International Journal of Financial Management
11 (2) 2021, 01-12
http://publishingindia.com/ijfm/

Regional Heterogeneity, Monetary Shock, and Bank Lending: Evidence from Chinese Real Estate Market

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Abstract

This paper investigates whether the Chinese real estate price rise is a national monetary shock and driven mainly by monetary shocks, or is controlled by the regional governments and driven mainly by local bank lending activities. The paper attempts to reveal how the determinants on residential property prices differ from those of the commercial property prices. Using both cross-sectional OLS regression and dynamic GMM method, it shows that, historically, movements in Chinese house prices have strong regional heterogeneity, meaning that they have mainly been driven by the local (provincial or region-specific) components, rather than nation-wide components. In addition, the local income level is a strong candidate in explaining the housing price movements. The paper extends prior literature by shedding light on the current debate that increases in house prices in China reflect a national phenomenon, rather than a collection of "local bubbles". In addition, the paper empirically addresses the role of monetary shock and bank lending activities in the Chinese real estate market.

Keywords: Chinese Real Estate, Monetary Policy, Bank Lending, Regional Heterogeneity

JEL Classification: C11, E58, R31

Introduction

The real estate property in China used to be treated as a welfare right and was allotted by per person space entitlements (Andrusz, 1984). In other words, houses, as a public property, could not be bought or sold on the market (Zhou & Logan, 1996). Moreover, rental rates are set very low such that "ownership" of rental property yielded no returns (Deng et al., 2009). Thus, there was little incentive for housing investment or maintenance improvement in China before 1994. As a result, China suffered both severe shortages in housing and a deterioration of its existing housing stock as the population increased dramatically. Recognising the limits of a centrally planned public housing system, the state launched a series of economic reforms in real estate markets since 1994. Property rights were re-introduced, people were free to buy and sell properties, and firms or individuals were allowed to profit from their housing investment or rentals. Consequently, huge profits in real estate investment and strong incentives for home purchase were observed in the Chinese housing market. However, scholars still question if China has completely, or at least in terms of the property market, moved from a centrally planned public housing system to a market-based system (Ye & Wu, 2008; Deng et al., 2009).

Others point out that this new Chinese real estate system remains heavily on regulated economy. Local government continues to play a strong role in the market because all land still belongs to the state and local governments are permitted to expropriate rural land for urban uses, according to the Chinese Constitution. By controlling both the land supply and the zoning regulations, local governments can decide what can be built and who can build. Scholars thus conclude that, despite the reforms, the property market remains firmly under the control of the local government. Deng et al. (2011) argue that China's stimulus package and monetary policy derive house booming from state control over its banking system and corporate sector. On the one hand, China's economic stimulus boosted real Growth Domestic Product (GDP) growth, on the other hand, land auction and house prices in major cities soared. "Beijing ordered state-owned banks to lend, and they lent. Beijing ordered centrally-controlled state-owned enterprises (SOEs) to invest, and they invested (Deng et al., 2011)."

This paper aims to shed light on the current debate, that is, increase in house prices in China reflects a national

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phenomenon or rather a collection of "local bubbles". The answer to this question has important policy implications. "Local bubbles" are most likely attributable to local factors, such as the circumstances that are specific to each geographic market, rather than monetary policy, which is the same for the entire nation. On the contrary, if the boom in house price is a national phenomenon, monetary policy may be a likely suspect. Therefore, this study tests the applicability of two models: monetary model, which implies that the monetary shock presently dominates the Chinese property markets, and a bank lending model for testing government control, which explicitly accounts for the role of local government's intervention in the regional real estate markets.

Using the Chinese real estate dataset during the period from 1994 to 2010, this study adopts a pooled Ordinary Least Square (OLS) model and a dynamic Generalised Method of the Moments (GMM) model, in the spirit of Geweke (1977), Sargent and Sims (1977), and Stock and Watson (1989), to investigate the determinants of state-level residential and commercial house prices. The empirical results show that historical movement in house prices has strong regional heterogeneity, meaning that the local (provincial or region-specific) component plays an important role rather than the nation-wide components. The price rise in the Chinese real estate market was mainly driven by local bank lending activities; this phenomenon is even popular in the less developed Western part of China, rather than the more developed Eastern region. In addition, the local income level is a strong candidate in explaining regional housing price movements.

The remainder of this paper is structured as follows. Section 2 presents the evolution of the Chinese real estate market. Section 3 reviews the literature and presents the hypotheses. Section 4 discusses the data and methodologies. Section 5 reports the empirical results. Section 6 discusses the implications and concludes the paper.

The Evolution of Chinese Real Estate Market

During 1949-1966, the Chinese government set up the Municipal Bureau of Housing Management (MBHM) and confiscated all properties that had belonged to former officials, "anti-communist reactionaries", and foreign capitalists (Zhou & Logan, 1996). The state quickly moved to nationalise land and to dismantle the system of private housing, which includes (1) all residential housing that was 100 m^2 or larger (housing owned by overseas Chinese and by the remaining petty bourgeoisie, such as merchants and small business owners, was usually within this target range); (2) all privately owned rental housing; and (3) all privately owned commercial buildings. However, during the Cultural Revolution (1966-1976), all remaining private property was completely taken over by the socialist state, and the sale of land and development of real properties for speculative purposes were prohibited (Wang, 1990). Housing property was treated as a social welfare, to which everybody was entitled, and was ideally intended to be distributed according to a formal definition of a minimum requirement and a maximum entitlement of space per person (Andrusz, 1984; Friedman, 1983). Rental rates were set such that "ownership" of rental property yielded no returns (Deng et al., 2009; Lee, 1988). Thus, there was little incentive for housing investment and improvement. Consequently, as the population increased, China began to suffer both severe shortages in housing and deterioration of its existing housing stock.

Recognising these limits, the State Council formed the Housing Reform Task Force in 1982. Four cities (later extended to 80 other cities and towns in 23 provinces) were designated for experimentation in housing reform (Wang & Murie, 2000; Zhou & Logan, 1996). Rental rates were adjusted, the existing housing stock began to be privatised, and the state began a process of confirming and registering ownership titles to properties. In 1988, the Chinese central government issued an important document, 'Implementation Plan for a Gradual Housing System Reform in Cities and Towns', with the purpose of raising funds to recover the costs of construction and maintenance, and of limiting the demand for housing (Zhou & Logan, 1996). As a result, public housing units throughout the country started to be sold to their sitting tenants at heavily discounted prices. Simultaneously, rents were increased to stimulate investments by residents. Since then, policymakers have begun to rely on market forces to adjust the scarcities and inequalities that characterised the socialist housing system.

The real estate market in China is still incomplete because all land was (and still is) owned by the state. Land requisition for development projects was handled through the central planning process. Moreover, the central, provincial, and municipal governments had the power

to appropriate urban land gratis, to acquire buildings with minimum payment to owners, and to acquire rural land with payment for fair compensation to owners for government-approved development projects. In 1988, the Chinese government legally recognised property rights and further issued 'The Temporary Measure for Pricing Commodified Housing' in 1992. However, the municipal government continued to control the market and set prices arbitrarily (Zhou & Logan, 1996).

In 1994, the Chinese central government issued 'The Decision on Deepening the Urban Housing Reform', which facilitates the development of a housing market from both the supply side and the demand side. On the supply side, the government decided to build a multi-layer housing provision system for different income groups; on the demand side, a dual housing finance system was established to combine both social saving and private saving (Wang & Murie, 2000; Deng et al., 2009). Families who paid market prices for their units got full property rights, including the right to resell their units on the market, while families who paid subsidised prices would have partial ownership, but face restrictions regarding resale (State Council, 1994). Immediately after the 1994 reform, the country saw rapid growth of housing development industries and an accelerating increase in construction investment. However, most of the housing units were purchased by work units, which then resold them at deeply discounted prices to their employees (Wang & Murie, 2000). Since many of the work units were state-owned and were not subject to hard budget constraints, their purchase behaviours significantly distorted the emerging housing market. In 1990, 59% of housing properties in urban China was owned and managed by work units and 86% of new investment capital for public housing construction was raised by work units (Bian & Logan, 1996; Zhou & Logan, 1996).

Recognising the above problems, the Chinese central government decided to cut the link between work units and housing provision. Specifically, the government issued 'A Notification from the State Council on Further Deepening the Reform of the Urban Housing System and Accelerating Housing Construction', which prohibited work units from building or buying new housing units for their employees. This, effectively, terminated the distribution of housing by the welfare principle, which had been implemented for more than 40 years (Ye & Wu, 2008). Under this condition, urban residents were encouraged to seek houses in the market according to their own saving and income conditions. Thus, residents could no longer rely on governments or any other kind of institutional support in acquiring personal property. The government's role in the residential property market transformed to provide favourable policy and fund subsidies only to economically suitable houses. This symbolised that the market began to function as an invisible hand in the residential property system. Therefore, China has established a real market mechanism in both housing production and consumption (Deng et al., 2009; Ye & Wu, 2008). As a result, from 1997 to 2005, the annual housing investment increased by about six times (Ye et al., 2006) and homeownership in China soared to about 80% (Wang, 2003).

Some scholars argue that the Chinese property market has completely transformed and moved from a centrally planned public housing system to a market-oriented one, in both production and consumption (Ye & Wu, 2008; Deng et al., 2009). However, others argue that the transformation of the property market has not been completed. This new market-based system still has its own historic footprint and Chinese characteristics, for example, the state governments play a strong role in the housing market; they are the representatives of the state and are in charge of expropriating rural land for urban uses and allocating it among different users. By controlling both the land supply and the zoning regulations, local governments can decide what can be built, when it can be built, and who can build. This leads to an obvious question of how to explicitly account for the role of government intervention in the property market system.

In May 1990, 'Regulations on Sell and Transfer the Right of Use of State-Owned Land in City and Town Areas' was publicised, which allows one to sell and transfer the right of use of state-owned land in city and town areas. Therefore, a tradeable property market began to form. However, in China, the Central Government still plays a pivotal role in the residential property sector. The regulations stipulate that local government authority could retain part of the revenue from the state-owned land transfer and sales, thus, foreshadowing the property boom in late 2000s. Since residential property sector is closely related to the households and its development has exerted a crucial impact on households' economic behaviour, commercial property sector tends to be more market-based, and thus, may behave differently from the residential property sector. To answer this question, this

study tests the applicability of two models: monetary model, which implies that the monetary shocks presently dominate the Chinese property markets, and a bank lending model for testing government control, which explicitly accounts for the role of local government's intervention in the real estate market.

Literature Reviews and Hypotheses

A large body of literature studies the effect of housing on asset pricing, portfolio choice, business cycles, and consumption, while literature on the relationship between housing prices and monetary policy is scant. Chirinko et al. (2008) study the interaction between house prices, real estate activities, and stock prices for a sample of 13 countries. Iacoviello and Minetti (2008) use a sample of four countries. without the United States. Both studies document that the housing market plays an important role in formulating monetary policy, either through asset pricing or credit creation at nation-wide level. However, Fratantoni and Schuh (2003) study the effects of monetary policy on regions in the U.S. from 1966-1998. They find that the response of housing investment to monetary policy varies by regions. This study differs from the previous literature by using a dynamic GMM model to examine the regional differences in the response of house prices to policy shocks and regional bank lending. Del Negro and Otrok (2005) use VAR to examine the U.S. housing market, then investigate the extent to which expansionary monetary policy is responsible for the common component in house price movements. They find that although "local bubbles" have been important in some states during 2001-2004, the overall increase in house prices is a national phenomenon, and they further conclude that the impact of policy shocks on house prices is very small, and movements in house prices historically have mainly been driven by the local (provincial or region-specific) component.

The property sector in the national economy has even been endorsed by the official documents of the State Council as a pillar industry. Since 2004, the property prices have gone up extraordinarily with an annual growth rate of 15.1% and 19.5% in 2004 and 2005 (Liang & Cao, 2007). Thus, some scholars point out that local bank lending has played an important role in the roaring property prices. Liang and Cao (2007) investigate the relationship between property prices and bank lending in China over the period 1999Q1–2006Q2. They find that there exists unidirectional causality running from bank lending to property prices, and that the causality runs interactively through the error correction term from bank lending, GDP, and interest rate to property prices. These studies have resulted in a growing interest among academics and policymakers to study the interactions between property prices and bank lending, and the possible responsiveness of property prices to market rate adjustments.

In the wake of the 2008 financial crisis, Deng et al. (2011) argue that the speed and efficacy of China's stimulus package were derived from state control over its banking system and corporate sector. On the one hand, China's economic stimulus boosted real GDP growth, on the other hand, land auction and house prices in major cities soared. Beijing ordered state-owned banks to lend, and they lent. Beijing ordered centrally-controlled state-owned enterprises (SOEs) to invest, and they invested. However, they show that much of this investment was highly leveraged purchases of real estate. Residential land auction prices in eight major cities rose about 100% in 2009, controlling for quality variation. Moreover, higher price rises stimulate more of those SOEs to be active buyers. Finally, they argue that these centrally-controlled SOEs overbid substantially, fuelling a real-estate bubble; China's seemingly effective macroeconomic stimulus package may have induced costly resource misallocation. Accordingly, this study hypothesises that:

H1: Monetary model – The Chinese real estate market prices are a nation-wide phenomenon and driven mainly by monetary shocks.

H2: Bank lending model – The Chinese real estate market prices are controlled by the regional government and driven mainly by local bank lending activities.

H3: The determinants of Chinese property prices vary across different regions.

H4: The determinants of Chinese residential property prices differ from those of the commercial property prices.

Data and Methodologies

The sample consists of all the annual provincial data over 1994-2010. The data are obtained from the National Bureau of Statistics of China (NBSC), which was widely used by academics in previous research. The regional dummy is created by national regional classification standard of China. Beijing, Tianjin, Hebei, Shanghai,

Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan, Jilin, and Heilongjiang are classified as the Eastern region; the middle region includes Henan, Hubei, Hunan, Jiangxi, Anhui, Shanxi, and Neimenggu; and the Western area comprises Sichuan, Chongqing, Yunnan, Shanxi, Guangxi, Guizhou, Gansu, Qinghai, Ningxia, and Xinjiang. Comparing to the housing market in the Eastern region, the housing market in the Western region is less developed. Accordingly, the housing market in the Eastern region of China is more market-oriented, compared to the housing markets in the middle and Western parts.

To explain the price behaviour of the Chinese real estate market, this study uses a number of factors, such as bank lending, interest rate, money supply, and income level, as explanatory variables, which all have been well documented in prior research (Quigley, 1987; Englehardt & Poterba, 1991; Campbell, 2006). It also uses both residential and commercial property prices as dependent variables in this study. The prices are calculated as annual sales (10,000 yuan) of the property divided by annual square metres of property sold (10,000 m^2). All the variables are adjusted for inflation by using the Consumer Price Index (CPI), with base year 1995 as 100, and take the form of logarithmic values. The specific definitions for each variable are reported as follows:

P1: Commercial property price (yuan/m^2).

P2: Residential property price (yuan/m^2).

M0: Money supply measured by M0 (balance, 100 million yuan).

M2: Money supply measured by M2 (balance, 100 million yuan).

Loan: Bank lending or loan by local financial institution (balance, 100 million yuan).

Rate: Seven days' interbank offered rate adjusted for inflation rate (%).

Income: Local residents' income level measured by GDP per capita (current price, yuan).

Table 1 presents the descriptive statistics for each variable. The mean log value of real commercial property price (P1) is 3.178 over the sample period of 1995-2010, ranging from a high of 5.341 to a low of −4.605. The mean log value of real residential property price (P2) is 3.095, with a similar range as P1. On average, the log value of real GDP per capita is 4.833, with a relatively larger standard deviation of 0.775, indicating income inequality exists across the regions. The proxies for bank lending, such as M0, M2, and loan, are all left skewed with a Kurtosis greater than two, implying potential violation of the assumption of normality. The maximum real market rate is 21.198, while the minimum value is −2.994, symbolising the potential monetary shocks in Chinese financial markets. In addition, the mean value of rate (5.401) and the median of rate (2.777) illustrate the rapid growth in the Chinese real estate market.

Table 1: Descriptive Statistics

The table reports the summary of descriptive statistics for the variables selected from the Chinese real estate market over 1995-2010. Except for rate, all the other variables take the form of logarithmic values. P1 is commercial property price (yuan/m^2), P2 is residential property price (yuan/m^2), M0 is money supply measured by M0 (balance, 100 million yuan), M2 is money supply measured by M2 (balance, 100 million yuan), and loan is bank lending or loan by local financial institution (balance, 100 million yuan). Rate is seven days' interbank offered rate adjusted for inflation rate (%), and income is local residents' income level measured by GDP per capita (current price, yuan). All the variables are adjusted for annual inflation by using the Consumer Price Index (CPI), with base year 1995 as 100. Total number of observations is 492.

	N	*Mean*	*Median*	*S.D.*	*Min*	*Max*	*Skewness*	*Kurtosis*
P1	492	3.178	3.124	0.740	−4.605	5.341	−4.351	51.119
P2	492	3.095	3.036	0.752	−4.605	5.305	−3.958	46.138
Income	492	4.833	4.811	0.775	2.923	6.888	0.300	2.525
M0	492	5.403	5.418	0.522	4.350	6.297	−0.165	2.127
M2	492	7.807	7.845	0.736	6.391	9.087	−0.037	2.053
Loan	492	7.489	7.571	0.651	6.207	8.672	−0.022	2.195
Rate	496	5.401	2.777	6.524	−2.994	21.198	1.048	2.856

Further examination from the correlation matrix in Table 2 illustrates that commercial property price (P1) and residential property price (P2) are highly correlated (0.997). Comparing the correlations between each proxy for bank lending, such as M0, M2, and loan, we can observe high correlations among them, implying potential multicollinearity problem. The market rate has a relatively lower relationship with real estate prices and other bank lending proxies, and the relationships are negative.

Table 2: Correlation Matrix

The table reports the correlation matrix between each variable selected from the Chinese real estate market over 1995-2010. Except for rate, all the other variables take the form of logarithmic values. P1 is commercial property price (yuan/m^2), P2 is residential property price (yuan/m^2), M0 is money supply measured by M0 (balance, 100 million yuan), M2 is money supply measured by M2 (balance, 100 million yuan), and loan is bank lending or loan by local financial institution (balance, 100 million yuan). Rate is seven days' interbank offered rate adjusted for inflation rate (%), and income is local residents' income level measured by GDP per capita (current price, yuan). All the variables are adjusted for annual inflation by using the Consumer Price Index (CPI), with base year 1995 as 100. Total number of observations is 492.

	P1	*P2*	*Income*	*M0*	*M2*	*Loan*	*Rate*
P1	1						
P2	0.997	1					
Income	0.723	0.736	1				
M0	0.569	0.576	0.720	1			
M2	0.570	0.578	0.725	0.998	1		
Loan	0.570	0.577	0.720	0.994	0.997	1	
Rate	−0.331	−0.329	−0.454	−0.716	−0.685	−0.679	1

To investigate the determinants of Chinese housing price movement, this study adopts a pooled OLS regression model and a dynamic GMM model, in the spirit of Geweke (1977), Sargent and Sims (1977), and Stock and Watson (1989), to investigate the state-level residential and commercial house prices over the sample period of 1995-2010. Then it uses the monetary model and bank lending model to disentangle the component of the increase in the value of housing that is common to all states, from the component that is idiosyncratic to each state. The bank lending proxies are used to capture the "local bubbles", while the monetary shock captures the common components across all states, which is referred to as a "national bubble". Specifically, the estimated equations are expressed as follows:

$P1_{i,t} = \alpha + \beta_1 * Lending_{i,t} + \beta_2 * Rate_{i,t} + \varepsilon_{i,t}$, Lending = (Loan, M0, or M2) (1)

$P2_{i,t} = \alpha + \beta_1 * Lending_{i,t} + \beta_2 * Rate_{i,t} + \varepsilon_{i,t}$, Lending = (Loan, M0, or M2) (2)

To control for unobserved individual-specific factors, I further employ the dynamic GMM method (Arellano & Bond, 1991) by taking the first differentiation to eliminate state-specific effects and time-invariant explanatory variables. Moreover, the dynamic GMM procedure is capable of addressing endogeneity problems. Specifically, the dynamic GMM estimation process can be expressed as:

$$Y_{i,t} = \alpha_i + \gamma Y_{it-1} + \sum_{j=1}^{K} \chi_{it}^{j} \beta_i + \varepsilon_{it}, \qquad i = 1,2,\cdots,N; t = 1,2,\ldots,T.$$

Where, $Y_{i,t}$ is the dependent variables $P1_{i,t}$ or $P2_{i,t}$, $Y_{i,t-1}$ is the first lagged dependent variables, $X_{i,t}$ are the independent variables measured by banking lending (loan, M0, or M2) and market rate (rate), and $\varepsilon_{i,t}$ is the error term.

Empirical Results

The Determinants of Chinese Real Estate Prices

Table 3 reports the cross-sectional regression on the determinants of Chinese real estate prices over the

sample period of 1995-2010. In the first three columns, it uses commercial property price (P1) as the dependent variable, while in the last three equations, it uses residential property price (P2) as the dependent variable. The results show that the real seven days' interbank offered rate (rate) is not significant in explaining the variations of commercial property price (P1). Although the role of market rate in explaining residential property price (P2) becomes stronger, it still maintains a marginally significant statistically contribute to the real estate price movements.

level. On the contrary, all the proxies for bank lending, such as M0, M2, and loan are positively associated with the Chinese real estate market prices, controlling for the regional income level. The results appear to support the bank lending hypothesis that the Chinese real estate market prices are controlled by the regional government and are mainly driven by the local bank lending activities. If the Chinese real estate market price soaring is a nation-wide phenomenon, the monetary shock (measured rate) should

Table 3: Cross-Sectional Regression on the Determinants of Chinese Real Estate Prices

The table reports the cross-sectional regression on the determinants of Chinese real estate prices over the sample period of 1995-2010. Except for rate, all the other variables take the form of logarithmic values. P1 is commercial property price (yuan/m^2), P2 is residential property price (yuan/m^2), M0 is money supply measured by M0 (balance, 100 million yuan), M2 is money supply measured by M2 (balance, 100 million yuan), and loan is bank lending or loan by local financial institution (balance, 100 million yuan). Rate is seven days' interbank offered rate adjusted for inflation rate (%), and income is local residents' income level measured by GDP per capita (current price, yuan). All the variables are adjusted for annual inflation by using the Consumer Price Index (CPI), with base year 1995 as 100. Total number of observations is 492. *t*-values are reported in parentheses. ***, **, and * denote significance level at 1%, 5%, and 10%, respectively.

	Dependent Variables					
	Commercial Property Price: P1			*Residential Property Price: P2*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Income	0.617***	0.612***	0.620***	0.641***	0.636***	0.643***
	(14.39)	(14.21)	(14.31)	(15.03)	(14.86)	(14.94)
M0		0.233***			0.244***	
		(2.86)			(3.01)	
M2			0.141**			0.150***
			(2.54)			(2.71)
Loan	0.167***	0.233***	0.141**	0.176***		
	(2.70)	(2.86)	(2.54)	(2.86)		
Rate	0.007	0.009*	0.007	0.009*	0.010**	0.008*
	(1.47)	(1.74)	(1.40)	(1.80)	(2.06)	(1.74)
Constant	−1.094***	−1.085***	−0.957***	−1.366***	−1.353***	−1.231***
	(−2.81)	(−2.94)	(−2.65)	(−3.53)	(−3.69)	(−3.43)
N	492	492	492	492	492	492
R^2	0.53	0.53	0.53	0.55	0.55	0.55
Adj. R^2	0.527	0.528	0.526	0.546	0.547	0.546

Regional Heterogeneity, Monetary Shocks, and Bank Lending Effects on the Chinese Real Estate Prices

Table 4 reports the cross-sectional OLS regression on the determinants of Chinese commercial property prices by region over the sample period of 1995-2010. Using the national standard of regional classification defined

by the Chinese government, this study divided the 31 provinces into three groups: the Eastern region, Middle region, and Western region. Compared to the more developed Eastern area, the Western region in China is less developed. The results show that the monetary shock represented by market rate is significant in the Eastern and Middle region, but insignificant in the Western region. On the other hand, the proxies for measuring bank

lending (such as M0, M2, and loan) are all significant in the Western and Middle region, but insignificant in the Eastern region. The results clearly reveal that the real estate price in China has strong regional heterogeneity. The well-developed region appears to be more marketised, and thus, are more likely to be influenced by the market rate, while in the less-developed regions, the local government still has strong incentives of intervention and control over the commercial property prices.

Table 4: Cross-Sectional Regression on the Determinants of Chinese Commercial Property Prices by Region

The table reports the cross-sectional regression on the determinants of Chinese commercial property prices by region over the sample period of 1995-2010. Except for rate, all the other variables take the form of logarithmic values. P1 is commercial property price (yuan/m^2), P2 is residential property price (yuan/m^2), M0 is money supply measured by M0 (balance, 100 million yuan), M2 is money supply measured by M2 (balance, 100 million yuan), and loan is bank lending or loan by local financial institution (balance, 100 million yuan). Rate is seven days' interbank offered rate adjusted for inflation rate (%), and income is local residents' income level measured by GDP per capita (current price, yuan). All the variables are adjusted for annual inflation by using the Consumer Price Index (CPI), with base year 1995 as 100. Total number of observations is 492. *t*-values are reported in parentheses. ***, **, and * denote significance level at 1%, 5%, and 10%, respectively.

Dependent Variable: Commercial Property Price: P1									
	Eastern Region			*Middle Region*			*Western Region*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Income	0.740***	0.741***	0.740***	0.255***	0.209**	0.204**	−0.239	−0.356	−0.268
	(18.05)	(17.97)	(17.84)	(3.25)	(2.55)	(2.42)	(−1.06)	(−1.56)	(−1.13)
M0		0.090			0.657***			1.511***	
		(1.29)			(5.60)			(4.72)	
M2			0.061			0.449***			0.933***
			(1.29)			(5.48)			(4.12)
Loan	0.069			0.452***			1.022***		
	(1.33)			(5.25)			(4.23)		
Rate	0.012***	0.013***	0.012***	0.008**	0.012***	0.009***	0.012	0.023*	0.014
	(3.05)	(2.99)	(3.02)	(2.41)	(3.34)	(2.69)	(1.01)	(1.81)	(1.11)
Constant	−0.990***	−0.960***	−0.945***	−1.694***	−1.676***	−1.587***	−3.721***	−3.774***	−3.235***
	(−3.18)	(−3.23)	(−3.27)	(−4.81)	(−5.07)	(−4.93)	(−3.37)	(−3.69)	(−3.16)
N	208	208	208	112	112	112	172	172	172
R^2	0.795	0.795	0.795	0.869	0.873	0.872	0.293	0.309	0.289
Adj. R^2	0.792	0.792	0.791	0.866	0.869	0.868	0.280	0.297	0.277

Table 5 reports the cross-sectional OLS regression on the determinants of Chinese residential property prices by region over the sample period of 1995-2010. The results show that there is more evidence of government control over the residential property prices; although the monetary shock represented by market rate is significant in the Eastern and Middle regions, there is still some weak evidence of bank lending effects in the Eastern region, and very strong bank lending effects in the Middle area. On the contrary, in the Western region, the market rate is not significant and the proxies for bank lending (such as M0, M2, and loan) are all highly significant (represented by significant coefficients of 1.482, 0.920, and 1.007), indicating that the residential property prices in the Western region are dominated by the local government, and this results in strong regional heterogeneity in residential house prices. The results affirm that the residential property markets are even more controlled by the local government and supported by bank lending activities.

Table 5: Cross-Sectional Regression on the Determinants of Chinese Residential Property Prices by Region

The table reports the cross-sectional regression on the determinants of Chinese residential property prices by region over the sample period of 1995-2010. Except for rate, all the other variables take the form of logarithmic values. P1 is commercial property price (yuan/m^2), P2 is residential property price (yuan/m^2), M0 is money supply measured by M0 (balance, 100 million yuan), M2 is money supply measured by M2 (balance, 100 million yuan), and loan is bank lending or loan by local financial institution (balance, 100 million yuan). Rate is seven days' interbank offered rate adjusted for inflation rate (%), and income is local residents' income level measured by GDP per capita (current price, yuan). All the variables are adjusted for annual inflation by using the Consumer Price Index (CPI), with base year 1995 as 100. Total number of observations is 492. *t*-values are reported in parentheses. ***, **, and * denote significance level at 1%, 5%, and 10%, respectively.

Dependent Variable: Residential Property Price: P2									
	Eastern Region			*Middle Region*			*Western Region*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Income	0.741***	0.741***	0.739***	0.244***	0.185**	0.180**	−0.190	−0.300	−0.219
	(17.74)	(17.64)	(17.50)	(3.02)	(2.21)	(2.09)	(−0.85)	(−1.32)	(−0.93)
M0		0.134*			0.725***			1.482***	
		(1.90)			(6.05)			(4.67)	
M2			0.092*			0.495***			0.920***
			(1.91)			(5.92)			(4.10)
Loan	0.102*			0.488***			1.007***		
	(1.91)			(5.52)			(4.21)		
Rate	0.013***	0.014***	0.013***	0.011***	0.016***	0.012***	0.014	0.025*	0.015
	(3.25)	(3.25)	(3.25)	(3.11)	(4.14)	(3.47)	(1.15)	(1.91)	(1.25)
Constant	−1.308***	−1.273***	−1.254***	−2.029***	−2.045***	−1.944***	−3.932***	−3.964***	−3.455***
	(−4.13)	(−4.21)	(−4.26)	(−5.60)	(−6.06)	(−5.91)	(−3.60)	(−3.91)	(−3.41)
N	208	208	208	112	112	112	172	172	172
R^2	0.797	0.797	0.797	0.867	0.872	0.871	0.307	0.322	0.303
Adj. R^2	0.794	0.794	0.794	0.863	0.869	0.867	0.294	0.310	0.291

On the Dynamics of Chinese Real Estate Price Movements

Table 6 reports the dynamic GMM estimations on the determinants of Chinese real estate prices over the sample period of 1995-2010. It uses the GMM method developed by Arellano and Bond (1991) to capture the dynamic process of Chinese real estate price movements. The method takes the first differences of the equation model to remove the state effects and produces an equation that is estimable using instrumental variables in which endogenous explanatory variables are instrumented with suitable lags of their own. The dynamic results show that the Chinese commercial property prices (which are more marketised) are more likely affected by monetary shocks, as indicated by the significant coefficients on rate of 0.007, 0.008, and 0.007. On the contrary, commercial property prices are less marketised and affected by both monetary shocks and bank lending activities. As we can see in the table, the coefficients of M0 (0.120), M2 (0.651), and loan (0.108) are all significant at the 5% level. To sum up, the residential property prices follow a dynamic process and are affected by nation-wide monetary shocks, but they are more strictly controlled by the local government.

Table 6: Dynamic GMM Estimations on the Determinants of Chinese Real Estate Prices

The table reports the dynamic GMM estimations on the determinants of Chinese real estate prices over the sample period of 1995-2010. Except for rate, all the other variables take the form of logarithmic values. P1 is commercial property price (yuan/m^2), P2 is residential property price (yuan/m^2), M0 is money supply measured by M0 (balance, 100 million yuan), M2 is money supply measured by M2 (balance, 100 million yuan), and loan is bank lending or loan by local financial institution (balance, 100 million yuan). Rate is seven days' interbank offered rate adjusted for inflation rate (%), and income is local residents' income level measured by GDP per capita (current price, yuan). All the variables are adjusted for annual inflation by using the Consumer Price Index (CPI), with base year 1995 as 100. The Sargan test reports the Chi-square under the null that the overidentified restrictions are valid. AB (1) and AB (2) correspond to the Arellano-Bond *z*-test for AR(1) and AR(2) serial correlation, under the null of no autocorrelation. Total number of observations is 492. *t*-values are reported in parentheses, while *p*-values are reported in square brackets. ***, **, and * denote significance level at 1%, 5%, and 10%, respectively.

Dependent Variables						
	Commercial Property Price: P1			*Residential Property Price: P2*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Lag(P1/P2)	0.510***	0.502***	0.506***	0.511***	0.503***	0.510***
	(11.55)	(11.51)	(11.57)	(11.89)	(11.84)	(11.92)
Income	0.293***	0.298***	0.295***	0.291***	0.290***	0.288***
	(4.59)	(4.58)	(4.39)	(4.61)	(4.50)	(4.34)
M0	0.098			0.120**		
	(1.64)			(2.05)		
M2		0.127			0.165**	
		(1.55)			(2.07)	
Loan			0.086			0.108**
			(1.56)			(2.01)
Rate	0.007**	0.008**	0.007**	0.008***	0.009***	0.008***
	(2.54)	(2.54)	(2.50)	(2.77)	(2.89)	(2.77)
Constant	−0.573**	−0.526**	−0.507**	−0.772***	−0.742***	−0.705***
	(−2.30)	(−2.23)	(−2.24)	(−3.15)	(−3.20)	(−3.18)
N	461	461	461	461	461	461
AB(1)	−6.66***	−6.23***	−6.32***	−6.25***	−6.19***	−6.28***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AB(2)	0.01	0.02	0.03	−0.31	−0.31	−0.30
	[0.993]	[0.980]	[0.974]	[0.758]	[0.758]	[0.765]
Sargan Test	137.27***	125.93***	125.42***	137.71***	137.71***	137.83***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

GMM estimations are said to be consistent if there is no second-order autocorrelation in the residuals and the instruments employed are valid. The most common test employed to verify the validity of instruments in this GMM setup is the Sargan (1958) test of over-identifying restrictions. Table 6 shows that all the Sargan tests are above 125.42, with highly significant *p*-values. In addition, the Arellano-Bond tests for AB(1) in the first differences all report significant z-values. Since the first-order serial correlation is fairly common in the residuals, applied work has emphasised both AB (2) and the Sargan statistic as the standard statistical tests of the GMM estimator. Baltagi et al. (2009) discuss the moment conditions that utilise the orthogonality conditions between the differenced errors and lagged values of the dependent variable. On the two diagnostic tests, to check for first-order and second-order serial correlation in the disturbances, they state that "one should reject the null of the absence of first order serial

correlation and not reject the absence of second order serial correlation".

Conclusion

Using data for the Chinese real estate market during the period from 1994 to 2010, this study adopts a pooled OLS model and a dynamic GMM model, in the spirit of Geweke (1977), Sargent and Sims (1977), and Stock and Watson (1989), to investigate the state-level residential and commercial house prices for the Chinese real estate market. Then it uses the monetary model and bank lending model to disentangle the component of the increase in the value of housing that is common to all states, from the component that is idiosyncratic to each state. It uses the proxies (loan, M0, and M2) of bank lending activities to capture the "local bubbles", and use the monetary proxy (rate) to capture the common components across all states, which is referred to as a "national bubble". The results show that the Chinese real estate market prices are mainly controlled by the regional government and heavily associated with local bank lending activities, while the monetary shock throughout the nation has less effect on the Chinese real estate market price movements.

In addition, the results reveal that there are strong regional heterogeneities in the Chinese commercial and residential house markets. The well-developed Eastern region appears to be more marketised, and thus, the house prices in this region are more affected by the market rate or monetary shocks, while in the less-developed Western region, the local government still has strong incentives of intervention and control over the property prices, and thus, there is little evidence in support of a solid monetary effect. In addition, the local income level measured by real per capita income is a strong candidate in explaining the regional housing price movements.

Finally, it can be concluded that the Chinese housing market follows a dynamic adjusting process. The commercial property prices are more likely affected by nation-wide monetary shocks, while the residential property prices are not only affected by the nation-wide monetary shocks, but also affected by the local bank lending activities. Particularly, the commercial property prices in the Eastern region are positively associated with monetary shocks, while the residential property prices in the Western region are still severely dominated by the local government and bank lending activities.

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