Analysis on the Mechanism of Intermediate Goods Import and Total Factor Productivity on Enterprise Innovation

Rui Niu[1, a], Yueyang Zhang[2, b]*
[a]niuruitj@126.com, [b]*957197363@qq.com

[1]Tianjin Foreign Studies University, Tianjin, China

[2]Tianjin Foreign Studies University, Tianjin, China

Abstract: In recent years, the degree of economic globalization and the continuous deepening and development of global value chain integration have spawned research on the relationship between enterprise innovation based on the import of intermediate goods and total factor productivity. This paper uses the 2006-2010 China industrial enterprise database and import and export customs database to filter and sort out the intermediate goods trade data, and calculates the company's total factor productivity using the OP method using the company's net fixed assets, number of employees, production costs and other data. The fixed effects (FE) method builds a panel model to test the impact and mechanism of intermediate product imports and total factor productivity on enterprise innovation. Research shows that the import of intermediate goods and total factor productivity have a positive role in promoting enterprise innovation mainly through technology spillover effects and profit growth effects. Among them, capital-intensive companies and high-productivity companies have a comparative advantage in absorbing technology spillover effects brought about by imports of intermediate goods, and labor-intensive companies and low-productivity companies are more sensitive to profit growth effects related to total factor productivity.

Keywords: import of intermediate goods; total factor productivity; enterprise innovation; fixed effects model

1 Introduction

With the development of economic globalization, technological innovation has become an important source of economic growth in various countries, and has also become a core engine for enhancing the comprehensive strength of enterprises in various countries and expanding international competitive advantages. The nature of public goods possessed by enterprise technological innovation has obvious technological diffusion and incentive effects, and enterprise innovation activities are also generally regarded as the primary condition for grasping market opportunities and responding to market challenges. After more than 40 years of development in reform and opening up, Chinese enterprises have actively joined the global value chain production activities to absorb foreign advanced production factors and knowledge and technology, continuously improve the level of enterprise technological

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innovation, and have achieved a series of remarkable achievements.1Innovation capabilities have become the first driving force leading the development of domestic and foreign enterprises.

On the other hand, domestic enterprises are closely integrated with the global industrial chain, their participation in international trade continues to increase, and the scale of imports and exports continues to hit a record high. Under the influence of the new crown epidemic, the total annual import and export value of Chinese enterprises in 2020 will still reach 32.16 trillion yuan, a year-on-year increase of 1.9%. Among them, the total export trade volume will reach 17.93 trillion yuan, and the total import trade volume will reach 142,300 yuan. Billion yuan, the depth and breadth of trade has also been deepening. The ever-deepening international trade also actively encourages import and export enterprises to absorb advanced technology, equipment and management experience, which has increased their demand for intermediate goods imports. The import of intermediate products not only saves the production cost of the enterprise, but also can produce the final product through the introduction of diversified production input factors, which simplifies the production process and brings greater production profits to the enterprise [13].

At present, the situation in which Chinese enterprises innovate key technological fields is subject to others has not changed, and there is still huge room for improvement in innovation capabilities. In this context, companies should make full use of the advantages of intermediate product imports and total factor productivity, break through the bottleneck restricting corporate innovation, and continuously improve corporate innovation capabilities. However, not all companies have sufficient capacity to resist the impact of import cuts or internal changes. It is difficult to continue to analyze the relationship between import of intermediate goods and corporate innovation or total factor productivity and corporate innovation in isolation [11]. Under the premise that a single focus on international trade or corporate total factor productivity cannot benefit all corporate innovation activities, companies should integrate internal and external factors to explore their impact on corporate innovation activities [1]. In recent years, global trade protectionism has been rampant, and the new crown epidemic has also brought the trade exchanges between companies of various countries to a freezing point. The corporate economies of various countries have suffered the most serious impact since the 2008 financial crisis. However, the complex international situation will also bring new challenges and opportunities to enterprises in various countries. Enterprises should realize that only by driving their own development with innovation and advancing their own structural adjustments can they overcome the crisis and achieve sustainable development. Therefore, this article compares the current international situation with the international situation under the 2008 financial crisis, using the corporate data and customs data under the background of the financial crisis in 2006-2010 for analysis, exploring the expansion of intermediate goods imports and improving the total factor productivity of enterprises. What kind of influence does the current background have on the promotion of enterprise innovation? Discussing from a new perspective the key factors that enhance the innovation ability of enterprises from the perspective of economic globalization has profound academic significance for the development of enterprises in the current international economy.

[1] The latest report of the State Intellectual Property Office shows that in 2020, my country has 15.8 invention patents per 10,000 people, replacing the United States as the country with the largest number of patent applications in the world,

2 Theoretical analysis

Under the background of economic globalization, the import of intermediate goods and total factor productivity have played an increasingly important role in the production process of enterprises. The import of intermediate products by enterprises can encourage enterprises to learn advanced production technology and reduce their production costs; the increase in total factor productivity of enterprises It can promote the efficiency of the use of production factors by the enterprise, and then expand the profit of the enterprise.[2] Assuming that in the production activities, the innovation capability of the enterprise is reflected by the innovation production function of the enterprise, then construct the innovation production function of the enterprise conforming to the Poisson distribution:

$$\lambda n = R^{\theta}\{[tfp+(1+IN)^{\xi}]n\}^{1-\theta} \tag{1}$$

Among them, λ is the enterprise innovation rate, R is the enterprise research investment, tfp is the enterprise's own total factor productivity, n is the enterprise's innovative product quantity, $tfp+(1+IN)^{\xi}$ is the enterprise's knowledge capital, and $(1+IN)^{\xi}$ is the technology spillover generated by imported intermediate products,ξ>0 represents the spillover amplitude, and$\theta$is Instead of elasticity, and 0<θ<1. From the enterprise's innovative production function, it can be seen that the technology spillover brought by the import of high-quality intermediate products and the increase in enterprise production capacity brought about by the increase in enterprise's total factor productivity can affect the number of innovative products of the enterprise, which in turn affects the innovation ability of the enterprise.

Further parameterizing the R&D input costs of companies that do not have import trade and companies that have import trade can get:

$$WC(\lambda)_{n_1} = \left(WC_0\lambda^{1+C_1} * n\right)/tfp \tag{2}$$

$$WC(\lambda)_{n_2} = (WC_0\lambda^{1+C_2} * n)/[tfp+(1+IN)^{\xi}] \tag{3}$$

$WC(\lambda)_n$ refers to the R&D investment cost of the enterprise. n_1 is the enterprise that does not have import trade, but n_2 is the enterprise that does import trade. Comparing the R&D input cost of different enterprises, $WC(\lambda)_{n1} > WC(\lambda)_{n2}$ is obvious that the R&D of enterprises participating in the import of intermediate products and enterprises with high total factor productivity The smaller the input cost, the better the innovation ability of the enterprise. The ultimate goal of enterprises' investment in innovation is to maximize production profits. The use of imported intermediate products for production and the improvement of total factor productivity can obtain excess innovation benefits by reducing R&D costs and achieve the ultimate goal of the enterprise. In summary, expanding the import of intermediate products and increasing total factor productivity can affect enterprise innovation through technology

[2] This paper refers to the theoretical models of Lin Xuedong, Wei Hao, and Li Biao, selects the import of intermediate goods in the internal and external factors of the enterprise and the total factor productivity of the internal factors of the enterprise as the key factors to correlate, and constructs theoretical and mathematical models to study the impact of both on the enterprise. The influence of innovation ability and its internal mechanism.

spillovers and increasing profits [4]. This article summarizes the specific mechanism of action as the following two effects:

2.1 Technology spillover effect

The import of intermediate goods is the most important way in the import trade of enterprises, which directly determines the profit level and international market position of the enterprise. The import of high-quality intermediate goods by enterprises will often increase the opportunities for enterprises to learn knowledge resources and draw on the advanced technological advantages and efficiency of the source country [7]. Advantages urge companies to break through technical barriers. Enterprises realize technological upgrades by importing intermediate products, reducing their production costs, and allowing enterprises to have more sufficient funds for enterprise innovation. This is the technology spillover effect brought about by the import of intermediate products.

2.2 Profit growth effect

In the production process of an enterprise, total factor productivity reflects the average output per unit after the input of each factor of production, that is, the overall efficiency of the transformation of production input into final output. The increase in the total factor productivity of an enterprise can increase the profit of the enterprise, and the increased profit provides research funds and test costs for the enterprise to engage in R&D and innovation activities [6]. This is the profit growth effect. From the internal perspective of the enterprise, the enterprise can improve its own total factor productivity through internal management adjustment and production technology optimization, which can promote enterprise innovation, and technological innovation can in turn increase the enterprise's factor resource utilization and enterprise output efficiency, and increase the enterprise The production profits of the company have promoted the redistribution of the company's innovation results among different departments, which has increased the enthusiasm for innovation.

3 Data and model settings

3.1 Model building

Based on the existing literature, this paper constructs an econometric model based on the determinants of enterprise-level innovation:

$$\text{inno}_{it} = \beta_0 + \beta_1 \text{qty}_{it} + \beta_2 \text{tfp}_{it} + \gamma \sum X_{it} + \varepsilon_{it} \tag{4}$$

Among them, i represents the company, t represents the year, $inno_{it}$ represents innovation qty_{it} represents capability in t year; tfp_{it} represents the import quantity of intermediate goods of company i in year t; X_{it} represents the total factor productivity of company i in year t; represents other control variables, including the company Scale ($size_{it}$), financing constraints ($\text{int}\, erest_{it}$), operating profit ($profit_{it}$), age of the enterprise (age_{it}), etc., ε_{it} represent random error terms.

3.2 Mechanism test

The above analysis results show that the promotion of intermediate product imports and total factor productivity on enterprise innovation is mainly through two mechanisms: technology spillover effect and profit growth effect. In order to further confirm the two main adjustment paths of intermediate product imports and total factor productivity on enterprise innovation, the econometric model is as follows:

$$inno_{it} = \beta_0 + \beta_1 qty_{it} + \beta_2 tfp_{it} + \eta_1 jsyc_{it} + \gamma \sum X_{it} + \varepsilon_{it} \quad (5)$$

$$inno_{it} = \beta_0 + \beta_1 qty_{it} + \beta_2 tfp_{it} + \eta_2 lrzz_{it} + \gamma \sum X_{it} + \varepsilon_{it} \quad (6)$$

$$inno_{it} = \beta_0 + \beta_1 qty_{it} + \beta_2 tfp_{it} + \eta_1 jsyc_{it} + \eta_2 lrzz_{it} + \gamma \sum X_{it} + \varepsilon_{it} \quad (7)$$

Among them, $jsyc_{it}$ $lrzz_{it}$ respectively represent the technology spillover effect and profit growth effect of firm i in period t. In the regression analysis, we use the interaction term of the company's production cost and the import of intermediate goods to represent the technology spillover effect, using the company's total profit and all factors The interaction term of productivity represents the profit growth effect, and the definitions of other variables remain unchanged. Theoretically, it means that the interaction of technology spillover effects is a reverse inhibitory relationship to corporate innovation, that is, when production costs rise, corporate innovation is inhibited. The profit growth effect plays a positive role in promoting enterprise innovation.

3.2.1 Technology spillover effect

This paper further divides enterprises into capital-intensive enterprises and labor-intensive enterprises, high-productivity enterprises and low-productivity enterprises according to their capital intensity and enterprise productivity, and continues to examine the specific effects of import of intermediate goods and total factor productivity on enterprise innovation in different types of enterprises. Influence Mechanism. The regression results in Table 1 show that the estimated coefficients of technology spillover effects for labor-intensive companies and capital-intensive companies are significantly negative, indicating that the technology spillover effect brought by the import of intermediate goods can be reduced by enterprises with different capital intensiveness [9]. Cost of production to promote enterprise innovation. Further observation of the estimated coefficient shows that labor-intensive companies are more sensitive to technology spillover effects than capital-intensive companies. This is because labor-intensive companies have a low level of production technology and have made breakthroughs in technological innovation and increased total factor productivity. The ability of the company is not strong, and the degree of sensitivity to total factor productivity is not high. It is more dependent on the import of high-quality intermediate products to achieve rapid technological upgrades.

Table 1 Technology Spillover Effects of Enterprises with Different Factor Intensity

	Labor-intensive enterprises	Capital intensive enterprise
Tfp	0.406**	0.824***

	(0.179)	(0.147)
Intermediate imports	0.045*	-0.009
	(0.03)	(0.033)
Technology spillover effect	-0.018***	-0.009***
	(0.003)	(0.003)
Enterprise size	-0.786**	-0.809**
	(0.354)	(0.399)
Financing constraints	-0.489***	-0.527***
	(0.118)	(0.131)
Corporate profits	0.107*	0.057*
	(0.101)	(0.115)
Business age	0.023	0.015
	(0.028)	(0.027)
Constant term	14.49***	11.825***
	(4.049)	(4.556)
Number of observations	9664	9635
R^2	0.03	0.053

Table 2 Technology Spillover Effects of Different Productivity Enterprises

	High-productivity enterprise	Low-productivity companies
Tfp	2.289***	-0.005*
	(0.261)	(0.203)
Intermediate imports	0.052*	0.033*
	(0.031)	(0.033)
Technology spillover effect	-0.008***	-0.017**
	(0.003)	(0.003)
Enterprise size	-0.205*	-0.966*
	(0.352)	(0.393)
Financing constraints	-0.468***	-0.502**
	(0.123)	(0.123)
Corporate profits	-0.013	0.325***
	(0.103)	(0.116)
Business age	0.009	0.006
	(0.029)	(0.025)
Constant term	0.327	14.321**
	(4.163)	(4.448)
Number of observations	9959	9340
R^2	0.072	0.052

The regression results in Table 2 show that the regression coefficients of technology spillover effects of high-productivity firms and low-productivity firms are significantly negative,

indicating that technology spillover effects can play a corresponding role in different firms, but the effect of technology spillover effects of high-productivity firms is obvious It is stronger than low-productivity companies. This may be due to the fact that high-productivity companies are more capable of absorbing technological advantages than low-productivity companies. By participating in international trade and importing intermediate products with advanced technology, high-productivity companies can make full use of the advanced technology is basically consistent with the above-mentioned theory.

3.2.2 Profit growth effect

The regression results in Table 3 show that the profit growth model has a significant promoting effect on both labor-intensive and capital-intensive companies, but the regression coefficient of labor-intensive companies is significantly worse than that of capital-intensive companies, and its value is also higher than that of capital-intensive companies. Compared with labor-intensive enterprises, capital-intensive enterprises have a higher level of total factor productivity. They have strong production capacity and are highly sensitive to total factor productivity. Therefore, capital-intensive enterprises are more sensitive to profit growth effects.

Table 3 Profit growth effect of enterprises of different intensity

	Labor-intensive enterprises	Capital intensive enterprise
Tfp	-0.177	0.935***
	(0.179)	(0.144)
Intermediate imports	0.118***	0.041*
	(0.027)	(0.03)
Enterprise size	-0.122	-0.306
	(0.322)	(0.359)
Financing constraints	-0.567***	-0.563***
	(0.116)	(0.128)
Business age	-0.009	0.039
	(0.027)	(0.026)
Profit growth effect	0.01*	0.016**
	(0.009)	(0.01)
Constant term	5.833	4.334
	(3.819)	(4.239)
Number of observations	10045	10147
R^2	0.028	0.042

Table 4 Profit growth effect of different productivity enterprises

	High-productivity enterprise	Low-productivity companies
Tfp	0.112*	2.528***
	(0.203)	(0.247)
Intermediate imports	0.081***	0.091***
	(0.03)	(0.028)

Enterprise size	-0.387	0.156
	(0.354)	(0.309)
Financing constraints	-0.512***	-0.484***
	(0.121)	(0.118)
Business age	0.013	-0.003
	(0.024)	(0.027)
Profit growth effect	0.016*	0.02**
	(0.01)	(0.009)
Constant term	8.508**	-6.09
	(4.219)	(3.74)
Number of observations	9772	10420
R^2	0.02	0.076

The regression results in Table 4 show that the profit growth effect is significantly positive for both high-productivity firms and low-productivity firms, but the significance and regression coefficients of low-productivity firms are slightly larger than those of high-productivity firms, indicating that low-productivity firms have an effect on total factor productivity. The resulting profit growth effect is more sensitive.

In general, technology spillover effects and profit growth effects are two significant mechanisms by which imports of intermediate goods and total factor productivity affect enterprise innovation. For most companies, profit growth effects are slightly better than technology spillover effects, but they are different. Types of companies have slightly different mechanisms of influencing corporate innovation. Capital-intensive companies and high-productivity companies are more sensitive to profit growth effects, while labor-intensive companies and low-productivity companies are more sensitive to technology spillover effects. Therefore, when designating corresponding innovation incentive policies, the government should distinguish different enterprises from the labor intensity and productivity of the enterprises, adopt different policies for different enterprises, and make appropriate strategic decisions within different types of enterprises according to their own conditions. In the end, it can promote enterprise innovation more reasonably.

4 In conclusion

This paper adopts the research method combining fixed effects and instrumental variable method, selects the import of intermediate goods and the total factor productivity of the internal factors of the enterprise as the key factors to explore the relationship and mechanism of enterprise innovation, and divides the different capital intensity Performing heterogeneity analysis with companies with different productivity, the following conclusions are obtained: First, the participation of companies in international trade and the import of advanced intermediate products have played a significant role in promoting corporate innovation, and the mechanism is to reduce corporate innovation through technology spillover effects. Production costs enable companies to invest more available funds in the field of corporate innovation, which is conducive to the improvement of innovation capabilities; second, the overall factor productivity of enterprises also has a significant role in promoting corporate innovation, mainly through profit growth Effect to increase corporate profits, so that companies have more R&D funds, and then improve the company’s innovative production

capacity [6]. In the process of innovative production, the effect of profit growth is slightly better than the technology spillover effect. Third, companies with different capital intensiveness are more sensitive to intermediate product imports and total factor productivity. Capital-intensive companies are more dependent on intermediate product imports, while labor-intensive companies are more sensitive to total factor productivity. From the perspective of productivity level, high-productivity companies are more sensitive to the profit growth effect brought about by the increase in total factor productivity. In the production process, they can give priority to promoting corporate innovation by increasing their total factor productivity, while low-productivity companies import intermediate products. The technology spillover effect brought about is more sensitive.

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