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The Effect of Industrial Intermediate Inputs on the Export Diversity of Chinese Enterprises

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Abstract: China has put forward the policy direction of domestic market integration in response to the volatile domestic and international political and economic environment. Meanwhile, enterprise export diversification is becoming the research frontier of the new trade theory (NTT). In order to make research on the factors affecting or determining export diversification in the contemporary context, this paper links the trend of domestic market integration with export diversification, and constructs a fixed-effects regression model using the Chinese industrial-enterprise customs matching database from 2000 to 2007 to study the relationship between industrial intermediate inputs and export diversification and the enterprise heterogeneity effects. According to the empirical results, it shows that the increase of intermediate inputs can promote the export diversification. The results of the heterogeneity analysis show that such kind of effect also varies depending on the differences in firm ownership, firm location, firm trade patterns, and capital intensity. In such a case, in order to complete the industrial upgrading of the domestic value chain and upgrade the export industrial structure under the trend of domestic market integration, it is necessary to pay attention to the liberalization of intermediate goods trade and the improvement of relevant policy conditions.

Keywords: Export Diversification, Industrial Intermediate Inputs, Enterprise Heterogeneity

1. Introduction

The good standing and growth of an enterprise is inevitably accompanied by the expansion of business and resource allocation, which can be reflected in the extension of major products or the launch of new products, and when an enterprise reaches a certain export threshold, such enterprise often has the ability to export multiple products. Different from the traditional trade theory of "product equals to enterprise" type of single-product heterogeneous enterprise trade model, the multi-product heterogeneous enterprise trade model is now gradually becoming the research direction of the new trade theory, in which case the study of trade diversity - especially export diversification - has begun to get attention and gradually step into the vision of scholars.

In today's unpredictable international relations environment, the international trade environment has also been greatly affected, which can be reflected in the uncertainty of the policy conditions, and in this complex and changing background, the export transaction of lots of products have also been affected, so the export diversification has become one of the solutions for enterprises and even countries to break the shackles of single-quantity growth development. In addition, export diversification is conducive for enterprises to allocating resources in a reasonable way, sharing international market risks, and exploring new profit growth points, and the increase of product variety choices can also bring benefits to consumers. These rich and practical welfare effects have driven researchers to study enterprises' export product variety decisions and resource allocation adjustment.

For the production of industrial products, intermediate product inputs play an essential role, and the industrial products that meet export requirements are featured by the higher quality and more significant characteristic, in which case their intermediate inputs are more intensive. Especially in the global value chain system, export products with a certain degree of complexity may be jointly produced and manufactured by different countries and enterprises. For example, an iPhone consists of more than five hundred

components, which are subcontracted to hundreds of suppliers in dozens of countries around the world under the global value chain system. During the process, the headquarter of the Apple Company holds the core technologies, brand value and marketing channels. The remaining parts are intermediate products that accumulate added value through layers of processing, and finally the iPhone become qualified and complete final products for export to all over the world, and these final products not only include cell phones, but also the parts circulating in the global division of labor system can be used for the manufacture of the final products of other categories such as headphones, laptops and smart home products as common intermediate products. This economy of scope is given full play in this value chain. The integration of export enterprises represented by large multinational corporations into the value chain has increased the mobility of intermediate products among enterprises, and the effect of the increase of these intermediate inputs can be reflected not only in the increase of enterprise export value on the intensive margin, but also in the increase of the diversity of enterprise export products on the extensive margin.

For Chinese exporters, the proposed goal of domestic market integration provides an impetus for the integration and upgrading of the domestic value chain, which may become an important policy inducement to intensify the transformation of China's export industrial structure to high quality and diversification structure. Under the background of domestic market integration, the economic interest community with enterprises as the main body and the government as the auxiliary will take regional integration as the starting point, continuously play the inter-regional spillover effect to expand outward, so as to achieve the open and connection among regional markets, form a unified market framework, as well as formulate the new development trend of "taking the domestic circulation as the main body and mutual promotion of domestic and international circulation". In such integration process, the domestic value chain system will also continue to develop in a comprehensive manner, prompting cooperation among enterprises in competition and forming a new vertical specialized division of labor production system. Multi-product export enterprises with a certain scale will choose to divest their non-core business in the process of value chain development, intensively allocate their resources to the research, development and brand marketing of core products and core technologies, and outsource some upstream production and processing links to other enterprises in the value chain while holding the high-end links steadily, which means that lots of enterprises do not need to produce intermediate products by themselves, but can outsource the immediate products by the way of purchasing, manufacturing consignment and others. This mode, with the emergence of intermediate product suppliers in the unified market, has greatly reduced the transaction costs of intermediate products, and on this basis, such mode has also forced the improvement of intermediate product quality, which in turn

has promoted the circulation of intermediate products and the increase of intermediate inputs of enterprises. All in all, the integration of domestic market ensures the smooth transaction of factor market, improves the liquidity of production factor market, reduces the transaction cost of intermediate products among export enterprises, is conducive to optimizing the allocation of resource factors, further promotes the vertical specialization in domestic value chain system, and the resulting economy of scale effect and knowledge spillover effect also helps enterprises in the value chain to make innovation on the products, expand product range, drive export diversification, and finally realize the upgrading of the value chain, advancing China's opening-up level to reach a higher level.

In summary, among the multiple factors that influence export diversification, perhaps the extent of intermediate inputs is the most direct one. The sources of intermediate inputs of enterprises include domestic and international ones, and since China has implemented an "export-oriented" economy, the trade of intermediate goods has been greatly developed. Especially since China joined the WTO in 2001, the import tariff of intermediate goods has been greatly shaved, and just in 2002, the tariff rate of Chinese intermediate goods was reduced by as much as 30.7%, to 11.47%. Therefore, the study of the impact of intermediate inputs on China's foreign trade has gradually become an important topic of research by scholars.

Therefore, the research content of this article is to explore the relationship between industrial intermediate investment and the diversity of export products of Chinese enterprises, and to explore the differences in the impact of heterogeneous enterprises with different attributes through heterogeneity analysis. It is hoped that this article can provide practical support for China's market integration policy and obtain policy insights with practical significance and value.

The innovation of this article lies in the fact that there is currently limited research on the relationship between industrial intermediate investment and export diversification. Therefore, this article supplements relevant research in the fields of industrial intermediate investment and export diversification.

2. Literature Review

The academic literature on export product diversification can be roughly divided into two types of studies: what factors does influence export diversification and what targets are influenced by export diversification.

The increase in the range of exported products is a result of both the launch of new products due to investment in research and development on the supply side and the expansion of exports on the demand side due to risk reduction or market development. Karlsson points out that it is easier to make statistics on the relatively richer variety of exports for the regions with intensive research and development investments [1]; imported intermediate products, regardless of their sources, can contribute to increasing the

variety of products exported by enterprises and the number of export destinations. In such a case, China shall actively carry out the trade policies for intermediate products to help enterprises diversify their exports [2]; the stability of the policy environment constitutes an important factor to enhance export diversification: C. Liu simulated and found that the full implementation of the WTO Trade Facilitation Agreement (TFA) would increase APEC's export product variety by about 14% [3]; joining the WTO and strengthening the ability of SMEs to differentiate production can then promote trade diversification [4].

Export diversification can also have an impact effect on aggregate national economic indicators at the macro level. The higher the degree of export diversification, the higher the economic growth rate of a country or region, and it can even be argued that items to be exported content plays a more important role than export volume [5]; Eicher et al, found that for low-income countries, such kind of growth effect would decrease with increasing income levels [6]; W. Lei et al found that countries with high export product diversification tend to implement a floating exchange rate system and countries with low export product diversity tend to implement a fixed exchange rate system [7]; according to the opposite view, it points out that increase of the diversity does not necessarily have a beneficial effect on the country and also have the dampening effect on the economy [8]. It is worth noting that a country's export diversification trend does not increase monotonically with economic development; Hu L et al. found that the variety of the products exported by a country has an S-shaped relationship with GDP, and export diversification may hit an upper limit after reaching a certain threshold [9]. Therefore, a government still needs to be cautious when considering export diversification as a policy objective.

The literature on intermediate inputs focuses on the effect of the degree of intermediate product inputs or the convenience of intermediate product inputs on firm performance. One of the most common studies discusses the impact effects of intermediate goods trade liberalization: L. Cao takes the event of China joining WTO as a window of impact and by the double difference method, argues that the liberalization of China's intermediate goods trade has a significant and large driving effect on the growth of the export diversification of the enterprises [10]. Such effect shows an "inverted U-shaped" with the time passing; subdividing intermediate services trade, the liberalization of intermediate services trade can bring about the growth of export broadening and intensive margin by reducing service costs [11]. The mechanism of action of all these impact effects includes the spillover of imported technology and the accompanying increase in total factor productivity, which ultimately lays the foundation for product diversification. In addition, some scholars have also paid their attention to the domestic conditions: Y. Zhao points out that although the size of the city may set a threshold for the production efficiency for enterprises, at the same time the local market effect from economies of scale of the urban intermediate goods can even grant SMEs a competitive advantage by supplying intermediate goods at a low price [12]. Nowadays, the country's continuous promotion of domestic market integration is conducive to achieving the convergence of efficiency thresholds in cities of different sizes, and to form a specialized division of labor between large and small cities on the basis of the demand levels for intermediate goods by manufacturers. The major approaches in which intermediate goods affect the industrialization process in China include income effects, distributional effects, reduction of minimum effective size, and productivity gains, while size, technology, human resources, and some other conditions are the main constraints to the expansion of intermediate goods production [13].

Since the goal of a unified domestic market was released by the central government on April 10, 2022, the selected literature related to domestic market integration focuses on the literature published in the last two years. Based on the theory of geographical nature, supplemented by foreign market integration experience, Z. Liu analyzed the importance of promoting regional market integration for the construction of a national unified market, and whether a large national unified market can be established depends on whether regional commodity factor resources can fully circulate freely, and the comprehensive construction of public transportation infrastructure plays a crucial role [14]; Y. Lu, R. Zhou, Wang Hao et al have a common point - they empirically demonstrate the relationship between market integration and technological innovation of enterprises: Y. Lu argues that market integration has a positive impact on the rationalization of local industrial structure, and technological innovation as a mediating factor can help to strengthen the role of market integration in the advanced of industrial structure [15]; R. Zhou argues that market integration can improve the efficiency of enterprise innovation, and this influence has spatial spillover effects [16]; Wang Hao focuses on the influence of market integration on the innovation effect of foreign investment, and the results show that the improvement of science and technology innovation level brought by market integration will achieve the effect of replacing FDI innovation to a certain extent, in which case the construction of a large national unified market shall be steadily promoted to encourage local innovation while stimulating foreign innovation, and jointly advance the high-quality development of economic and foreign trade [17]. W. Shi explains the market integration under the new development pattern of "double-loop" from the perspective of domestic value chain, and he believes that the expansion of market scale and the decrease of transaction costs of intermediate products are important intermediary channels for market integration to promote domestic vertical specialization [18]. Through an empirical study, N. Lei finds that market integration can promote the increase of export technological sophistication through the transmission mechanisms of cost-saving effect, demand-driven effect, technological innovation effect and institutional improvement effect [19].

In summary, there is a large amount of literature focusing on the factors influencing export diversification and economic performance. The importance of intermediate inputs has also been recognized by scholars, and research on the relationship, impact effects and interaction mechanisms between the two has been carried out continuously. However, such kind of researches still face the following questions such as not abundant, not comprehensive and not deep. Therefore, this paper will focus on exploring the effects of industrial intermediate inputs on export diversification and heterogeneity of Chinese multi-product exporters to make a contribution to the field.

3. Methodology

3.1. Econometric Model Construction

We intend to explore the impact of industrial intermediate inputs on the export product diversity of Chinese enterprise and thus constructed the following model:

$$DIV_{it} = \alpha_i + \beta_1 intermedia_{it} + \sum_k \beta_k X_{kit} + \mu_t + \varepsilon_{it}$$

Where, DIV_{it} denotes the export diversification of enterprise i at the time t, α_i denotes the enterprise fixed effect, which controls the characteristics of the enterprise that do not change over time, $intermedia_{it}$ denotes the industrial intermediate input of enterprise i at the time t, and its coefficient β_1 can reflect the effect of industrial intermediate input on export diversification, if $\beta_1 > 0$, it means that the export diversification of Chinese enterprises will increase with the increase of industrial intermediate input; if $\beta_1 < 0$, it means that the decrease of the industrial intermediate input would restrain the improvement of the export diversification. $\sum_k \beta_k X_{kit}$ is the set of control variables that control for a set of factors that can affect export diversification over time. μ_t refers to a time fixed effect that controls for the effect of common annual cycles. The last ε_{it} is a random error term.

3.2. Variable Selection and Measurement

There are various methods to measure export diversification. The most direct method is to calculate the number of categories of products exported by enterprises, and the criteria for distinguishing categories are based on HS-6 commodities in the Chinese customs database, which simply sums up the number of HS-6 commodity categories exported by enterprises. However, it simply treats commodity categories with small export quantities as the same as those with large export quantities, while ignoring the possible commodity differences within a commodity category.

At present, the most dominant measure of commodity diversity adopted by the scholars is the Herfindahl Index (HHI), a composite index that measures the degree of concentration, expressed as the sum of the squares of the proportions of the main indicators of each component of a group to the overall indicators, or, if export diversification at

the firm level is to be studied, the sum of the squares of the proportions of the values of the enterprise' exports of each product to the total value of exports, i.e.:

$$HHI_{it} = \sum_{p=1}^n \left(\frac{E_{p,t}}{E_{i,t}} \right)^2$$

$$DIV_{it} = \frac{1}{HHI_{it}}$$

Where, $E_{i,t}$ denotes the total value of exports of enterprise i in the year t, then $E_{p,t}$ denotes the total value of product p exported by enterprise i in the year t. The larger the Herfindahl index is, the more concentrated the exports are, i.e., the lower the export diversification, and conversely, the smaller the index is, the less concentrated the part of the overall content is, and the higher the degree of export diversification is. Since the Herfindahl index is an inverse measurement index, in order to more intuitively reflect the level of export diversification, it did the reciprocal processing and noted as DIV_{it}.

As the main explanatory variables, this paper adopts industrial intermediate input data from the Chinese Industrial Enterprise Database, which is then logarithmized and denoted as $intermedia_{it}$.

X_{kit} is a collection of control variables that control for factors other than the main explanatory variables that affect export diversification, including: enterprise size (size) measured by the number of employees in the enterprise at the end of the year; the enterprise exist year (exist) measured by the difference between the current year and the year of opening; the administration efficiency (admin) measured by the ratio of 1 minus overhead to total revenue, human capital (HC) measured by the number of employees in the enterprise at the end of the year; policy environment measured by policy uncertainty (tpu) (the tpu faced by the enterprise is measured by the difference between the normal trade partnership tariff and the abnormal trade partnership tariff faced by the industry in which the product is located, and then weighted by the product's share of total exports), capital intensity (kl) is measured by the ratio of fixed assets to the number of employees for production operations, as well as the enterprise profits (profit) and subsidy income (subsidy), can also be obtained from the Chinese Industrial Enterprise Database.

4. Results and Discussion

4.1. Baseline Regression

Table 1 presents the results of the benchmark regressions. In particular, columns 1-3 list the regression results using the inverse of the Herfindahl index as a measure of export diversification, while columns 4-6 adopt the number of product categories exported by enterprises (range of exported products, denoted as n) as a proxy measure of export diversification. We focus mainly on the sign and magnitude of β1, which represents the direction and extent of the effect of intermediate inputs on export diversification.

Column 1 is a simple regression of the explained variable intermedia on the explanatory variable div without the addition of control variables, and column 2 is a baseline regression with the addition of control variables. Due to the possible mutual causality between intermedia and export diversification, in order to control for endogeneity, the regression is operated in column 3 with a lag one phrase of intermedia as an instrumental variable in place of the original explanatory variable. According to the regression results, the coefficients of the explanatory variables are significantly positive in all three cases, indicating that an increase in industrial intermediate inputs can promote export diversification, specifically, in the simple regression, a 10% increase in industrial intermediate inputs can lead to a corresponding increase in export diversification of 2.12%, and a 10% increase in industrial intermediate inputs can lead to a corresponding increase in export diversification of 1.8% after controlling for the relevant factors; and the effect of industrial intermediate inputs with a lag one phrase is 1.11%. These results are both logical and consistent with the theoretical assumptions in the previous literature.

By processing the intermediate goods, the enterprises increase more added value to the products, and then export such product to overseas as finished or semi-finished products to earn added value profits. The increase in intermediate inputs not only implies that enterprises have reached a corresponding level of productivity, but also may reflect their confidence in the export market and their willingness to increase intermediate inputs to expand their exports at the intensive and extensive margins. In such a case, it can be argued that the increase of intermediate inputs can promote the increase of export diversification of enterprises.

In addition, all of the enterprise size (size), enterprise existing duration (exist), enterprise profit (profit), subsidy income, and enterprise research and development input (train cost) have positive and significant effects on the increase of export diversification, which indicates that an enterprise with larger size, longer of enterprise existing duration, and stronger ability in profit tends to export more diversified products because it has a higher level of risk resistance and broader export channels, while the emphasis on R&D helps enterprise develop new products for export, and subsidies granted by the national government also stimulate and increase the motivation for the enterprises to export different products. When the policy environment becomes more volatile and uncertainty (tpu) increases, the coefficient is significantly negative, indicating that enterprises perceive the risk and reduce export diversification, cutting off some export business with average profitability, high level risk and vulnerable to policy environment. Finally, the improvement of enterprise administration efficiency (admin) can improve the export diversification of enterprises.

Table 1. *Enterprise Export Diversification and Industrial Intermediate Inputs.*

Explained Variables	(1) div	(2)	(3)
intermedia	0.212***	0.180***	
	(0.011)	(0.011)	
L. intermedia			0.111***
			(0.016)
size		0.127***	0.178***
		(0.016)	(0.024)
exist		0.102***	0.0705*
		(0.028)	(0.041)
profit		0.0181***	0.0134*
		(0.006)	(0.008)
subsidy		0.0459***	0.0285***
		(0.005)	(0.007)
HC		0.0400***	0.0233*
		(0.011)	(0.014)
tpu		-0.131**	-0.143*
		(0.060)	(0.073)
admin		0.173**	0.309***
		(0.075)	(0.103)
2001. YEAR	0.120***	0.133***	
	(0.029)	(0.028)	
2002. YEAR	0.232***	0.218***	0.0255
	(0.033)	(0.034)	(0.031)
2003. YEAR	0.414***	0.374***	0.151***
	(0.035)	(0.037)	(0.036)
2004. YEAR	0.676***	0.582***	0.279***
	(0.036)	(0.038)	(0.040)
2005. YEAR	0.812***	0.702***	0.502***
	(0.037)	(0.041)	(0.042)
2006. YEAR	1.042***	0.915***	0.625***
	(0.038)	(0.044)	(0.046)
2007. YEAR	1.541***	1.395***	1.041***
	(0.040)	(0.049)	(0.052)
Constant	1.027***	0.350**	1.496***
	(0.114)	(0.155)	(0.225)
Observations	283,144	265,760	170,785
R-squared	0.01	0.031	0.035

Note: The values in parentheses are robust standard errors; *, **, and *** indicate significant at 10%, 5%, and 1% significance levels, respectively.

4.2. Heterogeneity Analysis

In order to explore whether there is also significant heterogeneity in the export diversification of heterogeneous enterprises as affected by industrial intermediate inputs, heterogeneity regressions are conducted in this part based on the nature of ownership, geographical affiliation, trade mode, and capital intensity of enterprises, and the results are shown in table 2.

Table 2 shows the results of the heterogeneity regressions based on the nature of enterprise ownership. The regression results show that the regression coefficients of the explanatory variables are all significantly positive for enterprises of different ownership, but the coefficients of the enterprises with different sizes are varied, indicating that the increase in industrial intermediate inputs has different degrees of contribution to the export diversification of enterprises of different ownership, specifically, each 10% increase in industrial intermediate inputs can increase the export diversification of foreign-funded enterprises by 1.11%,

the export diversification of state-owned enterprises by 2.71%, and the export diversification of private enterprises by 3.45%, in which the promoting effects on the foreign-funded enterprises is smallest. It can be explained by the fact that foreign-funded enterprises, due to the participation of foreign capital, already hold the original intention to enter into the international market in which case the exporting business is their regular business, so the foreign-funded enterprises are already equipped to produce export goods with industrial intermediate inputs, i.e., the category and scale of commodities foreign-funded enterprises have already reached a mature or the most optimized phrases. Therefore, the increase in export diversification brought about by increasing intermediate inputs on top of this has a marginal decreasing effect, and its impact is relatively less significant. In contrast, private enterprises are generally small and medium-sized enterprises, whose scale and financing constraints determine that most private enterprises' exports are concentrated in their core business and the scale of exports is also at a low level, so the effect of increased export diversification brought by increased intermediate inputs is more obvious.

Table 2. *Regression Results of Heterogeneity in the nature of Enterprise Ownership.*

VARIABLES	(1)	(2)	(3)
	div		
	Foreign-Funded Enterprises	State-Owned Enterprises	Private Enterprises
intermedia	0.110***	0.271***	0.345***
	(0.0108)	(0.0498)	(0.0473)
Observations	132,950	28,086	39,794
Number of groups	43,703	9,250	18,614
R-squared	0.023	0.016	0.054

Note: The values in parentheses are robust standard errors; *, **, and *** indicate significant at 10%, 5%, and 1% significance levels, respectively.

Table 3 lists the results of the heterogeneity regression based on the geographical location of the enterprises. According to the regression results, the regression coefficients of the explanatory variables are significantly positive for enterprises in different regions, but the coefficients of the enterprises with different geographical locations are varied, indicating that the increase in industrial intermediate inputs has different degrees of promoting effects on the export diversification of enterprises in different regions, specifically, each 10% increase in industrial intermediate inputs can increase the export diversification of enterprises in western region by 2.87%, the export diversification of enterprises in central region by 1.77%, and the export diversification of enterprises in eastern region by 1.78%, in which the effects on the enterprises in central region and the enterprises in eastern region have little difference and the effects on the enterprises in western region is large. This can be explained by the fact that enterprises in the western region are less connected to the international market and have a more homogeneous export business (especially in the field of natural energy resources) due to

their geographical location and economic transportation conditions. Therefore, for these enterprises with less export accumulation, the effect of increased intermediate inputs is equivalent to that of the initial marginal incremental phase, which has a more significant contribution to export diversification. In contrast, the central and eastern regions have richer and more developed clusters of enterprises, and the effect of increasing export diversification through intermediate inputs is relatively limited based on the wider range of exports already available.

Table 3. *Regression Results of the Geographical Heterogeneity of Enterprises' Location.*

VARIABLES	(1)	(2)	(3)
	div		
	Western Region	Central Region	Eastern Region
intermedia	0.287***	0.177***	0.178***
	(0.072)	(0.0409)	(0.0115)
Observations	9,644	14,967	241,486
Number of groups	3,500	5,663	78,414
R-squared	0.03	0.027	0.035

Note: The values in parentheses are robust standard errors; *, **, and *** indicate significant at 10%, 5%, and 1% significance levels, respectively.

Table 4 shows the results of heterogeneity regressions based on the trade mode and high capital density of, where the capital density is measured by the ratio of fixed assets to the number of employees of the enterprise. In accordance with the regression results, it shows that the regression coefficients of the explanatory variables are significantly positive for different types of enterprises, indicating that the increase of industrial intermediate inputs has a positive effect on the export diversification of enterprises with different trade modes and capital density, specifically, a 10% increase of industrial intermediate inputs can increase the export diversification of general trade enterprises by 2.43% and the export diversification of the enterprises for processing trade by 0.46%. The increase levels of the export diversification of the enterprises for general trade and the enterprises for processing trade have great difference. The reason is that the enterprises for processing trade export a relatively fixed variety of intermediate goods, and there is little room for increasing diversity of export diversification. The increase in intermediate inputs only leads to a corresponding increase in exports of more fixed types of processed goods and rarely generates innovative products. Moreover, a 10% increase in industrial intermediate inputs can increase the export diversification of the enterprises of high capital density by 1.59% and the export diversification of the enterprises of the enterprises of low capital density by 2.22%. The reason for the higher impact on the enterprises of the enterprises of low capital density is that these enterprises have less original accumulation and less capital investment and resources required for making innovation in export products. The increase in intermediate inputs can bring effects equivalent to those brought about at the initial marginal incremental stage, and in relative terms, the upgrading space for the enterprises

of high capital density is relatively limited.

Table 4. Results of the Heterogeneity of Enterprise Trade Mode and Capital Density.

VARIABLES	(1)	(2)	(3)	(4)
	div			
	General Trade	Processing Trade	High Capital Density	Low Capital Density
intermedia	0.243***	0.0465***	0.159***	0.222***
	(0.0152)	(0.0152)	(0.0203)	(0.0176)
Observations	188,915	77,182	62,631	203,466
Number of groups	71,418	29,569	29,262	72,785
R-squared	0.037	0.021	0.032	0.033

Note: The values in parentheses are robust standard errors; *, **, and *** indicate significant at 10%, 5%, and 1% significance levels, respectively.

4.3. Robustness Tests

1) Alternative measures of export diversification

The export diversification mentioned above is measured by taking the inverse of the DIV index obtained from the Herfindahl index (HHI). For the sake of robustness considerations, the sum of enterprise export product types is further used to measure the export diversification of enterprises, in which case the sum of the number of enterprise export product types (n) will used as the explained variable to replace DIV for fixed effects regression estimation, similar to the basic regression, which are conducted direct regression, the baseline regression with the inclusion of control variables, and the regression with lag one phrase of intermediate inputs as explanatory variables, and the results are shown in table 5.

The results show that the coefficients of the main explanatory variables are positive and pass the 1% significance test, verifying that an increase in intermediate inputs does intuitively lead to an increase in the product range of the enterprises, and that a 1% increase in intermediate inputs leads to a 2.35% increase in product variety, further solidifying the findings.

Table 5. Robustness Test - Alternative Explained Variables.

Explained Variables	(1)	(2)	(3)
	n		
intermedia	2.897***	2.305***	
	(0.125)	(0.126)	
L. intermedia			2.305***
			(0.126)
Observations	283,144	265,760	265,760
R-squared	0.022		0.0345

Note: The values in parentheses are robust standard errors; *, **, and *** indicate significant at 10%, 5%, and 1% significance levels, respectively.

2) Change regression methods

In this paper, we mainly use fixed effects (FE) regression methods to control for individual heterogeneity and temporal heterogeneity of enterprises, and for the sale of robustness, we further use other regression methods for the sample, including random effects (RE) regression, mixed OLS, and maximum likelihood estimation (MLE), and the results are shown in table 6.

The results show that the coefficients of the main explanatory variable intermedia are positive and pass the 1% significance test in these different statistical regression methods commonly used, and in addition the coefficients are similar under different statistical regression methods (the larger values of the mixed OLS may be due to the fact that the enterprises' own attributes also increase the impact on product range in the absence of controlling for individual fixed effects thus exaggerating the extent to which intermediate inputs affect the growth of product diversity), all of which again validate the above conclusions.

Table 6. Robustness Test - Change of Regression Method.

VARIABLES	FE	RE	MLE	Mixed OLS
	div			
intermedia	0.180***	0.183***	0.183***	0.222***
	(0.011)	(0.00742)	(0.00743)	(0.00813)
Observations	266097	266097	266097	266097
Number of groups	87575	87575	87575	87575
R-square	0.034	0.031		0.041

Note: The values in parentheses are robust standard errors; *, **, and *** indicate significant at 10%, 5%, and 1% significance levels, respectively.

3) Sample classification regression

In order to exclude the imbalance where the findings are valid in only part of the sample but not in the other part, and to ensure that the findings based on the sample as a whole are reliable and robust, the sample as a whole is grouped in this part, which are specifically operated in two ways: the explained variable - enterprise export diversification div, is bifurcated and divided in seventy-thirty ratio. The fixed effects regressions were respectively run for samples with export diversity above the mean (and above 70%) and samples below the mean (and below 30%) simultaneously. The results are shown in table 7.

The results show that the coefficient of the explanatory variable intermediate, regardless of the group way, is positive for either grouping and passes the 1% significance test, indicating that the findings are robust in the sample overall. It is worth noting that the results also show that the effect of intermediate inputs on export diversification is much larger in the sample of enterprises with higher export diversification compared to the sample of the enterprises with lower export diversification, indicating that an enterprise with a highly diversified range of export products will have a much larger contribution of intermediate inputs than those enterprises with higher export concentration, which also proves the

contribution of increased intermediate goods inputs to the

degree of export diversification from another perspective.

Table 7. *Robustness Tests-Sample Classification & Controlling for Final Goods Tariffs.*

VARIABLES	Above 30%	Below 30%	Above 50%	Below 50%	Control Tariff
	div	div	div	div	div
intermedia	0.399***	0.00410***	0.377***	0.0298***	0.180***
	(0.0408)	(0.00124)	(0.0385)	(0.003)	(0.011)
Observations	80,061	79,604	83,394	182,703	266,097
Number of groups	34,181	42,722	35,397	73,187	87,575
R-squared	0.041	0.011	0.041	0.02	0.034

Note: The values in parentheses are robust standard errors; *, **, and *** indicate significant at 10%, 5%, and 1% significance levels, respectively.

4) Control for final goods tariff

All regressions mentioned above do not take into account the import competition effect from tariff concessions on final goods in the control industry. In order to exclude the effect of industry import competition, the control variable of industry final goods tariff (output tariff) is further added to all regressions mentioned. The results show that the coefficient of the explanatory variable intermediate is still positive after adding this control variable, and it passes the 1% significance test, which verifies the conclusion.

5. Conclusion

This paper explores the effect of intermediate inputs on the export diversification of enterprises using Chinese Industrial Enterprises Database and China Customs Database as well as UN tariff data from 2000 to 2007. The results show that the increase of intermediate inputs can promote the increase of export diversification of the enterprise, and suck kind of promotion effect is persistent. According to the heterogeneity analysis, it shows that: (1) the increase in intermediate inputs has the largest contribution to the increase in export diversification of private enterprises and the smallest effect on foreign-funded enterprises; (2) the increase in intermediate inputs has the largest contribution to the increase in export diversification of enterprises in the western region, and the effects on enterprises in the central and eastern regions are almost the same; (3) the increase in intermediate inputs has the largest contribution to the increase in export diversification of enterprises for general trade, and the largest contribution to the increase in export diversification of enterprises for processing trade; and (4) the increase in intermediate inputs has a greater effect on the increase in export diversification of enterprises with low capital density than that of enterprises with high capital density.

With the gradual disappearance of China's "demographic dividend", the trade mode in which price advantage is the main competitive advantage has played a gradually decreased role in promoting the economic development of China. At present, it is urgent for China transform its price advantage into a quality advantage, and product diversity is an important way to measure the product quality advantage of enterprises, which deliver the positive influence on the consumers' product choices. On this basis, advancing the expansion of the export product range of the Chinese

enterprises is an important economic task for the current economic development of China. The author offers several suggestions in terms of the policy as following policy:

(1) The government shall break down the barriers of each regional market and firmly speed up the process of domestic market integration. Local governments must break down the administrative barriers, achieve interconnection among the regions, intensify the construction of infrastructure facilities and unified market laws and regulations in each region, achieve "mutual construction, interoperability and mutual sharing", continuously expand the scope of regional integration, strengthen the synergistic development effect among regions, and move toward the goal of a unified market framework nationwide, for which the specific measures include improving the layout of trade circulation, providing digital platform support for merchants, strengthening the transparency and openness of trade information, promoting digitalization, and creating a fair and competitive market environment.

(2) Enterprises play a major role and deepen the division of labor. In the unified market framework, with the reduction of intermediate product transaction costs and the improvement of enterprise innovation efficiency, enterprises shall give full play to their main role in the market economy, deeply cultivate the domestic value chain system, allocate resources to core business, outsource secondary business, continuously optimize the allocation of factor resources, improve their own productivity, and thus increase export diversification, so as to make contribution to the transformation and upgrading of China's export industry structure. The government also needs to introduce incentive policies such as VAT levy reduction to encourage enterprises to optimize and upgrade their export structure, including promoting cross-regional exchanges and cooperation in science and technology innovation and cross-regional circulation of talent and capital and other factors to achieve industrial structure optimization.

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