Empirical Study on the Impact of Trade Institutional Environment on Open Innovation Model of Manufacturing Industry

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Abstract—With the in-depth development of world trade, the relevant trade system is gradually improving, and the impact of the trade system environment on a country's manufacturing industry is growing. Based on the literature review, this paper analyses the impact of trade system environment on the open innovation model of manufacturing industry, carries out empirical research, and finally draws relevant conclusions. Through this study, we hope to provide reference for relevant departments to formulate trade policies.

Keywords—Trade System; Manufacturing Industry; Innovation

I. INTRODUCTION

The international community is more and more aware that whether a country's trade system environment is sound or not has an important and far-reaching impact on its open innovation mode of manufacturing industry and the development of manufacturing industry. Since 13th Five-Year, the Chinese economy has come to a new normal. General Secretary Xi Jinping stressed that the construction of "one belt and one road" should be combined with foreign trade development and regional economic development and opening up. When Professor Li Yining talked about the development of "one belt and one road" under the new normal, the key is institutional innovation. Therefore, under the background of "one belt and one road" strategy, this topic focuses on the influence and integration of country's trade system environment on the open innovation mode of manufacturing industry, and promotes the development of cross disciplinary knowledge such as world economics, new institutional economics, management engineering and environmental engineering. These theories are the cornerstone of this topic and play an important guiding role. At the top of the trade system and the formation of the open innovation mode of manufacturing industry, it promotes the development of country's real manufacturing economy.[1]

Making full use of the strategic opportunities brought by the "one belt and one way" initiative, enhancing the status of Chinese manufacturing in the global value chain will provide new market opportunities for country's solid manufacturing industry, such as machinery and equipment, power generation equipment and transportation equipment, and also conducive to the structural adjustment and investment transfer of country's manufacturing industry. Schumpeter, an American economist, put forward the theory of innovation in his book Economic Development Theory. The research of innovation theory is carried out in two ways: one is from the perspective of technology, the branch of innovation centered on technological change, the other is from the perspective of system, and the branch of institutional innovation centered on institutional change. Chesbrough put forward the concept of open innovation, explained the connotation, mode and mechanism of open independent innovation, and constructed an open independent innovation analysis framework to further enrich innovation research. Under the background of the "one belt and one way" strategy, through the reform and improvement of trade system and mechanism, it is the theoretical significance of our research in this field to create an open mode of creation in the field of solid manufacturing and provide theoretical support for our country to take the road of industrial power. In the future, how to seize the opportunities and deal with challenges calmly, and continue to push forward the strategy of "one belt and one road", and make greater progress, more consensus and gains, are a major issue that needs further study.

II. LITERATURE REVIEW

A. Review of the Research Status Abroad

There are many studies on trade system and manufacturing investment abroad. The impact of trade system on manufacturing industry and industrial economic performance is mainly reflected in two aspects. On the one hand, trade system innovation is also a kind of productivity; on the other hand, an effective trade system can reduce the transaction cost of technological progress and transformation of technological achievements in manufacturing industry, thus promoting the development of productivity. At present, there are two main methods for the quantitative analysis of institutional performance: one is case analysis, for example, when some major institutional changes are excluded from other factors, the performance of a certain institutional change or institutional innovation can be quantitatively analyzed, such as the performance analysis of manor system (North), shipping system (North), slavery system (Basel, Fogel).Second, model
analysis, such as the use of modern economic analysis model to analyze the economic performance of institutional variables. In the field of international industrial transfer theory, new economic geography mainly studies industrial transfer from the perspective of industrial location, industrial agglomeration and industrial diffusion. Pug and Venables (2015) believe that the interaction of market structure, transportation cost and industrial input-output structure of monopoly competition determines the agglomeration of all companies in a certain industry in a certain region. Klimenko (2016) believes that the high price of non-traded goods, rising land prices, environmental pollution and other congestion costs in the agglomeration area caused by industrial agglomeration to a certain extent will cause the centrifugal force of industrial diffusion [2]. Pug and Venables believe that the first industry transfer in industrial agglomeration area is determined by product input-output structure and industry forward-backward correlation degree. There is still much room for future industrial transfer theory.

There are also studies on the open innovation of manufacturing industry abroad. The theory of open innovation was not put forward in a hurry, but conformed to the progress of economic development and technology. It was put forward by the earliest famous economist Schumpeter in his book "Economic Theory" in the early period of "Analyzing economic problems from the point of view of evolutionism", and then put forward the theory of innovation as early as the 1930s. After the later scholars' research, it gradually evolved. Open innovation is the trend of technological innovation in the era of knowledge economy. Henry W. Chesbrough, professor of Harvard Business School, put forward the concept of "open innovation" in May 2003. According to Mildred A. Hastbacka (2012), the practice mode of open innovation includes four parts: strategy, resources, process and organization, which together construct a pyramid model; Chesbrough (2013) believes that open innovation mode is to commercialize the internal and external two paths; Robert Kirschbaum (2013) proposes opening up through in-depth study of DSM company. Open innovation activities should be endogenous to a company to achieve the results of open innovation activities; Gassmann (2013) believes that different innovation modes play an important role in promoting industrial innovation; Liehtenthaler (2015) uses a questionnaire survey, the main object of which is 154 large and medium-sized European enterprises, with a systematic perspective to analyze the open enterprise. Sungjoo (2016) takes Korean SMEs as the research object, and finds that enterprise network can effectively promote innovation. Compared with large enterprises' open innovation to promote R&D, SMEs pay more attention to utilizing the commercialization approach of open innovation. Liehtenthaler & Ernst (2017) believes that manufacturing enterprises of different sizes are open innovation. New applications have an important impact. In order to facilitate the search for innovation, we should choose the mode of open innovation.

B. Review of Domestic Research Status

In the field of domestic research, Jinyuguo (2015) used three indicators to measure the regional macro-institutional environment: property rights system, marketization degree and opening degree. Accordingly, he introduced three institutional variables: non-nationalization rate, marketization degree and opening degree. In June 2015, "Macro-institutional Environment: An Explanation for the Decline of Heber's Relative Economic Level", a method for calculating the comprehensive index of institutional environment in a certain region was given. Through the regression analysis of the system variables and GDP value, it is concluded that the four aspects of the selected system variables have a very significant positive correlation with economic growth. In order to meet the needs of China's economic construction practice, many scholars in China are learning from foreign theories and conducting theoretical research, forming a relatively complete innovation model of manufacturing industry transfer.

Relevant scholars have also done some research on the open innovation of manufacturing industry and its innovation mode. Chen Yufen and Chen Jin (2013) believe that the open innovation mode is also achieved through the integration of internal and external innovation resources, and the innovation, especially the enterprise's own technology can achieve the goal of commercialization through external channels. Wang Yong (2015) thinks that in the process of open innovation, the open innovation mode can also be realized through the integration of internal and external innovation resources. The possession of intellectual property rights in manufacturing industry is particularly important. In the process of open innovation, enterprises break the original independent mode of intellectual property rights, and seek the combination of intellectual property rights in innovation. Chen Yantai et al. (2015) analyzed the relationship between organizational open innovation culture support, market orientation and innovation performance in view of enterprises; You Daming, Sun Jie (2016) Open integrated innovation is the realistic way to improve the innovation ability of Chinese enterprises at present. An evaluation system of enterprise open integrated innovation ability is constructed by using ANP method. Sun Hai and others (2017) also believe that open innovation and independent innovation are closely related, and open innovation can transform external technology into enterprise's own ability through independent innovation. Subsequently, more domestic scholars have conducted in-depth research and analysis in this regard. [3]

The above research is enlightening and the basis of follow-up research, but it also has some shortcomings. Firstly, it is necessary to study the impact of national trade system environment and open innovation mode of manufacturing industry, and to conduct cross-integration research. Secondly, the data used in the study have some limitations, mostly from government macro-statistics. More data directly from enterprises and listed companies need to be collected for empirical analysis, so that the study is more convincing. This topic strives to break through and improve, and enrich the relevant theoretical research.
III. EMPIRICAL ANALYSIS OF THE IMPACT OF TRADE INSTITUTIONAL ENVIRONMENT ON THE OPEN INNOVATION MODEL OF MANUFACTURING INDUSTRY

A. Data Sources and Processing

1) Variable settings and data sources

With regard to the trade system environment, we have made a compromise for quantitative analysis, dealing with it according to the optimization of the economic environment brought about by the improvement of the trade system environment, replacing it with measurable economic indicators, selecting and defining the endogenous variables of the SVAR model according to Blanchard & Perotti (2002), and selecting the total government expenditure () and government investment expenditure. Output (), government service expenditure (), total resident consumption () and total economic output () are five variables. According to expenditure items and expenditure functions, government expenditure can be divided into: (1) investment expenditure mainly for economic construction, covering investment, development and operation of infrastructure such as energy, transportation, communication, electricity, agriculture, forestry and water conservancy; (2) service expenditure, covering social security expenditure such as science, education, social security and employment, environmental protection, national defense and public safety; (3) consumption expenditure, covering social security expenditure. Administrative expenses, employee wages, foreign aid, urban and rural community services, industrial and commercial finance and other transaction expenditures. Because of the significant external time lag in fiscal expenditure policy, this paper selects quarterly data from 1992 to 2017, which comes from the statistical database of the special economic network of China, with a sample size of 76.

2) Data processing

Data processing mainly involves seasonal adjustment, inflation and trend adjustment: (1) Variables show certain seasonal characteristics, using TRAMO/SEATS method to get seasonal adjustment items including trend part and irregular part except seasonal fluctuation part; (2) According to the government expenditure variable of Hubei Province, CPI index based on 1990Q1=100 is used to get the actual value to eliminate the circulation. Influences of inflation; (3) Logarithm of variables and decomposition of logarithmic periodic parts of variables by HP filter, i.e., sum, sum. According to Marcet & Ravn (2003), the trend smoothing factor is obtained and the endogenous economic variable vector is finally obtained.

B. Estimated Results and Test of SVAR Model

In view of the complexity of the economic system, Sims (1980) believes that the Vector Autoregression (VAR) model can describe the statistical properties of the economic system more accurately than the traditional macro-econometric model. However, the VAR model ignores the economic theory background of how the variables in the economic system work. It is more appropriate to adopt the structural SVAR model with the economic theory background. This study identifies expansionary fiscal policy shocks by constructing SVAR model, and analyses their dynamic effects on real output, household consumption and fiscal expenditure structure.

1) SVAR Model Estimation Process

Firstly, identification conditions. Christiano et al. (2006) believed that short-term constraints under small samples had better statistical properties, so short-term identification constraints were applied to identify fiscal policy shocks. Assuming that the rules of fiscal policy (Christiano et al., 1999) are:

$$S_t = f(\Omega_t) + \sigma E_t^2$$

In the model, it is the financial policy rules, the information collection of implementing the policy rules, and the policy impact. Because of the time lag between data structure and fiscal policy, the information set includes the sequence of policy variables () and the sequence of economic system variables (), the former involves the current and lag values of sum, and the latter involves the past values of sum. According to Cholesky's recursive identification assumption, the policy has a time lag effect on real output and consumption. [4]

Secondly, the lag order of the model is determined and the stationarity test is carried out. The lag length information standard (AIC) shows that the optimal lag order of VAR model is 4 (Kim, 2001); the stationarity test shows that the root modulus of the characteristic polynomial is in the unit circle, indicating that VAR (4) is stationary. At the same time, the structural equation obtained by SVAR model does not exist over-recognition.

Thirdly, the impulse response map of expansionary fiscal policy shocks is obtained. The real line is the impulse response of economic variables, and the dashed line is the 95% confidence interval of Bootstrap 2000 repeated sampling.

2) Analysis and conclusion of pulse response diagram

Firstly, the analysis of impulse response chart: 1) real output, output under expansionary fiscal policy gradually increased to the maximum in the third quarter, and then decreased to the initial steady state level in the seventh quarter. The overall performance of output adjustment is a "hump" process, indicating that the sustainability of output adjustment is strong; 2) resident consumption, resident consumption declined in the current period, and then continued to rise in the "hump" form. It reached its maximum in the sixth quarter and then converged to the initial steady-state level in the third quarter, which indicated that the time lag of fiscal policy was longer. Thirdly, government investment expenditure and service expenditure, investment expenditure and service expenditure increased, but the extent of investment expenditure was much larger than service expenditure, indicating that under the endogenous fiscal expenditure structure, the fiscal expenditure structure tended to be "heavy investment".

Secondly, the analysis of impulse response chart concludes that expansionary fiscal policy has the following characteristics: (1) there is a structural bias of fiscal expenditure under "China-style decentralization" and "all-round development", "heavy investment in construction, light of public services"; (2) the increase of household consumption presents a "hump shape"; (3) it can continue to increase the actual output of the current period for a long time. This is the same conclusion as the bias of fiscal expenditure structure, crowding-in effect on household...
consumption (Li Yongyou, Congshuhai, 2006; Pan Bin, 2006) and positive impact on real output. The results of impulse response map show that there are factual characteristics of Macro-effect of fiscal policy.

From the above empirical analysis, we can see that the improvement of the trade system environment is conducive to promoting the transformation of government functions. Trade system and open innovation mode are important contents of economic research. Based on decentralization, this paper puts forward the theoretical hypothesis that there exists a circulating operation mechanism among the three, and draws the conclusion that the transformation of government functions can affect the transformation of open innovation mode in manufacturing industry. Through the empirical study of SVAR model, it is concluded that the structure of government expenditure under expansionary fiscal policy tends to be "heavy investment in infrastructure construction, light of public services". After analyzing the transmission mechanism of the model, we find that the improvement of trade system and the incentive mechanism of GDP growth are important factors affecting the open innovation of manufacturing industry.

Ⅳ. CONCLUSION

With the rapid development of Chinese manufacturing industry and the growing prosperity of foreign trade, Chinese trade system environment is constantly improving. The relatively good institutional environment and investment prospects attract foreign capital and manufacturing industry into Chinese market, making Chinese economic scale continue to grow rapidly and steadily, and becoming a hot spot of international external capital investment. Open innovation mode is becoming more and more important. Under the circumstances of absorbing foreign investment and greeting the transfer of external manufacturing industry, the study of Chinese trade system and theory is conducive to attracting foreign investment and promoting the innovation of open mode of Chinese real manufacturing industry. The design and formulation of trade system is of great practical significance for the revitalization and development of Chinese manufacturing industry. Creating a good trade system environment is of great significance for China to further expand foreign economic exchanges, guide the rational flow and transfer of international manufacturing industry to China, and promote the prosperity of Chinese manufacturing industry. [5]

Entity manufacturing enterprises are regarded as the dissipation system of exchanging energy and material with the outside world. Every enterprise is not closed, but needs to constantly exchange resources, energy and information with the outside world. As the basic industry of national economy and national defense construction, manufacturing industry is the main symbol of national strength and international competitiveness, and has extremely important strategic and practical significance. Revitalizing Chinese real manufacturing industry is a strategic measure to improve the realization of comprehensive, coordinated and sustainable economic development. To build an innovative economic power, manufacturing industry is the key. To enhance the ability of independent innovation, manufacturing industry should take the lead. Manufacturing enterprises need to use the mode of open innovation to improve their innovation ability. If manufacturing enterprises want to continuously obtain a large number of external sources of innovation, they need to carry out open innovation and have the concept of open independent innovation. Therefore, a thorough study of the impact of Chinese trade system environment on the open innovation model of manufacturing industry is conducive to formulating reasonable policies and promoting the development of manufacturing industry.

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