Urban Housing Price Fluctuations and Regional Systemic Financial Risks: Panel Spatial Economic Models in Jiangsu, China

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Abstract: The regional systemic financial risks driven by escalating urban housing prices have been of great concern recently. Based on the theoretical analyses on the mechanism of formation of regional systemic financial risk driven by urban housing price fluctuations, this paper builds panel spatial economic models to empirically analyze the relationship between urban housing price fluctuations and regional systemic financial risks, in addition to their spatial linkages, in 13 cities in Jiangsu, a representative province of China. The empirical results show the following. (1) The excessive investment or speculation of local governments, banks, real estate developers, individuals, and families on the housing market stimulate the escalation in urban housing prices, leading to the systemic financial risks; (2) Urban housing prices and the land supply price of local governments have strong spatial contagion effects among cities, which will diffuse risks to adjacent cities, causing regional systemic financial risk; (3) Compared with North Jiangsu, South Jiangsu has more serious investment expansion from real estate developers and stronger spatial contagion effects, suggesting the existence of heavier regional systemic financial risks derived from housing price fluctuations; (4) North Jiangsu has slightly stronger “imitative behavior” among local governments, and fewer “substitution effects” of central cities’ demand to adjacent cities’ demand than does South Jiangsu.

Keywords: urban housing price; regional systemic financial risk; spatial contagion

1. Introduction

Financial risk is a potential threat to the healthy development of the economy, which can possibly devolve into financial crisis and economic recession. The destructive impact of a financial crisis has been evidenced in economic history, for instance, the Asian financial crisis in 1997 and the global financial crisis in 2008. Thus, it is necessary to study financial risk in order to avoid its possible potential damage to the economy, and thus to maintain the sustainability of social development. China now faces a severe situation of financial risk caused by the real estate market. High housing prices have extended from first-tier cities to second and third-tier cities. Local governments are heavily indebted to the development of industrial parks; real estate developers borrow heavily for real estate development; buyers (individuals or families) buy multiple or even dozens of houses for speculation; and banks offer large amounts of real estate-related loans in an effort to obtain benefits from soaring house prices. All of these are encouraged by the short-term benefits, which may cause serious financial problems that impede the sustainable development of the economy and thus society. Two questions arise. (1) How do urban housing price fluctuations relate to these participants’ financial...
risks? (2) How do the risks derived from urban housing price fluctuation diffuse to various participants and adjacent cities, thereby causing the regional systemic financial risks? It is important to study these issues, because the mechanism of formation of regional systemic financial risk led by housing price fluctuations must be clarified before we can control regional financial risks and avoid a subsequent shock to the economy and society that could be as destructive as the global crisis in 2008. Accordingly, this paper will use empirical evidence from Jiangsu Province to analyze the mechanisms behind the contagion of housing price risks among participants and cities. Jiangsu is one of the most developed of China’s provinces from the perspectives of finance and the housing market, although the economic development between the northern and southern parts of the province differs. The gross domestic product (GDP) per capita in North Jiangsu was 55,127 RMB in 2015, whereas that in South Jiangsu was 125,002 RMB, which is nearly 2.27 times that in North Jiangsu (data source: Statistic Bureau of Jiangsu Province). Thus, Jiangsu is considered as an ideal region for studying regional contagion and differences in real estate financial risks. Due to China’s particular political environment, legal system, and culture [1], interesting results that differ from those in either the United States (US) or the United Kingdom (UK) markets will be revealed.

There are typical theoretical studies for systemic financial risks, such as Kaufman [2,3], Allen and Gale [4], and Fouque and Langsam [5]. Kaufman [3] defined systemic financial risk from the perspective of risk contagion as follows: a single event affects various parts of the system, and then, in a domino effect, the effects extend to a series of institutions and markets, finally resulting in the possibility of collapse or the loss of functionality of the entire financial system. Reinhart and Rogoff [6,7] pointed out that asset price fluctuation is the most important trigger event for systemic risk, as is evidenced by historical financial crises caused by the bursting of asset price bubbles. A collapse in asset prices is particularly unwelcome news, especially a collapse in housing prices and commercial real estate prices [6,7]. A decrease in asset prices could result in direct book losses for the asset-held financial institutions and investors. Moreover, it could have adverse effects on investors’ market expectations, which could trigger a run on these financial institutions, further reducing their assets and the prices of other financial assets, and leading to a series of losses [8].

After the subprime mortgage crisis in the United States in 2007, scholars started to pay attention to housing price fluctuation for the study of systemic risks. Pezzuto [9] pointed out that low interest rates, high leverage, credit euphoria, and the pursuit of short-term interests caused the housing bubble before the subprime crisis. Acharya et al. [10] asserted that the housing bubble burst resulted in a series of losses in the subprime crisis—including a bank credit default loss, associated losses caused by lack of liquidity, the collapse of the stock market, economic recession—and that all of these losses are derived from personal (family) housing loan default problems following the bursting of the housing bubble. Puliga et al. [11] found that a stress test on the network of correlations among credit default swaps in the US could not detect the systemic risk before 2008 until the potential losses of financial assets caused by decreases in the housing prices were introduced. Meng et al. [12] pointed out that real estate bubble bursts generally bring financial system collapses and economic recessions. Liu [13] introduced the housing market price to forecast the systemic risk. Although the existing literature has recognized the important impact of housing price on the systemic financial risk, the mechanism of formation of the systemic financial risks derived from housing price fluctuations has not been clarified yet. Therefore, this paper studies the issue through both theoretical and empirical analyses, which is one of the paper’s innovative aspects.

With respect to the financial contagion effects, most of the empirical literature focuses on the transnational contagion and the linkage effects of financial markets. Stehle [14] discussed the relationship of the pricing of risky assets among nations. Sarno and Taylora [15] studied the relationship of capital flows, stock market bubbles, and financial risks among Asian countries in 1997. Hui et al. [16] built a Fractionally Integrated Vector Error Correction Model with nine securitized real estate indices, showing that the markets of Asia, Europe, and North America converge in a similar trend, with a peak before the 2008 global crisis and cointegration from North America to Asia and Europe. Accordingly,
most of the literature focuses on the international financial risk contagion effects of financial markets, whereas systemic financial risk contagion among cities is rarely studied. Therefore, taking 13 cities in Jiangsu, China as the study area, this paper analyzes the issue of how the systemic financial risks that are derived from housing price fluctuations diffuse from one city to adjacent cities and, thus, to the whole Jiangsu region. This is another innovative aspect of this paper.

In the real estate field, many studies have shown the spatial contagion effects of housing prices. Clapp and Tirtiroglu [17] introduced spatial contagion effects into their dynamic analysis of the housing market. Moreover, empirical evidence of the spatial diffusion effect of housing prices has been provided by many studies, such as Pollakowski and Ray [18], and Brady [19]. Hui et al. [20] found that the domino effect on the Chinese housing market apparently diffused from the east to the west and from the south to the north. Chen [21] asserted that it is important to consider the spatial linkages of real estate investment among the provinces in China. Accordingly, numerous articles determine the spatial contagion effects of housing prices from the geographic spatial perspective. This paper extends the geographic spatial perspective and methodology from housing prices to the field of regional systemic financial risks, and studies the spatial contagion effects of financial risk derived from the urban housing price fluctuations between cities. This is another innovative aspect of this paper.

Overall, the existing literature has made some achievements in both theoretical and empirical research on the issue of asset price fluctuation and systemic risks. With respect to housing price volatility and systemic risks, most studies focus on personal (family) loan defaults and the subsequent bank risks. This is consistent with the housing market supply being transformed from newly built housing to stock housing both in the US and in European countries; thus, real estate developers have not been the main participants in the real estate financial market. However, the situation in China is different, because real estate developers and local governments play important roles in both real estate supply and the real estate financing markets. As Su and Tao [22] and Liu et al. [23] stated, local governments, real estate developers, banks, and individuals or families are united through financial ties, jointly promoting urban expansion and housing prices. Therefore, urban housing price volatility will create risks for local governments, real estate developers, banks, and other participants, and lead to systemic financial risks that should be studied in future research. Accordingly, this paper analyzes the relationships between urban housing price fluctuation and the financial risks of the main participants (local governments, real estate developers, banks, and individuals or families), and tries to reveal the mechanism of formation of the systemic financial risk that is derived from housing price fluctuations.

Furthermore, while the transnational linkages of financial markets and the spatial contagion of housing prices have been studied by many scholars, the regional contagion of the systemic financial risk that is derived from urban housing price fluctuations has not been studied. Thus, this paper also builds spatial economic models and empirically analyzes the spatial contagion effects of the financial risks that are derived from urban housing price fluctuations among the 13 cities in Jiangsu.

The remainder of the paper is organized as follows. Section 2 analyzes the theoretical mechanism of formation of the regional systemic financial risk that is led by urban housing price fluctuations. Section 3 builds panel spatial econometric models to test the relationship between urban housing prices and participants’ excessive investment or speculation and the spatial contagion effects among the 13 cities in Jiangsu, and compares the differences between South and North Jiangsu. Section 4 is a discussion of real estate developers’ excessive investment. Section 5 outlines the conclusions.

2. Mechanism of Formation of Regional Systemic Financial Risk Led by Urban Housing Price Fluctuation

In this section, we first discuss the role of the four main participants in the formation of systemic financial risk, and then establish a theoretical model to capture the spatial contagion of the financial risk.
2.1. Systemic Financial Risk

Unlike the case in the real estate financial market in the West, a real estate secondary finance market has not been established in China, and housing mortgage loans and real estate development loans are the main tools in the primary market. The real estate financial chain has four main direct participants: land suppliers (local governments), housing suppliers (real estate developers), capital providers (banks), and the real estate demand side (either individuals or families). Below, we discuss the role of the four players in systemic financial risk.

2.1.1. Local Governments

Since land is owned by the state in urban China, local governments are the monopolists of land supply. On the one hand, local governments employ various land supply strategies and rely on land-use right transaction fees to expand their financial revenue, in addition to gaining economic, and thus political, advantages [22–25]. On the other hand, local governments indirectly receive numerous land mortgage loans from banks through their subsidiary institutions, such as local government financing vehicles, to develop industrial zones and infrastructure in order to further promote the local land value, and thus gain economic and political advantages; this is called “land finance” [23,26–28]. Consequently, local governments are encouraged to push up local housing prices, which will create a housing price bubble.

Once the housing price bubble bursts, land prices will decline sharply, and local governments will be trapped by many debts, relying on land revenue for repayment. Since local governments will not be able to repay their debts, banks and other lenders will face massive losses, which will bring systemic financial risks. The “land finance” is unsustainable, and is harmful to the sustainable development of the economy and society.

2.1.2. Real Estate Developers

With the housing price increase, real estate developers will seek to increase their financing scale to expand production and obtain more profits. From the perspective of collateral, a housing price increase will raise the mortgage value, and thus developers’ financing capacity. With respect to liquidity, housing price growth is indicative of a market boom and the favorable performance of developer enterprises, although the liquidity of assets may be overestimated. With regard to capital, the growth of housing prices increases the net assets of developers’ enterprises, and thus their long-term solvency and expected return, which will attract more investors [29]. In China, real estate developers’ real self-owned capitals only account for a low part of the total, and they mainly rely on bank loans for the rapid expansion of real estate investment [23]. With increasing housing prices, real estate developers tend toward overleveraging and overinvestment, which could create a housing price bubble.

A decline in housing prices decreases the value of inventory and fixed assets, creating liquidity risks for real estate developers. Besides, a decline decreases real estate developers’ capital and increases the book capital liability ratio, which will result in equity loss for investors and claim loss for banks, spreading the systemic financial risks.

2.1.3. Banks

The growth in housing prices promotes banks’ credit ability, lowers their expectation of risks, and leads to banking credit expansion, particularly for mortgage loans and real estate development loans. There were 32.2 trillion in real estate bank loans by the end of 2017, accounting for 26.8% of the total amount of bank loans [30]. With the expansion of banking credit, economic participants can obtain more funds to either invest in or speculate on real estate, which brings housing price upswings, and can even cause a housing price bubble. Guerrieri and Uhlig [31] stated that the boom or busting of credit causes the boom or busting of housing prices. Shen et al. [32] found that there is a bidirectional lead-and-lag relationship between credit and the housing prices in China.
If the housing prices decline, banks will face the following three problems: (1) credit defaults from real estate developers, local governments, and individuals or families (buyers); (2) the need to dispose of collaterals to achieve liquidity, in addition to the negative consequences from the markdown value loss and the market loss of further housing price decreases; (3) panic due to undesirable expectations arising from the decline in housing prices, even triggering a run on banks. Banks then are faced with huge loss or even bankruptcy, leading to systemic financial risk.

2.1.4. Individuals or Families

Soaring housing prices attract more and more individuals or families to either invest in or speculate on the housing market in the following two ways: (1) as creditors or shareholders, to expand their investment in real estate financial markets; and (2) as real estate buyers, to purchase more real estate and sell it when the prices increase. Such investment or speculation could further increase the housing prices in the short term, creating a positive feedback loop between price and speculation, and thus producing a price bubble. In China, many studies use the high housing vacancy rate to illustrate the heavy degree of speculation [23].

When the housing price bubble bursts, investors and speculators face big losses, and cannot repay the loans from banks, causing systemic financial risks and the possibility of social instability.

2.1.5. Mechanism of Formation of Systemic Financial Risk

In summary, the mechanism of formation of systemic financial risk is as shown in Figure 1.

![Figure 1. Mechanism of formation of systemic financial risk.](image)

2.2. Spatial Contagion

After having clarified the financial risk led by housing fluctuation to the four participants, this section explains how the risk diffuses between cities. According to Zhang [33], adding price expectations to the demand equation, the dual expectation models of supply and demand are as follows:

\[
S_t = a + b\hat{P}_t^s \\
D_t = c - dP_t + e\hat{P}_{t+1}^d \\
\hat{P}_t^s = E_tP_t = fP_{t-1}^d \\
\hat{P}_{t+1}^d = E_tP_{t+1} = gP_t \\
S_t = D_t
\]

(1)
where \(a, b, c, d, e, f,\) and \(g\) are non-negative. \(S_t, D_t,\) and \(P_t\) are housing supply, demand, and price, respectively, at the \(t\) period. \(\hat{P}_t\) is the expected value of \(P_t\). Here, \(\hat{P}_t^s\) and \(\hat{P}_t^d\) are the expected values of the supply side and the demand side, respectively.

The supply volume of the current housing market is determined by the price expectation in the previous period—that is, the current supply is a function of the price expectation in the previous period—and the current housing market demand depends on both the current price and the expectation of the price in the next period. The expected value expresses the expectation of price. Real estate developers’ expectation of the current price in the previous period is \(\hat{P}_t^s = E_{t-1}P_t = fP_{t-1}\). When the market price is expected to rise, then \(f > 1\); when the market price is expected to decline, then \(0 < f < 1\). Similarly, real estate demanders’ expectation of the price in the next period in the current period is \(\hat{P}_t^d = E_{t}P_{t+1} = gP_t\). When the market price is expected to rise, then \(g > 1\); when the market price is expected to decline, then \(0 < g < 1\). \(e\) is the ratio of demand derived from either investment or speculation to the total demand; when only real demand exists in the market, \(e = 0\).

Solving the Equation set (1), we obtain:

\[
P_t = \frac{bf}{eg - d}P_{t-1} + \frac{a - c}{eg - d} \tag{2}
\]

Introducing \(P_0\) into Equation (2), then:

\[
P_t = \left(\frac{bf}{eg - d}\right)^t P_0 + \frac{a - c}{eg - d - bf} \left[1 - \left(\frac{bf}{eg - d}\right)^t\right] \tag{3}
\]

Assuming that the housing price of City A rises continuously and attracts the attention of investors in City B, who will expect the rise of housing price in City B, thereby increasing the housing demand by \(\pi\) in City B, the demand equation will be as follows:

\[
D_t = e - dP_t + e\hat{P}_{t+1}^d + \pi \tag{4}
\]

Fixing \(S_t\), and solving Equation set (1), then:

\[
P_t = \frac{bf}{eg - d}P_{t-1} + \frac{a - c}{eg - d} - \frac{\pi}{eg - d} = \left(\frac{bf}{eg - d}\right)^t P_0 + \frac{a - c - \pi}{eg - d - bf} \left[1 - \left(\frac{bf}{eg - d}\right)^t\right] \tag{5}
\]

Comparing Equation (5) with Equation (2), the demand shock \(\pi\) brought about by the expectation of change causes the housing price to fluctuate by \(\pi / (eg - d - bf) \left\{1 - \left[(bf / (eg - d))^t\right]\right\}\). Assuming that the housing price in City B is in equilibrium, which is determined by the market fundamentals, then \(e = 0\). If \(|bf| < |d|\), the housing price in City B changes from Equation (5) into:

\[
P^B_t = \left(\frac{bf}{-d}\right)^t P_0 + \frac{a - c}{-d - bf} \left[1 - \left(\frac{bf}{-d}\right)^t\right] \tag{6}
\]

If \(t \to \infty\), then \(\left[bf / (-d)\right]^t \to 0\), \(P^B_t \to (a - c) / (-d - bf)\). Due to the rise in housing prices in City A, the demand in City B increases by \(\pi\), and then:

\[
P^B_{t+1} = \frac{bf}{-d}P_t + \frac{a - c}{-d} + \frac{\pi}{d} \tag{7}
\]
The growth of the housing price in City B will raise both investment demand $e$ and real estate developers’ expected price $f$. When $e$ and $f$ rise to a certain point, if $bf > eg - d > 0$, then the housing price will tend to diverge, that is:

$$P_{t+2}^B = \frac{bf}{eg - d} P_{t+1} + \frac{a - c}{eg - d} > P_{t+1}^B$$

(8)

The housing price in City B will increase continuously along the path of Equation (3): $P_t^B = \left[\frac{bf}{(eg - d)}\right] P_0 + \left\{\frac{(a - c)}{(eg - d - bf)}\right\} \left\{1 - \left[\frac{bf}{(eg - d)}\right]^t\right\}$ and finally deviate from the initial equilibrium price $b_t^B = \left(\frac{a - c}{-d - bf}\right)$, accompanying the growth in investment demand $e$ and real estate developers’ expected price $f$. Accordingly, the housing price bubble in City A diffuses to City B by changing the investment demand and the expected housing price in City B.

Based on the above analysis, the increase in the housing price will stimulate heavy investment or speculation from participants, causing a sharp increase in the housing price, and thus financial systemic risk due to the financial loss or bankruptcy of all of the participants when the housing price decreases. Furthermore, the housing price bubble could diffuse to adjacent cities, thereby spreading the risk to the whole region, resulting in regional systemic financial risk.

3. Empirical Analysis

3.1. Data

The empirical analysis employs the annual panel data of 13 cities (Nanjing, Wuxi, Xuzhou, Changzhou, Suzhou, Nantong, Lianyungang, Huai’an, Yancheng, Yangzhou, Zhenjiang, Taizhou, and Suqian) in Jiangsu Province, China from 2003 to 2014. This is the latest officially published data set as of the publication of this paper.

Based on the mechanism of formation of the systemic financial risk led by housing price fluctuations in Section 2, housing price (HP) is adopted to describe the real estate price level. The average land-use right transaction price (LTP) is used as a proxy of the local governments’ land supply monopoly and land revenue dependence, equalling to the value of the land-use right transaction space divided by the total transaction fees. The expansion of real estate developers’ investment is expressed by their real estate development investments (RDI). The bank credit expansion is represented by the ratio (LB/GDP) of the loan balance of financial institutions to the gross national product (GDP). The demand from individuals or families is represented by the sold space of housing (HSS). Except for LB/GDP, the logarithms of the other variables are introduced into models, that is, loghp for the dependent variable, and logltp, logrdi, bl/gdp, and loghss for the independent variables. Employing the longitude and latitude of various regions, the spatial weight matrix W is generated by Matlab software. All of the data are from the “China Land and Resources Statistic Yearbook” for various years, the “Jiangsu Statistical Yearbook” for various years, the statistical yearbooks of the 13 cities for various years, and the CEIC database.

3.2. Methodology and Modeling

3.2.1. Modeling

Anselin [34] defined spatial correlation, which is the beginning of spatial econometric models. Baltagi [35] and Elhorst [36] introduced the spatial error lag and the spatial dependent variable lag into the traditional panel model. Anselin et al. [37] pointed out that, because of the possible interaction effects among dependent variables, the spatial panel data model should include the spatial dependent variable lag, which is named the spatial lag model (SLM). LeSage and Pace [38] suggested that estimation without considering the possible spatial dependence among independent variables leads to biased results, and they proposed the spatial Durbin model (SDM), which includes both the spatial dependent variable lag and the spatial independent variable lag.
Here, we introduce the dependent variable loghp and the independent variables lnLTP, lnRDI, lb/gdp, and logHSS into Equations (9) and (10) to build an SLM and an SDM, respectively, for the 13 cities in Jiangsu. To compare the difference between South and North Jiangsu, this paper also builds an SLM for South Jiangsu and North Jiangsu. To maintain a sufficient sample size, the three Middle Jiangsu cities—Yangzhou, Nantong, and Taizhou—are included in the samples for both South and North Jiangsu. That is, the South Jiangsu sample area includes Nanjing, Suzhou, Wuxi, Zhenjiang, Changzhou, Yangzhou, Nantong, and Taizhou, and the North Jiangsu sample area consists of Huai’an, Lianyungang, Suqian, Xuzhou, Yancheng, Yangzhou, Nantong, and Taizhou. The models are shown as follows:

1. SLM for the 13 cities in Jiangsu

\[
\text{loghp}_{it} = \delta \sum_{j=1}^{13} W_{ij}\text{loghp}_{jt} + \alpha + [\text{logLTP}_{it}, \text{logRDI}_{it}, (\text{lb/gdp})_{it}, \text{logHSS}_{it}]\beta + \epsilon_i + \lambda_t, i = 1, \ldots, 13; t = 1, \ldots, 12
\]  

where loghp_{it} is the observed value of the loghp in area i at period t, i = 1, ⋯, 13; t = 1, ⋯, 12. \( \delta \) is the spatial autoregressive coefficient, describing the impact of the loghp in the adjacent city on the loghp in the local city. \( W_{ij} \) is a 13 × 13 spatial weight matrix; \( \sum_{j=1}^{13} W_{ij}\text{loghp}_{jt} \) indicates the endogenous interaction effect among the loghp in various cities, implying the spatial dependence. \([\text{logLTP}_{it}, \text{logRDI}_{it}, (\text{lb/gdp})_{it}, \text{logHSS}_{it}] \) is an observed value vector of independent variables of 1 × 4 order, and \( \beta \) is an unknown parameter vector of 4 × 1 order. \( \alpha, \epsilon_i, \) and \( \lambda_t \) represent the constant term, the area fixed effect, and time fixed effects, respectively. \( \epsilon_i \) is the random error term, which obeys the standard normal distribution with zero expectation value and \( \sigma^2 \) variance.

2. SDM for the 13 cities in Jiangsu

\[
\text{loghp}_{it} = \delta \sum_{j=1}^{13} W_{ij}\text{loghp}_{jt} + \alpha + [\text{logLTP}_{it}, \text{logRDI}_{it}, (\text{lb/gdp})_{it}, \text{logHSS}_{it}]\beta + \sum_{j=1}^{13} W_{ij}[\text{logLTP}_{jt}, \text{logRDI}_{jt}, (\text{lb/gdp})_{jt}, \text{logHSS}_{jt}]\theta + \epsilon_i + \lambda_t, i = 1, \ldots, 13; t = 1, \ldots, 12
\]  

Here, the term of \( \sum_{j=1}^{13} W_{ij}[\text{logLTP}_{jt}, \text{logRDI}_{jt}, (\text{lb/gdp})_{jt}, \text{logHSS}_{jt}] \) represents the exogenous interaction among independent variables, reflecting the spatial dependence—the impact of independent variables in adjacent cities on the dependent variables in the local city—and the direction and degree of influence are described by the unknown parameter vector \( \theta \) of 4 × 1 order. Accordingly, SDM contains interactions among both independent and dependent variables [39].

3. SLM for South Jiangsu

\[
\text{loghp}_{it} = \delta \sum_{j=1}^{13} W_{ij}\text{loghp}_{jt} + \alpha + [\text{logLTP}_{it}, \text{logRDI}_{it}, (\text{lb/gdp})_{it}, \text{logHSS}_{it}]\beta + \epsilon_i + \lambda_t, i = 1, \ldots, 8; t = 1, \ldots, 12
\]  

(11) (12)

4. SLM for North Jiangsu

\[
\text{loghp}_{it} = \delta \sum_{j=1}^{13} W_{ij}\text{loghp}_{jt} + \alpha + [\text{logLTP}_{it}, \text{logRDI}_{it}, (\text{lb/gdp})_{it}, \text{logHSS}_{it}]\beta + \epsilon_i + \lambda_t, i = 1, \ldots, 8; t = 1, \ldots, 12
\]  

The implications of the variables and terms in Equations (11) and (12) are similar to those in Equation (9).

3.2.2. Direct and Indirect Effects of SLM and SDM

LeSage and Pace [38] proposed the direct and indirect effects of independent variables to test the influences of spatial interaction. The direct effect refers to the impact of a certain independent variable of a certain city on the dependent variables of the local city, which are represented by the
average value of the sum of the influences of the certain independent variable in all of the cities on the dependent variable in the local city. Due to the direct effect, including the influence of feedback between “the local city” and “adjacent cities”, the $\beta$ in Equations (9)–(12) does not represent the direct effect.

The indirect effect refers to the impact of a certain independent variable of a certain city on the dependent variables of other cities, which equals the average value of the sum of the influences of the certain independent variable in all of the cities on the dependent variables in other cities.

The total effect is the average value of the sum of the influence of the certain independent variable in all of the cities on the dependent variable in both the local city and other cities. The total effect is the sum of the direct effect and the indirect effect.

### 3.3. Empirical Results

#### 3.3.1. Results for the Whole Jiangsu Province

Table 1 describes the test results of the SLM and the SDM with time-fixed effect for the 13 cities in Jiangsu. The coefficients of logltp, lb/gdp, and logrdi in both the SLM and the SDM, and the coefficient of loghss in the SDM are significantly positive, showing that local governments’ land supply monopoly, banks’ credit expansion, real estate developers’ investment expansion, and individuals’ or families’ investment or speculation drive the increase in the housing price. The role of logltp is the most important, with a coefficient of 18.27%, followed by lb/gdp (17.48%), logrdi (13.28%), and loghss (5.41%) in SDM. It is interesting that logrdi has a positive influence on loghp, showing that the housing price will rise when the real estate developers raise their investment, and thus, the supply. Although it is difficult to match all kinds of demand and supply due to the unavailability of data, the areas of houses that are completed and sold in the typical cities in South Jiangsu and North Jiangsu in recent years suggest that demand exceeds supply, as shown in Table 2. In all four cities, there were more sold houses than completed houses between 2013–2016. The prosperous demand in the housing market not only includes the high rigid demand brought by urbanization [40], but also the speculative demand that is evidenced by the high vacancy rates and “ghost towns” [41]. Housing purchasers lining up and rushing to purchase houses in the early morning frequently appear in the housing markets in the four cities. As a result, houses are sold out as soon as the housing sale is started. Some real estate developers even hoard houses, which stimulates a rise in housing prices. The local government often issues a house-purchasing restriction policy to avoid the chaos of housing market. In this context, real estate developers have strong market power and increase investment to gain more profits. All of these show the investment-driven housing prices. As Lai [42] and Liu et al. [24] stated, investment-driven growth exists in China. The positive influences of the four participants—local governments, banks, real estate developers, and individuals or families—on housing prices are consistent with the mechanism of formation of financial systemic risk in Section 2.1, suggesting that the housing market has generated the systemic financial risk in Jiangsu province, China.

Furthermore, the coefficient of $W^* \logph$ is positive in both SLM and SDM, and is 22.30% in SDM, indicating a strong spatial interaction of housing prices among the 13 cities. That is, the increase of housing prices in other cities will elevate the local housing price, showing the spatial contagion of a housing price bubble risk among the cities in the region, thereby generating the regional systemic financial risk. This is consistent with the theoretical analysis of Section 2.2.
Table 1. Test results of the spatial lag model (SLM) and spatial Durbin model (SDM) with a time fixed effect for the 13 cities in Jiangsu.

| Variables          | SLM with Time Fixed Effect | SDM with Time Fixed Effect |
|--------------------|----------------------------|----------------------------|
| W * logph          | 0.433984 ***               | 0.229291 *                 |
| logltp             | 0.182663 ***               | 0.181122 ***               |
| lb/gdp             | 0.174817 ***               | 0.136104 ***               |
| logrdi             | 0.132791 ***               | 0.107283 ***               |
| loghss             | 0.054057                   | 0.07819 *                  |
| W * logltp         | 0.438803 ***               | 0.380812 ***               |
| W * lb/gdp         | -0.278769 *                | -0.275056 *                |
| W * logrdi         | -0.016331                  | -0.000567                  |
| W * loghss         | -0.012249                  |                            |
| R²                 | 0.9452                     | 0.9443                     |

Note: "***", "**", and "*" represent the 1%, 5%, and 10% levels of significance, respectively.

Table 2. Areas of houses completed and sold from 2013–2016 (Million sq. m.)

| Year/City | South Jiangsu | North Jiangsu |
|-----------|---------------|--------------|
|           | Nanjing       | Suzhou       | Xuzhou | Lianyungang |
| 2013       |               |              |        |
| Completed  | 16.93         | 11.51        | 7.03   | 2.73        |
| Sold       | 18.75         | 9.09         | 8.57   | 4.90        |
| 2014       |               |              |        |
| Completed  | 15.27         | 9.58         | 5.09   | 1.97        |
| Sold       | 15.99         | 8.39         | 7.38   | 3.38        |
| 2015       |               |              |        |
| Completed  | 16.53         | 11.80        | 6.72   | 2.07        |
| Sold       | 21.34         | 9.87         | 7.91   | 4.42        |
| 2016       |               |              |        |
| Completed  | 18.82         | 13.25        | 6.02   | 2.90        |
| Sold       | 15.58         | 12.76        | 10.71  | 5.24        |

Besides, the coefficients of W * logltp and W * lb/gdp are significant in the SDM at 43.88% and −27.88%, respectively, showing that the local governments’ land supply strategy and banks’ credit expansion will affect the housing price in adjacent cities. Local governments in cities will adopt the same strategies when they find that local governments in adjacent cities have gained economic and political advantages through promoting a land-use right transaction price, showing the existence of “imitative behavior” among local governments. This coincides with Huang and Du’s [25] findings of the interaction among local governments land-supply strategies in China. However, the local bank credit expansion will attract real estate developers and buyers (individuals or families) from adjacent cities, thereby reducing the housing price driven by excessive investment in adjacent cities. Thus, the systemic financial risk led by housing price fluctuations could diffuse to adjacent cities through the “imitative behavior” of local governments regarding land-supply strategies.

Accordingly, the strong positive influences on housing prices of local governments’ land-supply price, banks’ credit expansion, real estate developers’ investment expansion, and individuals’ or families’ demand, and the negative influence of banks’ credit expansion in local cities on the housing prices in adjacent cities suggest the existence of sharp increases in housing prices driven by excessive investment, and thus, the formation of financial systemic risk in Jiangsu. Liu et al. [43] found overpricing in housing prices in some regions of China, although it is not as serious as it was in Japan in the 1980s. The significant positive influences of housing price and local governments’ land supply price in adjacent cities on the housing price in the local city indicate the spatial contagion of the housing price bubble risk among cities, and thus, the formation of the regional systemic financial risk in Jiangsu.

Table 3 describes the direct and indirect effects of independent variables in SLM and SDM. The direct effects of logltp, lb/gdp, and logrdi are significantly positive in both SLM and SDM, and are
higher than their coefficients in Table 1. This is not the case for \( \text{lb/gdp} \) in SDM, due to its negative influence on the housing price in adjacent cities, and thus, the negative feedback influence from adjacent cities. \( \text{logltp} \) has the largest direct effect, followed by \( \text{lb/gdp} \), and then \( \text{logrdi} \), which is coincident with their coefficients in Table 1. The indirect effects of \( \text{logltp} \), \( \text{lb/gdp} \), and \( \text{logrdi} \) in SLM and \( \text{logltp} \) in SDM are also positive, showing that local governments’ land supply price rise, banks’ credit expansion, and real estate developers’ investment expansion in adjacent cities will increase the housing prices in local cities. In particular, \( \text{logltp} \), having a greater indirect effect than a direct effect, indicates that the strong “imitative behavior” seen in local governments’ land-supply strategies substantially promotes the local housing price. Thus, the direct and indirect effects of independent variables suggest heavy investment from these participants and the spatial contagion of the housing price fluctuation risk, that is, the formation of the regional systemic financial risk.

### Table 3. The direct and indirect effects of independent variables in SLM and SDM.

| Model | Variable | Direct Effect | Indirect Effect | Total Effect |
|-------|----------|---------------|-----------------|-------------|
| **SLM** | \( \text{logltp} \) | 0.188616 ***  | 0.135716 ***   | 0.324333 *** |
|       | \( \text{lb/gdp} \) | 0.181052 ***  | 0.133874 **    | 0.314926 *** |
|       | \( \text{logrdi} \) | 0.139236 ***  | 0.101087 **    | 0.240323 *** |
|       | \( \text{loghss} \) | 0.055181      | 0.041329       | 0.096509    |
| **SDM** | \( \text{logltp} \) | 0.196901 ***  | 0.599663 ***   | 0.796564 *** |
|       | \( \text{lb/gdp} \) | 0.127120 **   | -0.321211      | -0.194091   |
|       | \( \text{logrdi} \) | 0.109565 **   | 0.015124       | 0.124689    |
|       | \( \text{loghss} \) | 0.076648      | 0.011114       | 0.087762    |

Note: ‘***’, ‘**’, and ‘*’ represent the 1%, 5%, and 10% levels of significance, respectively.

3.3.2. Comparison of South Jiangsu and North Jiangsu

Due to the big economic development difference between South and North Jiangsu, the SLMs are built to compare the two areas, and the results are shown in Table 4. The coefficients of \( W \times \text{logph} \), \( \text{logltp} \), \( \text{lb/gdp} \), and \( \text{logrdi} \) are positive in both South and North Jiangsu. The interactions of housing prices among the southern cities are bigger than those among the northern cities, at 39.40% and 38.20%, respectively. A possible reason for this is that South Jiangsu has a more developed housing market, and thus a stronger response to a shock from adjacent cities. The coefficient of \( \text{lb/gdp} \) in North Jiangsu (23.09%) is larger than that in South Jiangsu (11.85%), indicating that North Jiangsu is more dependent on banks’ credit for financing. \( \text{logltp} \) has a slightly stronger effect in North Jiangsu (18.83%) than in South Jiangsu (18.55%), and thus does the “imitative behavior” among local governments.

### Table 4. Test results of SLM with no fixed effect for South and North Jiangsu.

| Variables | South Jiangsu | North Jiangsu |
|-----------|---------------|---------------|
| **intercept** | 2.816289 *** | 2.472432       |
| \( W \times \text{logph} \) | 0.393979 *** | 0.472967 ***   |
| \( \text{logltp} \) | 0.185545 *** | 0.107293 ***   |
| \( \text{lb/gdp} \) | 0.118482 *** | 0.099901 ***   |
| \( \text{logrdi} \) | 0.176479 *** | 0.211803 ***   |
| \( \text{loghss} \) | -0.006009    | 0.139633 ***   |
| \( R^2 \) | 0.9546       | 0.9594         |

Note: ‘***’, ‘**’, and ‘*’ represent the 1%, 5%, and 10% levels of significance, respectively.

Furthermore, the coefficient of \( \text{logrdi} \) is significant in South Jiangsu, but the opposite is true for North Jiangsu, implying that South Jiangsu has serious excessive investment in real estate, which is consistent with the reality. The coefficient of \( \text{loghss} \) is not significant in South Jiangsu, but it is significant in North Jiangsu, suggesting that the “substitution effects” of central cities offset their “driving effects” on housing prices to adjacent cities in South Jiangsu. The central cities with much higher housing
prices, such as Suzhou and Nanjing, can attract buyers (individuals or families) from adjacent cities, and thus reduce the housing demand and housing prices in adjacent cities. However, in North Jiangsu, as there is no great difference in the housing prices among the cities in this region, any increase in the housing prices of local cities will increase the housing price expectation of individuals or families, and thus increase the housing demand and price in adjacent cities.

Accordingly, compared with North Jiangsu, the systemic financial risk led by the housing price fluctuations shows a stronger spatial contagion in South Jiangsu, which is mainly derived from the local government’s land supply monopoly, real estate developers’ investment expansion, and bank credit expansion. The role of real estate developers is not significant in North Jiangsu, and the individuals or families subsequently increase their demand, and thus increase the housing price in adjacent cities following the housing price increase in central cities. Conversely, in South Jiangsu, due to a great difference among the real estate prices in different cities, real estate developers, and individuals or families from adjacent cities are attracted to central cities, substantially offsetting the “driving effects” of the increase in the housing price in central cities on the housing price in adjacent cities.

Table 5 illustrates the direct and indirect effects of independent variables in the SLM in South and North Jiangsu. Both the direct and indirect effects of logltp, lb/gdp, and logrdi in South Jiangsu are significantly positive, and the direct effects are larger than their coefficients in Table 4, coinciding with the results of the 13 cities. logltp has the largest direct and indirect effects, followed by logrdi, and then lb/gdp. It is noteworthy that the investment expansion from real estate developers in South Jiangsu contributes even more to the increase in housing price than does bank credit expansion, indicating heavy investment expansion from real estate developers. This is consistent with the continuous appearance of the phenomenon of “land king” (“land king” is the name for land for construction use with the highest auction price on record in China) in Suzhou and Nanjing in recent years.

Table 5. The direct and indirect effects of independent variables in SLM in South and North Jiangsu.

| Area       | Variable | Direct Effect | Indirect Effect | Total Effect |
|------------|----------|---------------|-----------------|--------------|
| South Jiangsu | logltp   | 0.196657 ***  | 0.108938 ***  | 0.305595 ***  |
|            | lb/gdp   | 0.126570 **   | 0.074432 *    | 0.201002 **   |
|            | logrdi   | 0.187969 ***  | 0.105255 ***  | 0.293225 ***  |
|            | loghss   | −0.007324     | −0.003588      | −0.010912     |
| North Jiangsu | logltp   | 0.197627 ***  | 0.108352 **   | 0.305979 ***  |
|            | lb/gdp   | 0.244581 **   | 0.135671 *    | 0.380252 **   |
|            | logrdi   | 0.062737      | 0.030754      | 0.093491      |
|            | loghss   | 0.147097 **   | 0.083533 *    | 0.230630 **   |

Note: "***", "**", and "*" represent the 1%, 5%, and 10% levels of significance, respectively.

In north Jiangsu, the direct and indirect effects of logltp, lb/gdp, and loghss are significantly positive; they are also larger than their coefficients in Table 4. lb/gdp has the greatest direct and indirect effects, followed by logltp and then loghss, suggesting that the bank credit expansion is the variable that most influences the growth in housing prices in North Jiangsu. Since the finance market in North Jiangsu is not as developed as that of South Jiangsu, housing market participants rely on direct finance—bank credit—more heavily, and thus, the effect of bank credit expansion on housing prices is also more severe.

The total effect of lb/gdp in North Jiangsu is larger than the equivalent in South Jiangsu, because a less developed economy and financial market in North Jiangsu leads to greater dependence on bank financing. logltp has a slightly larger total effect in North Jiangsu (30.60%) than in South Jiangsu (30.56%), and thus does the “imitative behavior” among local governments. In accordance with their coefficients, logrdi in South Jiangsu and loghss in North Jiangsu have significant total effects due to heavy investment by real estate developers and the strong “substitution effects” of housing prices in central cities on housing prices in adjacent cities in South Jiangsu.
4. Discussion

The SDM and the SLM show that the expansion of real estate developers’ investment has a positive influence on housing prices, suggesting that the soaring housing prices is driven by participants’ heavy investment. To further discuss the existence of excessive investment from participants in the housing market, the vacant space (VS) of houses and RDI are introduced as evidence. In theory, if real estate developers are rational, they should decrease RDI along with the growth of VS. What is the situation in Jiangsu?

4.1. South Jiangsu

Due to data availability, Changzhou and Suzhou are adopted as the typical cities for South Jiangsu. As shown in Figure 2, the VS in Changzhou increased from 2004 to 2015, except for 2011, while the RDI of real estate developers rose, except for 2009 and 2015. That is, during most of the years from 2004 to 2015, real estate developers expanded their investment, ignoring the risk from the increasing VS of houses. In Suzhou, the situation is more serious. The VS in Jiangsu grew rapidly from 2002 to 2008, receded in 2009, and then kept increasing from 2010 to 2015. At the same time, the RDI of real estate developers rose rapidly, except for a slight decrease in 2009. The movement of VS and RDI showed a similar tendency in reality, rather than a contrary tendency in theory, suggesting excessive investment by real estate developers.

4.2. North Jiangsu

As shown in Figure 3, Yancheng and Nantong are employed as the representative cities for North Jiangsu. VS in Yancheng increased rapidly from 2010 to 2015, but the RDI of real estate developers expanded substantially until 2014, with a slight decrease in 2015. In Nantong, VS grew dramatically from 2007 to 2009, decreased in 2010, and then rose sharply again from 2010 to 2015. However, the RDI of real estate developers increased rapidly from 2002 to 2015, particularly from 2010 to 2014. Thus, real estate developers expanded their investment dramatically while neglecting the increase in VS, particularly from 2010 to 2014, indicating their heavy investment expansion.
Accordingly, there has been significant investment expansion by real estate developers in both South and North Jiangsu, which has been accompanied by neglect of the rising VS of houses. The rapid increase in housing prices has attracted more and more individuals and families to either invest in or speculate on houses, thereby increasing housing demand and price. In this context, real estate developers hoard houses for future sale at an increased price, and the limited current supply further drives the growth in housing prices. At the same time, the dramatic rise in housing prices creates an overly optimistic expectation of real estate developers in the housing market, and thus stimulates RDI expansion without any consciousness of the risk. These findings are consistent with the empirical results in Section 3. Heavy investment or speculation from participants have driven the further expansion of housing prices and brought financial risks to various sectors and adjacent cities, resulting in regional systemic financial risks.

The paper analyzes housing price fluctuations and regional systemic financial risks in Jiangsu Province. The development history of the housing market and financial market in Jiangsu province is the same as the whole of China, specifically regarding housing reform, financial reform, housing and finance-related regulation, commercialization, etc. Therefore, the estimated results further the understanding of the housing prices and financial risks in the whole of China. However, Jiangsu Province is different from other provinces in China in terms of housing prices, market size, and housing supply. The estimated results in Jiangsu Province may be different from those in other provinces to some extent. Thus, future studies could be conducted to analyze housing price fluctuations and regional systemic financial risks in other provinces, and provide more insights in the understanding of housing prices and risks in China.

5. Conclusions

This paper finds that various participants benefit from the soaring housing prices, and thus they are encouraged to expand investment to promote the increase of housing prices and ignore the subsequent risks and sustainability of economic and social development. Once housing prices decrease, these participants will face a series of financial problems and systemic financial risk. The spatial conduction of the risk of the housing price bubble between cities has also been found in theoretical models. Based on the theoretical analysis—the mechanism of formation of regional systemic financial risk derived from housing price fluctuation—this paper builds a spatial lag model (SLM) and a spatial Durbin model (SDM) to empirically study the effects of investment from participants on housing prices and spatial contagion effects among cities in South and North Jiangsu. Employing panel data from 2003–2014, this paper finds that participants’ investment expansion stimulates the sharp increase in housing prices. They ignore the subsequent financial problems once housing prices declines to pursue more profits, which will trap various sectors in either loss or bankruptcy, thereby leading to systemic risks.
financial risk. At the same time, the increases in housing prices and local governments’ land supply prices in local cities elevate housing prices in adjacent cities, diffusing the risk derived from housing price fluctuation among cities, and thus generating regional systemic financial risk. The main findings in detail are as follows:

(1) Local governments’ land supply price, banks’ credit expansion, real estate developers’ investment expansion, and individuals’ or families’ demand have strong positive influences on housing price. Real estate developers’ expansion of real estate development investment (RDI) elevates housing price, showing that the excessive investment from participants stimulates the sharp growth of housing prices. The movement of RDI and the vacant space of houses show a similar tendency in the typical cities in Jiangsu, rather than the opposite tendency, as is the case in theory, suggesting excessive investment from real estate developers. These heavy investments or speculation from participants drive a dramatic increase in housing prices, creating financial systemic risk in Jiangsu, because the participants will face great financial loss or even bankruptcy if the housing prices decrease. Furthermore, there is a significant positive interaction of housing prices among cities, and local governments’ land supply strategies in adjacent cities have significant positive effects on the housing prices in local cities due to “imitative behavior” among local governments, suggesting a spatial contagion of the housing price bubble risk among cities, and thus the formation of regional systemic financial risk in Jiangsu.

(2) In South Jiangsu, local governments’ land supply price has the largest influence on housing prices, followed by real estate developers’ investment expansion, and then bank credit expansion. The real estate developers’ investment expansion contributes even more than bank credit expansion to the increase in housing prices, suggesting heavy investment from real estate developers in South Jiangsu, which is consistent with the reality. However, demand from individuals or families has no significant influence on housing prices, because the “substitution effects” of central cities offset their “driving effects” in South Jiangsu. Housing prices in the central cities, such as Suzhou and Nanjing, are much higher than in adjacent cities, which attracts individuals or families from the adjacent cities to the central cities, thereby reducing the housing demand and housing prices in adjacent cities.

(3) In North Jiangsu, bank credit expansion has the greatest effect on housing price, followed by local governments’ land supply price, and then demand from individuals or families. This shows that housing market participants rely on direct finance—heavily so on bank credit due to the undeveloped financial market in North Jiangsu—and that banks’ credit expansion to the housing market is also considerable. The expansion of demand from individuals or families has a significant positive effect on housing prices. Since there is no big difference in housing prices between central cities and other cities, individuals or families will raise their price expectation, and thus increase their housing demand in adjacent cities when housing prices in central cities rise.

(4) Compared with North Jiangsu, the spatial contagion effect on housing prices in South Jiangsu is stronger, and the expansion of real estate developers’ investment is more serious, which makes the regional systemic financial risk more severe. Due to the great difference in housing prices between central cities and adjacent cities, there is slightly less “imitative behavior” among local governments in South Jiangsu, and there are substantial “substitution effects” between the housing demand in central cities and the housing demand in adjacent cities. Participants rely more heavily on bank credit in North Jiangsu due to the less developed financial market compared to South Jiangsu.

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