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Research on the Impact of Industrial Clusters on the High-Quality Development of Foreign Trade

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Abstract: This article constructs panel data of 30 provinces and cities in China from 2001 to 2021, explores the relationship between industrial clusters and high-quality development of foreign trade based on the heterogeneous industrial dynamic model, and elaborates on it from three aspects: enterprise cost, transaction efficiency, and knowledge spillover. The theoretical mechanism for industrial clusters to promote high-quality development of foreign trade. Research shows that: (1) Industrial clusters have a significant positive impact on the quality of foreign trade development. The higher the degree of industrial clusters, the more conducive it is to the high-quality development of China's foreign trade. (2) The impact of industrial clusters on the quality of foreign trade development in the eastern region is greater than that in the central and western regions. (3) Industrial clusters promote the high-quality development of trade mainly through three channels: transaction cost mechanism, transaction efficiency mechanism and knowledge spillover mechanism. (4) As new trade protectionism continues to rise, the impact of industrial clusters on the quality of foreign trade development has been weakened, and the impact of technological innovation on the transformation and upgrading of foreign trade has increased significantly.

1. Introduction

The development of industrial clusters in China is an important part of China's economic transformation and upgrading, and a key force in promoting economic growth and industrial competitiveness. Industrial clusters are closely linked groups of related industrial enterprises, suppliers, service providers and related institutions in a specific geographical area, which achieve synergistic development and competitive advantages by sharing resources, technology and market information. This paper theoretically analyses the mechanism of industrial clusters affecting the transformation and upgrading of foreign trade, and on this basis empirically tests the specific effect of industrial clusters affecting the transformation and upgrading of foreign trade by using the panel data of 30 provinces and regions in China. It is concluded that the higher degree of industrial clusters is more favourable to the transformation and upgrading of China's foreign trade, and the effect of industrial clusters on the quality of foreign trade development in the eastern region is greater than that in the central and western regions.

2. Theory Hypothesis

2.1. Industrial Clusters Can Save Enterprise Costs and Thus Promote the High-Quality Development of Foreign Trade

The competitiveness of enterprises in industrial clusters means that their products can be sold well in the international market and earn a good reputation. After the industrial cluster, the specialisation level of enterprises is improved, the management cost is reduced, and the transaction cost of enterprises in the cluster will be gradually reduced, which leads to the reduction of comprehensive cost. Therefore, enterprises clustering in a certain spatial geography will reduce the cost of products, enhance the competitiveness of export products, and promote the high-quality development of foreign trade. In addition, producers, suppliers and sellers clustered in the same area, due to geographic proximity, it is easier for producers to obtain market information, effectively reducing the asymmetry between creative producers and market information. Finally, enterprises in the agglomeration area can easily establish credibility and ethical mechanisms, build up interdependence, and reduce the average cost of enterprises through joint ventures and co-operation. In the whole industrial zone[1], products and services continue to flow to markets outside the region, expanding market share, realising the benefits of external economies of scale, further reducing all kinds of costs, and ultimately improving the quality and development of foreign trade.

2.2. Industrial Clusters Can Improve the Efficiency of Transactions and Thus Promote High-Quality Development of Foreign Trade

Due to the superb division of labour in the cluster, each enterprise is in the industrial chain of professional division of labour, so after the raw materials enter the cluster from the beginning, each enterprise is responsible for its own most suitable part, after processing, production and finally output of finished products, similar to the production assembly line, to achieve the economies of scale of each process, thus enhancing the efficiency of the division of labour. According to the viewpoint of neoclassical economics, the improvement of transaction efficiency can promote international trade and improve international competitiveness, thus enhancing the quality of trade development. In addition, the division of labour within the cluster is fine, and there are a large number of similar enterprises in each production link, and the competition between enterprises is very fierce, and at the same time, due to the rapid flow of information within the cluster, so this kind of competition is similar to perfect competition, which greatly improves the flow of raw materials and intermediary products between enterprises, and realizes the connection and matching of each production link, and reasonably utilizes the production capacity of enterprises within the cluster. The production tasks of the enterprises in the cluster are continuously allocated to the downstream enterprises, and at the same time subcontracted to the enterprises in the unified platform, which realises the fine decomposition of production tasks to meet the individual and diversified needs of customers, and greatly improves the operational efficiency[2]. This efficient cluster mode is quick in response and high in efficiency, which is conducive to enterprises' advantageous position in international market competition. In other words, the efficient division of labour in clusters can improve the transaction efficiency of foreign trade, thereby enhancing the quality of trade development.

2.3. Industrial Clusters Can Accelerate Technology and Knowledge Spillovers, Thereby Promoting High-Quality Development of Foreign Trade

Enterprises in cluster areas can share public infrastructure, such as energy, transport and

communications, and establish common sales centres to form retail and wholesale markets; they can also share high-level specialized labour markets, save on information flow costs, and gain rapid and low-cost access to relevant information on technology, products and markets. As new ideas are disseminated and adopted, the resulting technology and knowledge spillovers will greatly increase labour productivity and contribute to the development and growth of export trade. Industrial clusters are driven by market forces; the emergence of market demand will attract more talent, and individual career motives contribute to the formal diffusion of knowledge. The use of large amounts of specialised information and knowledge is accelerated and made more efficient, resulting in higher productivity for firms in the cluster area[3]. In addition, enterprises within the cluster area can obtain financial externalities and participate in the international division of labour with lower transport and production costs, thus enhancing their international competitiveness, which will be conducive to the transformation and upgrading of foreign trade and ultimately improve the quality of foreign trade development.

Based on this, the research hypothesis of this paper is proposed:

Hypothesis 1: Industrial clusters can promote high-quality development of foreign trade.

Hypothesis 2: Industrial clusters can promote high-quality development of foreign trade through transaction cost effect, transaction efficiency effect and knowledge spillover effect.

3. Description of Models, Variables and Data

3.1. Modelling

Based on the theoretical foundation and factual experience analysis in the previous section, the following basic model is constructed in order to further test whether industrial clusters can significantly affect the high-quality development of foreign trade:

$$TU_{\mathrm{it}} = \partial_0 + \partial_1 IC_{it} + \mu_i + \nu_t + \varepsilon_{it} \tag{1}$$

In the above equation TU represents the level of high-quality development of foreign trade, IC represents industrial clusters, i represents regions, and t represents years. In addition, considering that other factors also have an important impact on trade quality development, technological innovation, human capital, foreign direct investment, fiscal expenditure and infrastructure construction are also added as control variables to obtain the final model:

$$TU_{\mathrm{it}} = \beta_0 + \beta_1 IC_{it} + \beta_2 CX_{it} + \beta_3 \mathrm{HUM}_{it} + \beta_4 FDI_{it} + \beta_5 GOV_{it} + \beta_6 INF_{it} + \mu_i + \nu_t + \varepsilon_{it} \tag{2}$$

Where TU refers to the high-quality development of foreign trade, IC denotes the degree of industrial clusters in the region, CX denotes the level of technological innovation, HUM denotes the accumulation of human capital, FDI denotes foreign direct investment, GOV denotes fiscal expenditure, and INF denotes the construction of infrastructure. i denotes the region, t denotes the year, μ and ν are the region fixed effects and time fixed effects, and ε is a random perturbation term.

3.2. Selection of Variables

3.2.1. Explained Variable: Quality of Foreign Trade Development (TU)

The explanatory variable of this paper, the quality of foreign trade development (TU), adopts the contribution rate of foreign trade to GDP to express the quality of foreign trade development in each region, in order to reflect the status of high-quality development of foreign trade[4]. The higher the

contribution rate of foreign trade to regional GDP, the higher the quality of foreign trade development in the region.

3.2.2. Core Explanatory Variables: Industrial Clusters (IC)

There are many ways to measure industrial clusters (IC), the core explanatory variable of this paper, including industrial concentration, industrial cluster index, location entropy, spatial Gini coefficient, Herfindahl index and so on. Combining the research objectives and referring to the research ideas of Liu Yan and Deng Ruobing (2017), the location entropy of the tertiary industry is used to portray and analyse the degree of development of industrial clusters. The calculation formula of location entropy is: $E_{ij} = \frac{Y_{ij}/Y_i}{Y_j/Y}$, where Y_{ij} denotes the output value of industry j in region i, j=1,2,3, which denotes the tertiary industry, respectively; Yi denotes the gross product of region i; Yj denotes the output value of industry j in the whole country; and Y denotes the gross product of the whole country[5].The larger the value of Eij, the higher the degree of clustering of the industry. When Eij>1, it means that industry i has agglomeration condition in region j; when Eij<1, it means that the distribution degree of industry i in region j is lower than the national level; when Eij=1, it means that the distribution degree of industry i in region j is the same as the national level.

Other control variables

This paper also controls for other variables: (1) technological innovation (CX). It is generally believed that the more patent applications granted, the higher the level of technological innovation[6], this paper draws on Liu Jun et al. (2010) and selects the number of patent applications granted per capita in each region to indicate. (2) Human capital (HUM). This paper refers to the research method of Peng (2005) and adopts the logarithm of human capital stock to express it. The formula of human capital stock is: $Y = \exp(\ln(h)) * L$, where Y denotes the human capital stock, ln(h) is the per capita human capital in each region, which is calculated from the data of return to education and average years of education of labour force, and L denotes the number of employed people in each region. (3) Foreign Direct Investment (FDI). It is expressed by using the ratio of actual foreign direct investment to GDP in each region. (4) Fiscal Expenditure (GOV). Drawing on the research ideas of most scholars, total fiscal expenditure as a proportion of regional GDP is used to measure it. (5) Infrastructure development (INF). Referring to Bai Junhong et al. (2016), the length of long-distance fibre optic cable lines per capita in each region is used to express it.

3.3. Data Sources

This paper empirically investigates the effect of industrial clusters on the quality of foreign trade development by using relevant data from 30 Chinese provinces, autonomous regions and municipalities directly under the central government from 2001 to 2021. In the course of the study, the data of the adopted variables were smoothed and supplemented by interpolation for some of the missing data. Most of the raw data used in this study come from the China Statistical Yearbook, the China Science and Technology Statistical Yearbook, the China Population and Employment Statistical Yearbook, as well as the previous years' statistical yearbooks of various provinces and regions, and China's economic and social development statistical database.

4. Empirical Results and Analyses

4.1. Baseline Regression Results

As can be seen from Table 1, at the level of China as a whole, industrial clusters (*IC*) have a significant positive impact on the quality of trade development. In the results of model 2, the regression coefficient of industrial clusters is 1.447, i.e., if the degree of industrial clusters is increased by 10%, the quality of China's foreign trade development will be improved by 14.47%, and it passes the significance test of 1%, which indicates that the industrial clusters can significantly promote the high-quality development of China's foreign trade, and verifies the hypothesis 1. As a matter of fact, industrial clusters are able to reduce the cost of the enterprises and improve the efficiency of the transaction, which is helpful to improve the quality of foreign trade development. When the industrial clusters are at the medium-low level, the agglomeration economic effect generated by the industrial clusters is greater than the excessive competition effect, then the industrial clusters can help to improve the quality of the export products of the enterprises, so as to promote the high-quality development of China's foreign trade.

For the control variables: (1) technological innovation (*CX*). The impact of technological innovation on the development quality of China's foreign trade is significantly positive, with a regression coefficient of 0.003, which passes the 10% significance test, indicating that technological innovation is conducive to the improvement of the development quality of China's foreign trade, and is the driving force for the high-quality development of foreign trade, which is in line with the conclusions of the research of most scholars. A large number of practices have proved that in the process of foreign trade development, improving the level of technological innovation will have a positive effect on factors[7], products and sectors. Accelerating technological innovation will not only help the aggregation of factors and improve production efficiency, but also help to innovate products and services, accelerate product upgrading, improve product added value, provide more innovative and satisfactory products and services, so that enterprises can maintain a favourable position in foreign trade, which greatly affects the structure of foreign trade commodities, the structure of the foreign trade market and so on, and ultimately promotes the high-quality development of foreign trade. (2) Human capital (*HUM*). The impact of human capital on the quality of trade development is significantly positive, with a coefficient of 0.046, and passes the 5% significance test. In fact, trade activities are carried out by human beings, and human capital determines the level of trade development to a large extent. If a country or region wants to achieve efficient and high-quality foreign trade development, it must put human capital in the leading position[8], strengthen the investment in human capital, and build a good human resources system. (3) Foreign direct investment (*FDI*). The regression coefficient of FDI is 0.051 and passes the 1% significance test, indicating that FDI can significantly improve the quality of foreign trade development. On the one hand, along with the entry of foreign capital, more or less will bring advanced equipment and management means, so that enterprises benefiting from these elements in the efficiency and product quality to improve[9], the formation of product differentiation. On the other hand, the introduction of foreign direct investment at the same time brought the more advanced technology of these countries or regions, and promote the dissemination of these technologies in the enterprises related to foreign investment, improve the technological level of the foreign trade industry, and provide technological support for the high-quality development of foreign trade. (4) Fiscal expenditure (*GOV*). The impact of fiscal expenditure on the quality of trade development is negative (coefficient of -0.805). Generally speaking, expanding fiscal expenditure not only provides financial support, but also can increase the public products needed for the high-quality development of trade, which will be conducive to improving the market environment,

reducing transaction costs, and improving the allocation and use efficiency of production factors. The negative impact may be due to the fact that, in the process of economic development, too much government intervention has hindered the development of regional trade and economic cooperation[10]. More fiscal expenditure will cause an increase in government purchases and a decrease in private investment, making the market less efficient and thus not conducive to the improvement of the quality of foreign trade development. (5) Infrastructure construction (*INF*). The regression coefficient of infrastructure construction is 0.008 and passes the 1% significance test, indicating that the impact of infrastructure construction on the quality of trade development is significantly positive. Convenient infrastructure conditions will be conducive to enterprises to expand the product sales market, reduce costs, but also conducive to reducing product inventory, accelerate the flow of enterprise funds. In addition, infrastructure construction can not only effectively promote the development of regional economic activities and facilitate the flow of trade, but also promote the specialisation of the division of labour, improve the efficiency of the allocation of factors of production, and thus promote the high-quality development of foreign trade.

Table 1: Benchmark regression results

variant	Model 1	Model 2
industrial cluster (*IC*)	1.526*** (0.073)	1.447*** (0.080)
technological innovation (*CX*)		0.003* (0.002)
human capital (*HUM*)		0.046** (0.021)
overseas foreign direct investment (OFDI) (*FDI*)		0.051*** (0.006)
financial expenditure (*GOV*)		-0.805** (0.167)
Infrastructure development (*INF*)		0.008*** (0.005)
constant term (math.)	-1.615*** (0.069)	-1.583*** (0.303)
regional effect	Yes	Yes
time effect	Yes	Yes
R^2	0.508	0.515
observed value	630	630

Note: ***, **, and * indicate significant at the 1 per cent, 5 per cent, and 10 per cent levels, respectively, with robust standard errors in parentheses. Same as below.

4.2. Robustness Tests

The core explanatory variable is replaced by the entropy value of the secondary sector location, denoted as IC_2, which is re-estimated for both the overall level and the regional level data. Table 2 reports the results of this robustness test. As can be seen from Table 2, the sign of the coefficients of the core explanatory variables is fully consistent with the corresponding results in Table 1, indicating that the empirical results of the study are robust.

Table 2: Robustness test results

variant	Level of Integration	eastern part	Central Region	Western Region
	Model 14	Model 15	Model 16	Model 17
industrial cluster (IC_2)	0.332*** (0.117)	0.585*** (0.249)	0.045* (0.123)	0.010* (0.045)
technological innovation (*CX*)	0.016** (0.002)	0.007** (0.004)	0.005* (0.011)	0.009*** (0.002)
human capital (*HUM*)	0.033** (0.025)	0.151** (0.077)	0.062* (0.043)	0.018*** (0.008)
overseas foreign direct investment (OFDI) (*FDI*)	0.072*** (0.010)	0.078** (0.017)	0.044** (0.019)	-0.005* (0.005)
financial expenditure (*GOV*)	-0.825** (0.290)	-0.566 (0.831)	-1.122** (0.557)	-0.190*** (0.078)
Infrastructure development (*INF*)	0.003 (0.002)	-0.056** (0.027)	0.015 (0.011)	-0.003* (0.002)
constant term (math.)	1.241*** (0.258)	-0.197 (0.682)	0.709* (0.556)	0.321*** (0.092)
regional effect	Yes	Yes	Yes	Yes
time effect	Yes	Yes	Yes	Yes
R^2	0.405	0.218	0.254	0.233
observed value	630	231	168	231

4.3. Heterogeneity Analysis

From the subregional level, Table 3 shows that industrial clusters (*IC*) have a significant positive impact on the quality of foreign trade development in the eastern, central and western regions, which means that industrial clusters can significantly improve the quality of regional foreign trade development. The regression coefficient of industrial clusters in the eastern region is 1.747, and passes the 1% significance test; the regression coefficient of industrial clusters in the central region is 0.023, and passes the 10% significance test; the regression coefficient of industrial clusters in the western region is 0.183, and passes the 1% significance test. It can be seen that for different regions, industrial clusters have different effects on the quality of regional foreign trade development[11], in which the promotion effect on the quality of foreign trade development in the eastern region is the largest, the effect on the western region is the second largest, and the effect on the quality of foreign trade development in the central region is the smallest.

As for the control variables, there are some differences in the impact of the factors on the quality of foreign trade development in different regions. The impact of technological innovation (*CX*) and human capital (*HUM*) is significantly positive in all three regions, indicating that technological innovation and human capital can significantly contribute to the quality of regional foreign trade development, and that these two factors are the new driving force for the development of regional foreign trade of high quality. The impact of fiscal expenditure (*GOV*) is negative in all three regions, indicating that fiscal expenditure has a certain inhibitory effect on the quality of regional foreign trade development. While foreign direct investment (*FDI*) and infrastructure construction (*INF*) have a positive impact on the eastern and central regions, and a negative impact on the western region. The reason why there is a negative impact in the western region may be because: the effect of FDI on the quality of regional foreign trade development will be affected by many other

factors[12], and a large number of infrastructure construction inputs may produce a certain amount of excess and ineffective production capacity, crowding out other types of investment, resulting in the construction of infrastructure does not have the expected effect on the development of high quality of local foreign trade.

Table 3: Results of the regional heterogeneity test

variant	eastern part	Central Region	Western Region
	Model 3	Model 4	Model 5
industrial cluster (*IC*)	1.747*** (0.129)	0.023* (0.215)	0.183*** (0.056)
technological innovation (*CX*)	0.007*** (0.003)	0.004* (0.008)	0.011*** (0.002)
human capital (*HUM*)	0.140*** (0.042)	0.068* (0.050)	0.023*** (0.007)
overseas foreign direct investment (OFDI) (*FDI*)	0.059*** (0.015)	0.037** (0.013)	-0.005* (0.006)
financial expenditure (*GOV*)	-1.582*** (0.570)	-1.119** (0.524)	-0.143** (0.061)
Infrastructure development (*INF*)	0.0243* (0.019)	0.012 (0.010)	-0.002*** (0.001)
constant term (math.)	-2.673*** (0.466)	0.901* (0.520)	0.530*** (0.088)
regional effect	Yes	Yes	Yes
time effect	Yes	Yes	Yes
R^2	0.604	0.577	0.231
observed value	231	168	231

5. Analysis of the Mechanism of the Impact of Industrial Clusters on High-Quality Trade Development

5.1. Modelling and Metrics

5.1.1. Modelling of Intermediation Effects

Drawing on Wen Zhonglin et al.'s (2004) test of the mediating effect, the mediating effect model of the following form is set up and transaction costs, transaction efficiency and knowledge spillovers are used as the three mediating variables to test the mechanism of the role of industrial clusters on the quality of trade development:

$$M_{it} = \beta_0 + \beta_1 \mathrm{IC}_{it} + \sum_{j=2}^{6} \beta_j control_{it} + \varphi_i + \varepsilon_{it} \tag{3}$$

$$TU_{it} = \lambda_0 + \lambda_1 \mathrm{IC}_{it} + \delta M_{it} + \sum_{j=2}^{6} \lambda_j control_{it} + \nu_i + \varepsilon_{it} \tag{4}$$

5.1.2. Measurement of Mediating Variables

(1) Transaction costs: Cost savings can lower the threshold for enterprises to participate in

exporting and promote more enterprises to participate in exporting activities, thus enhancing the overall export capacity of the region. Drawing on the measurement method of Huang Jiu-Li and Li Kun-Wang (2006), the proximity of overseas markets in each region is used as a proxy variable, and the specific formula is:

$$FMA_i = \begin{cases} 100D_{ii}^{-1}, i \in C \\ 100\left(\min D_{ij} + D_{jj}\right)^{-1}, i \notin C, j \in C \end{cases} \tag{5}$$

(2) Transactional efficiency: Transactional efficiency refers to the volume or number of transactions that can be achieved with a given input of resources under existing conditions such as policy and technology. Typically, there are two main approaches to metrics of transaction efficiency. One method is to directly adopt infrastructure indicators, such as the number of fixed telephones and the number of mobile telephones, as a metric of transaction efficiency, and the other method is to use principal component analysis, which reflects the transaction efficiency from a combination of multiple dimensions (e.g., infrastructure and communication). In this study, given the relatively small number of indicators and the long data span, and in order to avoid missing information, indicators such as the number of mobile phones owned, the number of Internet accesses, the area of actual urban roads at the end of the year, and the total amount of road, water and air freight transport have been selected to measure the transaction efficiency of the region by considering these factors together.

(3) Knowledge spillovers: Academics typically use a variety of methods to measure the extent of knowledge spillovers, including the knowledge production function method, the cost function method, the technology flow method, the total factor productivity method, and the literature tracking method. The literature tracking method is a direct measurement method that uses patent data or patent citation data to assess knowledge spillovers. The idea behind this method is that patent records are traces of the knowledge spillover process and can reflect the characteristics, paths, time distribution and geographical distribution of knowledge spillovers. This study chose to use the literature tracking method to measure the level of knowledge spillover in the region. The number of patent applications is used to represent the knowledge and technology output of a region. If a region has a higher number of patent applications, it means that the region creates more knowledge, which may lead to more knowledge spillovers to the outside. Therefore, the number of domestic patent applications filed is used and logged to measure the level of knowledge spillovers.

5.2. Examination of the Mechanism by Which Industrial Clusters Affect the Quality of Trade Development

Table 4 regresses the results of the test of the mediating effect of industrial clusters on the quality of trade development. Among them, model 6 examines the estimation results with transaction costs as the explanatory variables, and it can be seen that the estimated coefficient of industrial clusters is significantly negative, indicating that industrial clusters can significantly reduce the transaction costs of enterprises. Model 7 examines the impact of industrial clusters and transaction costs on the quality of trade development, and it can be seen that the regression coefficients of industrial clusters are significantly positive, while the estimated coefficients of transaction costs are significantly negative, indicating that the increase of transaction costs is not conducive to the high-quality development of foreign trade, and it can be seen that industrial clusters contribute to the enhancement of the quality of foreign trade development by reducing transaction costs. Further, the sobel test statistic in Model 7 is significant at the 1% level, which also identifies transaction costs as an influential channel for industrial clusters to promote the high-quality development of foreign

trade. Model 8 and Model 9 report the results of the mediation effect test of transaction efficiency, in which Model 8 examines the estimation results with transaction efficiency as the explanatory variable, and from the regression results, the estimated coefficients of industrial clusters are significantly positive at 1% confidence level, which indicates that industrial clusters can significantly enhance transaction efficiency. Model 9 simultaneously incorporates industrial clusters and transaction efficiency to examine the impact of both on the quality of trade development, it can be seen that the estimated coefficients of industrial clusters and transaction efficiency both pass the 1% significance test, and the regression coefficient is significantly positive, indicating that improving the transaction efficiency can significantly improve the quality of foreign trade development, which shows that the industrial clusters can promote the enhancement of the quality of trade development by improving the transaction efficiency of enterprises[13], and , the sobel test statistic is significant at the 1% level, which also further verifies the existence of the intermediary channel of industrial clusters to promote the quality development of foreign trade through the enhancement of transaction efficiency. Model 10 and model 11 report the results of the intermediary effect test that industrial clusters have an impact on the quality of trade development through the knowledge spillover effect, and it can be seen from model 10 that the estimated coefficients of industrial clusters are significantly positive, which indicates that industrial clusters can significantly promote knowledge spillover. From the regression results of model 11, it can be seen that the estimated coefficients of industrial clusters and knowledge spillovers are both significantly positive, and passed the significance test at the 1% level, indicating that industrial clusters can promote the development of high quality of trade through the promotion of knowledge spillovers, and the corresponding sobel test is significant at the 5% level. The above mediation effect test process confirms that industrial clusters can indeed promote the quality of regional trade development through the transaction cost effect, transaction efficiency effect and knowledge spillover effect, thus verifying hypothesis 2.

Table 4: Tests of the mediating effect of industrial clusters on the quality of trade development

variant	transaction cost		Transaction efficiency		Knowledge spillover	
	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11
IC	-0.043** (0.016)	1.424*** (0.317)	0.454*** (0.146)	0.521*** (0.177)	0.727** (0.172)	0.702*** (0.183)
CX	-0.021** (0.008)	-0.438*** (0.127)	0.589*** (0.217)	0.614*** (0.245)	0.612** (0.297)	0.852*** (0.324)
HUM	-0.056*** (0.013)	-0.501 (0.182)	0.208*** (0.054)	0.293*** (0.106)	0.314*** (0.108)	0.465*** (0.141)
FDI	0.005 (0.004)	-0.159* (0.087)	0.130** (0.054)	0.279* (0.072)	0.239* (0.123)	0.257** (0.110)
GOV	0.017 (0.013)	0.443 (0.642)	0.137 (0.194)	0.473 (0.518)	2.704** (1.003)	1.328** (0.633)
INF	-0.059*** (0.023)	-0.269*** (0.011)	0.576* (0.284)	2.310** (1.415)	1.507*** (0.019)	1.097*** (0.182)
M		-1.690*** (0.247)		1.268*** (0.354)		0.377*** (0.026)
constant term (math.)	-0.005 (0.024)	2.061*** (0.701)	2.408** (0.816)	1.978*** (0.673)	4.807** (2.461)	1.947*** (0.156)
Sobel test		0.000 (0.305)		0.000 (0.227)		0.029 (0.249)
R2	0.931	0.942	0.907	0.918	0.958	0.963
observed value	630	630	630	630	630	630

6. Conclusions and Insights from the Study

This paper draws the following conclusions: Firstly, whether at the overall level or at the sub-regional level, industrial clusters have a significant positive impact on the quality of foreign trade development, indicating that the higher the degree of industrial clustering is more conducive to the high-quality development of China's foreign trade. Secondly, from the sub-regional level, the effect of industrial clusters on the quality of foreign trade development in the eastern region is larger than that in the central and western regions, indicating that strengthening the construction of industrial clusters in the eastern region has a more obvious effect on improving the quality of foreign trade development. Thirdly, the promotion of industrial clusters on the quality of trade development mainly works through three channels: transaction cost mechanism, transaction efficiency mechanism and knowledge spillover mechanism.

Based on the above conclusions, the following policy recommendations are put forward: (1) Focus on innovation, accelerate product upgrading and improve product value-added, especially after the implementation of the new trade protection, the impact of technological innovation on the quality of foreign trade development has increased significantly, and efforts to improve the level of technological innovation has become an important element in promoting the high-quality development of China's foreign trade. (2) Put human capital in the leading position, strengthen human capital investment, and build up a good human resources system. (3) Appropriate infrastructure construction can not only effectively promote the development of regional economic activities and facilitate the flow of trade, but also promote the specialisation of the division of labour, improve the efficiency of the allocation of factors of production, and thus promote the high-quality development of foreign trade.

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