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The impact of enterprises' cross-border entry into real estate industry on their total factor productivity

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Abstract. Based on the research of domestic and foreign scholars,this paper discusses the influence of non-real estate enterprises investment behavior in the real estate industry of listed companies on the total factor productivity of enterprises,and attempts to study the total factor productivity of enterprises investing in the real estate industry from the perspective of micro-enterprises investment decision.From the micro level,the cross-border investment of non-real estate enterprises in the real estate industry belongs to one of the diversification strategies of enterprises.The concept of “diversification discount” is proposed, and the degree of diversification of enterprises is negatively correlated with the value of enterprises.In fact,it is mergers and acquisitions to implement diversification that reduce the value of enterprises.It is also found that the “diversification discount” is due to the measurement error of Tobin Q.Using the flow of diversified investment to measure the diversification strategy,it is found that the diversification strategy will cause the loss of enterprise value.It is found that the unrelated diversification strategy of enterprises will expand the scale of enterprises and enhance the innovation investment of enterprises. In order to verify the impact of non-real estate enterprises' investment in the real estate industry on their total factor productivity (TFP), A simple theoretical model was first constructed to explain the mechanism of the negative impact of enterprises' investment in non-main business on their total factor productivity,and relevant hypotheses were proposed.Then,the TFP of China's A-share non-real estate listed companies was measured. In addition, the data of non-real estate enterprises investing in the real estate industry of A-share listed companies are collected manually, and the negative impact of this cross-border investment behavior of enterprises on their total factor productivity is proved by empirical research method, so as to explain the negative effect of overheating of the real estate market on the economy and the importance of macro-control to stabilize real estate prices.

Keywords: Cross-border investment, diversification strategy,negative impact, macro-control, value loss.

1. Introduction

Since the reform of housing commercialization, China's real estate industry has developed rapidly and made great contributions to economic growth. At the same time, the overheating of the real estate industry has also brought a series of social and economic problems, such as the widening gap between the rich and the poor and the hollowing out of the manufacturing industry. The lessons of the Great recession brought by the outbreak of the subprime mortgage crisis in the United States and the bursting of the real estate price bubble in Japan remind us that we must be alert to the harm brought by the real estate bubble. At present, China's economic growth is in a critical period of slowing down and shifting gear, and the development of the real estate industry has a complex and far-reaching impact on economic development. Under the background of supply-side structural reform, in order to promote the destocking of real estate and the high-quality development of the real estate industry, It is of great practical significance to study the total factor productivity of China's real estate industry from the perspective of market overentry and investment.[1].

2. Theoretical model and research hypothesis

Olivier built an endogenous growth model that included the R&D sector, demonstrating that the impact of a rational bubble depends on the type of asset to which it is attached. Qiu Yunjie and Wei Wei used propensity score matching method to prove that R&D behavior of enterprises can improve their total factor productivity. Zhu Xingwen believes that the increase in enterprise R&D investment will lead to an increase in the number of technological innovation results, which will improve the average labor productivity. Based on the above research, a theoretical model including R&D department is constructed under Olivier's research framework to illustrate the negative impact of increasing the proportion of non-main business investment on total factor productivity. The research hypothesis is that the investment of non-real estate enterprises in the real estate industry will reduce their total factor productivity[2].

2.1 Basic Settings

In order to reflect the difference between main business and non-main business, two production departments are introduced into the model: one is the final product department, which produces final consumer goods through a series of intermediate products; The other is the research and development department, corresponding to the main business development, research and development of new intermediate products. In the same way as the basic Diamond model, we assume that the micro-subject exists in two periods: youth period and old age period, assuming that there is no population growth and the total population is L[3].

2.1.1 R&d department setting

During the period of t, the total number of intermediate products invented and the number of enterprises are N_t, which can be understood as the accumulation of intellectual capital in the economy, and each enterprise has exclusive rights to use specific intermediate products. In order to simplify the model, only the input of labor force is considered in this model, and the growth rate of intermediate products follows the equation (2-1).

$$\dot{N}_t = AN_tL_t^R \tag{2-1}$$

That is, the speed of development of new intermediate products. By technical parameters A, the number of enterprises in the current period are N_t. And labor decisions that go into research and development L_t^R. After a new intermediate product is produced, the micro-entity integrates it into a new enterprise and has a monopoly on the use of the intermediate product. Assume that the enterprise does not provide intermediate products in the period of establishment, but will start to provide intermediate products in the next period. The newly established enterprise has a price P_t in the current period, and the micro-entity establishes a new enterprise t in the period and sells it in the period t+1, and the selling price is $(1+r)P_t$, where is the risk-free interest rate.

2.1.2 Micro-subject setting

Micro subjects choose to divide their labor between the two production sectors during their youth, putting labor in the research λ_t and development sector and labor in the final product sector . The micro-agents work during their youth, and the income of labor $(1-\lambda_t)$ in the final product sector($(1-\lambda_t)w_t$) is partly used for youth consumption (c_t^Y) and partly used for savings (s_t). The micro-subjects do not work in old age, and their consumption (c_{t+1}^O) is paid for by the savings (s_t) of youth and the income from the sale of enterprises $\lambda_t AN_tP_t$. Assuming that the utility function of the micro-agent is logarithmic and the discount coefficient is β, the micro-agent is faced with the following optimization problems[4]:

$$\begin{aligned} &\max \ln c_t^Y + \beta^{-1}\ln c_{t+1}^0 \\ &\text{st: } c_t^Y + s_t = (1-\lambda_t)w_t \\ &c_{t+1}^0 = (s_t + \lambda_t AN_tP_t)(1+r) \end{aligned} \tag{2-2}$$

2.1.3 Final product department setting

Knowledge capital has spillover in both intermediate and final product sectors. The final product i follows the following decreasing scale production function:

$$y_i = Z(AN_t l_i)^{\gamma} \quad (2\text{-}3)$$

Where, l_i is the labor force invested in the department i, Z and γ is constant, and $0<\gamma<1$. The optimization problems are as follows:

$$\max_{l_i}\{Z(AN_t l_i)^{\gamma} - w_t l_i\} \quad (2\text{-}4)$$

Based on the ideas and conclusions of the above model analysis, the behavior of non-real estate enterprises' investment in the real estate industry reduces the total factor productivity of enterprises. Because the bubble in the real estate industry will lead to the redistribution of capital among different production sectors, non-real estate enterprises are attracted by the high profit margin of the real estate industry and invest in the real estate industry, thus crowding out the innovation investment in the original main business of the enterprise, and reducing the total factor productivity of the enterprise. In addition to the crowding out effect on innovation input, non-real estate enterprises blindly entering unfamiliar fields may cause agency problems, reduce the efficiency of capital use, and also bring damage to the total factor productivity of enterprises.

2.2 Data sources and variable definitions

The non-real estate enterprises of A-share listed companies from 2003 to 2015 are taken as research samples.The financial data of listed companies mainly come from the Guotai 'an China Economic and Financial Research Database (CSMAR), and the missing part is supplemented by Wind China Financial Database (Wind).The accounting overlap data of the two databases are consistent.In addition to excluding enterprises in the real estate industry, since the method used to calculate the total factor productivity of enterprises is based on the production function in the form of Cobb-Douglas, the sample does not include enterprises in the financial industry, service industry and comprehensive industry [5]. According to the above criteria,we search the annual reports of listed companies and find that the behavior of non-real estate enterprises investing in the real estate industry is very common, and the proportion of non-real estate enterprises investing in the real estate industry in the sample data is shown in Figure1.

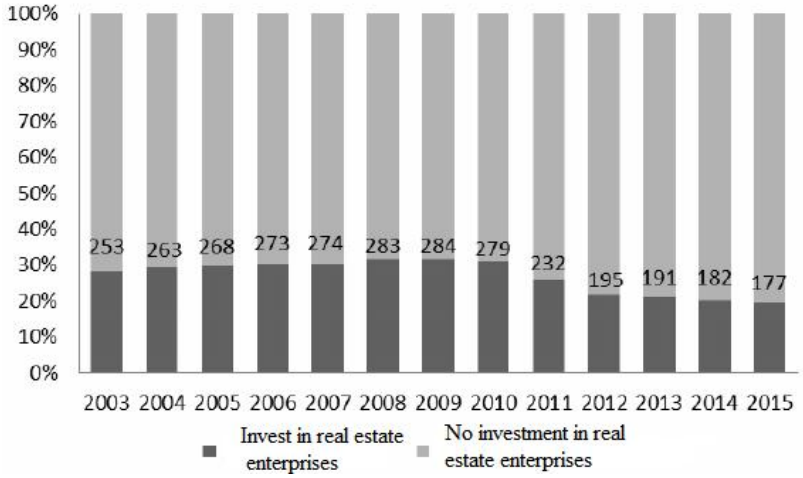

Fig.1 Proportion of investment in real estate industry by non-real estate enterprises in listed Chinese companies

Total factor productivity (TFP): This variable reflects the average level of output per unit of each input factor in the production process[6].In actual production,this index is often determined by a series of unobtainable factors such as technical level,management skills and institutional environment.We used least squares method (OLS method) and semi-parameter method (OP method and LP method) respectively to measure the total factor productivity of the enterprises in the sample as explained variables of the model. OLS method is a direct regression of the production function in the form of Cobb-Douglas to calculate the total factor productivity of enterprises,while the

semi-parametric rule solves the simultaneousness bias and sample selection bias caused by direct use of OLS method, and the OP method uses the current investment of enterprises as the proxy variable of unobservable shocks. LP method uses intermediate product input index as proxy variable, and the main variables are described in Table 1.

Tab. 1 Descriptive statistics of main variables

Variable	Variable name	Observed value	Mean value	Standard deviation	Minimum value	Maximum value
TFP_OLS	Total factor productivity	10120	0.005	0.364	-2.585	2.136
TFP_OP		10120	1.491	0.448	-1.275	3.780
TFP_LP		10120	12.022	1.078	9.705	17.503
dummy	Whether to invest in real estate dummy variable	10120	0.372	0.444	0.000	1.000
Size	Enterprise scale	10120	21.87	1.215	19.219	25.276
InEMP	Labour force	10120	7.646	1.322	2.197	12.902
age	Enterprise age	10120	11.862	4.666	0.000	25.000
FC	Financing constraint	10120	1.205	4.204	-169.983	131.450
LEV	Financial leverage	10120	0.252	0.190	0.085	0.935
tobinQ	Tobin's Q value	10120	1.652	1.569	0.206	9.698
ROA	Return on assets	10120	0.028	0.060	-0.228	0.197
ins	Proportion of shareholding by institutional investors	10120	32.464	24.779	0.054	86.061
block	The proportion of the largest shareholder	10120	37.264	7.409	1.477	77.220

Control variables: Referring to previous studies on corporate finance, we selected enterprise size (size), labor input (InE1y1P), age (age), financing constraint (FC), financial leverage (LEV), tobinQ and return on assets (ROA) as control variables. Among them, the size of the enterprise is the logarithm of the total assets of the enterprise, the labor input is the logarithm of the number of employees, and the age of the enterprise is calculated from the year when the enterprise is listed. The degree of financing constraint is measured by the ratio of cash flow to fixed assets, which reflects the difficulty of internal financing of enterprises.The greater the ratio of cash flow to fixed assets, the easier internal financing of enterprises and the lower degree of financing constraint. Financial leverage is measured by asset-liability ratio, that is, the ratio of total liabilities to total assets; Tobin's Q is the ratio of market capitalization to total assets, reflecting the ratio of two different estimated values of an enterprise. The rate of return on assets is used to measure how much net profit an enterprise can create per unit of assets, reflecting the profitability of the enterprise. The shareholding ratio of institutional investors (ins) and the shareholding ratio of the largest shareholder (block) reflect the shareholding structure of an enterprise and affect the investment decision of an enterprise[7].

3. Regression results of fixed effect model

3.1 Full sample regression

Based on the results of Hausman test, this chapter adopts the fixed-effect model to investigate the impact of non-real estate enterprises' investment in the real estate industry on the total factor productivity of enterprises. In order to verify the impact of non-real estate enterprises' investment in

the real estate industry on their total factor productivity, we constructed the following regression model:

$$TFP_{it} = \alpha_0 + \alpha_1 * dummy_{it} + \alpha_2 * controls_{it} + w_i + \mu_t + \varepsilon_{it} \quad (3\text{-}1)$$

In the regression model (3-1), i and t represent firms and years, respectively. Among them, the explained variable TFP is the total factor productivity of enterprise i in year t, including OLS method, OP method and LP method.w is the firm fixed effect,μ is the time fixed effect,ε is the random disturbance term. It is proved that non-real estate enterprises' investment in the real estate industry will have a negative impact on their total factor productivity, that is, the coefficient α_1 of dummy is statistically significant negative. Moreover,in order to control the fixed effect of enterprises, the fixed effect model is used for regression, and the cluster processing is carried out at the industry level to obtain robust estimation results. The regression results are shown in Table 2.

Tab. 2 Fixed effect model regression of the impact of investment in real estate industry on TFP

Variable	（1）TFP_OLS	（2）TFP_OP	（3）TFP_LP	（4）TFP_OLS	（5）TFP_OP	（6）TFP_LP
Dummy	-0.024*（-1.79）	-0.022*（-1.69）	0.005（0.22）	-0.027**（-2.06）	-0.025*（-1.99）	-0.012（-0.51）
Size	-0.083***（6.96）	-0.084***（7.34）	-0.476***（18.97）	-0.086***（7.23）	-0.087***（7.56）	-0.492***（17.59）
InEMP	-0.050***（-5.22）	-0.058***（-6.08）	-0.008（-0.43）	-0.050***（-5.31）	-0.058***（-6.18）	-0.007（-0.37）
Age	0.012***（6.36）	0.057***（32.23）	0.028***（8.78）	0.009***（5.29）	0.054***（31.43）	0.026***（7.39）
FC	-0.001（-0.71）	-0.001（-0.66）	-0.001（-0.98）	-0.001（-0.72）	-0.001（-0.67）	-0.001（-0.83）
LEV	-0.111**（-2.32）	-0.111**（-2.1）	-0.111**（2.21）	-0.111**（2.73）	-0.111**（-2.56）	-0.111**（1.06）
TobinQ	0.018***（7.31）	0.017***（7.42）	-0.001（-0.20）	0.019***（5.68）	0.019***（5.72）	0.006（1.05）
ROA	1.448***（14）	1.487***（14.05）	2.446***（10.34）	1.422***（14.30）	1.455***（14.40）	2.224***（10.25）
Year fixed effect	Out of control	Out of control	Out of control	Out of control	Out of control	Out of control
Firm fixed effect	Controls	Controls	Controls	Controls	Controls	Controls
Sample size	10120	10120	10120	10120	10120	10120
Number of enterprises	892	892	892	892	892	892
R2	0.222	0.586	0.537	0.227	0.589	0.555

It can be seen from Table 2 that when other factors at the control enterprise level remain unchanged, the coefficients of dummy are all negative except LP algorithm which does not control annual variables, and when the TFP values calculated by OLS algorithm and OP algorithm are used as explained variables, the coefficients of dummy are all significant at the significance level of 10%. When the explained variable is TFP_OLS, the coefficient of dummy is -0.0241, that is, the investment of non-real estate enterprises in the real estate industry will reduce their total factor productivity by 0.0241. However, after we further control the year fixed effect, after non-real estate enterprises invest in the real estate industry, TFP_OLS decreases by 0.0267, and the influence degree becomes larger, and the significance level is significant at 5%, and the significance level is increased.When the explained variable is TFP_OP, dummy's coefficient is -0.0220.When a non-real

estate enterprise invests in the real estate industry, its total factor productivity will decrease by 0.0220. Similarly, after controlling for the year fixed effect, we find that TFP_ OP is more affected, and the investment of non-real estate enterprises in the real estate industry will reduce TFP_ OP by 0.0294. When the explained variable is TFP_LP, dummy's coefficient is not significant, but after controlling the year fixed effect, dummy's coefficient is negative, which accords with our hypothesis.

3.2 Average treatment effect of investment in real estate by non-real estate enterprises on TFP

Based on the endogenous transformation model, we can use equations (3-2) and (3-3) to represent the average total factor productivity of non-real estate enterprises that have invested in the real estate industry and the average total factor productivity of non-real estate enterprises that have not invested in the real estate industry respectively. The average total factor productivity of non-real estate enterprises investing in real estate industry and non-real estate enterprises after making corresponding investment decisions can be expressed by equations (3-4) and (3-5) respectively. The corresponding counterfactual estimate is that the average total factor productivity of non-real estate enterprises investing in real estate industry can be expressed by equation (3-6) if they do not invest in real estate industry, and the average total factor productivity of non-real estate enterprises investing in real estate industry can be expressed by equation (3-7)[8].

$$E(TFP_{1i}|dummy_i = 1) = \beta_{10} + \beta_{12} * controls_{1i} \quad (3\text{-}2)$$

$$E(TFP_{oi}|dummy_i = 0) = \beta_{00} + \beta_{02} * controls_{0i} \quad (3\text{-}3)$$

$$E(TFP_{1i}|dummy_i = 1) = \beta_{10} + \beta_{12} * controls_{1i} + \alpha_1\rho_1 f(\gamma z_i)/F(\gamma z_i) \quad (3\text{-}4)$$

$$E(TFP_{0i}|dummy_i = 0) = \beta_{00} + \beta_{02} * controls_{0i} - \alpha_0\rho_0 f(\gamma z_i)/[1 - F(\gamma z_i)] \quad (3\text{-}5)$$

$$E(TFP_{1i}|dummy_i = 0) = \beta_{10} + \beta_{12} * controls_{1i} - \alpha_1\rho_1 f(\gamma z_i)/[1 - F(\gamma z_i)] \quad (3\text{-}6)$$

$$E(TFP_{0i}|dummy_i = 01) = \beta_{00} + \beta_{02} * controls_{0i} + \alpha_0\rho_0 f(\gamma z_i)/F(\gamma z_i) \quad (3\text{-}7)$$

Where, $\rho_1 = \sigma_{1\pi}^2/\sigma_\pi\sigma_1$ is the correlation coefficient of representing τ_{1i} and π_i, $\rho_0 = \sigma_{0\pi}^2/\sigma_\pi\sigma_0$ is the correlation coefficient of representing $\tau_{0i}$and π_i, *f(.)* And *F(.)* Represents the density function and the cumulative distribution function of the standard normal distribution respectively.

Thus, we can get the average treatment effect (ATE) of non-real estate enterprises investing in the real estate industry:

$$ATE = E\ (TFP_{1i} - TFP_{0i}) \quad (3\text{-}8)$$

ATE represents the impact of investment in the real estate industry on the TFP of an enterprise randomly selected from the sample. Further, we can express the average treatment effect (ATT) of the total factor productivity of non-real estate enterprises investing in the real estate industry as the difference between equation (3-4) and equation (3-7), as shown in equation (3-9). Similarly, the average treatment effect (ATU) of the total factor productivity of non-real estate firms that do not invest in real estate can be expressed as the difference between equation (3-6) and equation (5-5), as shown in equation (3-10).

$$ATT = E(TFP_{1i} - TFP_{0i}|dummy_i = 1) \quad (3\text{-}9)$$

$$ATU = E(TFP_{1i} - TFP_{0i}|dummy_i = 0) \quad (3\text{-}10)$$

The estimation results of fixed effect model regression for equation (3-4) without considering the selection bias problem are reported in Table 2 above. The results show that non-real estate

enterprises' investment in the real estate industry has a significant negative impact on their total factor productivity. When endogenous and selection bias problems are considered, the endogenous transformation model can be used to obtain the consistent estimates of equations (3-9) and (3-10), and we can also estimate the impact of real estate investment decisions on total factor productivity according to the counterfactual state expressed in equations (3-6) and (3-7).

According to the estimation results of equations (3-4) to (3-7), we get the density distribution comparison diagram shown in Figure 2, and give the fitting TFP and corresponding counterfactual estimation TFP comparison of investment real estate enterprises and non-investment real estate enterprises respectively under the three total factor productivity measures. Figure 2 shows that if enterprises that actually invest in real estate choose not to invest in real estate, their total factor productivity will increase significantly. If the enterprises that have not actually invested in real estate choose to invest in real estate industry, the change of total factor productivity is not significant[9].

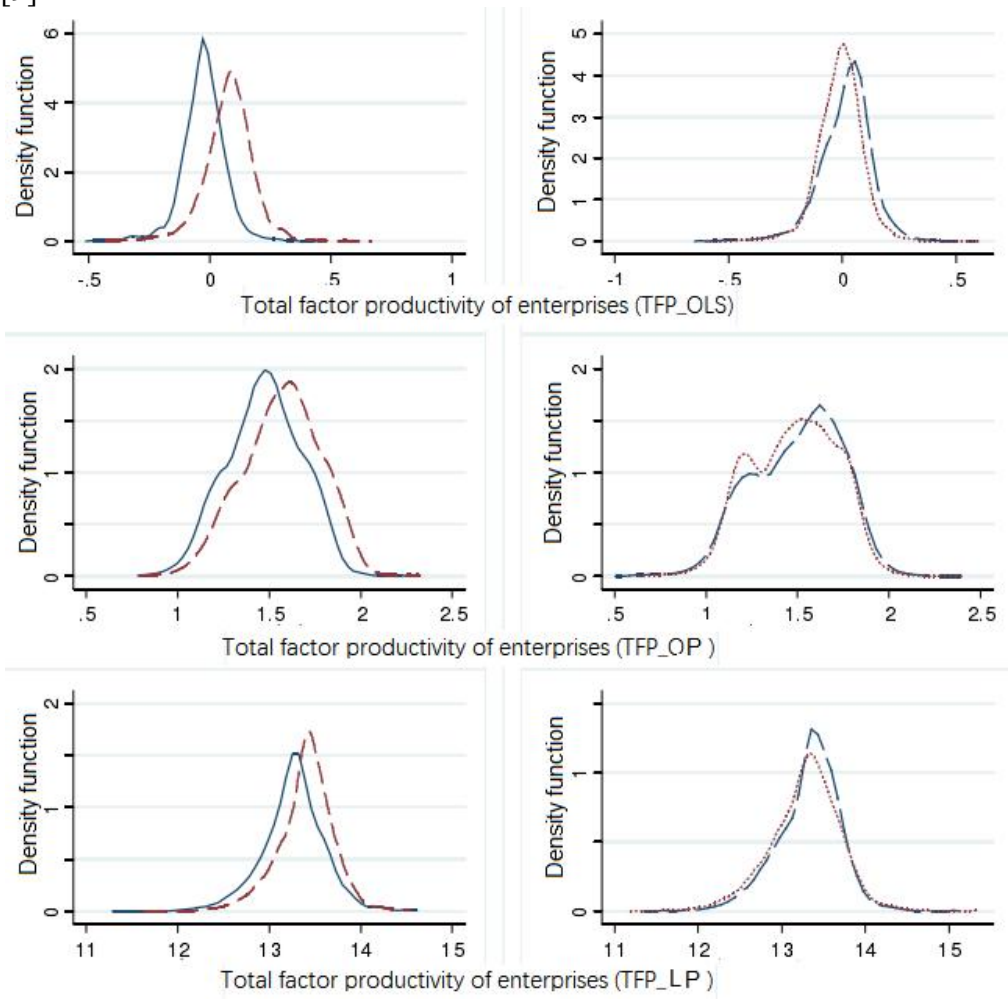

Fig.2 Composite superimposed structure formed by general thin shell and reinforced rib

Table 3 shows the comparative results of the impact of non-real estate enterprises' investment in real estate industry on the total factor productivity of enterprises obtained by different methods. FE is the regression result of the fixed-effect model controlling the year factor, that is, the coefficient of dummy reported in columns (4), (5) and (6) of Table 3; ATE, ATT and ATU are the regression results of the above endogenous transformation model. The regression results based on the endogenous transformation model show that under the three TFP measures, the average treatment effect (ATE) of investment real estate industry on the total factor productivity of a non-real estate enterprise is negative. The average treatment effect (ATT) of total factor productivity of non-real estate enterprises investing in real estate industry is negative, and the average treatment effect (ATU) of total factor productivity of non-real estate enterprises not investing in real estate industry is also

negative. The negative values of ATE, ATT and ATU indicate that the investment of non-real estate enterprises in the real estate industry will indeed reduce their total factor productivity[10].

Tab. 3 The influence of different methods on TFP estimated by enterprises' investment in real estate industry

Variable	Estimated result		
	TFP_OLS	TFP_OP	TFP_LP
FE	-0.027	-0.025	-0.012
ATE	-0.047	-0.040	-0.139
ATT	-0.105	-0.097	-0.042
ATU	-0.025	-0.018	-0.038
Deviation*	0.020	0.015	0.127
Selection bias**	0.078	0.072	0.030
Sorting effect***	-0.058	-0.057	0.097
Note:Deviation=FE-ATE;Selection bias=FE-ATT;Sorting effect=ATT-ATE			

4. Conclusion

This paper establishes a theoretical model to illustrate the negative impact of enterprises' investment in non-main business on total factor productivity, and proposes a research hypothesis in this chapter: non-real estate enterprises' investment in real estate industry has a negative impact on total factor productivity of enterprises. Considering the influence of the nature of the enterprise, it is found that whether it is a state-owned enterprise has no significant influence on the empirical research results. Considering the problem of sample selection, scenario transformation regression and endogenous transformation model are used to further test the negative impact of investment in real estate industry on TFP of enterprises, and it is estimated that the average treatment effect of non-real estate enterprises' investment in real estate industry on their total factor productivity is also negative. Counterfactual analysis also shows that if enterprises actually invest in real estate industry choose not to invest in real estate industry, Its total factor productivity will increase significantly; If the enterprises that have not actually invested in real estate choose to invest in real estate industry, the change of total factor productivity is not significant. The above estimated results indicate that non-real estate firms' investment in the real estate industry will reduce their total factor productivity.

The research on the relationship between the development of the real estate industry and the stable development of the economy is a hot issue at present. It is a common phenomenon for non-real estate enterprises to invest in the real estate industry in China. From the micro level of listed companies, this paper finds that non-real estate enterprises' cross-border investment in the real estate industry will cause losses to their total factor productivity, which is the most important driving force for economic growth. This also explains the reverse phenomenon of the gradual slowdown of economic growth and the decline of productivity in China's real estate market in recent years from another aspect. In this regard, the government should give full play to its regulatory role, help loss-making enterprises withdraw from the real estate industry in the form of subsidies, mergers and acquisitions, and strive to form a pattern of organic unity, mutual complement, mutual coordination and mutual promotion of market role and government regulation, and promote the sustainable and healthy development of the real estate industry.

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