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Industrial Employment in China

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Highlights

1. Using panel data of above-scale industrial enterprises in 31 provinces in China from 2001–2020, we find that corporate profit has a significantly positive impact on the depreciation rate estimated in this paper.

2. We estimated Tobin's marginal q values of industrial firms by province and year. The q value has decreased since 2015. Panel regression analyses show that the q value has a significantly positive impact on investment.

3. q has a significantly positive impact on employment. This implies a complementary relationship between fixed investment and employment.

4. Replacement investment, new investment, and employment have decreased with the declining q value, which may have been caused by the slump in China's real estate market.

Abstract

First, using panel data on above-scale industrial enterprises in 31 provinces in China from 2001–2020, we show the significantly positive impact of corporate profit on the depreciation rate estimated in this study. Second, from our estimations of Tobin's marginal *q* values, panel regressions show that the *q* values have a significantly positive impact on investment. Third, *q* has a significantly positive impact on employment. This implies that there is a complementary relationship between fixed investment and employment. Fourth, the empirical results indicate that replacement investment, new investment, and employment have decreased with the declining *q* value, which may be caused by the slump in the real estate market.

JEL Classification：E22; J21; L60

Keywords: Tobin's marginal *q*, investment, employment, industrial enterprise, China

1 Introduction

1.1 Decreasing Numbers of Employees in Industrial Sectors

The number of employees in above-scale industrial enterprises in 31 provinces in China peaked in 2014 and then began to decline, as shown in Figure 1. As such, the country is seeing a rise in unemployment, especially among college and university graduates (Qian et al. 2023). Given that China is both a developing and transitional economy, the reduction in employment of first and secondary industries may be due to re-allocation of the labor force, i.e., labor transfer from first and secondary industries to third-level industries. However, the increase in employment in third-level industries does not account fully for the potential labor transfer from the first and secondary industries. Furthermore, currently in China, the manufacturing sector is the driving force of local employment in the third sector. Wang and Chanda (2020) found that every 100 new manufacturing jobs created 34 additional jobs in the non-tradable or service sector. Therefore, we can conclude that China's current employment issues with second- and third-level industry sectors are due mainly to decreasing employment in the second sector.

1.2 Decreasing Investments in Housing-related Industries

Due to the serious housing bubble in China (Wan 2015, 2018a, b, 2021d, 2024a; Rogoff and Yang 2021; Jiang et al. 2022), the massive expansion of the real estate sector resulted in serious overinvestment in all housing-related industries in the bubble era (Wan and Qiu 2020, 2023; Wan 2024b). Under this "abnormally high marginal *q* during the period of explosive housing prices" (Wan and Qiu 2023, p. 850), the government placed strict regulations on both speculative housing purchases for investors and bank lending to housing-related businesses for corporate firms (Wan 2015, 2018a, b); this began with the inversion of the housing market and bursting of the housing bubble. Consequently, the investment in the housing industry has decreased (Wan and Qiu 2023; Wan 2024b). As reported by Qiu and Wan (2021a, b) and Huang and Wan (2022), investments in the listed residential firms in China have decreased due to the sluggish housing market. These decreasing investments have reduced the input to upstream industries, such as those involving construction (Cheng and Wan 2022) and steel and coal production (Wan and Qiu 2023).

To sum up the empirical findings on China, the state of the housing market has been the most important driver of corporate investment. Thus, investment has lagged with the sluggishness of the housing market. As corporate investment and employment are presumably complementary, as argued by theoretical analysis (Wan 2024b), it could be also inferred that the current inactivity in the housing market has reduced employment in the industrial sector, as well as in the third sector via industrial transmission.

1.3 Related Literature

The explosive growth of housing prices in China resulted in significant overinvestment in real estate-related industries (Rogoff and Yang 2021; Wan and Qiu 2024, Wan 2024a, b). Overinvestments in a bubble era will, in turn, induce slumps in fixed investment and employment when the housing market begins to cool. There are many views on the factors contributing to the employment issues in China. Examples include the effects of the introduction of artificial intelligence on employment (Ma et al. 2022) and of the actions of state-owned enterprises on employment and unemployment duration (Feng and Guo 2021). Increasing housing prices have led to an expansion of the construction industry and wage increases in manufacturing firms (Tong et al. 2018; Gong et al. 2022). To our knowledge, the relationship between China's stagnant housing market and unemployment in industry has not been addressed in the existing literature.

1.4 Contributions of this Research

Using panel data of the above-scale industrial enterprises in 31 provinces in China from 2001–2020, we found a significantly positive relationship between corporate profit and the depreciation rate estimated in this study. Next, we estimated Tobin's marginal *q* values. Panel regression analyses show that the *q* value has a significantly positive relationship with investment. Finally, the *q* value has a significantly positive impact on employment. Thus, there is a complementary relationship between fixed investment and employment. The empirical results in this study imply that replacement investment, new investment, and employment decrease with a declining *q* value, which is likely due to the slump in the real estate market.

1.5 Organization of the Paper

This paper is organized as follows. The research questions and hypotheses are detailed in Section 2. Section 3 describes the data sources for the depreciation rates and specifies how the depreciation rate, Tobin's marginal *q*, and the investment function are derived. Section 4 summarizes the empirical results, and Section 5 presents conclusions and policy implications.

2 Research Question and Hypotheses

If corporate technology is assumed to be the Leontief type, as in the analysis of Wan (2024b), then a complementary relationship can be assumed between fixed investment and employee or human capital investment. As such, the decreasing fixed investments in housing-related sectors, as confirmed by Huang and Wan (2022), Chen and Wan (2022), and Wan (2023), imply that there should be decreasing employment in industrial firms in China.

Here, we assume that a corporate firm faces three problems. The first is to replace the existing fixed investment, the second is to make new investments, and the third is to employ a large labor force. Based on these issues, we present the following three hypotheses.

Hypothesis 1: Replacement investment, which is proxied by the depreciation rate, is impacted positively by the corporate profit rate (Wan 2019, 2023; Wan and Qiu 2022).

Hypothesis 2: The investment behavior of Chinese industrial firms is explained by Tobin's marginal q theory. Thus, corporate investment is significantly positively correlated with Tobin's marginal q. These q values may include abnormal profits from bubbles (Jorgenson 1963; Tobin 1969; Ogawa 1994; Wan 2021c; Wan and Qiu 2023; Wan 2024b).

Hypothesis 3: The employment (labor demand) of Chinese industrial firms is explained by Tobin's marginal q theory. Thus, corporate employment is significantly positively correlated with Tobin's marginal *q*. These *q* values may include abnormal profits from bubbles (Jorgenson 1963; Wan 2021c; Wan and Qiu 2023; Wan 2024a, b).

3 Data, Methods, and Empirical Specifications

3.1 Panel Data on 31 Provinces in China

We obtained data from the China Industrial Statistical Yearbook for 31 provinces in China for the period 2001–2020. We collected data on the 'Main Indicators of Industrial Enterprises Above Designated Size' by region. The China Industrial Statistical Yearbooks for 2004, 2017, and 2018 were not published; thus, here we supplemented the data for these years using data from the industrial section of the China Statistical Yearbook. Specifically, for the data on accumulated depreciation, total fixed assets, and interest payments in 2004, 2017, and 2018, we interpolated the values in 2004 using the averages from 2003 and 2005, and interpolated the values in 2017 and 2018 using the averages from 2016 and 2019, respectively.

Price index of investment in fixed asset (PIIFA) and producer price index (PPI) data were taken from the China Statistical Yearbook 2001–2021. Data was missing for Xizang; thus, we interpolated the data for Xizang from the national average. Regarding the wages of employed persons, we focused on manufacturing wages and wage data from the China Statistical Yearbook 2001–2021. Manufacturing wage data for Xizang from 2012–2018 were also missing; the missing values were interpolated using the wage data for Qinghai Province, a neighboring province that presumably has a similar wage level. In total, we obtained balanced panel data with 620 (31 provinces × 20 years) observations.

3.2 Depreciation Rate

According to Wan and Qiu (2022, 2023), capital stock is given by the following:

$$TVFA_{it} = OVFA_{it} - DFA_{it} + Errors_{it}, \tag{1}$$

where

$TVFA_{it}$ is the total value of fixed assets of province *i* at time *t*;

$OVFA_{it}$ is the original value of fixed assets of province *i* at time *t*;

$DFA_{it}$is the depreciation of fixed assets of province *i* at time *t*;

$Errors_{mt}$ is the error term. This mainly indicates the individual deviation of any enterprise in terms of fixed asset valuation, accumulated depreciation, and/or provision for impairment of existing conditions.

We use the depreciation expense as an accounting item (DEAI) method of Wan and Qiu (2022) to estimate the depreciation rates of industrial firms. The DEAI of an industrial firm in a province is estimated by the following:

$$\delta_{DEAI-it} = \frac{(AD_{it} - AD_{it-1})/PIIFA_t}{TVFA_{it-1}}, \tag{2}$$

where

$\delta_{DEAI-it}$ is the DEAI depreciation rate of the industrial firm in province *i* at time *t*;

AD_{it} is the accumulated depreciation of the industrial firm in province *i* at time *t*;

$PIIFA_t$ is the average PIIFA;

$TVFA_{it-1}$ is the total fixed assets value of the industrial firm in province *i* at time $t - 1$.

The estimated values of the depreciation rate by province and by year are reported in Table 1a, b. The national average for our sample is 0.0696, which is very close to the value in Wan and Qiu (2022).

3.3 Estimation of Tobin's Marginal *q*

It was reported by Tobin (1969) and Hayashi (1982) that investment is a function of q. Following the method of estimation of marginal q by Ogawa (2003, 2020), we consider that a firm choosing the optimal level of investment (I_t) and employment (L_t) maximizes its firm's value (V_t). The Bellman equation is as follows:

$$V_t(K_{t-1}) = p_t\big(F(K_{t-1}, L_t) - A(I_t, K_{t-1})\big) - w_t L_t - p_t^I I_t$$

$$+E_t[(1 + r_{t+1})^{-1} V_{t+1}(K_t)]. \quad (4)$$

The capital accumulation equation is given by

$$K_t = (1 - \delta)K_{t-1} + I_t, \quad (5)$$

where

p_t is the output price at time *t*;

p_t^I is the price of investment goods paid by the firm at time *t*;

w_t is the wage rate at time *t*;

L_t is the labor input at time *t*;

I_t is the investment at time *t*;

K_{t-1} is the capital stock at the end of period $t - 1$;

r_{t+1} is the interest rate at time $t + 1$;

δ is the depreciation rate;

$F(K_{t-1}, L_t)$ is the production function, which is homogenous with degree 1;

$A(I_t, K_{t-1})$ is the convex adjustment cost of investment.

The first-order conditions for I_t are as follows:

$$\frac{\partial A}{\partial I_t} = [Mq_t - 1]\frac{p_t^I}{p_t}, \tag{6}$$

Mq_t is marginal *q* at time *t*, which is written as

$$Mq_t = \frac{1}{p_t^I} E_t\left[\sum_{j=1}^{\infty} \mu_{t+j}(1-\delta)^{j-1} p_{t+j}\left(\frac{\partial F}{\partial K_{t+j-1}} - \frac{\partial A}{\partial K_{t+j-1}}\right)\right], \tag{7}$$

where

$$\mu_{t+j} = \prod_{i=1}^{j}\left(1 + r_{t+j}\right)^{-1}, \quad (j = 1,2,\cdots).$$

Tobin's marginal *q* is the market value after adding a unit of capital to the replacement cost. By replacing $p_{t+j}\left(\frac{\partial F}{\partial K_{t+j-1}} - \frac{\partial A}{\partial K_{t+j-1}}\right)$ in Equation (7) with π_{t+j}, we obtain,

$$Mq_t = \frac{1}{p_t^I} E_t\left[\sum_{j=1}^{\infty} \mu_{t+j}(1-\delta)^{j-1}\pi_{t+j}\right]. \tag{8}$$

Following Ogawa (2003) and Wan and Qiu (2023), we assume that the discount rate and profit rate follow a random walk independently.

$$r_{t+1} = r_t + u_{t+1}, \tag{9}$$

$$\pi_{t+1} = \pi_t + v_{t+1}, \tag{10}$$

where u_{t+1} and v_{t+1} represent stationary white noise. Then the marginal q can be written simply as

$$Mq_{it} = \frac{\pi_{it}}{p_{it}^{I}} \frac{1 + r_{it}}{r_{it} + \delta_{it}}, \tag{11}$$

where

Mq_{it} is the before-tax marginal q of the industrial firm in province i at time t;

π_{it} is the ratio of total before-tax profit of the industrial firm in province i at time t;

p_{it}^{I} is the price index of investment of the industrial firm in province i at time t;

δ_{it} is the average depreciation rate (DEAI) of the industrial firm in province i at time t;

r_{it} is the average interest payment of the industrial firm in province i at time t

To estimate the marginal q, we use the mean value of the depreciation rate and the mean value of the interest rate by province. The estimated marginal q values are reported in Table 2a, b. The marginal q peaked at 1.9865 in 2013 and then showed a decreasing trend from 2014 onward. The national average value was 1.5257, which is close to the value cited in Wan and Qiu (2023).

3.4 Empirical Specification of Investment Equation

Following Abel (1980), Chirinko (1993), Ogawa (2020), Ogawa and Kitasaka (1999), Ogawa et al. (1994, 2019), Chen and Wan (2022), Huang and Wan (2022), and Wan and Qiu (2023), we assume that the adjustment cost *A* of the investment in Equation (7) is quadratic:

$$A(I_{it}, K_{it-1}, \tau) = \frac{\alpha}{2}\left(\frac{I_{it}}{K_{it-1}} - \tau\right)^2 K_{it-1}, \tag{12}$$

where α and τ are parameters of the quadratic adjustment cost function, respectively. We used the following empirical specification of the investment function with a structural form:

$$\frac{I_{it}}{K_{it-1}} = \tau + \frac{1}{\alpha}(q_{it} - 1)\frac{p_{it}^I}{p_{it}} + \mu_i + \gamma_t + \varepsilon_{it}, \tag{13}$$

where

I_{it} is the fixed assets investment of the industrial firm in province *i* at time *t*;

K_{it-1} is the TVFA of the industrial firm in province *i* at time *t – 1*;

q_{it} is the before-tax marginal *q* of the industrial firm in province *i* at time *t*;

τ is a coefficient implying long-term equilibrium of the investment;

μ_i, γ_t, and ε_{it} are constants related to province-specific effects, time effects, and random errors, respectively. Regarding $\frac{1}{\alpha}$, a smaller coefficient indicates a larger adjustment cost. We performed panel estimation with fixed effects and robust standard errors to obtain the coefficients in Equation (13).

3.5 Empirical Specification of Employment Equation

By solving Equation (4) using the method in Ogawa (2020, p. 126), we assume the following labor demand equation:

$$\log(L_{it}) = \beta_0 + \beta_1 \log(X_{it}) + \beta_2 \log\left(\frac{w_{it}}{p_{it}}\right) + \beta_3 (q_{it} - 1)\frac{p_{it}^I}{p_{it}} + \varphi_i + v_t + u_{it} \tag{14}$$

where

L_{it} is the number of employees of the industrial firm in province *i* at time *t*;

X_{it} is the real revenue of the industrial firm in province *i* at time *t*;

w_{it} is the nominal wage of the industrial firm in province *i* at time *t*;

q_{it} is the before-tax marginal q of the industrial firm in province *i* at time *t*.

β_2 is the effect of wages on labor demand, which is expected to have a negative sign;

β_1 is the impact of final goods demand on corporate labor demand, which is expected to have a positive sign;

β_0 is a constant term;

φ_i, v_t, and u_{it} represent constant province-specific effects, time effects, and random errors, respectively. For β_3, a positive (negative) sign implies a complementary (substitute) relationship between investment and employment.

We performed panel estimation with fixed effects and robust standard errors to obtain the coefficients in Equation (14).

4 Empirical Results

4.1 Depreciation Rate

The depreciation rate by province from 2001–2020 is reported in Table 1a, b. The transition of the median depreciation rate revealed by DEAI from 2001–2020 is illustrated in Figure 3. Consistent with the findings of Wan and Qiu (2022), the depreciation rate shows a decreasing trend from 2012 onward. The summary statistics are shown in Table 3, and according to the panel regression results in Table 4, the profit rate has a significantly positive impact on the depreciation rate. This result supports the economic depreciation hypothesis of Wan (2019, 2023) and implies that replacement investment decreases with the profit rate. The decreasing profit rate of industrial firms could be caused by the slump in the housing market, following Wan and Qiu (2023) and Wan (2024b).

4.2 Tobin's Marginal *q* and Investment

Tobin' marginal *q* values by province from 2001–2020 are reported in Table 2a, b. As illustrated in Figure 4, Tobin's marginal *q* has shown a decreasing trend since 2011. Regarding the investment (Figure 2, Table 3), the regression results in Table 5 reveal that Tobin's marginal *q* has a positive and significant association. This implies that neoclassical investment theory is supported by the provincial panel data for industrial firms and that the industrial firms follow the market trend. This result has special meaning for China, because it also implies that its industrial sector is market-oriented, as argued by Wan and Qiu (2023).

4.3 Tobin's Marginal *q* and Employment

Regarding employment, as shown in Figure 1 and Table 3, the regression results in Table 6 reveal that Tobin's marginal *q* has a significantly positive correlation. The complementary relationship between fixed investment and employment is confirmed. These results are also consistent with the theoretical predictions of neoclassical investment and employment theories, indicating a decline of both fixed investment and employment with a decreasing value for Tobin's marginal *q* due to stagnation of the housing market, as proposed by Wan and Qiu (2023) and Wan (2024a, b).

5 Conclusions and Policy Implications

We have used the depreciation rate, proxied by DEAI and Tobin's marginal *q*, to analyze the investment and employment of above-scale industrial enterprises in 31 provinces of China over the period 2001–2020. First, based on the significantly positive impact of corporate profit on DEAI, the replacement investment hypothesis is supported by the provincial panel data. The result implies that the declining profit ratio significantly decreases or postpones replacement investment in the industrial sector.

Second, based on Tobin's marginal *q* theory, we estimated before-tax Tobin's marginal *q* values for 31 provinces from 2001–2020 for the first time. We found that *q* has decreased since 2011. Further, panel regression analysis showed that *q* has a significantly positive correlation with investment. Thus, fixed investment in the industrial sector has decreased with declining *q*.

Finally, based on both Tobin's marginal *q* theory and neoclassical investment theory, we found that *q* had a significantly positive correlation with employment for the above-scale industrial enterprises in 31 provinces of China during the period 2001–2020. This implies that the relationship between fixed investment and employment as human capital investment is complementary, and that employment has also decreased with the declining *q* value.

Determining why Tobin's marginal *q* value has decreased in China since 2011 is an important research topic. One reason for the decline could be the introduction of an economic stimulus package of > 4 trillion yuan, which was allocated mainly to the real estate market, in response to the 2008 global financial crisis; ultimately, this led to a reduction in efficiency of industrial investments and the creation of bubbles in housing-related sectors (Chen et al. 2020; Wan and Qiu 2023). Hence, one implication of this study is that both fixed investment and employment have been reduced by the housing market bubble that induced overinvestment and overcapacity issues in housing-related industries, as argued by Wan and Qiu (2023) and Wan (2024a, b). Under these conditions, it is important to stabilize the current housing market in China to promote fixed investment and employment in the industrial sector.

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Table 1a: Depreciation rate of the above-scale industrial enterprises by province in China, 2001-2022

Year	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Liaoning	Jilin	Heilong jiang	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Jiangxi	Shan dong	Henan
2001	0.0518	0.0722	0.0398	0.0838	0.0540	0.0531	0.0473	0.0454	0.0762	0.0848	0.1036	0.0600	0.0935	0.0404	0.0821	0.0674
2002	0.0551	0.0716	0.0713	0.0835	0.0392	0.0428	0.0618	0.0701	0.0409	0.0769	0.0679	0.0493	0.0692	0.0259	0.0609	0.0608
2003	0.0438	0.0830	0.1005	0.0572	0.0529	0.0356	0.0286	0.0592	0.1013	0.0588	0.0681	0.0522	0.0890	0.0434	0.0675	0.0533
2004	0.1280	0.0787	0.0729	0.0781	0.1538	0.0750	0.0899	0.0780	0.1101	0.0925	0.0946	0.0579	0.0701	0.0417	0.0867	0.0433
2005	0.0977	0.0735	0.0651	0.0629	0.1053	0.0677	0.0807	0.0748	0.0977	0.0769	0.0761	0.0529	0.0627	0.0381	0.0719	0.0390
2006	0.0776	0.0771	0.0902	0.0764	0.0615	0.0455	0.0887	0.0814	0.0854	0.0963	0.0804	0.0699	0.0892	0.0586	0.0811	0.0861
2007	0.0700	0.0838	0.0500	0.0777	0.0937	0.1498	0.0777	0.1068	0.0795	0.0987	0.0699	0.0553	0.0561	0.0871	0.0968	0.0572
2008	0.0622	0.0718	0.0663	0.0644	0.0786	0.0770	0.0862	0.0828	0.1437	0.1754	0.0776	0.1373	0.0562	0.0867	0.1195	0.0312
2009	0.0695	0.0655	0.0945	0.0802	0.0931	0.1193	0.0258	0.0736	0.0755	0.0409	0.0767	0.0804	0.0761	0.0871	0.1626	0.0849
2010	0.0716	0.1099	0.0905	0.1124	0.1826	0.1413	0.3701	0.1000	0.0750	0.1214	0.0639	0.0744	0.0666	0.0734	0.1150	0.1036
2011	0.0653	0.0988	0.1454	0.1090	0.1244	0.0896	0.3780	0.0560	0.0523	0.1986	0.0653	0.1775	0.0623	0.1774	0.2271	0.1438
2012	0.1386	0.1108	0.0583	0.0840	0.0940	0.0826	0.3421	0.1080	0.0570	0.1294	0.0808	0.0989	0.1072	0.1875	0.1090	0.0142
2013	0.0842	0.1023	0.0672	0.0832	0.0769	0.1383	0.1136	0.1274	0.0740	0.1235	0.0726	0.1388	0.1073	0.1639	0.2279	0.0537
2014	0.0821	0.0847	0.0639	0.0369	0.0999	0.0767	0.1905	0.0764	0.0688	0.1128	0.0704	0.0638	0.0762	0.1186	0.0936	0.0599
2015	0.0818	0.1227	0.0533	0.0262	0.0657	0.0768	0.0646	0.1007	0.0848	0.0902	0.0674	0.1382	0.0708	0.0811	0.1158	0.0554
2016	0.0701	0.0494	0.0417	0.0323	0.0877	0.0763	0.1162	0.0931	0.0740	0.0921	0.0600	0.0465	0.1005	0.1227	0.1279	0.0234
2017	0.0674	0.0838	0.0713	0.0555	0.0940	0.0572	0.1351	0.0267	0.0695	0.0982	0.0555	0.0796	0.1035	0.1017	0.1156	0.0159
2018	0.0735	0.0838	0.0713	0.0551	0.0940	0.0614	0.1351	0.0294	0.0683	0.0983	0.0551	0.0797	0.0976	0.0994	0.1124	0.0162
2019	0.0855	0.0838	0.0713	0.0543	0.0940	0.0651	0.1403	0.0305	0.0721	0.0967	0.0530	0.0786	0.1026	0.0998	0.1095	0.0208
2020	0.1091	0.0681	0.0404	0.0783	0.1345	0.0720	0.0286	0.0513	0.0685	0.0610	0.0673	0.0524	0.0498	0.0921	0.1053	0.0127
Avg	0.0792	0.0838	0.0713	0.0696	0.0940	0.0802	0.1300	0.0736	0.0787	0.1012	0.0713	0.0822	0.0803	0.0913	0.1144	0.0521

Source: Authors' estimation based on China Industrial Statistical Yearbook, 2001-2022.

Table 1b: Depreciation rate of the above-scale industrial enterprises by province in China, 2001-2022

Year	Hubei	Hunan	Guang dong	Guangxi	Hainan	Chong qing	Sichuan	Guizhou	Yunnan	Xizang	Shannxi	Gansu	Qinghai	Ningxia	Xinjiang	National total
2001	0.0544	0.0513	0.1068	0.0482	0.0783	0.0490	0.0697	0.0733	0.0728	0.0317	0.0878	0.0397	0.0769	0.0532	0.1064	0.0662
2002	0.0793	0.0428	0.0673	0.0359	0.0794	0.0386	0.0735	0.0541	0.0638	0.0089	0.0637	0.0614	0.0905	0.0542	0.0824	0.0534
2003	0.0305	0.0452	0.0722	0.0449	0.0239	0.0409	0.0803	0.0381	0.0632	0.0437	0.0701	0.0394	0.0446	0.0650	0.0684	0.0611
2004	0.0489	0.0349	0.0995	0.0465	0.0801	0.0451	0.0831	0.0769	0.0563	0.0379	0.0876	0.0702	0.0850	0.0639	0.1063	0.0814
2005	0.0451	0.0319	0.0896	0.0410	0.0553	0.0403	0.0759	0.0618	0.0533	0.0327	0.0736	0.0719	0.0592	0.0500	0.1399	0.0703
2006	0.0540	0.0628	0.1176	0.0492	0.0555	0.0711	0.0340	0.0422	0.0682	0.0339	0.1039	0.1008	0.0496	0.0658	0.0585	0.0793
2007	0.0796	0.0718	0.0465	0.0697	0.0646	0.0582	0.1267	0.0530	0.0739	0.1450	0.1022	0.0809	0.0470	0.0598	0.1501	0.0822
2008	0.1630	0.0932	0.0842	0.0771	0.0653	0.0872	0.0620	0.0658	0.0553	0.0500	0.0678	0.1547	0.0554	0.0455	0.0910	0.1088
2009	0.0161	0.0705	0.0836	0.0769	0.0484	0.0819	0.1461	0.0661	0.0588	0.0383	0.0236	0.0830	0.0573	0.0668	0.1362	0.0673
2010	0.1385	0.1266	0.1189	0.0762	0.0744	0.1327	0.2132	0.0436	0.0683	0.0570	0.0957	0.0700	0.0778	0.0615	0.0824	0.1146
2011	0.1935	0.1048	0.0649	0.0859	0.0493	0.1354	0.0963	0.0521	0.0530	0.0353	0.2077	0.1664	0.0514	0.0526	0.0777	0.1333
2012	0.0919	0.0708	0.0930	0.0674	0.0830	0.0657	0.0220	0.0568	0.0629	0.0656	0.1322	0.1037	0.0689	0.0656	0.1820	0.0805
2013	0.2047	0.0737	0.1081	0.0710	0.0595	0.1052	0.0707	0.0702	0.0649	0.0591	0.0988	0.0843	0.1214	0.0538	0.0499	0.1081
2014	0.0653	0.0337	0.1048	0.0561	0.0650	0.0981	0.1119	0.0508	0.0687	0.0680	0.2668	0.0453	0.2189	0.0453	0.0951	0.0869
2015	0.0885	0.0515	0.1206	0.0773	0.0741	0.1161	0.0165	0.0831	0.0388	0.0817	0.0705	0.0249	0.1383	0.0488	0.0870	0.0605
2016	0.0627	0.0641	0.1080	0.0723	0.0768	0.1293	0.1311	0.0631	0.0453	0.0385	0.1245	0.0673	0.0756	0.0447	0.0925	0.0765
2017	0.0637	0.0768	0.0711	0.0594	0.0526	0.0224	0.0232	0.0456	0.0566	0.0773	0.1037	0.0438	0.0756	0.0465	0.0692	0.0078
2018	0.0625	0.0725	0.0691	0.0592	0.0826	0.0235	0.0258	0.0451	0.0557	0.0664	0.1012	0.0447	0.0748	0.0413	0.0689	0.0079
2019	0.0619	0.0789	0.0710	0.0596	0.0839	0.0245	0.0214	0.0491	0.0577	0.0645	0.0955	0.0470	0.0765	0.0413	0.0680	0.0083
2020	0.0618	0.0902	0.0724	0.0668	0.1190	0.0551	0.0604	0.0408	0.0470	0.0845	0.0920	0.0746	0.0438	0.0583	0.0791	0.0383
Avg	0.0833	0.0674	0.0885	0.0620	0.0685	0.0710	0.0772	0.0566	0.0592	0.0560	0.1034	0.0737	0.0794	0.0542	0.0946	0.0696

Source: Authors' estimation based on China Industrial Statistical Yearbook, 2001-2022.

Table 2a: Marginal q of the above-scale industrial enterprises by province in China, 2001-2022

Year	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Liaoning	Jilin	Heilong jiang	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Jiangxi	Shandong	Henan
2001	0.6418	1.1551	0.5014	0.1899	0.1408	0.2584	0.4366	1.9012	0.9691	0.7541	1.2992	0.3629	0.5857	0.1205	1.0301	0.4278
2002	0.7938	0.8128	0.5194	0.2450	0.2450	0.2818	0.4998	1.6937	1.2144	0.8984	1.4065	0.5172	0.8969	0.1865	0.9576	0.4847
2003	1.1195	1.0398	1.3985	0.4729	0.4245	0.4193	0.8011	1.9972	1.8479	1.1954	1.5890	0.8495	1.3156	0.3949	1.3160	0.6132
2004	1.3826	1.7161	1.0983	0.6721	0.6648	0.7098	0.8544	2.6082	2.0559	1.3332	1.4388	0.7700	1.2724	0.4887	1.5217	0.7849
2005	1.4761	2.2453	1.3444	0.6745	0.9161	0.5967	0.5981	3.5234	1.6989	1.3648	1.3783	0.8713	1.3179	0.7051	1.9578	1.2229
2006	1.5250	2.6874	1.4866	0.7813	1.0118	0.6941	0.7767	4.3161	1.6920	1.4807	1.3745	0.9074	1.6376	1.0333	1.9929	1.8213
2007	1.7220	2.5516	1.7688	0.9697	1.6176	1.1216	1.4444	3.6781	1.8425	1.7468	1.4455	0.9711	2.1504	1.4332	1.9841	2.5287
2008	1.0886	1.8773	1.5176	0.7833	1.4267	0.8533	1.0610	3.7116	1.1492	1.8924	1.0642	1.1731	1.6373	1.6431	1.7657	2.3519
2009	1.4917	2.1400	1.5991	0.6424	1.5675	1.3326	1.2622	2.2191	1.8046	1.9049	3.0994	1.5198	2.0395	1.3965	2.1250	2.3761
2010	2.0477	2.9500	1.7381	1.1187	2.1552	1.8569	1.8438	2.3773	2.7151	2.4302	1.8180	2.0237	2.6518	2.1411	2.2716	2.4888
2011	1.9035	3.0597	1.8035	1.3300	2.3482	1.6711	1.9681	2.3287	2.4914	2.3590	1.6535	1.8436	2.7189	2.3290	2.3219	2.5571
2012	2.1938	3.1490	1.5636	0.9078	1.8289	1.6146	1.8541	2.1037	2.4239	2.3911	1.5688	1.8576	2.4496	2.7480	2.4634	2.1825
2013	1.9872	2.9566	1.4137	0.5027	1.6785	1.9455	1.5453	1.6963	2.8617	2.4934	1.7562	1.8260	2.4946	2.8940	2.4827	2.2490
2014	2.2287	2.5128	1.2062	0.1775	0.8999	1.1192	1.6532	1.2723	2.8689	2.2598	1.6574	1.4012	2.2483	2.7965	2.1422	1.9686
2015	2.6005	2.5777	1.0159	-0.0204	0.7246	0.6286	1.3471	0.6251	3.3108	2.4628	1.7404	1.5296	2.0720	2.8001	1.9322	1.8066
2016	2.4198	1.8651	1.2433	0.1910	0.9155	0.3596	1.5054	0.3989	3.4807	2.5541	2.0268	1.5756	2.4961	2.7133	1.8280	0.7828
2017	2.8116	0.8662	1.1125	0.6203	0.9173	0.7524	1.0739	0.5506	3.6654	2.1518	1.9311	1.6424	2.6162	2.1850	1.5936	1.6145
2018	2.2955	1.3686	0.9675	0.8049	0.9122	1.0958	0.9421	0.7028	3.6714	1.9752	1.9139	1.8044	2.7318	2.4625	0.9988	0.9263
2019	2.4628	1.7414	1.0500	0.6950	1.0132	1.1208	1.0356	0.6326	3.4287	1.7279	2.1294	1.6724	3.5912	2.7007	0.9036	1.4063
2020	2.4960	1.2708	1.0661	0.5973	0.8655	1.0124	0.8925	0.4317	3.3217	2.2293	2.4047	1.8810	3.1182	3.3190	1.2572	1.1210
Avg	1.8344	2.0272	1.2707	0.6178	1.1137	0.9722	1.1698	1.9384	2.4257	1.8803	1.7348	1.3500	2.1021	1.8245	1.7423	1.5857

Source: Authors' estimation based on China Industrial Statistical Yearbook, 2001-2022.

Table 2b: Marginal q of the above-scale industrial enterprises by province in China, 2001-2022

Year	Hubei	Hunan	Guangdong	Guangxi	Hainan	Chongqing	Sichuan	Guizhou	Yunnan	Xizang	Shannxi	Gansu	Qinghai	Ningxia	Xinjiang	National total
2001	0.5883	0.3050	0.9190	0.2931	0.3160	0.2173	0.2911	0.2096	0.5791	0.5454	0.3050	0.0691	0.0945	0.1058	0.7434	0.6455
2002	0.6258	0.3809	1.0971	0.2675	0.6273	0.3348	0.3780	0.2097	0.4633	0.3887	0.4366	0.1681	0.1898	0.1114	0.5419	0.7275
2003	0.6759	0.5510	1.4197	0.4841	0.7029	0.6991	0.4550	0.3331	0.6605	0.6008	0.7432	0.2460	0.2174	0.2043	0.8739	0.9981
2004	0.6283	0.6807	1.4806	0.8170	0.9491	0.8880	0.5190	0.4908	1.0266	0.5567	1.0304	0.4227	0.8095	0.2919	1.3793	1.1736
2005	0.7398	0.7399	1.8034	0.7905	0.8974	0.8265	0.7899	0.4782	1.2221	0.7177	1.4547	0.1853	0.9909	0.3486	3.1127	1.3324
2006	0.8297	0.9051	2.0580	0.9704	1.1656	1.0050	0.9823	0.6140	1.6092	0.8492	1.6259	0.6597	1.1882	0.3426	2.8509	1.5030
2007	1.0733	1.2874	2.3176	1.3249	0.9164	1.2585	1.2971	0.7623	1.5754	1.0104	1.8786	1.0326	1.2252	0.5125	2.7794	1.7291
2008	1.0341	1.3147	1.9470	0.6433	0.8900	1.1758	1.1895	0.7212	0.8715	0.4264	2.0755	0.4450	1.3519	0.3095	2.4512	1.4981
2009	1.2046	1.4487	2.6338	0.8627	1.5325	1.3178	1.5606	0.6892	1.1490	0.5956	1.7469	0.6771	0.6447	0.6574	1.6413	1.6913
2010	1.4161	2.1242	3.3850	1.7588	1.8160	1.6372	1.7120	0.8750	1.2971	0.8391	2.2976	0.7117	0.9472	0.9112	1.8944	2.1170
2011	1.0966	2.1379	2.3498	1.6781	1.9796	1.5590	1.8161	1.1186	1.1272	0.7183	3.2505	0.6462	1.0308	0.9070	1.7727	2.0570
2012	1.5754	1.8548	2.3827	1.7049	1.5977	1.5111	1.8195	1.9209	0.9916	0.6611	2.2622	0.6080	0.7408	0.4982	1.5454	1.9660
2013	1.8533	1.9526	2.8319	1.6318	1.4751	1.8792	1.5627	1.3421	0.9233	0.2936	1.9239	0.5808	0.5831	0.6012	1.2480	1.9865
2014	1.4991	1.3941	2.7925	1.5439	1.0362	1.9053	1.1157	1.0480	0.5336	0.4595	1.8404	0.3731	0.3263	0.3540	0.7631	1.6771
2015	1.6462	1.4390	2.9542	1.9050	0.8966	2.0593	1.0973	1.2183	0.4461	0.2033	1.0978	-0.1356	0.2866	0.2502	0.3175	1.5970
2016	1.7802	1.6079	3.0393	2.0618	0.6790	1.1049	1.1400	1.3214	0.3233	0.3807	1.1004	0.1029	0.1945	0.3578	0.3422	1.6586
2017	1.5927	1.5890	3.0245	2.2423	0.6472	1.6155	1.2106	1.3129	0.7144	0.5008	1.2654	0.3189	0.2301	0.3219	0.5695	1.5979
2018	1.7219	1.2806	2.6944	1.4339	1.3280	1.3669	1.1627	1.2662	0.8260	0.2744	1.3063	0.3593	0.1426	0.3516	0.6069	1.4443
2019	1.9418	1.8827	2.8690	1.3414	1.6098	1.4589	1.3915	1.5680	0.8731	0.1043	1.3691	0.4235	-1.3564	0.4472	0.5328	1.5402
2020	1.7294	2.1120	2.7968	1.4390	1.3342	1.7873	1.4911	1.7959	1.0804	0.2679	1.0842	0.4306	0.2570	0.3681	0.5067	1.5737
Avg	1.2626	1.3494	2.3398	1.2597	1.1198	1.2804	1.1491	0.9648	0.9146	0.5197	1.5047	0.4162	0.5047	0.4126	1.3237	1.5257

Source: Authors' estimation based on China Industrial Statistical Yearbook, 2001-2022.

Table 3: Summary statistics for main variables

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
year	620	2010	2010	5.770937	2001	2020
depreciation rate	620	0.0800	0.0736	0.0398	0.0089	0.3780
profit rate	620	0.1616	0.1581	0.0919	-0.0174	0.4571
Marginal q	620	1.3550	1.2750	0.8014	-0.1400	4.3200
Marginal q -1	620	0.3548	0.2838	0.8158	-2.4678	3.0813
i/k (investment rate)	620	0.1892	0.1800	0.1296	-0.3200	0.8100
employment (10,000 persons)	620	520.7580	173.2400	1444.9620	1.6300	9977.2100
ln_employee	620	5.0820	5.1546	1.4977	0.4886	9.2081
real_revenue	496	216.4532	117.9004	271.4134	0.2401	1453.7970
real_wage	620	0.0215	0.0177	0.0131	0.0066	0.0907

Source: Authors' calculations.

Table 4: Determinants of depreciation rate, panel regression with fixed effect and robust standard errors

VARIABLES	depreciation	depreciation	depreciation
profit rate	0.1823***	0.1824***	0.0994***
	(0.0397)	(0.0409)	(0.0279)
d2002			-0.0068*
			(0.0035)
d2003			-0.0126***
			(0.0042)
d2004			0.0023
			(0.0047)
d2005			-0.0087*
			(0.0044)
d2006			-0.0051
			(0.0046)
d2007			0.0027
			(0.0077)
d2008			0.0061
			(0.0093)
d2009			-0.0006
			(0.0075)
d2010			0.0262**
			(0.0117)
d2011			0.0355***
			(0.0128)
d2012			0.0152
			(0.0099)
d2013			0.0192**
			(0.0092)
d2014			0.0124
			(0.0094)
d2015			0.0023
			(0.0073)
d2016			0.0035
			(0.0064)
d2017			-0.0055
			(0.0058)
d2018			-0.0039
			(0.0057)
d2019			-0.0036
			(0.0058)
d2020			-0.0061
			(0.0067)
year		-0.0000	
		(0.0003)	
Constant	0.0505***	0.0581	0.0603***
	(0.0064)	(0.6373)	(0.0052)
Observations	620	620	620
R-squared	0.1251	0.1251	0.2119
Number of id	31	31	31

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Determinants of investment rate, panel regression with fixed effect and robust standard errors

VARIABLES	i/k	i/k	i/k (without robust standard errors)	i/k
Marginal q - 1	0.0306**	0.0618***	0.0197**	0.0197
	(0.0127)	(0.0159)	(0.0088)	(0.0140)
d2002			-0.0548**	-0.0548***
			(0.0265)	(0.0110)
d2003			-0.0435	-0.0435**
			(0.0267)	(0.0188)
d2004			0.0835***	0.0835***
			(0.0269)	(0.0290)
d2005			0.0576**	0.0576**
			(0.0272)	(0.0272)
d2006			0.0568**	0.0568***
			(0.0276)	(0.0198)
d2007			0.0592**	0.0592*
			(0.0281)	(0.0338)
d2008			0.1092***	0.1092***
			(0.0275)	(0.0266)
d2009			0.0433	0.0433
			(0.0280)	(0.0329)
d2010			0.0712**	0.0712*
			(0.0290)	(0.0367)
d2011			-0.0181	-0.0181
			(0.0290)	(0.0372)
d2012			0.0444	0.0444
			(0.0288)	(0.0364)
d2013			0.0224	0.0224
			(0.0286)	(0.0308)
d2014			0.0154	0.0154
			(0.0278)	(0.0320)
d2015			-0.0392	-0.0392
			(0.0276)	(0.0324)
d2016			-0.0699**	-0.0699**
			(0.0275)	(0.0260)
d2017			-0.1514***	-0.1514***
			(0.0277)	(0.0335)
d2018			-0.1607***	-0.1607***
			(0.0275)	(0.0268)
d2019			-0.1094***	-0.1094***
			(0.0277)	(0.0298)
d2020			-0.0611**	-0.0611
			(0.0279)	(0.0452)
year		-0.0091***		
		(0.0018)		
Constant	0.1783***	18.4473***	0.1894***	0.1894***
	(0.0045)	(3.5299)	(0.0192)	(0.0190)
Observations	620	620	620	620
R-squared	0.0214	0.1711	31	0.3739
Number of id	31	31	0.3739	31

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

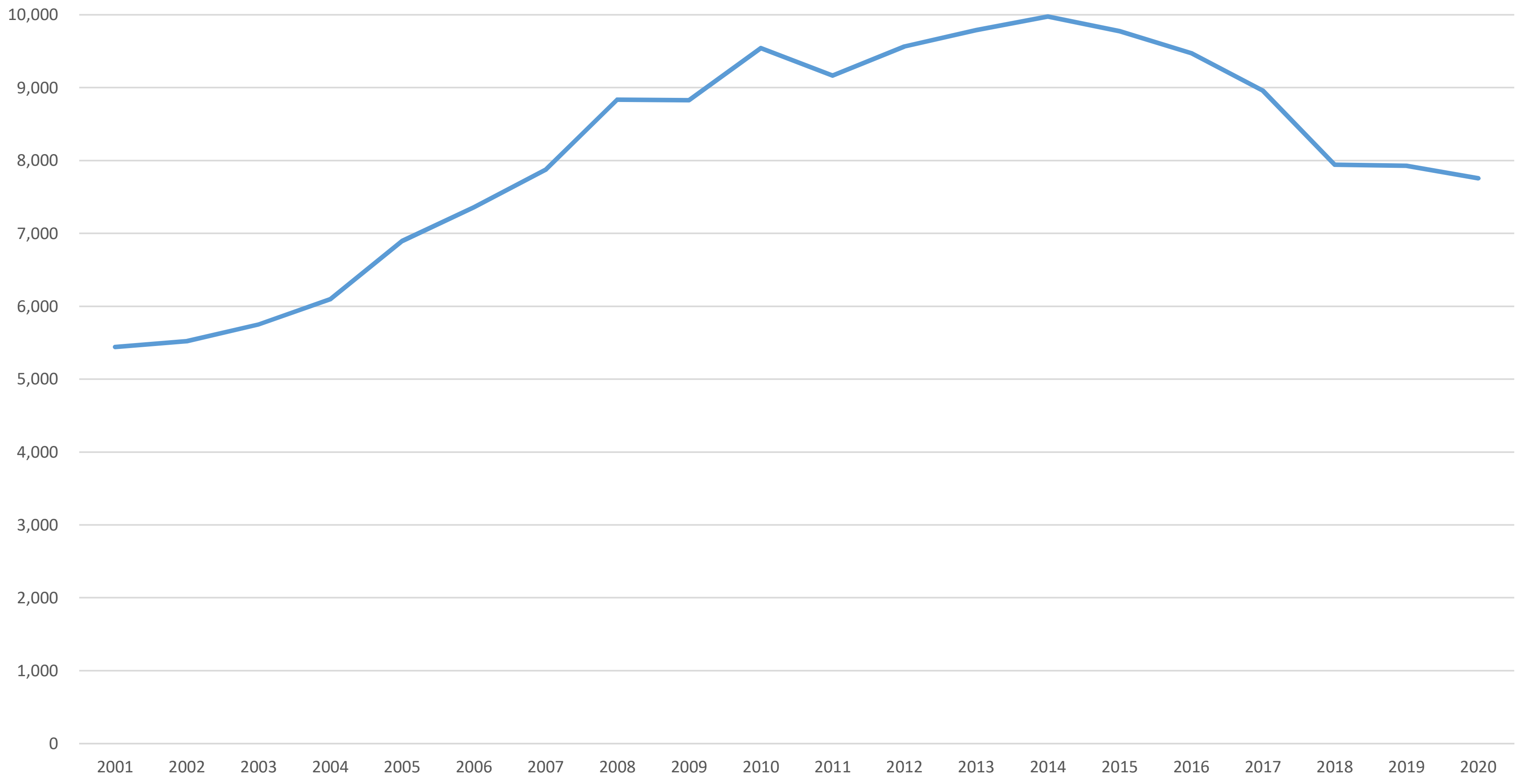
Table 6: Determinants of employment, panel regression with fixed effect and robust standard errors

VARIABLES	ln_employee	ln_employee	ln_employee
real_revenue	5.4082***	6.1413***	3.6425***
	(1.3553)	(1.6214)	(1.2168)
real_wage	-8.2798***	-1.6273	-3.6143
	(2.3854)	(1.6566)	(2.8068)
Marginal q - 1	0.1341***	0.1499***	0.1157**
	(0.0370)	(0.0399)	(0.0480)
d2002			-0.0117
			(0.0103)
d2003			-0.0459
			(0.0288)
d2004			-0.0462
			(0.0431)
d2005			0.0141
			(0.0558)
d2006			0.0461
			(0.0667)
d2007			0.0623
			(0.0779)
d2008			0.1841**
			(0.0745)
d2009			0.1571**
			(0.0724)
d2010			0.1848**
			(0.0815)
d2011			0.1542*
			(0.0881)
d2012			0.2108**
			(0.0895)
d2013			0.2592***
			(0.0914)
d2014			0.3152***
			(0.0927)
d2015			0.3074***
			(0.1000)
d2016			0.2586**
			(0.1133)
d2017			0.2076*
			(0.1178)
d2018			0.1274
			(0.1193)
d2019			0.1031
			(0.1347)
d2020			0.1173
			(0.1367)
year	0.0168**		
	(0.0067)		
Constant	-28.7032**	4.9522***	4.9222***
	(13.3340)	(0.0353)	(0.0474)
Observations	620	620	620
R-squared	0.4748	0.4250	0.5779
Number of id	31	31	31

Robust standard errors in parentheses

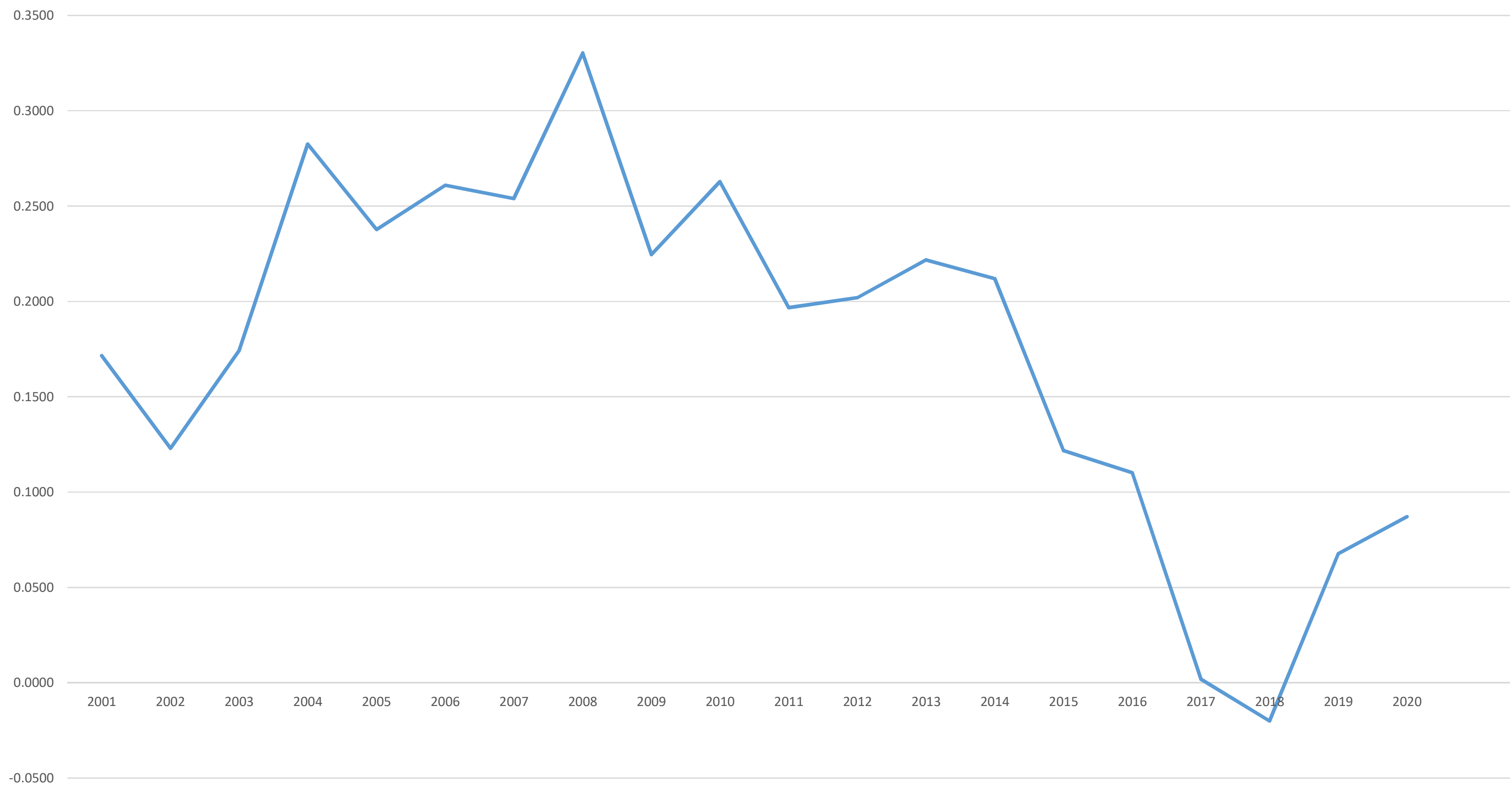
*** p<0.01, ** p<0.05, * p<0.1

Figure 1: Number of employees of the above-scale industrial enterprises in China, 2001-2020
(unit: 10,000 persons)



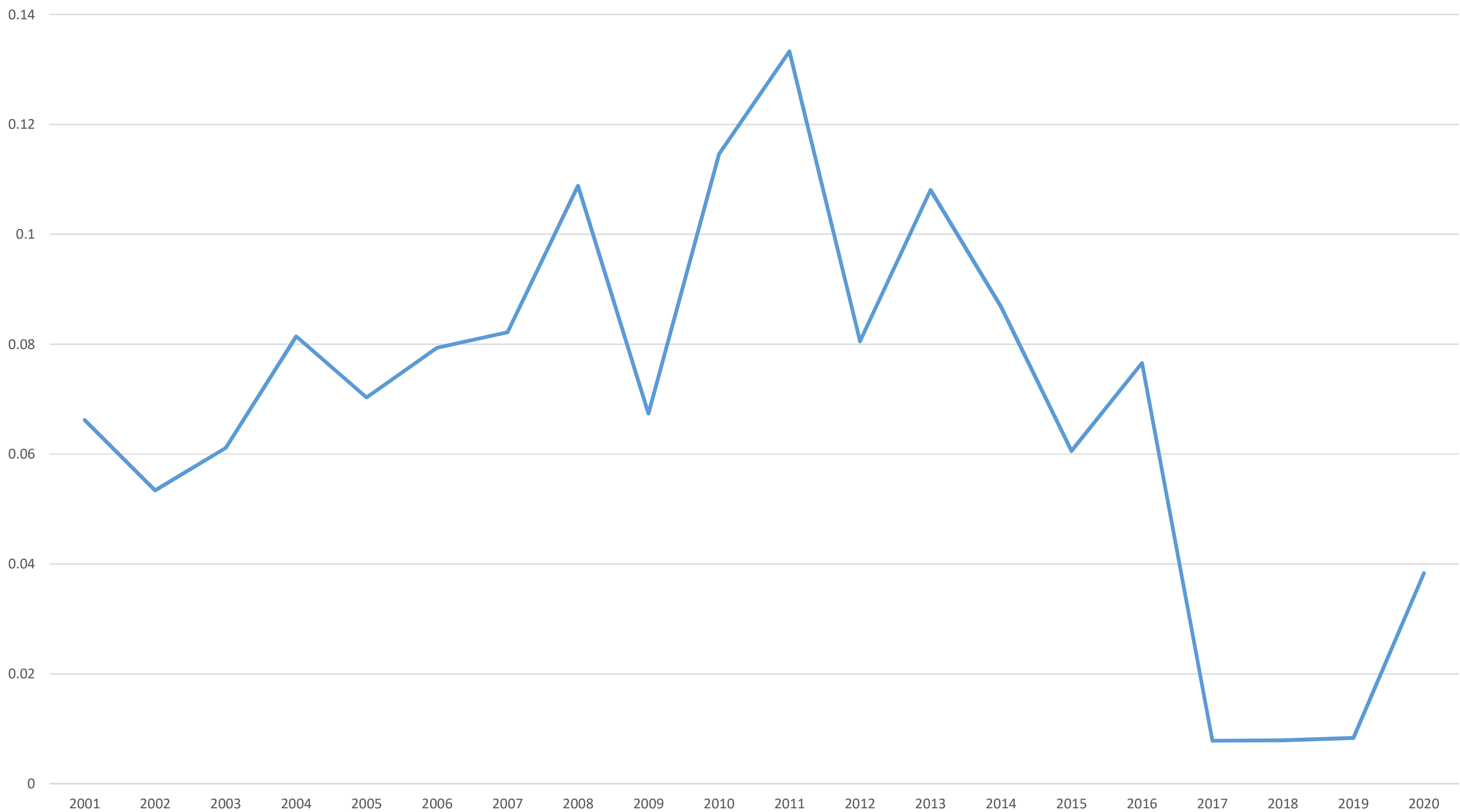
Source: China Industrial Statistical Yearbook 2001-2021.

Figure 2: Ratio of investment to capital of the above-scale industrial enterprises in China, 2001-2020



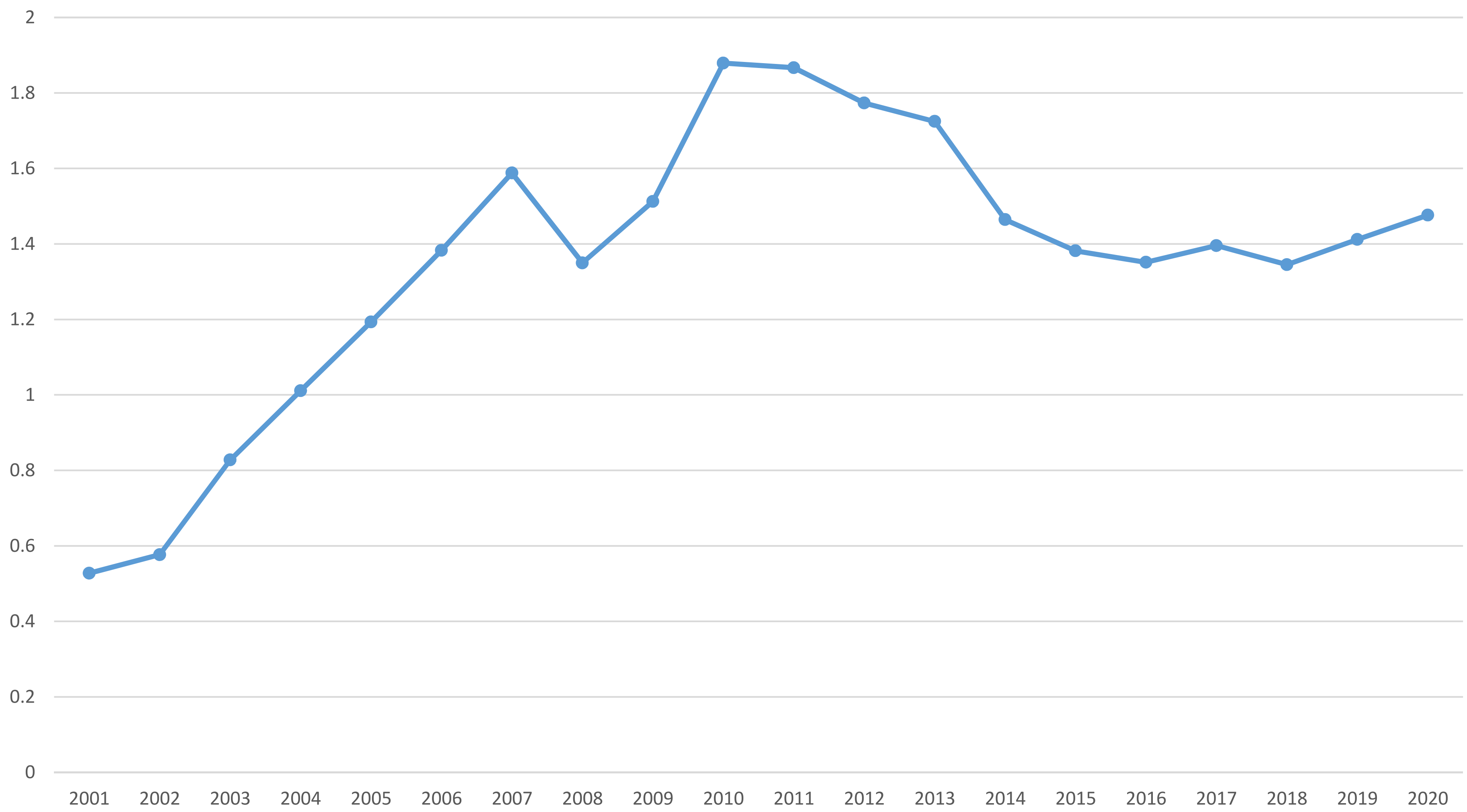
Source: : China Industrial Statistical Yearbook 2001-2021.

Figure 3: Depreciation rate of the above-scale industrial enterprises in China, 2001-2020



Source: Authors' estimation based on China Industrial Statistical Yearbook 2001-2021.

Figure 4: Marginal q of the above-scale industrial enterprises in China, 2001-2020
(average value for 31 provinces)



Source: Authors' estimation based on China Industrial Statistical Yearbook 2001-2021.