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Empirical Study on the Evaluation of the Transformation of China's Foreign Trade Development Mode under Dual Perspectives

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Abstract

By analyzing the current studies about the transformation of foreign trade development mode, we find that the researches involving the change of necessity of foreign trade pattern ,the evaluation of the result , the way of the transformation and the power of it ,but there exist some problems which focus on the unreasonable index systems and empirical method . Therefore, The paper constructs two equations from the two angles such as trade process and trade outcome based on the analysis of connotation of foreign trade patterns. And then the author use the method named Sharp value decomposition to evaluate the effects of each factors on the trade patterns transformation from the level of trade process and result. The results show that the effect of the scale factor is the biggest in our scale of foreign trade development, the contribution of the technical factors need to be improved, and there is poor coordination between the domestic economy and the technology of the export sector. On the view of the trade result, the growth of the effect of price is the highest, and then is the quantity; the effect of species has a large decline. This indicates the quality of our product has been improving, but the degree of innovation needs to be improved. Hence, our transformation of foreign trade development mode has a certain degree of improvement, but still needs efforts. Our next step should be improving the technical coordination between the export sector and the other sectors, as well as the innovation ability of enterprise.

Keywords transformation of trade development mode; index system; Shapley value

1 Introduction

In the process of China's development towards the rank of foreign trade power, the issue of the labor cost improvement, the rising of the pressure of resource strain and environment damage is increasingly obvious, so the transformation of trade development mode has become the consensus of consensus. It was put forward at the Central Economic Working Conference in 2015 that the cultivation of new comparative

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advantages in the export field must be enhanced, so that exports continue to play a supportive role in economic development. In 2016,the central government continued to emphasize the consideration for the overall domestic and international situations, in accordance with "the five-in-one general layout" and "the four-pronged comprehensive strategy", so as to accelerate the formation of a new pattern of opening-up and cultivate the new advantage of international competition. In 2017, the 19th CPC National Congress specified that lying behind the significant improvement of China's general social productivity level and China's social productive capacity entering into the forefront of the world in many aspects was the salient issue of the imbalance and inadequacy of development. Therefore, to elaborately promote the transformation of foreign trade development mode is the equivalent of understanding, adapting into and guiding China's new normal economic development, and it is more about the implementation in foreign trade of the guiding ideology of "solving the problem of unbalanced development and improving the quality and efficiency of development" under the background of promoting the structural reform of the supply side.

2 Literature review and the problems

2.1 Literature review

The early research on the transformation of trade development mode outside China was mainly about the structural change trade products, such as Chakravatti(1949)[1]. The development of theories laid an foundation for the research advancement on this topic, such as the theory of endogenous economic growth and quantitative methods. so that related research increased gradually,some studies put forward the concept of the impetus of international trade development based on the new trade theory and the trade geography model respectively,Such as Edens (1992)[2], Krugman (1987)[3], Lucas (1988)[4], Grossman and Helpman (1989)[5], Redding (1999)[6] and Krugman and Venables (1995)[7]. Learning-by-doing and thedifferences on R&D among countries have a self-reinforcing mechanism for trade patterns. The follow-up empirical research mostly follows the neo-classical economic theory tradition, which takes the direct factor functioning in the trade development as the observation object and simulates the observed economic behaviors to establish a system of equations to explain the main factors or main driving forces that function in the transformation of the trade development mode. For example, Bastos (2007)[11] thought that the initial supply of skilled labor was an important determinant of the development and transformation of intra-industry trade patterns. Dettmer (2011)[12] held that FDI was a major factor not only of China's rapid integration into global value chains but also of increasing China's exports of technology-intensive products. Carolan and Mora (2012) [13] maintained that the dynamic of the transformation of East Asian trade development model depended on technology, especially the flying geese model. Hausmann (2010) pointed out that the transformation of development equaled with the transition from simple products to newly complex products. But Nunez and Marquez (2014) [15] believed that the change in the comparative advantage of technology, capital and human capital was the main reason for the change of trade, which just resembles the criticism of institutional change theory: capital accumulation, technological progress and the change in the comparative advantage of factors resulted from the previous two were not so much the cause of economic growth as the economic growth itself. In fact, the Baldwin (1986) [16] of NBER in the United States criticized the study on changes of trade development patterns: whether static or dynamic trade theory, its research on the mode of trade development mainly focused on the technology, factors and the resulting changes in trade structure, but these changes were only the consequences of changes in system and policy. Therefore, the study of trade development models should focus more on the causes of the change of these factors. Adelman (1999) [17], through combing the process of historical development, found that the government, exerted a great impact on the development of trade whether in the industrial

revolution or in the 20th century. The analysis of Berger and Martin (2011) [18] argued that the reason for China's trade change lay in the policy adjustment; Lin and Rosenblatt (2012) [19] believed that governments should play an active role in structural transformation to mitigate the effects of externalities.

What domestic research in China focused on was: (1) Study on the reason and necessity. Zhang Yabin, Che Ming, Yi Xianzhong (2010)[20] believed that the synthetic fallacy in the development of China's foreign trade and the urgency of avoiding it impelled to enhance the transformation of the foreign economic development mode; Shanghai Customs Research Group (2011)[21] thought that the service economy needed the development mode of foreign trade to achieve three changes. Guo Xibao, Chen Zhigang (2013) [22] held that major structural adjustments in the world's economic growth, production and trade patterns have raised the demand for changes in the way China's foreign trade develops. Huang Jingbo (2008) [23] considered that the crux of the existing problem in the development mode of foreign trade lay in the lack of core competitiveness of export enterprises. (2)Evaluation index system and empirical research: Wang Yuhua (2010)[24], Wang Suqing(2011, 2014) [25] [27], Chen Haibo, Zhu Huali(2012) [26], etc. (2)Countermeasure and path research: to innovate technology to improve productivity, enhance the core competitiveness of enterprises(Huang Jingbo,2008) [28] to implement the subsidy policy of service trade(Jin Xiaobo,2011) [29]; to establish the green trade policy system(Fu Jingyan, Zhang Shanshan,2011) [30]; to promote the upgrading of industrial structure(Ye Zhidong,2012) [31]; to build and perfect the export credit insurance system and carry out tax policy reform(Zhang Yajun,2012) [32], all these above targeted to promote and realize the transformation of the development mode of foreign trade. (4)Following the new classical research paradigm and using endogenous economic growth model to study the dynamic mechanism of the transformation of China's foreign Trade Development mode. Zhu Qirong (2011)[34] deemed that system change, technological progress and human capital accumulation have exerted great influence on the transformation of China's foreign Trade Development mode. Li Xiaoping (2012) [35] emphasized that technological innovation played an important role in the transformation of foreign trade development mode. Wang Chenzhong, Shi Bingzhan (2012)[36], based on the gravity model, put forward that economic growth and the reduction of trade costs were the main driving forces for the development of foreign trade. Huang Jingbo (2008)[37] and Wang Suqin (2012)[38] suggested that technological innovation was the main factor to realize the transformation of foreign trade development mode. Chen Haibo, Zhu Huali (2012)[39] put forward the idea of promoting internal power based on consumption power. Chen Xi (2011) [40] observed the endogenous dynamics of the trade subject and proposed to promote the transformation of the trade development mode through intermediaries. Hong Lianying, Liu Jianjiang (2012) [41], from the perspective of micro-production structural control, employed the game theory to analyze the realistic predicament of the foreign trade development pattern transformation, and found out the concrete reason of bad effects of transformation.

2.2 Research and analysis

At present, the research on the transformation of trade development mode has formed a more complete theoretical system involved the necessity of transformation, the evaluation of transformation effect, the transition path analysis to the dynamic mechanism of transformation. However, in this logical chain, for the evaluation of transformation effect, whether its literature quantity or its research methods are less than that of the other three fields. First of all, most studies focus on the transformation necessity and influence factors, and the empirical research on the transformation effects needs to be strengthened. Secondly, although the amount of evaluation indicators has gradually increased (see table 1), there still exist a number of problems. (1) The more indicators, the smaller the probability of mutual independence among indicators, the less the data availability, the higher the cost of evaluation. For example, such indicators as structure, efficiency, competitiveness and sustainable development are strongly correlated, and the indicator of trade

development momentum, devoid of direct numerical value, needs to be replaced by the alternative. (2) The unified theoretical logic is poor among indicators, between indicators and the trade development, and the research just presented the results of trade development directly, such as trade structure and trade benefits. (3) Currently research methods centers upon principal component analysis and analytic hierarchy process (See Table 1). These belong to adaptive selection made mainly based on the current indicator system, involved with numerous factors, of evaluating the transformation of trade development mode, but these are not the optimal choices aimed at the evaluation of the trade mode transformation.

The evaluation of the transformation of foreign trade development mode can not only provide a more solid empirical basis for the necessity of the transformation of trade development mode, but also provide enlightenment and thinking for the transition path of the mode of trade development and the choice of driving force. Therefore, the evaluation of the transformation of foreign trade development mode must grasp the kernel that the change of trade development mode was just to change the way of market exploitation and resource utilization (Pei Changhong,2012) [42]. However, a series of problems existing in the current study of the transformation evaluation of foreign trade development mode not only make the above goals difficult to achieve, but also cause deficiencies existing in the evaluation itself to be insurmountable. Therefore, we must construct a new index system, choose a set of new evaluation methods, and build a more solid base of theories and methods for the transformation evaluation of trade development mode.

Table 1: Empirical study on the transformation of China' s foreign trade development mode in recent years

Researcher	Year	First-class Indicator
Fan Aijun, Liu Yunying	2007	Foreign trade structure, foreign trade comprehensive benefits, sustainability of foreign
Huo Qiang, Luo Wei	2008	Foreign trade structure, foreign trade comprehensive benefits, foreign trade security,
Huang Xiaofeng	2008	Quantitative development, structure optimization, efficiency improvement, sustainabl
Ji Kaisheng	2010	Foreign trade structure, foreign trade efficiency, international trade competitiveness
Wang Yuhua	2010	Foreign trade benefit, foreign trade structure, development foundation
Zhu Qirong	2011	Foreign trade economic benefit, foreign trade social benefit, foreign trade resources u
Wang Suqin	2011	Foreign trade scale, foreign trade benefit, foreign trade structure, sustainable developn
Chen Haibo, Zhu Li	2012	Trade growth, development impetus, foreign trade structure, sustainable development
Xiang Yijun, Lv Wen	2013	Foreign trade growth, development impetus, foreign trade structure, sustainable devel
Wang Suqin	2013	Foreign trade rate index, foreign trade structure index, foreign trade benefit index, fo
Du Zhuangli	2013	——
Wang Suqin	2014	Trade scale, trade structure, trade benefit, trade competitiveness, trade sustainable deve
Pu Xiaodong, Zheng Hongwen	2015	Trade scale, quality benefit, trade structure, competitive advantage

Combed by the author according to papers published by CNKI

3 Indicators and methods of the evaluation of foreign trade development mode transformation

3.1 Indicator selection of the evaluation of the foreign trade development mode transformation

The evaluation of the transformation of trade development mode should be conducted from the following two perspectives: the first is to evaluate the utilization of resources, that is, whether the resource utilization has realized the transformation from lower factors to higher factors; the second is to evaluate the trade development result, that is, whether market development realizes the change from quantity orientation to quality and variety orientation. To build the evaluation indicator system of the transformation of the trade development mode by this way not only captures the essence of the transformation of the foreign trade

[1]Principal component factor analysis model.

development mode, but also improves the quality of the evaluation index, that is, the number of indicators is small and their connotation is clear, and the indicators are easy to obtain.

3.1.1 A trade identity from the perspective of input

The development of foreign trade is the result of combined effect of related factors (See Formula 1), i.e., per capita GDP (GDP/P), together with national economy technology density (T/GDP), trade intensity of technical sector (Q/T) and P, contributes to the development of foreign trade. Among them, Q stands for the scale of trade development[2]; GDP, for gross domestic product; P, for the total population; T stands for the number of patents authorized.

$$Q = \left(\frac{GDP}{P}\right) \cdot \left(\frac{T}{GDP}\right) \cdot \left(\frac{Q}{T}\right) \cdot P \tag{1}$$

In different stages of the development mode of foreign trade, there exist some differences in the factors which its development depends on. For example, if foreign trade lies in the primary stage of the promotion of scale, the contribution of per capita GDP and labor input (P) to trade development overweighs other factors. At this time, the important supports of foreign trade development involve large-scale investment of labor, land and other resources; while the foreign trade develops into a higher stage, technical factors will play a greater role. At this point, the first two items in formula 1 will play a major role in boosting, their contribution to trade development greater than the latter two. In addition, the formula 1 also shows: the impact on trade development of the average technical level of national economy differs from the technical level of trade sector.

3.1.2 A trade identity from the perspective of market expansion

International market exploration can be achieved through product variety increase (extension in breadth), price increase or quantity growth respectively and in combinations. Different market exploration modes reflect different stages of trade development. If quantity growth predominates in market exploration modes, the trade lies in the stage of extensive-scale development, in which such issues are prone to emerge as the decline in terms of trade, along with the growth of poverty resulted. Therefore, all countries strive to achieve the progressive realization of exploring the international market mainly relying on quality and variety promote the development of domestic trade through to the quality and variety, and consequently to achieve the transformation from the follower to the leader. Based on the research of Hummels and Klenow (2005) [43], Shi Bingzhan (2009, 2010, 2011) and Gang Wei (2014), the author establishes a trade identity (See Formula 2) to decompose the trade growth (X_i) into the product variety (EX_i), product price (P_i) and product quantity (Q_i). The change of the contribution of three components to the trade growth embodies the path change of trade growth, i.e., the transformation of trade development mode.

$$X_i = EX_i \cdot P_i \cdot Q_i \tag{2}$$

Note: (1) X_i: the proportion of export products of nation i to the total export of the world. (2) x_i: export volume of nation i, and x_w: the world export volume. (3) I_i, I_w stands for the export set of nation i, I_w stands for the world export set. (4) p_{ig}: the price of export product g of nation i, and p_{wg}: the world price of export product g. (5) q_{ig}: the quantity of export product g of nation i, and q_{wg}: the quantity of export product g of the world. (6) $EX_i = \frac{\sum_{g\in I_i} x_{wg}}{\sum_{g\in I_w} x_{wg}}$, $P_i = \frac{\sum_{g\in I_i} p_{ig}q_{ig}}{\sum_{g\in I_i} p_{wg}q_{ig}}$, $Q_i = \frac{\sum_{g\in I_i} p_{wg}q_{ig}}{\sum_{g\in I_i} p_{wg}q_{wg}}$. s_{ig}: the export ratio of product g of nation i, and s_{wg}: the export ratio of product g of the world.

[2]Here refers to commodity trade

3.1.3 The evaluation indicator system of foreign trade development mode transformation

To sum up, through the establishment of two trade identities from perspectives of input and market exploration, indicators of two levels–the trade development process and trade development results–can be obtained, so as to identify and judge the way of resource utilization and the way of international market exploration in trade development. This indicator system greatly fits into the connotation of the transformation of trade development mode. If the impetus of foreign trade in China is able to shift from a major reliance on non-technical factors to technical factors, and the way of market exploration can shift from quantity reliance to variety enrichment and quality orientation, then a big transformation will emerge in foreign trade development mode, so that the development of foreign trade will reduce its resource dependence, and will be more environmentally friendly. Besides, the transformation will enable the internal and external economy more related, and the international market exploration more efficiently. More importantly, the evaluation indicator system of trade development mode is endogenous in the process and the results of trade development. Thus, the amount of indicators is simplified, data acquisition is more convenient, and economic connotation and relation mechanism are more clear (See Table 2). Therefore, the evaluation indicator system based on trade identities has better settled the existing problems in the current evaluation indicator system of trade development.

Table 2: The indicator selection of the evaluation of foreign trade development mode transformation

Indicator source	Evaluation indicator	Basic Implication	Perspective
The identity of trade development scale	Per capita GDP	Driving effect of economic scale (Non-technical factors)	Ways of resource utility
	Technical density of GDP	Driving effect of technical factors	
	Trade intensity of technical sector	Driving effect of technical sector on trade development	
	Population	Driving effect of population size	
The identity of trade development results	Export variety	New products play a major role.	Ways of market exploration
	Export price	Product quality plays a major role.	
	Export amount	Production scale play a major role.	

3.2 Selection of evaluation methods for the transformation of foreign trade development mode

3.2.1 The principle of Shapley value decomposition

If the cooperative alliance S is composed of n people, the value that any individual obtains from the cooperative alliance can be determined by their marginal contribution to the cooperative alliance S[3]. This thought was further formulated by Shapley, that is, the union of n people can form $2^n - 1$ patterns of cooperation. For any individual i, the amount of the cooperation forms participated is $(n-1)!$, and $|S|$ stands for the size of the cooperation form S i participates; the amount of the cooperation forms individual i does not participate is $(n-1)!$. For individual i, the marginal contribution created by the union individual i participates can be expressed as (See Formula 3):

$$\phi_i(v) = \sum_{S \subseteq N \setminus \{i\}} \frac{|S|!(n-|S|-1)!}{n!}[v(S \cup \{i\}) - v(S)] \tag{3}$$

In the formula, $v(S)$ stands for the value created by the cooperative alliance S; $v(S \cup \{i\})$ stands for the value created by the union when individual i participates in it; $v(S)$ stands for the value created by the union when individual i is not involved. Utilizing the equation $\sum_{k=0}^{n-1} \binom{n-1}{k} = 2^{n-1}$ further, Shapley gave

a more concise expression of the marginal contribution created by the union individual i participates (See Formula 4).

$$\phi_i(v) = \frac{1}{n!}\sum_R [v(P_R \cup \{i\}) - v(P_R)] \tag{4}$$

In formula 4, $v(P_R)$ stands for the value created by the union excluding individual i. When every cooperative alliance game with limited carrier satisfies the requirements of cooperative alliance games, formula 7 stands for the sole payoff function, which is the marginal contribution created by the union individual i participates.

It can be seen that the Shapley value, with strong theoretical completeness, is a very useful concept of cooperative game solution. It not only intuitively presents the sole payoff function of the participant in the alliance game, but also utilizes the concept of marginal contribution to take into account the principle of fairness or impartiality of the participants' feasible distribution. The objective of the evaluation of the development mode transformation of foreign trade is to measure the contribution of different types of resources and different market exploration ways to the trade, in order to judge whether the trade development has realized the change of the way of resource utilization and market exploitation. Therefore, based on the concept of Sharply value, the author calculates the marginal contribution of different factors to the process and the results of trade development, so that it will be more convenient and efficient to measure the contribution of various resources and different market exploitation ways in the process of trade development.

3.2.2 The Sharply value decomposition of the identity of trade development

(1) Shapley value decomposition of the contribution degree of different input factors to trade development Formula 1 shows that the development of foreign trade is the result of the cooperation of such four factors as population (p), per capita GDP (gp), technical density of national economy (tg) and export intensity of technical department (qt). Therefore, the contribution of any factor change to the change of the scale of foreign trade development can be measured by its marginal contribution in the context of joint cooperation. Utilizing the Shapley value decomposition method to decompose the contribution degree of the above four factors to the scale change of foreign trade in each period, and comparing the contribution degree change of each factor year by year, the author has completed the measurement of dynamic value of any factors' contribution degree in the trade development process. The calculation formula of the contribution degree of the population factor to the trade development process can be expressed as follows:

$$\phi_p(\Delta Q) = \sum_{S \subseteq N \setminus \{p\}} \frac{|S|!(n - |S| - 1)!}{n!}[\Delta Q(S \cup \{p\}) - \Delta Q(S)] \tag{5}$$

In the formula, $\Delta Q(S \cup \{p\})$ stands for the decision function, including the change of population factor p, of the scale change of foreign trade, and $\Delta Q(S)$ is the decision function, excluding the change of population

[3]This paper was earliest included in the book Contributions to the Theory of Games by H.W. Kuhn and A.W. Tucker, published by Princeton University, and later included in a book Classics in game theory by H.W. Kuhn, published by Princeton University. The latter book was then translated by Han Song, published by China Renmin University Press. Here is the seventh chapter.

factor p, of the foreign trade scale change. The final decomposition formulas are:

$$\begin{aligned}\phi_p =&\frac{1}{4}\Delta Q(p)+\frac{1}{12}[\Delta Q(p,gp)-\Delta Q(gp)]+\frac{1}{12}[\Delta Q(p,tg)-\Delta Q(tg)]\\&+\frac{1}{12}[\Delta Q(p,qt)-\Delta Q(qt)]+\frac{1}{4}[\Delta Q(p,gp,tg,qt)-\Delta Q(gp,tg,qt)]\end{aligned}\tag{6}$$

$$\begin{aligned}\phi_{gp} =&\frac{1}{4}\Delta Q(gp)+\frac{1}{12}[\Delta Q(p,gp)-\Delta Q(p)]+\frac{1}{12}[\Delta Q(gp,tg)-\Delta Q(tg)]\\&+\frac{1}{12}[\Delta Q(gp,qt)-\Delta Q(qt)]+\frac{1}{4}[\Delta Q(p,gp,tg,qt)-\Delta Q(p,tg,qt)]\end{aligned}\tag{7}$$

$$\begin{aligned}\phi_{tg} =&\frac{1}{4}\Delta Q(tg)+\frac{1}{12}[\Delta Q(p,tg)-\Delta Q(p)]+\frac{1}{12}[\Delta Q(gp,tg)-\Delta Q(gp)]\\&+\frac{1}{12}[\Delta Q(tg,qt)-\Delta Q(qt)]+\frac{1}{4}[\Delta Q(p,gp,tg,qt)-\Delta Q(p,gp,qt)]\end{aligned}\tag{8}$$

$$\begin{aligned}\phi_{qt} =&\frac{1}{4}\Delta Q(qt)+\frac{1}{12}[\Delta Q(p,qt)-\Delta Q(p)]+\frac{1}{12}[\Delta Q(gp,qt)-\Delta Q(gp)]\\&+\frac{1}{12}[\Delta Q(tg,qt)-\Delta Q(tg)]+\frac{1}{4}[\Delta Q(p,gp,tg,qt)-\Delta Q(p,gp,tg)]\end{aligned}\tag{9}$$

Thus, the contribution degree of each factor to the scale change of trade development is precisely presented, i.e., the dependence degree of foreign trade on different factors in different stages of the trade development scale can be calculated clearly, accurately and objectively, so as to realize the judgment of the transformation of supporting factors in the process of trade development.

(2) Shapley value decomposition of the contribution degree of different marketing ways to trade development The position of China's export trade in the global export trade is the result of combined effect of export product variety (EX), product prices (P) and product quantity (Q) (See Formula 2). According to the Shapley value decomposition method, the contribution of any factor change to the change of the proportion of export trade in global trade can be measured by its marginal contribution in the cooperation where the factor is involved. Thus, we can work out the annual contribution degree of related factors to the proportion change of our country's export in the global export. By calculating the annual contribution degree of three different market exploration ways to the proportion change of China' s export in the world export trade, we are enabled to measure the trade development mode through contrast from the perspective of results. The decomposition formulas are:

$$\begin{aligned}\phi_{EX} =&\frac{1}{3}\Delta X(EX)+\frac{1}{6}[\Delta X(EX,P)-\Delta X(P)]\\&+\frac{1}{6}[\Delta X(EX,Q)-\Delta X(Q)]+\frac{1}{3}[\Delta X(EX,P,Q)-\Delta X(P,Q)]\end{aligned}\tag{10}$$

$$\begin{aligned}\phi_P =&\frac{1}{3}\Delta X(P)+\frac{1}{6}[\Delta X(EX,P)-\Delta X(EX)]\\&+\frac{1}{6}[\Delta X(P,Q)-\Delta X(Q)]+\frac{1}{3}[\Delta X(EX,P,Q)-\Delta X(EX,Q)]\end{aligned}\tag{11}$$

$$\begin{aligned}\phi_Q =&\frac{1}{3}\Delta X(Q)+\frac{1}{6}[\Delta X(EX,Q)-\Delta X(EX)]\\&+\frac{1}{6}[\Delta X(P,Q)-\Delta X(P)]+\frac{1}{3}[\Delta X(EX,P,Q)-\Delta X(EX,P)]\end{aligned}\tag{12}$$

4 An empirical study on the evaluation of the transformation of foreign trade development mode

4.1 Empirical analysis on the transformation of trade development mode based on process

The indicator values of input factors in the process of trade development are adopted in accordance with its annual version of China Statistical Yearbook then, published by the National Bureau of Statistics. Considering the inflation factor, this study uses GDP deflator to revise the nominal GDP and foreign trade data. Excluding the influence of inflation factor, we obtain the indicator data of four input factors (See Table 3). From 2000 to 2014, China's per capita GDP and technical density of GDP increased significantly, by 242.95% and 234.11% respectively, with an average annual increase of 9.2% and 9%. The trade intensity of the technology sector decreased from 0.104 in 2000 to 0.033 in 2014, down by 68.4%, while the population maintained a weak growth rate of 7.92% during that period (See Table 3). Thus, while per capita GDP and the technical density of GDP were steadily increasing, the trade intensity of the technology sector has declined considerably. This shows poor coordination between China's national economy and its export sector.

Table 3: Indicator values of factors affecting the development process of China's foreign Trade (commodity trade)

Year	Gp (Billion Yuan/Per 10,000 People)	Tg (Items/Billion Yuan)	Qt (Billion Yuan/Item)	p (I
2000	0.219686	3.783438	0.104036	
2001	0.236269	3.788879	0.100966	
2002	0.256091	4.024824	0.105497	
2003	0.280063	5.035017	0.102506	
2004	0.306477	4.775256	0.124489	
2005	0.339265	4.824138	0.130379	
2006	0.380299	5.361167	0.120811	
2007	0.432044	6.162373	0.101029	
2008	0.471221	6.583388	0.086281	
2009	0.512232	8.513971	0.051194	
2010	0.563982	10.77457	0.045786	
2011	0.614521	11.60075	0.042093	
2012	0.658877	14.06876	0.032492	
2013	0.70602	13.66717	0.032124	
2014	0.753406	12.64101	0.032872	
Increase (%)	**242.9462**	**234.1144**	**-68.403**	

According to Formulas (10)-(13), we can obtain the contribution of various factors to trade development in the trade process. From 2001 to 2014, the contribution of population to the development of foreign trade increased by 183.1%, an average annual increase of 7.72%; the contribution of per capita GDP to trade development increased by 237.59%, an average annual increase of 9.08%; the contribution of the trade intensity of technical sector to trade development increased by 390.2%. But the contribution of the technical density of national economy to the trade development decreased by as much as 20635.7% (See Table 4).

From the average value of the contribution of each indicator to trade development, the per capita GDP and the technical density of GDP are much higher than the other two indicators. The average value of the contribution of the population to trade development is positive, while the average value of the contribution of the trade intensity of the technical department is negative. From perspectives of other statistical indicators, these four factors also show a greater difference. Variance and coefficient of variation indicate that the contribution of the population factor is more stable, followed by per capita GDP. However the contribution of the technical density of national economy and the product export intensity of technical

sector shows a great and unstable change (See Table 4).

Table 4: Changes of the contribution of indicators to trade development from 2001 to 2014

	ϕ_p	ϕ_{gp}	ϕ_{tg}	ϕ_{qt}
2001	78.1977	818.4696	16.1691	-337.0400
2002	82.0862	1023.8650	768.0273	558.2639
2003	97.8422	1454.4760	3628.0530	-468.8300
2004	124.2728	1904.3590	-1122.4000	4097.0190
2005	151.7441	2614.7230	262.3281	1190.1420
2006	159.1811	3438.6210	3179.1510	-2300.6700
2007	176.3369	4349.1730	4747.9850	-6110.8700
2008	181.1353	3094.6240	2356.1810	-5626.0800
2009	163.2431	2801.7680	8654.6530	-17371.2000
2010	161.1129	3230.4850	7883.4130	-3762.0000
2011	186.4336	3337.6430	2873.5070	-3274.4500
2012	202.9593	2855.6740	7902.7170	-10610.1000
2013	204.2129	2867.1880	-1201.8400	-472.3850
2014	221.3773	2763.0720	-3320.4400	978.0946
Increase (%)	183.10	237.59	-20635.70	390.20
Average	156.44	2611.01	2616.25	-3107.86
Variance	2060.38	969688.40	13668282.00	30638389.00
Variation coefficient	0.29	0.38	1.41	-1.78

What contributes hugely and stably to China's foreign trade (commodity) development is still the scale factor. The contribution of population factor to trade development is small, yet showing a steady growth trend. Although the contribution of the technical density of national economy to trade development is larger than per capita GDP, it is unstable, fluctuating largely. Especially after 2009, it showed a great decline. The trade intensity of technical sector, the most unstable, not only varies enormously among years, but also contributes negatively to the development of trade in most years. In addition, after 2001, the technical density of the national economy showed a significant negative correlation with the strength of the export products of the technology sector. Although after 2008 the trade intensity of China's technical sector showed an upward trend, and even in 2014, for the first time it turned positive form negative, yet the contribution of technical density of national economy to the trade development declined in volatility. It also shows the poor coordination between China's export trade and its national economy. Therefore, from the perspective of the development of trade, China's foreign trade development has not successfully realized the transformation from relying on scale to relying on technology to elevate the driving, and the coordination between the domestic economy and export trade is still poor.

4.2 Empirical analysis on the transformation of trade development mode based on results

From Formula 2, these three indicators EX_i, P_i, Q_i contribute together to the change of X_i, and better depict the ways of China's export market development. From 1995 to 2013, the development trend of the three coefficients of these three factors showed a big difference: the growth rate of the coefficient of variety factor is the lowest, only 0.44%, relatively stable. The growth rate of price coefficient was 87.46%, extremely unstable, and the variance was as high as 0.91. The growth rate of quantity coefficient was the highest (97.94%) , most stable, and the variance was close to 0 (See Table 5).

Table 5: Annual changes of indicators of trade development outcomes

	Xi	Qi	Pi	EXi
1995	0.010389	0.004863	2.147167	0.994970
1996	0.014397	0.007012	2.067126	0.993232
1997	0.017555	0.008304	2.128312	0.993304
1998	0.012799	0.005860	2.195381	0.994985
1999	0.015955	0.007226	2.215784	0.996479
2000	0.005581	0.004404	1.271083	0.997048
2001	0.006190	0.005833	1.063278	0.998198
2002	0.006965	0.006245	1.116981	0.998468
2003	0.012592	0.005371	2.347592	0.998702
2004	0.009842	0.004046	2.435672	0.998667
2005	0.017269	0.005646	3.060221	0.999435
2006	0.019479	0.006014	3.240910	0.999460
2007	0.015791	0.004613	3.424579	0.999504
2008	0.015137	0.004712	3.213507	0.999627
2009	0.020619	0.005800	3.557575	0.999195
2010	0.034101	0.009045	3.770946	0.999745
2011	0.029908	0.008107	3.690871	0.999571
2012	0.039139	0.009170	4.273196	0.998817
2013	0.038721	0.009626	4.025077	0.999312
Increase (%)	272.71%	97.94%	87.46%	0.44%
Variance	0.000101	0.000003	0.907822	0.000004

Data Source: CEPII—Basic database (1995-2013), and calculated according to Formula 2

According to the method of Shapley value decomposition, the contribution of various factors to the change of the ratio of China's export to the world export is available. First of all, in the sample period, quantity and price were the main influencing factors of the development of China's foreign trade. Especially the quantity factor, for 14 years of the 19 years in the sample period, the contribution degree of quantity factor was the largest. Secondly, considering the development and change of the contribution degree of various factors, the growth rate of the price factor was the highest, up to 360%, the contribution degree of product quantity and product variety decreased differently in the sample period. The contribution degree of the quantity factor dropped the biggest, by 57.78%, and for the factor product variety, 11.19%. This shows that in China's foreign trade market, product quantity still plays the most important role, the price factor follows, and the factor of product variety has the smallest impact on China's export trade development, with a further declining trend. However, with the development of foreign trade, the contribution degree of quantity factor is decreasing gradually, and the influence of price factor is gradually increasing. The contribution degree of China's price factor is less stable, susceptible to other factors. For example, due to the impact of the international financial crisis, in 2009, the contribution degree of price factor significantly decreased, while the contribution degree of quantity factor rose sharply (See Table 6).

5 Summary and Prospect

5.1 Research conclusion

This study adopted a completely different method to evaluate the transformation of trade development mode, which is first embodied in the selection of evaluation indicators: Traditionally the evaluation indicators center upon trade development scale and product structure, gradually adding environmental pro-

tection, innovation and other elements. In addition to the issues discussed above, such an evaluation system will encounter the question of how to assess which products are highly valuable, for both trade development practices and theoretical studies show: High-tech intensive enterprises possess lower per capita added value[4]. Therefore the indicators based on traditional trade classification can not accurately reflect the market development way of export trade. This paper constructs the identities of trade development from two angles of trade development process and development results. Through the decomposition of the identities, we obtain two indicator systems concerning trade development resource utilization and market exploration ways. Furthermore, there exist clear logic links between indicators and trade development scale and trade development results, among these indicators, which bear clear economic connotation. Therefore, based on this economic logic, the author chooses Sharply value method in the cooperative game to judge the contribution degree change of each indicator in the annual trade development scale and the development results. Good effects can be achieved judging the effects of the contribution degree change on the transformation of trade development mode.

Table 6: Changes of the contribution degree of product variety, product price and product quantity to the growth of China's export trade

Year	**ΔEX**	**ΔP**	**ΔQ**
1996	0.0000217277	0.0005	0.0045
1997	0.0000011675	0.0005	0.0027
1998	0.0000257109	0.0005	0.0053
1999	0.0000215589	0.0001	0.0030
2000	0.0000058983	0.0055	0.0049
2001	0.0000068384	0.0011	0.0017
2002	0.0000017812	0.0003	0.0004
2003	0.0000023302	0.0071	0.0015
2004	0.0000003941	0.0004	0.0032
2005	0.0000102863	0.0030	0.0044
2006	0.0000004680	0.0011	0.0012
2007	0.0000007698	0.0010	0.0047
2008	0.0000019132	0.0010	0.0003
2009	0.0000077001	0.0018	0.0037
2010	0.0000149800	0.0016	0.0119
2011	0.0000055504	0.0007	0.0035
2012	0.0000259905	0.0050	0.0042
2013	0.0000192962	0.0023	0.0019
Increase (%)	-11.19%	360.00%	-57.78%
Average	0.00000969	0.001861	0.0035
Variance	0.00000000	0.000069	0.000115

The calculated results show: from the perspective of the development process, i.e., the resource utility way, the scale factor has always been the supporting factor of the stability of China's foreign trade development. Although the contribution of the technical density of national economy to export trade has improved to a certain extent, it is extremely unstable. Especially since the global financial crisis, its contribution to the scale of trade development has dropped rapidly. The contribution of the export intensity of technical sector has been significantly improved in recent years, and turned positive from negative. However, it showed that there was a significant negative correlation between the technical density of national economy and the export intensity of the technical sector, which implied poor coordination between the

export trade and the domestic economy. From the perspective the result, i.e., the market exploration way, the quantity coefficient still had a biggest influence on the change of the ratio of China's export trade to the world trade. The price coefficient ranked the second, and was vulnerable to be affected by exteriors. The contribution degree of variety coefficient was the smallest, and prone to descend. These showed that the quality level of China's export products has improved to a certain extent, but the lack of innovation has led to that the growth of new products contributed little to trade development. In summary, considering whether the development process or the results, the transformation of China's foreign trade development mode has achieved certain effects, and the impact of technical factors on China's foreign trade development has been significantly improved. However, at present, China's foreign trade development still largely depends on quantity factor, and the coordination between internal and external economy is still poor. Therefore, China's trade development mode transformation still needs to be strengthened, the relevant policies should be aimed to (1)improve the coordination between export sector and the non-export sector of national economy; (2) enhance product innovation, and elevate the productivity and export capacity of new products.

5.2 Inadequacy and research prospect

Although this paper has made a breakthrough in the indicator system and the empirical method of the foreign trade development mode transformation, there still exist inadequacy to be improved.

5.2.1 Empirical methods to be improved

Firstly, the author assumes that the trade development is the result of combined effects of relevant factors when building trade identities. However, in the subsequent indicator decomposition and empirical process, the paper is still based on traditional ideas. Assuming that other factors remain unchanged, the author measures the contribution of each factor to the development of trade through its net effect. Reasons for the social phenomena are interdependent rather than isolated. The effect of any function is not caused by a single factor, but caused by a combination of factors. Different combinations of various factors could not only play a different role, but also function the same. And the relationship between a single factor and the function is not symmetrical. Therefore, it is necessary to take a holistic approach to explain the causes of social phenomena. A great deal of empirical research tells us that the uniform symmetry between variables a research found out is often negated by other researches. One important reason is the lack of the analysis of the interdependence between variables and their configuration effects. Secondly, the measurement of the contribution has not clearly presented the definite relationship between the factors, their combination and the effect of the transformation of the foreign trade development mode, while the qualitative comparison study based on the view of configuration (QCA) better explained the mutual dependence and complicated causal relationships between factor condition and results. However, if we apply QCA method in the field of foreign trade to analyze the cause of the transformation of foreign trade development mode, there still exist some challenges. The first is how to select the data calibration standard to adapt to the QCA configuration analysis and its truth-table construction needs, and there is no corresponding standards and norms. The second is that currently QCA is not suitable to analyze the panel data. Thus in consequence the analysis is limited to a section. Therefore, it is unclear that whether the conclusion QCA analysis concludes matches a given year or matches universally. However, this method still has great implications for this research field.

[4]纳谢德·福布斯，戴维·韦尔德著，沈瑶、叶莉蓓等翻译. 从追随者到领先者——管理新兴工业化经济的技术与创新，高等教育出版社，2005 年版：P121

5.2.2 Research perspectives to be expanded

Including this study, the current research is limited to the comparative analysis of attribute indicators of trade development, and pays little attention to the change of global trade network development and the attributes of China's foreign trade in network and related indicator changes. Especially in the context that the ratio of intermediate goods trade to the world trade increasingly rises, it is very easy to neglect some important information if we only analyze the attribute indicators of the foreign trade development. Therefore, in the future, we should pay much more attention to the changes of the network attribute indicators of China's foreign trade in the global trade network, and propose and formulate corresponding strategies and measures based on the judgment of the transformation of foreign trade development mode. This is not only a holistic view possessed by a nation transforming from a large trade country to a trade power, but also a basic reference for the formulation and adjustment of China's future foreign trade development strategy.

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