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On China's Monetary Policy and Asset Prices

By
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Abstract: This paper investigates the dynamic and long-run relationships between monetary policy and asset prices in China using monthly data from June 2005 to September 2010. Johansen's cointegration approach based on vector autoregression (VAR) and Granger causality test are used to identify the long-run relationships and directions of causality between asset prices and monetary variables. Empirical results show that monetary policies have little immediate effect on asset prices, suggesting that Chinese investors may be 'irrational' and 'speculative'. Instead of running away from the market, investors rush to buy houses or shares whenever tightening monetary actions are taken. Such seemingly irrational and speculative behavior can be explained by various social and economic factors, including lack of investment channels, market imperfections, cultural traditions, urbanization and demographic changes. The results have two important policy implications. First, China's central bank has not used and should not use interest rate alone to maintain macro-economic stability. Second, both monetary and non-monetary policies should be deployed when asset bubbles loom large to avoid devastating consequences when they burst.

JEL: G12, G18

Keywords: Monetary policy, Asset prices, Interest rates, Bank reserve ratio, China

Non-technical Summary

Following a 50% hike in 2009, house prices in Beijing, Shanghai, Guangzhou and Shenzhen (four first-tier cities) rose from 24% to 42% in 2010. On average, new house prices of Shanghai, Beijing and Shenzhen climbed to 22,000-24,000 RMB/M^2, and that of Guangzhou nearly 14,000 RMB/M^2. Consumer price index (CPI) reached a 28-month high of 5.1% in November 2010.

This paper establishes the long-run relationships between asset prices and monetary policy. It tests whether Chinese investors are irrational and speculative when they face rising asset prices. Monthly data from June 2005 to September 2010 are used to construct various econometric models and test a few hypotheses that help answer our research questions. The theoretical underpinning hinges on the dynamic and long-run relationships between monetary policy and asset prices.

A multi-instruments approach is used to examine how different policy tools may have affected house and share prices in China. It uses Granger Causality Test, Johansen's VAR Approach and impulse analysis to have a comprehensive study on the dynamic as well as long run relationships between various monetary policy instruments on house and share prices based on monthly data from June 2005 to September 2010.

A few interesting and important results are found from various econometric exercises. First, house and share prices continued to rise rapidly despite various tough monetary tightening actions taken by PBOC. Such a result contradicts common-sense expectations and results found in other countries. This strange phenomenon can be explained by the so-called 'irrational' or 'speculative' behaviour of Chinese investors.

Such 'irrational' and 'speculative' investment behaviour, however, can be explained by various economic, social and cultural factors which are unique to China. Rapid urbanization, attitude towards home ownership, lack of investment channel and imperfect market competition are some of the key factors responsible for large stock market and housing bubbles.

As for the causal relationships between monetary instruments and asset prices, there are also some interesting results. The government paid more attention to house price movements than to share price changes. When house prices were rising rapidly, both the government and PBOC reacted quickly and aggressively to cool down the market. In contrast, it took more than one year for the government to tighten its monetary stance to cool down the stock market when it was ballooning.

From the results found in this paper and additional anecdotal evidence, it can be seen that Chinese investors have a strong but irrational economic psychology in the sense that people tend to take excessive risks when asset prices are rising. This kind of investment behavior can be observed in any part of the world, but in China, due to various other special factors, such irrational and speculative behavior is particularly strong. This will have important policy implications. Apart from acting early and more aggressively, the Chinese government should try to create more investment channels, to promote a fairer and better free market system, to shift its economic structure which will depend less on investment and more on effective domestic consumption.

1. Introduction

From the 1990s to 2007, monetary policies in most developed economies were dominated by interest rate adjustments which were primarily used to control inflation. China's key monetary policy instruments include not only interest rate but also money supply and bank reserve ratio.

As a concerted effort to fight the current world financial crisis with other G20 economies, China announced a four trillion RMB stimulus package to boost its economy in October 2008. The government also encouraged banks to issue 9.5 trillion RMB new loans in 2009 and 7.95 trillion RMB new loans in 2010. Such a massive capital injection was critical to achieve its ambitious GDP growth target, but at the same time, excess liquidity triggered a huge surge in house prices and general inflation.

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Following a 50% hike in 2009, house prices in Beijing, Shanghai, Guangzhou and Shenzhen (four first-tier cities) rose from 24% to 42% in 2010. On average, new house prices of Shanghai, Beijing and Shenzhen climbed to 22,000-24,000 RMB/M^2, and that of Guangzhou nearly 14,000 RMB/M^2. Consumer price index (CPI) reached a 28-month high of 5.1% in November 2010 (EIU ViewsWire, 2010). All these developments forced the government to act decisively and to shift its monetary policy from being 'appropriately loose' to being 'prudent' (Dyer and Waldmeir, 2010). Bank reserves ratio was raised eight times to reach 19.5% by February 2011. In the meantime, one-year bank deposit rate and lending rate were raised four times to reach 3.0% and 6.06%, respectively (Yao, 2011).

Rising house prices during 2008-10 (or share prices during 2006-07) in China was caused not only by excess liquidity but also by irrational or speculative behaviour of consumers and investors as pointed out by Yao and Luo (2009). Due to asymmetric reactions to gains and losses, investors tend to take excessive risk when prices are rising, but become overcautious when prices are declining.

This paper aims to establish the long-run relationships between asset prices and monetary policy. It also aims to test whether Chinese investors are irrational and speculative when they face rising asset prices. Monthly data from June 2005 to September 2010 are used to construct various econometric models and test a few hypotheses that help answer our research questions. The theoretical underpinning hinges on the dynamic and long-run relationships between monetary policy and asset prices.

Koivu (2008), Laurens and Maino (2007) and Mehrotra (2007) argue that the role of interest rate in China is modest. But, does this mean that interest rate has no effect on asset prices? China's central bank, People's Bank of China (PBOC), closely monitors money supply (M2) and argues that rapid increase in M2 in recent years is not responsible for rising house prices and CPI. Whether these arguments hold true will be answered with our empirical results.

The rest of this paper is organized as follows. Section 2 studies the development of China's monetary policy. Section 3 reviews existing literatures on the relationship between monetary policy and asset prices. Section 4 discusses the data. Section 5 presents research methodologies and

empirical results. Section 6 concludes with some policy recommendations.

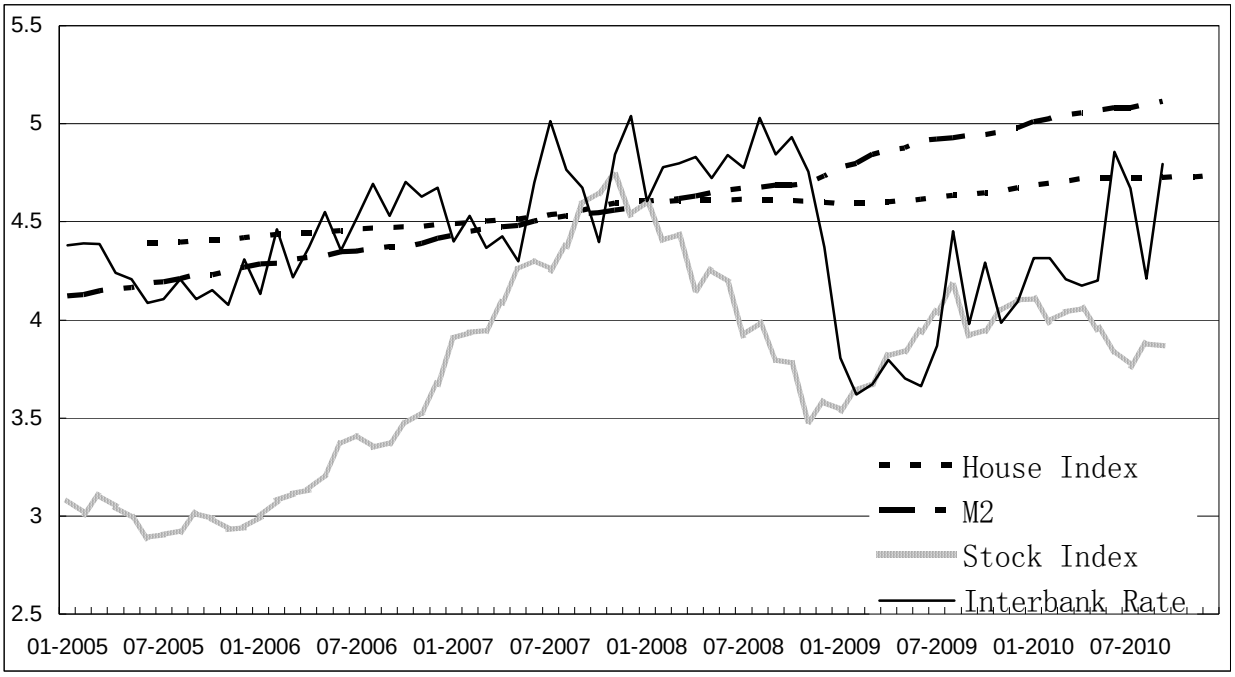
2. Development of China's monetary policy

The *Law of the People's Republic of China on the People's Bank of China*, Article 5, states that the objectives of monetary policy are to maintain price stability and to promote economic growth (PBOC, 2003). It has been argued that these two objectives can be contradictory in nature (Xie and Yuan, 2003; Dai, 2002).

Although PBOC's primary objective is to control inflation, government's overwhelming objective is to stimulate growth (Geiger, 2008; Zhang, 2010; Shu and Ng, 2010). When there is no excess liquidity, fast economic growth may not necessarily lead to high inflation, as it was in China during the decade before the world financial crisis (Zhang, 2010). However, when there is a structural shock triggering excess liquidity to maintain high growth, inflation pressure mounts, as it has been in China since the crisis.

Figure 1 depicts the movements of two asset price indexes (housing and stock) and two monetary instruments (M2) and inter-bank rate. All the values are measured in indexes (Jan 2008 = 100) and in natural logarithms. It is obvious that interbank rate does not have a close co-movement with other variables, but M2 seems to be a main driving force throughout the data period.

Figure 1 Movements of M2, stock market index, house price index and inter-bank rate (January 2008 = 100, all values are in natural logarithms)



Sources: Housing index: National Bureau of Statistics (BNS). Composite Stock Index: SSE (Shanghai Stock Exchange) and SZSE (Shenzhen Stock Exchange) Monthly Statistic Books. M2 and Interbank rates: DataStream.

China's monetary policy development can be divided into four stages. The first stage was during 1949-84 when PBOC was the country's central bank and only commercial bank (Luo and Yao, 2010). In reality, however, PBOC acted as an accounting agent for the government (Xie and Luo, 2002). The Ministry of Finance (MOF) collected taxes and other incomes which construed as state revenue. The State Planning Commission (SPC) decided how and where state revenue should be spent. PBOC acted as a go-between, taking deposits from MOF and handing out money to other agents based on the instruction of SPC.

The second period of development started from 1984 when a series of bank reforms were implemented to transform the monopolistic banking system to a decentralized, competitive and profit-oriented system (Yao et al., 2007). PBOC was officially renamed as the Central Bank and was

expected to assist China's transformation to a market-oriented economy. However, it was not until 1993 that an explicit monetary target was announced. The primary intermediate target specified at the time was on currency in circulation and credit control (Laurens and Maino, 2007).

Hence, 1993 signified the beginning of the third stage development. The Chinese Communist Party Central Committee (CCPCC) approved "*Decisions on Certain Issues in Establishing the Socialist Market Economic System*" and proclaimed for the first time that the ultimate target of monetary policy was to maintain currency stability via adjustment in money supply (Geiger, 2008). This stage of development lasted for five years until 1998 when the credit quota system was abolished. Major reforms during the period included the establishment of money supply announcement system in 1994, the removal of upper limits on interbank lending rates and the specification of monetary intermediary target in 1996[①]. Since then, controlling for broad money supply, M2, has formally become the intermediate target set by PBOC and it has been found to outperform the original bank credit system in predicting future price movements (Yu, 1997; Laurens and Maino, 2007; Porter and Xu, 2009).

The fourth stage of development was signified by the State Council's policy 'to maintain currency stability and promote economic growth' in 1998 (Laurens and Maino, 2007). Table 1 presents data on inflation rates and money supplies during 1998-2010. Except for the initial period and 2008-09 during the financial crisis, there was a stable and consistent relationship between money supply (M1 and M2) and inflation. A series of monetary policy instruments, such as reserve requirements and

① Three layers of money supply indictors, M0, M1 and M2 were defined according to the money supply announcement system

open market operations (OMOs)[②] were also introduced, marking PBOC's determination to shift its monetary policy from direct to indirect control (Geiger, 2008).

Table 1 Targeted and actual growth rates of money supply 1995-2010Q2

	M1 (%)			M2 (%)			Inflation
	Target	Actual	Deviation	Target	Actual	Deviation	
1998	17	11.9	-5.1	17	15.3	-1.7	-1.4
1999	14	17.7	3.7	16	14.7	-1.3	0.4
2000	16	16.0	0.0	16	12.3	-3.7	0.7
2001	15	12.7	-2.3	16	14.4	-1.1	-0.8
2002	13	16.8	3.8	13	16.8	3.8	1.2
2003	16	18.7	2.7	16	19.6	3.6	3.9
2004	17	13.6	-3.4	17	14.6	-2.4	1.8
2005	15	11.8	-3.2	15	17.6	2.6	1.5
2006	14	17.5	3.5	14	16.9	2.9	4.8
2007	16	21.0	5.0	16	16.7	0.7	5.9
2008	16	9.1	-6.9	16	17.8	1.8	0.7
2009	17	32.4	15.4	17	27.7	10.7	2.6
2010Q2	17	24.6	7.6	17	18.5	1.5	3.3

Notes: Deviation is calculated as the actual growth rate minus the target growth rate. Inflation is consumer price index (CPI).

Sources: Geiger, 2008; Bank of China, China Monetary Policy Report, various issues, http://www.pbc.gov.cn/publish/zhengcehuobisi/591/index.html.

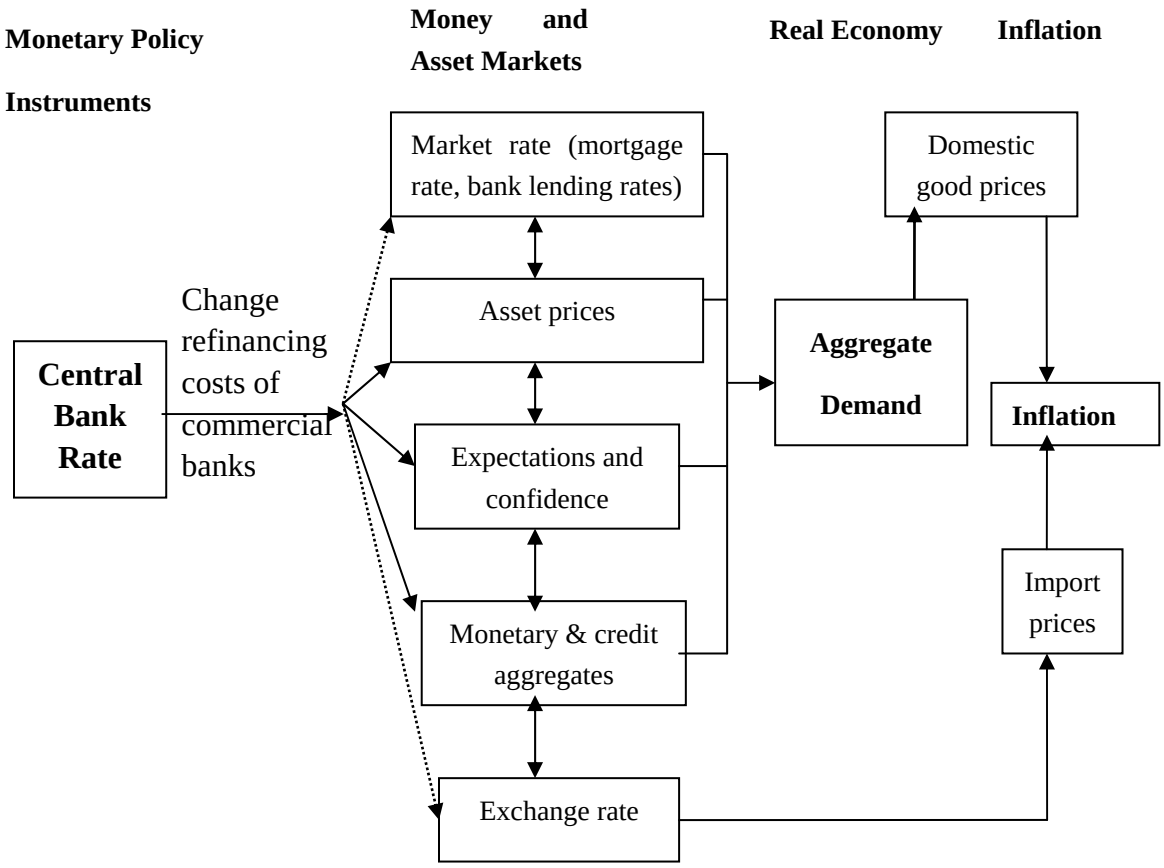
Monetary policy can be defined as a strategy of monetary authority to control money supply and inflation. The basic element of monetary policy is the official interest rate which can be transmitted through a sequence of mechanisms to affect macro-economic stability as well as economic growth. As shown in Figure 2, for example, when inflation exceeds a certain target level, the central bank is likely to deploy a contracting strategy by raising the base rate.

In a perfectly liberalized market, any adjustment to the base rate will be displayed as refinancing

[②] OMOs include national bonds, Central bank bills and financial bonds from other financial institutions. They are market-based instruments and are conducted on a regular, high frequency basis (two days per week—Tuesday and Thursday). The PBOC influences liquidity in the banking system through the issuance and redemption of central bank bills (Dai, 2003; Geiger, 2008; Shu and Ng, 2010). OMOs were first introduced in 1993. Due to the absence of interbank market and non-liberalized interest rates, OMOs was suspended in 1997. It was re-introduced later in 1998 as a key instrument for monetary policy in China (Geiger, 2008).

costs, leading to a rise in other market rates, such as mortgage and bank deposit rates. A change in government policy also signifies the future course of the economy. This would affect market confidence and expectations and consequently influence asset prices and exchanges rate. Consumers and investors tend to adjust consumption and investment accordingly, causing changes to aggregate demand and supply. Consequently, contraction in spending and lesser demand for credits from businesses will lead to an overall slowdown of the real sector, relieving inflationary pressure. On the contrary, when a restrictive monetary stance exists, the reverse holds true. By interacting with intermediate targets, monetary policy determines nominal or real values of goods and services and ultimately affects aggregate demand in the economy.

Figure 2 Transmission mechanism of monetary policy—conventional form



Source: Bank of England, www.bankofengland.co.uk.

In China, the impact of interest rate on the economy is less effective due to a number of reasons. Firstly, the interest rate system has not been fully liberalized (Laurens and Maino, 2007). Despite growing reliance on OMOs, bank deposit and lending rates are largely dictated by the central bank (Porter and Xu, 2009). In October 2004, PBOC removed the ceiling on lending rates but retained the ceiling on deposits and the floor on lending rates. Secondly, the banking industry is dominated by four large state-owned banks, which enjoy significant oligopolistic market power (Geiger, 2008). Furthermore, because large state-owned enterprises also enjoy huge monopoly power and absorb over 60% of bank loans, they earn huge amount of abnormal profits and hence become insensitive to interest rate changes (Dickinson and Liu, 2007). The dotted lines in Figure 2 indicate where base rate adjustments may not be effectively transmitted to certain market segments due to lack of competition and the pervasiveness of liquidity constraints (Wan and Zhang, 2002). Thirdly, despite the establishment of corporate bond and stock markets in early 1990s, bank lending remains the main source of funding for Chinese enterprises, particularly the state-owned enterprises (Liu and Xie, 2006). Lastly, the specific consumption habit of Chinese consumers has also reduced the effectiveness of interest rate as a monetary policy instrument (Yue and Zhou, 2007). As Chinese people tend to have a high saving rate, their consumption is not sensitive to interest rate changes, either.

The factors mentioned above imply that China cannot just rely on interest rate for its monetary policy. As a result, PBOC has adopted a series of other policy methods for monetary control (Feyzioglu et al., 2009). A series of non-central bank policy instruments are also in place to achieve

monetary policy targets (Geiger, 2008).

3. Literature review

The US credit crunch and a series of monetary policies adopted by central banks of many major industrialized economies to fight the financial crisis have generated huge interest in research on monetary policies and their effectiveness on macro-economic management. In the US and other major western economies, monetary policy targeting on inflation is conducted through interest rate adjustments. However, due to the increasing importance of the real-estate sector to the overall economy, whether monetary policy should include asset price variations in their policy decision has triggered a hectic debate (Taylor, 2007; Bordo and Jeanne, 2002; Lansing, 2003).

Although changes in house prices can influence the wider economy through it wealth effect, the Tobin q effect and asset leverage effect, it is argued that interest rates should only be adjusted to control macroeconomic trends rather than house price variations (Taylor, 2007; Feng, 2010; Bernanke and Gertler, 2000). This is to prevent moral hazard and to ensure that investors are responsible for their own investments. In addition, it is also argued that central banks should not take deliberate steps to prevent or deflate asset bubbles due to the fear of sending the economy into recession (Lansing, 2003). Instead, policymakers should adopt appropriate strategies to address the consequences of asset bubbles (Greenspan, 2004).

Studies related to monetary policy in China have a relatively short history and they generally fall into three groups. The first group reviews the evolution of monetary policy (Pan and Xie, 2006;

Laurens and Maino, 2007; Koivu; 2008; Geiger, 2008; Zhang, 2010). Unlike the West, China does not rely on a single monetary policy instrument to achieve its monetary target. Instead, a variety of instruments are adopted. Liu and Zhang (2007), Geiger (2008) and Porter and Xu (2009) argue that the adoption of a mixture of monetary policy instruments in China was arguably more effective in keeping inflation under control. However, it also leads to various distortions. The application of such policy prevents the interest rate channel of monetary transmission from functioning properly and the influence of interest rate on the real economy remains weak (Koivu; 2008). Further liberalization is warranted to make market rates more responsive to fundamental changes in liquidity and risk characteristics in China (Yue and Zhou, 2007; Porter and Xu, 2009; Zhang, 2009).

The second group applies Taylor's rule, McCallum's rule and other internationally accepted measurements to test the suitability of monetary stance in China. The standard Taylor's rule is inadequate to capture China's actual interest rate, particularly in the period before 1996 (Liu and Zhang, 2007). The deviation between Taylor's rule rate and actual interest rate is mainly caused by delayed policy reaction to economic development (Xie and Luo, 2002). As China has officially announced that its monetary policy targets on M2, or broad money supply, McCallum's rule is found to be a better fit (Burdekin and Siklos, 2008; Mehrotra and Fung, 2010). Koivu et al. (2008) confirms the consistency of the rule, in particular in providing inflation related information, whereas Laurens and Maino (2007) argue that PBOC is only able to meet the base money target M1 but not the broad money target. This casts doubt on the controllability of monetary target set by PBOC. Zhang (2009) suggests that the linkage between money supply and inflation has actually become weaker over time. These findings seem to confirm government's intention to shift the

monetary policy regime to a price based one as the economy becomes more market-oriented. Moreover, several studies find evidences that monetary policy reacts counter-cyclically to the output gap and pro-cyclically to the inflation gap (Zhao and Gao, 2009; Mehrotra and Fung, 2010; Shu and Ng, 2010). Such evidences are consistent with the 'dual legal mandate' of PBOC.

The third group studies the relationship between monetary policy and asset prices in China. A responsive, despite weak, relationship has been identified by several studies (Yang and Wang, 2006; Zhao and Gao, 2009; Feng, 2010; Koivu; 2010). This relationship can be explained by the immaturity of the Chinese housing and stock markets and the dominant power of four large state-owned banks in the financial sector. The recent housing boom has called for the need to incorporate house price variations into monetary policies in China (Zhao and Gao, 2009). Nevertheless, it could only be used as a reference rather than a direct monetary target as house prices in China are highly volatile (Feng, 2010).

Previous studies provide important insights for our study but few of them have directly examined the relationship between asset bubbles and monetary policy. This paper aims to fill in this literature gap. Unlike previous studies which only prove the existence of a relationship between monetary policy and asset pricing, we focus on the timing, direction and intensity of reactions. Instead of using a single proxy for monetary policy, such as M2, we use a series of proxies to reflect the multiple monetary instruments deployed by PBOC. Both house price and stock market index are examined as these two types of assets are different in nature and respond differently to policy shocks. The results help to identify market irregularities and hence have important policy

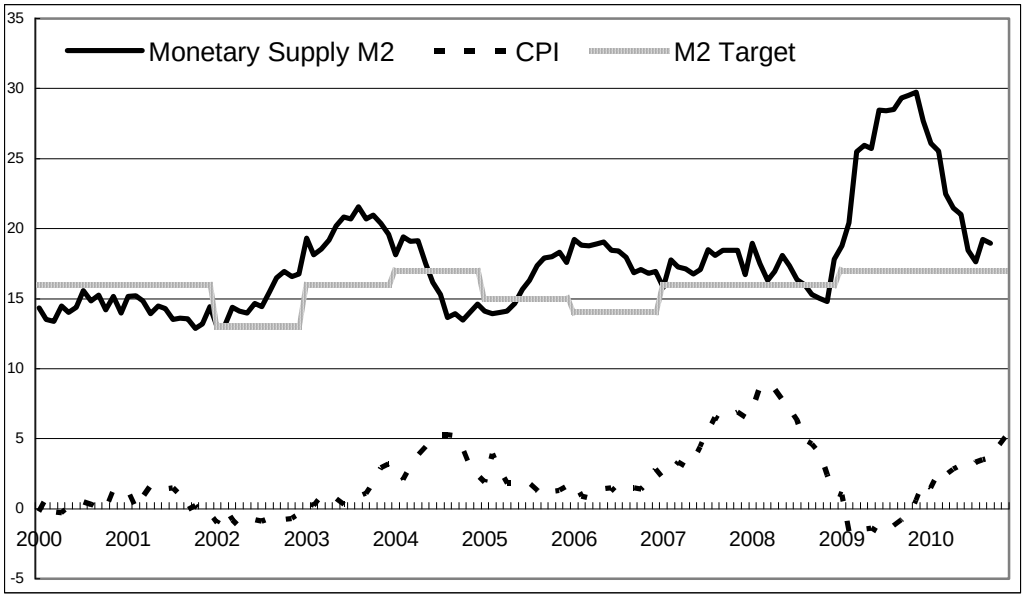
implications.

4. Data

China does not have a clear policy rate like the Federal Reserve rate in the US. Money supply (M2) is used as an intermediate target but the growth rate of M2 can deviate significantly from its target without causing high inflation (Figure 3).

As an indirect monetary policy instrument, the market interest rate has become increasingly important in recent years (Laurens and Maino, 2007). This paper uses M2 and several bank rates as alternative instruments of monetary policy.

Figure 3 Target and actual M2 monthly growth rate, Jan 2000- Nov 2010



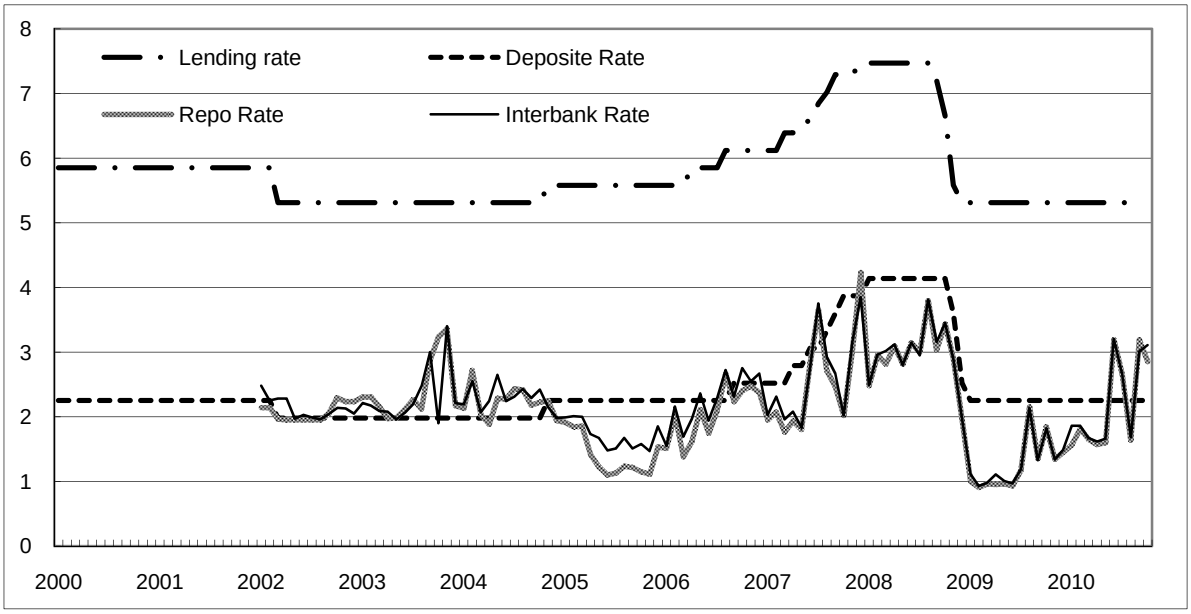
Source: Thomson DataStream.

Bank one-year lending rate is determined by PBOC and acts as the official rate. For market-based interest rates, the 7-day repo rate and interbank rate are used as they have been traded actively and

commonly used as benchmarks for pricing other financial assets (Porter and Xu, 2009; Zhao and Gao, 2009).

The movements of various interest rates are shown in Figure 4 with their correlation coefficients listed below the figure. The two market-determined rates are highly correlated but less influenced by the official bank rate, suggesting that interest rate liberalization in China is far from complete.

Figure 4 Correlations between bank deposit, lending, interbank and repo rate



Correlation	DEPOSITE	LENDING	INTERBANK	REPO
DEPOSITE	1.000000			
LENDING	0.971760	1.000000		
INTERBANK	0.550122	0.597065	1.000000	
REPO	0.521125	0.551198	0.951009	1.000000

Source: Thomson DataStream.

The growth of bank credits is another monetary policy instrument. It aims to detect whether the government uses the so-called ‘window guidance’ to influence bank operations (Koivu, 2010). The

government has frequently used both price (interest rates) and quantity-based (credits and M2) instruments to achieve its monetary goals (Xie and Li, 2010). To examine the effect of these instruments on asset prices an integrated proxy, R&L, is constructed to represent the dual effects of interest rate and bank reserve ratio. The principle component method is deployed to compile the index using data for real bank lending rates and reserve requirement ratios.

Asset prices refer to stock market indexes and house prices. Stock market indexes include the indexes of both Shanghai and Shenzhen Stock Exchanges as well as a combined index of the two. The combined index is the weighted average of the two indexes by their market sizes. Most studies, e.g., Koivu (2010), use the Shanghai Stock Exchange only. As companies and investors in Shanghai and Shenzhen are different, it is useful to examine the two markets separately. For residential house price, the 70-large and medium sized cities index only started from July 2005 up to now. The 35 large and medium-sized cities index was calculated on a quarterly basis from 2005 up to June 2008 only. Zhao and Gao (2009) argue that the housing prosperity index is a better measure that reflects house price changes in China, and in this paper, we use this index.

Appendix 1 summarizes all the variables used in this paper. The starting dates vary according to data availability. All data run from June 2005 to September 2010. Except M2, all data are year-on-year changes in real terms. Most data are obtained from Thomson DataStream, supplemented by China Statistic Yearbook (National Bureau of Statistics), People's Bank of China Statistical Year Book (2000-09), China Monetary Policy Report (PBOC, Quarterly, 2000-10) and Shanghai and Shenzhen Stock Exchange Statistical Yearbook and Monthly Statistics.

5. Methodology and results

To see whether the time series of asset prices and various proxies of monetary policy instruments are co-integrated with meaningful relationship, both Augmented Dickey Fuller (ADF) Test and Phillips-Perron Test are applied. The lag length is based on the information criteria, AIC, SC and HQ. The test results show that all the time series are I (1) processes but their first differences are I(0).

As the first differences are stationary, Johansen's cointegration test is applied to identify the long-run relationships between the variables. The test results are reported in Table 2. There is a clear cointegration relationship between real house price and all the monetary policy instruments. Only M2, interbank and repo rates have a long-run relationship with the stock market indexes. No cointegration is identified between loan growth rate and any of the stock market indices. Our results are similar with those in Zhang (2010) and Liu (2010). According to Wu et al. (2001), such results could be explained by the fact that bank loans are not allowed to buy shares in China.

Table 2 Johansen's cointegration test

Series		Eigenvalue	Statistics	P-value	Cointegration Vectors
House Index with Monetary Policy Proxies:					
M2	None *	0.1784	30.2485	0.0007	2^{***}
	At most 1	0.0464	5.8867	0.0152	
Interbank	None *	0.2150	30.5918	0.0006	2^{**}
	At most 1	0.0618	6.3816	0.0115	
R & L	None *	0.1962	33.3956	0.0002	2^{**}
	At most 1	0.0496	6.3101	0.0120	
Aggregate Stock Market Index with Monetary Policy Proxies					
M2	None *	0.1253	21.8000	0.0161	2^{**}
	At most 1	0.0397	5.0598	0.0245	
Interbank	None *	0.1153	20.6469	0.0239	2^{**}
	At most 1	0.0768	8.1450	0.0043	
R & L	None *	0.0999	17.759	0.0612	2^{*}
	At most 1	0.0361	4.5953	0.0321	

Note: ***, **, * represent that the test hypothesis is rejected at 1%, 5% and 10% levels respectively. M2 = money supply, Interbank = interbank loan interest rate, R & L = combined index of bank lending rates and reserve ratios using the principle component measure.

A bivariate Vector Autoregression (VAR) approach is used to investigate the dynamic interaction between real asset prices and monetary policy instruments. VAR is the preferred method to study monetary policy and asset prices where variables endogenously influence each other. Another appeal of VAR is that it can be used to identify monetary policy transmission without having to identify the economic system.

We begin with a bivariate VAR with no restriction. Asset prices and monetary policy instruments are allowed to respond to each other freely. For paired variables with cointegration relationship, VAR is performed at level whilst for those that are not cointegrated, VAR is performed at first difference. Without loss of generality, the constant term is ignored. Consider the following

structural VAR:

$$A\,Z_t = \phi\,Z_{t-1} + \varepsilon_t \qquad (1)$$

where A is a 2x2 full rank matrix, Z is a vector for endogenous variables and $\mathrm{E}[\varepsilon_t \varepsilon'_t] = I$. Our main interest is the dynamic responses to structural shocks, ε_t. The reduced form VAR is:

$$Z_t = B\,Z_{t-1} + C\,\varepsilon_t \qquad (2)$$

where $A^{-1}\phi = B$, $C = A^{-1}$. The variance and covariance matrix of the reduced-form residuals would be $\sum = \mathrm{E}\left[(C\,\varepsilon_t)(C\,\varepsilon_t)'\right] = C\,C'$.

Table 3 reports the Granger Causality Test results based on the reduced form VAR.[③] This test investigates the dynamic relationship of variables. The lag length is based on Akaike (AIC) and the model is subject to stability test using inverse roots of AR polynomial (see Lütkepohl, 1991, for more discussion).

[③] Causality test results between all monetary policy instruments and asset prices are available on request.

Table 3 Granger causality test

Series	Chi-sq.	Lag	Prob.	Causal Relationship
House Price Index with Monetary Policy Instruments (House):				
M2	4.10	5	0.5348	House ⇒ M2
	9.83	5	0.0800*	
Interbank	7.89	7	0.3417	House ⇒ Interbank
	22.09	7	0.0025***	
R& L	13.26	3	0.0041***	House ⇔ R & L
	14.97	3	0.0018***	
Combined Stock Market Index with Monetary Policy Instruments (Stock)				
M2	24.72	13	0.0251**	Stock ⇔ M2
	32.36	13	0.0021***	
Interbank	27.32	11	0.0041***	Stock ⇔ Interbank
	36.82	11	0.0001***	
R& L	3.71	5	0.5917	Stock ⇒ R & L
	16.18	5	0.0063***	

Notes: For each monetary policy variable, the first line reports Granger Causality statistics. When asset prices are dependent variables, monetary policy instruments are excluded. In the second line, when monetary policy indictors are dependent variables, asset prices are excluded. *** , **, * represent that the test hypothesis is rejected at 1%, 5% and 10% levels respectively. R&L = combined index for bank lending rates and reserve ratios.

Strong uni-directional causality relationship from house price to all monetary policy instruments explains and supports why the government has used all these instruments to achieve its monetary goals. In addition to direct control over M2 and bank loans, the central bank also tries to influence house prices through price methods.

In sharp contrast, monetary policy can hardly affect house prices. This may be partially explained by house shortage or other social economic factors. As one of the most important sectors in the economy, the real-estate industry has attracted serious attention by the government. Housing market is managed as an integrated part of fixed asset investment. Therefore, a single policy shock could not exert strong enough impact on house prices. It is worth noting that the combined adjustment of

interest rate and bank reserve requirement, as represented by R&L, is found to have a significant bi-directional causality relationship with house prices.

Turning to the relationship between stock market indices and monetary policy instruments, the former has a strong causal relationship with the latter. This result is consistent with that of earlier studies, such as Yi and Wang (2002). This is because the funding source of firms is closely related to the money market and shares are more actively traded than houses. The growth of bank loans is found to influence share prices uni-directionally. Bank credits could raise share prices in the short term, but the opposite does not hold.

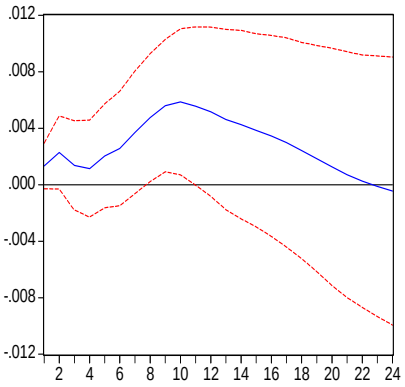
VAR results can be further examined in the form of impulse-response functions (IRFs). The 95% bootstrapped confidence intervals are computed based on 500 replications over 24 periods. Only the variables with long-term cointegration relationship are selected. The following discussion is restricted to the responsive relationship when monetary policy is represented by M2 and interbank rate and asset prices are represented by house prices and the overall stock market index.④

To ensure consistency, the same lag length as the Granger causality test is applied. Figure 5 shows the IRFs using a Cholesky decomposition of the estimated variance-covariance matrix. As suggested by the causality test, asset prices are placed before monetary policy instruments, reflecting the fact that monetary policy responds more actively to asset price changes than the other way round.

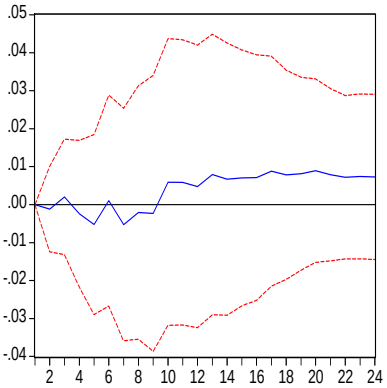
④ The IPR figures between other monetary policy and asset price variables are available on request.

Figure 5 Orthogonalized reduced-form impulse response functions (IRFs)

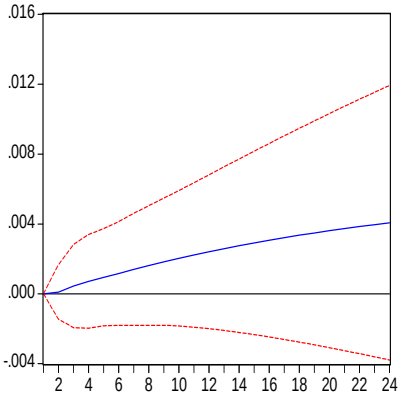
M2 → House



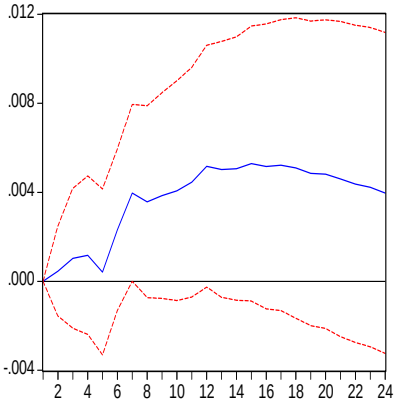
House → M2



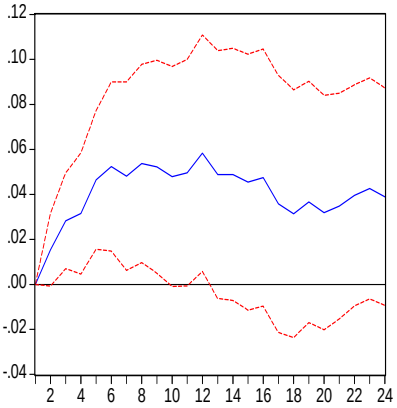
R&L → House



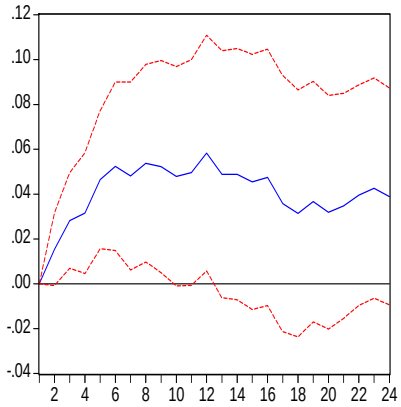
Interbank → House



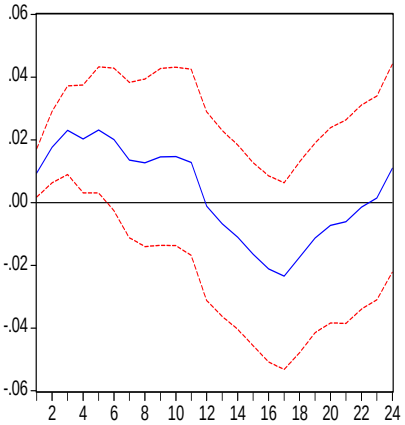
House → Interbank



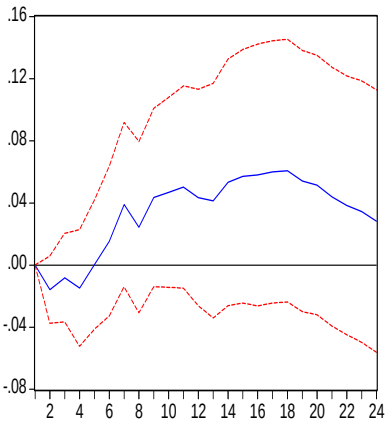
M2 → Stock Market



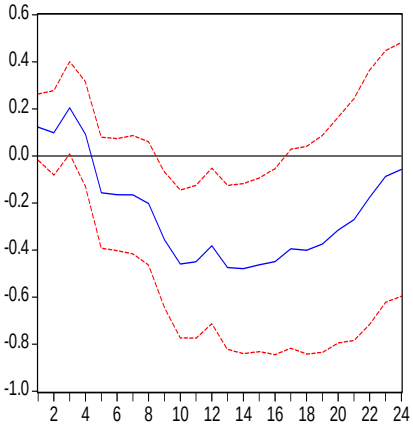
Stock Market → M2



Interbank → Stock Market



Stock Market → Interbank



A one standard deviation positive shock to M2 would lead to higher house prices. The impact peaked at 0.0059 after 10 months. However, it is surprising that the positive effect of M2 on house prices turns negative after 23 months.

A rise in interbank rate is also found to raise house prices to a maximum of 0.0053 after 15 months. The effect remains positive but starts to fall after reaching its peak. This result contradicts the general expectation that house prices should react negatively to an increase of bank rate. Focusing on Finland, Sweden and the UK, Iacoviello and Minetti (2003) show an instant and significant decrease in real house prices, about 0.75%-2%, following a rate rise. Negro and Otrok (2005), Sliva (2008) and Carstensen et al. (2009) have a similar finding for the US house market but the price fall is found to be as large as 13% after a year. A recent study of 17 OECD countries confirms a similar immediate and persistent drop in real property prices in response to a rate rise, with the only exception of Germany where house prices are less affected by monetary policy shocks (Wesche and Gerlach, 2008).

In China, the simultaneous increase in interbank rate and house price suggests that a contracting monetary stance is ineffective in curbing house prices. For fear of further interest rate rise, people rush to buy more houses, pushing the price up by over 5% in a year. This result has been further confirmed by replacing other monetary policy instruments with bank rates and the R&L index. This ‘irrational’ behavior can be explained as follows.

First, rapid urbanization and demographic changes imply that there is always a shortage of housing in Chinese cities although more and more houses are built every year.

Second, local governments have exclusive rights to sell lands for house construction. As a result, they have strong incentives in raising land prices to achieve high revenues. From 2003 to 2010, total land revenue rose from RMB 300 billion to RMB 2.7 trillion as average house prices increased sharply over the same period. Average newly built house prices in Beijing, Shanghai, Guangzhou and Shenzhen more than doubled. In 2010, Beijing's land sales revenue reached a historical high of RMB 164 billion, 12% higher than the combined revenue achieved in 2008 and 2009, accounting for nearly 70% of the city total revenue of RMB235 billion in the same year (Yao, 2011).

Third, the Chinese culture and traditions imply that house is not just a place to live but a symbol of social status. In most parts of the country, having a house is a pre-requisite for a man to get married (Jia and Liu, 2007). Consequently, purchasing a house by young people is determined by the timing of marriage, not by a mere interest rate change. Many Chinese families tend to buy houses for their children moving to cities by taking out savings from three generations. When interest rate goes up, families are more likely to bring forward their planned purchase rather than suspend or postpone it until interest rate comes down. This explains the unexpected jumps in house prices in response to an announcement of interest rate or bank reserve ratio rise.

Last but not least, high house prices are also caused by the investment behavior of urban residents. In China, apart from bank savings, there are no other attractive investment opportunities. As a result, housing is not necessarily regarded as a place to live but an important investment channel. Most well-off families tend to buy two or more than two houses, creating even more demand when the market is short of houses. Furthermore, a significant proportion of rich households buy houses by cash, not by bank loans, making interest rate movements irrelevant to their house-buying decision.

Economic psychology is also important. According to Yao and Luo (2009), asset bubbles can be sharply inflated by people's irrational investment behavior. Their research on the Chinese stock market during 2006-2008 demonstrated that investors took excessive risk when prices were high. Three psychological factors, greed, envy and speculation, are important elements of such an irrational psychology. The current housing boom in China and people's investment behavior are not dissimilar to the stock market bubble and its subsequent burst towards the end of 2007.

As for the shock from asset markets, a positive shock of house prices causes an immediate fall in M2 and rise of interest rate. This is as expected because a counteractive monetary policy would be implemented following a rise in house prices. Nevertheless, after 9 months, the supply of M2 is found to restore to a positive level. A contraction in money supply cannot be sustained for long in China as it may

hamper economic growth. M2 is expected to grow steadily over time regardless of asset price movements. Therefore, PBOC may prefer to use other mechanisms, such as ’interest rate’ and ’window guidance’ to cool the housing market down.

To sum up, our results show that an expansionary monetary policy could indeed push up house prices. However, attempts to cool down the housing market through credit control and interest rate adjustments are not as effective in China as in other countries due to a number of special economic and social characteristics. Since market confidence has been restored over the US financial crisis, the Chinese property market has experienced a significant booming period, aided by the generous government stimulus plan. House prices increased enormously from the second half of 2009 up to the end of 2010 in all Chinese cities. Although the government responded rapidly to address the issue as early as the beginning of 2010, the housing boom continues to spread from the first-tier to the second- and third-tier cities.

High house prices forced PBOC to raise interest rates in October and December 2010 as well as January 2011. The bank reserve ratio was raised eight times over the same period. Meanwhile, the central government has also made a series of announcements to contain soaring house prices. Such repeated uses of monetary instruments and other non-central bank instruments are aimed at cooling down the housing market, but by February 2001, there was no sign that house prices would come down.

In contrast, the stock market indexes respond more quickly to monetary policy shocks compared to house prices. The reactions between stock indices and monetary policy are consistent.

A one standard deviation positive shock to M2 leads to a steep rise in the stock market index in the first three months. The positive effect remains statistically significant over 24 months and reaches a maximum of 0.058 in the twelfth month.

A rise in bank rate brings down the stock market index instantly. Nevertheless, after four months, share prices are found to bounce back, suggesting that the responsive relationship is short-lived. Such short-lived share price fall in response to a contracting monetary stance has also been identified by other studies on developed countries (Rigobon and Sack, 2004; Neri, 2004; Wesche and Gerlach, 2008). However, it would take a much longer period, in about two years for share prices in developed countries to restore to the baseline level and the average maximum price fall is smaller, about 0.75% (Wesche and Gerlach, 2008) than the 1.5% drop in China.

In China, a rise of interest rate could only deter investors for a relatively short period. This is due to the excessive speculative behavior of Chinese investors. Stock market investment is more likely to be considered as a substitute for bank savings as bank deposit rate is usually lower than CPI. Real negative saving rate makes investors highly sensitive to policy changes. However, after the initial turmoil, speculative

investors would quickly return to the market, pushing share prices up again. In this occasion, a one-off interest rate hike would hardly have a long-standing impact on curbing share prices as there is always a substantial amount of free capital flowing in and out of the market. It explains why PBOC had to lift the bank rate four times every other month from March 2007 to October 2007 to finally cool down the stock market by the end of 2007.

On the other hand, a positive shock to stock index is found to cause a contraction in money supply in the mid-term. The change in M2 only turns negative after one year and bottoms out in 17 months. Such a long response period may be due to the fact that the impact of stock markets on the economy is less significant than that of the housing market.

To test the robustness of our results, two types of restrictions are added to the VAR model: short run restriction where monetary policy does not contemporaneously react to asset prices, and long-run restriction which is inspired by money neutrality, e.g., money should not have a long-run effect on real variables. Based on US data, Bernanke and Mihov (1998) find strong evidence of money neutrality. The long-run restriction involves a response matrix. See Blanchard and Quah (1989), denoted by D:

$$D = (I - B)^{-1} C \qquad (3)$$

where $D D' = (I - B)^{-1} C C' [(I - B)^{-1}]' = (I - B)^{-1} \sum [(I - B)^{-1}]'$.

From the estimates of B and $\sum$ in the reduced form VAR, D and $C = A^{-1}$ are obtained. Long run money neutrality in the bivariate VAR implies that $d_{12}=0$.

$$D = \begin{pmatrix} Asset\ \Pr ice \\ Monetary\ Policy \end{pmatrix} \begin{bmatrix} d_{11} & 0 \\ d_{21} & d_{22} \end{bmatrix} \qquad (4)$$

The short run restriction is inspired by PBOC's argument that it does not target asset prices in its monetary policy although the government is proactive in guiding asset market development. No contemporaneous reaction to asset price implies that $a_{21}=0$.

$$A = \begin{bmatrix} a_{11} & a_{12} \\ 0 & a_{22} \end{bmatrix} \qquad (5)$$

The main IRF results are presented in Figure 6. The relationships between monetary policy and asset prices are still preserved. Despite responding immediately, all the monetary policy instruments are unable to present house prices from rising in the short-term. The stock market index becomes more rational, even though a tightening monetary stance could only affect share prices temporarily. The evidence in this robustness test reaffirms the speculative behavior of Chinese investors.

Figure 6 Impulse response function with restrictions

Panel A: Short-run restriction

Panel B: Long-run restriction

6. Conclusions and policy implications

Due to China's expansionary policy to fight the world financial crisis with a 4 trillion RMB stimulus package and 9.5 trillion RMB new loans announced in 2008, house prices rocketed from the second half of 2009. Despite a series of State Council decrees and PBOC's decisions to raise bank reserve ratios and interest rates in 2010, house prices continued to rise in the order of 22-45% in four first-tier cities.

House prices have become unusually high by international standards in terms of house price/household income ratio, or in terms of house price growth rates vis-à-vis household income growth rates.

By February 2011, there was no sign that house prices will come down, but the situation of the Chinese housing market is similar to the stock market boom during 2006-2007. Although the Chinese stock market suffered a spectacular crash from the end of 2007, it may still be too early to predict a similar crash in the housing market. This, however, remains a strong possibility.

The Chinese central bank, PBOC and the State Council have used both administrative and monetary policies to control asset prices. As administrative measures cannot be quantified and their effects, if any, are most likely to be short-lived, the impact of monetary policies is more important and long lasting.

Due to a number of specific characters of the Chinese monetary system and people's investment behavior, interest rate adjustment is not the only instrument of China's monetary policy regime. Other instruments, such as money supply (M1 or M2), bank commercial lending rates and reserve ratios are other important instruments.

This paper uses the multi-instruments approach to examine how these different policy tools may have affected house and share prices in China. It uses Granger Causality Test, Johansen's VAR Approach and impulse analysis to have a comprehensive study on the dynamic as well as long run relationships between various monetary policy instruments on house and share prices based on monthly data from June 2005 to September 2010.

A few interesting and important results are found from various econometric exercises. First, house and share prices continued to rise rapidly despite various tough monetary tightening actions taken by PBOC. Such a result contradicts common-sense expectations and results found in other countries. This strange phenomenon can be explained by the so-called 'irrational' or 'speculative' behaviour of Chinese investors.

Such 'irrational' and 'speculative' investment behaviour, however, can be explained by various economic, social and cultural factors which are unique to China. Rapid urbanization, attitude towards home ownership, lack of investment channel and imperfect market competition are some of the key factors responsible for large stock

market and housing bubbles.

As for the causal relationships between monetary instruments and asset prices, there are also some interesting results. The government paid more attention to house price movements than to share price changes. When house prices were rising rapidly, both the government and PBOC reacted quickly and aggressively to cool down the market. In contrast, it took more than one year for the government to tighten its monetary stance to cool down the stock market when it was ballooning. There may be two explanations for the different attitudes of the government towards intervening into the two asset markets.

One explanation is that the housing market is more important than the stock market in terms of their potential impact on the wider economy. The other explanation may be due to experience-learning. Because of government's slow reaction to the stock market in 2006-07, the stock market bubble became so large that it could not recover to half its peak level reached in 2007 after more than three years. If the housing market bubble were to be as large as the stock market bubble, the potential damage to the Chinese economy and society would be devastating. As a result, the government decided to intervene aggressively in the housing market in 2010 and continued to do so into 2011.

Although such government actions may not really cool down the housing market as

we have discussed and found out from our empirical evidences in this paper, the housing bubble may not be able to become too large to have a devastating impact on the economy once it eventually bursts.

From the results found in this paper and additional anecdotal evidence, it can be seen that Chinese investors have a strong but irrational economic psychology in the sense that people tend to take excessive risks when asset prices are rising. This kind of investment behavior can be observed in any part of the world, but in China, due to various other special factors, such irrational and speculative behavior is particularly strong. This will have important policy implications. Apart from acting early and more aggressively, the Chinese government should try to create more investment channels, to promote a fairer and better free market system, to shift its economic structure which will depend less on investment and more on effective domestic consumption.

References

Bordo, M. D. and O. Jeanne (2002), Monetary Policy and Asset Prices: Does "Benign Market" Make Sense? *International Monetary Fund Working Paper, No. 225*.

Bernanke, B. S. and I. Mihov (1998), The Liquidity Effect and Long-run Neutrality, *Carnegie-Rochester Conference Series on Public Policy*, 49 (1): 149-194.

Bernanke, B. S. and M. L. Gertler (2000), Monetary Policy and Asset Price Volatility, *National Bureau of Economic Research, NBER Working Papers*, No. 7559.

Blanchard, O. and D. Quah (1989), The Dynamic Effects of Aggregate Demand and Supply Disturbances, *American Economic Review*, 79 (4): 655-73.

Burdekin, R. C. K. and P. L. Siklos (2008), What has Driven Chinese Monetary Policy since 1990? Investigating People's Bank's Rule, *Journal of International Money and Finance*, 27: 847-859.

Carstensen, K., O. Hülsewig and T. Wollmershäuser (2009), Monetary Policy Transmission and House Prices: European Cross-Country Evidence, *CESifo Working Paper, No. 2750.*

Dai, G. Y. (2003), Open Market Operations, Practice and Experience in China (in Chinese), *Journal of Financial Research (Jingrong Yanjiu),* 271: 55-65.

Dickinson, D. and J. Liu (2007), The Real Effect of Monetary Policy in China: An Empirical Analysis, *China Economic Review,* 18(1): 87-111.

Dyer, G. and P. Waldmeir (2010), China to Intensify Battle against Inflation, *Financial Times,* p.4, 13 December 2010.

EIU ViewsWire (2010), China Politics: Raising Inflation Could Threaten Social Stability, EIU ViewsWire, New York, (14 December 2010).

Feng, K. (2010), Zhongguo Fangdichan Shichang zai Huobizhengce Chuandaojizhi Zhong de Zuoyong (in English: Influence of Real-estate Sector to the Monetary Policy Transmission Channel in China: An investigation based on Data from 2000 to 2009), *Working Paper of Pecking University, C-2010-09-014*.

Feyzioglu, T., N. Porter and E. Takats (2009), Interest Rate Liberalization in China, *IMF Working Paper*, WP/09/171.

Geiger, M. (2008), Instruments of Monetary Policy in China and Their Effectiveness: 1994-2006, *United Nations Conference on Trade and Development,* Discussion Papers, No. 187.

Greenspan, A. (2004), Risk and Uncertainty in Monetary Policy, *American Economic Review*（Papers and Proceedings）, 94: 33-40.

Iacoviello, M. and R. Minetti (2003), Financial Liberalization and the Sensitivity of House Prices to Monetary Policy: Theory and Evidence, *The Manchester School*, 71(1):20-34.

Jia, K. and M. J. Liu (2007), An Analysis of Issues Related to China's Housing Reform and Housing Security System, *Public Finance research*, 7: 8-23.

Koivu, T. (2008), Has the Chinese Economy Become More Sensitive to Interest Rates? Studying Credit Demand in China, *Bank of Finland, BOFIT Discussion Papers, 1-2008*.

Koivu, T., A. Mehrotra, and R. Nuutilaninen (2008), Mccallum Rule and Chinese Monetary Policy, *Bank of Finland, BOFIT Discussion Papers, 15- 2008*.

Koivu, T. (2010), Monetary Policy, Asset Prices and Consumption in China, *European Central Bank, Working Paper Series, No. 1240*, ECB.

Lansing, K. J. (2003), Should the Fed React to the Stock Market? *FRBSF Economic Letter*, 2003-17 (June 20).

Laurens, B. J. and R. Maino (2007), China: Strengthening Monetary Policy Implementation, *IMF Working Pape*r, WP/07/14.

Law of the People's Republic of China on the People's Bank of China (2003), *The People's Bank of China*, (27 December 2003), http://www.pbc.gov.cn/publish/english/964/1954/19541/19541.html.

Liu, X. M. (2010), Yinhang Daikuan, Waishangzhijietouzi yu Gushi de Guanxi, (in English: The Relationship among Bank Loans, Foreign Direct Investment and Stock Market Performance), Changchun Daxue Xuebao, *Journal of Changchun University*, 20(5): 11-15.

Liu, L. and W. Zhang, (2007), A New Keynesian Model for Analyzing Monetary Policy in Mainland China, *Hong Kong Monetary Authority Working Paper, 18/2007*.

Lütkepohl, H., (1991), *Introduction to Multiple Time Series Analysis*, Berlin: Springer-Verlag.

Luo, D. and S. J. Yao (2010), World Financial Crisis and the Rise of Chinese Commercial Banks: An Efficiency Analysis Using DEA, *Journal of Applied Financial Economics*, 20(19): 1515-1530.

Mehrotra, A. and J. R. S. Fung (2010), China's Monetary Policy and the Exchange Rate, *Federal Reserve Bank of San Francisco, Working Paper Series, 2010-10.*

Negro, M. D. and C. Otrok, (2005), Monetary Policy and the House Price Boom across U. S. State, *Federal Reserve Bank of Atlanta, Working Paper Series,* No. 2005-4.

Neri, Stefano (2004), Monetary Policy and Stock Price: Theory and Evidence, *Temi di discussione (Economic working papers) from Bank of Italy, Economic Research Department*, No. 513.

Pan, L. and X. Tao, (2006), The Monetary Policy Transmission in China- Credit Channel and Its Limitations, *Berlin School of Economics, Working Paper No. 22*.

Porter, N. and T. T. Xu, (2009), What Drives China's Interbank Market? *IMF Working Paper*, WP/09/189.

Rigobon, R. and B. Sack (2004), The Impact of Monetary Policy on Asset Prices, *Journal of Monetary Economics*, 51(8): 1553-1575.

Shu, C. and B. Ng, (2010), Monetary Stance and Policy Objectives in China: A Narrative Approach, Hong Kong Monetary Authority, *China Economic Issues* (in Chinese), 1/10.

Silva, C. V. (2008), The Effect of Monetary Policy on Housing: A Factor-Augmented Vector Autoregression (FAVAR) Approach, *Applied Economics Letters*, 15(10): 749-752.

Taylor, J. B. (2007), Housing and Monetary Policy, *NBER Working Paper No.*

13682, http://www.stanford.edu/~johntayl/Onlinepaperscombinedbyyear/2007/Housing_and_Monetary_Policy.pdf.

Wan, G. H. and Y. Zhang, (2002), Household Consumption and Monetary Policy in China, *China Economic Review*, 13(1): 27-52.

Wesche, K. A. and S. Gerlach, (2008), Ensuring Financial Stability: Financial Structure and the Impact of Monetary Policy on Asset Prices, *Institute for Empirical Research in Economics, University of Zurich, Working Paper Series, No. 361*.

Wu, X. Q., Q. S. Song and C. Y. Ying (2001), Guanyu woguo yinhang xindai zijin jinru gupiaoshichang de zhangceyanjiu (in English: Study of Investment of the Bank Loan to the Stock Market), *Guanlishijie (Journal of Management World)*, 4: 86-95.

Xie, H. and R. Li (2010), Fifth Reserve Rate Increase and Potential Further Interest Rate Raise in China, Reuters, (22 November 2010), http://cn.reuters.com/article/chinaNews/idCNCHINA-3373620101121.

Xie, P. and X. Luo (2002), Taylor Rule and Its Empirical Test in China's Monetary Policy (in Chinese), *Journal of Economic Research (Jingji Yanjiu)*, 3:3-12.

Xie, P. and Q. Yuan (2003), Analysis of the Effects of China's Interest Rate Policy in Recent Years (in Chinese), *Journal of Financial Research (Jingrong Yanjiu)*, 275: 1-13.

Yang, J. H. and W. C. Wang, (2006), Woguo Huobizhengce Shihfou Yingxiang Gushi Paomo de Shizhengfenxi (in English: Whether Monetary Policy could Influence Stock Market Bubble), A case Study of China, *Finance and Trade Economics*, 3: 38-40.

Yao, Shujie; Chunxia, Jiang; Genfu, Feng and Dirk, Willenbockel (2007), 'WTO Challenges and Efficiency of Chinese Banks', *Applied Economies*, 39(5): 629-643.

Yao, S. J. and D. Luo (2009), 'The Economic Psychology of Stock Market Bubbles in China', *The World Economy*, 32 (5): 667-691.

Yi, G. and Z. Wang (2002), Monetary Policy and Financial Assets Price, *Economic Research Journal (Chinese)*, 03.

Yao, Y. Y. (2011), Land Sales of Beijing was as High as RMB164 billion in 2010, China Daily, 4 January 2011, <Accessed on 12 February 2011>, http://www.chinadaily.com.cn/hqcj/fcdt/2011-01-04/content_1510249.html.

Yu, Q. (1997), Economic Fluctuation, Macro Control, and Monetary Policy in the Transitional Chinese Economy, *Journal of Comparative Economics*, 25: 180-197.

Yue, Y. D. and S. H. Zhou (2007), Empirical Analysis of the Monetary Policy Transmission Through Interest Rate Channel in China, *Chinese Business Review*, 6(3): 8-13.

Zhang, C. S. (2010), Inflation Uncertainty and Monetary Policy in China, *China and World Economy*, 18(3): 40-55.

Zhang, W. L. (2009), China's Monetary Policy: Quantity versus Price Rules, *Journal of Macroeconomics*, 31: 473-484.

Zhao, J. W. and H. Gao (2009), Zichanjiage Podong dui Zhongguo Huobizhengce de Yingxiang (in English: The Impact of Asset Price Volatility on Monetary Policy in China), *Social Science in China (Zhongguo Shehui Kexue)*, 2: 98-114.

Appendix 1 Data Source and Definitions

Variable	Definition	Sources
Monetary Policy Indictors:		
M2	Ln (M2, year-on-year Change)	Thomson DataStream
Repo	Nominal Repo rate --1 week deflated by CPI	Thomson DataStream
Interbank	Nominal Interbank rate --1 week deflated by CPI	Thomson DataStream
Lending	Nominal Bank Lending rate deflated by CPI	Thomson DataStream
Loan	Ln (Annual Growth Rate of Total Loans)	People's Bank of China
R& L	Index computed based on principal component method by real bank lending rate and bank reserve requirement ratio	Thomson DataStream; People's Bank of China
Asset Price Indicators:		
SSE	Ln (Shanghai Stock Index deflated by CPI)	Official Website of SSE
SZSE	Ln (Shenzhen Stock Index deflated by CPI)	Official Website of SZSE
Stock	Ln (Real Aggregate Stock Index) = Ln ((SSE * Market Capitalization of SSE/Total Market Capitalization + SZSE * Market Capitalization of SZSE/Total Market Capitalization) deflated by CPI)	China Statistical Yearbook; SSE and SZSE Monthly Statistic
House	Ln (Sales Price of 70 Large- and Medium-sized Cities deflated by CPI)	National Bureau of Statistics