商學研究所
RESEARCH INSTITUTE FOR BUSINESS
恒生管理學院
HANG SENG MANAGEMENT COLLEGE

RIB Working Paper Series: RIB16-100003

Home Purchase Restriction and Housing Price: A Distribution Dynamics Analysis

Author: Victor Jing Li [1], Andy Wui Wing Cheng[2] and Tsun Se Cheong[3]

Abstract

China's residential housing market has been largely influenced by the central government's policy initiatives. This study examines how implementation and removal of home purchase restrictions affect housing price changes in major cities. Based on the dataset of 70 large and medium sized cities between 2014 and 2015, the price evolution trends are evaluated by the distribution dynamic analysis based on the method of Mobility Probability Plot (MPP). This newly developed method allows for better exploring housing price dynamics under home purchase restriction policy. There are four major findings: First, home purchase restriction has salient effect on curbing speculative investment demand in terms of lowering large sized housing price growth; Second, home purchase restriction has long run effect in bringing down housing prices if current price increase does not exceed 5 percent on a month-to-month basis; Third, small or large sized housing may face more downward pressure of housing prices than medium sized housing under home purchase restriction; Fourth, removal of home purchase restriction may saliently increase the housing price levels that had been contained.

Keywords Housing purchase restriction; housing price; distribution dynamics; China

JEL Classifications R21• R31• R38

[1] Department of Geography and Resource Management, Chinese University of Hong Kong.
[2] Department of Economics and Finance, School of Business, Hang Seng Management College
[3] Corresponding author. Email address: jamescheong@hsmc.edu.hk. Department of Economics and Finance, School of Business, Hang Seng Management College

1. Introduction

China has transformed from a planned economy into a market economy. Nevertheless, the government has resorted to regulative policies from time to time. Housing market is without exception, after the transition from the welfare housing provision system to the commodity housing market (J. Li et al. 2011; Mak et al. 2007; Tian and Ma 2009). Government basically influences the housing market through three channels: land administration, loan regulation, and purchase restriction. While land management mainly focuses on the supply side, lending and purchase policies aim at controlling housing demand. As China has experienced robust property booms over the last one and half decades, the government has taken a more active role in curbing housing price from going up too fast through demand side interventions. A series of regulative and restrictive policy initiatives have been implemented in recent years, including restriction on home mortgage loans, restriction on selling price, and restriction on home purchase.

Among these restrictive policies, home purchase restriction policy seemed most effective to curbing housing price escalation (J. Li and Xu 2015). On 30 April 2010, the State Council issued the home purchase restriction (HPR) policy to be implemented in 46 major cities. The HPR policy maintained that: i) residents with local hukou or experts with special allowance can buy up to two flats in the city that they live; ii) non-local residents or foreign buyers can buy one flat only; iii) For households who are allowed to purchase two flats, the interval for buying a second property must be at least two years. The HPR policy was first implemented in Beijing, and then adopted in many major cities. The goal was to curb the speculative housing demand for owning more than one property, thus providing more affordable housing opportunities for the first-time buyers and middle income households. Basically, the home purchase restriction was successful in reining the housing bubbles and lowering transaction volumes (Cao et al. 2015; J. V. Li 2016; Sun et al. 2014).

While the home purchase restriction has salient effect on containing housing prices, growing complaints about increasing local fiscal debt due to declining land sale revenues are on the rise. As land sale was a major contributor to local fiscal income, containing housing prices would affect fiscal sustainability of the local governments. Hence since late 2014, various cities have started relaxing home purchase restriction. By mid-2015, most cities have quitted the HPR policy except Beijing, Shanghai, Guangzhou, Shenzhen and Sanya. Previous work has investigated the impact of implementing home purchase restriction on housing price (Z. Du and Zhang 2015), however little is known about the housing price dynamics after removing home purchase restriction. To the best of our knowledge, no study has been conducted to examine the responses to the HPR policy for different sizes of flats. This paper intends to fill in both gaps, using a distribution dynamic analysis to evaluate the price evolution trends of 70 large and medium sized cities' housing markets covering the period of January 2014 to June 2015, during which most cities had abandoned home purchase restrictions. The remainder of this paper is organized as follows: Section 2 reviews relevant literatures on China's housing market performance and housing price dynamics. Section 3 explains the mechanism of the distribution dynamics model and illustrates the data structure. Section 4 discusses the estimation results. Section 5 concludes the findings.

2. Literature Review

Substantial literatures have examined the determinants of housing prices in China. Various factors were investigated, including land price and land sale (J. Li and Chiang 2012; Pan et al. 2015; Wen and Goodman 2013; Jing Wu et al. 2012; D. Zhang et al. 2013), monetary supply and mortgage rate (Liang and Cao 2007; Xu and Chen 2012; Yu 2010; X. Zhang and Sun 2006; Y. Zhang et al. 2012), income growth and unemployment rate (Chow and Niu 2015; Hongyu and Yue 2005; J. Li et al. 2014; Q. Li and Chand 2013; Z. Wang and Zhang 2014; H. Zhang et al. 2007), and hedonic price factors (Hanink et al. 2012; Jim and Chen 2006; Kong et al. 2007; Zheng and Kahn 2008). H. Du et al. (2011) maintained that urban housing market was more efficient than urban land market in terms of price response to external supply and demand shocks. Guo and Huang (2010) found inflow and outflow of hot money an influential contributor to real estate price fluctuation. Bian and Gete (2015) maintained that productivity, saving glut and policy stimulus were dominant factors of housing price booms. Lin and Tsai (2016) found an asymmetric reversion pattern of housing price rise and fall: there was resistance to the falling of housing prices, but an overreacting behavior to the rising of housing prices. Ahuja et al. (2010) argued that housing price boom will be maintained due to low interest environment, lack of alternative investment vehicles and underdeveloped housing mortgage market. Zheng et al. (2010) found that housing prices are lower in cities with higher ambient pollution levels. S. Wang et al. (2011) found that 1% increase in urban economic openness would lead to 0.282% increase in urban real estate prices. Choy and Li (2016) discovered that housing prices are jetted up indirectly in provinces with higher proportions of degree holders.

There has been no consensus on whether government intervention with the housing market was successful in China. On the one hand, Chen et al. (2011) found government's initiative of quickening urbanization significantly contributed to residential housing price increase. Mak et al. (2007)

explored the homeownership constraints of Chinese households and found that the government restricted less affluent and rural buyers from accessing urban housing market. Tian and Ma (2009) argued that state intervention through land supply largely accounted for the real estate bubbles. On the other hand, Hui and Wang (2014) maintained that government's macro-control measures are inefficient to affect housing price and transaction volume. Wei et al. (2014) unraveled the evasive practices and illicit tactics of real estate developers to invalidate the policy effects of government's credit controls. Due to the Global Financial Tsunami, since 2009 the Chinese government has implemented a large fiscal stimulus package to maintain economic development. However, an intended outcome was that much of the fiscal stimulus package transfer paid to state owned enterprises were used to purchase real estate assets (Deng et al. 2011).

Regarding the effectiveness of home purchase restriction, Sun et al. (2014) found that home purchase restriction was helpful to squeeze out speculative demand and dampen the soaring home prices in Beijing: specifically 17-24% decrease in resale price, 25% drop in the price-to-rent ratio compared to its historical mean, and a 50% to 75% reduction in sales transaction volume. Cao et al. (2015) argued that although home purchase restriction was effective to reduce property prices and transaction volumes, it was ineffective to contain the nationwide construction booms. J. V. Li (2016) found that the minimum effective period of home purchase restriction on containing housing price bubbles was 2 years for the 30 cities studied, which coincided with the banning period of eligible households for buying a second flat. He further revealed that among the 30 cities 26 did not show signs of housing bubbles for a period of 3 years after implementing the HPR policy. While these studies took different perspectives and adopted various techniques, none of them explored the housing price dynamics after quitting the HPR policy. This paper aims at filling this gap, based on the distribution dynamics analysis.

3. Research Method and Data

Distribution dynamics analysis was first proposed by Quah (Quah 1993a, 1993b, 1996c, 1996b, 1996a, 1997). It can be broadly divided into two approaches, namely, the discrete Markov transition matrix approach and the stochastic kernel approach. The latter can be viewed as an improvement of the former as the latter can circumvent the issue of demarcation of state.

The bivariate kernel estimator used in the analysis can be represented as:

$$\hat{f}(x,y) = \frac{1}{nh_1h_2}\sum_{i=1}^{n} K(\frac{x-X_{i,t}}{h_1},\frac{y-X_{i,t+1}}{h_2}) \quad (1)$$

where h_1 and h_2 are optimal bandwidths which are calculated based on the approach suggested by Silverman (Silverman 1986), *K* is the normal density function, *n* is the number of observations, *x* is a variable representing the monthly growth rate of housing price of a city at time t, *y* is a variable representing the monthly growth rate of housing price of that city at time t+1, $X_{i,t}$ is an observed value of the monthly growth rate of housing price of a city at time t, and $X_{i,t+1}$ is the observed value of the monthly growth rate of housing price of a city at time t+1. It should be noted that the technique of adaptive kernel with flexible bandwidth is employed in this analysis in order to take the sparseness of data into consideration (Silverman 1986).

Suppose that the evolution is first order and time invariant, so that the distribution at time $t+\tau$ depends on *t* only and not on any previous income distribution, then the distributions at time $t+\tau$ can be computed by:

$$f_{t+\tau}(z) = \int_0^\infty g_\tau(z|x)f_t(x)dx \quad (2)$$

where $f_{t+\tau}(z)$ is the τ-period-ahead density function of *z* conditional on *x*, $g_\tau(z|x)$ is the transition probability kernel which maps the distribution from time *t* to $t+\tau$, and $f_t(x)$ is the kernel density function of the distribution of growth rate of housing price at time *t*.

The long-term steady state is termed the ergodic distribution. It can be computed by:

$$f_\infty(z) = \int_0^\infty g_\tau(z|x)f_\infty(x)dx \quad (3)$$

where $f_\infty(z)$ is the ergodic density function when τ is infinite.

In this paper, the Mobility Probability Plot (MPP) is employed to analyze the mobility of growth of housing price for each city. This tool was developed by Cheong and Wu (2015), and it has been employed in various research areas in analyzing distribution dynamics, such as industrial output (Cheong and Wu 2015), rural household income (S. Li and Cheong 2016) and even carbon dioxide emissions (Cheong et al. 2016; Jianxin Wu et al. 2016).

The MPP shows the net upward mobility probability of each city and it can be calculated by computing $p(x)$:

$$p(x) = \int_{x}^{\infty} g_{\tau}\,(z|x)dz - \int_{0}^{x} g_{\tau}\,(z|x)dz \qquad (4)$$

The MPP ranges from -100 to 100. Negative values indicates that the city has a net probability of moving downwards in the distribution of growth rate indicating that the city has a high tendency of registering a decline in growth rate of the housing price. In contrast, a positive value of MPP suggests that the city will have a net probability of moving upwards in the distribution of growth rate indicating that the city will high tendency of registering an increase in growth rate of the housing price.

This study is based on an analysis of the latest housing price data available from the website of National Bureau of Statistics of China (http://data.stats.gov.cn/easyquery.htm?cn=A01). The data of the monthly growth rates of housing price of different areas are compiled for 70 large and medium sized cities from January 2014 to June 2015. It is worth noting that the growth rate is expressed as ratio, and computed by dividing the housing price of the current month by the price in last month. The growth of housing price is expressed in percentage; so a 100 means that there is no change in the housing price. A value greater than 100 means that there is an increase in the growth rate of housing price, whereas a value smaller than 100 means that there is a decline of the growth rate of the housing price.

4. Discussion of Results

Stochastic kernel analyses are performed to compute the transitional dynamics for each city. Fig. 1a shows the three-dimensional plots of residential housing with unit area that is 144 square meters and above, for cities with HPR. Fig. 1b shows the three-dimensional plots of the same sized housing, but for cities without HPR. In the 3D plot, X-axis presents housing price at period t. Y-axis presents housing price at period t+1. The width of the transition probability kernel for both HPR and non-HPR cities are dispersed with the density mass concentrated along 45 degree diagonal line. This indicates that future housing price can vary saliently. There is only one peak for non-HPR cities located near 100, suggesting that housing price change tend to cluster among most of these cities. However, there are twin peaks in Fig. 1a, indicating that housing prices in cities with HPR are clustered with two groups.

a) Sized 144+ with HPR b) Sized 144+ without HPR

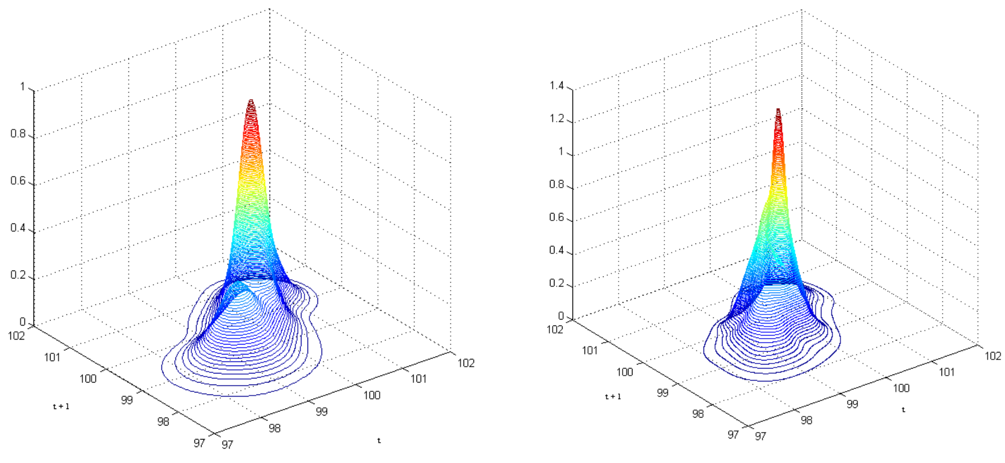


Fig. 1 Three-dimensional plot of transitional probability kernel for growth rate of housing price with monthly transitions, sized 144 square meters and above, from Jan 2014 to Jun 2015. Source: authors' calculation.

To better present the transitional dynamics, Fig. 2 displays the associated overhead view of their contour maps in Fig. 1, with the stochastic transition probability kernel of growth rate of housing price changes across the range 97 to 102. The width of the transition probability kernel is dispersed in Fig. 2, implying inconsiderable persistence in the growth rate of housing price distribution.

a) Sized 144+ with HPR b) Sized 144+ without HPR

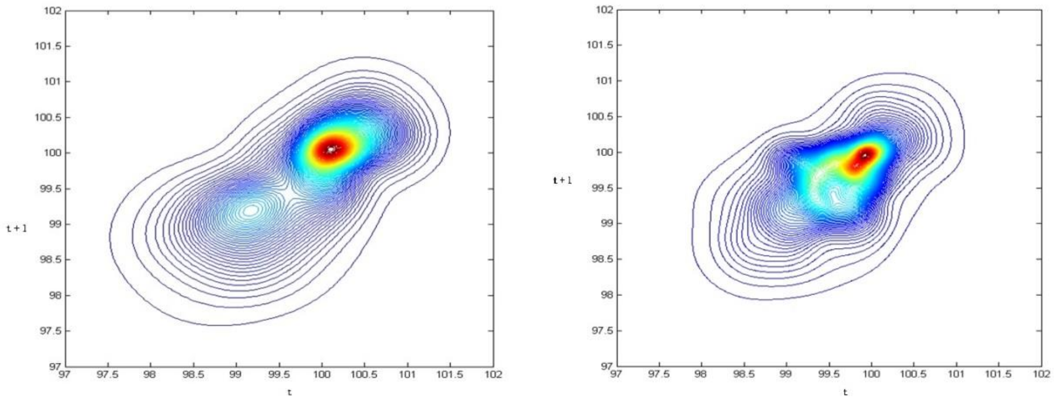


Fig. 2 Contour map of transition probability kernel for growth rate of housing price with monthly transitions, sized 144 square meters and above, from Jan 2014 to Jun 2015. Source: authors' calculation.

Fig. 3 shows the three-dimensional plots of residential housing with unit area between 90 and 144 square meters. Unlike large sized housing, both housing price changes in cities with or without HPR have only one peak near 100, suggesting that housing price changes tend to cluster among these cities. The width of the transition probability kernel for both HPR and non-HPR cities are dispersed with the density mass concentrated along 45 degree diagonal line. Hence there is not much difference in the clustering of housing price in HPR and non-HPR cities.

a) Sized 90-144 with HPR b) Sized 90-144 without HPR

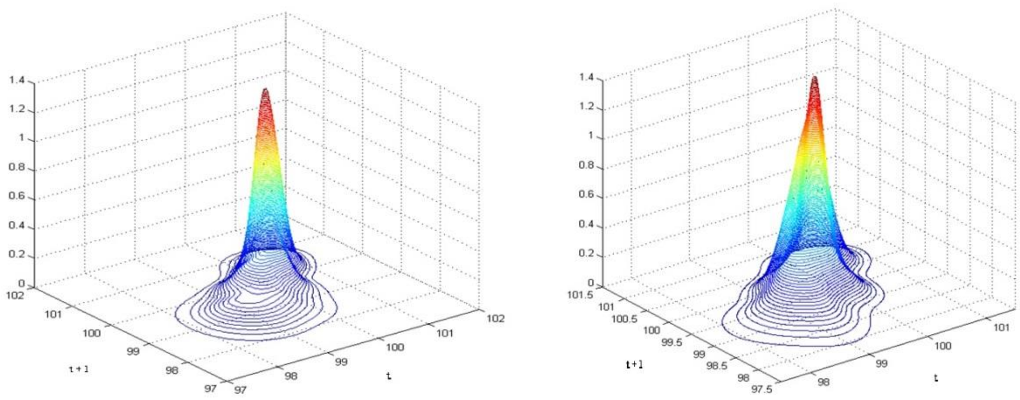
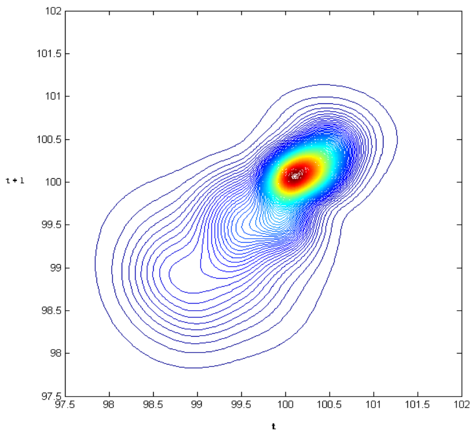


Fig. 3 Three-dimensional plot for transition probability kernel for growth rate of housing price with monthly transitions, sized 90-144 square meters, from Jan 2014 to Jun 2015. Source: authors' calculation.

Fig. 4 displays the associated overhead view of their contour maps in Fig. 3, with the stochastic transition probability kernel of growth rate of housing price changes across the range 97.5 to 102. It is apparent that the width of the transition probability kernel is dispersed in Fig. 4, implying inconsiderable persistence in the growth rate of housing price distribution.

a) Sized 90-144 with HPR



b) Sized 90-144 without HPR

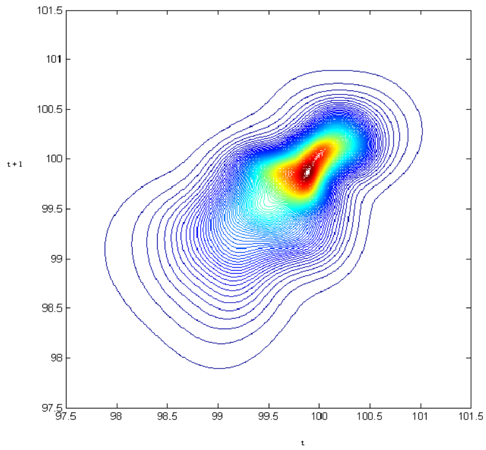


Fig. 4 Contour map of transition probability kernel for growth rate of housing price with monthly transitions, sized 90-144 square meters, from Jan 2014 to Jun 2015. Source: authors' calculation.

Fig. 5 shows the three-dimensional plots of residential housing with unit area below 90 square meters. Similar to large and medium sized housing, the width of the transition probability kernel for both HPR and non-HPR cities are dispersed with the density mass concentrated along 45 degree diagonal line. There is only one peak for non-HPR cities, but twin peaks for HPR cities. Compared with large and medium sized housing, the plots of small sized housing are more widespread. In particular, the plot area of small sized housing with HPR constraints is largest among different figures. This observation indicates that small sized housing prices have the highest volatility. Even the plot area of small sized housing without HPR is larger than the plot areas of large and medium sized housing, implying that small sized flats are quite volatile compared to the other sizes. This finding is reasonable as small sized flats are favored by the market buyers because they are more affordable.

a) Sized 90- with HPR

b) Sized 90- without HPR

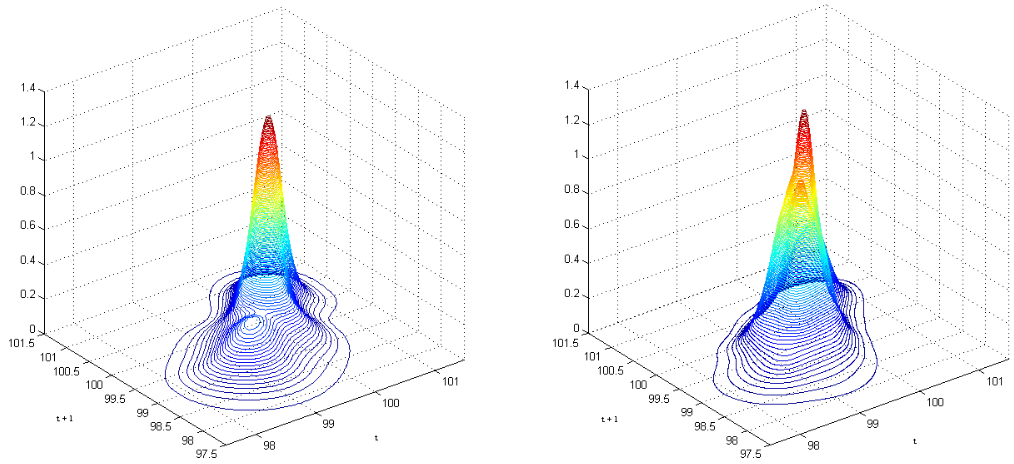


Fig. 5 Three-dimensional plot for transition probability kernel for growth rate of housing price with monthly transitions, sized 90 square meters and below, from Jan 2014 to Jun 2015. Source: authors' calculation.

Fig. 6 displays the associated overhead view of their contour maps in Fig. 5, with the stochastic transition probability kernel of growth rate of housing price changes across the range 97.5 to 101.5. It is noteworthy that the wider range of transition probability kernel and the twin peaks of HPR cities of small sized housing are in similar forms to large sized housing. Yet no observation of two clusters of housing prices is found for medium sized housing, this can explain why the developers would like to build more medium sized housing despite governments' requirements on providing more small sized housing: selling small or large sized housing may face more uncertainty in housing price changes in the downward direction.

a) Sized 90- with HPR b) Sized 90- without HPR

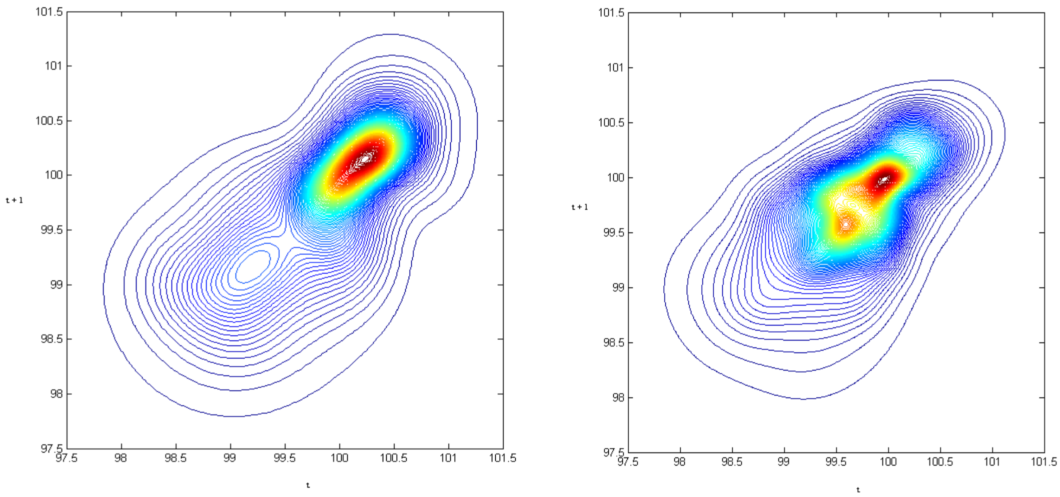


Fig. 6 Contour map of transition probability kernel for growth rate of housing price with monthly transitions, sized 90- square meters, from Jan 2014 to Jun 2015. Source: authors' calculation.

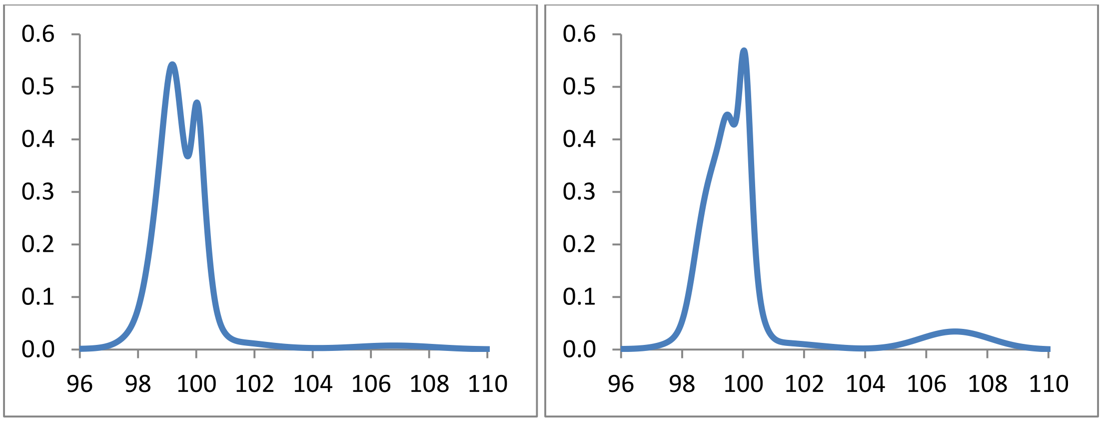
While figures 1 to 6 provide the current state of housing price distributions, it is essential to prepare a forecast of future distributions so as to gain a better understanding of future evolution of the growth rate of the housing price. Ergodic distribution is adopted to estimate the future price trends. Fig. 7 shows the long run distribution of housing prices for three housing sizes with HPR. Convergence clubs can be observed for all three housing sizes. For large sized housing, the highest and second highest peaks were 99.10 and 99.96. For medium sized housing, the highest and second highest peaks were 99.36 and 99.96. For small sized housing, the highest and second highest peaks were 99.03 and 99.91. The highest and the second highest peaks in all the three distributions of different housing sizes are situated below 100, thereby indicating that the growth rate would be reduced after the implementation of HPR. The finding shows clearly that HPR was effective in curbing the growth of housing prices.

However, it can be observed that there is a small peak situated around the value of 107 for all the housing sizes. This finding is disturbing as it indicates that even though HPR was implemented in some of the cities, the housings with high growth rate (those with an increase of 7% in price on a monthly basis) would still register an increase in growth rate in the next month.

In comparison, Fig. 8 shows the long run distribution of housing prices for three housing sizes without HPR. In contrast to housing price convergence under HPR, the housing price ratio without HPR constraints for all three sizes will converge to the unity level, which is with a ratio equal 100. Specifically, the value of convergence is 99.83 for large sized housing, 99.79 for medium sized housing, and 99.89 for small sized housing. By comparing Fig. 7 with Fig. 8, it can be observed that the highest peaks of both figures are situated around 100 (Except for Fig. 7a which is below 100 for the large sized housing), however, the second highest peak (which is far below 100) can be found in the cities with HPR for medium and small housing sizes; it implies that after the implementation of HPR, although some cities still have a growth rate of 100, those cities which are belong to the second highest peak would have a much lower growth rate. In particular, for large sized housing the effect is more significant than small and medium sized housing, indicating that HPR is effective in curbing speculative demand (speculative buyers prefer to buy large sized housing as they anticipate higher asset appreciation).

a) Sized 144+ with HPR

b) Sized 90-144 with HPR



c) Sized 90- with HPR

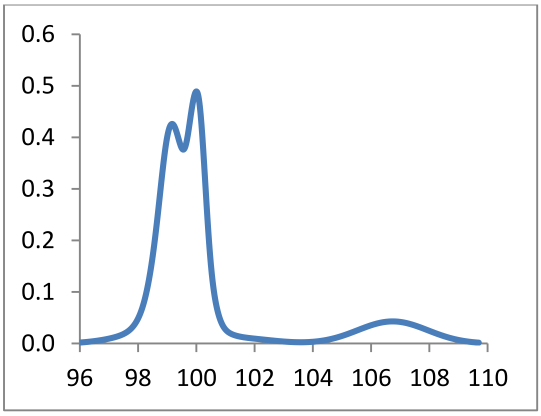
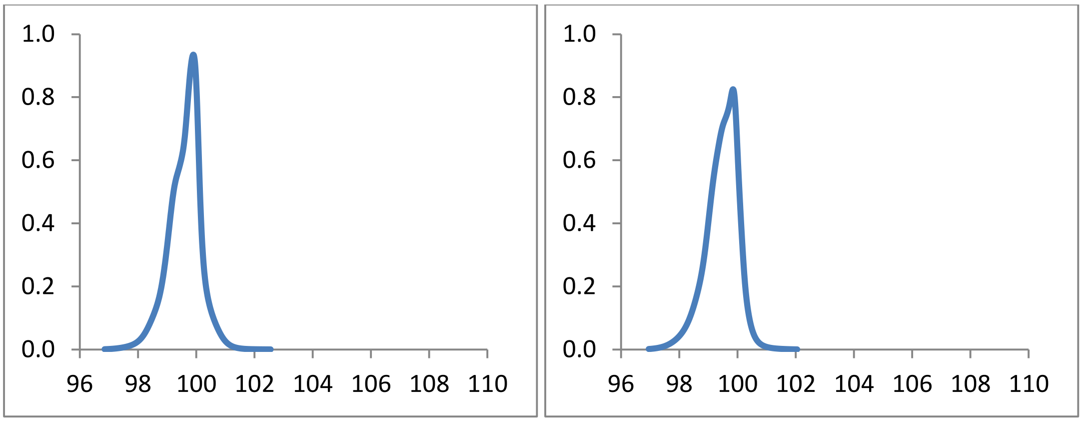


Fig. 7 Ergodic distribution for growth rate of housing price (with HPR) monthly transitions, Jan 2014 - Jun 2015. Source: authors' calculation.

Moreover, comparing figures 7 a, b, and c, it can be observed that medium and small sized housing also have a peak around 107, but the peak of the large sized housing at 107 is very small and negligible; thereby suggesting that HPR was more effective in curbing housing price for large sized housing. The convergence to unity under no HPR clearly differs from the twin-peaks pattern under HPR, indicating the effectiveness of HPR in curbing housing prices. It also implies that removal of HPR will significantly increase the housing price levels that had been contained.

a) Sized 144+ without HPR

b) Sized 90-144 without HPR



c) Sized 90- without HPR

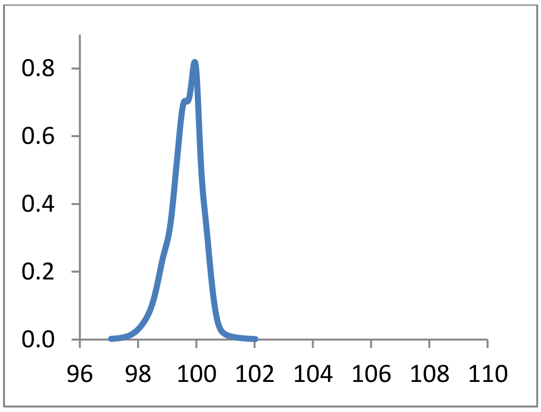


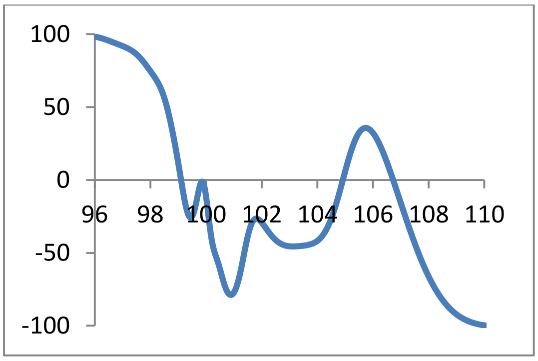
Fig. 8 Ergodic distribution for growth rate of housing price (without HPR) monthly transitions, Jan 2014 - Jun 2015. Source: authors' calculation.

As the ergodic distribution in Fig. 7 has shown the emergence of convergence clubs, however, the mobility of the cities cannot be known. Although one can always examine the distribution of the probability mass in the three-dimensional plot and the contour map, it is difficult to discern the greatest portion of probability mass by eye. The new framework of MPP can effectively tackle the problem and offer a direct interpretation of the probability mass.

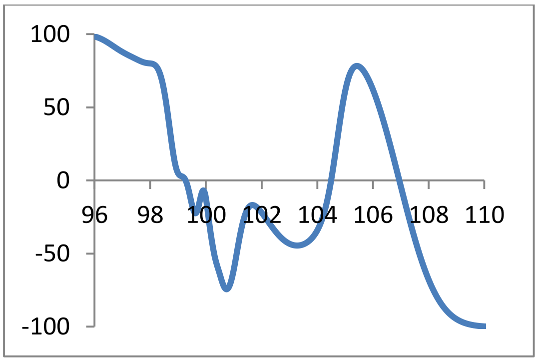
Fig. 9 displays the MPP on distributions of the probability mass under HPR. Fig. 9a indicates that MPP for large sized housing is below zero for cities with growth rate of housing price ratio ranged from 99.10 to 104.86. Yet for growth rate of housing price ratio from 104.86 to 106.68, the MPP lies above zero which shows a net probability of moving upward. Afterwards, it displays a net tendency to move downward in the coming periods again for growth rate of housing price greater than 106.68. The distribution suggests that cities with HPR will have a net probability of downward housing price trend if current price levels are between 99 and 105, or above 107. Accordingly, it may call for the attention of the policy makers on large sized housing with growth rate of housing price between 105 and 107. At this range HPR seem not effective to curb housing price increase in large sized units.

Similarly patterns are observed for medium and small sized housing units. In Fig. 9b, the MPP for medium sized housing stays above the horizontal axis with growth rate of housing price ratio from 96 to 99 and intersects the horizontal axis at 99.03. Afterwards, it lies below the horizontal axis and all the way down to 104.46. It should be noted that medium sized housing priced at 104.46 to 106.89 has a net tendency of moving upwards. Regarding the MPP for small sized housing, in Fig. 9c the MPP lies below the horizontal axis from the intersection point of 99.06 onwards till 104.19. Yet for housing price between 104.19 and 106.62 the overall trend is upward. In summary, HPR is effective to curb housing price in the long run, however, it is no longer effective for those cities which have a growth level of 5 percent.

a) Sized 144+ with HPR



b) Sized 90-144 with HPR



c) Sized 90- with HPR

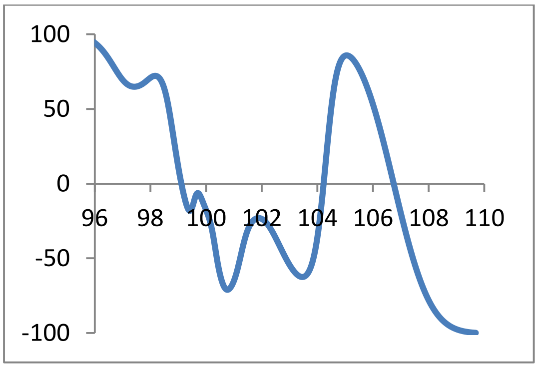


Fig. 9 Mobility probability plot (MPP) for growth rate of housing price ratio (with HPR) with monthly transitions, Jan 2014 - Jun 2015. Source: authors' calculation.

5. Conclusion

This paper examines the impacts of home purchase restriction on the transitional dynamics of housing prices among China's 70 major cities. Stochastic kernel analysis are performed for large, medium and small sized housing to depict city level housing price evolution dynamics. The ergodic distributions reveals that convergence of growth rate to unity is possible for cities with home purchase restriction, indicating that HPR have salient effect on curbing housing price growth compared to cities with no restrictions, echoing some previous studies (Cao et al. 2015; Z. Du and Zhang 2015; J. V. Li 2016; Sun et al. 2014). The paper further introduces a new framework of distribution dynamics analysis namely the mobility probability plot (MPP), which facilitates the comparison of policy effectiveness on price trends in different sized housing units. According to MPP, home purchase restriction has long run effect in bringing down the growth rate of housing prices if current price increase does not exceed 5 percent on a month-to-month basis. Moreover, contour maps of transition probability kernel suggest that small or large sized housing may face more downward pressure of housing prices than medium sized housing under home purchase restriction. Finally, comparison of the three-dimensional plot of transitional probability kernel indicates that removal of HPR may significantly increase the housing price levels that had been contained.

Reference

Ahuja, A., Cheung, L., Han, G., Porter, N., & Zhang, W. (2010). Are House Prices Rising Too Fast in China? *IMF Working Papers*.

Bian, T. Y., & Gete, P. (2015). What drives housing dynamics in China? A sign restrictions VAR approach. *Journal of Macroeconomics, 46*, 96-112, doi:http://dx.doi.org/10.1016/j.jmacro.2015.08.004.

Cao, J., Huang, B., & Lai, R. N. (2015). On the Effectiveness of Housing Purchase Restriction Policy in China: A Difference in Difference Approach. *SSRN Working Paper*.

Chen, J., Guo, F., & Wu, Y. (2011). One decade of urban housing reform in China: Urban housing price dynamics and the role of migration and urbanization, 1995–2005. *Habitat International, 35*(1), 1-8, doi:http://dx.doi.org/10.1016/j.habitatint.2010.02.003.

Cheong, T. S., & Wu, Y. (2015). Convergence and Transitional Dynamics of China's Industrial Output: A County-Level Study Using a New Framework of Distribution Dynamics Analysis. *China Economic Review, Forthcoming*, doi:doi:10.1016/j.chieco.2015.11.012.

Cheong, T. S., Wu, Y., & Wu, J. (2016). Evolution of Carbon Dioxide Emissions in Chinese Cities: Trends and Transitional Dynamics. *Journal of the Asia Pacific Economy, Forthcoming*.

Chow, G. C., & Niu, L. (2015). Housing Prices in Urban China as Determined by Demand and Supply. *Pacific Economic Review, 20*(1), 1-16, doi:10.1111/1468-0106.12080.

Choy, L. H. T., & Li, V. J. (2016). The role of higher education in China's inclusive urbanization. *Cities*, doi:http://dx.doi.org/10.1016/j.cities.2016.04.008.

Deng, Y., Randall, M., Jing, W., & Bernard, Y. (2011). Monetary and Fiscal Stimuli, Ownership Structure, and China's Housing Market. *NBER Working Paper*

Du, H., Ma, Y., & An, Y. (2011). The impact of land policy on the relation between housing and land prices: Evidence from China. *The Quarterly Review of Economics and Finance, 51*(1), 19-27, doi:http://dx.doi.org/10.1016/j.qref.2010.09.004.

Du, Z., & Zhang, L. (2015). Home-purchase restriction, property tax and housing price in China: A counterfactual analysis. *Journal of Econometrics, 188*(2), 558-568, doi:http://dx.doi.org/10.1016/j.jeconom.2015.03.018.

Guo, F., & Huang, Y. S. (2010). Does "hot money" drive China's real estate and stock markets? *International Review of Economics & Finance, 19*(3), 452-466, doi:http://dx.doi.org/10.1016/j.iref.2009.10.014.

Hanink, D. M., Cromley, R. G., & Ebenstein, A. Y. (2012). Spatial Variation in the Determinants of House Prices and Apartment Rents in China. [journal article]. *The Journal of Real Estate Finance and Economics, 45*(2), 347-363, doi:10.1007/s11146-010-9262-3.

Hongyu, L., & Yue, S. (2005). Housing Prices and General Economic Conditions: An Analysis of Chinese New Dwelling Market. *Tsinghua Science & Technology, 10*(3), 334-343, doi:http://dx.doi.org/10.1016/S1007-0214(05)70078-X.

Hui, E. C. M., & Wang, Z. (2014). Price anomalies and effectiveness of macro control policies: Evidence from Chinese housing markets. *Land Use Policy, 39*, 96-109, doi:http://dx.doi.org/10.1016/j.landusepol.2014.04.003.

Jim, C. Y., & Chen, W. Y. (2006). Impacts of urban environmental elements on residential housing prices in Guangzhou (China). *Landscape and Urban Planning, 78*(4), 422-434, doi:http://dx.doi.org/10.1016/j.landurbplan.2005.12.003.

Kong, F., Yin, H., & Nakagoshi, N. (2007). Using GIS and landscape metrics in the hedonic price modeling of the amenity value of urban green space: A case study in Jinan City, China. *Landscape and Urban Planning, 79*(3–4), 240-252, doi:http://dx.doi.org/10.1016/j.landurbplan.2006.02.013.

Li, J., Chiang, Y.-H., & Choy, L. (2011). Central–local conflict and property cycle: A Chinese style. *Habitat International, 35*(1), 126-132, doi:http://dx.doi.org/10.1016/j.habitatint.2010.06.002.

Li, J., & Chiang, Y. H. (2012). What pushes up China's real estate price? *International Journal of Housing Markets and Analysis, 5*(2), 161-176, doi:doi:10.1108/17538271211225913.

Li, J., & Xu, Y. (2015). Evaluating restrictive measures containing housing prices in China: A data envelopment analysis approach. *Urban Studies*, doi:10.1177/0042098015594594.

Li, J., Xu, Y., & Chiang, Y.-H. (2014). Property Prices and Housing Affordability in China: A Regional Comparison. *Journal of Comparative Asian Development, 13*(3), 405-435, doi:10.1080/15339114.2014.927747.

Li, J. V. (2016). Housing Policies in Hong Kong, China and the People's Republic of China. *ADBI Working Paper*.

Li, Q., & Chand, S. (2013). House prices and market fundamentals in urban China. *Habitat International, 40*, 148-153, doi:http://dx.doi.org/10.1016/j.habitatint.2013.04.002.

Li, S., & Cheong, T. S. (2016). Convergence and Mobility of Rural Household Income in China: New Evidence from a Transitional Dynamics Approach. *China Agricultural Economic Review, Forthcoming*.

Liang, Q., & Cao, H. (2007). Property prices and bank lending in China. *Journal of Asian Economics, 18*(1), 63-75, doi:http://dx.doi.org/10.1016/j.asieco.2006.12.013.

Lin, W.-Y., & Tsai, I. C. (2016). Asymmetric Fluctuating Behavior of China's Housing Prices. *China & World Economy, 24*(2), 107-126, doi:10.1111/cwe.12153.

Mak, S. W. K., Choy, L. H. T., & Ho, W. K. O. (2007). Privatization, housing conditions and affordability in the People's Republic of China. *Habitat International, 31*(2), 177-192, doi:http://dx.doi.org/10.1016/j.habitatint.2006.11.003.

Pan, J.-N., Huang, J.-T., & Chiang, T.-F. (2015). Empirical study of the local government deficit, land finance and real estate markets in China. *China Economic Review, 32*, 57-67, doi:http://dx.doi.org/10.1016/j.chieco.2014.11.003.

Quah, D. (1993a). Empirical Cross-Section Dynamics in Economic Growth. *European Economic Review, 37*, 426 - 434.

Quah, D. (1993b). Galton's Fallacy and Tests of the Convergence Hypothesis. *Scandinavian Journal of Economics, 95*, 427 - 443.

Quah, D. (1996a). Empirics for Economic Growth and Convergence. *European Economic Review, 40*, 1353 - 1375.

Quah, D. (1996b). Regional Convergence Clusters across Europe. *European Economic Review, 40*, 951 - 958.

Quah, D. (1996c). Twin Peaks: Growth and Convergence in Models of Distribution Dynamics. *The Economic Journal*, *106*, 1045 - 1055.

Quah, D. (1997). Empirics for Growth and Distribution: Stratification, Polarization, and Convergence Clubs. *Journal of Economic Growth, 2*, 27 - 59.

Silverman, B. W. (1986). *Density Estimation for Statistics and Data Analysis*. New York: Chapman and Hall.

Sun, W., Zheng, S., Geltner, D., & Wang, R. (2014). The Housing Market Effects of Local Home Purchase Restrictions: Evidence from Beijing. *Journal of Real Estate Finance and Economics*, Forthcoming

Tian, L., & Ma, W. (2009). Government intervention in city development of China: A tool of land supply. *Land Use Policy, 26*(3), 599-609, doi:http://dx.doi.org/10.1016/j.landusepol.2008.08.012.

Wang, S., Yang, Z., & Liu, H. (2011). Impact of urban economic openness on real estate prices: Evidence from thirty-five cities in China. *China Economic Review, 22*(1), 42-54, doi:http://dx.doi.org/10.1016/j.chieco.2010.08.007.

Wang, Z., & Zhang, Q. (2014). Fundamental factors in the housing markets of China. *Journal of Housing Economics*, *25*, 53-61, doi:http://dx.doi.org/10.1016/j.jhe.2014.04.001.

Wei, Y., Lam, P. T.-I., Chiang, Y.-H., Leung, B. Y.-P., & Seabrooke, W. (2014). An Exploratory Analysis of Impediments to China's Credit Control on the Real Estate Industry: an institutional perspective. *Journal of Contemporary China, 23*(85), 44-67, doi:10.1080/10670564.2013.809978.

Wen, H., & Goodman, A. C. (2013). Relationship between urban land price and housing price: Evidence from 21 provincial capitals in China. *Habitat International*, *40*, 9-17, doi:http://dx.doi.org/10.1016/j.habitatint.2013.01.004.

Wu, J., Gyourko, J., & Deng, Y. (2012). Evaluating conditions in major Chinese housing markets. *Regional Science and Urban Economics, 42*(3), 531-543, doi:http://dx.doi.org/10.1016/j.regsciurbeco.2011.03.003.

Wu, J., Wu, Y., Guo, X., & Cheong, T. S. (2016). Convergence of Carbon Dioxide Emissions in Chinese Cities: A Continuous Dynamic Distribution Approach. *Energy Policy*, *91*, 207 - 219.

Xu, X. E., & Chen, T. (2012). The effect of monetary policy on real estate price growth in China. *Pacific-Basin Finance Journal, 20*(1), 62-77, doi:http://dx.doi.org/10.1016/j.pacfin.2011.08.001.

Yu, H. (2010). China's house price: Affected by economic fundamentals or real estate policy? [journal article]. *Frontiers of Economics in China, 5*(1), 25-51, doi:10.1007/s11459-010-0002-7.

Zhang, D., Cheng, W., & Ng, Y.-K. (2013). Increasing returns, land use controls and housing prices in China. *Economic Modelling, 31*, 789-795, doi:http://dx.doi.org/10.1016/j.econmod.2013.01.034.

Zhang, H., Weng, S., & Zhou, X. (2007). Housing Price Fluctuations Across China: An Equilibrium Mechanism Perspective. *Tsinghua Science & Technology, 12*(3), 302-308, doi:http://dx.doi.org/10.1016/S1007-0214(07)70045-7.

Zhang, X., & Sun, T. (2006). China's Current Real Estate Cycle and Potential Financial Risks. *China & World Economy, 14*(4), 57-74, doi:10.1111/j.1749-124X.2006.00030.x.

Zhang, Y., Hua, X., & Zhao, L. (2012). Exploring determinants of housing prices: A case study of Chinese experience in 1999–2010. *Economic Modelling, 29*(6), 2349-2361, doi:http://dx.doi.org/10.1016/j.econmod.2012.06.025.

Zheng, S., & Kahn, M. E. (2008). Land and residential property markets in a booming economy: New evidence from Beijing. *Journal of Urban Economics, 63*(2), 743-757, doi:http://dx.doi.org/10.1016/j.jue.2007.04.010.

Zheng, S., Kahn, M. E., & Liu, H. (2010). Towards a system of open cities in China: Home prices, FDI flows and air quality in 35 major cities. *Regional Science and Urban Economics, 40*(1), 1-10, doi:http://dx.doi.org/10.1016/j.regsciurbeco.2009.10.003.