

# Intermediate Effect and Dynamic Panel Model of Investment Impulse and Overcapacity

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**Abstract** – In agriculture, moderate overcapacity is a normal phenomenon in a market economy, which can promote competition and achieve survival of the fittest. However, at present, China's overcapacity has become a stubborn obstacle to economic development, falling into a vicious cycle of "more regulation, more expansion", which has attracted high attention from the government and academia. In order to further study the phenomenon of overcapacity, this paper constructs a mediation effect model and a dynamic panel model to examine and test the mechanism by which government fiscal intervention affects investment and thus affects overcapacity. The research results confirm that investment is an intermediary channel for fiscal intervention on overcapacity, and fiscal subsidies do indeed cause efficiency losses and worsen the overcapacity effect of investment.

**Keywords** – Overcapacity, Mediation Effect, Government Financial Intervention, Intermediary Channels.

## I. BACKGROUND AND SIGNIFICANCE

On the basis of sorting out the connotation and causes of overcapacity in China, based on the "supply side demand side" analysis framework, this paper explores the internal mechanism of outward direct investment to alleviate overcapacity [1]. In the new stage of development, addressing the problem of overcapacity requires not only promoting the exit of existing overcapacity, but also fundamentally building a long-term mechanism to prevent the recurrence of overcapacity, improving market-oriented and legal mechanisms, and constructing an efficient exit mechanism for overcapacity [2-3]. Structural overcapacity in the economy: expansion of production in mid to downstream industries, alleviation of upstream overcapacity pressure, and support for commodity performance; Increasing domestic supply to suppress inflation and boost bond performance; Promoting exports by exchanging price for quantity and supporting the RMB exchange rate; Production expansion leads to overcapacity in some industries, reduces corporate profits, and affects stock performance [4-5]. The solar photovoltaic market in 2023 is quite similar to this weather. The 2023 China Photovoltaic Industry Annual Conference, held in Suqian from December 14th to 16th, remains highly popular [6-7]. The development of the digital economy can to some extent resolve overcapacity. Based on this, taking the development of the digital economy as the research background, this paper analyzes the theoretical mechanisms for resolving overcapacity from three aspects: resource mismatch, information asymmetry, and insufficient innovation capacity, and proposes corresponding solutions based on theoretical analysis [8-10]. Based on the dimensions of the causes, duration, scope, and severity of overcapacity, it can be classified into three types: frictional overcapacity, cyclical overcapacity, and structural overcapacity. The degree of overcapacity is severe and it is difficult to automatically restore supply and demand balance through market mechanisms, making it a key target for overcapacity governance. Comprehensive measures, including supply side structural reform and demand side management, should be taken to address this issue [11-13].

## II. MEDIATING EFFECT OF OVERCAPACITY AND DYNAMIC PANEL MODELS

Firstly, a brief introduction to the mediating effect: examine the influence of the basic independent variable X

on the dependent variable Y. If X affects Y through the influence variable M, then M is called the mediating variable. For example, if "intellectual property protection" affects "enterprise research and development investment", which in turn affects "enterprise innovation", then "enterprise research and development investment" can serve as a mediating variable for the effect of "intellectual property protection" on "enterprise innovation", and it is believed that there is a mediating effect among the three. Use stepwise testing of regression coefficients to verify the existence of mediating effects. Specifically, to test whether the selected basic independent variables tax and subs have an impact on the dependent variable EC through the mediating effect of mediator variable invest, the following two regression models are set:

$$invest_{it} = \beta_{10} + \beta_{11}subs_{it} + \eta_1 CV_{it} + b_{i1} + \mu_{it1} \quad (1)$$

$$EC_{it} = \beta_{20} + \beta_{21}subs_{it} + \eta_2 CV_{it} + b_{i2} + \mu_{it2} \quad (2)$$

$$EC_{it} = \beta_{30} + \beta_{31}subs_{it} + \beta_{32}invest_{it} + \eta_3 CV_{it} + b_{i3} + \mu_{it3} \quad (3)$$

$$invest_{it} = \alpha_{10} + \alpha_{11}tax_{it} + \xi_1 CV_{it} + a_{i1} + \varepsilon_{it1} \quad (4)$$

$$EC_{it} = \alpha_{20} + \alpha_{21}tax_{it} + \xi_2 CV_{it} + a_{i2} + \varepsilon_{it2} \quad (5)$$

$$EC_{it} = \alpha_{30} + \alpha_{31}tax_{it} + \alpha_{32}invest_{it} + \xi_3 CV_{it} + a_{i3} + \varepsilon_{it3} \quad (6)$$

Among the six regression estimation equations mentioned above, equations (1), (2) and (3) form a mediation effect model to test the direct and indirect mechanisms of tax burden on overcapacity. Among them, equation (1) examines the impact of tax burden level on investment proportion, where  $invest_{it}$  and  $tax_{it}$  represent the investment proportion and tax burden level of industry  $i$  in the  $t$  year, respectively,  $CV_{it}$  represents the set of control variables; (2) Exploring the impact of tax burden on overcapacity without considering the proportion of intermediate variable investment  $invest$ , where  $EC_{it}$  represents the overcapacity index of industry  $i$  in the  $t$  year; (3) Exploring the impact of tax burden level on overcapacity with the addition of intermediary variable investment proportion  $invest$ .  $a_{i1}$ ,  $a_{i2}$  and  $a_{i3}$  are all industry effects, while  $\varepsilon_{it1}$ ,  $\varepsilon_{it2}$  and  $\varepsilon_{it3}$  are random disturbance terms.

Similarly, equations (4), (5), and (6) form an intermediary effect model to test the direct and indirect mechanisms of fiscal subsidies on overcapacity. Among them, equation (4) examines the impact of fiscal subsidies on investment proportion, where  $subs_{it}$  represents the fiscal subsidy intensity of industry  $i$  in the  $t$  year; (5) Exploring the impact of fiscal subsidies on overcapacity without the inclusion of intermediate variable investment proportion  $invest$ , where  $\mu_{it2}$  is a stochastic disturbance term; (6) Exploring the impact of fiscal subsidies on overcapacity with the inclusion of intermediary variable investment proportion  $invest$ ,  $b_{i1}$ ,  $b_{i2}$ ,  $b_{i3}$  are fixed effects of the industry, while  $\mu_{it1}$ ,  $\mu_{it2}$  and  $\mu_{it3}$  are random disturbance terms.

Firstly, consider the mediation effect model constructed by equations (1), (2), and (3) to verify the validity of hypothesis 1. According to the procedure for testing the existence of mediation effects, we should first examine the impact of industry tax burden level  $tax$  on investment proportion  $invest$ , corresponding to equation (1). If the former has a significant effect on the latter, it indicates that the latter may become a mediator variable. At the same time, if there is a negative correlation between the two, it can also indicate that the first half of hypothesis

1 is valid. Secondly, it is necessary to observe the relative magnitude and significance of the regression coefficients of overcapacity *EC* on the level of tax burden *tax* when excluding and adding *invest* this intermediate variable (corresponding to equations (2) and (3) respectively). Finally, if the regression coefficient of *tax* is significant in both equations (2) and (3), it indicates that *invest* partially mediates the effect between *tax* and *EC*; If the regression coefficient of *tax* in equation (3) changes from significant to insignificant compared to equation (2), it indicates the existence of a complete mediating effect. Similarly, we can make the same thinking and judgment on the mediating effect model that verifies the validity of hypothesis 2, which is composed of equations (4), (5), and (6).

### III. REGRESSION RESULTS OF THE MEDIATION EFFECT MODEL

The examination of the mechanism of the impact of tax burden level on overcapacity. Based on the previous discussion, this paper first discusses the estimation results of equation (1), that is, the impact of tax burden level *tax* on investment proportion *invest*. The specific regression results are shown in the left half of Table 1. Observing Table 1, it can be seen that the regression coefficient of *tax* is negative and significant at the 1% level, indicating that a decrease in tax burden will increase the proportion of industry investment, which verifies the first half of Hypothesis 1 that tax incentives will trigger corporate investment impulses. Secondly, further observation of the regression coefficients of variable *tax* in comparison equations (2) and (3) shows that the regression results of the two equations are shown in columns (1) and (2) of Table 2, respectively. Based on the previous analysis, in order for investment proportion to become an intermediary channel for the impact of tax burden on overcapacity, the following conditions need to be met: firstly, the regression coefficient of *invest* is significant in column (2); Secondly, the regression coefficient of *tax* is smaller in column (2) than in column (1). Observing Table 2, it can be observed that these conditions are all met: firstly, there is a significant positive correlation between *invest* and *EC*; Secondly, the regression coefficient of *tax* changed from -1.858 to -0.937, with a significant decrease, indicating the existence of a partial mediating effect.

Based on the above results and analysis, it is believed that the proportion of investment can become an intermediary channel for the effect of tax burden on overcapacity, supporting and verifying that tax incentives can lead to overcapacity by triggering corporate investment impulses.

Table 1. Regression results of the effect of fiscal intervention on investment proportion.

Effect of <i>tax</i> on <i>invest</i>		Effect of <i>subs</i> on <i>invest</i>	
<i>Tax</i>	-0.139***	<i>Subs</i>	0.667***
	(0.034)		(0.133)
<i>Labor</i>	-0.009	<i>Labor</i>	0.001
	(0.006)		(0.005)
<i>rd</i>	-0.016*	<i>Rd</i>	-0.019**
	(0.009)		(0.009)
<i>Open</i>	-0.183***	<i>Open</i>	-0.147***
	(0.029)		(0.028)
<i>Constant term</i>	0.179***	<i>constant term</i>	0.090***

Effect of <i>tax</i> on <i>invest</i>		Effect of <i>subs</i> on <i>invest</i>	
	(0.027)		(0.026)
<i>Sample capacity</i>	396	<i>sample capacity</i>	396

Note: \*\*\*, \*\* and \* respectively represent significant levels of 1%, 5%, and 10%.

Table 2. Regression results of fiscal intervention on overcapacity.

Effect of <i>tax</i> on <i>EC</i>			Effect of <i>subs</i> on <i>EC</i>		
	(1)	(2)		(3)	(4)
<i>Tax</i>	-1.858***	-0.937**	<i>subs</i>	12.959***	8.893***
	(0.480)	(0.435)		(1.84)	(1.707)
<i>Invest</i>		6.622***	<i>invest</i>		6.097***
		(0.642)			(0.631)
<i>Labor</i>	-0.146*	-0.087	<i>labor</i>	0.013	0.006
	(0.079)	(0.070)		(0.074)	(0.067)
<i>rd</i>	-0.400***	-0.291**	<i>rd</i>	-0.456***	-0.342***
	(0.123)	(0.110)		(0.119)	(0.108)
<i>Open</i>	0.672	1.884***	<i>open</i>	1.222***	2.121***
	(0.409)	(0.382)		(0.387)	(0.360)
<i>Constant term</i>	2.375***	1.189***	<i>constant term</i>	0.939***	0.390***
	(0.392)	(0.366)		(0.358)	(0.327)
<i>Sample capacity</i>	396	396	<i>sample capacity</i>	396	396

Note: \*\*\*, \*\* and \* respectively represent significant levels of 1%, 5% and 10%.

Testing the mechanism of the impact of fiscal subsidies on overcapacity. Similarly, the mechanism by which fiscal subsidies affect overcapacity can be analyzed. Firstly, observe the estimation result of equation (4), which is the impact of fiscal subsidies *subs* on investment proportion *invest*. The specific regression results are summarized in the right half of Table 2. Observing Table 2, it can be found that the regression coefficient of *subs* is positive and significant at the 1% level, indicating that the increase in fiscal subsidies will promote the increase of industry investment proportion, which verifies the first half of Hypothesis 2 that fiscal subsidies will trigger corporate investment impulse. Secondly, further observe the regression coefficients of the variable *subs* in comparison equations (5) and (6), and the regression results of the two equations are shown in columns (3) and (4) of Table 2, respectively. Based on the previous analysis, in order for investment proportion to become an intermediary channel for fiscal subsidies to affect overcapacity, the following conditions need to be met: firstly, the regression coefficient of *invest* is significant in column (2); Secondly, the regression coefficient of *subs* in column (4) is smaller than its coefficient in column (3). Observing Table 2, it can be observed that these conditions are all met: firstly, there is a significant positive correlation between *invest* and *EC*; Secondly, the regression coefficient of *tax* changed from 12.959 to 8.893, indicating the existence of partial mediating effects.

Based on the above regression results and analysis, it is believed that investment proportion can serve as a mediating variable to characterize and explain the impact of fiscal subsidies on overcapacity, supporting and verifying hypothesis 2 proposed in Chapter 3- that fiscal subsidies lead to overcapacity by triggering corporate investment impulses.

In summary, empirical research results indicate that investment can be seen as an intermediary channel for fiscal intervention to affect overcapacity, that is, government fiscal intervention leads to industry overcapacity by acting on investment (triggering investment impulses and excessive investment).

Drawing on and referencing relevant literature in the field, and according to research needs, the interaction term between fiscal subsidies and investment proportion is introduced into the econometric model. At the same time, due to the path dependence of technological level in the production process, technological efficiency often exhibits a certain degree of inertia, which leads to the inertia of production capacity utilization at the production level; In addition, in the current immature market environment, enterprise decision-makers often find it difficult to adjust current output in a timely manner based on product supply and demand information. Generally, they can only develop current production plans based on previous sales situations. Therefore, the degree of overcapacity in the current period may be greatly affected by the previous period, which shows dynamic continuity. To capture the impact of such "inertia" and dynamic continuity, the lagged one period of overcapacity index is introduced into the model, and the following form of dynamic panel model is attempted to be established:

$$EC_{it} = \beta_0 + \gamma EC_{it-1} + \beta_1 invest_{it} + \beta_2 subs_{it} \times invest_{it} + \beta_3 labor_{it} + \beta_4 rd_{it} + \beta_5 open_{it} + c_i + \varepsilon_{it} \quad (7)$$

Among them, the overcapacity index of industry  $i$  in the  $t$  year is represented by proxy  $EC_{it}$ ,  $EC_{it-1}$  is its lagged period,  $c_i$  is the industry effect, and  $\varepsilon_{it}$  is the random error term.

Considering the endogeneity issue of the dynamic panel data model, the two-stage generalized moment estimation (SYS-GMM) method was used to perform stepwise regression on the above models. The estimation results are summarized in Table 3.

Firstly, by observing the estimation results in Table 3, it can be seen that a sequence autocorrelation Arellano Bond test was performed on the disturbance term of the equation, and it was found that models 1, 2, 3 and 4 all have first-order sequence correlation. However, the null hypothesis that the disturbance term does not have second-order autocorrelation cannot be rejected, indicating that there is no second-order sequence autocorrelation, indicating that the estimation results of the model are reliable; Moreover, the Sargan test results also indicate that there is no over identification problem with the instrumental variables of all models, and the selected instrumental variables are appropriate.

Observing the regression results of each explanatory variable again, the estimated coefficients of  $LEC$  are significantly positive, indicating that, consistent with the previous analysis, the degree of overcapacity in the current period is significantly affected by the previous period, showing obvious path dependence and inertia characteristics. The estimated coefficients of  $invest$  are significantly positive, indicating that the increase in investment proportion has indeed exacerbated overcapacity, which further confirms the research results in related fields. Investment is the most direct factor leading to overcapacity. For a long time, the balance of savings deposits of urban and rural residents in China has grown rapidly, and the growth rate of fixed assets

investment has remained high for years, which is likely to lead to economic overheating and overcapacity. In this environment, the extensive and inefficient development model that mainly relies on investment to drive economic growth has formed. There is a significant mismatch of resources in the input and use of capital and factors, resulting in efficiency losses and exacerbating overcapacity. For example, in 2008, the government introduced a four trillion yuan investment plan, ten major industrial revitalization plans, and a series of loose monetary policies to alleviate the economic downturn caused by the global financial crisis, which stimulated blind investment in many industries and made the contradiction of overcapacity even more severe. The coefficients of  $subs \times invest$  are significantly positive, indicating that an increase in fiscal subsidies will exacerbate the deterioration of overcapacity caused by investment. In order to observe the indirect effect of fiscal subsidies on overcapacity, the derivative of equation (7) to  $invest_{it}$  can be obtained:

$$\frac{\partial EC_{it}}{\partial invest_{it}} = \beta_1 + \beta_2 subs_{it} \tag{8}$$

In equation (8), due to  $\beta_1 > 0$ ,  $\beta_2 > 0$ , and  $subs_{it} > 0$ , the overall result on the right side of the equation is greater than 0, indicating that an increase in investment proportion will worsen the phenomenon of overcapacity. Further analysis shows that as  $subs_{it}$  increases, the value of  $\beta_1 + \beta_2 subs_{it}$  also gradually increases, indicating that with the increase of fiscal subsidies, the increase in investment proportion will lead to more severe overcapacity, which means that the increase in fiscal subsidies will exacerbate the deterioration of investment on overcapacity. The reason is that fiscal subsidies can be seen as an input factor similar to capital entering the production function of enterprises. The increase in subsidies leads to an increase in the private marginal productivity of capital, which in turn leads to excessive entry of private capital, resulting in overheated investment and a decrease in the social marginal productivity of capital, resulting in efficiency losses and overproduction; On the other hand, fiscal subsidies may also lead to rent-seeking behavior by enterprises, that is, increasing investment is not for the pursuit of profit or the expansion of production scale, but to obtain government fiscal subsidies. The resulting investment is often inefficient or even inefficient, resulting in a decrease in the output efficiency of investment and a strengthening of the overcapacity effect of investment. This actually verifies hypothesis 3 proposed earlier, which is that fiscal subsidies will distort corporate investment behavior, cause efficiency losses, and further worsen the overcapacity effect of investment.

For the symbols of control variables, provide the following explanation: The estimated coefficients of *labor* are significantly positive, indicating that excessive labor input is also one of the reasons for overcapacity. The possible reason is that the supply of high-quality labor exceeds the demand, while the supply of low-quality labor exceeds the demand. The imbalance of supply and demand causes the allocation of labor factors to not reach the optimal state, resulting in efficiency losses. On the other hand, employment is the greatest livelihood, and maintaining full employment is also one of the basic goals of macroeconomic development. Employment has always been a concern for government departments at all levels.

Table 3. Estimation results of Dynamic Panel Model.

Variable	Model 1	Model 2	Model 3	Model 4
<i>lec</i>	1.029***	1.052***	1.049***	1.068***
	(0.001)	(0.003)	(0.003)	(0.002)

Variable	Model 1	Model 2	Model 3	Model 4
<i>Invest</i>	0.263*** (0.005)	0.170*** (0.014)	0.108*** (0.014)	0.070*** (0.015)
<i>Subs<sub>Invest</sub></i>	4.092*** (0.024)	4.242*** (0.090)	4.457*** (0.094)	3.207*** (0.089)
<i>Labor</i>		0.234*** (0.002)	0.233*** (0.003)	0.130*** (0.005)
<i>rd</i>			-0.037*** (0.028)	-0.030*** (0.004)
<i>Open</i>				1.370*** (0.015)
<i>Constant term</i>	-0.128*** (0.002)	-1.305*** (0.011)	-1.317*** (0.019)	-1.178*** (0.029)
<i>Value of ar (1) p</i>	0.038	0.042	0.041	0.004
<i>Value of ar (2) p</i>	0.529	0.565	0.581	0.0727
<i>Sargan test p-value</i>	0.305	0.455	0.490	0.390
<i>Number of instrumental variables</i>	36	37	38	39
<i>Sample size</i>	360	360	360	360
<i>Number of industries</i>	36	36	36	36

Note: \*\*\*, \*\* and \* represent significance levels of 1%, 5%, and 10%, respectively.

At present, China is still in the transition stage of industrialization in the middle and later stages, and the industrial sector is still a key sector for absorbing employment. Faced with the increasing employment pressure, the industrial industry inevitably passively absorbs excess labor, which causes the input structure of production factors to deviate from the optimal state, resulting in a decrease in production capacity utilization at the production level. Therefore, the passive increase in labor input in order to maintain social stability is another reason for overcapacity. In addition, due to the current rapid development of China's urbanization process, which seriously deviates from the laws of industrial evolution, there is an excessive supply of low skilled labor, forcing the government to require enterprises to choose production decisions that are conducive to promoting employment, resulting in efficiency losses and overcapacity.

The coefficient of *rd* is significantly negative, indicating that an increase in innovation investment can effectively alleviate overcapacity. The reason is that, on the one hand, an increase in innovation investment can promote technological progress, bring about an improvement in technological level, and thus improve production efficiency, leading to an increase in capacity utilization at the production level; On the other hand, product innovation may also create new demand, such as improving product quality through innovation, which can enhance its competitiveness in the international market and resolve overcapacity at the supply and demand



level. But looking at it from a different perspective, this estimation also precisely indicates that insufficient innovation is another reason for overcapacity. Based on reality, this explanation is: on the one hand, due to insufficient technological innovation, the expansion of output levels of industry enterprises relies on low-end production inputs for a long time, and production efficiency cannot be improved, so capacity utilization can only be maintained at a relatively low level. Even with the expansion of production scale, a large number of idle factors will be generated, resulting in excess production capacity; On the other hand, due to insufficient innovation, enterprises in the industry often have small differences in core technologies and severe product homogenization. Therefore, competition between enterprises is usually based on quantity, which means that through continuous capacity expansion, scale advantages are formed, production costs are reduced, and enterprise market share is expanded. This can easily lead to problems such as excessive investment and duplicate construction, and further cause overcapacity.

The coefficient of *open* is significantly positive, indicating that an increase in exports will exacerbate the problem of overcapacity. The possible reason is that the increase in exports and the increase in openness have led to a large number of domestic enterprises joining the global value chain (GVC) with a comparative advantage in factor costs, engaging in production activities in low tech links, that is, "utilizing the low-end factors of their own country in other countries' markets" (Liu Zhibiao, 2012). This development model has made domestic enterprises enthusiastic about technology introduction, learning and imitation, gradually falling into path dependence. Over time, Not conducive to the improvement of enterprises' independent innovation capabilities and the transformation and upgrading of production activities, while not innovating means that the evolution and upgrading of domestic and foreign market demand will lead to overcapacity in this "imitation" production supply. On the other hand, excessive reliance on the international market and optimistic expectations of the international market situation may lead to irrational production by export enterprises, blind investment, and expansion of production capacity, which actually condones the occurrence of overcapacity. Once the international market shrinks and stagnates, the problem of domestic overcapacity can only become more serious.

In summary, the estimation results of the dynamic panel model indicate that: ① China's overcapacity exhibits obvious "inertia" characteristics; ② Overinvestment will directly lead to an increase in overcapacity; ③ Financial subsidies can affect the production and investment decisions of enterprises, distort their investment behavior, reduce investment efficiency and losses, and exacerbate the deterioration of overcapacity caused by increased investment. This result supports and verifies the research hypothesis 3 proposed in Chapter 4; ④ In addition, the regression results of each control variable are basically in line with expectations: excessive labor input and expansion of foreign trade will significantly exacerbate overcapacity, while an increase in innovation investment can significantly alleviate overcapacity. However, it also indicates that insufficient innovation is another important factor leading to overcapacity in China.

#### IV. CONCLUSION

By establishing a mediation effect model and a dynamic panel model, panel data from 36 industrial sectors in China from 2011 to 2020 were used as research samples. The investment and overcapacity effects of fiscal intervention were examined from the dimensions of tax incentives and fiscal subsidies, verifying that investment is the intermediary channel for fiscal intervention to act on overcapacity and the results indicate that fiscal subsidies do indeed cause efficiency losses and worsen the overcapacity effect of investment.



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