China's Sustainable Trade Development Assessment and Early Warning System

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1. Influence between sustainable trade development, environment and resource

1.1 Definition of sustainable trade development

"Sustainable development" generally refers to the long-term stable and healthy development in a certain field in human economics and society. And the development and benefit of the present is not a guarantee of the same for the next generation. From 1978 when China began to reform and open to the world until now, the trade and market economics direction have greatly influenced domestic economics, especially the sustainability of trade development, which acts as the engine of GDP growth, is under focus. Sustainable trade development means that trade development should act under its certain inherent rules and improve the trade system and running mechanism, as well as enhance trade efficiency, while effectively making use of the trade resource, thus to reach a long-term stable and healthy development in a certain field of human economics and society. As an important part of sustainable development, the sustainable trade highlights three fundamental principles: durative principle, coherence principle and fair principle.

1.2 The domestic sustainable trade development research development

In the matter of trade development, a united sustainable development assessment system has yet to emerge. The main international related representations on the sustainable trade development index system are as follows: The United Nations Committee of Sustainable Development (UNCSD) sustainable development index system; LEIPERT Adjustment National Economics Model; The Canada Institution of International Sustainable Development (IISD), Environment Economics Sustainable Development Index System (EESD); The World Bank (WB), Sustainable Development Index System; The United Nations Statistics Bureau, Frame Index of Sustainable Development (FISD); Environment Science Committee, sustainable development index system; Wealth Model of Sustainable Development (WMSD); The

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United Nations Development Program (UNDP), Human Development Index (HDI); Sustainable Development Index (CSERGE); Barometer of Sustainability (Prescott-Allen).

The contribution of the Chinese researchers on sustainable development index system is also quite significant, namely: the National Statistics Bureau, sustainable development degree model (DSD); the environment, society and economics development assessment index system by Wu Lindi; The Development Contribution Index by Niu Wenyuan; The Measurement and Index System of sustainable development; The area of social economics integrated development strength index system by Zhu Konglai; The area sustainable development index system by Wang Liming; The "China sustainable development strategy report" by the Chinese Academy of Science, sustainable development strategy research group from the year of 2003.

A big difficulty in effecting sustainable development is the lack of sufficient, related or varied data from different areas out of which a unified choice of different indexes can be compiled. Thus is short term period, a complex assessment system on sustainable development which can meet all the requirements of various areas cannot be established.

1.3 The influence to the environment and resource by the trade sustainable development

The trade environment influence refers to the integrated influence on the natural environment by the trade related economics activity. These influences include both positive and negative ones. Thus the same division can also exist regarding the influence on the environment and resources by international trade.

Different views on the trade environment affection vary from one to the other: on one hand, international trade promotes the scale of the economics in each country to enlarge and speed up the development of natural resource, while on the other hand, it broadens the scale of consumption, thus increasing the speed of degeneration of the natural resource and the environment; on the other hand, international trade also has the function of promoting the protection of the environment. International trade improves a country's economic growth and increases income, therefore the country will gain the ability to increase its contribution to environmental protection. Meanwhile, due to the level of foreign exchange augmented by trade, the country can afford to import advanced foreign environmental protection technology and instruments. Actually speaking, the trade environment affection analysis is uncertain, and further analysis of the trade environment affection reveals that this influence has several aspects. Grossman and Krueger (1991) divides the international trade environment influence into scale affection, structure affection and technological affection, and established the basic frame of the trade environment affection. However, OECD (1994) divides the trade environment influence into product influence, technological influence, structure influence and scale influence; Panayotou (2000) divides the trade environment influence into product influence, technological influence, structural influence, law influence and scale influence.

1.4 The influence of the trade sustainable development by resource and environment

Sweden economists Eli F. Heckscher and Bertil C. Ohlin (1963) offered the gift factor theory, which explained the causes of international trade. They held that the pattern of international trade was formed by the situation of each country's gift factor. Nevertheless, with the appearance of the resource and environment problem in international trade, the theory encounters new challenges. The Table 1 shows the relationship between the trade structure and environment among the developing and developed countries.

Table 1. Product direction in developing and developed countries (the percentage of exports)

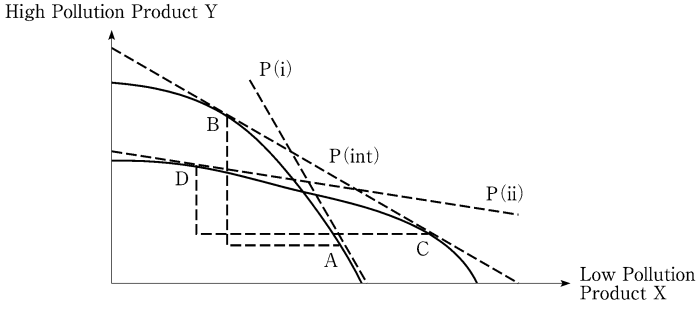
Year	To developed countries	To developing countries
1960	72.2	22.3
1970	73.4	20.0
1980	70.1	24.9
1984	64.3	29.6

Sources: World Bank 1986A

This Table 1 shows that the developing counties send their products mainly to the developed countries. Through the analysis of the 1990 trade structure, the fact shows that in developing countries 66% of farm products, 65% of the industrial material and 75% of the mining products are sent to the developed countries. This shows that the developing counties depend greatly on the export resource product, while the developed counties over-consume through the purchase of cheap import resource product from the developing counties.

Suppose the country 'I' is an environmentally sufficient one, and country 'II' is an environmentally poor one, the production possibilities curves of the two countries are as show in Figure 1.

Figure 1: The production possibilities curves and the environment resource



Under the condition of the colluding economy, since the factor of the environment in country I is the sufficient one, thus the production possibilities curve will deflect to the high pollution product Y, under the domestic relative price p(i), with point A being the best production point. For country II, the factor of the environment is the poor one, thus the production possibilities curve will deflect to the low pollution product X, under the domestic

relative price p(ii), the point D should be the best production point. Obviously, p(i)>p(ii). Under the open economy, the international exchange price should be between p(i) and p(ii). Meanwhile, the best production point of country I will transfer from A to B, and country II, D to C.

However, if, after several years of the trade development, we check for the gift situation of the developing counties, many such countries turn out to lack the resources, with consequent destruction of the environment. Due to low level technology the purchase cost of the primary product increases. The developing countries take the non-renewable resource product to export in order to exchange capital and technology, which leads to a worse trade condition. Most of the developing countries are bereft of the merit of the natural resource and labor force resource, and the gift factor is changing.

1.5 Trade unsustainable theory and the fact of China

1.5.1 The traditional resource gift international trade structure appears unsustainable

Firstly, the export oriented resource product output will lead to the overuse of natural resources and the destruction of the ecological system, thus more concentrated pollution will lead to unsustainable trade.

Secondly, the developing counties keep the resource to export to the developed counties, which adds up the energy to the developed countries; however, this leads to greater difficulties in the developing countries sustainable development. Due to the very low price of the resource, these continuous imports do not reflect their own value. On the contrary, because of the influence of trade conditions, the degeneration of the environment is kept back in the developing countries, and from the macro scope viewpoint, it is unsustainable.

Thirdly, the products exported from developed counties to developing counties are mainly the finished ones. The natural resource producing exterior and consumption exterior are mostly left to the developing counties. The causes are, on one hand, the extent to which the environment resource protection of developing countries is low; while, on the other hand, the developed counties will pursue the aim of protecting the domestic environment and saving domestic resources, thus to transferring the pollution to the developing countries.

1.5.2 Situation in China

Regarding the situation of resource gift in China, the gift of labor force and resources is abundant, compared with the environment, technology and capital gifts. The China environment standard is relatively low, and the environment policy is not strict enough. At present, China's trade structure reflects this situation of gift: from 1980, Chinese export products have been mainly and increasingly primary ones, among which, except for mine fuels and lubricants which began to decrease since 1990, the export quantity of the other primary products is increasing. Although the export quantity of the finished products is growing rapidly, the export field still remains in the labor and resource low technology level products, for instance, clothing, base oil, textiles and food. This kind of export structure lacks sustainability.

The same situation pertains in relation to China's import structure, it lack sustainability:

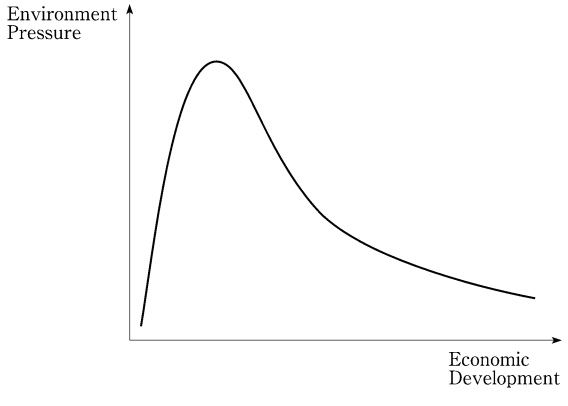
among the imported products, the primary products are decreasing, with the growth of the mine fuel and lubricants; the demand for finished products is increasing, among which machine and transportation instruments count very high. Since 1990, the main imports have been chemical materials, aircraft, computers, electronic instruments and automobiles. The import products also have the problem of contributing to the severe levels of pollution. In particular, some multinational companies import these materials and products to avail of the cheap labor costs and low taxes, after that they send the finished products back to their own countries. Thus, not only is the cost to environment assumed by China, but this in turn aggravates China's ability to sustain development.

2. Sustainable trade development index system designing basic principle and its content

2.1 The function of the Environmental Kuznets Curve in relation to the assessment of the sustainable trade development

The Environmental Kuznets Curve (EKC) hypothesis refers to the running down of the quality of the environment at the early stages of economic development, and after the economy reaches a certain level, the quality of the environment will improve itself to a better phase, which forms a conversed 'U' (See Figure 2)

Figure 2: The Environmental Kuznets Curve



The relationship between environmental pressure and economic growth can be a long existing problem, and the Environmental Kuznets Curve hypothesis is based on this debate. The growth of a particular economy is meanwhile the booming in the consumption of raw materials, energy and natural resources. In the 1970s, it was widely believed that economic growth contributed to the deterioration of the environment. Later, the publication of the IPAT equation, which is used to analyze the influence of human activity on the environment, indicated that the progress of technology can compensate for this influence.

In the year of 1991, Grossman and Krueger studied the relation of the SO_2, dust and granule to income, and learnt that these three substances of pollution have the conversed 'U'

connection with income. After that, Arrow identified this as a conversed 'U' hypothesis. And it is theoretically explained as follows:

(1) The structure of technology and industry: The progress of technology and the changing of the industry structure reduce the environmental pressure at the high income phase. And the development of the social economy urges this. Technology can increase the utilization rate of the resources and reduce the production of pollution. Industry is a high pollution one and has a great influence on the environment; on the contrary, the service industries have a lower influence on the environment. After the replacing of service industry to the traditional industry, the environmental pressure will greatly decline and the environmental pressure and the economic growth will be separated.

(2) The income elasticity of the environment quality demand: With the increase of income, the demand on the environment quality will also greatly increase, and the income elasticity of the environment quality will enlarge. When the income elasticity of the environment quality is larger than 1, people will improve the environment quality at the cost of the economic benefit.

(3) International trade: The EKC emerges in certain countries because the import products reduce civil pollution and transfer the environmental pressure abroad. However, the environmental pressure of the entire world does not decrease. Another aspect is that trade urges a wider use of 'green' technology.

(4) Market policy: The transferring of the market policy can also reduce environmental pressure. When the natural resource and pollution join in the market, the internal adjust function of the market will stop the environment from deteriorating, and the external cost of pollution will transfer to the internal cost.

(5) The environment policy: The full environmental policy and its rigorous implementation will improve the environment and reduce the pressure. Even some researchers believe that the appearance of EKC is not a result of income growth, but the right implementation of the environmental policy.

2.2 Sustainable trade development assessment index selection principle

Scientific system principle: The sustainable development index definition and statistics standard cannot be separated from the sustainable development fundamental theory. The index chosen should be correct, real and criterion. It should also be stable and so greatly reflect the sustainable trade development.

Sensitivity on time principle: This is because of the requirement of dynamic supervision, and the system should contain the index that will keep up with the pace of economic development. When the entire trade level is swinging, the index should also reflect the changes.

Cooperation and association principle: Sustainable trade development demands that, at any period, the economic development level or the natural resource consumption level, the environment quality and environment loading situation, as well as the society organizing form, should all be within the state of sustainable trade development index coherence. Thus, each

index should be tightly related.

Difference principle: The different districts of China do not have united and standard index system, and due to the differences between each province, the detail statistics index also exist difference.

Maneuverability principle: The key of the assessment index system is the choice of statistics method and mathematics model, which ought to have maneuverability.

2.3 Sustainable trade development index direction

A country's sustainable trade development should contain these directions:

Firstly, a country's trade amount stability and stable growth ability. The whole amount of trade is the most important indexes of ruling the trade scale.

Secondly, a country's trade resource stable supply ability. Trade resource has two kinds: the natural one, which can be directly used as the trade aim, and the factors in the course of production, namely, the material factor and labor factor.

Thirdly, a country should update its trade product structure as international product competition increases. The considered structure should be the one that contains more finished products and fewer raw materials.

Next, a country's trade should contribute a high rate to the domestic economy and societal development. Therefore, when assessing the contribution of trade to the domestic economy, we should use not only the economics index but also the sustainable development index of societal development.

Lastly, a country's trade condition should be improved. The trade condition should be the same exchange rate between export and import. This makes the connection between the international balance and economic long-term development.

2.4 Trade sustainable development assessment system index setting

According to the principles mentioned above, the indexes in the figure are chosen carefully to change the situation of a country's trade sustainable development. It contains seven subsystem indexes to measure from different angles, which cover the economy, society and trade, especially in the long-term.

3. Sustainable Trade Development Assessment Model

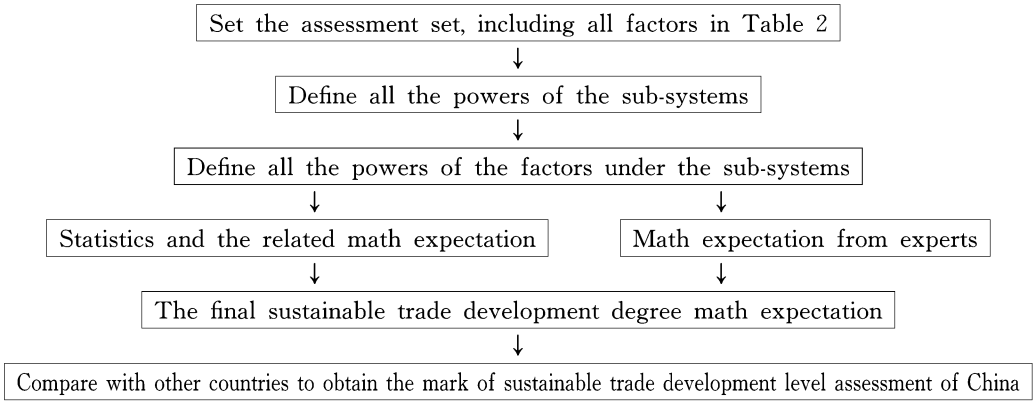


Table 2. Trade sustainable development assessment system index

Total index	Sub-system index	Detail index	Factor contained
	Macroeconomics development level	Economic gross	Average green GDP
			Export trade in GDP rate
		Economic structure	The third industry rate
			Hoffman index
		Economic growth	GDP growth rate per year
			Region finance income growth rate per year
		Economic affection	Society produce rate
			GDP energy consumption
	Macro society development level	Population development	Population growth rate
			Society worker education level
			Population civilization level
		Life quality	Engel Coefficient
			Gini Coefficient
			Urban unemployment rate
			Society guarantee index
			Inflation rate
		Science and education	The science and education input rate in GDP
			The contribution rate of science development
	Resource bearing ability	Resource condition	Average plantation area
			Average water resource possess
			Average energy possess

Sustainable Trade Development Index		Utilization affection	Mine resource re-exploitation rate
			Changing rate of energy produce
			Energy saving rate
	Environment bearing ability	Environment quality	City atmosphere environment quality
			Water environment quality
			Virescence covering rate
		Pollution management	Industry waste release rate disposing rate
			Urban waste disposing rate
			Investment of pollution management in GDP
	Trade economics development level	Total index	Trade contribution rate to GDP growth Trade draw degree to GDP growth Product trade growth rate Service trade growth rate
		Export index	Export product technology contribution rate Export industry produce rate Primary product export rate Finished products export rate Export product creating foreign exchange rate Export product foreign exchange cost
		Import index	Import product technology contribution rate Import product produce rate Primary product import rate Finished products import rate Import product cost changing rate Import product average benefit rate
	Trade society development level		Trade industry employee quantity Trade industry employee rate Trade industry tax changing rate Trade industry average income changing rate Custom tax growth changing rate
	Trade ecological development level	Import index	Export product material utilize rate (per unit) Export product energy consume rate (per unit) Export product waste release rate (per unit)
		Export index	Resource product import changing rate Environment protection technology and instruments import changing rate Pollution product (waste) import changing rate
	Trade environment and resource affection		Export ecology affection Import ecology affection Export resource affection Import resource affection

4. Sustainable trade development early warning system

4.1 Sustainable trade development early warning system function

To establish the operational early warning system, we should firstly solve the model principle and method problem. The early warning system should have five basic functions : description function, explanation function, assessment function, forecast function and policy function.

4.2 Sustainable Trade development early warning system content

4.2.1 Sustainable Trade development definition

The **Sustainable Trade** development aim is not constant, and will be adjusted by the changes in trade. Each period of the trade and development phase should have the sustainable development aim that it both satisfies the benefit of the present age and the ensuing age. After the whole aim of the trade system sustainable development is confirmed, the trade policy should determine the sub-system's (society development, resource environment protection, economic development) sustainable development aim.

4.2.2 Trade sustainable development system analysis

After the whole aim of the trade system sustainable development is confirmed, the trade policy should make the sub-system's aim system analysis and discern the most probable reasons for a system break-down. Through this system analysis, the base of the SWARM stimulation and modeling of the next trade sustainable development early warning system is founded.

4.2.3 Trade sustainable development early warning SWARM stimulation model system

The warning system is the core of the assessment system, and its model establishment, analysis and model correctness will directly influence the early warning system. The early warning signal is based on the statistics and analysis of the source data, and it is divided into five areas, which are the light warning (yellow), mid warning (light red), severe warning (dark red), high warning (double red) and safety (green).

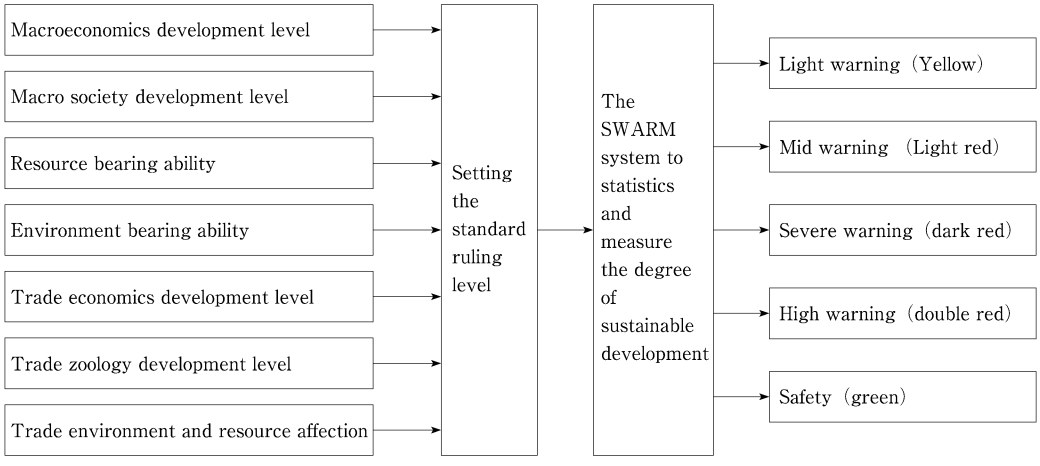
4.3 Trade sustainable development early warning system structure

As a trade sustainable development early warning system, it should not only report the cases of trade sustainable development, but also offers the correct policy for prevention warnings. This research follows the structure of sustainable development early warning aim →system analysis→ trade sustainable development early warning SWARM stimulation model →early warning signal system→ warning and preventing system to form a dynamic circling system. The structure of the system is as Figure 3.

4.4 Conclusion

This early warning system sets the assessment standards as mentioned in Figure 2. These standards are meaningful for both economics and society, and they particularly influence the

Figure 3: Trade sustainable development early warning system structure



trade sustainable development. The system analyzes the real degree of trade sustainable development through statistical analysis; it also classifies the warning levels of trade sustainable development. The limit of each level and marks are crucial and meaningful to the actual development of trade. The assessment result can be directly used for the formulation of policy and government management.

Postscript: The primary research was done in 2005. Then, on Feb. 9, 2006, we presented the study report at the International Conference on "Business and Regional Innovation in Asia" at Ritsumeikan University, and in 2006 China Association for Science and Technology Annual Meeting on Sep. 16, 2006 (Beijing, China). Here we give our special thanks to the Foundation for the Japanese and Chinese Friendly Scholarly Research Plan of Soka University of Japan and to the Japan Foundation for the short-Term Fellowship Program (2007-2008); Social Sciences Project by Guangdong Province Science and Technology Office (*yukejizi* [2006] 118). We have also to thank Dr. Yamai Toshiaki, Professor in Ritsumeikan University of Japan for his constructive comments. Also we appreciate to Ms. Maureen Grant for her proofreading this paper.

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Abstract

The relationship of China's sustainable trade development and its bearing on the environment is studied in this paper. According to the Environmental Kuznets Curve (EKC) hypothesis, the assessment principles and the index orientations are set and the sustainable trade development assessment system is established. On the basis of the statistics and analysis on each assessment index, the related early warning system is discussed and established.

Keywords: Sustainable trade development; Assessment; Early warning system