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Monetary Policy, House Prices, and Consumption in China：A National and Regional Study

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This paper studies the relationships among monetary policy, house prices, and consumption in China from both national and regional perspectives. Using a panel vector autoregression (VAR) model and a counterfactual simulation method, we find that monetary policy has a significant effect on consumption but with a regional pattern, in terms of the magnitude and the housing wealth channel. It is found that in the middle southern and the western cities, the monetary policy has strong effects on consumption while the house prices have minimal contribution to the monetary policy transmission to household consumption. By contrast, in the Tier-1 and the eastern cities, house prices play a more important role in monetary policy transmission; even household consumption is less sensitive to monetary policy changes.

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Keywords

Monetary Policy; Housing Price; Household Consumption; VAR; Chinese Regional Market

1.   Introduction

Despite the notable economic achievements in China since the end of the 1980s, the effort to achieve a sustainable pace of growth still faces great challenges. At the heart of these challenges is the need to effectively stimulate aggregated demand and cope with lackluster consumption and investment. In 2012, the household consumption rate in China reached its lowest level and contributed to the amount of output by only 36%. This level was not only much lower than those in the Organisation for Economic Co-operation and Development (OECD) countries, but also much lower than the two other large developing countries, India and Brazil, with a respective level of 71% and 80% in 2008. In the 1990s, the Chinese government called for a rebalancing of the economy towards a greater reliance on consumption and away from the investment and foreign trade that had been favored in recent years. The Chinese monetary authority thus faces new challenges to manage household consumption to realize sustainable economic growth.

However, such a structural economic adjustment is currently under pressure from increasing house prices and the inflation rate. According to the Chinese Statistical Yearbook, from 2004 to 2010, the average transaction price of new apartments in urban China rose by 10.71% annually, which is about 3.92 times higher than that from 1998 to 2003. The share of the net value of housing assets to the total net wealth of household rose to 73.44% in 2010.[1] At the same time, the inflation rate in China has continued to climb since 2008. It reached its highest level since 2000 when it jumped to 5.9% in 2008. In response to increasing pressure from inflation as well as liquidity flow abroad, the People's Bank of China (PBC) which is the central bank of China, has declared a shift from the "moderately loose" monetary policy that has helped the Chinese economy recover from the global financial crisis to a "prudent monetary policy".[2] Therefore, to assess the scope for private consumption in China with the use of monetary instruments, it is important to examine the correlations among monetary policy, house prices, and consumption.

China's monetary policy has several features that render it different from those of other countries. It has multiple objectives, including maintaining price stability, promoting economic growth, maximizing employment and balancing

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[1] Tsinghua University research on consumer finance in China and Citigroup Investor Education Research.

[2] Announcement by officers at a meeting of the Politburo of the Communist Party of China in December 2010.

international trade payments.[3] In the past, China's monetary authority applied monetary supply alone as a policy instrument, whereas more recently, it has also employed the interest rate as a target instrument. Instruments of both quantity and price are, therefore, combined in China's monetary transmission mechanism. This has prompted numerous papers to address the effectiveness of the monetary policy based on its relationship with inflation (Liu et al., 2009), effects on the real economy (Dickinson and Jia, 2007), and relevance to household consumption (Zhang and Wan, 2002). However, there is no assessment in the current literature of the correlations among monetary policy, house prices and household consumption from a regional perspective. This paper therefore aims to fill this gap.

Moreover, the spatial diffusion of monetary policy is important in the Chinese context because of the significantly divergent and segmented regional house prices and household consumption. This suggests that the correlations among monetary policy, house prices, and household consumption may be heterogeneous across regions. Although monetary policy does not target regional economic performance, its spatial pattern is relevant to an evaluation of the efficacy of the monetary policy at the national level. The aggregate effects of monetary policy depend on the distribution of regional market sensitivities to such a policy. Therefore, changes in the configuration of the heterogeneity can produce significant changes in the aggregate effect. An accurate estimation of the effect of monetary policy and an assessment of the role of the housing market in monetary transmission at the regional level are both critical to the formulation of an appropriate housing policy in China.

The objective of this paper is to therefore provide a better understanding of the monetary policy transmission mechanism and capture the role of the housing market in the effects of monetary policy on household consumption from both national and regional perspectives in China. In this paper, a panel vector autoregression (VAR) model is applied to capture the impact of monetary policy on household consumption for the whole nation and different regions, characterized by different house prices. A counterfactual simulation method by removing the estimated effect of house prices on consumption is used to capture the role of house prices in monetary policy transmission. The robustness of the study is determined by the re-estimation of the model with monetary supply. We find that household consumption responds to changes in monetary policy in a heterogeneous manner and through different channels in different regions in China. The regions with higher household debt are more sensitive to monetary policy, but housing price is not an important channel in monetary policy transmission in these cities. Instead, house prices tend to play a key role in monetary transmission in the high-price regions. This study contributes to an estimation of the effectiveness of monetary policy by analyzing the monetary transmission mechanism and its spatial patterns. It also contributes to an

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[3] Speech by Zhou Xiaochuan at the "2009 China Financial Forum".

understanding of the role of the housing market in the economy and offers insights into appropriate political responses to regional development.

The remainder of the paper is organized as follows. Section 2 offers a literature review and theoretical suggestions. Section 3 briefly describes monetary policy and the regional housing market in China. Section 4 provides the model used in the study and a description of the data. Section 5 presents the results, and Section 6 concludes.

2.   Literature Review: Monetary Policy, Houses Prices and Consumption

Maclennan et al. (1998) indicate that there are both direct and indirect channels by which monetary policy influences household consumer spending. The direct effect, which is the neo-classical effect, is through outstanding debt by way of interest payment burden. Changes in the interest rate directly influence household consumption and thus their role depends on the development of the mortgage market (Elbourne, 2008). Quantitatively, however, the direct effects appear to be less important than the indirect ones (Maclennan et al., 1998).

One important indirect effect of monetary policy on household consumer spending is via house price (Maclennan et al., 1998). The indirect role of housing in the monetary transmission process in principle includes two stages: monetary policy affects the value of housing wealth, and then changes in housing wealth influence consumption.

In the first stage of the indirect effect, the effects of monetary policy on housing prices can be modeled in the life cycle mode by using the concept of user cost of capital. Expectations of a rise in interest rates may quickly push up the user cost of capital by lowering the expected real rate of appreciation of residential prices. This mechanism is well-discussed as a neoclassical interest rate channel and argued to be important for monetary policy transmission (Taylor, 1995). Moreover, changes in the interest rate may change the arbitrage cost between financing housing and other assets and then impact on housing prices (Poterba, 1984; Miles, 1994; Yang et al., 2010). Shocks in the expected interest rates may enhance the risk premium of house consumption, initially inducing households to rearrange and diversify their portfolios away from housing (Kearl and Mishkin, 1977) or renting a dwelling. In addition, houses can be used as collateral, against which households borrow to finance housing consumption and investment. In this view, monetary policy can be transformed via a "credit channel" by the level of house prices. Changes in house prices deduced by the changes in the interest rate will change the ability of potential buyers to borrow and then in turn, further change the conditions for house price formation. Along this channel, the effect of an interest rate change is likely to be amplified in the property market (Aron and Muellbauer, 2000; Muellbauer and Murphy, 2008).

It is also suggested that this "credit channel" is important in the second stage of the indirect role of housing in monetary transmission. Studies on the linkage between housing wealth and consumption have focused on western countries that are stimulated by the life-cycle model of Modigliani and Brumberg (1954). These researchers have put forth effort into understanding the impact of housing prices on consumption, as well as the channel through which housing prices might influence consumption from both macro and micro perspectives (Attanasio and Weber, 1995; Poterba, 2000; Ludwig and Sløk, 2002; Yao and Zhang, 2005; Campbell and Cocco, 2007). Ludwig and Sløk (2002) identify realized and unrealized wealth channels as well as a substitute effect through which housing prices impact consumption. They further identify a "credit channel" as the most important channel, which has been widely provided in the western market (Aron and Muellbauer, 2000; Muellbauer and Murphy, 2008). In China, residential property is the most important asset of household wealth, but households have rather limited debt (Liao et al., 2010). Pan and Tao (2006) discuss the limited effects of the "credit channel" for monetary policy in China from the perspective of a regulatory bank system. In related studies, substitute effects in the short run are commonly found at the national level in China (Wei and Zhang, 2011; Yang and Zhao, 2014).

A small number of studies have examined the role of monetary policy in household consumption at the national level by combining the two stages outlined above. Based on a VAR model, Giuliodori (2005) finds a significant role for house prices in the transmission of monetary shocks to consumer spending in several European countries, particularly in Sweden, the U.K., and Finland. He indicates that financial liberalization in most countries enhances the role of the housing sector in monetary policy transmission. Calza et al. (2007) study the monetary policy of 11 countries and explore how the credit market can influence the sensitivity of housing and consumption to monetary shocks. Elbourne (2008) uses a structural VAR (SVAR) model for the U.K. economy and empirically estimates the links between house prices and consumption in the monetary transmission mechanism. He finds that changes in house prices explain for about one-seventh of the declines in consumption caused by interest rate shocks. Several Chinese papers have found that monetary policy has a significant role in household consumption but housing prices have a negligible role in monetary policy transmission. Jing (2006) carries out an empirical analysis on the regional effect of monetary policy in China with an SVAR model, and finds different impacts of monetary policy and lag time between the different regions. Koivu (2012) adapts an SVAR model and further identifies the contribution of asset price, including housing and stock prices, in Chinese monetary policy transmission. He finds that a loosening of the monetary policy leads to higher residential prices and increasing household consumption in China.

At the regional level, significant heterogeneity in housing price and household debt level across regions would suggest the spatial distribution of the effects of

monetary policy as well as the heterogeneous role of housing price in monetary transmission (Yang et al., 2010). Regional level studies of monetary policy, however, are still limited, particularly in the areas of house prices and household consumption. In terms of the monetary policy transmission channels, several studies have examined the heterogeneity of regional market performance in response to monetary shocks in many countries; for example, Schunk (2005), and Ashton and Gregoriou (2014) in the United States, Fraser et al. (2014) in Australia, Georgopulos (2009) in Canada, Rodríguez-Fuentes and Dow (2003) in countries in the European Economic and Monetary Union (EMU), and Dow and Montagnoli (2007) in the UK. Studies on the property market are quite rare, but include work by Negro and Otrok (2007) on the USA, Yang et al. (2010) on Sweden, and Liang and Gao (2007) on China. Yang et al. (2010) point out that the regional effects of monetary policy can be resultant of both the demand and supply sides of the housing market. When local governments understand the heterogeneous spatial effects of central government monetary policy, they can effectively respond to the monetary policy, and politicians can effectively address the effects of their decisions.

If the monetary policy effects on house prices present a regional pattern, and the consumption response to house prices varies across regions, then we would expect a spatial pattern within the monetary policy-household consumption transmission process. The regional effects of monetary policy on household consumption in China is an important issue that is worthy of study, in view of the increasing concern about regional discrepancies in the economy and the real estate market (Zhao and Tong, 2000; Wang, 2009). Capturing the regional effects of the relationships among monetary policy, house prices, and consumption will enrich our understanding of the effectiveness of policy decisions and their effects on the economy.

3.   Institutional Background: Monetary Policy and the Regional Housing Market in China

### 3.1   Monetary Policy in China

There is general consensus that monetary policy is formulated by central banks with the view to maintain a low inflation rate and reduce output volatility. Accordingly, central banks aim to maintain both macroeconomic stability and stability in the financial system. In recent decades, asset booms and busts have been important factors that underlie macroeconomic volatility (Bernanke and Gertler, 2001). In China, the PBC functions as the central bank with the power to control monetary policy and regulate financial institutions in China. According to the Law of the PBC, which became effective in 1995, the monetary policy objective is to maintain the stability of the currency and promote economic growth (http://pbc.gov.cn/english/huobizhengce/objective .asp). However, PBC Governor Zhou Xiaochun emphasized that, in the transitional period of economic reform, the bank's monetary policy has many

different objectives, including low inflation, economic growth, high employment rates, and balance of international payments. To achieve these goals, the primary monetary policy instruments of the PBC, like those of most of the developed central banks, include open market operations and changes in the discount rate and reserve requirements, but the PBC also provides "window guidance" to banks on their lending operations. In 1994, the PBC defined and announced three layers of money supply indicators: M0, M1, and M2. In 1996, the PBC formally treated money supply as an intermediary target, and in 1998, credit ceilings were eliminated, thus leaving money supply (M1 and M2) as the single intermediate target. Dai (2002), the director of the monetary policy department of the Chinese central bank in 1994, pointed out that M1 is mainly related to the short-run growth of output, while M2 is more related to that of long-run inflation and economic growth. The difficulties and ineffectiveness of the quantity rule in the monetary policy in China has been widely discussed (for example, Dickinson and Jia, 2007; Liu et al., 2009; Zhang, 2009). Conclusions on the link between monetary policy and prices, however, are mixed (Jun, 2009; Liu et al., 2009).

Figure 1 plots the quarterly growth rate of M2 in China from 2003 to 2010. As we can see, the country's monetary policy remained relatively stable from 2003 to 2008. Later in 2008, in response to the global financial crisis and subsequent shocks in the domestic economy, the Chinese authorities announced a significant stimulus package and introduced credit relaxation and several interest rate cuts. The country's M2 increased by more than 10% year-on-year from 2008Q4 to 2009Q1. The "moderate loss monetary policy" played a significant role in bolstering the economy and prevailed until 2009. Since then, China has begun a normalization of policy as its recovery has gathered steam. The reserve requirements of the banks were raised four times and interest rates were lifted once. In addition, restrictions have been placed on bank lending in response to the pressure of increasing inflation and an overheated economy. As a consequence, the pace of credit growth has slowed down in 2010.

In addition to the market orientation of the national economy and globalization of the financial market, the PBC started to apply indirect instruments, such as required reserve ratios and interest rates, in adjusting macroeconomics. In China, the interest rate is still regulated by the PBC, but slow progress has been made towards liberalization. Interest rates in the money market have not been used as benchmark interest rates; instead, the 1-year deposit rate administered by the central bank is widely used as the benchmark interest rate in China. Figure 2 plots the trend of interest rates for both the 7-day China Interbank Offered Rate (CHIBOR) and the benchmark 1-year lending rate. These two rates present similar dynamic trends.

**Figure 1   Quarter-on-Quarter Growth Rate of M2 in China
                   (2003Q1–2010Q4)**
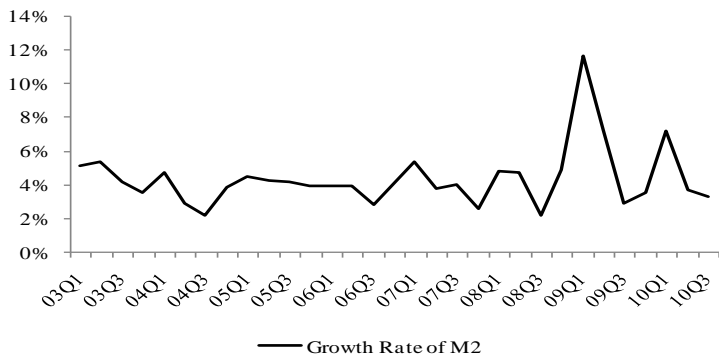
Source: PBC website and authors' calculation.

**Figure 2   One-Year Lending Rate and 7-Day CHIBOR
                   (2004 Q1-2010 Q4)**

Source: 1-year lending rate from Tsinghua Financial Database; 7-day CHIBOR from
          Macrochina Database.
Note: Both rates are at nominal level.

3.2   Regional Housing Market in China

Like the global trend in spatial disparity, the pronounced income and wealth
inequality across the regions is an important pattern of regional inequality in
China (Gustafsson et al., 2008) and has become an important policy issue
(Meng, 2004). The purchasing power of households varies significantly across
the regions (Fan et al., 2008). Increasing differences in regional economic
growth and house investment have created a volatile context for local house
prices. Social transmission in China, in particular the privatization of public

housing in the 1990s, has further enhanced the disparity in housing wealth across the regions[4] and may have indirect effects on this disparity.

The most traditional way to study the regional market in China is based on the division into eastern, middle, and western regions. However, an increasing number of current studies suggest that, in such a classification, disparities in house prices are significant within the eastern cities (Yu et al., 2008). For example, Beijing, Shanghai, Guangzhou and Shenzhen tend to have much a higher price level than the other cities. They are, however, placed in a different division in the traditional classification. In this study, we divide 35 large and major cities in China into five categories by using both geographical region and city housing price (Wang et al., 2008) called the Tier-1, northern, eastern, middle southern, and western cities. The classification of the five groups of cities is shown in Table 1. The most important motivation for classifying the cities by region in this study is to identify the homogeneous subgroups to minimize within-group variation in house prices. Disparities in house prices have been regarded as an important factor in the regional effect of monetary policy (Yang et al., 2010).

Figure 3 presents the real house prices (deflated by a city-specific consumer price index (CPI)) and Figure 4 presents the real living expenditure per capita (deflated by a city-specific CPI), in the five clustered regions from 2003 to 2010. As shown in Figures 3 and 4, the regional pattern is significant. Compared to the cities in the middle southern and western regions, the cities in the Tier-1 and eastern regions are characterized as having higher housing prices and living expenditure per capita. In general, the regional housing price pattern is consistent with the regional distribution of living expenditure per capita.

According to the Survey of Chinese Consumer Finance and Investor Education (SCCFIE) in 2008, Liao et al. (2010) indicate that the mean value of the total assets held by households in east China is US$105,400, which is twice the amount owned by those in the west and the northeast. However, only 8.8% of the households in the eastern cities (including the Tier-1 cities) have liability ownership, whereas this ratio is 16.6% and 12% in the cities in the central and northeast regions, respectively. This suggests that the consumption of a household depends, to a large extent, on salary or other income, but fewer depend on debt in the eastern and Tier-1 cities. Therefore, theoretically, we would expect that household consumption is less sensitive to monetary policy

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[4] During the housing reform of the 1990s, the central government vigorously promoted the sale of the existing public sector to existing tenants at considerably high discounts. However, the formal access of the tenants to housing resources was firmly linked to their work organizations or occupational ranks. Employees in state-owned enterprises and institutions had more opportunities to obtain privatized public housing at a lower price. The regions with a different scale of state-owned enterprises, institutions, and government departments may have been affected differently by the housing privatization reform, thus resulting in regional disparity in terms of the initial home ownership rate.

Table 1   Five Regional Groups of Cities

Type	Quantity	Cities	Description
Tier-1	4	Beijing, Shanghai, Guangzhou, Shenzhen	Cities with much a higher price level than all the other cities
Northern	8	Tianjin, Shijiazhuang, Taiyuan, Hohhot, Shenyang, Changchun, Harbin, Dalian	Cities that have similar housing price in northern region (Huabei and Dongbei)
Eastern	7	Nanjing, Hangzhou, Ningbo, Fuzhou, Xiamen, Jinan, Qingdao	Cities that have similar housing price in the eastern region[5]
Middle Southern	7	Haikou, Nanning, Hefei, Nanchang, Zhengzhou, Wuhan, Changsha	Cities that have similar housing price in the middle and south eastern region
Western	9	Chongqing, Kunming, Guiyang, Chengdu, Xi'an, Lanzhou, Xining, Yinchuan, Urumqi	Cities that have similar housing price in the western region

Source: Wang et al. (2008)

changes in the cities in these two regions. However, this is not to imply that housing price is not an important channel through which monetary policy impacts consumption. We notice that in 2008, more than 71% of the household wealth is housing wealth (US$75,000) in the eastern and Tier-1 cities, which is much higher than the cities in the other two regions. This might indicate the key role of housing wealth in monetary policy transmission in the cities in the eastern and Tier-1 regions. These assumptions will be tested by using the empirical studies below.

4.   Empirical Method and Data

4.1   Methodology and Hypothesis

Studies on the monetary transmission mechanism have focused on the VAR model proposed by Sims (1980) and the SVAR model developed by Cooley and LeRoy (1985) and Blanchard and Quah (1989). The advantage of SVAR over VAR is that the former identifies a set of independent disturbances by means of restrictions provided by the economic theory. It can capture the contemporaneous effects of endogenous variables and relax partial identification for Choleski decomposition (Elbourne, 2008). However, the

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[5] Hefei and Nanchang are generally regarded as geographically located in the eastern region of China, but classified as Middle Southern because of house price disparity with the Eastern cities but house price similarity with the Middle Southern cities.

Figure 3   Real Housing Price in Cities in Five Regions (2003Q1 – 2010Q4)
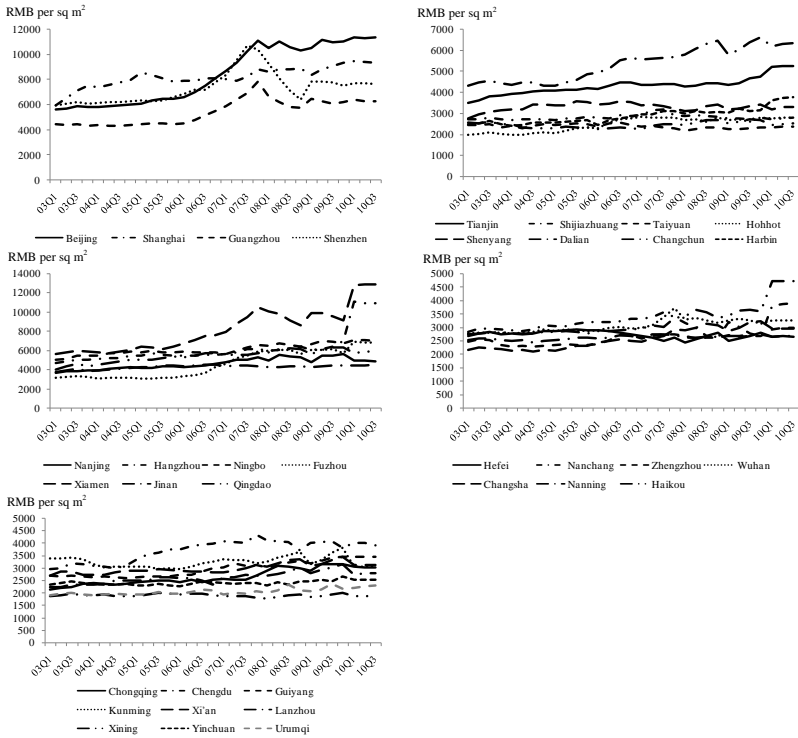
*Source*: China Price Index Research Institute

Note: Housing prices are deflated by city-specific CPI. Classification of each group can be found in Table 1.

orthogonality restriction, which is fundamental in SVAR, is likely to be fairly restrictive, due to the low dimension of SVAR (Leeper et al., 1996). Moreover, ripple effects among regional markets may also increase the theoretical difficulty of imposing restrictions in SVAR (Wang and Liu, 2009). In this study, we use a panel VAR method in the analysis, which combines the VAR approach with the panel-data approach in order to control for unobserved individual heterogeneity and regional correlations. This method was initiated by Chamberlain (1983) and further developed by Pesaran and Smith (1995), and McCoskey and Kao (1998).

The most general form of the multi- country VAR model can be written as:

$$Y_{it} = \beta_0 + \beta_1 Y_{i(t-1)} + ... + \beta_p Y_{i(t-p)} + f_i + e_t,$$

Figure 4   Real Living Expenditure Per Capita in Cities in Five Regions (2003Q1 – 2010Q4)
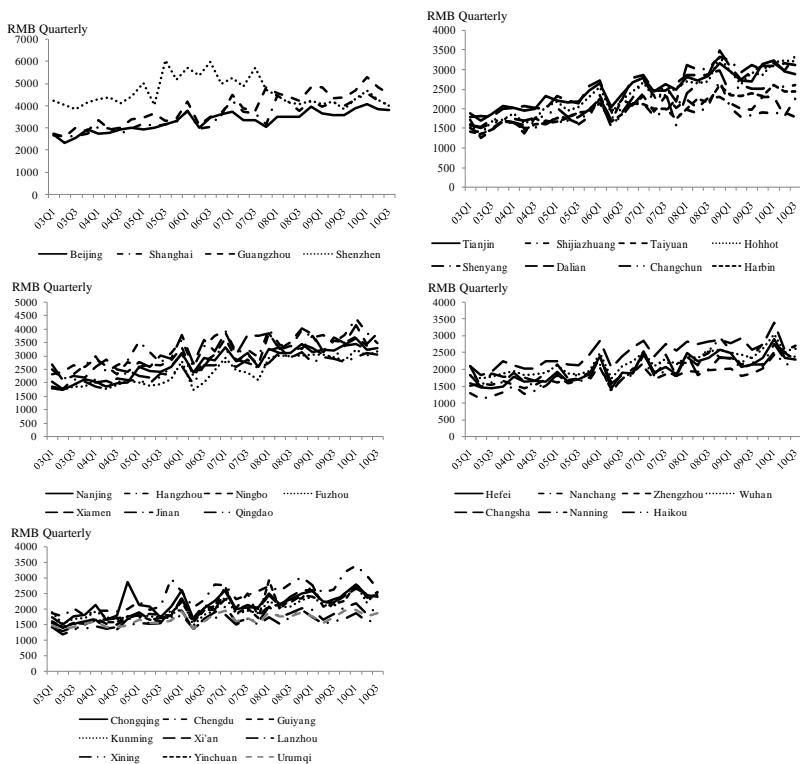
Source: National Statistics Bureau or respective regional statistics bureaus.
Note: Housing related expenditures are excluded from living expenditure indicator and figures show trend before removing seasonal effects.

where Y_{it} is a K x 1 vector of the variables of each of the I region i=1….I. β_i is the (K x I) matrix of coefficients. The disturbances e_t have zero means and a regional specific variance. f_i is the fixed effect in the model. *K* includes the 7-day CHIBOR (Rate) used to measure policy instruments, house prices (HP), household income (IN) and household consumption (CON) in this study. It is used to allow for "individual heterogeneity" at the levels of the variables. Since the fixed effects are correlated with the lags of the dependent variables, we use a forward mean-differencing procedure, referred to as the "Helmert procedure" (see Arellano and Bover, 1995), to avoid biased coefficients. This process preserves the orthogonality between transformed variables and lagged regressors. We can thus use lagged regressors as instruments and estimate the coefficients by using the system generalized method of moments (GMM).

To analyze the impulse responses function, we essentially decompose the structural errors (e_t) into components caused by the unexplained contemporary reduced-form shocks. We use the Cholesky decomposition (Hamilton, 1994) to impose a recursive structure on the model with the order: consumption (CON), household income (IN), house prices (HP), 7-day CHIBOR (Rate) or M2. This ordering is determined by the assumption that monetary policy innovations are orthogonal to other variables in the system. A similar ordering is used by Giuliodori (2005). In this ordering, monetary policy is regarded as the most exogenous variable in the model.

In the empirical test, we calculate the base line model: consumption response to monetary policy, and the counterfactual model: consumption response to monetary policy when the housing market is shut off. That is, we re-run the impulse response function with the restriction that the cross correlations between consumption and house prices are zero in the consumption equation. By comparing the different levels founded by these two models, we can identify the role of house prices in monetary policy transmission. Since the VAR used in the paper is a structural model, the identification problem due to the restricted VAR to shut down the housing price channel is limited.

4.2   Data

A number of indicators have been used as a measure of the monetary policy stance, such as the short-term interest rate (Sims, 1992 and Carlino and DeFina, 1998); index of the Federal Open Market Committee (FOMC) (Romer and Romer, 1989); monetary aggregation (Kajanoja, 2003) and monetary conditions index (MCI), (Freedman, 1995; Alexius and Holmlund, 2008). There is no consensus on the best measure of monetary policy. In Chinese studies, given the unique monetary system, both M2 (Zhang, 2009) and the interest rate (Dickinson and Jia, 2007; Zhang and Wan, 2002) have been used.

In this study, we use interest rate measured by the 7-day CHIBOR. However, as we point out, due to the unique attribute of the monetary policy, M2 is also an important variable in the monetary policy in China. Thus, we also run a panel VAR with M2 as robust tests, as shown in Section 5.3. Using the 7-day CHIBOR as the monetary policy is due to three reasons. First, as can be observed in Figure 2, the 1-year lending rate and the 7-day CHIBOR have common trends and we can choose one to represent the general level. Secondly, in the studies of Elbourne (2008) and Lettau et al.(2002), the interbank rate is used as a monetary policy measure. This may enable us to compare our results with theirs. Finally, due to an overly short period of time, it is difficult to capture the regime of monetary supply in 2009 mentioned above[6]. However, compared

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[6] To capture the potential effects of the global financial crisis, we tried to include a dummy variable. However, it is not significant in the model.

to M2, the 7-day CHIBOR on the other hand is not significantly dynamic, but only with a smoother decrease.

The study is based on quarterly data from 2004 to 2010. Real values deflated by the national CPI and respective regional CPIs are used in the model. The average house price per square meter for each city is obtained from the China Price Index Research Institute and adjusted as the quality-consistent price. The housing price is transaction based and designed to take into account the quality variations in the sample. Thus, they are currently the best available price data in China's housing market. Disposable household income and living expenditure per capita are used. Details on living expenditures are collected from the National Statistics Bureau and respective regional statistics bureaus. Housing related expenditures, including rental, mortgage service and maintenance costs, are excluded from the living expenditure indicator. Retail sales as an alternative indicator has been used to measure consumption in the previous Chinese studies. However, they contain a large proportion of government consumption in the China dataset. It is thus not used in the study. The seasonal effect on household income and consumption is removed by using the X-11 method. The descriptive statistics for the variables used in this paper for each region is shown in Table 2.

5.   Empirical Results

Before we estimate the impulse response functions for the national and regional markets, we first test the order of our time series and cointegration ranks. Panel unit roots tests, with the Levin-Lin-Chu (2002) (LLC) test, confirm that all series are integrated of order one. We also find a long run relationship between the variables at both the national and regional levels (the results are not shown here). Sims et al. (1990) point out that the system's dynamics can be consistently estimated in a VAR model, in levels, if counteraction among the variables exists. In this paper, therefore, we incorporate the levels of those variables into the model.

5.1   National Results

Figure 5 presents the impulse response of household consumption (CON) to a shock of the 7-day CHIBOR (RATE) at the national level. A VAR model is estimated with one lag for all of the variables suggested by the Akaike information criterion (AIC) and the Schwarz criterion (SC). The significance of the results can be interpreted based on the reported 95% confidence intervals (dashed lines in the figures).

Table 2   Descriptive Statistics of Variables for Cities in Each Region

	N	Mean	S.D.	Min	Max
Tier-1					
M2	140	357,629	153,801	158,737	690,931
RATE	140	5.75	1.93	0.95	10.69
IN	140	5,199	1,317	2,969	8,823
HP	140	7,279	2,164	4,126	12,276
CON	140	3,811	954	2,275	6,014
Northern					
M2	280	357,618	153,980	163,330	697,430
RATE	280	5.78	3.09	-2.24	15.97
IN	280	3,103	1,047	1,644	6,465
HP	280	3,276	1,148	1,849	7,206
CON	280	2,182	654	1,157	3,827
Eastern					
M2	245	357,456	153,668	161,559	699,297
RATE	245	5.71	2.50	-0.88	12.31
IN	245	4,288	1,440	2,158	9,810
HP	245	5,151	2,159	1,856	14,111
CON	245	2,804	778	1,606	4,728
Middle Southern					
M2	245	357,138	153,569	162,329	690,930
RATE	245	5.711	2.358	-3.274	12.88
IN	245	2,987	943.7	1,580	6,798
HP	245	2,871	548.6	1,969	5,403
CON	245	2,056	549	1,045	3,690
Western					
M2	315	356,992	153,236	161,411	690,258
RATE	315	5.71	2.53	-1.81	14.26
IN	315	2,645	800.6	1,553	5,832
HP	315	2,765	669.9	1,732	4,688
CON	315	1,960	531	1,117	3,761

Notes: *M2* is monetary supply; *RATE* is 7-day CHIBOR; *IN* is household income; *HP* is house price; and *CON* is household consumption. All are real values deflated by using CPI.

First, we look at the consumption responses to the interest rate via property price, which are shown with solid lines in Figure 5. In line with the expectation of the economic theory, the negative consumption response to the interest rate appreciation is found to be statistically significant at the 95% level. Following the increase in the interest rate, consumption immediately falls and reaches its lowest level of 0.27% in two quarters. The effect of the interest rate on consumption tends to disappear in six quarters. No long-run effect between the interest rate and consumption is found in the impulse response function.

Figure 5   Consumption Impulse Response to Interest Rate Shock Due to Property Prices at National Level
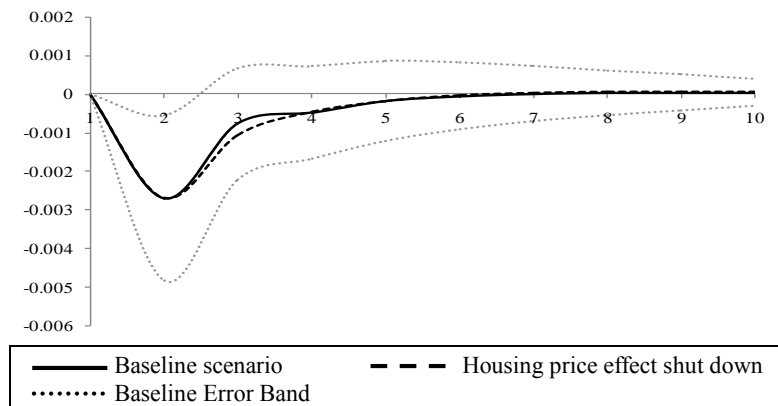
Note: Interest rate is 7-day CHIBOR.

Secondly, we look at the dotted lines in Figure 5, which show the consumption responses to the monetary policy shocks if the housing market effect is shut off. That is, we re-run the impulse response function with the restriction that the cross correlations between consumption and house prices are zero in the consumption equation. This is called the counterfactual impulse response. We can see that in this model, the consumption response is still significant with a slightly different pattern compared with the above baseline impulse response. They both arrive at the same peak level and then present a slightly different pace during two to four quarters.

By measuring the difference between the two effects, we can obtain the contribution of the housing market in monetary transmission. We find that, at the national level, this difference is minimal, which indicates that the role of house prices in interest rate transmission is quite low.

5.2   Regional Results

In terms of the impulse response functions of the five regions, with the exception of the cities in the northern region, we find that the interest rate has significant effects on consumption for the rest of the cities in the other four regions[7]. We also find a noticeable spatial pattern in the correlation among

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[7] The confidence intervals for impulse responses are calculated for the cities in each region. The consumption response to interest rate (monetary supply as well) is not significant at 5% for the cities in the northern region. So further estimation of the role of housing is not carried out for them.

monetary policy, house prices, and consumption. The results for the four significant groups of cities are shown in Figure 6.

First, we compare the role of the interest rate on consumption. We find that in the Tier-1 cities, interest rate shocks have significant effects on consumption with expected signs, but at a low level. The average effects of the interest rate on consumption are 0.2% - 0.3%. This is similar to those of the cities in the eastern region but with a slight higher average level at 0.15-1%. However, for the cities in the middle southern and the western regions, consumption is more sensitive to interest rate and the highest level of consumption response to interest rate for the respective regions is 2.5% and 1.7%.

To understand the role of the house wealth channel in the monetary transmission process, we first calculate the difference level between the results from the baseline and the counterfactual impulse responses, and then we estimate the ratio between the difference level and baseline impulse responses for each year. It is found that in the Tier-1 cities, the average ratio is about 91.25%, which indicates that more than 91.25% of the interest rate is transferred via house wealth, and this level is more than 51.88% in the eastern cities. Similarly, we can calculate the ratio and find that in the cities in the western and the middle southern regions, the role of housing in monetary policy is less significant, with 13.7% and 5.8% of the monetary policy effect transferred by the respective local housing price. All these can be referenced in Figure 6. This could be due to the highly diversified levels of housing wealth across regions as we have pointed out above.

In addition, we find in the Tier-1, middle southern, and western cities, the counterfactual response is slightly larger than the response to the baseline effect. This indicates the negative effect of house wealth on consumption, which is defined as the "substitute effect". In the eastern cities, we find quite a different pattern, in that the counterfactual responses are lower than those in the baseline model. A significant positive effect of household wealth on consumption is suggested, which indicates a "wealth effect" of house prices on consumption. In another study of ours, the regional effect of housing price on consumption is explained by the integration of the consumption function with the dual roles of housing consumption and investment (Yang and Zhao, 2014). Besides, household debt heterogeneity as mentioned in Section 3.2, could be another potential explanation for the regional heterogeneity, since the collateral effect is also an important channel of monetary policy transmission to consumer spending (Aladangady, 2014). Ramcharan et al. (2015) argue that debt rigidity would reduce the benefits that households reap from the effectiveness of expansionary monetary policies.

5.2   Robustness Tests

In this section, we rerun the panel VAR with M2 to test the robustness of the results. Developed by John Keynes, the supply of money and the liquidity-

preference curve interact to determine the level of interest rate at which the quantity of money demanded equals supply. In China, as we have mentioned above, the correlation between monetary supply and interest rate is not as straightforward as that in the western countries.

Figure 7 presents the impulse response of household consumption on M2 at the national level and in the cities of the four applicable regions – Tier-1, eastern, middle southern and western. Compared to the response to the interest rate shown above, we also find the same "substitute effect" of housing price on consumption for all of the regions except for the eastern region. Housing has the most important role in M2 transmission in the middle southern region, and 20% of M2 is transferred by housing wealth.

Figure 6   Consumption Impulse Response to Interest Rate Shock Due to Property Prices in Cities in Four Regions
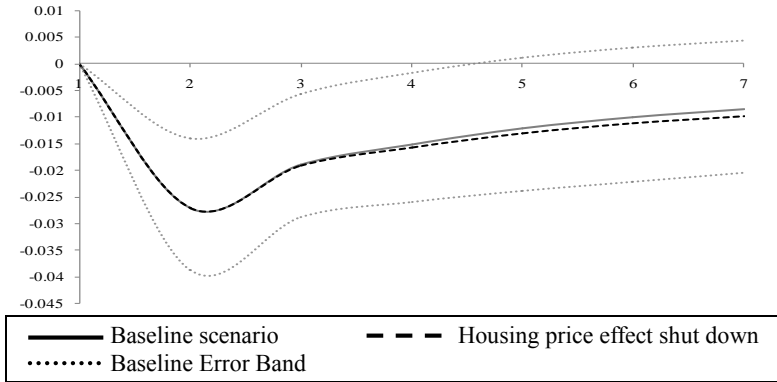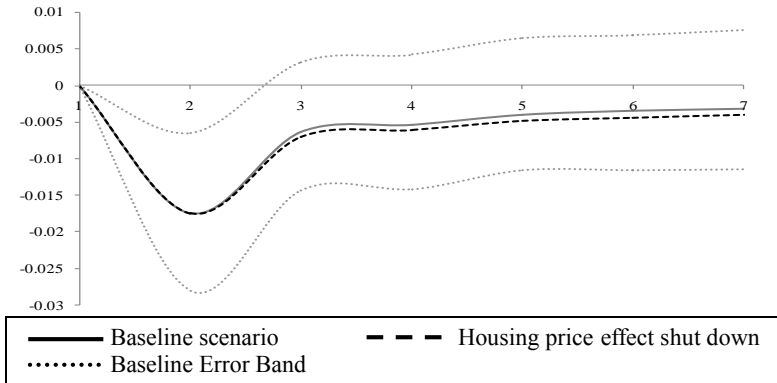
Tier-1 Region
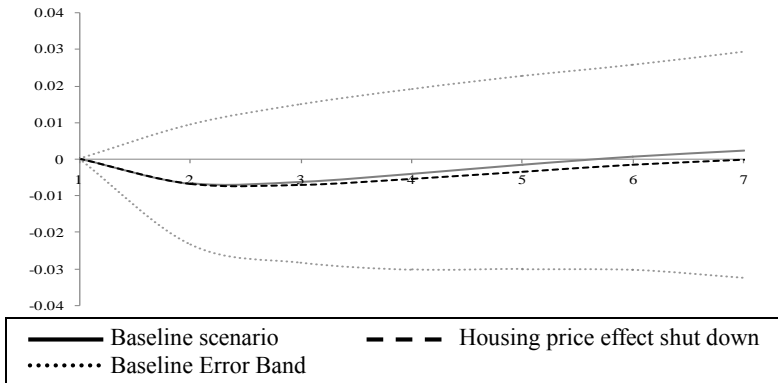
Eastern Region
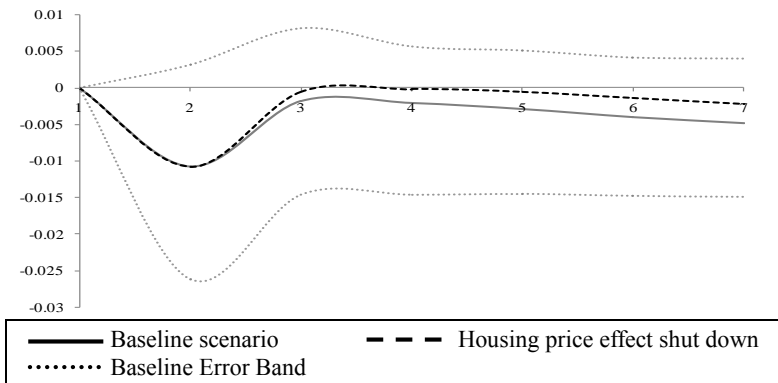
(Continued...)

(Figure 6 Continued)
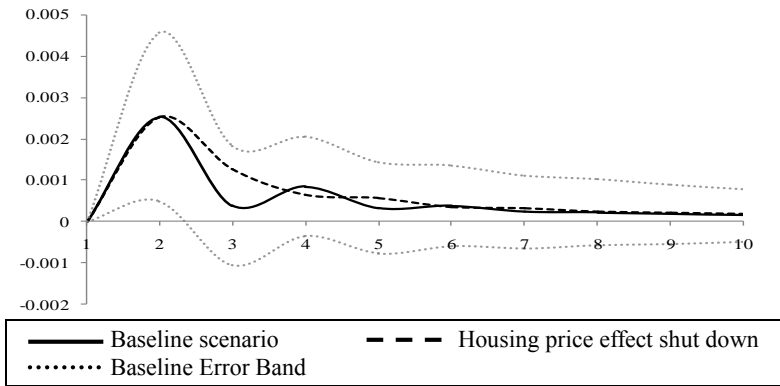
Middle Southern Region

Western Region

Note: 1. Interest rate is 7-day CHIBOR.
　　　2. To examine the role of housing in interest rate transformation, we calculate the difference between the results in the curve of the "baseline scenario" and results in the curve of the "housing price effect shut down" for each time period. When there is a higher average level of the difference, then the role of housing tends to be more significant.

Since the interest rate refers to the monetary price while M2 refers to the monetary volume, the adverse direction of the consumption impulse response to interest rate and M2 can be seen in Figures 6 and 7. It is not our objective in this study to compare the relative effect of the interest rate and monetary supply in China's economy. However, our results indicate that the housing wealth effect tends to be more evident in a price-based monetary policy, such as that measured by the interest rate.

**Figure 7   Consumption Impulse Response to Monetary Supply Shock
                Due to Property Prices, at National Level and in 4 Regions**
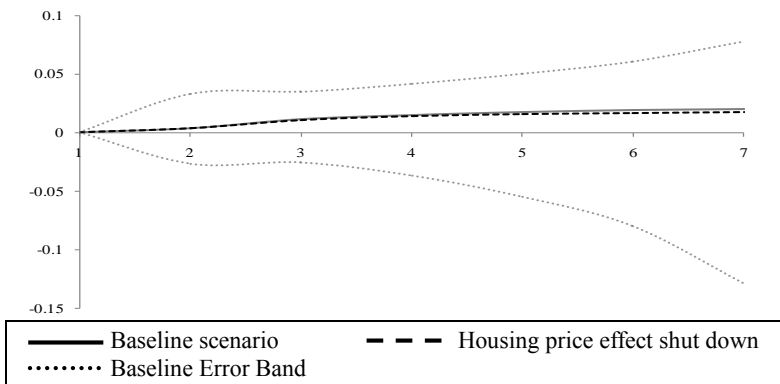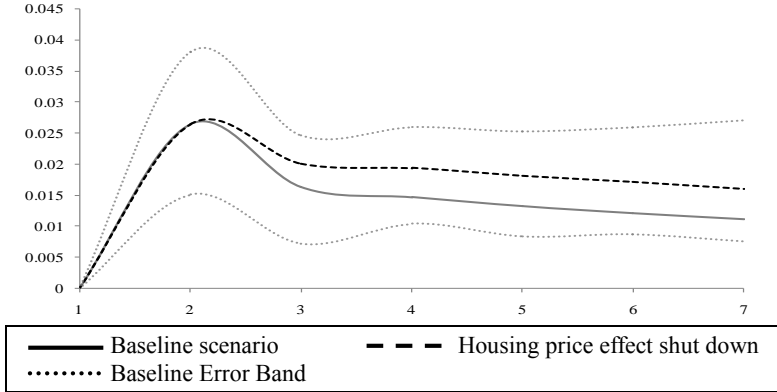
National
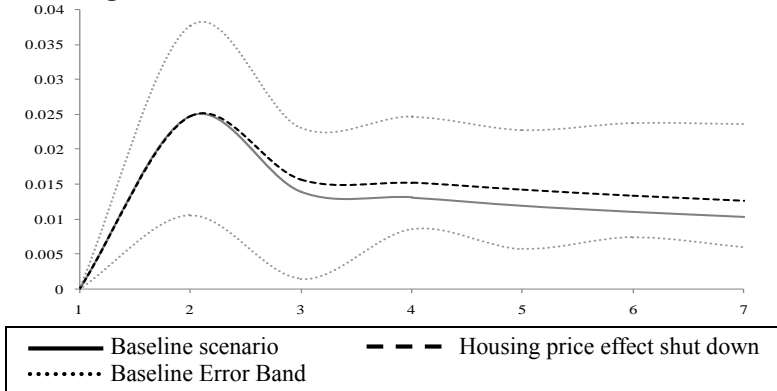

Tier-1 Region
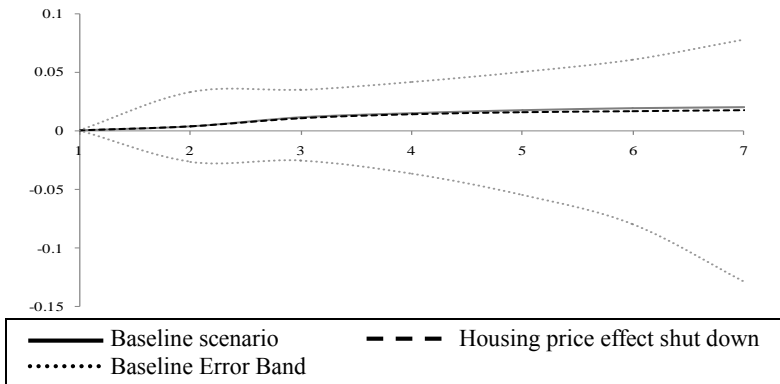
Eastern Region

(Continued...)

(Figure 7 Continued)

Middle Southern Region

Western Region

Note: 1. M2 is used to measure monetary supply.

2. To examine the role of housing in interest rate transformation, we calculate the difference between the results in the curve of the "baseline scenario" and results in the curve of the "housing price effect shut down" for each time period. When there is a higher average level of the difference, then the role of housing tends to be more significant.

6.   Conclusion and Political Implications

This study analyzes the effects of monetary policy on household consumption via the housing market by using a panel VAR from both national and regional perspectives. The effects of the interest rate on consumption are estimated in the national and the regional markets which are clustered into five groups, according to regional prices and economics. The role of house prices in the monetary transmission mechanism is also estimated for the respective markets.

Based on the quarterly data from 2004 to 2010, we find that monetary policy instruments, such the benchmark 1-year lending rate and M2 used in this study, have significant effects on the private expenditure of households, but with a noticeable regional pattern. In particular, we find that the impact of the interest rate on consumption, with the exception of the northern region, is significant at both at the national and regional levels, but has a considerable heterogeneous magnitude across all of the regions. The strongest effect of the monetary policy, measured by the interest rate, on consumption is found in the middle southern and western regions. However, only a small part of these effects are transferred via housing price. That is to say, the propagating contribution of house prices in the monetary transmission to household expenditure is lower in these two regions. Instead, house prices in the cities in the Tier-1 and the eastern regions play a more important role in monetary policy; even household consumption is less sensitive to the changes in the interest rate.

The heterogeneous regional effect found in the paper highlights the importance of understanding the mechanism by which monetary policy propagates through various regions. Monetary policy is generally found to have an important role in the decision-making of a household, and particularly important in interest – sensitive regions; in our case, these are the southern and western regions. Our finding of the regional effect of monetary policy is consistent with the facts found in Sweden (Yang et al., 2011), and the USA (Fratantoni and Schuh, 2003). A loose monetary policy would serve to stimulate household consumption, and can be an effective instrument that targets private consumption in those regions. However, for the Tier-1 and the eastern cities, the relatively low effect of monetary policy on consumption dominantly propagates through the housing market, and thus a loose policy would lead to a higher level of housing price and higher affordability burden. The higher housing wealth in the Tier-1 cities however cannot be successfully propagated to private consumption due to the substitute effect discussed above. Monetary policy cannot be an effective tool in stimulating private consumption and might cause welfare loss and increase inflation pressure.

It is important to further investigate the magnitude of the welfare costs of deviating from an ideal result of a nation – specific optimal monetary policy. This is far beyond the scope of the current study. However, the study suggests that a wisdom targeting monetary policy depends on its welfare effects. When monetary policy is endogenous in a macroeconomic system, such as under hard exchange rate pegs, other macroeconomic policies need to aid and improve the monetary transmission mechanism. Furthermore, monetary authorities need to track household wealth developments and compensate the most vulnerable households or regions for taking on the risk of their policies.

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