The Impact of International Trade Impact on the Industrial Structure —— Based on the Empirical Analysis of Jiangsu Province

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Abstract— Industrial structure is the organic and reasonable composition of each industrial sector in the process of national economy operation. This link includes the connection between various sectors in accordance with the industrial structure, supply and demand, and the rate of economic growth. The industrial structure is in the process of constant adjustment, which enables it to better adapt to the changes of resource endowment, population, economic level and other conditions. This paper calculates and analyzes the advanced degree, rationality and concentration degree of industrial structure of 13 cities in Jiangsu Province. The research results show that the regional distribution of industrial structure in each city in Jiangsu Province has certain similarities, which is basically the first place in southern Jiangsu, and the central and northern Jiangsu are in the second and third place. Subsequently, the linear regression model was used as the benchmark model to study the impact of international trade impact on the industrial structure of various prefecture-level cities in Jiangsu Province, and to analyze the correlation between the industrial structure and the total amount of import and export trade. Empirical research finds that international trade does not have a significant impact on the advanced degree of industrial structure and the concentration degree of industrial structure, but it has a positive promotion effect on the rationalization of industrial structure. Finally, relevant policy suggestions are put forward to promote the upgrading of industrial structure and the development of international trade in Jiangsu Province.

Keywords— Industrial structure; international trade; and coordinated development.

I. INTRODUCTION

Under the condition of open economy, the industrial structure of a country or region is closely related to the world economic activities in which it participates. The industrial structure of all countries in the world will form a large global "community" industrial structure, and this "community" industrial structure will promote the economic development of its member states.

In the early days of the founding of the People's Republic of China, China's economic development level was relatively backward, the industrial structure was dominated by agriculture, the industrial foundation was relatively weak, and the overall industry was in the primary stage. After the reform and opening up, China began to develop industry rapidly, and constantly improve and upgrade the industrial structure, so that it tends to reasonable development. Since the beginning of the 21st century, China has successfully joined the World Trade Organization and actively participated in various world trade activities. While continuously enhancing its economic strength, its industrial structure has also been continuously optimized, and China has successfully transformed from a major agricultural power to an industrial and economic power. The report to the 19th National Congress of the Communist Party of China pointed out that "China's economy has shifted from a stage of high-speed growth to a stage of high-quality development, and is in a critical period of transforming the development model, optimizing the economic structure, and transforming the drivers of growth."Promoting the transformation and upgrading of the industrial structure and optimizing the industrial structure are important issues to promote the sustained growth of China's economy. Since joining the WTO, China's import and export trade has been expanding. China's total import and export volume increased

from 2,413.386 billion yuan in 1996 to 3,15446 billion yuan in 2019. At the same time, China's economy has a high degree of foreign trade dependence. In 1996, the foreign trade dependence was 33.61%, but in 2006, China's foreign trade dependence reached a peak of 64.24%. Although the foreign trade dependence has decreased in recent years, it is still not less than 30%. In such a high dependence on foreign trade, it is crucial to prevent the negative impact of international trade shocks.

Therefore, this paper takes Jiangsu Province as an example, studies the impact of international trade impact on industrial structure, and puts forward policy suggestions according to the empirical results, so as to ensure the steady development of China's economy.

With the increasingly rapid development of Chinese economy, environmental pollution has become a hot topic of social concern. Apart from that, the severity of global environmental problems has also aroused international keen attention, both the United Nations Framework Convention on Climate Change and the Kyoto Protocol have made the discussion on environmental issues into a white heat. Facing the deep water area of China's reform and the plateau stage of development, it is imperative for China to adjust its industrial structure in order to accomplish the important task of energy conservation and emission reduction perfectly.

Many researchers and scholars believe that a reasonable industrial structure can contribute to low-carbon economic development. Wang et al. (2014) found in their study that the increase in the proportion of industrial output value will inhibit the improvement of green technical efficiency, but the increase in the proportion of high-end output value in the secondary industry can promote the improvement of green technical efficiency. Ma et al. (2010) believe that there is an inevitable

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connection between the optimization and upgrading of industrial structure and the progress of technological structure. At the same time, industrial structure will have a significant impact on carbon emissions. Guo et al. (2021) pointed out that there is a positive spatial correlation concerning the upgrading speed of China's industrial structure. Deng et al. (2018) verified the relationship between industrial structure upgrading and carbon emissions and they found that it was helpful to reduce carbon emissions. Yang (2009) calculated China's carbon efficiency from 2000 to 2006, and the results show significant differences in each province. By changing the traditional economic development mode and adjusting the industrial structure, carbon emission efficiency can be significantly improved, thus it can fundamentally improve ecological efficiency. Song et al. (2010) conducted a regression analysis on China's carbon emissions and its influencing factors by using the geographically weighted regression technology, and found that the proportion of output value of the secondary and tertiary industries was positively correlated with carbon emissions. Li et al. (2021) used empirical analysis to show that both scientific and technological innovation and industrial structure upgrading can significantly promote regional economic development, and industrial structure upgrading plays an intermediary role in the process of scientific and technological innovation. In order to effectively reduce carbon emissions, it is necessary to change the traditional extensive economic development mode and promote the evolution of industrial structure to a more reasonable direction. Scholars use various methods to analyze the impact of industrial restructuring on carbon emissions. Yang et el. (2018) used the static panel model to prove that the decline of the output value of the secondary industry is conducive to reducing carbon emissions. Li & Zhou (2012) analyzed carbon emission intensity from the perspective of industrial structure by using grey correlation analysis method, and believed that secondary industry had the greatest impact on regional carbon emission intensity, while primary industry had the least impact, while tertiary industry had no obvious impact on regional carbon emission intensity, which should be paid attention to.

The previous scholars have done a lot of research on industrial structure and achieved fruitful results. But the existing research mainly describes the industrial structure by the proportion of the output value of the secondary and tertiary industries in the total output value. Essentially, the evolution of industrial structure also includes the rationalization and concentration of the industry. Therefore, this paper will measure the evolution of industrial structure from the advanced degree, reasonable degree and concentration degree of industrial structure, and employ the cluster analysis of the industrial structure of 13 prefecture-level cities in Jiangsu province to provide relevant policy implications, which also provides theoretical support for the study of related issues in China.

Compared with other provinces, Jiangsu province has high energetic consumption but low energy output, therefore, relevant conclusions of other regions in recent researches are not completely applicable to Jiangsu province, which means that it's of necessity to adjust measures to adapt local conditions

and formulate suitable plan to optimizing the industrial structure in Jiangsu province. Due to the development differences among countries, the impact of industrial structure adjustment on carbon emissions is also different, but they all follow the same rule that carbon emissions will improve with the upgrading of industrial structure. Therefore, it is particularly important to select reasonable leading industries and accelerate industrial structure adjustment for the development of low-carbon economy. This paper takes Jiangsu province as an example to explore the spatial and temporal characteristics of industrial structure. Besides, it also establishes a typical case for other related researches, and possesses reference significance for cluster analysis of industrial structure in other regions. Furthermore, the author hopes that Jiangsu can accelerate the optimization of industrial structure and remain the economic development sustainable and stable through temporary economic adjustment to achieve a significant reduction of carbon emissions and protect the ecological environment.

II.   LITERATURE REVIEW

There are many factors affecting the upgrading of industrial structure, and its influence mechanism on the industrial structure will be different in different stages. There are many studies at home and abroad on the impact of international trade on the industrial structure, mainly focusing on the following aspects:

Many scholars at home and abroad believe that foreign trade is an important factor to promote the upgrading of industrial structure: Fujita and James (1989) using South Korea from 1973-1983 data studied the relationship between the export and the heavy industry, research found that export expansion and import substitution for the growth of some industry and manufacturing has a significant effect, and the expansion of domestic demand will promote the development of primary industry, processing industry, stimulate the output of these industries. Chenery et al. (1989) studied the relationship between urban policy, economic development and industrial structure, and divided the industrialization strategy into three modes. They believed that the national economic structure of export-oriented strategy changes rapidly, the correlation between domestic and foreign industries is relatively high, and the manufacturing industry has a relatively large role in promoting economic growth. Yang Quanfa (1998) used the export expansion production model to study the impact of China's export trade on economic growth. The linear regression results show that: (1) China's expanded import and export trade has a significant promotion effect on the primary industry; (2) the promotion effect of import expansion is more significant than the export expansion, among which the import of industrial finished products is the most significant; (3) in the tertiary industry, the import and export of service trade, the export of bulk raw materials and the import of unclassified goods. Gao Yue (2003) utilized China's GDP, first, second and third industrial output value, export value and import value from 1952-2001, And using the revised monotone analysis and coordinated inspection analysis method to study the impact of China's import and export on GDP and the three industries, The results show that: in the long-term, Export significantly

promotes the growth of GDP, the development of the secondary and tertiary industries, There is no long-term stable relationship with the primary industry; in short order, Export has a certain degree of promoting effect on the development of the secondary industry, Imports have no significant impact on the secondary industry, Both import and export expansion have a significant boost to the tertiary industry, But the impact on the primary industry is not significant. Ma Zhangliang, Gu Guoli (2011) from two aspects of theory and model analysis of the relationship between China's foreign trade and industrial structure, using during the 1980-2009 primary products imports and exports, industrial goods, imports and exports, three GDP, three industry growth, and three industry in the proportion of GDP of regression analysis, and adopts the generalized difference method model residual remain independent, eliminate the sequence autocorrelated problems, regression results show: import and export trade for three industry has a significant relationship, think there is a smooth transmission mechanism between the two. Cai Haiya (2017) using 2003-2014 provincial panel data, using the intermediary effect test method, the open trade theory of industrial structure upgrading mechanism mainly from consumer demand, system change, technological progress, capital accumulation and environmental burden, from the perspective of industry, industry to build multidimensional industrial structure upgrading index inspection trade open on the influence of industrial structure upgrading. The research and analysis found that trade opening can indeed promote the upgrading of industrial structure, and contribute to the optimization and upgrading of the industry, and this promotion effect is different between different regions. Developed countries in Europe and the United States promote the upgrading of 13 industrial structure more than the developed countries in East Asia

III. ANALYSIS OF INDUSTRIAL STRUCTURE IN JIANGSU PROVINCE

Industrial structure is the organic and reasonable composition of various industrial sectors in the process of national economy operation. This connection includes the connection established between various sectors according to the industrial structure of input and output, supply and demand relations and economic growth rate. The industrial structure is in a process of constant adjustment, which makes it better adapt to the changes of resource endowment, population, economic level.

A. Research methods

In order to describe the optimization and upgrading process of regional industrial structure more specifically, the decomposition of industrial structure is described as optimization, rationalization and concentration.

(a) Optimization of industrial structure

The optimization of industrial structure was first proposed by Japanese scholars. In the early stage of production, it means that the use of new technologies and processes can positively promote production efficiency and increase the added value of products and services in the short term. In other words,

upgrading technological level can promote the upgrading of industrial structure. The calculation method is as follows:

$$IH = \theta1 + \theta2 \qquad (1)$$
$$\theta1 = \pi - \mu2 - \mu3 \qquad (2)$$
$$\theta2 = \pi/2 - \sigma2 \qquad (3)$$

In the above formula, $\theta1$ is the substitution effect of the secondary and tertiary industries on the primary industry, and $\theta2$ is the substitution effect of tertiary industry on secondary industry. IH is the industrial upgrading index, and its value is directly proportional to the industrial structure upgrading level. $\mu2$ is the included angle between vector (x_1, x_2, x_3) and vector $(0, 1, 1)$, while $\mu3$ is the included angle between vector (x_1, x_2, x_3) and vector $(0, 0, 1)$. x_1, x_2, and x_3 are respectively the proportion of the output value of the first, second and third industries in the GDP of the same period respectively. $\sigma2$ is the angle between the vectors (x_2, x_3) and $(0,1)$. The calculation formula of the included angle between two dimensions and three dimensions is as follows:

$$\theta = \cos^{-1} \frac{\sum_{i=1}^{n}(x_i, x_{i,0})}{(\sum_{i=1}^{n} x_i^2)^{\frac{1}{2}}(\sum_{i=1}^{n} x_{i,0}^2)^{\frac{1}{2}}} , (n = 2,3) \qquad (4)$$

(b) Rationalization of industrial structure

The rationalization of industrial structure refers to the strengthening of coordination ability and improvement of correlation level between industries. It is a dynamic process. The rationalization of industrial structure should reflect not only the coordination degree of industrial structure, but also the coordination degree of factor input structure. The calculation method is as follows:

$$TL = \sum_{i=1}^{n} \left(\frac{Y_i}{Y}\right) \ln \left(\frac{Y_i}{L_i} \Big/ \frac{Y}{L}\right) \qquad (5)$$

In the above formula, Y, Y_i, L, and L_i are respectively the total added value, the added value of the three industries, the total number of employed persons and the number of employed persons of the three industries. It can be seen that when TL is 0, the economy is in equilibrium. The higher the TL value is, the more deviated the industrial structure is from the equilibrium state, and the more unreasonable the industrial structure is.

(c) Concentration of industrial structure

Industrial layout is usually based on the spatial allocation of resources. China has a vast territory, and the differences in resource endowment and economic and social development in different regions result in differences in industrial distribution in different regions. In the regional scope, the economic output gap between different industries is closely related to industrial concentration, and there is a positive correlation. Concentration index is an index that describes the degree of geographic data concentration. Similarly, industrial concentration index is an important quantitative index used to analyze and measure the degree of specialization of industry or economic sector in a certain region. The calculation formula is as follows:

$$I = (A - R)/(M - R) \qquad (6)$$

In the above formula, A is the cumulative percentage and actual data of the three industries. R is the cumulative percentage. M is the cumulative percentage. It is not difficult to speculate that the value of I is in the interval [0,1], and the larger the value of I is, the higher the degree of concentration of industrial structure is.

B. Analysis of research results

According to the data of the proportion of added value of the three industries in GDP of 13 prefecture-level cities in Jiangsu province from 2013 to 2018, the data of the number of employees in the three industries, and the level of optimization, rationalization and concentration of industrial structure, this paper employs Eq. (1) to (6) to calculate the corresponding values, and the results show in the following figures. Figure 1 to Fig.3 are corresponding to the data of optimization, rationalization and centralization of industrial structure in 13 prefecture-level cities in Jiangsu province respectively, and Fig.4 shows their mean values. (This paper uses the acronym of each city to represent the corresponding city, for example, NC stands for Nanjing.)
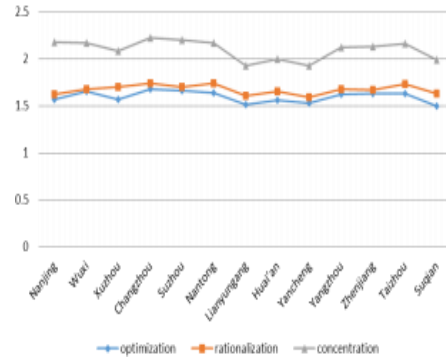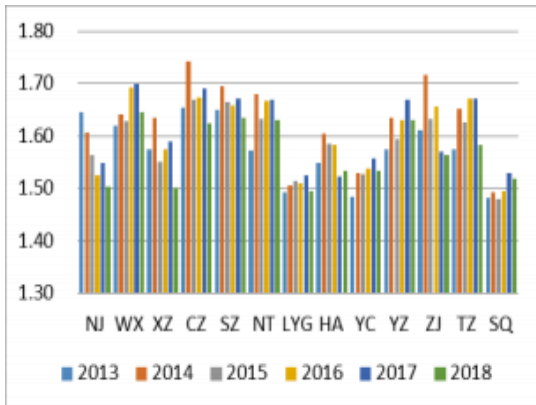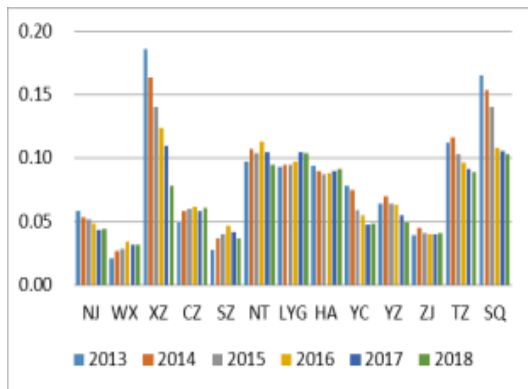

Fig. 1. Rationalization of industrial structure from 2013 to 2018

Fig. 2. Optimization of industrial structure from 2013 to 2018

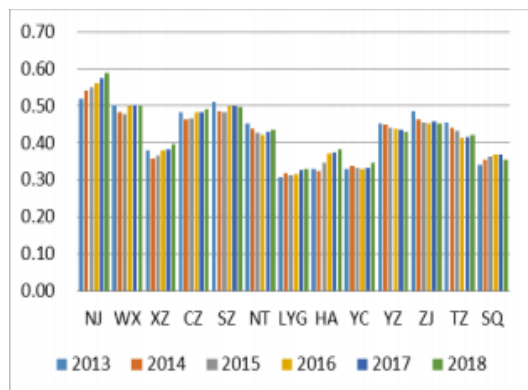Fig. 3. Concentration of industrial structure from 2013 to 2018

Fig. 4. Mean values of optimization, rationalization and concentration of industrial structure

The research results show that, (1) In terms of the optimization degree of industrial structure, the optimization index of Wuxi, Changzhou and Suzhou is above 1.65, belonging to the advanced and developed area of industrial structure. (2) In terms of the rationalization of industrial structure, the rationalization index of Wuxi, Suzhou and Zhenjiang are all below 0.05, which belong to the region with high rationalization of industrial structure. (3) In terms of concentration degree of industrial structure, the concentration index of Nanjing, Wuxi, Changzhou and Suzhou is above 0.47, belonging to the region with high concentration degree of industrial structure. (4) In terms of the mean values from 2013 to 2018, the level of industrial concentration in 13 prefecture-level cities in Jiangsu province is higher than that of optimization and rationalization.

Furthermore, from the perspective of the spatial distribution and development trend of the three dimensions of industrial structure, the spatial and temporal characteristics of the optimization, rationalization and concentration degree of industrial structure in Jiangsu province are relatively similar from 2013 to 2018, which indicates that there is a strong correlation among them.

In terms of the regional differences of industrial structure, the regional distribution of optimization, rationalization and concentration degree of industrial structure of all cities in Jiangsu province has a certain similarity, and basically the southern area of the province is superior to the central and northern areas of Jiangsu province. The reason of that is because the economic development, resource endowment, geographical location and the developed degree of surrounding areas in southern Jiangsu are better than those in central and southern Jiangsu. At the same time, there are differences in policy orientation in the process of economic development in different regions, resulting in the above spatial characteristics of industrial structure.

IV. CLUSTER ANALYSIS OF INDUSTRIAL STRUCTURE IN JIANGSU PROVINCE

According to the scores of the 13 prefecture-level cities in the province in three aspects obtained above, this paper further adopts cluster analysis to classify the industrial structure of the 13 prefecture-level cities in Jiangsu province. Cluster analysis is a statistical analysis method that divides research objects into relatively homogeneous groups according to their

characteristics in multiple aspects. It can reasonably classify a large number of samples without prior knowledge and change the types of research objects from variable to small ones. Therefore, systematic clustering method is selected to classify the industrial structure of 13 prefecture-level cities. In this paper, 13 prefecture-level cities in Jiangsu province are used for cluster analysis of the comprehensive scores in three aspects of industrial structure, and the pedigree diagram obtained is shown in Fig. 5.
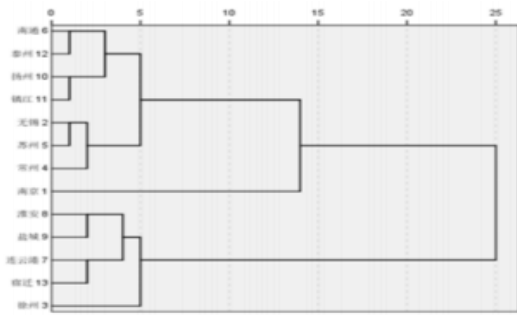

Fig. 5. Cluster analysis spectrum of industrial structure in Jiangsu province

According to the pedigree tree, the industrial structure of the 13 prefecture-level cities in Jiangsu province can be roughly divided into five categories: the first category is Nanjing, and the second one contains Wuxi, Suzhou and Changzhou, and the third one is Xuzhou, and the fourth one compromises Nantong, Taizhou, Yangzhou and Zhenjiang, and the fifth one includes Huai'an, Yancheng, Lianyungang and Suqian. In the first category, Nanjing has the highest level of industrial structure development and is in the leading position in the province. The second type is the prefecture-level city with excellent industrial structure. The industrial structure of the third type of prefecture-level city is good, but slightly lower than the development level of the first two types. The fourth category belongs to the general performance of industrial structure, and the overall performance of the advanced level of industrial structure is fair. The fifth category belongs to the prefecture-level city with mediocre industrial structure. As it shows in Fig. 1, the development level of industrial structure in Jiangsu province presents a pattern of high in the south and low in the north. The industrial structure of cities in the southern area of Jiangsu province is better than that in the central and northern area of Jiangsu, which indicates that there exists unbalanced development among different regions.

V. THE IMPACT OF THE INTERNATIONAL TRADE SHOCK ON THE INDUSTRIAL STRUCTURE

This paper uses the linear regression model as the benchmark model to study the impact of international trade impact on the industrial structure of various prefecture-level cities in Jiangsu Province, and analyzes the correlation between the industrial structure and the total amount of import and export trade. The basic measurement model is set up as follows:

$$structure_{i,t} = \beta_1 trade_{i,t} + control_{i,t} + \varepsilon_{i,t} \quad (7)$$

Structure represents the industrial structure advanced (IH), reasonable (TL) and concentration (I), and control represents the control variables. The regression results are shown in Table 1.

TABLE 1. Influence of international trade impact on industrial structure

	IH	TL	I
Trade	0.0513 (0.0664)	0.0581** (0.0278)	0.0220 (-0.0286)
Including the control variables	yes	yes	yes
Year fixed effect	yes	yes	yes
City fixed effect	yes	yes	yes
sample capacity	78	78	78
R²	0.3487	0.2663	0.1550

Note: The standard error of this coefficient is in parentheses, and *, * *, * * * means that the t-statistics are significant at the levels of 10%, 5% and 1%, respectively.

Can be seen from table 1, international trade is not on the industrial structure and industrial structure concentration has significant impact and influence, but the rationalization of industrial structure has a positive effect, this is due to the import and export trade products of Jiangsu province, and the industrial structure of the rise of the first and second industry GDP decline and the third industry GDP rise, but the characteristics of import and export trade in Jiangsu province and the industrial structure advanced properties, therefore, international trade did not significantly promote the improvement of industrial structure.

The rationalization of industrial structure refers to the strengthening of the coordination ability between the industry and the improvement of the correlation level, which is a dynamic process. The rationalization of industrial structure should not only reflect the coordination degree of industrial structure, but also reflect the coordination degree of factor input structure. In the import and export trade, Jiangsu province has gradually improved the coordination ability and correlation level between industries through demand driving and technology spillover of foreign enterprises, which is specifically shown that international trade has a positive role in promoting and promoting the industrial structure.

VI. CONCLUSION

This paper first summarizes the previous relevant research on industrial structure, and then expounds the relevant concepts which provide a theoretical basis for the further research to analyze the spatial and temporal characteristics of industrial structure in Jiangsu province. After that, the cluster analysis is made on the industrial structure of Jiangsu province, and the research results show that the coordination of internal development of Jiangsu province needs to be improved. Specifically, the economy development in southern area of Jiangsu is far ahead of northern area in Jiangsu, and it mainly depends on the contribution rate of the tertiary industry. North Jiangsu is in urgent need of catching up with south Jiangsu in the secondary and tertiary industries to achieve the balanced development of all regions of the province. The performance of optimization, rationalization and concentration degree of industrial structure is basically consistent with the economic development degree of each region, which means that the performance of southern Jiangsu is the best, followed by central Jiangsu and northern Jiangsu. The industrial structure of

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Jiangsu province still exist adjustable space at the same time, especially in terms of degree of optimization, rationalization and concentration of industrial structure. In accordance with the market mechanism Jiangsu province seize the chance to promote resources configuration, make the use of the resources to get maximum efficiency, and ensure the improvement of rationalization of industrial structure, while at the same time, fully releasing the industrial structure adjustment of structural dividends.

Need to change the structure of import and export trade. Urban areas shall expand their import and export trade according to their own advantages, try to import goods and services with high technology content, and export goods and services with high added value. Exporters and exporters are encouraged to choose more competitive countries as trading partners, and to formulate strategic industrial restructuring according to the local advantages of factor endowment and the import and export trade structure. When the international market changes, the government should take good measures to stabilize the market and stabilize the development of various industries;

We should continue to encourage the introduction of foreign capital, improve the introduction of foreign capital policies, especially relax the introduction of foreign capital in the tertiary industry, and encourage local enterprises in the financial industry, service industry, technology and other aspects of foreign capital introduction. While attracting foreign investment, all urban areas should give priority to projects with advanced technology and high production efficiency according to the actual situation of the development of local industries, so as to achieve the purpose of driving the local economic development and promoting the optimization of industrial structure.

the municipal government shall encourage enterprises to technology innovation, foster technology intensive manufacturing and emerging services, especially to support the local high-tech enterprises in the research and development and innovation, to strengthen the propaganda of knowledge industry, by improving the level of domestic technology to promote the development of the tertiary industry.

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