Industrial Investments and Housing Prices in China[1]

Qiqi Qiu and Junmin Wan[2]

Graduate School of Economics, Fukuoka University, Fukuoka, Japan

July 24, 2019

[1] This research was partially supported by the China Natural Science Foundation - Peking University Data Center for Management Science (Research grant 2016KEY05), and the JSPS KAKENHI Grant (#16K03764). The second author gratefully acknowledges the support of these funds.

[2] The authors thank Ko Nishihara, Zhaoxin Niu, Mitsuo Takase, Junren Yin and the participants for their beneficial comments when the paper was presented at Fukuoka University and the 11th (2019) International Conference on Financial Risk and Corporate Finance Management & Seminar of the Key Program of National Natural Science Foundation and the Major Program of National Social Science Fund at Dalian University of Technology on July 13, and give special thanks to Tsutomu Miyagawa for the constructive suggestions at the 2019 Spring Meeting of Japanese Economic Association on June 9. Any remaining errors here are the authors' responsibility.Correspondence: Nanakuma 8-19-1, Jonan Ward, Fukuoka City, Fukuoka 8140180, Japan; (e-mail) Wan: wan@fukuoka-u.ac.jp; (tel) +81-92-871-6631(ext.4208); (fax) +81-92-864-2904.

Highlights

1) Marginal *q* of 37 industrial sectors in China over the period 2001–2016 are estimated.
2) Housing bubbles have been identified in major cities in China. The housing price Granger causes the producer price index (PPI) and the PPI Granger causes the estimated Marginal *q* of 37 industrial sectors
3) Overinvestments are found in 37 industrial sectors over the period 2001–2016. Overinvestments in 13 industrial sectors including metal and coal are also identified.

Abstract

Housing bubbles have been identified in major cities in China, based on the monthly ratio of price to rent and the bubble test. We find that the housing price Granger causes the producer price index (PPI) and that the PPI Granger causes the estimated Marginal *q* of 37 industrial sectors over the period 2001–2016. Panel estimation results indicate that the Marginal *q* does not have a significant impact on investment, whereas Marginal *q* instrumented by PPI has a significant positive effect on investment. This implies that industrial investment is affected indirectly by the housing bubble, resulting in overinvestments caused by Marginal *q* from profits in 13 industrial sectors, including metal and coal, during the housing bubble.

JEL: E22; E32

Keywords: China, Housing bubble, Industrial sector, Marginal *q*, Overinvestment

1 Introduction

1.1 Industrial overcapacity as global and domestic issues

It is reported that the Organization for Economic Co-operation and Development (OECD) has required the Chinese government to monitor the negative impact of China's oversupply of iron, steel, and coal, as well as other resources, on the international market (Nikkei, May 28, 2016). The argument is that the low price of Chinese steel considerably reduces the price of steel in the United States (U.S.), a practice referred to as “dumping” by the U.S. government (U.S. Department of Commerce, Fact Sheet, November 13, 2017). It is also reported that the net profit of the steel industry rose 2.2-fold in 2017, with the top 15 steel companies being based in China (Nikkei, May 25, 2018). Thus, overcapacity in some of the industrial sectors from China is a hotly debated international issue.

President Xi Jinping has said that China is in the process of reducing excess capacity (Xi, September 3, 2016) and that China should work to contain the housing bubble, as shown in Figure 1 (Xi, December 22, 2016). Additionally, efforts are being made to remove zombie firms contributing to excess capacity in identified industrial sectors (Xi, February 28, 2017). Based on these comments by the top leader in China, it is obvious that overcapacity in some industrial sectors, as well the housing bubble, have been and continue to be key domestic and international concerns, as other countries call for an expedited resolution (Nikkei, November 21, 2018).

Prime Minister Li Keqiang reported that China has removed 0.17 trillion tons of excess capacity in steel (notably, China produced 0.83 trillion tons of the world's steel, a share of 0.83/1.69 = 49.1%, in 2017),[1] 0.8 trillion tons of excess capacity in coal (China produced 3.52 trillion tons, a world share of 3.52/7.73 = 45.5%, in 2017),[2] and laid off 1.1 million employees in these industries over the period 2013–2017 (Li, March 6, 2018).

The producer price index (PPI), profit growth, and the Marginal *q* in excess capacity industries such as coal, have decreased faster than those of other industries, as shown in Figures 2–4, respectively. Since 2010, the government has responded by raising the state capital ratio to address the overcapacity issue of these industries (e.g., coal) and rescue them from bankruptcy. For example, the state capital ratio of Mining and Washing of Coal was 0.86 in 2001; this ratio then decreased steadily, reaching 0.31 in 2010, after which it increased, reaching 0.48 in 2016.[3]

In recent years, China's corporate sector has faced many financial issues. One issue is that small- and medium-sized enterprises have difficulty obtaining loans to

---

1 See details. https://www.globalnote.jp/post-1402.html

2 See detail. http://www.coalchina.org.cn/detail//18/06/14/00000035/content.html

3 We estimated the state capital ratio based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

finance their investments, as described by the former Chairman Zhou Xiaochuan of the People's Bank of China (Wan 2015b, p. 5, "too difficult and expensive to obtain funds, Rongzinan, Rongzigui, in Chinese"). The other issue is that the huge housing bubble in China's major cities, as shown in Figure 1, prompts households to oversave (Wan, 2015a). As such, the banking sector has experienced underperformance in their loans due to corporate overinvestment, as indicated in bank data from 2007–2015 (Wan, 2015b, 2018b).

One may inquire as to why foreign countries, such as the U.S., have an interest in China's overcapacity issue during the period of a housing bubble. A burst in the housing bubble would cause a decline in corporate profits, triggering underperformance in bank loans, as emphasized by Wan (2018c, p. 29, "overinvestments in housing-related businesses such as construction materials''), potentially leading to a financial crisis down the road. "Dumping'', as argued by the U.S. government, in which the export price is lower than that of foreign markets, significantly impacts international trade. However, to date, no one has yet established a link between "dumping'' and housing bubbles in the literature. Here we examine this domestic issue in China, as well as the global overcapacity impact.

1.2 Related studies and this research

Lin et al. (2015) point out that state ownership of the Big Four Banks entails that the majority of loans are granted to inefficient state-owned enterprises (SOEs), implying that fund misallocation could cause overinvestments in some firms (e.g., SOEs) and simultaneous underinvestment in those that remain. Chen et al. (2016) and Ding et al. (2016) show that listed SOEs may have “free cash flow’’ to perform inefficient overinvestments via panel firm data. Kou et al. (2017) quantify the industrial policy and use a cost function method to estimate industrial capacity utilization; they determined that industrial policy created excess capacity, based on the empirical study of 33 industrial sectors in China from 1999 to 2014. Chirinko and Shcaller (2001) show that the bubble in the Japanese stock market had a significant positive effect on investment, and that the bubble boosted business fixed investment by 6–9% from 1987 to 1989.

Overcapacity stems from over-fixed capital stock (the stock variable) due to the accumulation of overinvestment (the flow variable). Here, we analyze the overcapacity issue from the perspective of overinvestment. Studies show that the housing bubble causes overinvestment in corporate firms, which in turn increases the number of non-performing loans on the balance sheets of commercial banks, based on panel data of

Chinese banks from 2007–2015 (Wan 2015b, 2018c). In this study, we confirm the degree of the housing bubble in major cities in China, using the newest information available, and identify the industries susceptible to overinvestment strategies as a result of the housing bubble.

A serious housing bubble would lead to excess capacity in steel, coal, and other industries, from both the demand and supply sides. From the demand side, the increase in housing prices would encourage speculative households to buy houses. Steel and coal are indispensable raw materials used in production in various industries, especially in the real estate industry. From the supply side, a housing bubble would incite developers to build more developments, thus, increasing the demand for more steel and other raw materials. Consequently, basic material prices, as indicated by the PPI, would rise and basic raw material industries would have a strong incentive to expand their investments.

1.3 Contribution of this research

In this research, the monthly ratio of price to rent and the bubble test are used to confirm the housing bubbles in major cities in China. Tobin's Marginal q of 37 industries over the period from 2001–2016 are estimated by sector. Overinvestments induced by housing bubbles are identified in 13 industrial sectors related to construction material and coal industries. The Marginal *q* of these 13 industrial sectors show abnormally high values in the housing bubble era, whereas it decreases sharply after the government started its policy to cool the housing bubble, as shown in Figures 5–7. Here, an abnormally high Marginal *q* is PPI-oriented by the housing price bubble; the higher Marginal *q* induces overinvestment. Notably, this value decreased after the bubble control policy was implemented.

We estimate the Marginal *q* of 37 industrial sectors, our first contribution to this research field. To our knowledge, there have been no studies of overinvestment by the industrial sector from the perspective of a housing bubble. Additionally, we present a new approach to identifying overinvestment by the industrial sector via linking the investment equation, Marginal *q*, the PPI, and housing price in a bubble; this is the second contribution of this study in that this method does not appear in the literature.

1.4 Organization of the paper

The remainder of the paper is organized as follows. Research question hypotheses are presented in Section 2. Section 3 shows the data source and the empirical specifications. Section 4 presents the estimation results. In Section 5, conclusions are summarized, and policy implications are discussed.

2 Research question and hypothesis development

2.1 Overinvestment and housing bubble

It is reported that the ratio of investment to gross domestic product in China has increased continuously since 1952, with an especially high rate of increase since 2000 (Horioka and Wan, 2007, 2008, Wan 2015a). At the industrial sector level, industrial policy has attempted to promote industrial investment; however, ultimately, this has resulted in overinvestment and/or resource misallocation (Kou et al. 2017). Here, we will clarify the relationship between housing bubbles and corporate overinvestment using panel data of 37 industrial sectors and time series data on housing prices and the PPI by province.

2.2 Conceptual framework

Investment theory

Following Tobin (1969) and Ogawa et al. (1994), we consider the following investment framework:

$$Mq_t = \frac{1}{P_t^I} E_t\left[\sum_{j=0}^{\infty} \beta_{t+j} \, (1-\delta)^j \pi_{t+j}\right] \tag{1}$$

$$\beta_{t+j} = \prod_{i=1}^{j} (1 + r_{t+i})^{-1}$$

$$\beta_t \equiv 1,\ j= 1,2,3,4\ldots,$$

where Tobin's marginal q, interest rate, discount factor, price of investment, depreciation rate, and rate of profit at time t are represented by Mq_t, r_t, β_t, P_t^I, δ, and π_t, respectively. Classically, the empirical investment equation is given by

$$\frac{I_{mt}}{K_{mt-1}} = \beta_1 q_{mt}, \tag{2}$$

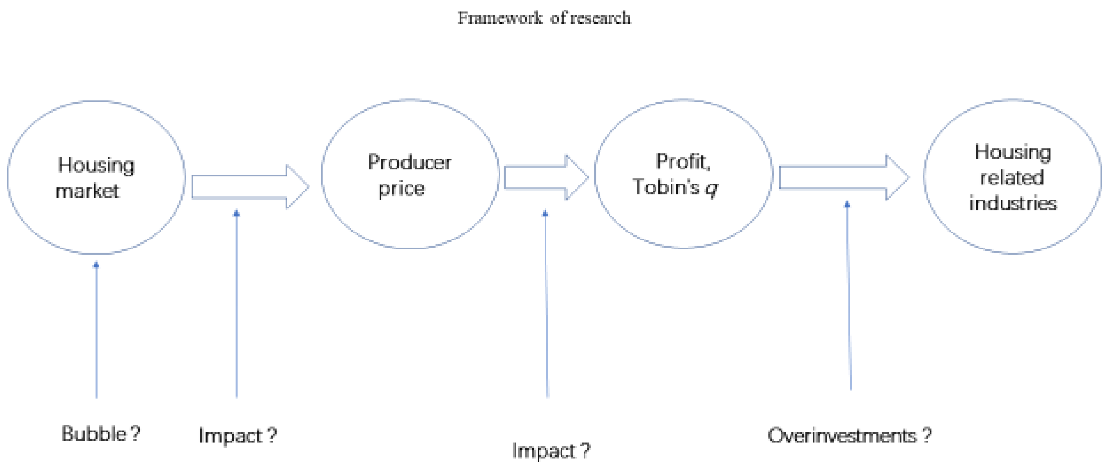
where investment, capital stock, and marginal q in industry m at time t are represented by I_{mt}, K_{mt-1}, and q_{mt}, respectively.

Investment and bubbly Marginal q

Following Wan (2018a, b), the speculative housing bubble would have a partial effect or, potentially, be the main effect, on the profit in Eq. (1), similar to what was observed in the coal and iron industries; thus, here Marginal q presumably would be affected or dominated by the "bubbly" price of output in some industries. To determine the relationship between PPI and Marginal q, we use PPI as a proxy for the price of output in determining Marginal q.

2.3 Hypotheses

In the "Framework of research'', we present four hypotheses to determine whether there are overinvestments, and the potential channel.



Hypothesis 1: Bubble confirmation.

To confirm a housing bubble, following Wan (2015a, b, 2018b, c), we predict that there were bubbles in major cities in China during the period from 2004–2017.

Hypothesis 2: Causality between housing price bubble, PPI, and Marginal *q*.

We predict that the PPI by province Grange causes the housing price, and that the PPI Grange causes Marginal *q* by industrial sector.

Hypothesis 3: Investment by Marginal *q*.

Following the standard theory of investment by Tobin (1969) and Hayashi

(1982), corporate investment should be positively and significantly correlated with Marginal *q*.

Hypothesis 4: Overinvestment by bubble.

Industrial investment is significantly affected by Marginal *q* instrumented by PPI, which is Granger caused by the housing price bubble; thus, overinvestment should exist in some industrial sectors, such as coal or construction materials.

3 Data and empirical specification

3.1 Data source

Ratio of housing price to rent

We collected data on monthly housing prices and residential rental prices for 36 major cities from December 2004 to December 2017 from “China Monthly Economic Indicators’’ issued by the National Bureau of Statistics.

Panel data of 37 industrial sectors

We collected panel data from the National Data provided by the China National Bureau of Statistics (http://data.stats.gov.cn/). The main economic indicators of

Industrial Enterprises above the designated size by industry sector, totaling 37 sectors, were downloaded. The aggregation and statistical method are different before and after 2000; thus, we only used data for 2000–2016.

3.2 Estimation of investment, depreciation rate, interest payment, and Marginal *q*

Our data source does not report information on investment, interest rate, or depreciation rate; thus, we estimate these variables based on the original value of fixed assets and interest expenditure by industry.

Estimation of investment

The investment and the book value of fixed assets of industry *m* at time *t* are given by I_{mt} and BV_{mt}, respectively; thus, we have

$$I_{mt} = BV_{mt} - BV_{mt-1}. \tag{3}$$

Estimation of depreciation rate

Following Qiu and Wan (2019), we can obtain the depreciation rate by industry. The depreciation rate of industry *m* at time *t* is represented by δ_{mt}, as follows:

$$\delta_{mt} = \frac{FA_{mt-1} + I_{mt} - FA_{mt}}{FA_{mt-1}}, \tag{4}$$

where the fixed asset at $t - 1$ is represented by FA_{mt-1}. We use the depreciation rate (0.074 averaged across all industrial sectors, as estimated by Qiu and Wan, 2019), which is very close to the value of 0.077, used in the Japan study of Ogawa et al. (1994).

Estimation of interest payment

Gao and Wan (2015) reports that since 2011, outstanding corporate deposits on the balance sheet of the banking sector have overtaken household deposits, leaving some firms with negative interest payments even if the firm has debt, as its deposit may be over the debt. In this study, we only had access to data on the final interest payment, i.e., the interest payment on the net debt; thus, we developed a coefficient to estimate the interest payment for outstanding debt. Roughly, the ratio of the sum of the corporate and household deposits in the banking sector to the corporate deposit in the banking sector, based on macro data from 2001 to 2016, is used as the multiplier of interest payment by industrial sector. The ratio for adjustment for each year from 2001 to 2016, in order of year, is as follows: 2.43 (2001), 2.45, 2.43, 2.41, 2.47, 2.43, 2.24, 2.38, 2.20, 2.24, 1.86, 1.90, 1.90, 2.21, 1.95, and 1.94 (2016), respectively. The interest rate by year can be estimated as

$$r_t = \frac{estimated\ interest\ payment}{total\ liability}. \tag{5}$$

Estimation of Marginal q

Following Ogawa et al. (1994), Marginal *q* by industrial sector is given by

$$Mq_{mt} = \frac{\pi_{mt}}{P^I_{mt}} \frac{1+r_t}{r_t+\delta_t}. \tag{6}$$

We first estimate π_{mt}. The rate of profit of industry *m* at time *t* is π_{mt}, defined as

$$\pi_{mt} = \frac{TP_{mt}}{FA_{mt-1}}, \tag{7}$$

where the total profit and fixed asset of industry *m* at time *t* are represented by TP_{mt} and FA_{mt-1}, respectively. For controlling potential multicollinearity and endogeneity issues, we used r_t and δ_t to estimate Marginal *q* by industrial sector. The estimated Marginal *q* of the 37 industrial sectors nationwide are reported in Table 2*a*–*d*.

3.3 Empirical specification

Bubble test

Following Phillips et al. (2015) and Wan (2015a, b, 2018b, c), we perform unit root and bubble tests for the monthly series of the ratio of housing price to rent in 36 major cities in China (data shown in Figure 1).

Grange causality between housing price, PPI, and Marginal q

We were unable to obtain housing price data by industrial sector; however, data on the housing price and PPI by province for 31 provinces, and PPI and Marginal *q* by industrial sector for 37 sectors, are available. Granger causality test results for housing price and PPI by province (Figure 5) and PPI and Marginal *q* by industrial sector are shown in Figure 6, based on the method of Toda and Yamamoto (1995).

Investment, Marginal q, and PPI

We consider the following empirical investment function:

$$\frac{I_{mt}}{K_{mt-1}} = \beta_0 + \beta_1 q_{mt} + \mu_m + \lambda_t + \varepsilon_{mt}. \tag{8}$$

where the investment ratio and *q* of industry *m* at time *t* are represented by $\frac{I_{mt}}{K_{mt-1}}$ and q_{mt}, respectively. q_{mt} is a coefficient, β_1 and β_0 are constants, and μ_m, λ_t, and ε_{it}, are error terms.

Housing price bubbles are a regional issue. The degrees of housing bubbles differ considerably among regions and from one year to the next. Housing prices in a bubble have an impact on the industrial PPI. To capture the potential direct effect of PPI on investment via Marginal q, we consider the following specification:

$$q_{mt} = \gamma_0 + \gamma_1 ppi_{mt} + \xi_m + \omega_t + \eta_{mt}. \tag{9}$$

where the PPI of industry m at time t is ppi_{mt} and its coefficient is γ_1. The predicted value (q'_{mt}) of q_{mt} by Eq. (9) is used in the first state as the explanatory variable in Eq. (8), to control the potential endogeneity of Marginal q from measurement error or simultaneity. This allows the investment function to be estimated in the second stage, as given below:

$$\frac{I_{mt}}{K_{mt-1}} = \beta_0 + \beta_1 q'_{mt} + \mu_m + \lambda_t + \varepsilon_{mt}, \tag{10}$$

Note that this is simply a two-stage least squares (2SLS) estimation.

3.4 Identification of overinvestment

In this section, we determine the overinvestment of an industrial sector using the following steps. We assume that the investment for all industrial sectors is dependent on Marginal q. As such, because q is determined by PPI and PPI is induced by housing prices in a bubble, there would be overinvestment in the industrial sectors (i.e., *Housing Price Bubble → PPI, PPI → Marginal q, Marginal q → Investment*). Here Granger causality between the PPI and Marginal q is used to identify which industrial sectors may have overinvestment. An industrial sector may have overinvestment if the PPI Granger causes a Marginal q in that sector.

4 Estimation results

4.1 Bubble test

Tables 1a and b show the estimation results of unit root and bubble tests for the monthly series of housing price to renting ratio in the major 36 cities. Tables 1*a* and *b* show that there are a unit root and bubbles, respectively. These results support Hypothesis 1, and confirm the housing bubble issue argued by Wan (2015a, b, 2018c).

4.2 Granger causality between housing price and PPI

The estimation results are summarized in Table 3a, b. For the hypothesis that housing price does not influence PPI based on Granger causality, 78 of 93 tests rejected the null hypothesis. For the hypothesis that PPI does not Granger cause housing price, 57 of 93 tests were unable to reject the null hypothesis. Thus, we conclude that the impact of housing price on the PPI is stronger than that of the PPI on housing price. The results by province also support Hypothesis 2, as shown in Figure 5.

4.3 Granger causality between PPI and Marginal *q*

The results are reported in Tables 4a, b. For the hypothesis that PPI does not Granger cause Marginal *q*, based on Granger causality test, several of the industries (e.g., Mining and Washing of Coal) reject the null hypothesis. For the hypothesis that Marginal *q* does not Granger cause PPI, some of the industries such as Smelting and Processing of Non-ferrous Metals reject the null hypothesis. The empirical results differ considerably among industrial sectors. The results by industrial sector are consistent with the prediction of Hypothesis 2, as shown in Figure 6.

4.4 Determinants of investment and overinvestment

The statistics of the main variables are summarized in Table 5; the estimated results are given in Table 6. In the first, second and third columns of Table 6, Marginal *q* does not appear to have a significant impact on investment, i.e., no inclination to control for industrial sector size proxied by the ratio of total assets to the total value of fixed assets. This result is not consistent with the prediction of Hypothesis 3. When PPI is used as an instrument for Marginal *q*, the predicted Marginal *q* in the fourth, fifth, and sixth columns indicates a significant positive impact on investment, regardless of controlling for year and size. These results imply that industrial investment is affected indirectly by the PPI, as Marginal *q* (or corporate profit) may depend on the PPI, as shown in Figures 6 and 7. These results support Hypothesis 4. Thus, we conclude that there would be overinvestment in industrial sectors, as the PPI is affected by the housing price bubble; this results in an abnormal profit that would raise the Marginal *q* value, leading to more investment.

4.5 Sectoral overinvestment

Next, we attempt to identify which industrial sector would have overinvestment using the estimation results of Granger tests between PPI and Marginal *q*, as shown in Table 4*a–c*. Here we use an arbitrary baseline. For the hypothesis that the PPI does not Granger cause Marginal *q*, if all three tests regardless of lag (1, 2, and 3) reject the null hypothesis, we conclude that the industry has overinvestment. Based on this assumption, a total of 13 industrial sectors, including Smelting and Processing of Non-ferrous Metals (*italic* items in Table 4*a-c*), are identified as having overinvestment. These results are also consistent with Hypothesis 4.

The Marginal *q* of coal and other industries (totaling 13) had abnormally high values in the housing bubble era, as shown in Table 2*a–d*, and decreased sharply (below 1 for some industrial sectors such as coal) after the government initiated a policy to cool the housing bubble, as shown in Figure 4. In the bubble era, a high Marginal *q* would coincide with a small capital stock; as such, the firm would require more investment. If the Marginal q value is lower than 1, this implies that that the industry had overinvestment in the past. An abnormally high Marginal q was attained from the PPI during the housing bubble. As such, a Marginal q value lower than 1 after bubble control policies would be a robust measurement for identifying overinvestment in some industrial sectors.

These results are consistent with those of Chen et al. (2016) and Ding et al. (2016) who applied a cash flow approach to identify bubbles resulting from “free cash flow’’. Our study results are also consistent with those of Kou et al. (2017) in terms of the cost function and industrial policy approach. The 2015 Annual Report of China's National Bureau of Statistics reveal that oversupply or over-inventory in housing reduced new investments in steel, coal, and other housing-related industries (Xinhuanet, Jan. 20, 2016). Our results are also consistent with the policies presented in “Five Measures to Exclude Excessive Industrial Capacity’’ proposed by the National Development and Reform Commission in China (NDRC, Jan. 13, 2016).

5 Conclusions and implications

We identify bubbles in housing prices in 36 major cities in China from 2004–

2017 via the monthly ratio of price to rent, as well as from bubble test results. We empirically examine whether housing bubbles have an impact on the PPI of manufacturing sectors, and whether the PPI impacts the Marginal *q* value of manufacturing investments. Our results show that the housing price during the housing bubble Granger caused the PPI; furthermore, the PPI Granger caused the Marginal *q* and finally, that the PPI-dependent Marginal *q* value affected industrial investment.

Here we introduce an approach to identify the industries with overinvestment. Specifically, Tobin's Marginal *q* of 37 industries in China from 2001 to 2016 are examined, in which 13 industries are identified as having overinvestments related to the housing bubble. This is attributed to the Granger causality effect of the PPI on the Marginal *q* of these sectors. Obvious overinvestments in some industrial sectors would also, potentially, cause underinvestments in some of the remaining sectors, thus accelerating the misallocation of resources and lowering the quality of economic growth. Therefore, to improve the efficiency and stability of investment in China, it is critical that the current housing bubble is managed properly, as emphasized by Wan (2018a, b, c).

Future research efforts should include a theoretical decision model of investment within bubble scenarios and a more detailed analysis based on firm or loan level data.

6 References

Chen, Xin, Yong Sun, Xiaodong Xu (2016) Free cash flow, over-investment and corporate governance in China, *Pacific-Basin Finance Journal*, Vol.37, pp.81-103.

Chirinko, Robert S. and Huntley Schaller (2001) Business Fixed Investment and Bubbles: The Japanese Case, *American Economic Review*, Vol. 91, pp.663-679.

Ding, Sai, John Knight and Xiao Zhang (2016) Does China overinvest? Evidence from a panel of Chinese firms, *The European Journal of Finance.* (doi:10.1080/1351847X.2016.1211546) (Early Online Publication)

Gao, Yan and Junmin Wan (2015) Estimation and Determinants of Corporate Saving by Time Series and Provincial Panel Data for China, Japanese Economic Association Spring Meeting, May 24. http://www.jeameetings.org/2015s/Gabstract/G-007abstract_JunminWan.pdf

Hayashi, Fumio (1982) Tobin's Marginal *q* and Average *q*: A Neoclassical Interpretation, *Econometrica*, Vol. 50(1), pp.213-224.

Horioka, Charles Yuji and Junmin Wan (2007) The Determinants of Household Saving in China: A Dynamic Panel Analysis of Provincial Data, *Journal of Money, Credit* *and Banking*, Vol.39(8), pp.2077-2096.

Horioka, Charles Yuji and Junmin Wan (2008) Why does China save so much? *China, Asia, and the New World Economy*, edited by Barry Eichengreen, Yung Chul Park and Charles Wyplosz, Oxford University Press, pp.371-391.

Kou, Zonglai, Xueyue Liu, and Jin Liu (2017) Did Industrial Policy Induce Overcapacity? Evidence from the Industrial Sector in China. *Fudan Journal (Social Sciences)*, No.5, pp.148-160. (in Chinese)

Li, Keqiang (March 6, 2018) Government Work Report. http://paper.people.com.cn/ rmrb/html/2018-03/06/nw.D110000renmrb_20180306_1-02.htm (in Chinese)

Lin, Justin Yifu, Xifang Sun, and Harry X .Wu (2015) Banking structure and industrial growth: Evidence from China, *Journal of Banking &Finance*, Vol. 58, pp.132-143.

Mackinnon, James G. (1996) Numerical Distribution Functions for Unit Root and Cointegration Tests, *Journal of Applied Econometrics*, Vol.11(6), pp.601-618.

National Development and Reform Commission (Jan. 13, 2016) Five Measures to Exclude Excessive Industrial Capacity. http://www.gov.cn/zhengce/2016-01/13/content_5032457.htm (in Chinese)

Nikkei Shimbun (May 28, 2016) Iron and Steel Excess Production Requested to China, *Morning Edition*, p.7. (in Japanese)

Nikkei Shimbun (May 25, 2018) Net Profit of World Steel Industry Rose by 2.2 Times: Top 15 Companies in China Overcame Overproduction in 2017, *Morning Edition*, p.17. (in Japanese)

Nikkei Shimbun (November 21, 2018) Miscalculation of Debt Reduction Policy in China, *Morning Edition*, p.2. (in Japanese)

Ogawa, Kazuo, Shin-ichi Kitasaka, Toshio Watanabe, Tatsuya Maruyama, Hiroshi Yamaoka, and Yasuharu Iwata (1994) Asset Markets and Business Fluctuations in Japan, *THE ECONOMIC ANALYSIS*, Economic Research Institute, Economic Planning Agency, No.138, pp. 17-97.

Phillips, Peter C. B., Shu-Ping Shi and Jun Yu (2015) Testing for Multiple Bubbles: Limit Theory of Real Time Detectors, *International Economic Review*, November, pp.1079-1134.

Qiu, Qiqi and Junmin Wan (2019) Depreciation Rate by Perpetual Inventory Method and Depreciation Expense as Accounting Item. *CAES Working Papers Series* WP-2019-012, Fukuoka University.
http://www.econ.fukuoka-u.ac.jp/researchcenter/workingpapers/WP-2019-012.pdf

Tobin, James (1969) A General Equilibrium Approach To Monetary Theory, *Journal of Money, Credit and Banking*, Vol. 1(1), pp.15-29.

Toda, Hiro Y. and Taku Yamamoto (1995) Statistical inference in vector autoregressions with possibly integrated processes, *Journal of Econometrics*, Vol.66 pp.225-250.

U.S. Department of Commerce (November 13, 2017) Fact Sheet. https://www.trade.gov/enforcement/factsheets/factsheet-prc-hardwood-plywood-products-ad-cvd-final-111317.pdf

Wan, Junmin (2015a) Household Savings and Housing Prices in China, *The World Economy*, Vol. 38, pp. 172-192.

Wan, Junmin (2015b) Non-performing Loans in Housing Bubbles, *CAES Working Papers Series* WP-2015-007.
http://www.econ.fukuoka-u.ac.jp/researchcenter/workingpapers/WP-2015-006.pdf

Wan, Junmin (2018a) Prevention and landing of bubble, *International Review of Economics & Finance*, Vol. 58, pp.190-204, July.

Wan, Junmin (2018b) Bubble occurrence and landing, Asia-Pacific Economic Association, Annual Meeting, Los Angeles, University of Southern California, August. http://apeaweb.org/confer/LA18/papers/Wan_Junmin.pdf

Wan, Junmin (2018c) Non-performing loans and housing prices in China, *International Review of Economics & Finance*, Vol.28, pp.26-42, September.

Xi, Jinping (September 3, 2016) China is Trying to Exclude Excess Capacity.

http://politics.people.com.cn/n1/2016/0903/c1001-28689050.html (in Chinese)

Xi, Jinping (December 22, 2016) Restraining Housing Bubble.

http://henan.people.com.cn/n2/2016/1222/c351638-29497758.html (in Chinese)

Xi, Jinping (February 28, 2017) Exclude Excess Capacity and Zombie Firms.

http://finance.china.com.cn/news/20170228/4117271.shtml (in Chinese)

Xinhuanet (December 21, 2015) From New Normal to Reform of Supply Side.

http://www.xinhuanet.com/politics/2015-12/21/c_128551111.htm (in Chinese)

Xinhuanet (January 20, 2016) Economic Efficiency Overwhelmed by Overcapacity.

http://www.xinhuanet.com/finance/2016-01/20/c_128646462.htm (in Chinese)

Table 1: Bubble test for monthly ratio of housing price to rent in 36 major cities

a: Unit root test

Null Hypothesis: The series has a unit root

Price-renting ratio (Dec. 2004 – Dec. 2017, 154 observations after adjustments)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.328	0.616

*MacKinnon (1996) one-sided p-values.

b: The SADF test and the GSADF test of the price-renting ratio

Null hypothesis: The series has a unit root

Price-renting ratio (Dec. 2004 – Dec. 2017, 157 observations after adjustments)

	SADF	GSADF
Test statistics	6.648	6.660
p-value	0.000	0.000

Right-tailed test.

Note: Critical values of tests are obtained by Monte Carlo simulation with 1,000 replications. The smallest window has 24 observations. The author's calculations.

Table 2a: Marginal q of 37 industrial sectors, 2001-2016

Year	National Total	Mining and Washing of Coal	Extraction of Petroleum and Natural Gas	Mining and Processing of Ferrous Metal Ores	Mining and Processing of Non-Ferrous Metal Ores	Mining and Processing of Non-metal Ores	Mining of Other Ores	Processing of Food from Agricultural Products	Manufacture of Foods	Manufacture of Liquor Beverages and Refined Tea
2001	0.7268	0.1746	2.8868	0.6566	0.9264	0.3516	1.0600	0.6680	0.8203	0.7942
2002	0.9450	0.3645	2.8787	0.8354	1.1374	0.4514	0.8100	0.9049	1.0992	1.0379
2003	1.2068	0.5071	3.4715	1.7095	1.7427	0.6060	9.0432	1.2204	1.2654	1.1755
2004	1.7282	1.2875	5.2922	7.0221	4.0397	0.9165	0.1097	1.7351	1.6289	1.3123
2005	1.9399	1.8702	7.9303	5.8690	7.7674	2.1105	5.1459	2.5305	2.2556	2.1131
2006	1.7763	1.5364	7.0963	4.3460	9.0975	2.4391	0.5659	2.4991	2.0898	2.0800
2007	1.9332	1.6518	5.2536	6.1421	7.8010	2.4407	3.6342	3.0824	2.4610	2.5590
2008	1.3402	2.2658	4.1733	6.8459	4.2923	2.5420	1.9098	2.4830	1.9003	2.0095
2009	2.9779	4.2563	3.6040	6.6183	5.9316	4.9867	3.9801	5.5608	5.3547	4.8488
2010	1.5628	2.1477	1.6467	4.3196	3.4620	2.4975	3.8641	2.8160	2.5991	2.4960
2011	1.2956	1.9132	2.0154	3.0485	3.1599	2.3392	0.8267	2.3178	2.2621	2.3329
2012	2.1370	2.3808	2.7810	4.5547	4.9309	4.1102	2.9482	4.1224	4.0820	4.3995
2013	1.5577	1.0797	2.0450	3.0362	2.7197	2.7949	1.3903	2.8273	3.0549	3.0848
2014	1.6926	0.6177	2.0900	2.3585	2.5548	2.7870	1.2719	2.7115	3.3923	3.1247
2015	2.1187	0.2344	0.5244	1.9045	2.4372	3.6059	2.6130	3.5453	4.6259	4.3694
2016	1.5144	0.4581	-0.2929	1.0177	1.6488	2.2254	1.6541	2.4774	3.1521	2.9368
Avg.	1.6533	1.4216	3.3373	3.7678	3.9781	2.3253	2.5517	2.5939	2.6277	2.5422

Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Table 2b: Marginal q of 37 industrial sectors, 2001-2016 (cont.)

Year	Manufacture of Tobacco	Manufacture of Textile	Manufacture of Textile Fabrics Wearing Apparel and Accessories	Manufacture of Leather Fur Feather and Related Products and Footwear	Processing of Timber Manufacture of Wood Bamboo Rattan Palm and Straw Products	Manufacture of Furniture	Manufacture of Paper and Paper Products	Printing Reproduction of Recording Media	Manufacture of Articles for Culture Education Art and Carfts, Sport and Entertainment Activities
2001	2.2913	0.4770	1.7116	1.3115	0.5449	1.2391	0.4597	1.1291	1.4232
2002	3.0589	0.7303	1.9794	1.9587	0.6751	1.4613	0.7411	1.1705	1.8826
2003	3.8293	0.8687	2.0332	2.3763	0.8730	1.7801	0.7854	1.4223	1.7799
2004	5.6903	0.9197	2.3391	2.8512	1.3984	2.5776	1.0405	1.6575	2.0005
2005	6.7615	1.3925	3.0132	3.6518	1.9009	2.6182	1.1721	1.6471	2.2501
2006	5.9844	1.3153	2.7733	3.2025	1.9586	2.4984	1.0604	1.4721	1.7514
2007	7.2629	1.4755	2.8675	3.7170	2.5735	2.2189	1.2811	1.7053	1.8613
2008	4.5218	1.1426	2.3585	3.0223	2.3064	1.6331	0.9706	1.4272	1.2581
2009	11.5843	2.8197	5.5614	7.3891	4.7114	4.4540	2.3003	3.3974	3.6283
2010	4.5755	1.6821	2.9439	4.0789	2.5135	2.4859	1.1917	1.6795	1.9541
2011	3.3843	1.4260	2.4090	3.3829	2.1057	2.1154	0.9066	1.4281	1.5317
2012	6.6150	2.3190	5.0656	6.2437	4.0040	3.7301	1.4952	3.1518	9.6239
2013	6.6635	1.8746	3.0008	3.8700	3.1028	2.5446	1.0532	2.4119	3.6375
2014	7.7572	2.1459	3.3779	4.2435	3.2730	2.8848	1.1121	2.7451	4.0257
2015	10.6072	2.9540	4.4821	5.8379	4.0523	3.9681	1.6960	3.6444	5.3382
2016	5.5997	2.1014	2.9855	3.9223	2.7811	2.8329	1.2627	2.3705	3.6359
Avg.	6.0117	1.6028	3.0564	3.8162	2.4234	2.5652	1.1580	2.0287	2.9739

Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Table 2c: Marginal q of 37 industrial sectors, 2001-2016 (cont.)

Year	Processing of Petroleum and Coking of Nuclear Fuel	Manufacture of Raw Chemical Materials and Chemical Products	Manufacture of Medicines	Manufacture of Chemical Fibers	Manufacture of Rubber and Plastics Products	Manufacture of Non-metallic Mineral Products	Smelting and Pressing of Ferrous Metals	Smelting and Pressing of Non-ferrous Metals	Manufacture of Metal Products	Manufacture of General Purpose Machinery
2001	-0.0485	0.3377	1.4439	0.1855	0.8225	0.3736	0.3863	0.4484	0.9768	0.6966
2002	0.2179	0.6460	1.7134	0.3519	1.1228	0.5237	0.6125	0.5640	1.2970	1.2167
2003	0.5205	0.9889	1.7855	0.6703	1.2162	0.8896	1.1695	0.9308	1.6216	1.7156
2004	1.3748	1.9245	1.7963	0.5820	1.5987	1.2955	2.0334	1.7976	2.4301	2.7075
2005	-0.5424	2.1461	2.0307	0.5213	1.7195	1.1823	1.7621	2.1701	2.9902	3.2259
2006	-0.9616	1.6214	1.4858	0.5541	1.5378	1.2387	1.4841	2.9910	2.5591	3.0409
2007	0.5093	1.9730	1.8963	1.1124	1.8960	1.7096	1.6918	3.1322	2.7011	3.3217
2008	-1.5052	1.2755	1.6283	0.3667	1.4029	1.5130	0.8004	1.2711	2.2337	2.5674
2009	2.8790	2.8580	4.1140	1.8562	3.7650	3.5991	1.4195	2.5346	4.4395	5.0710
2010	1.1590	1.5574	1.9590	1.5831	1.9831	1.8386	0.7414	1.5067	2.4036	2.6012
2011	0.2852	1.3358	1.6558	1.2235	1.5551	1.5652	0.5695	1.3364	1.8785	1.9249
2012	0.3271	1.9743	2.8965	1.3331	2.7041	2.3316	0.7540	1.8599	3.6035	2.9623
2013	0.4624	1.3825	2.1266	0.8857	2.2206	1.7745	0.5764	1.2175	2.2224	2.4658
2014	0.0687	1.4231	2.2766	1.0823	2.2889	1.9333	0.5766	1.1929	2.4203	2.6879
2015	0.8380	1.9118	3.1940	1.5497	3.1557	2.3330	0.2584	1.3312	2.7635	3.4943
2016	1.4674	1.3554	2.2448	1.3053	2.2019	1.7043	0.5293	1.2030	2.3165	2.3381
Avg.	0.4407	1.5445	2.1405	0.9477	1.9494	1.6128	0.9603	1.5930	2.4286	2.6274

Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Table 2d: Marginal q of 37 industrial sectors, 2001-2016 (cont.)

Year	Manufacture of Special Purpose Machinery	Manufacture of Automobiles, Railway Vessel Aerospaceand Other Transport Equipments	Manufacture of Electrical Machinery and Equipment	Manufacture of Communication Equipment Computers and Other Electronic Equipment	Manufacture of Measuring Instruments and Machinery	Utiliztion of Waste Resources	Production and Supply of Electric Power and Heat Power	Production and Supply of Gas	Production and Supply of Water
2001	0.6511	0.9671	1.3737	2.2023	1.5494		0.3914	-0.0184	0.0790
2002	1.2158	1.7025	1.7906	2.1732	1.8133		0.4278	-0.0286	0.0432
2003	1.5686	2.4353	2.1381	2.3296	2.6390		0.4442	0.1536	0.0114
2004	1.9326	2.4396	2.9217	3.0442	2.8594	14.0942	0.5385	0.3075	0.0472
2005	2.4322	1.8925	3.3505	2.5520	3.8961	5.5056	0.6196	0.3184	-0.0094
2006	2.5149	1.9678	2.9856	2.2390	3.4523	5.1757	0.6328	0.4320	0.1226
2007	3.1932	2.5691	3.5592	2.3075	3.7512	3.5779	0.5737	0.8112	0.1231
2008	2.4793	1.9415	3.1626	1.4889	2.7648	4.2889	0.0915	0.8888	0.0734
2009	4.9537	5.1436	6.7285	3.4329	6.3418	6.5255	0.4677	2.6358	0.1437
2010	2.7041	2.7717	3.1783	2.1534	3.2600	3.4808	0.2502	1.2348	0.1211
2011	2.1523	2.1893	2.2566	1.2776	2.4075	3.6615	0.1859	1.0893	0.1104
2012	3.3239	3.2996	3.6290	2.8435	3.8251	4.3289	0.4487	1.7644	0.2028
2013	2.3479	2.7327	2.5985	2.1604	3.3636	3.4129	0.4342	1.2157	0.1993
2014	2.3331	3.5123	3.0764	2.6201	3.9144	4.0532	0.5215	1.5782	0.3154
2015	2.8624	4.4805	4.4945	3.7967	5.1927	5.1116	0.7804	2.0361	0.5385
2016	1.9758	3.1564	3.3701	2.8407	3.7291	2.8101	0.4157	1.1725	0.3664
Avg.	2.4151	2.7001	3.1634	2.4664	3.4225	5.0790	0.4515	0.9744	0.1555

Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Table 3a: Granger causality tests for average selling price of commercialized residential buildings (CRB) and PPI for industrial sectors, 2000-2016

Province or city		H_0: CRB does not Granger cause PPI		H_0: PPI does not Granger cause CRB	
	lags	statistical value	p-value	statistical value	p-value
Beijing	1	1.96	0.1615	3.00	0.0833 *
	2	6.71	0.0349 **	5.66	0.0591 *
	3	12.08	0.0071 ***	19.88	0.0002 ***
Tianjin	1	1.23	0.2672	3.96	0.0467 **
	2	10.44	0.0054 ***	5.37	0.0682 *
	3	14.07	0.0028 ***	4.93	0.1769
Hebei	1	5.88	0.0153 **	1.48	0.2235
	2	33.46	0.0000 ***	1.89	0.3883
	3	30.28	0.0000 ***	1.39	0.7085
Shanxi	1	7.54	0.0060 ***	0.40	0.5271
	2	13.29	0.0013 ***	14.89	0.0006 ***
	3	23.21	0.0000 ***	15.31	0.0016 ***
Inner Mongolia	1	2.73	0.0983 *	11.68	0.0006 ***
	2	107.93	0.0000 ***	5.22	0.0735 *
	3	218.70	0.0000 ***	4.05	0.2563
Liaoning	1	4.14	0.0419 **	0.11	0.7375
	2	8.42	0.0148 **	1.00	0.6059
	3	13.36	0.0039 ***	7.21	0.0654 *
Jilin	1	2.13	0.1488 ***	0.01	0.9065
	2	23.05	0.0000 ***	0.10	0.9504
	3	41.86	0.0000 ***	4.63	0.2013
Heilongjiang	1	5.36	0.0207 **	0.02	0.8854
	2	11.03	0.0040 ***	1.11	0.5753
	3	16.43	0.0009 ***	11.22	0.0106 **
Shanghai	1	0.23	0.6333	0.73	0.3936
	2	11.21	0.0037 ***	1.82	0.4032
	3	13.73	0.0033 ***	2.32	0.5078
Jiangsu	1	1.52	0.2174	0.04	0.8486
	2	42.50	0.0000 ***	0.34	0.8433
	3	80.83	0.0000 ***	1.63	0.6531
Zhejiang	1	0.78	0.3783	1.57	0.2103
	2	34.52	0.0000 ***	4.44	0.1085
	3	52.21	0.0000 ***	3.92	0.2700
Anhui	1	2.38	0.1229	0.00	0.9913
	2	15.74	0.0004 ***	0.36	0.8344
	3	21.63	0.0001 ***	2.04	0.5645
Fujian	1	0.52	0.4716	3.30	0.0695 *
	2	29.22	0.0000 ***	2.30	0.3167
	3	33.83	0.0000 ***	7.40	0.0603 *
Jiangxi	1	2.78	0.0954 *	7.69	0.0056 ***
	2	12.50	0.0019 ***	3.92	0.1406
	3	28.30	0.0000 ***	2.30	0.5126
Shandong	1	3.00	0.0832 *	1.00	0.3177
	2	43.57	0.0000 ***	1.85	0.3962
	3	43.80	0.0000 ***	0.34	0.9520

Table 3b: Granger causality tests for average selling price of commercialized residential buildings (CRB) and PPI for industrial sectors, 2000-2016 (cont.)

Henan	1	3.89	0.0485	**	1.54	0.2147	
	2	21.03	0.0000	***	5.42	0.0664	*
	3	31.31	0.0000	***	10.16	0.0173	**
Hubei	1	1.94	0.1631		3.95	0.0470	**
	2	15.37	0.0005	***	4.97	0.0834	*
	3	38.03	0.0000	***	8.01	0.0458	**
Hunan	1	2.54	0.1109		0.37	0.5411	
	2	23.65	0.0000	***	0.46	0.7937	
	3	49.35	0.0000	***	1.16	0.7618	
Guangdon	1	0.13	0.7216		0.08	0.7735	
	2	13.93	0.0009	***	0.28	0.8676	
	3	19.55	0.0002	***	4.14	0.2469	
Guangxi	1	3.74	0.0532	*	0.57	0.4495	
	2	4.09	0.1296		2.10	0.3493	
	3	10.79	0.0129	**	8.16	0.0429	**
Hainan	1	0.37	0.5444		6.48	0.0109	**
	2	0.76	0.6840		13.08	0.0014	***
	3	10.96	0.0119	***	68.43	0.0000	***
Chongqing	1	1.17	0.2787		1.21	0.2711	
	2	15.83	0.0004	***	4.90	0.0861	*
	3	30.73	0.0000	***	4.78	0.1888	
Sichuan	1	1.63	0.2017		3.17	0.0748	*
	2	30.06	0.0000	***	0.19	0.9079	
	3	62.71	0.0000	***	7.42	0.0597	*
Guizhou	1	4.66	0.0308	**	4.12	0.0425	**
	2	18.13	0.0001	***	4.28	0.1176	
	3	23.87	0.0000	***	23.95	0.0000	***
Yunnan	1	5.22	0.0223	**	8.49	0.0036	***
	2	7.46	0.0240	**	10.37	0.0056	***
	3	21.34	0.0001	***	12.54	0.0057	***
Xizang	1	22.33	0.0000	***	4.70	0.0301	**
	2	56.26	0.0000	***	6.61	0.0367	**
	3	1028.05	0.0000	***	4.39	0.2220	
Shaanxi	1	5.54	0.0186	**	2.18	0.1400	
	2	11.06	0.0040	***	2.14	0.3433	
	3	22.27	0.0001	***	3.95	0.2666	
Gansu	1	3.84	0.0499	**	0.05	0.8227	
	2	23.03	0.0000	***	0.93	0.6283	
	3	36.34	0.0000	***	3.86	0.2767	
Qinghai	1	2.87	0.0901	*	0.06	0.8060	
	2	7.16	0.0278	**	3.95	0.1390	
	3	23.35	0.0000	***	2.75	0.4315	
Ningxia	1	3.66	0.0559	*	3.55	0.0595	*
	2	5.72	0.0574	*	5.44	0.0660	*
	3	12.86	0.0050	***	7.30	0.0628	*
Xinjiang	1	6.51	0.0107	**	1.29	0.2563	
	2	17.52	0.0002	***	2.23	0.3287	
	3	31.87	0.0000	***	3.43	0.3295	

*, **, ***, represents 10%, 5% and 1% significance level, respectively.

Table 4a: Granger causality tests for PPI and Marginal q for industrial sectors, 2000-2016

Sectors		H_0: PPI does not Granger cause Marginal q			H_0: Marginal q does not Granger cause PPI		
	lags	statistical value	p-value		statistical value	p-value	
Mining and Washing of Coal	1	21.48	0.0000	***	0.01	0.9325	
	2	26.11	0.0000	***	0.66	0.7195	
	3	34.96	0.0000	***	9.45	0.0239	**
Extraction of Petroleum and Natural Gas	1	3.35	0.0672	*	2.32	0.1275	
	2	5.43	0.0663	*	2.33	0.3116	
	3	5.89	0.1171		2.40	0.4933	
Mining and Processing of Ferrous Metal Ores	1	1.77	0.1835		0.11	0.7389	
	2	2.08	0.3528		1.86	0.3938	
	3	6.54	0.0880	*	3.69	0.2965	
Mining and Processing of Non-Ferrous Metal Ores	1	10.92	0.0010	***	0.76	0.3840	
	2	14.69	0.0006	***	23.42	0.0000	***
	3	15.70	0.0013	***	21.88	0.0001	***
Mining and Processing of Non-metal Ores	1	17.92	0.0000	***	0.05	0.8244	
	2	13.69	0.0011	***	0.90	0.6363	
	3	12.63	0.0055	***	2.78	0.4270	
Mining of Other Ores	1	0.04	0.8451		4.43	0.0354	**
	2	0.23	0.8915		7.58	0.0225	**
	3	12.83	0.0050	***	27.16	0.0000	***
Processing of Food from Agricultural Products	1	8.42	0.0037	***	0.06	0.8091	
	2	16.97	0.0002	***	1.90	0.3877	
	3	18.43	0.0004	***	9.82	0.0202	**
Manufacture of Foods	1	21.01	0.0000	***	0.08	0.7756	
	2	15.70	0.0004	***	0.81	0.6676	
	3	8.46	0.0374	**	1.71	0.6346	
Manufacture of Liquor Beverages and Refined Tea	1	8.63	0.0033	***	0.07	0.7984	
	2	5.60	0.0608	*	0.65	0.7212	
	3	1.81	0.6132		1.44	0.6973	
Manufacture of Tobacco	1	1.55	0.2129		0.06	0.7992	
	2	1.52	0.4684		79.17	0.0000	***
	3	5.64	0.1304		63.18	0.0000	***
Manufacture of Textile	1	1.18	0.2782		0.59	0.4421	
	2	0.99	0.6102		1.80	0.4061	
	3	7.61	0.0547	*	31.36	0.0000	***
Manufacture of Textile Fabrics Wearing Apparel and Accessories	1	6.51	0.0107	**	0.65	0.4203	
	2	7.11	0.0286	**	1.81	0.4038	
	3	3.64	0.3031		6.76	0.0800	*
Manufacture of Leather Fur Feather and Related Products and Footwear	1	5.79	0.0161	**	1.39	0.2391	
	2	7.13	0.0283	**	2.76	0.2519	
	3	2.86	0.4136		6.47	0.0909	*
Processing of Timber Manufacture of Wood Bamboo Rattan Palm and Straw Products	1	13.03	0.0003	***	0.08	0.7757	
	2	12.04	0.0024	***	0.48	0.7851	
	3	13.06	0.0045	***	1.88	0.5974	

Table 4b: Granger causality tests for PPI and Marginal q for industrial sectors, 2000-2016 (cont.)

Manufacture of Furniture	1	7.20	0.0073	***	0.16	0.6908	
	2	4.60	0.1001		0.39	0.8208	
	3	5.00	0.1722		1.49	0.6839	
Manufacture of Paper and Paper Products	1	6.57	0.0104	**	0.74	0.3895	
	2	5.64	0.0597	*	0.34	0.8444	
	3	2.71	0.4382		0.84	0.8397	
Printing Reproduction of Recording Media	1	5.00	0.0253	**	0.14	0.7122	
	2	4.28	0.1179		2.85	0.2411	
	3	3.59	0.3087		2.80	0.4233	
Manufacture of Articles for Culture Education Art and Carfts, Sport and Entertainment Activities	1	1.56	0.2116		0.52	0.4698	
	2	2.05	0.3593		2.67	0.2636	
	3	15.10	0.0017	***	8.16	0.0429	**
Processing of Petroleum and Coking of Nuclear Fuel	1	1.30	0.2544		15.41	0.0001	***
	2	2.72	0.2563		16.77	0.0002	***
	3	2.83	0.4183		27.62	0.0000	***
Manufacture of Raw Chemical Materials and Chemical Products	1	7.09	0.0078	***	1.20	0.2727	
	2	7.48	0.0238	**	5.11	0.0778	*
	3	9.24	0.0263	**	11.02	0.0116	**
Manufacture of Medicines	1	2.55	0.1101		1.34	0.2479	
	2	13.11	0.0014	***	0.76	0.6852	
	3	15.23	0.0016	***	0.69	0.8754	
Manufacture of Chemical Fibers	1	0.36	0.5506		0.91	0.3389	
	2	2.47	0.2903		14.39	0.0007	***
	3	5.73	0.1257		39.64	0.0000	***
Manufacture of Rubber and Plastics Products	1	0.12	0.2910		0.10	0.7508	
	2	0.54	0.7648		0.35	0.8406	
	3	3.04	0.3851		20.40	0.0001	***
Manufacture of Non-metallic Mineral Products	1	15.26	0.0001	***	0.01	0.9432	
	2	14.78	0.0006	***	0.68	0.7100	
	3	10.32	0.0160	**	5.16	0.1608	
Smelting and Pressing of Ferrous Metals	1	2.08	0.1494		5.56	0.0184	**
	2	2.41	0.3000		15.37	0.0005	***
	3	2.03	0.5670		12.65	0.0054	***
Smelting and Pressing of Non-ferrous Metals	1	3.06	0.0800	*	0.82	0.3651	
	2	5.32	0.0698	*	11.51	0.0032	***
	3	11.99	0.0074	***	12.58	0.0056	***
Manufacture of Metal Products	1	13.26	0.0003	***	0.01	0.9280	
	2	10.73	0.0047	***	0.63	0.7307	
	3	13.82	0.0032	***	9.69	0.0214	**
Manufacture of General Purpose Machinery	1	21.83	0.0000	***	0.04	0.8488	
	2	16.67	0.0002	***	0.19	0.9087	
	3	10.10	0.0177	**	6.06	0.1085	

Table 4c: Granger causality tests for PPI and Marginal q for industrial sectors, 2000-2016 (cont.)

Manufacture of Special Purpose Machinery	1	11.69	0.0006 ***	0.44	0.5075
	2	11.51	0.0032 ***	1.41	0.4943
	3	15.22	0.0016 ***	3.37	0.3385
Manufacture of Automobiles, Railway Vessel Aerospaceand Other Transport Equipments	1	2.47	0.1158	0.18	0.6677
	2	1.85	0.3971	0.44	0.8017
	3	3.13	0.3713	0.02	0.9994
Manufacture of Electrical Machinery and Equipment	1	0.66	0.4151	1.74	0.1870
	2	1.98	0.3714	6.70	0.0351 **
	3	4.12	0.2492	15.55	0.0014 ***
Manufacture of Communication Equipment Computers and Other Electronic Equipment	1	1.32	0.2514	0.00	0.9479
	2	2.51	0.2848	0.08	0.9607
	3	5.87	0.1181	3.92	0.2698
Manufacture of Measuring Instruments and Machinery	1	1.43	0.2324	0.05	0.8191
	2	2.14	0.3432	2.41	0.2998
	3	1.68	0.6407	12.44	0.0060 ***
Utiliztion of Waste Resources	1	5.34	0.0209 **	0.89	0.3453
	2	3.17	0.2047	4.56	0.1025
	3	15.31	0.0016 ***	474.64	0.0000 ***
Production and Supply of Electric Power and Heat Power	1	0.00	0.9852	2.64	0.1039
	2	0.53	0.7669	3.73	0.1547
	3	1.02	0.7962	20.13	0.0002 ***
Production and Supply of Gas	1	8.17	0.0043 ***	0.59	0.4407
	2	4.99	0.0823 *	0.67	0.7161
	3	8.40	0.0384 **	10.80	0.0129 **
Production and Supply of Water	1	0.08	0.7820	1.98	0.1598
	2	0.09	0.9568	7.67	0.0216 **
	3	0.14	0.9865	8.09	0.0442 **

*, **, ***, represents 10%, 5% and 1% significance level, respectively.

Table 5: Summary statistics of 37 industrial sectors, 2001-2016

Variable	Obs	Median	Mean	Std. Dev.	Min	Max
Investment / Capital Stock	589	0.1962	0.2483	0.6630	-1.1760	14.6726
Marginal *q*	589	2.1057	2.3607	1.7669	-1.5052	14.0942
PPI for Industrial Sectors	589	100.6000	101.3753	6.9911	62.7000	145.3000
Total Assets / Total Value of Fixed Assets	589	2.7533	2.8627	0.8721	1.2734	6.8588
year	589	2009	2008.533	4.6016	2001	2016

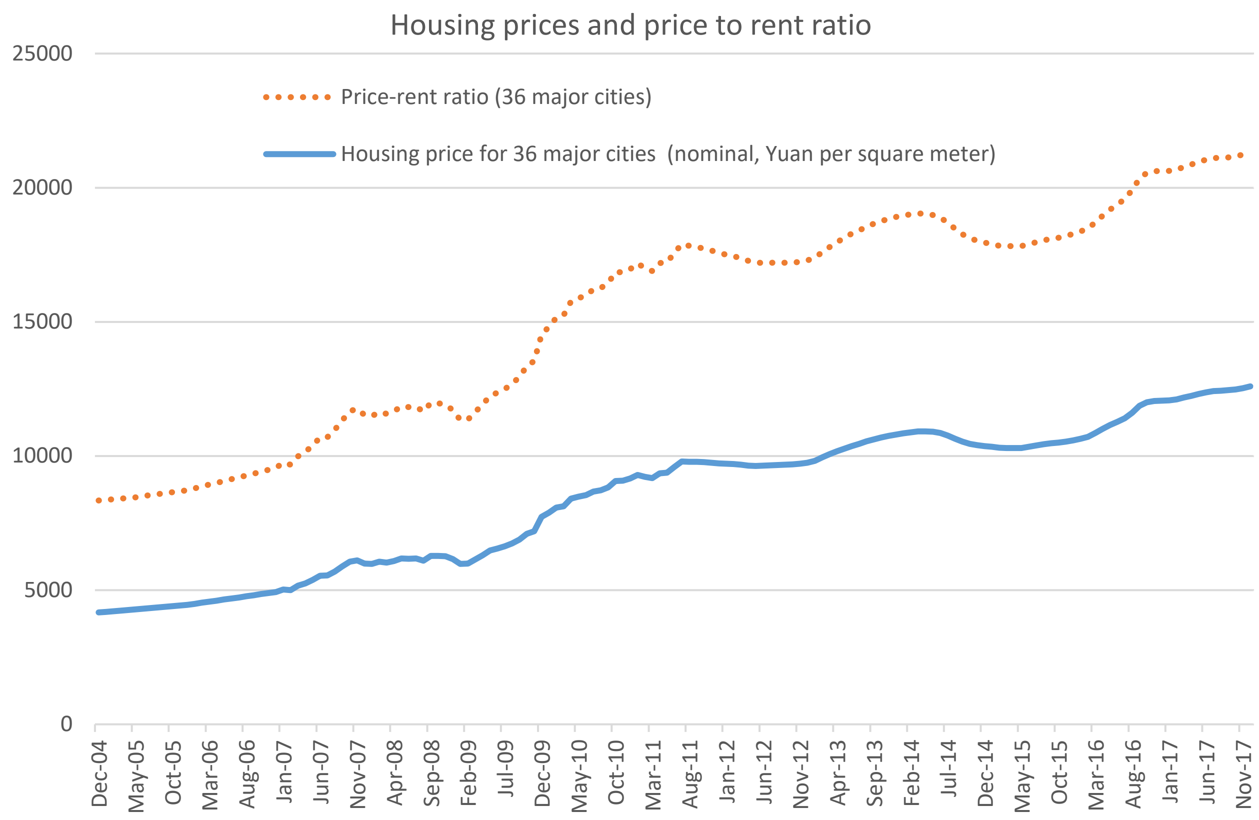
Source: See the text.

Table 6: Determinants of investments in 37 industrial sectors, 2001-2016
(Panel estimation with fixed effect and robust standard errors (FE) and 2SLS)

Independent Variables	Dependent Variable = Investment/Capital Stock (t)					
	FE	FE	FE	2SLS	2SLS	2SLS
Marginal $q_{(t)}$	0.1728	0.1919	0.1703	0.2567 **	0.1838 **	0.1768 **
	(0.1049)	(0.1162)	(0.1091)	(0.1109)	(0.0828)	(0.0850)
Total Assets / Total Value of Fixed Assets $_{(t-1)}$			0.2839 *			0.275 *
			(0.1445)			(0.1434)
Year		-0.0202	-0.0311 *		-0.0196 **	-0.0312 ***
		(0.0138)	(0.0158)		(0.0083)	(0.0067)
Constant	-0.1595	40.3290	61.4947 *	-0.3578	39.1118 **	61.6999 ***
	(0.2476)	(27.3686)	(31.2139)	(0.2630)	(16.4689)	(13.3022)
Observations	589	589	589	589	589	589
R-squared	0.1244	0.1443	0.1599			
Number of industiral sector	37	37	37	37	37	37

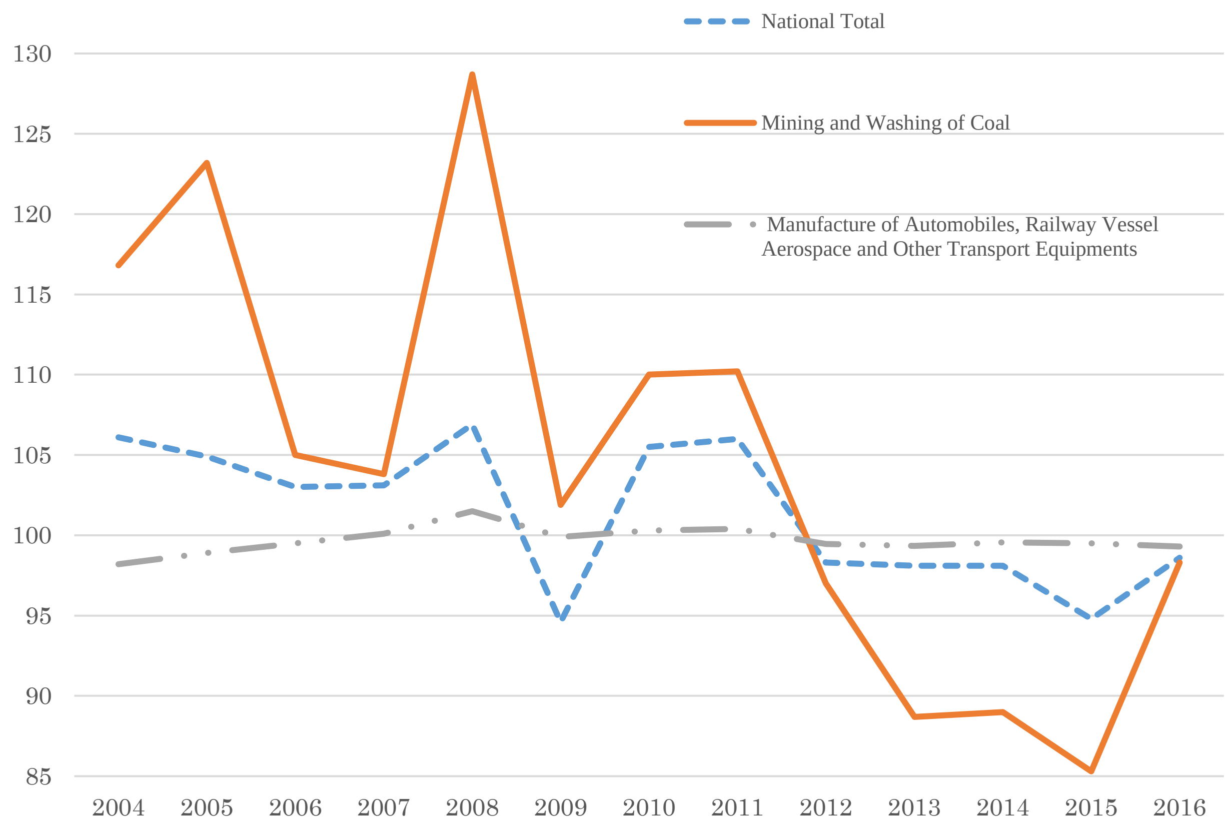
Note: Robust standard errors in parentheses (FE), Marginal q instrumented by PPI (2SLS), *** p<0.01, ** p<0.05, * p<0.1.

Figure 1: Monthly housing prices and ratio of price to rent during Dec. 2004-Dec. 2017



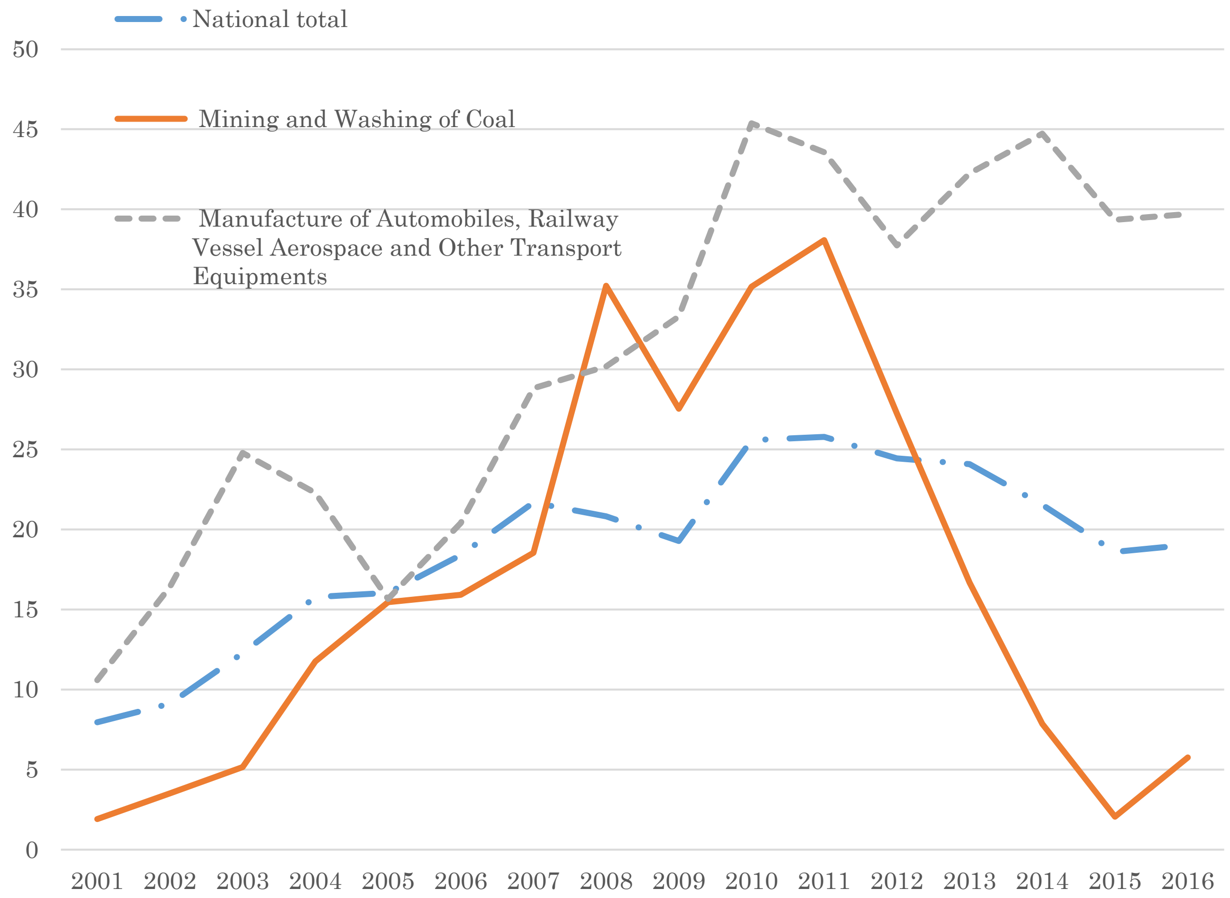
Source: The data are obtained from the China Monthly Economic Indicators by National Bureau of Statistics from Jan. 2005 to Jan. 2018.

Figure 2: PPI by industrial sector during 2004-2016 (previous year=100)



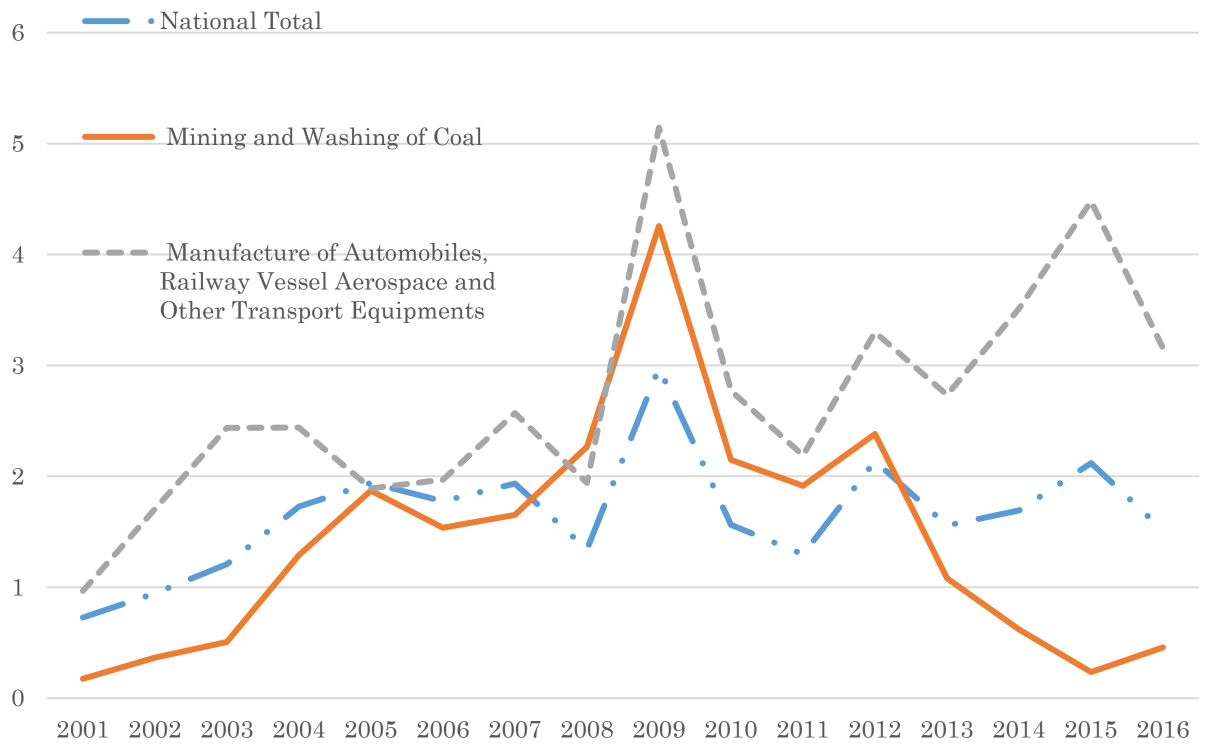
Source: The data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Figure 3: Ratio of total profit to fixed asset by industrial sector during 2000-2016 (%)



Source: The data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Figure 4: Marginal *q* by industrial sector during 2001-2016

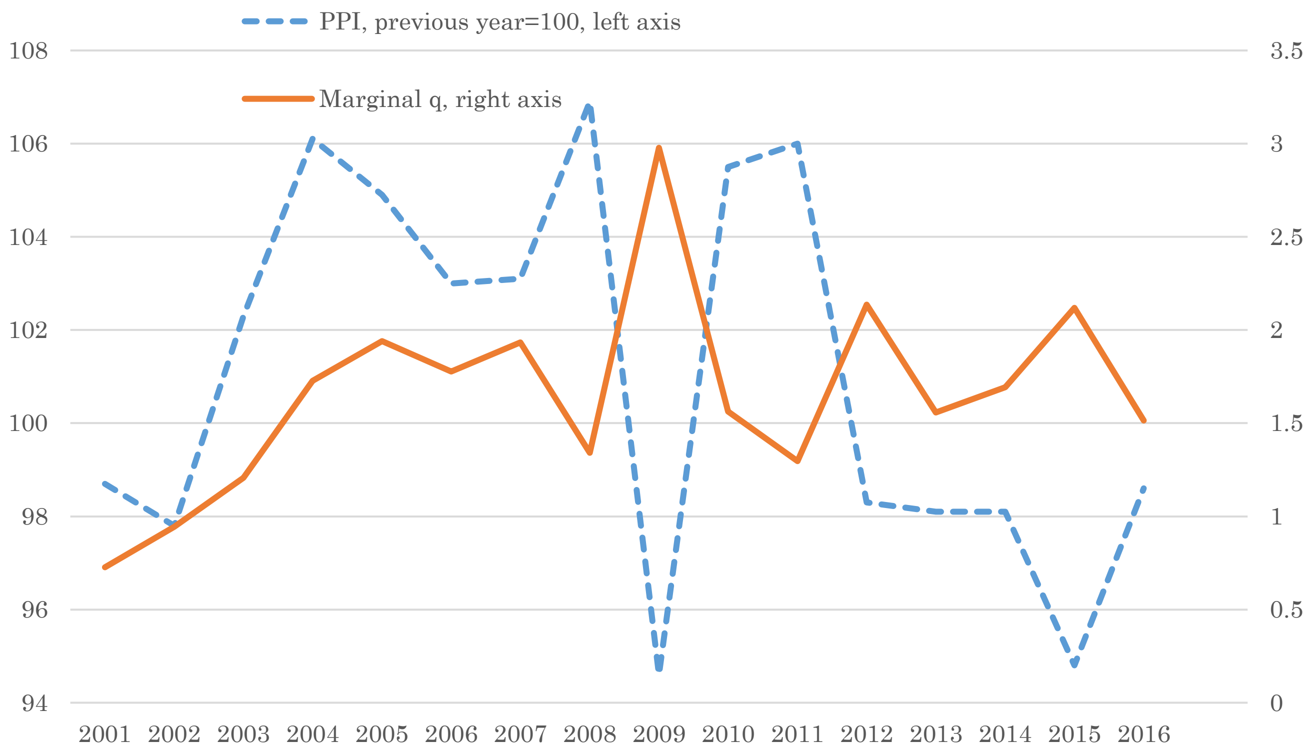


Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Figure 5: Growth rate of ratio of housing price to rent vs. PPI during 2001-2016

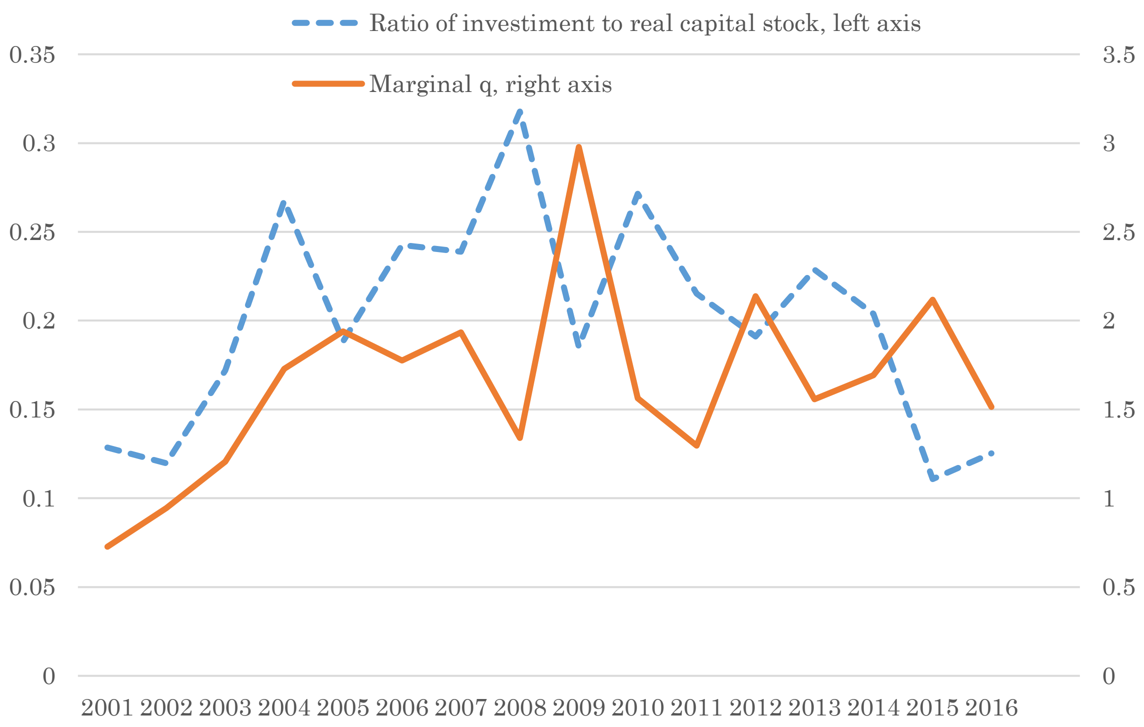
Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Figure 6: PPI vs. Marginal *q* during 2001-2016



Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Figure 7: Marginal *q* vs. ratio of investment to real capital stock during 2001-2016



Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/