Heterogeneous expectation, beliefs evolution and house price volatility ☆

Hao Zhang [a], Yuyuan Huang [b,c], Haixiang Yao [a,*]

[a] School of Finance, Guangdong University of Foreign Studies, Guangzhou 510006, PR China
[b] Sun Yat-sen Business School, Sun Yat-sen University, Guangzhou 510275, PR China
[c] GuangZhou Rural Commercial Bank, Guangzhou 510375, PR China

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ABSTRACT

After the subprime crisis, governments all over the world have gradually attached great importance to prevent excess volatility of house prices. This paper addresses the problem of house price volatility from the perspective of investors in the real estate market and constructs a demand function by maximizing the investor's wealth utility. Combined with the price adjustment rule of excess demand of the discounted dynamic behavior of suppliers, we propose a model for heterogeneous agents in the housing market. In the model we show how heterogeneous expectation and beliefs evolution affect the house price volatility. Meanwhile, the comparative static analysis on the difference between heterogeneous expectation and the rate of beliefs evolution is provided by numerical simulation. These results show that the change of fundamentalists' expectation on the house price will influence the frequency of the house price volatility, while the change of chartists' expectation which increases with the acceleration of beliefs in evolution will influence the range of the volatility.

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1. Introduction

Since the reform of housing system in 1998, real estate market has been booming in China, especially after 2003. Many scholars attributed the house prices' rise to the housing demand released by the urbanization process in China. However, according to relevant statistics from Chinese Academy of Social Sciences, the new urban commodity housing area in China has increased by 4.326 billion square meters and the new units were up to 43 millions from 2000 to 2010. By the end of 2010, the stock area of residential buildings was about 14.5 billion square meters. Since 2008, the number of new urban housing units in China has exceeded the number of the new households. So it is difficult to explain the rising house prices only from the gap between market supply and demand. Changes of house price show that the real estate bubble has been formed in China, from the historical experience of United States,

Japan, Hong Kong and other countries and regions. The house prices break away from macroeconomic fundamentals and rise in significant trend. In particular, after the end of 2007, when the US subprime crisis happened, China began to attach great importance to the price volatility in the real estate market. Since 2008, in the Working Reports of Chinese government, the government has proposed that preventing precipitous rise in house prices (in 2008), to resolutely control the over quick rising trend of house prices in some cities (in 2010), to stabilize house prices effectively (in 2011), to let house prices back to the reasonable level (in 2012) and to restrain speculation and investment demand in real estate market resolutely (2013). It is proposed during the 18th Central Committee of the Communist Party of China (CPC) held in 2013 that China needs to establish a long-term mechanism in accordance with the laws of the market and let the market determine the ups and downs of house prices.

After the Subprime Crisis in 2008, the real estate market price fluctuation has been regarded as one of the main culprits for the global financial crisis. It also have been valued and incorporated into macroeconomic management by governments. A survey on personal financial assets conducted by Southwestern University of Finance and Economics in China shows that real estate assets have accounted for 66% of the households' total assets in China. Thus, great price volatility of real estate assets will absolutely bring about economic and social unrest. According to the "two-way adjustment" policy on the real estate market proposed in NPC (National People's Congress) and CPPCC (Chinese People's Political Consultative Conference), China has set the major goal of the current regulation as to prevent high volatility in house prices. Earlier literatures found that house prices are mainly affected by demand and costs, and

the price volatility is caused by the volatility of macroeconomic fundamental variables. Therefore, Chinese scholars attributed the house price volatility mostly to credit scale, real interest rate, economic growth, population change and other macroeconomic fundamentals. However, these conclusions could not give a good explanation for the house price volatility when exogenous factors do not have major changes.

In accordance with the Central Economic Work Conference held at the end of 2013, China's GDP growth in 2014 is at about 7–8% and the PBOC (People's Bank of China) continues to maintain a prudent monetary policy, then house prices would not present greater volatility. However, in the case of no changes in economic fundamentals, house prices suddenly slumped in cities such as Hangzhou and Changzhou, and suddenly rose in other cities like Xi'an and Guangzhou in early 2014, which leads us to reconsider the deep-seated reasons of the house price volatility. In fact, some scholars have found that the house price volatility is hard to be interpreted as population growth, cost increase or changes of economic fundamentals (Shiller, 2005). Gallin (2006) showed that it cannot attribute the house price volatility in the United States after 2000 to the changes in personal income, housing construction costs, or population. Mikhed and Zemcik (2009) used panel data model to analyze house prices in the U.S. by introducing income of the house buyers, population, rent price, construction cost and other basic factors and found that the changes of these basic factors simply have nothing to do with the price volatility. Shiller (2005, 2008) theoretically pointed out that even if there is little change at the macroeconomic level, investors' irrational emotions, such as extrapolative expectation, excessive pessimism or optimistic psychology on the market, herd effect, will lead to unnecessary asset price fluctuations, including the real estate assets. As a result, rational expectation hypothesis in some relevant studies began to be questioned. In fact, in 1996, Clayton challenged the rational expectation hypothesis in the real estate market. From the data of Vancouver's house prices, he concluded that the house price volatility is irrational and can be partly put down to the irrational expectation of market participants. Hence it is debatable to use the rational expectations hypothesis in the relevant research on house price volatility. Hanushek and Quigley (1979) also proposed that different expectations of the market participants on economic factors will cause house price volatility. Especially, since Shiller (2005) theoretically pointed out that the irrational behaviors of the market participants will bring volatility to house prices, it has become a hot topic among researchers on real estate to study the effect of house price volatility from the bounded rational perspective. There has been a lot of empirical literatures (Maier and Herath, 2009; Malpezzi and Wachter, 2005) suggesting that the efficient market hypothesis or rational expectation hypothesis has become unable to fully explain the volatility in the real estate market.

According to the conclusion of Shiller (2005, 2008), the price volatility of real estate market mainly comes from the transaction behaviors in the market where the traders' heterogeneous beliefs will trigger the instability of the market. In order to study the heterogeneous expectation of the market participants, Day and Huang (1990) and Chiarella (1992) first created Heterogeneous-Agent Models (HAM). In their models, they found that, the interaction of heterogeneous agents in the market may lead to market volatilities, and internal mechanisms can also cause price volatilities without exogenous stochastic disturbance. Pagan (1996), Lux (1998) and Lux and Marchesi (2000) further established a strategy-switching HAM and discussed the effect on asset price volatilities imposed by the evolutionary selection of strategies of market participants. In essence, HAM is a kind of dynamic system model based on agent-based behavior characteristics. HAM abandons relevant fundamental hypotheses on participants' rational expectations and homogeneous individuals, and turns to study the effects of participants' heterogeneity on asset prices. Based on this framework, many relevant studies showed that the changes in asset prices largely depends on trading strategies and heterogeneous behaviors of market participants have important influence on the dynamic stability of asset price. Brock et al.

(2005) argued that heterogeneous expectations on asset prices will make the market price difficult to reach a stable equilibrium at the fundamental price. Hommes (2006) further pointed out that fundamental analysts push price toward the equilibrium price while chartists push price away from the equilibrium price. When the proportion of chartists exceeds a certain threshold, price will deviate from the fundamental price in the short run, but the long-term market equilibrium price is determined by the mean-reverting strategies of the fundamental analysts. Based on the summary of relevant empirical researches, Menkhoff and Taylor (2007) pointed out that decisions made by a market participant depend on whether he or she is a fundamental analyst or a chartist. Extrapolative expectations made by chartists will make the market more volatile, while the mean-reverting expectation made by fundamental analysts will stabilize the market prices.

With constant improvements of the heterogeneous agent model, it was more widely applied and was gradually employed in the real estate market to explain the price volatility. Kouwenberg and Zwinkels (2011) adopted a price adjustment rule of excess demand to establish a HAM on the real estate including both fundamental analysts and chartists, and conducted an empirical estimation using real data from 1962 to 2000 in American real estate market. The result indicated that heterogeneous expectation of the real estate market participants did cause house price volatility in the United States. Bolt et al. (2014) studied the price volatility phenomenon of the five OECD countries from 1970 to 2012 by building an HAM under the equilibrium pricing framework, which again confirmed the conclusion of HAM. Dieci and Westerhoff (2012, 2013) established a two-part HAM with real and speculative demand and discussed the effect of the parameters on the equilibrium point in the system using dynamic system approach. They studied the change of the equilibrium point when the system equilibrium point lost stability as well as depicted the boom-bust cyclical fluctuations in the real estate market.[1]

Since the findings of Kouwenberg and Zwinkels (2011) and Bolt et al. (2014) have provided empirical evidence using HAM to study the real estate market price volatility, we started from the perspective of investors in the real estate market and derived the investor's demand function by constructing wealth utility maximization problem as well as established a HAM using the price adjustment rule of excess demand. Compared to previous studies, we expected to offer a new perspective to study house price volatilities. We also have made a few improvements so as to be more in line with the real situation of China's real estate market.

Firstly, we further extended the basic assumptions of the model, added the depreciation of housing stock existing in the real estate market, new supply and other dynamic behaviors in the assumptions. The real estate market is different from other investment goods market such as stock market, exchange rate market etc. In such investment goods market, depreciation, new supply and other factors are often ignored. But in real estate market, especially in China, they are very important. Although Kouwenberg and Zwinkels (2011), Dieci and Westerhoff (2012, 2013), Bolt et al.(2014)have done some research in real estate market with HAM, we added the depreciation of housing stock existing in the real estate market, new supply and other dynamic behaviors in the model. So the assumptions and results of research may be better to conform to the actual situation in China.

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[1] However, the housing market is characterized by high transaction costs and important trading constraints, perhaps, the HAM modeling framework is not fit for it. In our opinion, though houses are lesser liquid than a financial asset, the question that our paper addresses is how prices are formed and whether differences in expectations can swing them in ways that are erratic and ultimately unsustainable. In this respect, we think it is appropriate to use this heterogeneous expectation approach to address their self-fulfilling role in price formation. So the key variable is how expectations matter in the formation of house prices (and therefore not only their fundamental house price component). This is what makes them comparable to other financial assets.