

4. LIQUIDITY CHARACTERISTICS, IMPLICIT INFORMATION OF ASSET PRICES AND MONETARY POLICY IN CHINA¹

Xiao WEIGUO²
Zhao YANG³
Yuan WEI⁴

Abstract

This paper empirically analyzes the liquidity characteristics of asset price boom-busts and the implicit information of asset prices in China during the period 1998-2011. The results indicate that liquidity plays an important role in asset price cycles and asset prices contain specific information of future output and inflation. Housing price booms are more consistent with credit expansion than stock price. Likewise, housing price has stable positive connection with future output gap and inflation relative to stock price. Based on the above results, the Chinese monetary policy should intervene in asset prices misalignment when in need, even targeting at housing price as conditions permit. Besides, credit control should be adopted to restrain housing price effectively.

Keywords: liquidity characteristics, asset prices, monetary policy, COBS approach

JEL Classification: E21, E42, E52

1 Introduction

After the American financial crisis, worldwide loose monetary policy stimulates the recovery of global economy, however, aggravating the global liquidity surplus. In China, the asset prices represented by stock price and housing price sustained a sharp rise in 2009. Huge liquidity played a crucial role in this process (Li and Deng, 2011). With the rapid development of capital market in China, the asset prices have gradually had tighter connection with real economy, financial stability and monetary policy. Asset prices fluctuation has already implied rich information of monetary policy decisions (Wu, 2007). The Chinese central bank (People's Bank of China, PBC) has

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² *Economic and Management School of Wuhan University. E-mail: wgxiao@whu.edu.cn.*

³ *Wuhan Branch of the People's Bank of China. E-mail: Sunnyzhao@whu.edu.cn*

⁴ *Corresponding Author: Yuan Wei, Economic and Management School of Wuhan University, Luojiashan, Wuhan, China, 430072. E-mail: yuanwei-10@163.com*

implemented tightening policy to curb housing price hikes since 2010. With liquidity tightening policies, the real economy grew sluggishly, but potential inflation pressure still existed. Therefore, the monetary authority of China fell into a dilemma. Since money and credit aggregates are still important contents in the conduct of Chinese monetary policy, it is essential to pay closer attention to liquidity characteristics in asset price cycles and to the information embedded in asset prices.

Liquidity is mainly denoted by monetary liquidity (in the sense of monetary aggregates in various calibers and money structure) and banking system liquidity (in the sense of total assets or total liabilities of the banking system and their term structure) at the macro-level (MGCCER, 2008). After the American financial crisis, the traditional view 'monetary liquidity results in asset bubbles' has been developed further into 'expansionary monetary policy causes asset bubbles'. The improved view emphasized the causative effect of monetary and credit expansion on asset prices (Luo, 2011). Many existing empirical results proved that monetary liquidity had significant effect on asset prices (Baks and Kramer, 1999; Congdon, 2005; Li and Deng, 2011; Liu and Yin, 2011), and credit expansion is the leading cause of asset price inflation (Bordo and Jeanne, 2002; Gerdesmeier *et al.*, 2010; Guo, 2010; Wang, 2010). Compared with monetary liquidity, total credit has stronger impact on asset prices (Machado and Sousa, 2006). Several studies concluded that the relationship between liquidity and asset prices is not simple linear, i.e. the liquidity expansion is closely related to asset price booms, while the connection between liquidity contraction and asset price busts is not that so (Adalid and Detken, 2007; He *et al.*, 2011). The relationship also depends on the environment of interest rate, inflation and output, etc.

At present, the academia and global central banks' practices have reached a consensus on the necessity that monetary policy should concern about asset prices. Nonetheless, whether, when and how should central banks intervene in asset prices are still puzzles. Two of the core issues are as follows: Whether or not asset prices imply macroeconomic information and, can asset prices forecast future output and inflation precisely (Wang *et al.*, 2008; Luo, 2011)? In light of the complexity of the asset prices' movement, the existing researches have not provided satisfactory solutions. Empirical evidences from different countries during different periods indicated that there were various combinations among asset prices, inflation and output (Stock and Watson, 2003; Han *et al.*, 2008). Due to different views on the information implied in the volatility of asset prices, current studies offer alternative monetary policies. If the predictive ability of asset prices on output and inflation is strong, asset prices transmission and general price transmission of monetary policy have an automatic balancing mechanism. Consequently, a central bank's efforts to stabilize sufficiently long-term inflation could also additionally realize the asset prices/financial stability objective (Schwartz, 1995; Borio, 2005). Asset prices should be incorporated into monetary policy decisions, only to the degree that those movements affect inflation expectation (Bernanke and Gertler, 2001; Miskin, 2007). Monetary policy should apply flexible inflation target, leaning against asset prices to reduce the cost of cleaning up the mess. However, all previous financial crises indicated that asset bubbles were apt to occur in a low and stable inflation environment. Furthermore, to some degree, asset prices volatilized independently

relative to output and inflation. The reality brought a big challenge to the traditional policy.

There are many serious practical difficulties in monetary policy concerning asset prices. First, policymakers can hardly identify whether asset prices are driven by fundamentals or non-fundamentals (Kohn, 2006). Second, it is difficult to construct a stable broad price index including asset prices as the nominal anchor. Third, considering the gains and losses of counter-fighting potential bubbles, the monetary authority needs to judge the intervening timing and the intervening depth accurately (Trichet, 2009). Finally, financial innovation integrates the money market, the credit market and the capital market, breaking the automatic balancing mechanism between general price transmission and asset prices transmission (Assenmacher-Wesche and Gerlach, 2008). Unfortunately, existing researches failed to develop a universal monetary policy frame theoretically. In specific countries and during specific periods, the information implied in asset price movements was diversified in empirical analysis. Correspondingly, the choice of monetary policy dealing with asset prices should have strong pertinence.

There are two main motivations for this paper. First, based on identifying asset price booms and busts, our analysis endeavors to shed light on the liquidity characteristics of asset price cycles in China, so as to provide useful precautionary alert signals for the monetary authorities concerning asset prices. Second, disclosing the information contained in the movements of asset prices contributes to clear-cut comprehensions of the relationship between asset prices and the real economy. More importantly, taking the macroeconomic relevant information into account facilitates the PBC's policy conduct, i.e. should, or how the PBC responds to asset price movements?

The remainder of this paper is organized as follows: Section 2 identifies asset price booms and busts with the COBS approach and then illustrates the liquidity characteristics of asset price boom-busts in China. Section 3 performs empirical analysis on the implicit information of asset prices after presenting the empirical model. Section 4 presents the main findings and the implications for the monetary policy in China.

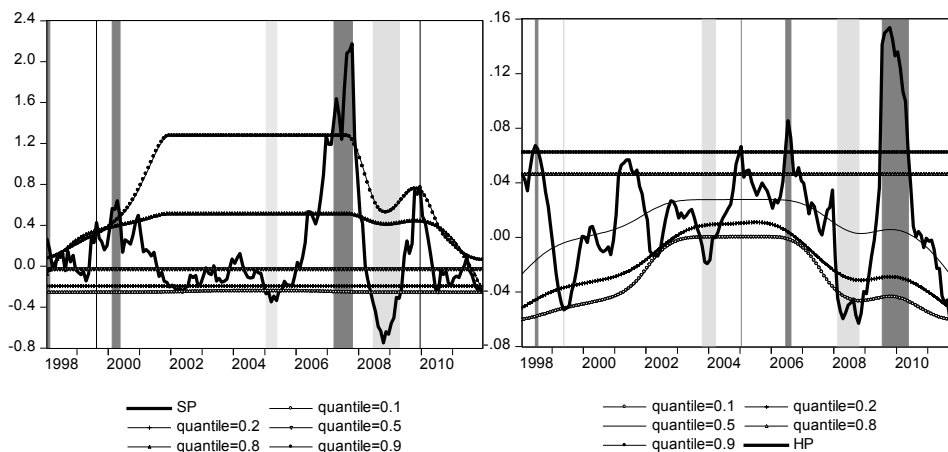
2. The Liquidity Characteristics of Asset Price Boom-Busts

2.1 Identifying Asset Price Booms and Busts with the COBS Approach

The Constrained Smoothing B-splines (COBS) approach was suitably introduced by Ng (2005) to identify the asset price booms and busts. The COBS approach considers asset returns as the function of fundamentals and underlines the extreme of asset prices misalignment, covering the deficiencies of defining asset price booms and busts as right and left 10% tails of the HP trend. In this paper, the COBS approach is employed to analyze empirically the stock price and housing price in China from 1998 to 2011, imposing the theoretical restriction that asset returns should be non-decreasing with the potential real GDP growth. The implementation of COBS in the statistical package R chose quadratic spline as roughness penalty and used AIC to

search automatically for the controlling parameter. The substitute variables are as follows: stock returns (SR), housing returns (HR) and output growth are proxied by growth rate of Shanghai Sock Exchange A-share closing indices (the same period of last year = 100), national housing sales price indices (the same period of last year = 100) and growth rate of value-added of industry (the same period of last year = 100), respectively. All series are adjusted by CPI (the same period of last year = 100). Monthly data was collected from the CEI database. The results are shown in Figure 1. For prudential considerations, we took asset returns over 90% conditional quantiles as booms and asset returns below 10% conditional quantiles as busts. In Figure 1, stock and housing price booms are in dark grey, while busts are in light grey. There are five boom periods and two bust periods of stock prices, and four boom periods and three bust periods of housing price. The boom periods and bust periods are in accordance with public intuition, basically.

Figure 1. The Booms and Busts of Stock Price (Left) and Housing Price (Right)



2.2 The Liquidity Characteristics

Starting with liquidity indicators, we compare the asset price boom-busts with monetary liquidity and banking system liquidity. Real M_2 growth rate (RM_2) and M_1/M_2 are proxies for monetary liquidity in the form of aggregate and structure, respectively. Similarly, real total domestic CNY loans (RL) and the ratio of long-term loans to total loans (LL/TL) are proxies for banking system liquidity. Relevant data originated from PBC data streams. Figure 2 and Figure 3 describe the above four liquidity indicators in stock price and housing price boom-busts, respectively. We can observe the following three characteristics.

- i. Stock price booms or busts were not fully consistent with the period during which money and credit aggregates expanded fast or contracted fast (mostly lagged). For instance, in the case of stock price booms, the linkage was not clear, as in some cases real M_2 growth rate rose and in other it declined.

ii. The housing price booms were remarkably consistent with the fast-expanding periods of liquidity aggregates. Unexpectedly, liquidity aggregates also expanded in housing price busts.

iii. M_1/M_2 had powerful explanation on stock price boom-busts. M_1/M_2 and LL/TL were both better structural liquidity indicators of interpreting housing price boom-busts.

Figure 2. The Liquidity Characteristics in Stock Price Boom-Busts

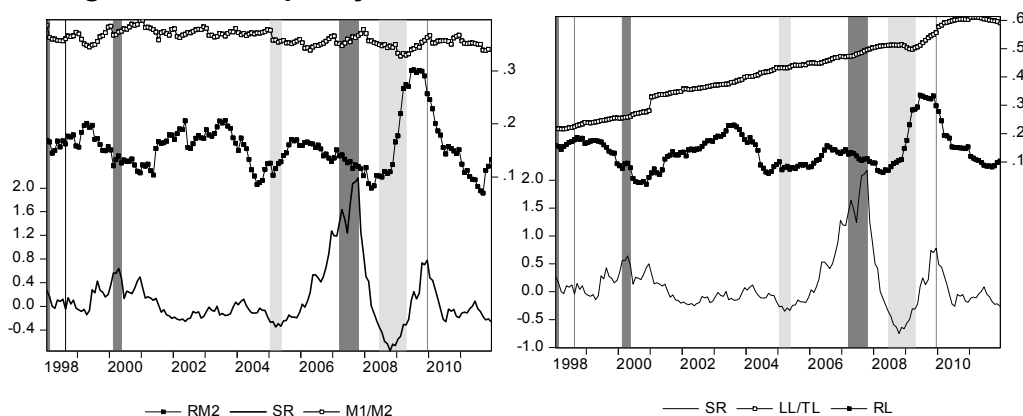
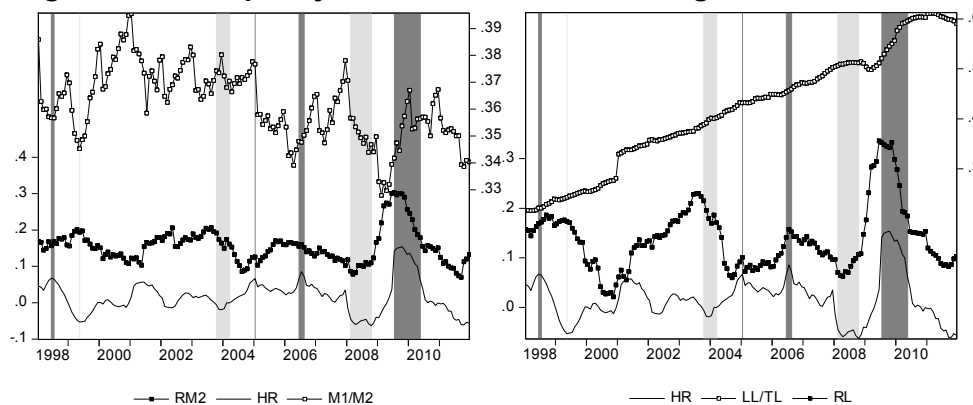


Figure 3. The Liquidity Characteristics in Housing Price Boom-Busts



3. Empirical Analysis of the Implicit Information of Asset Prices

Asset prices can influence the real economy via wealth effect, Tobin Q and balance sheet channels of enterprises and households, etc. A vast amount of literature on developed countries used asset prices as predictor of output gap and inflation. The empirical conclusions of some literatures demonstrated that some asset prices

predicted either output gap or inflation effectively, which ensured the possible existence of specific economic relevant information in asset prices.

3.1 The Model

Following Stock and Watson (2003), we build model (1) and model (2) to analyze empirically the predictive ability of asset prices on future output gap and inflation.

$$ygap_{t+h} = \mu_1 + \alpha_1(L)ygap_t + \beta_1(L)AP_t + \gamma_1(L)Z_{1t} + \xi_{1,t+h} \quad (1)$$

$$Inflation_{t+h} = \mu_2 + \alpha_2(L)Inflation_t + \beta_2(L)AP_t + \gamma_2(L)Z_{2t} + \xi_{2,t+h} \quad (2)$$

where: $\alpha_1(L), \beta_1(L), \gamma_1(L), \alpha_2(L), \beta_2(L), \gamma_2(L)$ are lag polynomials, h represents steps ahead of independent variables, μ_1, μ_2 are constants, $ygap_t$ is output gap at time t , $Inflation_t$ is inflation rate at time t , AP_t denotes stock price or housing price at time t , Z_{1t}, Z_{2t} represent additional predictors of output gap and inflation at time t .

The benchmark models (3) and (4) are also employed. By comparing the forecast performance of (1) relative to (3) and (2) relative to (4), we can examine the predictive ability of asset prices. The forecast performance is measured by the Theil inequality coefficient.

$$ygap_{t+h} = \mu_1 + \alpha_1(L)ygap_t + \gamma_1(L)Z_{1t} + \xi_{1,t+h} \quad (3)$$

$$Inflation_{t+h} = \mu_2 + \alpha_2(L)Inflation_t + \gamma_2(L)Z_{2t} + \xi_{2,t+h} \quad (4)$$

Evidences from China indicate that, in addition to asset prices, consumer price, producer price and monetary growth, etc. are the main influential factors of output gap (Zhang, 2009). The main factors affecting inflation are stock price, housing price, excess liquidity, output gap, RMB exchange rate and interest rate (Huang *et al.*, 2010; Zhang, 2008; Wang, 2008). Consequently, the candidate predictors in Z_{1t} include consumer price, producer price and monetary growth. The candidate predictors in Z_{2t} include excess liquidity, output gap, RMB exchange rate and interest rate.

3.2 Data

We use monthly data of eleven series over 1998-2011 as sample. Table 1 summarizes the substitute variables and their sources. Nominal GDP and nominal interest rate are adjusted by CPI (December 1997 = 100) to obtain real values. Others are adjusted by CPI (preceding month = 100) to obtain real values. The steps ahead of independent variables are set to three months, six months and nine months. The fixed three-months lags is used for $\alpha_1(L), \beta_1(L), \gamma_1(L), \alpha_2(L), \beta_2(L), \gamma_2(L)$. For data-dependent lag lengths, these lag polynomials contain at most three non-zero coefficients. In the process of auto-regression, we remove the insignificant coefficients gradually.

Table 1

The Substitute Variables and Source

Data series	Substitute variables	Source
Output gap	The deviation of GDP series from the HP trend	CEIC database
Consumer price/inflation	CPI (preceding month = 100)	CEIC database
Producer price	PPI (preceding month = 100)	Wind database
Excess liquidity	M ₂ growth rate - GDP growth rate (preceding month = 100)	CEIC database
RMB exchange rate	RMB effective exchange rate indices	BIS database
Interest rate	RMB one-year benchmark deposit interest rate	CEIC database
Stock price	Growth rate of Shanghai Stock Exchange A-share closing indices (preceding month = 100)	CEIC database
Housing price	National housing sales price indices (preceding month = 100)	Sina Financial Statistics
Monthly GDP	The sum of monthly total retail sales of consumer goods, investment in fixed asset and net export (in logarithm form)	CEIC database

3.3 Empirical Results and Analysis

The empirical results are listed in Table 2 and Table 3. Inspection of Table 2 and Table 3 reveals four facts.

- i. By introducing the stock price, predictive ability of output gap in model (1) outperformed model (3) in the first and the second quarter, while it was inferior to model (3) in the third quarter. After introducing the housing price, model (1) sufficiently improved its predictive ability of output gap relative to model (3) in the first and the third quarter, but performed worse in the second quarter.
- ii. Stock price was negatively correlated with the first quarter ahead forecast of output gap, but positively correlated with the second and the third quarter ahead forecast of output gap. Nonetheless, the housing price was positively correlated with forecast of output gap in each quarter.
- iii. By introducing the stock price, the predictive ability of inflation in model (2) outweighed model (4) in every quarter, especially in the third quarter. After introducing the housing price, model (2) sufficiently improved its predictive ability of inflation relative to model (4) in each quarter, especially in the first quarter.
- iv. Stock price was negatively correlated with the first quarter ahead forecast of inflation, but positively correlated with the second and the third quarter ahead forecast of inflation. Nonetheless, the housing price was positively correlated with forecast of inflation in each quarter.

The results suggest that the forecasting of output gap and inflation based on stock price or housing price succeeds. However, there are some differences between stock price and housing price. The forecasts of output gap based on stock price worked well in short-term, while the forecasts of output gap based on housing price worked well in relative long-term. The predictive ability of stock price on inflation was strong in relative long-term, while the predictive ability of housing price on inflation was strong in short-term. This means that the Chinese stock price and housing price movements

contain specific information on future output and inflation in one or the other period. Besides, the housing price had stable positive connection with future output gap and inflation relative to stock price.

Table 2

Forecasting Performance of Asset Prices on Output Gap

	Steps ahead	Estimated coefficients	Adjusted R ²	Akaike information criterion	Performance improved by model (1) relative to benchmark model (3)
Stock Price	h=3	-0.0021(-2.1015 ^{**})	0.5831	0.3168	0.48%
	h=6	0.0025(5.3383 ^{***})	0.5345	0.3105	0.49%
	h=9	0.0029(2.2761 [*])	0.5677	0.3211	-4.6%
Housing Price	h=3	0.0223(1.8949)	0.5514	0.2655	1.3%
	h=6	0.0189(2.4391 [*])	0.4902	0.2761	-2.5%
	h=9	0.0568(-2.8113 ^{***})	0.6118	0.2383	5.1%

Note: *t*-statistics in () and the absolute value of *t*-statistics should be higher than critical value 2. ^{***}, ^{**}, ^{*} represent 1%, 5% and 10% significant level, respectively. The Theil inequality coefficient of benchmark model (3) is 0.5316, 0.5468 and 0.5271 when the value of *h* is 3, 6 and 9, respectively.

Table 3

Forecasting Performance of Asset Prices on Inflation

	Steps ahead	Estimated coefficients	Adjusted R ²	Akaike information criterion	Performance improved by model (2) relative to benchmark model (4)
Stock Price	h=3	-0.0036(-2.0020 ^{**})	0.3559	1.2475	0.21%
	h=6	0.0046(2.3331 [*])	0.3624	1.3712	0.39%
	h=9	0.0196(6.6917 ^{***})	0.5618	0.8964	7.1%
Housing Price	h=3	0.1297(3.6714 ^{***})	0.4748	0.4297	6.3%
	h=6	0.0446(1.8921)	0.3415	1.3543	0.62%
	h=9	0.0386(2.0153 [*])	0.3617	1.2306	0.49%

Note: The Theil inequality coefficient of benchmark model(4) is 0.5633, 0.5881 and 0.4458 when the value of *h* is 3, 6 and 9, respectively.

4. Conclusions and Policy Implications

The empirical analysis of liquidity characteristics in asset price cycles is obviously highly stylized and concludes three features that may be of practical significance, including the disaccord between liquidity aggregates and stock price, the high consistency between expansion of liquidity aggregates and housing price booms, and the great explanation power of structural liquidity indicators on stock price and housing price. During special period (i.e. the Asian financial crisis in 1998 and the American financial crisis in 2008), money and credit aggregates in China were expanding against asset prices depression, which was different from the mature economies. In general, asset prices substantially downward worsened the balance sheet of commercial banks and then the 'credit grudging' behavior prevailed. Subsequently,

credit growth declined sharply in asset price busts. As for China, the credit decision of commercial banks is not exactly market-oriented, but depends on the government need of macro-control (Yuan, 2012). Moreover, the monetary policy decision is affiliated to some degree to the fiscal policy with soft constraint (Qian, 2007). When government engages in counter-cyclical fiscal policies to stimulate economic recovery, the PBC injects huge liquidity into market through the banking system. Therefore, the asset price (especially housing price) surges following the expansion of money supply and credit. Additionally, compared with aggregate liquidity indicators, structural liquidity indicators provide more useful warning information for monetary policy concerning asset prices and potential risk of the financial system. On one side, money structure and term-structure of credit assets are apt to shorten in asset price booms, and vice versa. On the other side, liquidity structure contains richer information, including saving and investment decisions of households, policy expectation and credit decision of commercial banks, etc. Based on these results, it is necessary for the Chinese monetary policy to respond to asset prices promptly when structural liquidity indicators change fast. In the meantime, the rapid expansion of credit aggregate and short term structure of credit assets become important indicators of possible housing bubbles in China.

Implicit information embedded in asset prices shows that both stock price and housing price have specific predictive power for the future output gap and inflation, while housing price has more stable positive connection with future output gap and inflation relative to stock price. This difference could be reflected by the history of Chinese stock market and housing market development. Stock and Watson (2003) argued that the predictive power of asset prices relied on the nature of shocks hitting on the economy, the degree of financial markets development and other institutional details differing across countries. In the past twenty years, housing investment and its pulling effect on upstream-downstream industries have made tremendous contributions to China's double-digit economic growth. The housing industry was taken as one of the pillars of national economy. Therefore, the volatility of housing prices exerts a great influence on the macroeconomy. In contrast, the Chinese stock market had experienced several institutional reforms and it is still not mature. At most times, stock price could not reflect the true fundamentals, and then has weak predictive power on future output gap and inflation. Lv (2005) proved that stock price did not Granger cause real economic growth, although there was co-integrating relationship between stock price and China's real economy. Owing to the implicit information embedded in asset prices, the Chinese monetary policy should intervene in asset price misalignments when in need, even targeting at housing price when conditions permit (e.g., completion of interest rate liberalization, more flexible RMB exchange rate system and more independent central bank). In addition, considering the closer relationship between housing price booms and credit expansion, the Chinese monetary policy should adopt strict credit control and supervision to restrain housing price effectively.

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