



Shengguo Li¹, Jiaqi Liu¹, Jichang Dong¹ and Xuerong Li^{2,*}

- ¹ School of Economics and Management, University of Chinese Academy of Sciences, Beijing 100190, China; shengguo_Li95@163.com (S.L.); liujiaqi191@mails.ucas.ac.cn (J.L.); jcdonglc@ucas.ac.cn (J.D.)
- ² Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing 100190, China
- * Correspondence: lixuerong@amss.ac.cn

Abstract: Since the 2008 global financial crisis, the study of real estate risks, bubbles and exuberance has attracted a lot of attention, which is of great significance to the government, enterprises and individuals. This paper carries out a statistical and bibliometric analysis of 739 studies over the past 20 years in this field, and identifies the theoretical basis, research topics and latest research hotspots in this field. Through the construction of a co-citation network and co-word network, we find that the current studies have commonly employed basic economic theories or econometric methods to detect and quantify real estate bubbles. Explosive bubbles and financialization of real estate are frontier hotspots that have gained much popularity. Based on the comparative study, we further discover that American scholars have paid more attention to topics related to the financial crisis, while Chinese scholars have studied topics more related to real estate market policies. Finally, this paper proposes several important research directions in this field for the future.

Keywords: real estate; risk; bubble; exuberant; bibliometric

1. Introduction

Since the 1980s, financial liberalization and global integration have intensified financial market risks and increased the frequency, severity and scope of financial crises. One of the essential causes of many financial crises is the bursting of real estate market bubbles, such as the Asian financial crisis in 1997 and the global financial crisis in 2008 [1,2]. In the case of the 2008 financial crisis, around 2000, the loose monetary policy of the Federal Reserve (FED) boosted the U.S. real estate economy, and financial derivatives, such as subprime loans and securitizations, accumulated the crisis. With the bursting of the real estate bubble, the tsunami of the financial crisis in the United States swept across the world, causing devastating economic, social and political disasters in many countries around the world. Over the next decade, the economic crisis brought by the housing bubble spread to the real economy, with rising unemployment, stagnant economic growth and increased social instability. The global economy is still in a period of recovery.

This shows that the real estate industry is highly correlated with many industries of the macro economy. If the development of the real estate market violates the law of value and produces bubbles, it will bring a huge and long-term negative impact on the development of the whole national economy. Risks and price fluctuations in the real estate market can easily spread to other sectors of the economy and directly affect the stability of the country's macro economy. Therefore, research on the risk to, the bubbles in and exuberance of the real estate market has important practical significance; indeed, this has been the focus of academic circles in recent years.

Currently, the relevant literature on the risks, bubbles and exuberance of the real estate market is in a period of rapid growth. Scholars in various fields have different research perspectives and diverse research methods, and a relatively unified research paradigm has not been formed. For example, several studies by Philips developed a series



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Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). of methods based on recursive regression and statistical tests to detect bubbles in real estate and other financial markets [3–5]; In addition to mathematical and statistical models, Brunnermeier (2009) [6] studied the relationship between real estate market risks and financial crises by event sorting and conceptual modeling. Other studies utilized new data sources, such as remote sensing data, to study the supply and risk factors in the real estate market [7]. Thus, reviewing the important research results from a systematic perspective would summarize and highlight the academic research of the real estate market and provide practical applications for the business community.

In recent years, bibliometrics scholars have adopted quantitative methods to analyze the evolution trend in hotspots by combining the professional knowledge of the research field. Among them, several researchers have carried out bibliometrics analysis on the top literature studies and found the changes in the research hotspots. For example, Pan et al. (2019) [8] conducted a bibliometric study on the research trends in the field of gray systems. Kocak et al. (2019) [9] used cluster analysis to summarize the research hotspots in the field of neuroscience. Numerous bibliometric studies have also been published in the fields of economics, finance and real estate [10–12].

In this study, a large number of literature studies related to the risks, bubbles and exuberance in the real estate market are quantitatively and systematically analyzed by using the related bibliometrics methods. First of all, this paper describes the statistics of the publications, citations and characteristics of the publishing journals in the related fields. Then, by means of co-citation and co-word analysis, the research hotspots, research trends and evolution process in the related fields are sorted and investigated. In addition, this paper carries out a comparative analysis of the literature on real estate in China and the United States, to provide insight for academic research and policy making regarding the real estate market in China and other emerging countries.

The empirical results of this paper show that the number of publications in this field has shown a fluctuating, rising trend in recent years, while the number of citations shows an exponentially rising trend. From the perspective of research methods, the interdisciplinary studies are still relatively scarce. Important research topics in this fields include bubble tests, risk factors, price dynamics and volatility characteristics of the real estate market. The latest research frontiers include explosive bubbles, momentum, financialization of real estate and immigration. Compared with the United States, studies in China put more emphasizes on real estate policies. Finally, this paper summarizes several promising future research directions, including risk prevention in real estate markets, the dynamic characteristics of bubbles, and simulation of real estate policies.

The remainder of this paper is arranged as following: Section 2 introduces the bibliometric indicators and the methodology of co-citation and co-word analysis; Section 3 calculates the bibliometric indicators and other descriptive statistics; Section 4 focuses on the research area distribution, research hotspots and dynamic evolution of the area of real estate bubbles, risk and exuberance; Section 5 undertakes a comparative study between the Chinese and US literature, to illustrate the differences in research focuses between emerging economics and developed economics; and Section 6 concludes the empirical results and puts forward some promising research directions for the future.

2. Methodology

2.1. Data Collection

We collected publications and citation data compiled by the ISI Web of Science[™] Core Collection, which provides researchers, administrators, faculty and students with quick, powerful access to the world's leading citation databases. This authoritative, multidisciplinary content covers over 12,000 of the highest impact journals worldwide—including open access journals—and over 160,000 conference proceedings.

In order to cover the literature related to real estate risks and bubbles as comprehensively as possible, we select 12 search keywords in related fields to search in the database. The 12 search keywords are: {"housing market bubble", "housing market risk", "housing market exuberant", "housing price bubble", "housing price risk", "housing price exuberant", "real estate market bubble", "real estate market risk", "real estate exuberant", "real estate price bubble", "real estate price risk", "real estate price exuberant"}. A subject search was conducted in the database, and the initial sample data of 1351 articles was retrieved on 20 October 2019. After refinement to the disciplines of business, management and economics in order to ensure the relevancy, a 739-article dataset was used in the subsequent analysis.

2.2. Co-Citation and Co-Word Analysis

A co-citation analysis is able to identify emerging trends and hot topics from a large number of articles. If two articles were cited simultaneously by *n* paper (n = 1, 2, ...), then the two articles are defined to have a relationship of co-citation in the strength of n. Co-cited articles are generally considered to have similarities in terms of content. Co-citation analysis routinely includes an essential procedure of identifying clusters of "co-cited" references or authors by creating a link between two or more references or authors when they co-occur in the reference lists of the citing articles [13].

Co-citation clusters are regularly visualized in the form of networks based on visualization techniques, which helps to identify frequently co-cited articles, authors and journals more credibly and provides important insights into the knowledge domains. In a co-citation network, a node represents an article, and a link between two nodes means the two articles have been co-cited by another article.

Co-word analysis focus on vocabulary or noun phrases with co-occurrence, to identify the relationships between ideas within the subject presented in the sample articles [14]. Co-word analysis reveals patterns and trends in a specific discipline by measuring the association strengths of the keywords. Based on the frequency of co-occurrence, the coword network can be formed to observe the distance between the network nodes, thereby reflecting the similarities in content.

The research process of this paper is divided into the following steps: (1) descriptive statistical analysis of publications, citations, important journals, productive countries, institutions and scholars; (2) identifying the theoretical basis and important landmarks in this field through co-citation network and clustering; (3) conducting co-word networks and clustering, as well as keyword statistics, and investigating the research hotspots and latest frontiers in this field; and (4) comparing the co-word networks of the Chinese and U.S. literature by summarizing the similarities and differences in the research focus of the two countries.

3. Descriptive Statistics of the Literature

3.1. Publications and Citations

The number of publications is generally regarded as an important indicator to measure the level of discipline development and scientific output, as well as scientific achievements and contributions [15]. This section analyzes the overall growth trend in real estate risk studies through the statistics of publications and citations over the past decade.

Figure 1 shows the total number of published papers of each year. The number of literature studies in this field presents a large growth after 2003, which is exactly around the period of the 21st century housing bubble in the U.S. The number of published papers peaked in 2018, at 73 articles. From 1997 to 2018, the number of publications increased 24 times in 11 years, highlighting the great attention given by academic researchers to real estate in recent years.



Figure 1. Number of publications per year.

Figure 2 shows the statistics of the citations of each year. The number of citations in this field is also growing rapidly. Before 1999, the real estate risk-related literature has never been cited by other scholars. In 2003, the citations are less than 10. In 2018, the total number of citations in this field grew to 1556. The most cited article in the literature sample is Brunnermeier (2009) [6]; the author has sorted the origin and major events during the 2007–2008 financial crisis. By the end of 2019, this paper has been cited 994 times, and it is a foundational study in the field of real estate risk.



Figure 2. Number of citations per year.

In addition to Brunnermeier (2009) [6], several other highly cited literature studies and their overviews are summarized in Table 1. Himmelberg et al. (2005) [16] studies housing bubbles from the perspective of housing holding cost; Glaeser et al. (2008) [17] proposes a bubble measurement integrating housing supply; Case and Shiller (2003) [18] tested the existence of real estate market bubbles based on economic fundamentals and homebuyer surveys. Phillips and Yu (2011) [3] proposed a method of testing general asset bubbles.

Article	Citations	Journal	Overview
Brunnermeier (2009)	994	Journal of Economic Perspectives	The paper reviews the origin and major events of the 2007–2008 U.S. financial crisis, and proposes the mechanism and conceptual model of the formation and spread of the crisis.
Himmelberg et al. (2005)	324	Journal of Economic Perspectives	The paper proposes a new measure of housing price bubbles, the cost of owner-occupied housing, and examines the bubbles in different markets.
Glaeser et al. (2008)	255	Journal of Urban Economics	The paper proposes a bubble calculation method combined with housing supply.
Case and Shiller (2003)	255	Brookings Papers on Economic Activity	By investigating the economic fundamentals of U.S. and the survey results of home buyers in several major cities, this paper discusses whether there is a bubble in the U.S. real estate market.
Phillips and Yu (2011)	168	Quantitative Economics	The paper proposes a method of detecting and forewarning asset bubbles, and the conduction of the bubbles was discovered.

Table 1. Highly cited papers in the literature samples.

3.2. Journals and Research Areas

While the number of publications has increased rapidly in recent years, scholars in different fields have also studied the risks of the real estate market from a diversified perspective. This section analyzes the research fields through the journal distribution of literature samples.

Figure 3 shows the distribution of the discipline classifications of the literature samples. The categories were given by the Web of Science database. The result shows that the main research fields of the literature samples are economics, business and finance and urban studies, at 64.38%, 26.75% and 25%, respectively. Other research fields include environmental studies, management, political science, etc. This result indicates that most scholars in the field of real estate risk adopt methodologies of economy, business, finance and management. Research with interdisciplinary perspectives are relatively scarce, such as the combination of computer sciences and economics.



Figure 3. Distribution of the disciplines found in the literature samples.

We calculated the distribution of the published journals of the literature samples and evaluated the quality of the journals by their Impact Factors. The results are shown in Table 2. The Impact Factor of the most highly published journals is between 1 and 4, and they are some of the most influential journals in the field of real estate economics. For example, the *Journal of Housing Economics* has published many articles on real estate price fluctuations [19–21]. In addition to real estate economics and applied economics journals,

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the literature samples published in other fields of journals are relatively scarce. These results also indicate that the use of interdisciplinary methods is a large gap in this field.

Table 2. The most highly published journals from the literature samples.

Journals	Publications	Impact Factor
Journal of Real Estate Finance and Economics	39	1.174
Journal of Housing Economics	23	1.64
Applied Economics	20	0.968
Real Estate Economics	19	1.764
Economic Modelling	18	2.056
Urban Studies	15	3.272
Housing Studies	14	1.882
Regional Science and Urban Economics	12	2.092
Habitat International	11	3.846
Journal of Real Estate Research	10	1.25

3.3. Publication Countries (Regions), Institutions and Scholars

An investigation into the productive countries (regions), research institutions and scholars could identify the major contributors in this field and help those interested in this field to seek cooperation. Figure 4 shows the distribution of the countries (regions) in which the papers were published. The United States and China published the most papers in the literature samples, with a total of 259 and 157, respectively. One possible reason is that one of the main sources of the global financial crisis in 2008 was the U.S. real estate market, which attracted a large number of scholars' attention. In addition, the real estate bubbles in the United States and China have had a great impact in recent years, which made academia pay more attention to the research in related fields.



Figure 4. Distribution of the countries (regions) engaged in the literature.

Table 3 shows the 10 institutions with the highest number of published articles. Hong Kong Polytech University and University of Pennsylvania have the most publications, with 15 and 14, respectively. Most of the productive institutions are located in China and the United States, indicating that real estate risk has received more attention in these two countries and that there are numerous topics worth studying in the real estate markets in these two countries.

Institution	Country	Publications
Hong Kong Polytech University	China	15
University of Pennsylvania	USA	14
National Bureau of Economic Research	USA	13
University of Aberdeen	England	13
Nanyang Technology University	Singapore	11
Harbin Institute of Technology	China	10
Massachusetts Institute of Technology	USA	10
National University of Kaohsiung	China	10
University of California Berkeley	USA	9
University of Geneva	Switzerland	9

Table 3. Top 10 productive institutions.

Table 4 lists the prolific authors with more than five publications in the literature samples. Similar to the results in Table 3, most of the prolific authors are from China, the United States and European countries, such as Hui, Eddie Chi-man; Tsai, I-chun; Sornette, Didier; Wachter, Susan M.; and so on. However, none of the prolific scholars in Table 4 come from mainland China.

Table 4. Prolific authors with more than five publications.

Author	Institution	Publications
Hui, Eddie Chi-Man	Hong Kong Polytech University	12
Tsai, I-Chun	National University of Kaohsiung	10
Sornette, Didier	University of Geneva	7
Xiao, Qin	University of Aberdeen	6
Hoesli, Martin	University of Aberdeen and University of Geneva	5
Huang, Mei Chi	National Taipei University	5
Wachter, Susan M.	University of Pennsylvania	5

4. Hot Topics and Evolution Trends

This section constructs the co-citation network and co-word network of the real estate risk literature, and identifies the evolution trends and hot issues of the research in this field through network clustering. Among them, co-citation network and its clustering identify the knowledge base and evolution trends in the field, while the co-word network identifies the hotspots and the latest research frontiers.

4.1. Co-Citation Network: Knowledge Base and Essential Nodes

This section analyzes the knowledge base and evolution trends of the real estate risk field through a co-citation network. Figure 5 shows the co-citation network and clustering results of the real estate risk literature citations. The node size in the figure represents the citation frequency, and the higher the citation frequency, the larger the nodes in the figure. The connecting lines of the two nodes represent that two literature studies have been cited together, and the nodes and connecting lines of the different colors represent different clusters, respectively representing the knowledge frontiers in this field at different periods. The label of each cluster in the figure is the one with the highest mutual information (MI) value among the cluster members' keywords, representing the characteristic theme of each cluster.



Figure 5. Co-citation network and clusters.

In Figure 5, there are nine clusters in the co-citation network, representing the nine main research perspectives. The nine clustering labels are "rebounds", "rational bubbles", "corporate governance", "dynamics", "behaviors finance", "monetary policy", "financial mercifully", "price stickiness" and "income".

Table 5 lists all the clustering details. The contour coefficient in Table 5 represents the clustering quality, and the closer it is to 1, the higher the clustering quality is. The keywords column lists the three keywords with the highest MI value in the cluster members. By analyzing the above clustering results, the knowledge base in the field of real estate risk can be summarized in the following aspects:

Cluster Number	Cluster Members	Average Publishing Year	Contour Coefficient (Clustering Quality)	Keywords
1	44	2014	0.709	rebounds, housing market predictability, exuberance
2	30	2012	0.833	rational bubbles, investment, debt
3	28	2011	0.867	corporate governance, bank risk, great recession
4	33	2010	0.696	dynamics, Schumpeterian growth, counter-factual simulations
5	45	2008	0.774	behavioral finance, banks, defaults
6	44	2007	0.791	monetary policy, impulse response function, simulation models
7	12	2006	0.983	financial bubble, complex systems, stock market crash
8	21	2005	0.989	price stickiness, policy, adjustment hazard
9	19	2004	0.994	income, state-space model, housing price

Table 5. Clusters details of the co-citation network.

(1) Market prices dynamics of real estate and other assets. The corresponding clusters are 1, 8 and 9. This part of the literature studies the dynamics, volatility and stickiness of real estate prices to examine the risk factors of real estate market prices. For example, Glaeser and Nathanson (2017) [22] in Cluster 1 found three features of real estate market prices: positive short-term serial correlation, longer-run mean reversion and excess volatility. Based on these characteristics, they further proposed an extrapolative model to describe the dynamics of housing prices. Lai and Van Order (2017) [23] have studied the housing prices in major U.S. cities for nearly 30 years and estimated the long-term and short-term determinants of U.S. real estates. Hatzvi and Otto (2008) [24] in Cluster 9 tested the asset pricing model in the Sydney real estate market and found that the rent-to-sale ratio could

not predict the future growth of the rental, but could clearly reflect the expectation change in the future depreciation factors.

(2) Asset bubbles. The corresponding clusters are 2 and 7. This part of the literature focuses on the calculation model and detection method of asset bubbles, providing a theoretical basis for the measurement of bubbles in the real estate market [25–27]. For example, Zhao (2015) [28] in Cluster 2 found that there was a rational bubble in the real estate market, which was caused by the overlapping status of housing holders and real estate investors. In Cluster 7, Sornette and Zhou (2004) [29] discussed the main role of foreign capital inflows in the process of the new economy bubble of the United States in 2000, and provide some suggestions on the anti-bubble of the United States economy and stock market.

(3) Banking risks and corporate governance. The corresponding clusters are 3 and 5. This part of the literature studies the important transmission medium of real estate risk; that is, the role of bank business in the formation of price bubbles and the formation of crisis. For example, Huang and Ratnovske (2011) [30] in Cluster 3 pointed out the "dark side" of retail funds. When negative policy signals appear, it is easy to cause inefficient liquidity. In Cluster 5, Green and Wachter (2005) [31] discussed the positive roles of mortgage loans for the U.S. economy and house owners from the perspective of history and global economics, but also points out the potential risks of mortgage loans for creditors. For example, investment banks such as Fannie Mae and Freddie Mac tend to pursue high profits and increase fiscal spending or cause systemic risks.

In addition to the analysis of co-citation clusters, the key nodes connecting different clusters represent the turning points of the knowledge base in different periods and reflect the important nodes of the research trend in this field. Figure 6 shows five key turning points in the co-citation network: Himelberg et al. (2005) [16], Glaeser et al. (2008) [17], Philips et al. (2015) [5], Saiz (2010) [7] and Philips et al. (2011) [3]. Details about these nodes are listed in Table 6. Among them, Himmelberg et al. (2005) [16] and Glaeser et al. (2008) [17] both propose methods to measure real estate bubbles, while Philips et al. (2015, 2011) [3,5] propose methods to measure general asset bubbles. All these papers provide a theoretical basis for the study of the real estate bubbles. The other turning point, Saiz (2010) [7], is the early attempt to use remote sensing data for real estate research, and introduces geographical factors into the field of real estate risk.



Figure 6. Turning point nodes of the co-citation network.

Article	Overview	Methodology	Empirical Data	Conclusions
Himmelberg et al. (2005)	The paper proposes a new measure of housing price bubbles, the cost of owner-occupied housing, and examines the bubbles in different markets.	Theoretical inferences	Housing prices of U.S. metropolis 1980–2004	Classic measures of house prices (rent-to-sale ratio, price-to-income ratio) have some deviation. In addition to the cost of housing holdings, there are also factors need to consider such as economic fundamentals.
Glaeser et al. (2008)	The paper proposes a bubble calculation method combined with housing supply.	Theoretical inferences	Housing prices of U.S. metropolis 1987–2007	When housing supply is less flexible, housing prices will rise rapidly; when the elasticity of housing supply is large, the price rise is relatively gentle.
Phillips et al. (2011)	The paper proposes a method to test and predict the explosive investment behavior of stock prices.	Recursive regression, right-sided ADF test	Nasdaq 1973.2–2005.6	The empirical results shows that the proposed method can significantly test and predict the explosive behavior of the stock market, and conclude that the Nasdaq market exists obvious bubbles during some periods.
Saiz (2010)	The paper investigates exploitable land and land supply in the United States based on remote sensing data.	Econometric models	Housing prices of U.S. metropolis and remote sensing data 1970–2000	Land supply is related to both physical and regulatory constraints; geography is a determinant of urbanization.
Phillips et al. (2015)	A recursive elastic window method is proposed to examine multiple bubbles in complex long history periods.	Recursive elastic window method	S&P500 1871.1–2010.12	The empirical results show that the proposed method is better than the traditional method in detecting stock price fluctuations and crashes over long historical periods.

Table 6. Details of the turning point nodes.

4.2. Co-Word Network: Hot Topics and Evolution Trends

Co-word analysis constructs a network for the co-occurrence of keywords in the literature samples, through which the latest hot topics and their evolution in a research field can be identified. In this section, the clustering results of the co-word network are presented in a time view, so as to present the evolution trends in the field of real estate risk. In Figure 7, the keywords in each row represent a cluster, the size of nodes represents the frequency of occurrence of the keywords and the connections represent the co-occurrence relationship of the keywords. Each keyword is sorted from left to right according to the occurrence time.



Figure 7. Timeline view of the co-word network.

Based on the results in Figure 7, the literature in the field of real estate risk can be generally divided into the following topics, with the detailed information listed in Table 7:

Research Topic	Publication Period	Methodology	Highly Cited Articles
Housing bubbles	1998–2018	Theoretical inferences, statistical tests	Himmelberg et al. (2005), Glaeser et al. (2008), Case and Shiller (2003), Martin (2011), Hui and Yue (2006), Zhao (2015)
Real estate prices	2005–2010	Econometric models, investigation and survey	Rherrad et al. (2019), Oikarinen et al. (2018), Ling et al. (2015)
Financial crisis Real estate policy	2010–2015 2006–2017	Case study, econometric models Econometric models, case study	Allen et al. (2009), Stein (2011) Shi et al. (2014), Du and Peiser (2014)

Table 7. Hot research topics and details.

(1) Housing bubbles. The corresponding nodes in Figure 7 are "bubble", "price bubble", "rational bubble" and "thermonuclear bubble". These literature studies focus on various types of the bubbles in real estate markets, among which price bubbles and rational bubbles are the earlier research hotspots, while explosive bubbles are the latest research hotspots [16–18,31–33]. Among them, Zhao (2015) [28] studies an economy inhabited by overlapping generations of households and investors, with the only difference between the two being that households derive utility from housing services, whereas investors do not, forming a rational bubble in the market. Gil-Alana et al. (2019) [34] study the rational and explosive bubbles in the real estate market of Chile and confirmed the existence of bubbles through empirical research.

(2) Real estate prices. The corresponding nodes are "price", "price elasticity", "crash", "housing price" and "asset price". These literature studies investigated the trend and volatility in real estate prices, as well as identified the risk factors of price collapse. For example, Rherrad et al. (2019) [35] explored the dramatic fluctuations of the Canadian real

estate market after the financial crisis, and confirmed the Canadian real estate bubble and its contagion with the method of bubble monitoring. Oikarinen et al. (2018) [36] discovered the spatial heterogeneity of housing price dynamics in 70 U.S. metropolises, and analyzed the relationship between income elasticity and housing price elasticity, as well as the size and duration of the bubbles. Ling et al. (2015) [37] constructed the instrumental variable of real estate market sentiment through the investigation of home buyers, builders and lenders. They also investigated the non-fundamental emotional factors in the dynamics of housing prices and their lasting impact on housing prices.

(3) Financial crisis. The corresponding nodes are "financial crisis", "crisis", "mortgage", "the US mortgage" and "liquidity". These literature studies focus on the significant financial crises in history, especially the global financial crisis in 2008, as well as the role played by the real estate market bubbles and their meaning for the future. For example, Allen et al. (2009) [38] systematically investigated the theories and literature related to the financial crisis and point out that the occurrence of the financial crisis was always accompanied by the rise in real estate prices and other asset prices, the growth of credit and the emergence of panic, and emphatically discuss the relationship between the real estate price bubbles and the crisis. Stein (2011) [39] proposed a stochastic optimal control method for monitoring financial institutions, and points out that the probability of a credit crisis is related to the excess loan rate, providing an implement for the federal reserve to stabilize the financial system.

(4) Real estate policy. The corresponding nodes are "monetary policy", "policy", "interest rate" and "inflation". These literature samples study the effects of various macroeconomic policies, mainly monetary policies, on the real estate market. For example, Shi et al. (2014) [40] discuss the impact of central bank policies and mortgage interest rates on housing prices of New Zealand, confirming the role of central bank policy interventions in stabilizing housing prices. Du and Peiser (2014) [41] studied the policy issues of land sales, land hoarding and land pricing by local governments in China, discussing the mechanism of land speculation by local governments, and conducted an empirical study on the land pricing system.

We further investigated the most frequently published keywords in the last three years and identified the latest research trends in the field of real estate risk. Table 8 lists the highfrequency keywords in the literature samples from 2017 to 2019. The results show that the latest research hotspots in this field include explosive bubbles, momentum, financialization of real estate, housing price fluctuations, great depression, immigration and so on. For example, the study of explosive bubbles by Gil-Alana et al. (2019) [34], mentioned above. Moreover, Goldstein (2018) [42] studied the phenomenon of enterprises' investment in financialized real estate and analyzed the social welfare of such an investment. Simone and Walks (2019) [43] focused on the relationship between the excess debt of Canadian immigrants and studied the government's incentive policy for home purchase and the supply of the real estate market.

Year	Keywords	Frequency	Centrality
2019	Explosive bubble	4	0.02
	Economics	2	0.02
	Momentum	2	0.01
	Transition	2	0.01
	Agent	2	0.01
	Episode	6	0.00
	Spain	4	0.01
2018	Financialization	4	0.00
	Mortgage debt	3	0.01
	Bust	3	0.00
	Exuberance	20	0.01
	Performance	5	0.02
2017	Great recession	5	0.02
	United States	3	0.00
	Immigration	2	0.02

Table 8. High-frequency keywords (2017–2019).

5. Comparative Study between Chinese Research and U.S. Research

According to the statistical analysis of the published countries (Figure 4), the United States and China have published the most articles among all countries in the field of real estate economy. These two countries are also typical representatives of developed countries and emerging economies. A comparative analysis of the studies from these two countries would provide an overview of the different concerns and research results of the real estate research in these two countries, providing insight for policy making and academic research for China and other developing countries.

5.1. Comparison on Publication Scales

Figure 8 compares the number of publications in China and the United States from 2001 to 2019. The growth trends show that the number of publications in the two countries was basically the same from 2001 to 2004. Between 2005 and 2008, China published more articles than the United States, and after 2008, the United States published more articles than China.



Figure 8. Number of publications from China and the United States.

After analyzing the main research contents of these two countries in these periods, we find that the real estate bubbles have attracted more attention in China than in the United

States during the period from 2005 to 2007. Between 2008 and 2010, the global financial crisis became the focus of scholars from both countries. Since 2010, the U.S. has surpassed China in research topics such as housing bubbles, real estate risk and volatility.

Figure 9 shows the total number of citations from the two countries. The result shows that there is a large gap between the total citations of the two countries, indicating that the studies from the United States have obtained greater influence in the world. In our literature samples, Chinese scholars publish several conference papers, while the number of journal articles is relatively small. Therefore, Chinese scholars could further improve academic influence by publishing more papers in international peer-reviewed journals in related fields.



Figure 9. Number of citations from China and the United States.

5.2. Comparison of Research Topics

This section uses co-word network clustering to compare the research topics and their evolution in the two countries. Figures 10 and 11 are the clustering results of the co-word networks of publications of the United States and China, respectively. The results show that there are both similarities and differences between the studies on real estate risks in the two countries.

The similarities between the two countries lie in that they both concentrate on the real estate bubbles ("housing bubble"), speculative bubble ("speculative bubble"), housing prices ("house price"), the monetary policy ("monetary policy"), the real estate market ("housing market"), etc. The main difference lies in that U.S. scholars pay more attention to topics such as "financial crisis", "subprime", "credit risk", "mortgage" and "supply elasticity". The main reason is that the 2008 financial crisis originated in the United States and had a great impact on the U.S. real estate market. Since the Chinese real estate market is profoundly affected by policies, Chinese scholars pay more attention to the themes of housing "policy", housing prices in some big cities ("Shanghai", "Hong Kong"), "land", etc.

This paper further summarizes the major research topics of the two countries, as well as the typical literature corresponding to each topic. The results are presented in Figure 12. U.S. studies are mainly divided into the following three topics:

2006	2007			2010		2013		2016		2019
price	X				real estate housing bubble	stock marki investmen urban area speculative	et t variatioesiness bubble boom	cycle behavior		
			17	SXXX	1 A					
market			impact equilibrium ho	migration use price cris	is crashe		foreclo equi r21	sure ty growth	homeownership	exuberance
		housing	g market risk fun	subprime lending damental cointeg	china ration expectation	price bubble pritest	efficiency ice-rent ratio stock			
		dynamics bubble	income	credit re consum	financial wealth isidential real estate iption return				equity market mortgage debt	gentrification
					contagion information financial crisis				credit risk financialcrisis lending standar	d
				finance mortgage hous	subprime bias ing cost					
			constraint	monetary	y policy				supply elasticity housing supply elasticity city	
					model	portfolio ci	hoice	pol unempl shock	licy loyment united states	

Figure 10. Co-word network clustering of the U.S. publications.



Figure 11. Co-word network clustering of the Chinese publications.



Figure 12. Research topics of the U.S. publications.

(1) Housing bubble. Many scholars have tested the existence of bubbles in the real estate market based on the method of Phillips et al. (2015) [5]. Baur and Heaney (2017) [44] examine bubbles in the Australian real estate market and identified periods of explosive growth in housing prices. In addition to bubble detection, some scholars have quantified the size of the real estate bubbles. For example, Bourassa et al. (2009) [45] measured the real estate bubble with the asset pricing method and several other methods, and could identify the generation of the bubble in the bubble-forming period. Other scholars have focused on the phenomenon of bubble bursting. For example, Lim (2017) [46] discussed the main factors of housing price bubble bursting during the great depression in the United States, especially the role of the labor market. Flor and Klarl (2017) [47] found that after the housing bubble, the correlation of housing prices in different regions was significant in a short period.

(2) Subprime crisis or financial crisis. Some scholars have studied the relationship between credit risk and financial crises. For example, Duca et al. (2019) [48] point out that credit risk and bubbles not only reflect the inelasticity of land supply, but also amplify the bursting impact of bubbles. Other scholars analyze the causes and the formation of the crisis. For example, Roy and Kemme (2012) [49] construct the panel logit model and find that most of the bank crisis came from the real estate bubble, which was usually caused by the propaganda of the new era and the lack of supervision of the financial market. Income inequality was also one of the important reasons for the formation of the bubble. Other scholars have studied many abnormal phenomena in the economic and financial system during the crisis. For example, Raymond (2017) [50] studied the phenomenon of banks

holding real estate during the financial crisis, pointing out that the main risk factor is the wholesale financing of small banks by the financial market.

(3) The real estate markets. Some scholars have studied the price fluctuations of the real estate market. For example, Pavlidis et al. (2019) [51] investigated the time series characteristic changes of three real estate market indicators: housing price, price-to-income ratio and rent-to-sales ratio, and tested the occurrence time of the explosive dynamic period. Damianov and Escobari (2016) [52] examined the interdependence of different price percentiles during the bubble period and found that short-term price dynamics were related to the momentum of different percentiles. Other studies focused on the phenomenon of market speculation. Goodman and Thibodeau (2008) [53], for example, studied to what extent the real estate bubble in the United States depended on speculative factors, and explored regional differences. Other scholars have studied the relationship between real estate supply elasticity and housing price. For example, Ihlanfeldt, and Mayock (2014) [54] provide new evidence for the correlation between supply elasticity and price dynamics, and found that the changes in supply elasticity could explain most of the changes in housing price.

There are both similarities and differences between the research of Chinese scholars and those of the United States. The similarities are reflected in the research topics such as bubble detection and price fluctuation, while the differences are mainly reflected in the research on the impact of China's real estate policies on the market. These topics are presented in Figure 13. Specifically, the research of Chinese scholars is divided into the following topics:



Figure 13. Research topics of Chinese publications.

(1) Housing bubble. Some scholars have discussed the formation mechanism of real estate bubbles. For example, Fang et al. (2014) [55] described the formation mechanism of bubbles through multi-agent dynamic game network, and divide bubbles into holistic bubbles, structural bubbles and frictional bubbles. Chen and He (2013) [56] focus on the effect of investor heterogeneity on bubble formation by agent-based modeling. By adopting existing bubble detection methods, Chinese scholars have also tested the existence of bubbles in the Chinese real estate market [57,58]. Different from the studies of U.S. scholars, some Chinese scholars put forward some methods of bubble early warning. For example, Qin et al. (2015) [59] propose a series of early warning indicators of the real estate markets and bubbles, and also constructed an early warning system for real estate risk.

(2) Real estate policy. Since Chinese real estate market is profoundly affected by policies, many scholars focus on Chinese real estate policies. One of these policies is the purchase restriction policy. For example, Wu and Li (2018) [60] find that although the purchase restriction policy restrained the rise of housing prices and transaction volume, it did not significantly affect housing investment and construction. Zhang and Wang (2016) [61] came to a different conclusion. They discovered that the purchase restriction policy could restrain the speculative demand for housing, but it was not effective enough to restrain the price in areas with high housing prices. Monetary policy is also an important tool for the Chinese government to regulate the real estate market. Xu et al. (2015) [62] adopted ANOVA and VAR models to study the impact of money supply and interest rates on real estate prices. Tan and Wu (2014) [63] compare the impulse responses of the real estate market in China and the United States to monetary policy, and found that the real estate market in China showed a significant response to interest rate and money supply shocks, while the real estate market in the United States only responds to the interest rate but not to money supply. In addition, land policies are important and unique tools in Chinese real estate. For example, Shen et al. (2018) [64] found that urban land supply restrictions have different impacts on cities and periods with different price-to-income ratios. Li et al. (2019) [65] found that the real estate control policies issued by China's core cities have spillover effects on the surrounding cities of major urban agglomerations, and the real estate market within the urban agglomerations has the characteristics of regional linkage.

(3) Real estate prices. Similar to the studies in the United States, some Chinese scholars use different econometric models to explore the price volatility and dynamics of the Chinese real estate market [66,67]. Other scholars have studied the risk factors of China's real estate market. For example, Hui et al. (2014) [68] show that the linkage between Asian markets and changes in credit conditions were important factors for the rapid growth of bubbles. An et al. (2016) [69] provide a new approach to explain the real estate price risk from the perspective of capital inflow, pointing out that capital inflow is a significant factor in the rise of housing prices. Housing price forecasting is another research topic of Chinese scholars. For example, Lam and Hui (2018) [70] constructed a new measurement method of investor sentiment and applied it to the prediction of housing prices. They also found that investor sentiment had a significant effect on the prediction of speculative real estates.

6. Conclusions and Discussions

The risk and exuberance of the real estate market are closely related to the macroeconomy and several business sectors. In this paper, a bibliometric analysis and systematic review of the related literature in the Web of Science database were conducted, and the high-publishing countries, institutions and scholars in this field were identified. Through a co-citation network and co-word network clustering, the knowledge base, research hotspots and evolution trends in this field were explored. In addition, we also compared the similarities and differences of the real estate studies in China and the United States, enlightening for the relevant studies in developed countries and emerging countries. Based on the above work, we try to provide insights for future research directions in the real estate risk field.

- According to the empirical results of this paper, the following main conclusions can be drawn:
- The research in this field have attracted much attention around the world after the 2008 crisis, dominated by scholars from the United States and China.

In 2007, the burst of the real estate bubble led to the subprime mortgage crisis in the United States, which evolved into a global financial crisis. As a result, real estate prices in the United States have fallen sharply, and the national economy has been severely hit. Since then, academia has conducted a lot of research on the causes and effects of the subprime mortgage crisis in the United States, the measurement of real estate market bubbles and the prevention of real estate market risks. Since the reform of China's housing system in 1998, China's real estate market has achieved leapfrog development; but, it has also caused problems, such as skyrocketing housing prices, severe market differentiation and over-reliance on real estate for economic development. Scholars are specifically concerned about whether there is a bubble in the Chinese real estate market, how to measure the bubble, the degree of risk in the Chinese real estate market and how to conduct monitoring and early warning. In particular, the current extremely high level of housing prices in China's metropolis, the excessive proportion of real estate in household asset allocation and the excessive leverage of non-financial companies have led to huge risks for China's real estate. These topics have always been the focus of scholars' research.

(2) Current studies have commonly employed basic economic theories or econometric methods to detect and quantify real estate bubbles. So far, few studies in this field have adopted interdisciplinary methods and perspectives.

A real estate product is a commodity, but it has the characteristics of both capital goods and durable goods. Scholars mostly analyzed and discussed changes in real estate prices and bubbles from the basic theories related to economics, such as asset price theory and supply-demand relationship theory. The measurement of real estate bubbles and risks mostly use statistical analysis and econometric models and other commonly used methods in economics and management, such as selecting the typical indicators for measurement and judgment, unit root and cointegration tests and other statistical testing methods. Interdisciplinary methods, such as intelligence algorithms or qualitative analysis, are rarely employed.

(3) The formation and bursting of real estate bubbles are closely related with real estate risks. Bubble detection provides an effective approach to quantify real estate risks.

The dynamics of real estate price volatility is a direct manifestation of real estate risks. The real estate bubble is caused by the fact that economic entities are affected by speculative factors and expect that real estate prices will continue to rise in the future, and then use leveraged funds to buy and sell real estate in order to make a profit. The real estate bubble generally occurs in the period of economic prosperity and expansion and mainly occurs in highly developed urban areas. Once the real estate bubble bursts, real estate prices will plummet rapidly, a large number of financial institutions will default, triggering economic and financial crises, which will have a longer, broader and deeper impact. Looking back on the world history of the past crises and risk events, they are mostly related to the formation and bursting of the real estate bubble. The emergence of a real estate bubble means the irrational development of the real estate market. Financial institutions issue a large number of real estate loans and hold derivatives related to the real estate market, leading to increasing financial risks. Furthermore, the real estate industry has a strong correlation effect, which is closely related to many industrial sectors. The excessive development of the real estate industry has caused a falsely high demand in related industries, which may lead to overcapacity. This has led to serious problems, such as declining income and sluggish consumption. From the perspective of economic structure, over-reliance on the development of the real estate market has led to a huge influx of funds into the real estate market. It is difficult for the real economy to obtain financial support from financial institutions, causing the economy to become unbalanced. Scholars have found that the real estate bubble is an important risk exposure of systematic risk. Therefore, quantitative detection of real estate bubbles plays a vital role in preventing and resolving economic and financial risks.

(4) In recent years, explosive bubbles and the financialization of real estate have become frontier hotspots that have gained much popularity.

In recent years, the momentum of global economic growth has been weak, the overall performance of the US economy has been mediocre, economic growth in the euro zone has continued to decline, the Japanese economy has been on the verge of recession and the growth of emerging market economies has continued to diverge. The development of the real economy in various countries is not optimistic. Credit risks and market risks of the corporate sector and financial institutions continue to accumulate, pushing up the vulnerability of the financial system. At the same time, the scale of government deficits and debts has risen sharply, breaking the fiscal conservation policies that many countries have been pursuing, boosting the global debt ratio to continue to rise and increasing financial vulnerabilities. Without the support of fundamentals, real estate prices rose rapidly and the stock market rebounded sharply, pushing up the real estate market bubble and the financial market bubble. Explosive bubbles are caused by factors exogenous to the basic value of assets. These bubbles will continue to expand without converging. Compared with trending bubbles and endogenous bubbles, explosive bubbles may have a greater impact on the market in a short period of time according to recent studies.

Real estate financialization has become a novel risk factor in the real estate market in recent years. The rapid rise and prosperity of the real estate market are inseparable from the support of real estate credit. However, under the rapid expanding of real estate credit, the efficiency of financial resource allocation began to decline and the financial risks have accumulated. In recent years, the phenomenon of corporate financialization has been more serious. The rate of return on investment in the real economy continues to decline and the rate of return on financial investment continues to rise. Macroscopic excess liquidity has flowed into the capital market and the real estate market, causing asset price bubbles and real estate price bubbles, triggering a sharp rise in real estate financial risks. Especially for China, due to the imperfect credit information system, imperfect financing guarantee mechanism and the existence of information asymmetry, the fund transferor has higher requirements for collateral. Because of its immovability, high unit value and long-term appreciation, real estate is especially favored by financial institutions and is an important financing collateral. Rising housing prices and credit expansion will help each other, leading to a natural synergy between real estate and the credit cycle. However, the past real estate-dependent development model has caused problems, such as irrational allocation of social resources and distortion of the economic structure. The development of other industries and the growth of household consumption have changed from a crowdin effect to a crowd-out effect. Alleviating real estate dependence and promoting the de-financialization of real estate has become an essential choice for healthy and stable economic development. Therefore, these topics have become academic frontiers in the past two years.

(5) U.S. scholars pay more attention to topics related to the financial crisis, while Chinese scholars concentrate on topics related to real estate market policies. However, in the real estate risk field, the formation and bursting mechanism of the real estate bubble and the measurement of the real estate bubble are all issues of general global concern.

In 2007, the subprime mortgage crisis triggered by the bursting of the real estate bubble in the United States further led to a global financial crisis. As a result, the U.S. stock market crashed, and the economy fell into a prolonged downturn. Since then, American scholars have done a lot of research on the source, impact and prevention of the financial crisis. Since the beginning of the 20th century, the United States has formed a relatively developed and complete housing financial system. The U.S. housing financial system is highly securitized and market-oriented, which helps to amplify the real estate risks and may become an important tipping point for the financial crisis.

On the other hand, China has not experienced similar events such as the subprime mortgage crisis. China's housing financial system is very imperfect, financial innovation products related to real estate are rare and the development of asset securitization business is relatively slow. The main link between the real estate market and the financial market is that banks provide credit support for corporate real estate development and for residents to purchase houses. Compared with the US housing market, China's real estate market involves a special land supply system and local government land financial issues. Moreover, China's real estate market is affected by the strict control policies of the central government and local governments. The central government has overall control over the tone of real estate market regulation, and local governments have implemented strict purchase restrictions and loan restrictions due to urban policies. In contrast, China's real estate market has been greatly affected by policy controls. Various regions have implemented policies to restrict purchases and loans strictly due to the city's policies. Banks and other financial institutions strictly regulate credit policies, guide capital to flow to the real economy, strictly restrict capital inflows into the real estate sector and reduce non-systematic risks. Therefore, Chinese scholars pay more attention to the impact of policies on the real estate market.

Through the above comparison, we find that U.S. scholars tend to analyze the innovation of housing financial products and the real estate risks caused by the development of the housing financial system from the perspective of the financial crisis. Chinese scholars mainly focus on the impact of policy changes on the development of the real estate market. These research issues originated from the specific characteristics of their own country's real estate market, which may not be significant and contributing to other countries. However, in the real estate risk field, the formation and bursting mechanism of the real estate bubble and the measurement of the real estate bubble are all issues of general global concern.

Based on the above conclusions, this paper attempts to propose several directions worthy of future research in the field of real estate risk: (1) Prevention of real estate market risk. Existing studies have conducted in-depth studies on the risk factors of the real estate market and the driving factors of price fluctuations. However, further studies are needed on how to prevent real estate risks, especially from the perspective of policy making and government decision-making. (2) The real estate market anti-bubble. Most of the existing studies focus on detecting or identifying real estate bubbles, but few of them have discussed how to effectively remove real estate bubbles and restrict market prices to a rational range, which is of more practical significance. (3) Policy planning and simulation of the real estate market. The government's fiscal policy and monetary policy have an important impact on the formation and bursting of the real estate bubble. For developing countries such as China, the stabilization and rational development of the real estate market are heavily reliant upon effective policies and regulations. How to formulate effective real estate policies, and what impact the implemented policy plans will make, can be further studied by policy simulation tools, providing scientific fundamentals for government decision-making.

There are some limitations to this paper. First, the evolution trends in the number of articles contained in each research topic can be studied in greater detail. In addition, more statistics can be done on the research methods adopted in the literature samples to provide inspiration for future empirical studies. Finally, the papers in the Chinese journal database can be introduced into this research to investigate the academic achievements of Chinese scholars more comprehensively.

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