

The Influence Research of Sino-US Trade Friction on the Development Pattern of Shandong Manufacturing Industry Based on the Improved Trade Gravity Model

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Abstract: Under the current background of globalization, a series of measures taken by the United States against China are bound to have a certain negative impact on domestic trade-sensitive industries and the transformation of old and new drivers of manufacturing industry in Shandong Province. We use the second industry in Shandong province from 2008 to 2019, U.S. gross domestic product, GDP in Shandong province exports to the United States trade, RMB exchange rate against the dollar, such as data, with the introduction of TBT notification number (trade friction variable T), multiple linear regression, in Shandong province under the background of building trade friction improved manufacturing kinetic energy conversion between the old and the new trade gravity model, Based on this model, the influence of trade friction on the transformation of old and new driving forces in the garment, mechanical and electrical export manufacturing industries in Shandong Province in the next 10 years (2021-2030) is predicted and analyzed. The predicted development trend is in line with the statistical law. The results show that the Sino-US trade friction has a serious impact on the transformation of the old and new kinetic energy, increases the production cost and reduces the scale of foreign investment in the manufacturing industry in Shandong province. Finally, from four aspects of improving the ecological chain of export manufacturing industry, vigorously developing the green environmental protection industry, establishing and perfecting the trade early warning mechanism, and rationally utilizing WTO rules, the measures and suggestions for

Shandong's manufacturing industry to deal with the Sino-US trade frictions are put forward.

Keywords: Sino-US Trade Friction; Shandong Province; Replacing Old Growth Drivers with New Ones in Manufacturing; Improved Trade Gravity Mode

1. Introduction

The US government has gradually intensified trade frictions with China since Trump came to power, and vigorously advocated the return of US manufacturing.

The United States has repeatedly engaged in trade confrontations with China on the grounds of Section 337, Section 301, and 227 investigations. The United States has become increasingly tough on China in terms of trade. The change in the United States' attitude toward China is essentially to curb the upgrading of China's manufacturing industry and the rise of the value chain, and to consolidate the United States' long-term leadership position in the field of technological innovation. In the context of the current globalization, the US's series of measures against China are bound to have a certain negative impact on the domestic trade-sensitive industries and the conversion of the old and new kinetic energy of the manufacturing industry in Shandong Province. At present, Chinese manufacturing mainly participates in the global industrial division of labor based on import and foreign investment implantation. The manufacturing industry is obviously "exogenous" and dependent, and is easily impacted by the trade friction between China and the United States, resulting in changes in the manufacturing pattern.

Shandong province is based on the manufacturing industry, which occupies an important position. Affected by the sino-US trade friction, Shandong's manufacturing industry cannot be immune, and the conversion of old and new drivers of manufacturing industry will be affected to some extent.

2. Literature Review

2.1 Research on the Impact of Trade Frictions on Manufacturing

Li Feng et al. [1] found through the statistical calculation of the WIOD database that Chinese manufacturing relies heavily on external manufacturing industries. In recent years, the US government has created large-scale trade frictions in an attempt to disrupt the upstream supply chain of Chinese manufacturing. Zhang Manan [2] believes that China's manufacturing is more subordinate to the global value chain, and the US tariff sanctions will disrupt the order of the global value chain, industrial chain, and supply chain, and increase the risk of "chain disconnection." Wang Xia [3] analyzed the heterogeneous impact of Sino-US trade friction on the trade and production of related industries in the global manufacturing industry, and found that the implementation of trade friction and RCEP may provide benefits for the development of related manufacturing industries in Japan, India, Australia and other countries. Historic opportunity.

Fan Haichao and Zhang Lina [4] used the 2014 cross-sectional data of 18 manufacturing industries in China and the United States to estimate the heterogeneity of the tariff welfare effects of intermediate and final products under different conditions of trade friction. Bouet et al. [5] constructed a multi-country and multi-sector general equilibrium model to simulate effects and found that trade friction did not improve the overall welfare of the United States. Dixon [6] used the GTAP model to simulate the impact of the U.S.'s increase of China's import tariffs to 45% on the economies of various countries, and found that the GDP of China and the U.S. declined, and Australia was less affected. Zhou Zhengning et al. [7] applied the dynamic GTAP model to analyze the impact of trade frictions on the macroeconomics and various sectors of China and the United States, and found that China

suffered a greater negative impact.

2.2 Research on Countermeasures to the Impact of Trade Frictions

Craighead et al. [8] analyzed the determinants of the resilience of the manufacturing supply chain, and proposed the relationship model and coping strategies of the resilience of the manufacturing supply chain. Yu Tieliu et al. [9] believe that the essence of Sino-US trade friction has shifted from traditional trade in goods to the field of intellectual property rights, and export restrictions and foreign direct investment can be adopted to cope with it. Liu Bin et al. [10] proposed to deepen reforms, make full use of the domestic market, deepen neighboring economic and trade cooperation, expand regional cooperation in the "Belt and Road" region, and maintain the dialogue and cooperation mechanism between China and the United States. Zhang Xiaoyu et al. [11] proposed that in order to effectively buffer the infringement of trade frictions, China needs to rapidly increase its endogenous growth momentum and promote the transformation and upgrading of foreign trade. Xia Yinlei [12] reviews the development and follow-up of the US-Japan trade war, and provides lessons for China to deal with the trade war. Wang Houshuang et al., Xu Mei, Tian Zheng et al. summarized Japan's response measures and lessons learned in the process of handling Japan-US trade frictions. Lv Cong et al. took Shandong Province as the research object, and investigated the countermeasures of foreign trade companies in the eight major industries in Shandong Province under the environment of trade frictions. The survey found that the differences between different industries make them respond to trade frictions. The characteristics shown are also different. Zhang Zhiyuan and Li Weibang analyzed the impact and enlightenment of the Sino-US trade friction on the conversion of old and new kinetic energy in Shandong Province. Xu Yanling conducted a research and analysis on the impact of Heilongjiang manufacturing foreign trade enterprises in the Sino-US trade friction.

This article refers to the above documents and improves the traditional trade gravity model by introducing new variables such as the number of TBT notifications, the total production

value of the secondary industry in Shandong Province, the total exports of Shandong Province to the United States, and the exchange rate of RMB against the US dollar. The single-factor screening eliminates irrelevant variables. After the factors, an improved multiple linear regression trade gravity model was constructed, which analyzed and predicted the impact of trade friction on the conversion of the old and new kinetic energy of Shandong's manufacturing industry from 2021 to 2030, and put forward measures and suggestions to deal with the friction.

3. Improved Trade Gravity Model

In this paper, the gross domestic product of the secondary industry in Shandong Province, the exchange rate of RMB against US dollar in a certain period, and the variable of Sino-US trade barrier T (TBT number of reporting) are introduced into the traditional trade gravity model, and the distance constant is removed to get the improved trade gravity model for the conversion of old and new drivers of manufacturing industry in Shandong Province:

$$\ln M = \alpha_0 + \alpha_1 \ln Y + \alpha_2 \ln I + \alpha_3 \ln T + \alpha_4 \ln EX + \varepsilon \quad (1)$$

The types, symbols and data sources of each variable in Formula (1) are shown in the Table1.

Table 1. Model Variable Explanation

Variable type	Variable name	Variable symbol	variable data source
Explained variable	Total trade exports of Shandong province to the United States	M	Shandong Provincial Bureau of Statistics
Traditional gravity model variables	Us GROSS domestic product	Y	The world bank
	Gross product of secondary industry in Shandong Province	I	Shandong Provincial Bureau of Statistics
Trade friction variable	Technical Barriers to Trade Agreement between China and the United States	T	Technical barriers to trade issued by China'S WTO/TBT-SPS notification and consultation network shall be adopted instead
Control variables	The exchange rate of RMB to US dollar	EX	China National Bureau of Statistics

It can be seen from the improved trade gravity model that the higher the GDP of the secondary industry in Shandong province is, the higher the production capacity of the manufacturing enterprises in Shandong province is, and the greater the competitiveness of the products manufactured in Shandong province when exported to the United States is, which has a positive impact on the trade between Shandong province and the United States. If the value of GDP Y of the United States is higher, it indicates that the domestic purchasing power of the United States is higher, and the demand for imported goods is greater, which also has a positive impact on the export of products manufactured in Shandong province to the United States.

In this paper, the trade friction variable T between Shandong province and the United States is proposed to adopt the World Trade Organization/Technical Barriers to Trade (WTO/TBT) agreement, which is mainly the WTO member countries to establish trade barriers to protect their own trade. To some

extent, the number of agreements reflects the intensity of trade friction between China and the United States over the period. It is generally believed that this variable will hinder the trade between the two sides and is negatively correlated with the trade volume between Shandong province and the United States.

Currency fluctuations also have an important impact on bilateral trade. Generally speaking, the RMB exchange rate against the dollar once rise, in order to maintain the original price is the bottom line will make the dollar under the system of Shandong province of the manufacturing for export commodity price increase, this will weaken the manufacturing products in Shandong province, especially the price competitiveness of labor-intensive products, so the yuan's exchange rate against the dollar EX and negatively correlated with total exports to the United States trade in Shandong province.

4. Numerical Example

4.1 Univariate Screening

Correlation analysis was conducted for each independent variable and the dependent variable respectively to eliminate the confounding factors in the regression model. Then select the second industry in Shandong province from 2008 to 2019, U.S. gross domestic product, GDP in Shandong province exports to the United States trade and TBT notification for trade friction variables (T) and

the RMB exchange rate against the dollar and other data, using modified to improve the trade gravity model, trade friction with the manufacturing industry in Shandong province the influence of the old and the new kinetic energy conversion for regression analysis. SPSS Statistics software was used to test the correlation between each variable and Shandong province's total trade export to the United States M, as shown in Table 2.

Table 2. Correlation Test Results

Variables for correlation test with M	Pearson correlation coefficient	Coefficient of significance (bilateral)	significance level
Y	0.959	0.000	The correlation was significant at 0.01 level (bilateral)
I	0.951	0.000	The correlation was significant at 0.01 level (bilateral)
T	0.655	0.029	At the 0.05 level (bilateral) significant correlation
EX	-0.480	0.136	Weak correlation

It can be seen from Table 2 that, in the correlation test, Pearson coefficient showed that all variables except EX were correlated with the total export volume of Shandong Province to the United States. Therefore, the value of EX is removed from the model, and the modified and improved trade gravity

model is shown in Equation (2).

$$\ln M = \alpha_0 + \alpha_1 \ln Y + \alpha_2 \ln I + \alpha_3 \ln T + \varepsilon \quad (2)$$

4.2 Regression Analysis

We used Equation (2) and SPSS Statistics to conduct multiple linear regression analysis, and the results are shown in Table 3.

Table 3. Results of Multiple Linear Regression Analysis

variable	B	t-statistic	Sig.	VIF multicollinearity is low
(constant)	-11.671	-5.494	0.001	
lnY	1.153	4.744	0.002	5.377
lnT	-0.113	-1.808	0.114	2.200
lnI	0.455	4.021	0.005	4.855
Adjust the R square	0.968			
Durbin-Watson	2.305			
F-statistic	101.211			
Prob(F-statistic)	0.000			

As can be seen from Table 3, the adjusted R square is 0.968, indicating that variables Y, I and T can describe variable M to a large extent, and the model has a high degree of fitting. Durbin-watson value was 2.305, which was close to "2", indicating that each variable was independent of the residual. This result was consistent with the hypothesis of multiple linear regression. The value of f-statistic is 101.211, and that of Prob (f-statistic) is 0.00, indicating that there is a linear regression relationship between variables Y, I, T and M, completely rejecting the null hypothesis. Except for variable T, variables Y and I have passed the significance level test of 1%,

showing high statistical significance. In addition, the coefficient signs of all independent variables are consistent with the expected hypothesis, and the model can be accepted.

Finally, according to the results of regression analysis, the final expression form of the improved trade gravity model is shown in Equation (3).

$$\ln M = -11.671 + 1.153 \ln Y + 0.455 \ln I - 0.113 \ln T + \varepsilon \quad (3)$$

4.3 The Empirical Results

The analysis results in Table 3 show that the coefficient value of lnY is 1.153, the symbol is consistent with the expected hypothesis, and it

passes the significance level test under 1%, indicating that THE GDP of The United States can significantly promote the export trade growth of Shandong Province.

The coefficient of $\ln I$ is 0.455, the result is consistent with the expected hypothesis, and it passes the significance level test of 1%, indicating that the total output value of secondary industry in Shandong province will significantly promote the total export trade of Shandong province to the United States.

The calculated coefficient of $\ln T$ was -0.113, and the coefficient sign was consistent with the expectation. It did not pass the significance test of 10%, but the numerical deviation was small, which may be related to the small number of analysis years and small sample size. The sig. Value of this variable is 0.114, with a small deviation. Based on empirical theoretical analysis, sino-US trade friction will have a certain negative impact on Shandong province's export trade to the United States.

According to the trade data, China's exports to the US market are mainly machinery and equipment (divided into categories such as home appliances and electronic products), as well as miscellaneous goods, clothing and textile products and metal products. The main export products of Shandong to the US market are concentrated in electromechanical, textile and clothing products. As a result, the improved trade gravity model (3), key prediction in Shandong province from 2021 to 2030 in the United States the main export

products (mechanical and electrical products and textile products) of output value and the change trend of exports, in order to analyze the future sino-us trade friction may be main manufacturing in Shandong province, the influence degree of the old and the new kinetic energy conversion.

4.3.1 Influence analysis of garment textile industry

Shandong province is a big province of textile industry. According to the statistical data in Figure 1, the output value of Shandong province's garment and textile industry increased from \$84.139 billion in 2008 to \$165.289 billion in 2017, with an increase of more than \$80 billion. The total export of garments and textiles also increased from 15.55 billion US dollars in 2008 to 231.2 US dollars, up by nearly 6 billion US dollars, or 37.1%. According to the forecast data in Figure 2, the output of apparel and textiles in Shandong Province will increase from us \$179.687 billion in 2021 to US \$285.079 billion in 2030, with an increase of nearly US \$110 billion. Exports, however, increased from \$20.94 billion in 2021 to \$23.89 billion in 2030, an increase of only \$2.95 billion, or 14.08%. It can be seen that in the next ten years, sino-US trade friction will greatly affect the export of clothing and textile products in Shandong Province, and the forecast development trend conforms to the statistical law.

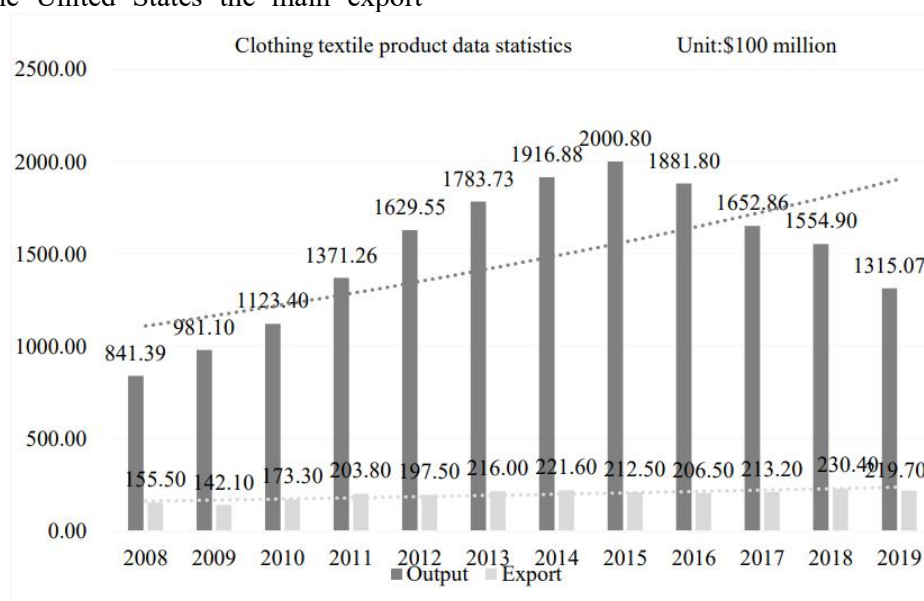
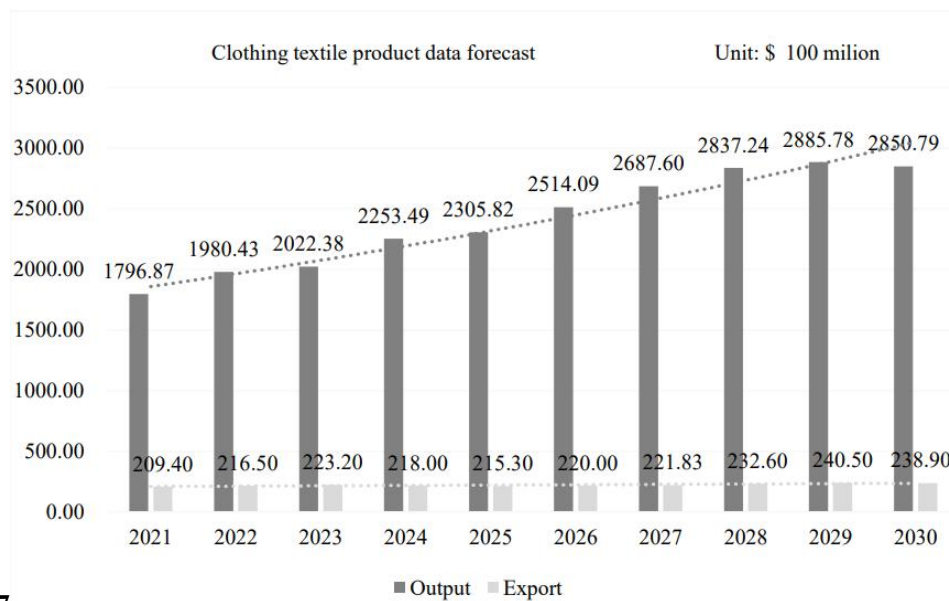


Figure 1. Output and Export Data of Apparel and Textile Products from 2008 to



2017

Figure 2. Forecast Value of Output and Export Data of Apparel and Textile Products from 2021 to 2030

4.3.2 Electromechanical industry impact analysis

According to the statistical data in Figure 3, the output value of mechanical and electrical products in Shandong Province increased from \$168.467 billion to \$351.389 billion during the decade from 2008 to 2017, with an increase of more than \$180 billion. The export value of mechanical and electrical products increased from 38.43 billion US dollars to 57.24 billion US dollars, up by more than 18.8 billion US dollars, or 48.95%. According to the forecast data in Figure 4, from 2021 to 2030, the output value of mechanical and electrical products in

Shandong Province will increase by nearly \$158.9 billion from \$368.429 billion to \$527.325 billion; Exports rose by 8.9% to \$63.58 billion from \$58.36 billion. As can be seen from the above data, the large scale of the domestic market makes the Chinese market have a good risk resistance capability. Sino-us trade friction has a relatively small impact on the domestic market demand of products manufactured in Shandong Province, while the impact on the export of products is relatively large. The forecast development trend conforms to the statistical law.

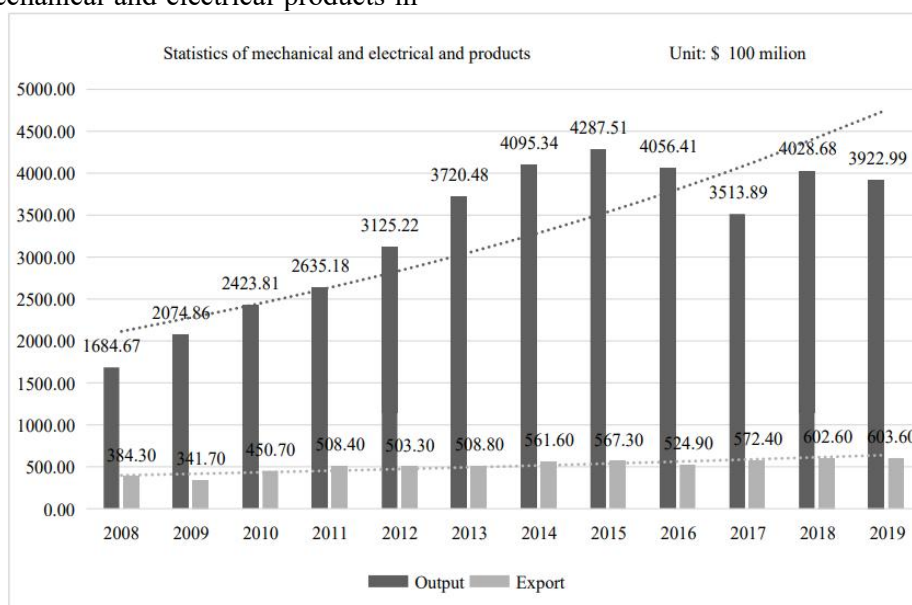


Figure 3. Output and Export Data of Mechanical and Electrical Products from 2008 to 2017

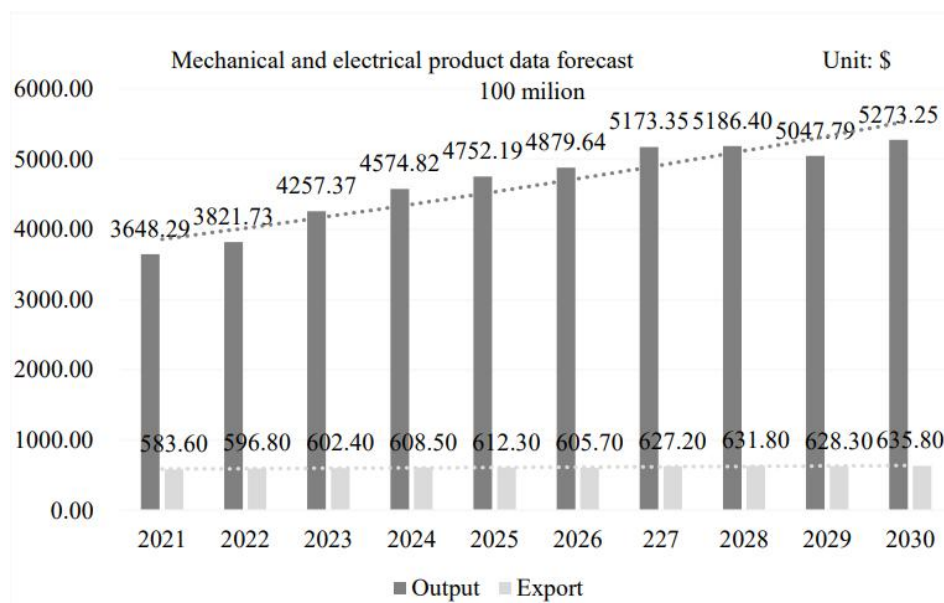


Figure 4. Output and Export Data Forecast of Mechanical and Electrical Products from 2021 to 2030

5. Conclusions and Suggestions

5.1 Conclusion

5.1.1 The trade friction between China and the United States has seriously affected the conversion of old and new drivers of manufacturing in Shandong Province.

Shandong province is in the key period of the “great adjustment” of the old and new driving forces, which shows that even without considering the impact of sino-US trade friction, the overall economic development of Shandong province is also facing a downward crisis. However, it can be seen from Figure 2 and Figure 4 that in the next 10 years, sino-US trade friction will seriously affect the export of Shandong products, exacerbate the downside risk and weaken the industrial upgrading capacity. Therefore, Shandong province should formulate effective policies and measures in time to restrain the negative effects of trade friction, accelerate the expansion of new kinetic energy, but also accelerate the efficiency and ability of promoting the conversion of old kinetic energy.

5.1.2 The trade friction between China and the United States increases the production cost of manufacturing industry in Shandong Province. Labor-intensive industries are traditionally advantageous industries in Shandong Province. Hong Junjie and Yang Zhihao (2019) put forward that since sino-US trade friction, the

annual average growth rate of China’s labor cost per unit output has risen to 3.8%, which makes The advantage of China’s labor cost in international trade smaller. The trade friction between China and the United States also increases the cost of raw materials imported by Shandong’s manufacturing industry. Related enterprises are more difficult to import raw materials from the United States, so they are forced to import raw materials from other countries, which increases the difficulty and cost of import at the same time, and then increases the production cost of related manufacturing enterprises.

5.1.3 Sino-us trade friction reduces the scale of foreign investment in Shandong manufacturing industry.

Since sino-US trade friction intensified, the actual use of foreign capital in Shandong province’s manufacturing industry has generally declined. Take 2018 as an example, the actual use of foreign capital in Shandong province’s manufacturing industry was 9.166 billion US dollars, down 3.6% compared with 2017, and the decline in high-tech manufacturing industry was more obvious. Shandong province is in the key link of the policy implementation of the conversion of old and new driving forces. The introduction of external funds is of great significance for the conversion of old and new driving forces and the development of Shandong real economy.

5.2 Recommendations

5.2.1 Improve the ecological chain of export manufacturing industries.

1) Improve the quality of mechanical and electrical products.

The development advantage of mechanical and electrical products in Shandong province largely depends on the low labor cost in Shandong province. In the future, related mechanical and electrical enterprises should focus on improving technological means and accelerating technological innovation, so as to enhance the quality and competitiveness of manufactured products, so as to reduce the negative impact of mechanical and electrical manufacturing industry in the trade friction. The development advantage of mechanical and electrical products in Shandong province largely depends on the low labor cost in Shandong province. In the future, related mechanical and electrical enterprises should focus on improving technological means and accelerating technological innovation, so as to enhance the quality and competitiveness of manufactured products, so as to reduce the negative impact of mechanical and electrical manufacturing industry in the trade friction.

2) Promoting innovation in the garment and textile industry.

Shandong province's garment manufacturing industry has always occupied a large number of market shares with the advantage of high quality and low price, but only relying on the garment quality and price advantage can not completely win in the fierce international market competition. Shandong province garment manufacturing industry must invest more funds in manufacturing technology innovation and style design innovation, hire and train high-quality and professional technical personnel, learn advanced enterprise management system, improve the overall level of Shandong province garment manufacturing industry.

3) Expand the trade advantage of chemical manufacturing products.

Chemical manufacturing industry is also an advantageous industry in Shandong province. Shandong province is rich in oil resources and has many large-scale chemical companies. Among the top 100 enterprises in Shandong in 2019, 35 chemical enterprises entered the list, among which 22 were petrochemical

enterprises, accounting for a large proportion. Shandong province should give full play to the advantages of rich resources, increase the output of chemical products, improve the level of chemical industry manufacturing technology, and expand the export scale and influence of related products.

5.2.2 Vigorously develop green and environmental protection industries.

Heavy and chemical industry accounts for a significant proportion in the industrial structure of Shandong province, which makes Shandong province face great pressure in environmental protection and energy consumption while developing economy, and has a great dependence on resources. Technical barriers to trade (TBT) is the main form of trade friction in Today's China, which sets up extremely high technical barriers to environmental protection indicators. Therefore, the development of green environmental protection enterprises is the top priority. At present, Shandong province green environmental protection enterprises still have a great space for development, and there is still a big gap with the world's advanced level. Therefore, Shandong province should make reasonable planning, vigorously support the development of green environmental protection enterprises, establish a sound and complete green enterprise investment mechanism, and promote Shandong green environmental protection enterprises to integrate with international advanced enterprises.

5.2.3 Establish a sound trade early warning mechanism.

In the complex international trade situation, the establishment and improvement of trade early warning mechanism, in-depth understanding of international trade laws and regulations and standards are the first prerequisite for enterprises to participate in foreign trade. This requires improving the coordination mechanism between government departments and enterprises to quickly notify and respond to trade frictions. At present, China's Ministry of Commerce has been preliminarily established national trade early warning mechanism, the Shandong province economic and trade management departments can according to the early warning mechanism, establishing multi-grade warning network monitoring exports situation of Shandong

province, involved in sino-us trade products focus on monitoring, to determine the key warning products and develop coping strategies, reduce the influence of trade friction, Reduce the depth of impact of trade friction.

5.2.4 Make rational use of WTO rules

Use appropriate trade strategies to strengthen cooperation with foreign investors in the United States. Fully communicate with us importers involved in bilateral trade, carefully process orders, and reasonably determine the standard and time of levying commodity taxes. When conducting bilateral trade, trade agreements made by the WORLD Trade Organization are often ignored. Enterprises in Shandong province can make reasonable use of relevant agreements when trading with the United States, and protect their economic benefits and enhance their ability to avoid trade friction through negotiation or filing complaints to relevant institutions.

Acknowledgments

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