# Real Estate Asset Bubbles and Monetary Policy: The Channel between Central Bank's Balance Sheet and Firms' Balance Sheets

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## Abstract

*After the Global Financial Crisis, the US Fed's unconventional monetary policy of purchasing mortgage-backed securities amid the policy rate reaching the zero bound has been claimed as the main driver for the rising prices in the property market. On the other side of the world, housing prices have been increasing even more dramatically in China in the past decade. One suspected reason is the easing monetary policy: The interest rate has not fallen significantly, but the Central Bank has been flooding credits to firms, which in turn have been invested by firms in the housing market rather than in production activities in the real sector. Utilizing a recently developed bubble date-stamping approach, we first trace the starting/ending period and the size of bubbles at the city level. We then examine the role of monetary policy in the form of changes in the balance sheet of the central bank on determining the housing price development. We implement this by differentiating the degree of co-movements between the balance sheets of firms located in the cities where the housing bubbles are detected and the balance sheet of the central bank. We find that: (1) the credit from the central bank to the commercial banks has significant "counter-cyclical" impact on housing bubbles in China; (2) the credit in the circulation, M2/GDP, has significant "pro-cyclical" impact through the balance sheet items of the firms in China, especially long-term asset acquisition, and it seems to be concentrated in the machinery sector; and (3) Chinese firms played an important role in channeling the credits from the central bank to the property markets, especially in cities with strong state-owned enterprises. The same finding cannot be observed among US firms.*

## Introduction

In this analysis, we first used the date-stamping of explosive patterns methodology developed by Philip et al. (2015) to identify the starting and ending date of an explosive pattern of house price-to-rental series in cities in China and the US and use the resulting explosive statistics as the dependent variable in the next step. Second, we ran a linear regression to test whether the changes in the central bank's balance sheet and changes in the firms' balance sheets at the aggregated provincial level determine the explosive housing price development. Several hypothesis were tested, such as, whether the credit injection of the central bank to commercial banks is the source of housing market bubbles, whether the firms responded to the credit injections by acquiring more real estates rather than enhancing real business activities, etc..

In the first step, we applied the date-stamping approach, the so-called Backward Sup Augmented Dickey-Fuller (BSADF) used by Philips, Shi and Yu (2015), to identify the starting and ending dates of explosive housing prices behaviors in 35 capital or metropolis cities in China and ten cities surveyed by the Case-Shiller Home Price Index in the US. The housing price index is adjusted by dividing it by the rental index to control for the fundamental factor on the housing demand. The adjusted housing price-to-rental ratio $y_t$ is used as the dependent variable. If the housing sales price index moves faster than the rental index in either upward or downward direction, it would be identified as explosive. The specification takes the following form:

$$y_t = \mu_y + \rho y_{t-1} + \sum_{j=1}^{l} \phi_j \Delta y_{t-j} + \varepsilon_{y,t}, \varepsilon_{y,t} \sim N(0, \sigma_y^2).$$

The null hypothesis to test is $H_0$: $\rho > 1$ against $H_1$: $\rho \leq 1$. Contrary to the traditional random walk test, the BSADF is a right-tail test used to determine whether explosive patterns are in process, that is, $H_0$: $\rho > 1$. Therefore, special test statistics need to be constructed.

For the date-stamping, Philips, Shi and Yu (2015) proposed a flexible window in a double recursive fashion. The BSADF performs a sup ADF test on a changing series with the ending point fixed at $r_2$ and the starting point changing with the size of the windows covered (from 0 to $r_2 - r_0$), where $r_0$ is the minimum length of data covered for an adequate initial estimation. The recommended starting date is $r_0 = 0.01 + 1.8/sqrt(T)$, where T is the total number of observations included in the test. In this BSADF test, it is $r_2$. The BSADF test takes the form of:

$$BSADF_{r_2}(r_0) = \sup_{r_1 \in [0, r_2 - r_1]} \{ADF_{r_1}^{r_2}\}.$$

The critical value for BSADF is calculated based on different ending points of windows using Monte Carlo simulation.

In the second step, we ran the below linear regression:

(2) $H_{it} = X_{it} B + \varepsilon_{it}$,

where $H_{it}$ is the explosive pattern indicator for city $i$ in time $t$, which is generated from the BSADF test statistics in the first stage. As discussed in the appendix, the first stage procedure will generate the BSADF statistics and the corresponding critical value to assess whether the statistic is significant or not. We get the difference by subtracting the critical value from the reported statistics. If the gap is positive, we keep the value of the difference and used it as the value of $H_{it}$. If the gap is zero or negative, which implies that no explosive pattern is identified, we assign a value of zero to $H_{it}$. That is, if the statistics are greater than the critical value, the difference indicates the size of the explosive pattern; otherwise, there is no explosive pattern. We further added the direction to $H_{it}$. If $H_{it}$ is significant due to the price-to-rental ratio showing upwards trend from the initial period, it is labelled positive. If the price-to rental ratio shows a downward trend from the initial period, it is labelled negative. Therefore, the upward or downward explosive patterns are also reflected in $H_{it}$.

We include three sets of variables in vector $X_{it}$. The first set of variables refers to the measures of monetary policy, including the traditional measures such as policy rate, required reserve ratio, and M2/GDP ratio, and the central bank's balance sheet asset side measures such as the claims to the government and the claims to other depository corporations, scaled by GDP. The second set of variables refers to the firms' activities reflected from their balance sheets and aggregated at the provincial level, including change in the value-added of firms, change in total fixed assets, share of the construction sector, share of the machinery sector, share of the other services sector, SOE share (in numbers), SOE share (value-added), change in the short-term debt to total asset ratio, and change in long-term debt to total asset ratio. The final set of variables is the interaction of the monetary policy proxied by claims to other depository corporations or M2/GDP with the aggregated balance sheet changes of firms to reveal the mechanism on how the credit will affect the housing market through the firms' activities.

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## Results

- There are more expansionary explosive patterns in recent years in the cities in China, while there are more expansionary explosive patterns detected during the pre-GFC periods in the cities in the US.
- In general, the increase in claims to other depository corporations to GDP ratio (commercial banks) is more likely to be associated with explosive declining patterns. That is, the injection of credits to the commercial banks from the central bank is more "counter-cyclical". Meanwhile, the M2-to-GDP ratio is more "pro-cyclical"; that is, if the M2-toGDP ratio increases, there are more likely to be positive bubbles in the housing market.
- The required reserve ratio is an effective "counter-cyclical" measure, while the policy rate reflects more the demand in the financing market and is "pro-cyclical".
- Based on provincial variables aggregated from the firms in Orbis, we found that:
  - Change in value-added is insignificant;
  - Change in fixed assets is significant and negative, suggesting that the investments in the housing market and real sectors tend to be substitutes. When firms invest in their plants and equipment, it is less likely for the housing market to experience a bubble;
  - The provincial share of firms in the construction sector is significant. The provincial shares of firms in the machinery and service sectors are "counter-cyclical". The reason why the coefficient of the machinery sector in specification (1) is positive is that by excluding the interacting terms of monetary policy and the machinery sector, the estimate shows the monetary policy impact;
  - The provincial changes in short-term debt to total asset ratio is positively associated with housing bubbles; that is, if firms are facing liquidity pressures, it is more likely to have housing bubbles;
  - The provincial change in long-term debt to total asset ratio has no significant impact.
  - The provincial SOEs in terms of value-added have significantly positive impact on housing bubbles.
- We interact the claims to other depository corporations to GDP ratio and M2 to GDP share with selected variables. As shown in column (2) - (4), the results are consistent with our expectations. The interacting term of claims on Other Depos. Corp. to GDP (M2/GDP) with Provincial changes in total fixed assets-Orbis are positive. This implies that when there is supply of credit either from the central bank to commercial banks or commercial banks to the real sectors and the firms in certain provinces have increased their fixed asset investments, a bubble is more likely to occur. This provides evidence to our conjecture that firms tend to use the credits from banks to purchase real estates during credit injection period, rather than investing them in the real sector.

| | 1 | 2 | 3 |
|---|---|---|---|
| Intercept | 31.275 | 90.115** | 0.0802 |
| | (33.004) | (33.6016) | (0.2566) |
| Year | -0.0157 | -0.0446** | - |
| | (0.0164) | (0.0166) | - |
| Provincial GDP growth rate | 0.0085** | 0.0055** | 0.0072** |
| | (0.0012) | (0.0013) | (0.0011) |
| Lagged provincial GDP growth rate | 0.0039** | 0.0027** | 0.003** |
| | (0.0012) | (0.0012) | (0.0012) |
| Required Reserve Ratio | -0.037** | -0.0335** | -0.028** |
| | (0.0067) | (0.0067) | (0.0064) |
| Policy Rate | 0.0403** | 0.0453** | 0.0351** |
| | (0.0126) | (0.0127) | (0.012) |
| M2/GDP | 0.0052** | 0.0011 | 0.0011 |
| | (9e-04) | (0.0011) | (0.0011) |
| Central Bank Balance Sheet (CBS) | | | |
| Claims on Government/GDP | -0.0506 | -0.0906** | 9.00E-04 |
| | (0.0379) | (0.0382) | (0.0172) |
| Claims on Other Depos. Corp/GDP | -0.0697** | -0.0739** | -0.084** |
| | (0.0098) | (0.0097) | (0.009) |
| Provincial Changes aggregated from firms in Orbis | | | |
| Changes in value-added in firms | -3.00E-04 | -2.00E-04 | -2.00E-04 |
| | (1e-04) | (1e-04) | (1e-04) |
| Changes in total fixed assets | 2.00E-04 | -0.0065** | -0.007** |
| | (1e-04) | (0.0015) | (0.0015) |
| Share of construction sector* | 0.0029 | -0.0477 | -0.0381 |
| | (0.0021) | (0.0291) | (0.029) |
| Share of machinery sector | 0.0017** | -0.0236** | -0.022** |
| | (4e-04) | (0.0039) | (0.0039) |
| Share of other services | -0.007** | -0.0058** | -0.006** |
| | (0.0013) | (0.0013) | (0.0013) |
| SOE share (in numbers) | -3.00E-04 | -4.00E-04 | -0.0021 |
| | (0.0017) | (0.0019) | (0.0018) |
| SOE share (value added) | 0.002** | 0.0018** | 0.002** |
| | (3e-04) | (3e-04) | (3e-04) |
| Changes in short term debt/total asset | -2.00E-04 | 0.0108** | 0.0107** |
| | (2e-04) | (0.0017) | (0.0017) |
| Changes in long term debt/total asset | 1.18E-05 | -2.00E-04 | -2.00E-04 |
| | (1e-04) | (7e-04) | (7e-04) |
| Interacting term of M2/GDP and Orbis | | | |
| M2/GDP * Changes in total fixed assets | - | 4.0e-05** | 4e-05** |
| | - | (9.3e-6) | (9.3e-6) |
| M2/GDP * Share of construction sector | - | 3.00E-04 | 2.00E-04 |
| | - | (2e-04) | (2e-04) |
| Share of M2 to GDP * Share of firms in machinery sector- Orbis | - | 2e-04** | 1e-04** |
| | - | (0.0015) | (2.3e-05) |
| M2/GDP * Changes in short term debt/total asset | - | -1e-04** | -1e-04** |
| | - | (1e-5) | (1e-5) |
| M2/GDP * Changes in long term debt/total asset | - | 2.57E-06 | 2.67E-06 |
| | - | (4.3e-6) | (4.3e-6) |
| Adjusted R-squared | 0.082 | 0.1047 | 0.1081 |
| No. of observations | 3753 | 3753 | 3753 |

**Table 1.** Regression Results using housing explosive indicators as dependent variables

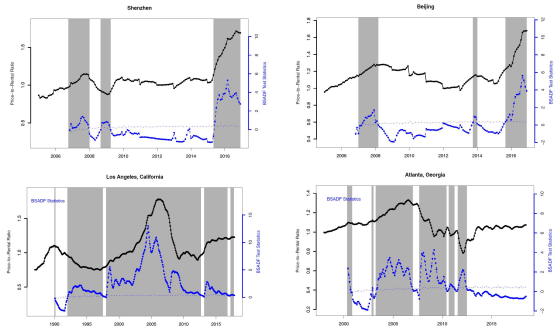


**Figure 1.** Date – stamping for Explosive Patterns in Sales to Rental Index Ratio for selected cities

## Conclusions

- *The credit from the central bank to the commercial banks has significant "counter-cyclical" impact on housing bubbles in China.*
- *The credit in circulation, M2/GDP, has significant "pro-cyclical" impact, through the balance sheet items of the firms in China, especially long-term asset acquisition, and this appears to concentrated in the machinery sectors.*
- *Chinese firms played an important role in channeling the credits from the central bank to the property markets, especially in cities with strong state-owned enterprises.*

## References

1. Phillips, P.C.B., Shi, S.-P. and Yu, J. (2015). Testing for multiple bubbles: historical episodes of exuberance and collapse in the S&P 500. International Economic Review 56: 1043-1078.