation. The threshold with the smallest sum of squared residuals (RSS) is used as the first threshold to be determined  $\hat{\gamma}_1$ . (To ensure that there are sufficient sample values in the search interval, an interval of 5%-95% of the numerical size of the ranked threshold is

selected for the search, with the quantile chosen as 1%)

3. The test is whether there is a threshold effect. The null hypothesis is that there is no significant threshold effect at the threshold value  $\hat{\gamma}_1$  to be determined. The test was conducted by constructing an F-statistic:

$$F = \frac{S_0 - S_1(\hat{\gamma}_1)}{\hat{\sigma}_1^2}$$

[Equation 5.12]

$S_0$  is the estimated OLS residual RSS value when there is no threshold effect,  $S_1(\hat{\gamma}_1)$  is the estimated OLS RSS value when the threshold is  $\hat{\gamma}_1$ ,  $\hat{\sigma}_1^2 = S_1(\hat{\gamma}_1) / [n \cdot (T-1)]$ ,  $n$  is the number of sample cross-sections,  $T$  is the number of sample periods.

Since the F statistic does not conform to the standard F distribution, the Bootstrap method can be used to construct the distribution of the F statistic and determine the critical value at a certain confidence level, so as to determine the p-value corresponding to the F statistic and determine whether the null hypothesis is rejected, in other words, whether the threshold effect is significant.

4. The threshold value is tested to see if it is the optimal result. The null hypothesis is that the threshold value  $\hat{\gamma}_1$  to be determined is the optimal threshold value. The likelihood ratio statistic can be constructed to test:

$$LR = \frac{S_1(\gamma_1) - S_1(\hat{\gamma}_1)}{\hat{\sigma}_1^2}$$

[Equation 5.13]

$S_1(\gamma_1)$  is the RSS value of the residuals from an OLS regression with other possible thresholds.

Non-rejected domain of likelihood ratio values at certain significance levels is constructed to determine whether to reject the null hypothesis that the proposed threshold value 1 is the optimal threshold value.

5. Further fix the first threshold value on the basis of determining the first threshold value. Repeat steps 2-4 until no new thresholds appear from the test.

Based on the above method, the five models in Table 5.1 were tested for the existence of threshold effects. The results of the search for threshold values are shown in Table 5.2. Existence tests for the threshold effects are shown in Table 5.3. The LR values obtained from the tests for the optimal threshold values are shown in Table 5.3.

Table 5.2: Estimated threshold values and confidence intervals for each model

Sample type	Model	Threshold value	95% Confidence Interval
Full Sample Companies	Single threshold	0.018	[0.017, 0.019]
	Double threshold 1	0.045	[0.045, 0.045]
	Double threshold 2	0.018	[0.017, 0.019]
Small Companies	Single threshold	0.018	[0.017, 0.019]
	Double threshold 1	0.041	[0.038, 0.045]
	Double threshold 2	0.018	[0.018, 0.018]
Large Companies	Single threshold	0.030	[0.019, 0.031]
	Double threshold 1	0.045	[0.045, 0.045]
	Double threshold 2	0.030	[0.019, 0.031]
Non-State-Owned Companies	Single threshold	0.018	[0.018, 0.018]
	Double threshold 1	0.045	[0.045, 0.045]
	Double threshold 2	0.018	[0.018, 0.018]
State-Owned Companies	Single threshold	0.018	[0.014, 0.021]
	Double threshold 1	0.045	[0.045, 0.045]
	Double threshold 2	0.018	[0.018, 0.021]

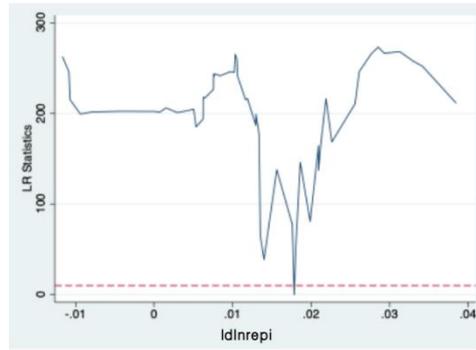
The estimation results for the single and double thresholds of the models are given in Table 5.2. It can be found that the single and double threshold estimates of the five models all lie within the confidence interval of 95%. Therefore these thresholds are all possible and the following needs to determine the validity of these thresholds by testing the existence of threshold effects for these thresholds.

Table 5.3 gives the F-statistics after the Bootstrap test for the Table 5.2 thresholds. The statistical results show that all five models reject the original hypothesis of the existence of a double threshold, but accept the original hypothesis of the existence of a single threshold, indicating that there are different mechanisms of switching in the impact of real estate price fluctuations on the share prices of property development companies. When the real estate price fluctuations reaches a certain level, the mechanism will be converted.

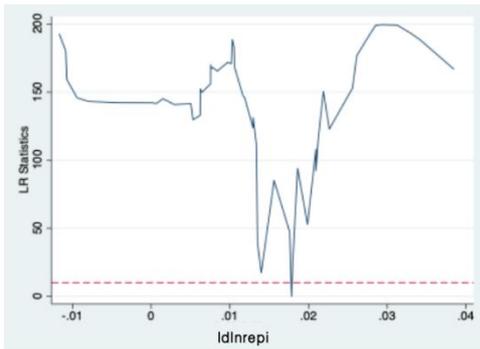
Table 5.3: Threshold effect BS test

Sample type	Model	F-Statistics	p-value	BS Times	Threshold values		
					1%	5%	10%
Full Sample Companies	Single threshold	223.18**	0.02	1000	294.87	212.30	204.68
	Double threshold	179.89	0.72	1000	274.18	250.64	230.76
Small Companies	Single threshold	173.44*	0.09	1000	248.81	216.51	163.96
	Double threshold	100.26	0.95	1000	164.93	153.51	147.20
Large Companies	Single threshold	54.55**	0.04	1000	98.26	51.25	31.76
	Double threshold	77.36	0.63	1000	129.88	117.30	110.71
Non-State-Owned Companies	Single threshold	131.78*	0.09	1000	202.26	176.63	121.92
	Double threshold	127.54	0.44	1000	172.99	163.22	151.81
State-Owned Companies	Single threshold	89.40*	0.04	1000	153.25	88.15	73.24
	Double threshold	77.96	0.44	1000	121.37	105.12	97.89

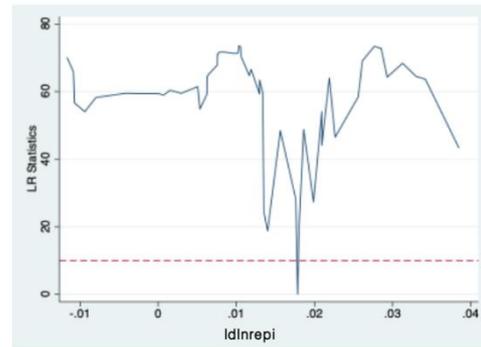
It is further examined whether the single threshold value that has been found is indeed the optimal threshold value. The LR values obtained by testing the single threshold in Table 5.2 are given in Table 5.3, with the non-rejected domain below the dashed line in the graph. It can be observed that the thresholds of the five models that have been found all fall between the non-rejection domains, and thus the original hypothesis cannot be rejected, which means it can be considered that the single threshold model thresholds found in Table 5.2 are optimal.



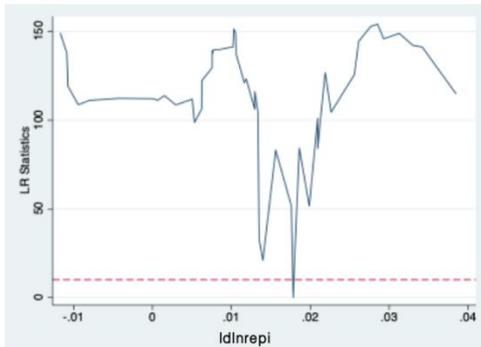
(a) Full Sample



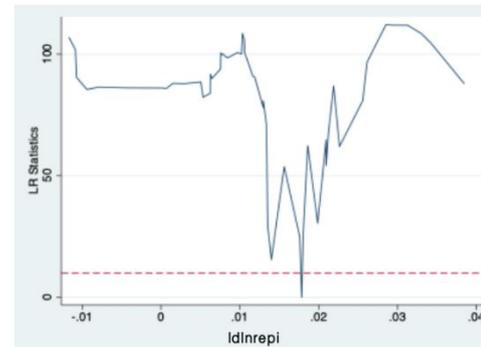
(b) Large



(c) Small



(d) State Owned



(e) Non State Owned

Figure 5.3: Distribution of LR values for a single threshold model

In summary, all five models in Table 5.1 are subject to a threshold effect and a significant single threshold can be found by testing and the optimal single threshold value can be obtained by estimation. Subsequently, a static panel threshold model with a single threshold will be developed for further analysis.

## 5.2.4 Empirical Model Results and Analysis Based on Panel Threshold Model

The five models in Table 5.2 were re-estimated by setting a single threshold value obtained from the estimation in Table 5.1. The models were estimated using the Panel EGLS method, using the variance of the cross-sectional residuals as estimation

weights and calculating the standard deviation of the coefficients using a robust estimation method (White cross-sectional weighting method), and the resulting estimates are shown in Table 5.4.

Table 5.4: Impact of real estate price fluctuations on stock prices of real estate enterprises (panel threshold model)

	Model 1 (ALL)	Model 2 (Large)	Model 3 (Small)	Model 4 (S-O)	Model 5 (Non-S-O)
Constants	1.74*** (14.18)	1.71*** (11.28)	1.77*** (8.97)	4.11*** (21.30)	0.90*** (7.30)
$d\log(\text{REPI}_{i,t-1})$	18.89*** (9.71)	18.08*** (7.04)	19.47*** (6.67)	16.43*** (6.66)	20.15*** (7.27)
$d\log(\text{REPI}_{i,t-1}) * q$	47.75*** (11.56)	52.34*** (9.65)	45.34*** (7.26)	57.70*** (10.60)	38.76*** (6.70)
Other influences	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes
Adjusted R <sup>2</sup>	0.26	0.30	0.26	0.32	0.38
F-Statistics	116.11***	81.98***	42.96***	34.62***	117.14***
Sample size	6254	3658	2596	3481	2773

Note: (1) The dependent variable is stock price; (2) The model is estimated using the panel generalized least squares method (Panel EGLS), with cross-sectional residual variance employed as the estimation weight; to eliminate cross-sectional heteroskedasticity and contemporaneous correlation, the robust estimation method (White cross-sectional weighting) is used to compute the standard errors of the coefficients; (3) "Yes" indicates the inclusion of other influencing factors or individual fixed effects, with the other influencing factors including (NAVPS<sub>i,t</sub>), (OPPS<sub>i,t</sub>), (EPS<sub>i,t</sub>), (MBR<sub>i,t</sub>), (NL<sub>i,t</sub>), (PSO<sub>i,t</sub>) and (CS<sub>i,t</sub>); (4) q is the threshold dummy variable, which takes the value of 1 when the threshold variable is below the threshold, and 0 otherwise; (5) The numbers in parentheses are t-statistics, and \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively. (6) Firms with annual operating revenue above RMB 2 billion are classified as Large, while firms with annual operating revenue below RMB 2 billion or total assets below RMB 100 million are classified as Small. "S-O" denotes state-owned enterprises (actual controller is the central or local government); "Non-S-O" denotes non-state-owned enterprises.

Based on the analysis of the quarterly real estate price growth rate corresponding to the threshold value (Table 5.5), it can be found that the impact of real estate price fluctuations on the stock price of real estate enterprises can be divided into two states, the mechanism can be defined as 'high real estate price growth period' and 'low real estate price growth and decline period' (Table 5.6).

Table 5.5: Threshold estimates from the panel threshold model and the corresponding quarterly real estate price growth rates

	Model 1 (ALL)	Model 2 (Large)	Model 3 (Small)	Model 4 (S-O)	Model 5 (Non-S-O)
Threshold estimates	0.018	0.018	0.03	0.018	0.018
Real estate price growth rate (quarterly)	4.63%	4.65%	4.90%	5.10%	5.10%

Table 5.6:  $\text{dlog}(\text{REPI}_{i,t-1})$  coefficients for different states

Period	Model 1 (ALL)	Model 2 (Large)	Model 3 (Small)	Model 4 (S-O)	Model 5 (Non-S-O)
High real estate price growth	18.89	18.08	19.47	16.43	20.15
Low real estate price growth & decline	66.64	70.42	64.81	74.13	58.91
Ratio	3.53	3.89	3.33	4.51	2.92

Note: Ratio=Periods of low real estate price growth and decline / Period of high real estate price growth

The results in Tables 5.5 and 5.6 indicate that the impact of real estate price fluctuations on the stock prices of real estate enterprises exhibits a significant regime-switching pattern. Taking the full-sample model as an example, the estimated threshold value is 0.018, corresponding to a quarterly real estate price growth rate of 4.63%. When the quarterly real estate price growth rate is below 4.63% (the “low” growth and declining period), the coefficient of  $\text{dlog}(\text{REPI}_{i,t-1})$  is 66.64. By contrast, in the “high” growth period, the coefficient is only 18.89, which is about 3.53 times smaller. Other sample models show a similar pattern: once real estate prices enter the “high” growth regime, the marginal impact of real estate price fluctuations on stock prices of development enterprises declines significantly.

These findings reveal several important characteristics of the real estate price–stock price relationship. First, during the “low” growth and declining period, rising real estate prices exert a strong positive effect on stock prices, as investors maintain strong confidence in the expected future earnings of real estate enterprises, thereby driving substantial stock price increases. Second, in the “high” growth period, the estimated coefficients decline markedly, suggesting that when real estate prices increase too rapidly, investors become more cautious about potential market risks. Although stock prices may still rise, the magnitude of the increase is considerably smaller, especially for large enterprises and state-owned firms. Finally, the results during the declining phase show that once real estate prices shift from the “high”

growth regime into a downward trend, stock prices experience a much larger decline. The magnitude of decline for large and state-owned enterprises is greater than that of small and non-state-owned firms, indicating greater sensitivity of market confidence toward these firms.

The impact of real estate price fluctuations on the stock prices of real estate enterprises is nonlinear and dynamic, characterized by the trajectory of “strong positive effect in the low-growth period—diminished marginal effect in the high-growth period—sharp declines during the downturn.” When real estate prices are in the “low” growth and declining state, stock prices move strongly with real estate price fluctuations, reflecting a relatively stable mechanism. However, once real estate prices enter the “high” growth regime, the positive effect weakens, and when real estate prices suddenly shift from “high” growth into a downturn, the stock prices of development enterprises experience substantial declines, particularly for large and state-owned firms.

### **5.3 Research Based on Excess Return Analysis of Real Estate Development Enterprises' Stocks**

According to the empirical results in the previous section, there will be differences in the extent to which real estate price fluctuations affects the share prices of real estate enterprises when real estate price fluctuations is in different states. In order to test the reliability of this pattern of influence, this section will analyze the excess returns on the stocks of real estate enterprises by using the findings in the previous section. Further empirical analysis of the findings in the previous section is provided by examining the impact of different conditions of real estate price fluctuations on the stock returns of real estate enterprises.

#### **5.3.1 Empirical Analysis of Equity Excess Returns**

The impact of different conditions of real estate price fluctuations on the stock returns of real estate enterprises can be studied using the excess stock return analysis framework proposed by Campbell, Lo, and MacKinlay (1997). Building on this framework, the present study specifies an estimable panel equation for Chinese listed real estate firms and actually estimates it in the following section, rather than treating it only as a theoretical relationship. The specific equation is shown below (5-14):

$$R_{i,t} = \alpha_i + \beta R_{m,t} + \gamma_i D_{i,t} + \varepsilon_t$$

[Equation 5.14]

For the company is stock in period  $t$ ,  $R_{i,t}$  is the return in period  $t$ ,  $R_{m,t}$  is the corresponding market return (return of Shanghai securities composite index),  $D_{i,t}$  is a dummy variable that affects whether the event occurs, and in this case whether the real estate price fluctuations are in the low or down cycle of real estate growth mentioned above. If yes,  $D_{i,t}=1$ , If not,  $D_{i,t}=0$ .  $\varepsilon_t$  is a random error term,  $\gamma_i$  is the estimated threshold value of the lagged real-estate-price growth. It divides the sample into a high price-growth regime and a low or negative price-growth regime. If  $\gamma_i < 0$ , it means the regime switch happens when real-estate-price growth turns negative, which is consistent with the previous section's result that the transmission becomes more pronounced in the downturn. If  $\gamma_i > 0$ , the switch occurs before prices actually turn negative, so the result should be interpreted with more caution.

According to the research results Ching and Fu (2003), the two tests of Equation 5.15 and Equation 5.16 can be used to determine whether the estimates of  $\gamma_i$  are jointly and statistically different from zero:

$$J_1 = \left\{ \sum_{i=1}^N \sigma_i^2 \right\}^{-1/2} \cdot \sum_{i=1}^N \gamma_i$$

[Equation 5.15]

$$J_2 = n^{-1/2} \sum_{i=1}^N \frac{\gamma_i}{\sigma_i}$$

[Equation 5.16]

$N$  is the number of enterprises,  $\sigma_i$  is the standard deviation of  $\gamma_i$ . Under the original assumption that the estimate of  $\gamma_i$  is jointly and statistically different from zero, both  $J_1$  and  $J_2$  should follow a standard normal distribution.

Determine whether the original hypothesis is rejected by calculating the value of the probability distribution function corresponding to  $J_1$  and  $J_2$ .

In order to provide a targeted test of the findings in the previous section, the setting of the variable  $D_{i,t}$  is important. This section will be based on the setting of the real estate price growth rate thresholds obtained in Table 5.5.  $D_{i,t}=1$  when the real estate price growth rate is below the threshold and  $D_{i,t}=0$  when it is above the threshold. Furthermore, in order to take advantage of the findings of the grouping

study in the previous section, the settings below the threshold are also divided into three scenarios: using the full sample threshold, the company size threshold and the company type threshold. When the full sample threshold is used, 4.63% is applied as the threshold for all sample companies. When using the enterprise size threshold, 4.65% was used as the threshold for large enterprises and 4.90% was used for small enterprises. When using the enterprise nature threshold, 5.10% was used as the threshold for state-owned enterprises and 5.10% was used for non-state-owned enterprises.

The explained variables of the model are chosen as the quarterly return on the stocks of real estate enterprises ( $SQRR_{i,t}$ ). To ensure the stability of the model estimation results, the explanatory variables are used separately equal-weighted average quarterly market return ( $EAMQR_{i,t}$ ), circulation market value weighted average quarterly market return ( $CWAMQR_{i,t}$ ) and total market value weighted average quarterly market return ( $TVAMQR_{i,t}$ ). Full sample thresholds, enterprise size thresholds and enterprise type thresholds are applied to Model  $EAMQR_{i,t}$ , Model  $CWAMQR_{i,t}$  and Model  $TVAMQR_{i,t}$  respectively, which together ensure the stability of the estimation results.

Before conducting the threshold effect estimation, it is necessary to test the stationarity of the relevant variables in order to avoid spurious regression problems and to ensure the reliability of the regression results. In this study, panel unit root tests are employed, specifically the Levin-Lin-Chu (LLC) test and the Fisher-PP (F-PP) test, to examine the stationarity of the major variables. The results are presented in Table 5.7.

Table 5.7 Results of Panel Unit Root Tests

	Level		Test Result
	-9.85***	632.77***	I(0)
NAVPS <sub>i,t</sub>	-30.83***	192.23***	I(0)
OPPS <sub>i,t</sub>	-33.75***	4759.67***	I(0)
EPS <sub>i,t</sub>	-34.53***	4778.51***	I(0)
MBR <sub>i,t</sub>	-40.91***	5258.70***	I(0)
NL <sub>i,t</sub>	-33.11***	5057.18***	I(0)
PSO <sub>i,t</sub>	-10.33***	442.30***	I(0)
CS <sub>i,t</sub>	-14.36***	792.92***	I(0)
SQRR <sub>i,t</sub>	-35.23***	4977.18***	I(0)
EAMQR <sub>i,t</sub>	-29.53***	3553.83***	I(0)
CWAMQR <sub>i,t</sub>	-29.37***	5626.49***	I(0)
TVAMQR <sub>i,t</sub>	-43.08***	5419.88***	I(0)

As shown in Table 5.7, the LLC test statistics for all variables are significantly negative, and the F-PP test statistics are significantly positive. At the 1% significance level, the null hypothesis of unit root is rejected for all variables. These results indicate that all variables are stationary at level, i.e., they are I(0) series.

Therefore, the variables selected in this study do not suffer from non-stationarity and can be directly included in the subsequent threshold model and regression analysis. This finding provides a solid statistical foundation for the empirical research and further enhances the robustness of the conclusions.

### 5.3.2 Model Estimation Results and Analysis

The estimation results of the excess return analysis model for real estate development firms are presented in Table 5.8. Based on the results, the following main conclusions can be drawn:

Table 5.8: Estimation results of the excess return analysis model for real estate enterprise stocks.

Coefficient	Full sample threshold			Enterprise size threshold			Enterprise type threshold		
	EMAQR	CWAMQR	TVAMQR	EMAQR	CWAMQR	TVAMQR	EMAQR	CWAMQR	TVAMQR
$\alpha_0$	-0.01 (-1.33)	0.00 (0.04)	-0.02** (-3.05)	-0.01 (-0.74)	0.01 (1.13)	-0.10*** (-12.28)	-0.00 (-0.38)	0.02* (2.16)	-0.19*** (-18.05)
$\beta$	0.99*** (67.68)	0.18*** (51.58)	0.01*** (10.03)	0.99*** (65.06)	0.18*** (51.42)	0.02*** (15.52)	0.99*** (64.26)	0.18*** (50.16)	0.02*** (15.41)
Enterprise fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y
Mean value (%)	-5.84	-5.18	-5.24	5.19	5.18	5.25	5.19	5.18	5.24
Median (%)	-1.04	-0.32	-5.91	-1.49	0.29	6.15	-1.49	0.28	6.0
Standard deviation (%)	21.98	16.64	3.93	21.31	16.64	4.70	21.31	16.65	4.84
$J_1$	-1.14	-1.15	-1.78**	-1.48*	-2.43**	-2.18**	-0.99	-1.39*	-1.23
Prob $N(0,1) >  J_1 $	0.13	0.13	0.04	0.07	0.01	0.01	0.16	0.08	0.11
$J_2$	-3.12***	-3.89***	-5.60***	-4.98***	-5.06***	-4.28***	-3.29***	-4.29***	-3.71***
Prob $N(0,1) >  J_2 $	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Adjusted R <sup>2</sup>	0.5749	0.3049	0.0168	0.4939	0.3049	0.0244	0.4939	0.3050	0.0255
F-Statistics	2348.1***	1330.2***	162.0***	2118.3***	1322.64***	261.11***	2124.94***	1390.18***	377.91***
Sample size	6254	6254	6254	6254	6254	6254	6254	6254	6254

Notes: (1) The explained variable is Quarterly returns on stocks of real estate enterprises. (2) Panel generalized least squares estimation using cross-sectional residual variance as estimation weights; to eliminate cross-sectional heteroskedasticity and contemporaneous correlation, robust estimation methods (White cross-sectional weighting) are used to calculate the standard deviation of coefficients. (3) Yes indicates the inclusion of enterprise fixed effects. (4) The t-statistics are in parentheses, \*\*\*, \*\*, \* indicates significant at 99%, 95% and 90% confidence levels.

For the EMAQR model, the CWAMQR model and the TVAMQR model under the full-sample threshold, enterprise size threshold, and enterprise type threshold, the estimated values of  $\beta$  are consistently greater than 1. This indicates that when real estate prices are in a high-growth period, investors in real estate development firms' stocks can achieve returns above the general market average. This result reflects a strong attractiveness and premium effect of development firm stocks in periods of rapid real estate price growth.

For the EMAQR model, the CWAMQR model and the TVAMQR model under the full-sample threshold, the estimated values of  $\gamma_i$  are generally negative. The J test values in the full-sample and enterprise type threshold EMAQR models fail to reject the null hypothesis, while the  $J_2$  test values across all models reject the null hypothesis. This suggests that the estimated values of  $\gamma_i$  are overall unstable and negative. Taken together, the threshold effect test results provide strong evidence that when real estate price growth becomes excessively rapid, the excess returns of development firm stocks decline significantly.

Further analysis shows that, regardless of whether the sample is divided by enterprise size or enterprise type, the excess returns associated with high real estate price growth tend to decrease. In other words, once real estate prices transition from a high-growth phase into a low-growth or declining phase, the excess returns of development firms drop markedly. This outcome not only reduces the gains for equity investors but also exerts downward pressure on the financing capacity of real estate enterprises.

The estimation results of the excess return analysis model for real estate enterprises are consistent with the conclusions in Section 5.2. They further confirm that real estate price fluctuations significantly affect the equity market of real estate enterprises through the excess return channel and that such effects display clear phase-dependent characteristics.

## **5.4 Chapter Summary**

This chapter starts from a theoretical analysis to motivate the empirical specification. Based on the equity-valuation logic in Campbell, Lo, and MacKinlay (1997), the stock price (or excess stock return) of a real estate development enterprise can be written as a function of its net asset position, operating earnings and the expected value of its real-estate-related assets. Since real estate price fluctuations directly affect these components, it is reasonable to build an estimable panel model in

which stock returns respond to lagged real-estate-price growth.

On this basis, the chapter conducts an empirical analysis using panel data on Chinese listed real estate development enterprises. The results show that stock returns are significantly and consistently affected by real estate price fluctuations, and that the relationship is non-linear: when real estate prices are in a low-growth or declining phase, the impact on stock returns is stronger and more stable than in high-growth phases. In other words, a normal and gradual slowdown in real estate price growth will lead to a decline in developers' stock prices that is broadly in line with investors' expectations, but a sudden shift from a high-growth phase to a low-growth or negative phase will cause stock prices to fall more sharply than expected, resulting in unexpected losses.

Finally, the chapter assesses whether real estate price fluctuations can trigger systemic risk in the stock market through the real estate enterprise channel. The evidence suggests a clear asymmetry: prolonged low growth or a smooth adjustment in real estate prices is unlikely to generate a large adverse shock to the equity market; however, when a period of rapid price increase (a potential bubble) is followed by a downturn, the associated correction in developers' share prices can exceed investor expectations, impair equity-based financing, and become a transmission point for broader market stress. In this sense, real estate price declines after a rapid rise are the scenarios that are most likely to transmit to the stock market as systemic risk, while price declines after slow growth are more likely to be absorbed by the market.

## **Chapter 6 Research Conclusions and Policy Recommendations**

Real estate price fluctuations can transmit system risk to the real-estate–finance nexus through balance-sheet, credit, and liquidity channels (Li et al., 2019). Against the backdrop of moderating macroeconomic growth and evolving supply–demand conditions—including regional oversupply—policy attention in China has focused on monitoring and containing risks associated with pronounced price swings (Wang & Liu, 2018). In this thesis, we do not construct or test a stand-alone “bubble” measure; accordingly, we refer to price fluctuations rather than “bubble bursting,” and base our empirical analysis on observed housing-price dynamics without taking a stance on the existence or timing of speculative bubbles.

This thesis examines the transmission mechanism of system risk in the real estate capital market based on the current situation of China's real estate market and real estate capital market. At a theoretical level, it analyzes the relationship between real estate price fluctuations and system risk, and identifies the channels through which system risk is transmitted due to real estate price fluctuations. Building on the theoretical analysis, this study explores the effects of real estate price fluctuations on real estate enterprises, banks, and the stock market. Drawing from empirical analysis, this study assesses the potential risk posed to real estate enterprises by real estate price fluctuations. Moreover, it investigates whether real estate price fluctuations can trigger adverse effects on bank risk and the stock market through the intermediary role of real estate enterprises.

The following section provides a summary of the key findings of this thesis. It focuses on the prevention of system risks that may arise from China's real estate capital market and the promotion of a stable and healthy development of the country's real estate market. Furthermore, this section proposes policy recommendations based on the findings, outlines the academic contributions of the thesis, addresses its limitations, and suggests avenues for future research.

### **6.1 Main Research Conclusions of the Thesis**

#### **6.1.1 Main Conclusions of Theoretical Analysis**

Theoretically, fluctuations of real estate prices has fundamental characteristics that can be classified as system risk within the real estate capital market. System risk

refers to the potential risks that can affect the stability and functioning of the entire financial system.

The main objective of the theoretical analysis section is to ascertain whether fluctuations of real estate prices possesses the inherent characteristics of system risk, thereby determining its classification as system risk. Our theoretical analysis confirms that fluctuations in real estate prices can have a detrimental impact on the real estate capital market. This impact results in the continuous transmission of losses among market participants, thus establishing the definition of system risk in relation to the influence of real estate price fluctuations on the real estate capital market.

System risk is transmitted in the primary real estate capital market through collateral, liquidity, and capitalization. In the secondary real estate capital market, transmission occurs primarily through asset securitization. The increase in real estate prices has resulted in overly optimistic expectations and excessive speculation and investment in real estate capital markets. Moreover, real estate enterprises may increase their debt ratios, expand investments, accumulate large inventories, and underestimate liquidity risks. Banks may issue significant amounts of real estate loans, while investors engage in substantial speculation and borrowing. Additionally, local governments may expand their debts by relying on land concessions as a means of debt servicing. These actions collectively contribute to the creation of system risk. A decline in real estate prices can trigger losses in the real estate market, the real estate capital market, and various sectors of the macroeconomy. These losses have the potential to spread across sectors, thus exacerbating system risk. The main channels through which system risk is transmitted include the real estate enterprise channel, the household sector channel, and the government channel.

### **6.1.2 Main Conclusions of Empirical Analysis**

The empirical analysis indicates the presence of system risk in China's current real estate capital market, which is primarily transmitted through the real estate enterprise channel. The purpose of this analysis is to evaluate the existence of system risk in China's real estate capital market. The findings reveal that a substantial decrease in real estate prices within China's current real estate capital market would result in liquidity risk for real estate enterprises. Consequently, this liquidity risk would extend to banks and have a detrimental effect on the stock market. Therefore, system risk exists within the real estate capital market, transmitted through the real estate enterprise channel.

Fluctuations in real estate prices has the potential to generate liquidity risk for real estate enterprises. Upon analyzing the sample companies, it becomes evident that these enterprises already maintain high levels of inventory. Against this backdrop, a decline in real estate prices would not pose a substantial threat to the long-term solvency of the sample companies. However, their liquidity would experience a significant weakening. Real estate price fluctuations demonstrates a notable impact on the financing capacity of the sample companies, with a heightened effect observed during a decline in real estate prices rather than an increase. Such a decline would impair the companies' ability to secure financing and subsequently reduce their short-term solvency. Although it could also diminish their long-term solvency and increase the likelihood of default, the effect on short-term solvency is much more pronounced. Hence, real estate price fluctuations can potentially evoke liquidity risk for real estate enterprises, albeit maintaining a relatively low solvency risk.

Real estate price fluctuations can expose banks to liquidity risk through the channel of real estate enterprises. A decline in real estate prices is less likely to cause extensive credit losses for the banking sector as a whole, specifically through the channel of real estate enterprises. However, it can lead to liquidity challenges for banks. The real estate enterprise channel has a more significant influence on banks' credit risk and a higher absorption of liquidity when real estate prices decrease, compared to the household channel. This amplifies the transmission of system risk to banks through the real estate enterprise channel. Consequently, real estate price fluctuations that generate liquidity risk for real estate enterprises will inevitably result in liquidity risk for banks, thereby creating system risk transmitted through the channel of real estate enterprises.

A fall in real estate prices after a rapid increase can negatively impact the stock market. The stock prices of China's real estate enterprises are significantly and uniformly influenced by fluctuations in real estate prices, and this effect exhibits non-linear characteristics. During periods of slow real estate price growth or decline, the impact of real estate price fluctuations on the stock prices of real estate enterprises is much stronger compared to periods of high real estate price growth. Transitions in real estate prices between different states of fluctuations can have an adverse effect on stock markets. When real estate prices are experiencing slow growth or decline, the impact of real estate price fluctuations on the stock prices of real estate enterprises follows more stable mechanisms. The decline in share prices triggered by a fall in real

estate prices during this time should be within investors' normal expectations. However, when real estate prices abruptly transition from a period of high growth to a period of slow growth or decline, it can lead to a sharp decrease in the stock prices of real estate enterprises, exceeding investors' expectations and resulting in significant losses. Consequently, fluctuations in real estate prices during periods of slow growth or decline do not generate adverse shocks to the equity market. On the other hand, a rapid decline in real estate prices following a period of rapid increase (such as a burst in the real estate market bubble) can cause severe adverse shocks to the market and trigger system risks.

## **6.2 Policy Recommendations**

Based on the findings of this thesis and from the perspective of promoting the establishment of a long-term mechanism for the stable and sustainable development of China's real estate market, as well as preventing system risks in China's real estate capital market, the following policy recommendations are made:

From the perspective of real estate enterprises, the central task is to mitigate corporate liquidity risk. The findings of this thesis highlight that liquidity risk has emerged as the foremost concern for China's current real estate enterprises. Given the high levels of debt and inventory typically associated with these enterprises, a decline in real estate prices can induce liquidity risk, thereby propagating system risk through the real estate enterprise channel and affecting other sectors. To avert system risk in the real estate capital market, addressing the liquidity risk of real estate enterprises should be prioritized.

The government should prioritize guiding real estate enterprises towards effective inventory management, while simultaneously considering long-term and short-term solvency management. Inventory management should serve as a fundamental aspect of real estate enterprises' operations. While maintaining a substantial inventory can yield economic benefits and increased profitability, a high inventory value ratio may also entail heightened short-term solvency risk. To promote sustainable development and avert liquidity crises, real estate enterprises must proactively control their inventories. Although the growth of Chinese real estate enterprises' inventory value ratio has significantly slowed compared to a decade ago, the overall inventory value ratio remains high, necessitating the need for destocking. Therefore, it remains crucial for real estate development companies to prioritize inventory management as an integral part of their daily operations. Additionally, real

estate enterprises should focus on managing both short-term and long-term solvency. In the short term, companies should mitigate short-term solvency shortages arising from declining real estate prices by expedited inventory reduction through lowering real estate prices, even if it entails lower anticipated earnings in exchange for enhanced short-term solvency.

In the long term, it is crucial to reconcile the relationship between anticipated returns and asset security. One way to achieve this is by transforming the sale of traditional houses into self-sustaining apartments (rented for sale), which can stabilize enterprise cash flow, enhance production and operation efficiency, reduce cash flow sensitivity to real estate price fluctuations, and ultimately attain a stable and secure sustainable development objective. The government should actively collaborate with regulators and financial institutions to support the reasonable financing needs of real estate enterprises, as well as provide essential liquidity support. Emphasizing the expansion of market-based financing channels for real estate enterprises, the government should endorse the issuance of debt financing instruments in the interbank bond market and continuously promote the formation of real estate investment trusts (REITs). These strategies will facilitate the effective conversion of real estate enterprises' inventories into self-owned properties, which can generate sustainable liquidity for the enterprises.

From the bank's perspective, it is necessary to mitigate credit risk associated with the property pre-sale policy, while simultaneously enhancing liquidity levels. The government should actively promote the augmentation of bank liquidity and risk diversification through financial instruments in the secondary real estate capital market. The empirical analysis conducted in this study demonstrates that the real estate price fluctuations impact banks primarily through the real estate enterprise channel, leading to liquidity risk for banks. Real estate-related loans possess long durations, stable cash flows, and low liquidity, which makes them well-suited for transformation into asset securitization products or mortgage-backed securities.

Developed Western countries, such as the United States, the United Kingdom, and Europe, established thriving secondary real estate capital markets several decades ago. These countries utilized various financial derivatives, including asset securitization instruments, to address the liquidity constraints of real estate loans. These measures also aimed to enhance banks' liquidity positions and diversify risks within the banking sector. However, the US secondary real estate capital market,

driven by a range of financial derivatives, notably contributed to the subprime mortgage crisis and the subsequent global financial tsunami. In contrast, China's distinctive "socialist economic governance system with Chinese characteristics" enabled the country to largely avert a similar financial crisis. The primary reason behind this outcome lies in the Chinese government and regulators' capacity and motivation to enforce strict control over the quality of underlying real estate-related loans used in securitization instruments. This approach has helped to enhance bank liquidity while managing associated risks.

The regulator should continue to strengthen supervision of pre-sale funds for commercial properties to mitigate the credit risk associated with pre-sale policies. Empirical research findings suggest that a decline in real estate prices has a larger effect on bank credit risk through the real estate enterprise channel compared to the household channel. Therefore, ensuring the successful completion of real estate development projects, particularly pre-sale projects, is crucial for minimizing banks' credit risk. It is recommended that the supervision of pre-sale funds for commercial properties be further enhanced, and the oversight of dedicated accounts for the safekeeping of pre-sale funds in real estate development projects be consistently promoted.

From the perspective of enhancing capital market efficiency, it is imperative to enhance the information disclosure capacity of publicly traded companies. The impact of real estate price fluctuations on the shares of real estate development firms is a fundamental phenomenon in capital market dynamics. To this end, the regulatory authority must strengthen its oversight of the stock market, with a focus on optimizing capital allocation efficiency. It should also aim to enhance the transparency of information disseminated by listed real estate enterprises, allowing investors to make well-informed investment decisions. Within the realm of information disclosure, special attention should be given to significant details that could influence company operations, such as the specific business distribution and inventory status of real estate enterprises.

From the perspective of people's livelihood, the government needs to actively support residents' reasonable demand for homeownership by adapting its policies to local conditions and cities. It is essential for the government to acknowledge that, with China's macroeconomic growth slowing down and the changing dynamics of supply and demand in the real estate market, merely regulating real estate prices is no

longer sufficient. The core objective of current real estate market regulations in China should be to ensure stable and healthy development. The real estate market in China is facing challenges like high inventory and price bubbles, which not only undermine the market itself but also pose potential system risks to the real estate financial sector. Therefore, to address these issues effectively and mitigate system risks, it is crucial to promote a balance between supply and demand in the real estate market, thus achieving stable and healthy development in China's real estate market.

For the demand side of the real estate market, the government should focus on protecting and supporting residents' reasonable housing demand while discouraging speculative activities. This can be achieved by encouraging residents to meet their legitimate housing needs and improving their housing conditions. The government should actively implement various measures to promote residents' reasonable housing demand. These measures include adjusting the down payment ratio for residents' first and improved homes, relaxing the criteria for personal provident fund loans, and supporting residents in meeting their housing needs. Furthermore, the government should expedite the implementation of the real estate tax, increase transaction costs for speculative home purchases (e.g., raising the transaction tax on short-term real estate sales and purchases), and effectively deter real estate speculation. As for the supply side of the real estate market, both the central and local governments should customize their policies to suit the unique characteristics of each region. Different real estate land supply schemes should be implemented to avoid applying a universal policy that may not be suitable for all regions.

To encourage balanced supply and demand in the Chinese real estate market, it is important to support and protect residents' reasonable real estate-related consumption. This can be achieved through localized regulation and control measures. These measures aim to reduce inventory, stabilize prices, and mitigate risks in the market. Furthermore, continuous optimization and improvement of various aspects such as real estate policy, land supply, financial support, fiscal and taxation measures, and market guidance are crucial. These efforts will eventually foster a sustainable development mechanism for the real estate market in China, aligning with China's socialist market economy characteristics.

### **6.3 Main Contributions of the Thesis**

As an effort to investigate the connection between real estate price fluctuations and system risk in China, this thesis makes the following contributions to the

advancement of system risk research in the realm of real estate finance in China:

Initially, this thesis establishes a theoretical framework to understand the relationship between real estate price fluctuations and system risk. It also identifies the transmission channels through which real estate price fluctuations trigger system risk in the real estate capital market. These findings provide a solid foundation for future research.

The real estate capital market functions as a unique capital market that simultaneously links the real estate market and the financial market. The impact of system risk in the real estate capital market extends beyond banks, institutional investors, and individual investors in the financial market. It also affects real estate enterprises, the household sector, and government departments in the real estate market. Drawing on the operational characteristics of China's real estate market and real estate capital market, as well as the general principles of system risk transmission, this thesis conducts theoretical analyzes on the influence of real estate price fluctuations on various market participants. Subsequently, it constructs a theoretical framework that elucidates the relationship between real estate price fluctuations and system risk.

A more comprehensive empirical examination is conducted on the system risk triggered by real estate price fluctuations through the real estate enterprise channel. This study enriches the empirical findings in system risk research and proposes a targeted empirical research perspective. While most international research on real estate price fluctuations and system risk primarily focuses on individual (household) level default on housing loans due to real estate price fluctuations and the resulting bank risk, this thesis specifically investigates the risks faced by real estate enterprises. It examines the impact of real estate price fluctuations on these enterprises, resulting bank risk, and its implications on the stock market. By providing new empirical evidence on the relationship between real estate price fluctuations and system risk, this research adds to the existing body of empirical knowledge in this area. Additionally, this study proposes targeted empirical research perspectives: examining the solvency and liquidity of real estate enterprises and banks from an integrated perspective, and exploring the non-linear characteristics of the stock market. These empirical perspectives not only cater to the research needs of this thesis, but also offer valuable insights for future studies.

Relevant financial indicators have been revised or estimated to better suit the

characteristics of real estate enterprises and banks. It should be noted that annual reports published by real estate enterprises adopt the lower of cost or net realizable value principle when calculating inventories and total assets. Furthermore, in the real estate market, a pre-sale policy is in place, resulting in a significant portion of the inventory value in the enterprise's books already being "pre-sold" to buyers. Consequently, if the book value of the enterprise's financial indicators is used directly for analyzing the risks of real estate enterprises, it may not provide an accurate assessment. Additionally, given the existence of the pre-sale system in real estate development, a considerable portion of funding sources for real estate enterprises comes from personal housing mortgages. These mortgages essentially transfer funds from the household sector to the real estate enterprises during the development phase. Therefore, loans associated with the real estate enterprise channel comprise not only real estate development loans but also individual housing mortgages. These loans need to be estimated and cannot be used directly for assessing real estate development loans. As such, this thesis proposes a correction method for the financial indicators of real estate enterprises and an estimation method for loans connected to the real estate enterprise channel. These methods enhance the scientific rigor and effectiveness of the analysis results in this thesis.

## **6.4 Limitations of the Thesis and Suggestions for Follow-up Research**

### **6.4.1 Limitations of the Thesis**

During the investigation period, China's real estate market was generally prosperous, with few instances of real estate price declines. However, this could potentially impact the stability of the empirical analysis results. Based on the data available in this study, it is evident that the Chinese real estate market experienced overall prosperity during the examined period. While real estate prices showed some fluctuations, there were limited instances of downward phases, and no sustained downward trend. It is important to note that the empirical analysis results regarding the impact of real estate price declines on real estate enterprises and, subsequently, on banks and the stock market through the property development firm channel, are derived from the sample data collected during the examined period. However, these results lack support from additional data on specific phases of real estate price declines, which may compromise their stability.

Empirical studies have not sufficiently explored the impact of real estate price fluctuations through the household channel. Theoretically, when real estate prices decline, real estate price fluctuations can potentially trigger strategic loan defaults by households. This poses a significant credit and liquidity risk for banks, as demonstrated by the US subprime mortgage crisis in 2007. However, it is important to note that this thesis does not specifically focus on the household channel in its empirical analysis section. Therefore, it does not provide an extensive analysis regarding whether real estate price fluctuations result in strategic defaults by Chinese households or examine other potential effects through the household channel.

The empirical study fails to capture the impact of real estate price fluctuations through the government channel. The absence of data regarding the utilization of land concession revenue to service Chinese government debt prevents the verification of the empirical implications derived from the theoretical framework concerning the transmission of system risk through the government channel. Consequently, the theoretical analysis of the impact of real estate price fluctuations through the government channel within this study remains unsupported by empirical evidence.

The empirical study overlooked the presence of the secondary market for real estate finance. Real estate price fluctuations have a substantial impact on financial products like Mortgage-Backed Securities (MBS) in the secondary market, leading to significant losses for financial institutions and individual investors holding MBS. This was a crucial aspect of the 2007 US subprime mortgage crisis, which caused systemic losses. However, given the nascent state of China's secondary real estate capital market and the limited availability of relevant data, it was not feasible to include it in the empirical study conducted for this thesis.

The empirical analysis may be constrained by the limitations of the basic data. Despite making every effort to utilize a variety of available basic data in this study, the quality of the data and the representativeness of the sample could still impose restrictions on the quality of the empirical analysis. There exist several limitations in the statistics and disclosure of relevant basic data in China. For instance, when it comes to bank-related data, only two types of data on bank loans associated with real estate development and individual housing mortgages are accessible, whereas data on other loans backed by properties is still unavailable.

#### **6.4.2 Suggestions for Follow-up Research**

The thesis focuses on examining the existence of system risk resulting from real

estate price fluctuations through the real estate enterprise channel. However, it does not provide an assessment of the magnitude of potential systemic losses in the event of risk activation. Evaluating the scale of these risk losses is crucial in understanding the potential impact of real estate price fluctuations on both the real estate market and the real estate capital market through the real estate enterprise channel. Therefore, future empirical research should prioritize estimating the size of these risk losses, building upon the existing body of literature.

An examination of strategic default on household loans in response to real estate price fluctuations. The potential for real estate price fluctuations to lead to strategic defaults on household loans is another crucial factor in determining whether real estate price fluctuations can trigger system risk. Given that China's real estate market has not yet encountered a prolonged and continuous downturn, there are limited instances of such defaults, and the availability of data is sparse. However, with access to fundamental data, further research on this topic will become a prominent area of focus in system risk analysis.

An examination of the risk of default on government debt in response to fluctuations in real estate prices. A significant portion of China's government debt is reliant on land concessions for financing, and a decline in real estate prices could potentially result in a substantial decrease in government revenue derived from land concessions. Consequently, this could elevate the risk of default for the government. This matter has become a shared concern among the Chinese central government, scholars, industry professionals, and society as a whole. However, given the limited disclosure of pertinent data, research on this subject is currently confined to governmental channels. As data becomes more accessible, it is expected that this issue will emerge as a new focal point within academic research.

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## Appendix

### Stock code of real estate enterprises:

000002.SZ	000631.SZ	000918.SZ	600208.SH	600641.SH	000036.SZ
000656.SZ	000961.SZ	600215.SH	600823.SH	000042.SZ	000667.SZ
000981.SZ	600246.SH	600890.SH	000046.SZ	000668.SZ	002016.SZ
600340.SH	000006.SZ	000048.SZ	000671.SZ	600007.SH	600383.SH
000011.SZ	000517.SZ	000691.SZ	600067.SH	600693.SH	000014.SH
000540.SH	000718.SZ	600077.SH	600466.SH	000029.SH	000573.SZ
000732.SZ	600094.SH	600503.SH	000031.SZ	000608.SZ	000838.SZ
600162.SH	600565.SH	000069.SZ	000609.SZ	000863.SZ	600173.SH
600603.SH	000090.SZ	000402.SZ	600048.SH	600510.SH	600665.SH
600807.SH	000514.SZ	600064.SH	600515.SH	600675.SH	600846.SH
000537.SZ	600082.SH	600533.SH	600683.SH	600895.SH	000558.SZ
600185.SH	600604.SH	600684.SH	601588.SH	000736.SZ	600223.SH
600606.SH	600708.SH	000616.SZ	000797.SZ	600239.SH	600622.SH
600736.SH	000720.SZ	000809.SZ	600266.SH	600648.SH	600743.SH
000965.SZ	000897.SZ	600322.SH	600649.SH	600748.SH	600159.SH
000909.SZ	600325.SH	600657.SH	600773.SH	600225.SH	000926.SZ
600376.SH	600663.SH	600791.SH	600463.SH	600638.SH	600639.SH
600658.SH	600692.SH	600716.SH	600848.SH		

Note: This table reports real estate enterprises of 106 Shanghai- and Shenzhen-listed real estate enterprises (listed as of 2006) used throughout Chapters 3 and 4. Sectoral/national real estate enterprises data reported elsewhere in the thesis are aggregate series and should not be read as additional real estate enterprises.

### Stock code of banks:

601169.SH	601398.SH	601818.SH	600015.SH	601939.SH	601328.SH
600016.SH	601009.SH	002142.SZ	601288.SH	000001.SZ	600000.SH
601166.SH	600036.SH	601988.SH	601998.SH		

Note: This table reports banks of 16 Shanghai- and Shenzhen-listed commercial banks (listed as of 2006) used throughout Chapters 3 and 4. Sectoral/national banking data reported elsewhere in the thesis are aggregate series and should not be read as additional banks.

## Descriptive Statistics of Real Estate Development Enterprise Data

Variable	Definition	Mean	STD	Maximum	Minimum	Size	Source
BIN	Book Value of Inventory	1613979	5409868	100000000	-9156931	6042	WIND
AIN	Actual Value of Inventory	3241698	12100000	238000000	-11900000	6042	Self Calculated
OPR	Operating Profit Ratio	-437.05	17311.9	34486.02	-1024395	6042	WIND
AR	Deposit Received	662535.6	2774283	40800000	0	6042	WIND
REPI	China Real Estate Price Index of 100 Cities	167.32	40.03	237.34	106.77	6042	WIND
BTA	Book Total Assets on	3789213	12000000	187000000	134.01	6042	WIND
ATA	Actual Total Assets	5416932	18500000	324000000	-2678739	6042	Self Calculated
TL	Total Liabilities	2947446	10000000	152000000	0	6042	WIND
ALR	Book Asset-Liability Ratio	76.58	224.4	9424.93	0	6042	WIND
RALR	Actual Asset-Liability Ratio	64.54	238.95	9996.35	-847.18	6042	Self Calculated
BIVR	Book Inventory Value Ratio	38.6	70.07	3496.8	-2820.68	6042	Self Calculated
AIVR	Actual Inventory Value Ratio	49.41	51.16	1448.62	-1720.59	6042	Self Calculated
QR	Quick Ratio	0.8	2.01	59.3	0	6042	WIND
OR	Quarterly Operating Income	436896.5	1985287	44400000	-327.7	6042	WIND
LTDR	Long-term Liability Ratio	26.82	18.37	91.68	0	6042	WIND
Q	Tobin q	1.95	13.74	510.65	0.04	6042	WIND
Z	Z Value	4.1	100.57	7514.88	-1028.82	6042	WIND

RFIR	Risk Free Rate	2.5	0	2.5	2.5	6042	WIND
AEV	Actual Equity Value	3786665	11000000	166000000	39370.3	6042	Self Calculated
SEV	Stock Equity Value Volatility	0.48	0.07	1.12	0.39	6042	WIND
LTD	Long Term Liability	7701.52	21268.37	247712.35	0	6042	WIND
STD	Short Term Liability	149.21	2236.27	77663.72	0	6042	WIND
SP	Share Price	5.64	3.89	43.995	0	6254	WIND
NAVPS	Net Assets Per Share	3.62	2.67	20.8549	-10.5659	6254	WIND
OPPS	Operating Profit Per Share	0.38	0.58	8.29	-5.206	6254	WIND
EPS	Earnings Per Share	0.2	0.37	4.75	-4.4	6254	WIND
MBR	Main Business Ratio	89	221.58	6339.69	-9258.773	6254	WIND
NL	Net Leverage Ratio	49.04	91.47	1066.08	-95.36	6254	WIND
PSO	Percentage of Shares Outstanding	0.79	0.28	1	0	6254	WIND
CS	Company Size	0.01	0.02	0.19	0	6254	Self Calculated
SQRR	Quarterly Return On The Stocks Of Real Estate Development Enterprises	0.06	0.3	2.95	-1	6254	WIND
EAMQR	Equal Weighted Average Quarterly Market Return	0.06	0.21	0.66	-0.37	6254	WIND
CWAMQR	Circulation Market Value Weighted Average Quarterly Market Return	0.3	0.95	3.11	-1.7	6254	WIND
TVAMRQR	Total Market Value Weighted Average Quarterly Market Return	-0.2	2.19	0.7	-16.79	6254	WIND

## Descriptive Statistics of Bank Data

Variable	Definition	Mean	STD	Maximum	Minimum	Size	Source
TL	Total Loan Balance	34378.93	39787.15	186243.1	255.05	840	WIND
REDL	Real Estate Development Loan Balance	9784.68	13910.99	66866.29	57.49	433	WIND
AREDL	Loan Associated With Real Estate Development Enterprise	2267.42	2311.67	11663.28	15.66	467	Self Calculated
PLP	Personal Housing Mortgage Loan Balance	7261.55	11696.74	58850.22	11.26	444	WIND
FLP	Family Channel Related Loan Balance	6036.05	9703.84	48365.33	-30.6	433	Self Calculated
REDLR	Real Estate Development Loan Balance to Total Loan Balance Ratio	0.23	0.07	0.42	0.03	433	Self Calculated
AREDLR	Real Estate Development Enterprises Channel-Related Loan Balance to Total Loan Balance Ratio	0.08	0.02	0.14	0.03	467	Self Calculated
PLPR	Individual Housing Mortgage to Total Loan Balance Ratio	0.63	0.16	0.91	0.04	433	Self Calculated
FLPR	Loan Related to Household Channel to Total Loan Balance Ratio	0.13	0.06	0.3	-0.01	433	Self Calculated
BDIR	3-Year Bank Term Deposit Rate	3.75	0.88	5.4	2.75	887	The People's Bank Of China

LLPR	Loan Loss Provision Ratio	2.65	0.99	22.02	0.71	851	WIND
LR	Liquidity Ratio	46.07	10	79.76	25.49	465	WIND
CAR	Capital Adequacy Ratio	12.55	2.18	30.67	-0.39	813	WIND
LTDR	Loan to Deposit Ratio	73.8	11.86	115.99	42.68	842	WIND
MICR	Cash Generating Ratio of Main Business	5.16	231.6	1069.77	-2824.05	887	WIND
NIM	Net Interest Margin	2.44	0.46	4.98	1.27	885	WIND
MPP	Main Business Ratio	99.82	3.77	207.74	85.66	887	WIND
ROE	Return on Net Asset	11.36	5.83	41.12	0	887	WIND
SIZE	Bank Size	0.02	0.03	0.17	0	887	WIND

## Descriptive Statistics of Macro Economy

Variable	Definition	Mean	STD	Maximum	Minimum	Size	Source
TL	Total Loan Balance	643003.6	383795.6	1468993	163445.8	60	WIND
$\gamma$	Personal Housing Mortgage Loan Balance to Real Estate Development Loan Balance Ratio	0.12	0.02	0.1692	0.075	60	WIND
REDL	Real Estate Development Loan Balance	53844.72	34141.29	121600	12000	60	WIND
AREDL	Loan Associated With Real Estate Development Enterprise	61203.4	39778.79	141154.3	12899.44	60	Self Calculated
PLP	Personal Housing Mortgage Loan Balance	123276.8	97242.59	345000	20000	60	WIND
FLP	Family Channel Related Loan Balance	115918.1	91596.15	326288.2	19100.56	60	Self Calculated
REDLR	Real Estate Development Loan Balance to Total Loan Balance Ratio	0.08	0.01	0.09	0.06	60	WIND
AREDLR	Real Estate Development Enterprises Channel-Related Loan Balance to Total Loan Balance Ratio	0.09	0.01	0.11	0.07	60	Self Calculated
PLPR	Individual Housing Mortgage to Total Loan Balance Ratio	0.17	0.04	0.23	0.12	60	WIND
FLPR	Loan Related to Household Channel to Total Loan Balance Ratio	0.16	0.04	0.22	0.12	60	Self Calculated
REPI	China Real Estate Price Index of 100 Cities	164.09	41.82	237.34	101.04	60	WIND

BDIR	3-Year Bank Term Deposit Rate	3.76	0.87	5.4	2.75	60	WIND
LLPR	Loan Loss Provision Ratio	2.81	0.44	3.5	2.1	60	WIND
LR	Liquidity Ratio	47.09	5.25	58.63	41.1	60	WIND
ALR	Asset-Liability Ratio	93.3	1.04	95.55	91.7	60	WIND
NPLR	Non Performing Loan Ratio	2.42	2.04	8.03	0.9	60	WIND
LTDR	Bank loan-to-deposit ratio	67.93	3.42	76.81	64	60	WIND

**Table 3.2 Sensitivity analysis of decline of business inventory value and change in business asset-liability ratio  
(Sample companies by size-Actual asset-liability ratio)**

Real asset liability ratios at different rates of decline in inventory value ratio (Small business)							Real asset liability ratios at different rates of decline in inventory value ratio (Large business)						
Period	0% OFF	10% OFF	20% OFF	30% OFF	40% OFF	50% OFF	Period	0% OFF	10% OFF	20% OFF	30% OFF	40% OFF	50% OFF
2006	63.11%	64.58%	66.19%	67.97%	69.94%	72.15%	2006	79.02%	81.00%	83.17%	85.55%	88.19%	91.15%
2007	66.55%	67.75%	69.19%	70.85%	72.77%	74.98%	2007	76.71%	78.42%	80.33%	82.47%	84.87%	87.60%
2008	55.60%	57.51%	59.67%	62.13%	64.98%	68.31%	2008	89.28%	88.54%	94.20%	95.95%	98.55%	101.79%
2009	51.58%	53.64%	56.55%	59.26%	62.53%	66.43%	2009	177.37%	174.97%	173.67%	173.35%	173.71%	174.90%
2010	48.20%	55.06%	55.22%	57.88%	61.20%	65.18%	2010	103.63%	98.07%	98.27%	101.00%	103.62%	107.08%
2011	48.03%	50.49%	53.40%	57.15%	59.75%	65.90%	2011	78.33%	79.65%	81.75%	84.56%	88.11%	92.53%
2012	45.52%	48.29%	51.49%	55.21%	59.62%	64.94%	2012	67.94%	70.92%	74.22%	79.40%	83.13%	88.46%
2013	45.40%	47.73%	50.57%	53.98%	58.06%	63.02%	2013	64.88%	67.39%	70.50%	74.20%	78.57%	83.80%
2014	44.64%	47.39%	50.56%	54.26%	58.65%	63.96%	2014	56.71%	59.95%	63.65%	67.94%	72.97%	78.97%
2015	41.98%	44.78%	48.03%	51.84%	56.40%	61.97%	2015	56.44%	59.63%	63.29%	67.57%	72.66%	79.20%
2016	38.56%	40.92%	43.65%	46.88%	50.79%	55.75%	2016	49.43%	65.62%	58.42%	67.11%	68.66%	73.46%
2017	37.18%	39.21%	41.54%	44.24%	47.43%	51.27%	2017	50.80%	53.69%	56.96%	60.70%	65.03%	70.11%
2018	35.53%	37.46%	39.68%	42.26%	45.33%	49.03%	2018	50.81%	53.62%	56.82%	60.49%	64.75%	69.78%
2019	34.70%	36.13%	37.97%	40.21%	42.95%	46.33%	2019	50.70%	53.47%	56.64%	60.31%	64.60%	69.70%
2020	31.28%	33.15%	35.32%	37.88%	40.96%	44.78%	2020	43.70%	46.93%	50.72%	55.22%	60.68%	67.44%

**Tanle 3.3 Sensitivity analysis of decline of business inventory value and change in business asset liability ratio**

(Sample companies by size-Real asset liability ratio  $\geq$  80%)

Actual asset-liability ratio at different rates of decline in inventory value ratio(Small business)							Actual asset-liability ratio at different rates of decline in inventory value ratio (Large business)						
Period	0% OFF	10% OFF	20% OFF	30% OFF	40% OFF	50% OFF	Period	0% OFF	10% OFF	20% OFF	30% OFF	40% OFF	50% OFF
2006	16.67%	18.00%	23.33%	28.67%	34.67%	39.33%	2006	12.50%	12.50%	18.75%	23.44%	32.81%	35.94%
2007	15.33%	17.33%	22.00%	26.33%	34.00%	43.67%	2007	10.94%	9.38%	13.28%	20.31%	28.91%	32.03%
2008	18.33%	19.33%	21.67%	31.33%	42.67%	52.00%	2008	12.50%	11.72%	11.72%	17.19%	24.22%	31.25%
2009	14.33%	15.67%	17.00%	23.00%	33.00%	50.67%	2009	6.25%	7.03%	8.59%	10.94%	18.75%	29.69%
2010	7.33%	9.33%	10.67%	17.33%	29.67%	43.67%	2010	1.56%	3.13%	6.25%	6.25%	11.72%	19.53%
2011	8.33%	9.00%	12.33%	17.00%	34.00%	50.00%	2011	4.69%	4.69%	4.69%	5.47%	13.28%	26.56%
2012	5.00%	5.33%	10.00%	18.67%	35.67%	965.33%	2012	0.78%	0.78%	2.34%	3.13%	12.50%	28.13%
2013	4.67%	4.67%	8.33%	14.33%	32.33%	47.33%	2013	2.34%	0.78%	0.78%	3.91%	11.72%	21.09%
2014	2.67%	2.67%	6.33%	14.67%	39.67%	50.67%	2014	0.78%	0.78%	2.34%	5.47%	10.94%	21.88%
2015	1.67%	1.67%	2.33%	11.33%	30.67%	49.33%	2015	0.00%	0.00%	0.00%	0.78%	8.59%	18.75%
2016	1.00%	1.33%	1.00%	1.67%	10.00%	31.67%	2016	0.00%	0.00%	0.00%	0.00%	5.47%	10.16%
2017	0.00%	0.00%	0.00%	0.67%	6.00%	28.67%	2017	0.78%	0.78%	0.78%	0.78%	3.13%	10.94%
2018	0.67%	1.00%	1.00%	2.00%	6.00%	24.67%	2018	3.13%	3.13%	3.13%	3.13%	5.47%	7.03%
2019	1.67%	2.00%	3.33%	4.00%	6.33%	15.00%	2019	0.78%	0.78%	0.78%	0.78%	3.13%	3.91%
2020	0.00%	0.00%	0.00%	0.00%	0.00%	6.33%	2020	0.78%	0.78%	0.78%	0.78%	3.91%	3.91%

Data source: Wind Informaton & Self Calculated

Note: For each listed real estate enterprise and for each quarter in the sample, first compute the actual inventory value and the actual asset–liability ratio according to Equations (3.4)–(3.5). Then impose hypothetical inventory-value shocks of 0%, 10%, 20%, 30%, 40%, and 50%, which stand for different magnitudes of housing-price declines. For every shock level, re-compute the firms’ actual asset–liability ratios, and we finally calculate (i) the cross-sectional average of the actual asset–liability ratio and (ii) the share of firms whose actual asset–liability ratio is  $\geq$  80%. When the sample is split by size (large/small) or by ownership (SOE/non-SOE), the same calculation is repeated for each subsample.

**Table 3.4 Sensitivity analysis of decline of business inventory value and change in business asset-liability ratio (Sample companies by type-Actual asset-liability ratio)**

Actual asset liability ratios at different rates of decline in inventory value ratio (Non State-Owned business)							Real asset liability ratios at different rates of decline in inventory value ratio (State-Owned business)						
Period	0% OFF	10% OFF	20% OFF	30% OFF	40% OFF	50% OFF	Period	0% OFF	10% OFF	20% OFF	30% OFF	40% OFF	50% OFF
2006	88.91%	90.91%	93.10%	95.49%	98.14%	101.09%	2006	64.18%	65.89%	67.77%	69.83%	72.14%	74.71%
2007	94.60%	95.82%	97.30%	99.03%	101.02%	103.33%	2007	59.34%	61.12%	63.09%	65.27%	67.70%	70.45%
2008	106.85%	103.86%	111.69%	112.55%	114.61%	117.38%	2008	60.18%	62.32%	64.72%	67.44%	70.54%	74.15%
2009	256.86%	251.26%	247.29%	244.20%	242.03%	240.87%	2009	59.22%	61.27%	63.93%	67.03%	70.61%	74.78%
2010	132.14%	120.46%	118.47%	120.51%	122.01%	124.47%	2010	56.02%	60.93%	62.62%	65.77%	69.53%	73.94%
2011	87.33%	87.31%	88.40%	90.65%	92.46%	97.30%	2011	56.80%	59.61%	62.81%	66.48%	70.74%	75.75%
2012	70.00%	72.77%	75.79%	81.66%	84.59%	89.71%	2012	55.15%	58.17%	61.61%	65.57%	70.19%	75.66%
2013	67.61%	69.32%	71.85%	75.04%	78.95%	83.74%	2013	53.12%	56.08%	59.46%	63.35%	67.90%	73.29%
2014	52.59%	55.60%	59.04%	63.03%	67.70%	73.28%	2014	53.39%	56.54%	60.15%	64.35%	69.29%	75.22%
2015	52.85%	55.77%	59.13%	63.03%	67.63%	73.13%	2015	51.55%	54.72%	58.38%	62.68%	67.84%	74.59%
2016	42.45%	67.85%	52.67%	64.42%	63.38%	67.42%	2016	48.68%	51.55%	54.84%	58.67%	63.18%	68.59%
2017	45.71%	48.14%	50.89%	54.03%	57.68%	61.95%	2017	47.36%	50.13%	53.27%	56.89%	61.11%	66.11%
2018	45.91%	48.27%	50.95%	54.03%	57.59%	61.80%	2018	46.40%	49.07%	52.12%	55.64%	59.77%	64.69%
2019	47.44%	49.32%	51.60%	54.30%	57.49%	61.29%	2019	44.80%	47.50%	50.60%	54.20%	58.45%	63.57%
2020	39.22%	41.86%	44.93%	48.56%	52.92%	58.29%	2020	40.44%	43.39%	46.84%	50.96%	55.95%	62.17%

**Table 3.5 Sensitivity analysis of decline of business inventory value and change in business asset liability ratio**

(Sample companies by type-Real asset liability ratio $\geq$  80% )

Actual asset-liability ratio at different rates of decline in inventory value ratio (Non State-Owned business)							Actual asset-liability ratio at different rates of decline in inventory value ratio (State-Owned business)						
Period	0% OFF	10% OFF	20% OFF	30% OFF	40% OFF	50% OFF	Period	0% OFF	10% OFF	20% OFF	30% OFF	40% OFF	50% OFF
2006	11.90%	11.90%	19.84%	24.60%	31.75%	37.30%	2006	19.77%	22.09%	24.42%	32.56%	36.05%	38.37%
2007	9.92%	11.11%	15.87%	18.65%	30.16%	39.68%	2007	19.77%	20.35%	23.26%	31.98%	34.30%	39.53%
2008	13.10%	14.68%	14.29%	25.00%	35.71%	44.84%	2008	19.19%	18.60%	23.26%	28.49%	37.79%	45.93%
2009	8.73%	10.71%	12.70%	17.46%	27.38%	45.24%	2009	13.95%	14.53%	15.12%	20.35%	29.07%	41.86%
2010	3.97%	7.14%	8.73%	13.10%	25.40%	35.71%	2010	6.98%	7.56%	9.95%	13.37%	20.93%	36.05%
2011	7.14%	7.94%	9.52%	13.49%	26.59%	41.67%	2011	6.40%	6.40%	9.30%	11.63%	27.91%	35.55%
2012	4.37%	4.37%	6.75%	12.70%	26.19%	42.06%	2012	2.91%	3.66%	9.30%	15.12%	30.81%	48.84%
2013	3.17%	3.57%	4.76%	8.73%	21.83%	36.11%	2013	4.65%	3.49%	8.14%	15.12%	31.40%	43.60%
2014	1.59%	2.38%	5.16%	9.13%	28.57%	38.89%	2014	1.74%	1.74%	5.23%	16.28%	36.05%	47.67%
2015	0.79%	1.19%	1.98%	6.75%	23.02%	36.11%	2015	1.16%	1.16%	1.16%	10.47%	26.16%	46.51%
2016	0.40%	0.40%	0.40%	0.79%	9.52%	25.00%	2016	0.58%	0.58%	1.16%	1.74%	7.56%	26.16%
2017	0.40%	0.40%	0.40%	0.79%	5.56%	23.41%	2017	0.00%	0.00%	0.00%	0.58%	4.65%	23.84%
2018	1.98%	1.98%	1.98%	1.98%	7.94%	18.65%	2018	0.58%	1.16%	1.16%	2.91%	2.91%	20.93%
2019	0.40%	0.79%	0.79%	0.79%	5.95%	11.90%	2019	2.91%	2.91%	5.23%	6.40%	4.65%	11.63%
2020	0.40%	0.40%	0.40%	0.40%	1.98%	7.14%	2020	0.00%	0.00%	0.00%	0.00%	0.00%	4.07%

Data source: Wind Informaton & Self Calculated

Note: For each listed real estate enterprise and for each quarter in the sample, first compute the actual inventory value and the actual asset–liability ratio according to Equations (3.4)–(3.5). Then impose hypothetical inventory-value shocks of 0%, 10%, 20%, 30%, 40%, and 50%, which stand for different magnitudes of housing-price declines. For every shock level, re-compute the firms’ actual asset–liability ratios, and we finally calculate (i) the cross-sectional average of the actual asset–liability ratio and (ii) the share of firms whose actual asset–liability ratio is  $\geq$  80%. When the sample is split by size (large/small) or by ownership (SOE/non-SOE), the same calculation is repeated for each subsample.

**Pairwise Pearson Correlations — Chapter 3 variables**

	QR	LTDR	REPI	ALR	RALR	BIVR	AIVR	Size	Ownership
QR	1	-0.0563	-0.0211	-0.047	-0.0384	-0.0521	-0.092	0.033	-0.0887
LTDR	-0.0563	1	0.1968	-0.0667	-0.0802	0.0984	0.1535	-0.0944	0.1305
REPI	-0.0211	0.1968	1	-0.0447	-0.0735	0.0508	0.1583	0	0
ALR	-0.047	-0.0667	-0.0447	1	0.9797	-0.04	-0.0689	-0.0604	-0.0563
RALR	-0.0384	-0.0802	-0.0735	0.9797	1	-0.0456	-0.1975	-0.0532	-0.0588
BIVR	-0.0521	0.0984	0.0508	-0.04	-0.0456	1	0.136	0.0442	0.0377
AIVR	-0.092	0.1535	0.1583	-0.0689	-0.1975	0.136	1	0.0262	0.0492
Size	0.033	-0.0944	0	-0.0604	-0.0532	0.0442	0.0262	1	-0.0426
Ownership	-0.0887	0.1305	0	-0.0563	-0.0588	0.0377	0.0492	-0.0426	1

Note: Pairwise Pearson Correlations — Chapter 3 variables Notes: Entries are Pearson correlation coefficients computed on the chapter’s estimation sample (pairwise listwise). Diagonal elements equal 1. Correlation indicates linear relationship and do not imply causality. Variable preprocessing (logs, growth rates, winsorization, etc.) follows the baseline specification unless otherwise noted.

## Pairwise Pearson Correlations — Chapter 4 variables

	REDL	AREDLr	PLP	FLP	REDLR	AREDLR	PLPR	FLPR	BDIR	LLPR	LR	CAR	LTDR	MICR	NIM	MPP	ROE	SIZE	REPI
REDL	1	0.91	0.997	0.996	0.7	-0.332	0.541	0.764	-0.365	0.172	0.086	0.428	0.104	-0.001	-0.183	-0.086	-0.167	0.291	0.421
AREDLr	0.91	1	0.873	0.87	0.658	-0.13	0.453	0.658	-0.345	0.24	0.069	0.314	0.151	0.032	-0.218	0.01	-0.145	0.421	0.394
PLP	0.997	0.873	1	1	0.694	-0.362	0.546	0.769	-0.347	0.157	0.089	0.438	0.081	-0.003	-0.181	-0.092	-0.146	0.264	0.4
FLP	0.996	0.87	1	1	0.691	-0.369	0.55	0.771	-0.354	0.156	0.086	0.438	0.084	0	-0.172	-0.086	-0.156	0.262	0.409
REDLR	0.7	0.658	0.694	0.691	1	0.02	0.702	0.925	-0.2	0.066	-0.055	0.221	0.307	0.019	-0.098	-0.138	-0.015	0.209	0.255
AREDLR	-0.332	-0.13	-0.362	-0.369	0.02	1	-0.54	-0.352	0.148	-0.051	-0.122	-0.278	0.108	-0.018	0.093	0.034	0.076	-0.051	-0.184
PLPR	0.541	0.453	0.546	0.55	0.702	-0.54	1	0.866	-0.112	0.007	-0.062	0.208	0.192	0.029	-0.107	-0.206	-0.015	0.207	0.166
FLPR	0.764	0.658	0.769	0.771	0.925	-0.352	0.866	1	-0.192	0.068	-0.022	0.296	0.214	0.022	-0.088	-0.176	-0.009	0.23	0.258
BDIR	-0.365	-0.345	-0.347	-0.354	-0.2	0.148	-0.112	-0.192	1	-0.315	-0.445	-0.276	-0.473	0.008	0.43	-0.02	0.365	0.231	-0.868
LLPR	0.172	0.24	0.157	0.156	0.066	-0.051	0.007	0.068	-0.315	1	0.129	0.263	-0.004	0.026	-0.07	-0.03	-0.137	0.082	0.362
LR	0.086	0.069	0.089	0.086	-0.055	-0.122	-0.062	-0.022	-0.445	0.129	1	0.222	0.105	0.135	-0.278	-0.051	-0.218	-0.267	0.43
CAR	0.428	0.314	0.438	0.438	0.221	-0.278	0.208	0.296	-0.276	0.263	0.222	1	0.046	-0.022	-0.08	-0.081	-0.183	0.05	0.377
LTDR	0.104	0.151	0.081	0.084	0.307	0.108	0.192	0.214	-0.473	-0.004	0.105	0.046	1	-0.12	-0.23	0.011	-0.254	-0.281	0.551
MICR	-0.001	0.032	-0.003	0	0.019	-0.018	0.029	0.022	0.008	0.026	0.135	-0.022	-0.12	1	0.053	0.076	0.076	0.032	0.019
NIM	-0.183	-0.218	-0.181	-0.172	-0.098	0.093	-0.107	-0.088	0.43	-0.07	-0.278	-0.08	-0.23	0.053	1	-0.118	0.142	0.144	-0.419
MPP	-0.086	0.01	-0.092	-0.086	-0.138	0.034	-0.206	-0.176	-0.02	-0.03	-0.051	-0.081	0.011	0.076	-0.118	1	-0.047	0.075	-0.025
ROE	-0.167	-0.145	-0.146	-0.156	-0.015	0.076	-0.015	-0.009	0.365	-0.137	-0.218	-0.183	-0.254	0.076	0.142	-0.047	1	0.076	-0.354
SIZE	0.291	0.421	0.264	0.262	0.209	-0.051	0.207	0.23	0.231	0.082	-0.267	0.05	-0.281	0.032	0.144	0.075	0.076	1	-0.301
REPI	0.421	0.394	0.4	0.409	0.255	-0.184	0.166	0.258	-0.868	0.362	0.43	0.377	0.551	0.019	-0.419	-0.025	-0.354	-0.301	1

Note: Pairwise Pearson Correlations — Chapter 4 variables Notes: Entries are Pearson correlation coefficients computed on the chapter's estimation sample (pairwise listwise). Diagonal elements equal 1.

Correlation indicates linear relationship and do not imply causality. Variable preprocessing (logs, growth rates, winsorization, etc.) follows the baseline specification unless otherwise noted.

## Pairwise Pearson Correlations — Chapter 5 variables

	SP	NAVPS	OPPS	EPS	MBR	NL	PSO	CS	SQRR	EAMQR	CWAMQR	TVAMRQR	dlogREPI	Size	Ownership
SP	1	0.0401	0.0247	0.0161	0.0021	0.054	0.1664	0.1311	0.1473	0.0547	0.1669	0.0257	0.1174	-0.0187	0.07
NAVPS	0.0401	1	0.5578	0.5176	0.0462	0.1573	0.0287	-0.0507	-0.0003	0.0028	0	-0.0092	0.0015	-0.0916	0.2678
OPPS	0.0247	0.5578	1	0.9254	0.0101	0.1275	0.0015	-0.0427	-0.0062	-0.0014	-0.0018	-0.0221	0.0059	-0.0154	0.1351
EPS	0.0161	0.5176	0.9254	1	0.0139	-0.0399	0.0001	-0.0288	-0.008	-0.0017	-0.0007	-0.0184	0.0086	-0.0076	0.094
MBR	0.0021	0.0462	0.0101	0.0139	1	-0.008	-0.005	-0.024	0.0043	0.0103	0.0119	-0.009	0.0086	0.0016	0.0203
NL	0.054	0.1573	0.1275	-0.0399	-0.008	1	0.0325	-0.013	0.0118	0.0107	0.0055	0.0081	0.0049	-0.0558	0.1937
PSO	0.1664	0.0287	0.0015	0.0001	-0.005	0.0325	1	0.0122	-0.0786	-0.1285	0.0208	0.0434	-0.0615	0.0298	0.1049
CS	0.1311	-0.0507	-0.0427	-0.0288	-0.024	-0.013	0.0122	1	0.0021	0	0	0	0	-0.1925	-0.0054
SQRR	0.1473	-0.0003	-0.0062	-0.008	0.0043	0.0118	-0.0786	0.0021	1	0.703	0.552	0.119	0.227	-0.01	0
EAMQR	0.0547	0.0028	-0.0014	-0.0017	0.0103	0.0107	-0.1285	0	0.703	1	0.786	0.169	0.323	0	0
CWAMQR	0.1669	0	-0.0018	-0.0007	0.0119	0.0055	0.0208	0	0.552	0.786	1	0.178	0.135	0	0
TVAMRQR	0.0257	-0.0092	-0.0221	-0.0184	-0.009	0.0081	0.0434	0	0.119	0.169	0.178	1	-0.23	0	0
dlogREPI	0.1174	0.0015	0.0059	0.0086	0.0086	0.0049	-0.0615	0	0.227	0.323	0.135	-0.23	1	0	0
Size	-0.0187	-0.0916	-0.0154	-0.0076	0.0016	-0.0558	0.0298	-0.1925	-0.01	0	0	0	0	1	-0.48
Ownership	0.07	0.2678	0.1351	0.094	0.0203	0.1937	0.1049	-0.0054	0	0	0	0	0	-0.48	1

Note: Pairwise Pearson Correlations — Chapter 5 variables Notes: Entries are Pearson correlation coefficients computed on the chapter's estimation sample (pairwise listwise). Diagonal elements equal 1.

Correlation indicates linear relationship and do not imply causality. Variable preprocessing (logs, growth rates, winsorization, etc.) follows the baseline specification unless otherwise noted.

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I dedicate this work to all who have loved me and whom I have loved; and to my thirtieth year.

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