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THE POSSIBILITY OF RECONCILABILITY BETWEEN
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Vorwort

Im Lauf der Zeit sind immer mehr Leute mit der Verschlechterung der Umwelt getroffen, wer auch versucht haben, die Ursachen herauszufinden. Einige glauben, dass Freihandel zur Erschöpfung der natürlichen Ressourcen und die Verschmutzung der Umwelt führt. Einige identifizieren die Armut als Hauptursache der Umweltzerstörung und erkennen die Notwendigkeit für einen neuen Bereich des Wirtschaftswachstums. Einige Länder verwenden die Handelsmaßnahmen für den Schutz der Umwelt, welche die „Handelshemmnisse“ führen können. Die Verknüpfung zwischen Handel und Umweltschutz ist daher ein wichtiges und umstrittenes Thema geworden. Die Meinung von den Leuten, wer sich vornehmlich mit der Umwelt befassen oder darüber bekümmern, ist deutlich unterschiedlich mit der Meinung von den Leuten, wer Handel vorziehen. Es gibt auch offensichtliche Unterschiede in der Haltung zu dem Streitpunkt zwischen den Entwicklungs- und Industrieländern.

Darüber hinaus hat China, welches mein Mutterland ist, in den vergangenen drei Jahrzehnten sehr großes und schnelles Wirtschaftswachstum. Aber es sind auch schwerwiegende Umweltprobleme mitgebracht, insbesondere die Verschmutzung der Luft, der Süßwasserressourcen. China sollte die geeigneten koordinierten Entwicklungsansätze zwischen dem Wirtschaftswachstum und der Umwelt finden.

Die Beziehung zwischen dem Umweltschutz und den freien Handel ist komplex. In dieser Abschlussarbeit möchte ich die Möglichkeiten von den Vereinbarkeiten zwischen den Umweltschutz und dem frei Handel untersucht. Die Möglichkeiten sind hauptsächlich in drei Bereichen diskutiert: erstens sind die Umweltkosten zu internalisieren; zweitens sind die Umweltstandards in verschiedenen Ländern zu koordinieren sowie harmonisieren; drittens sind die Möglichkeiten der Lösungen der Probleme unter WTO zu untersuchen.

Für die Vollendung von meiner Abschlussarbeit möchte ich mich Herrn Professor Wolfgang Weigel herzlich bedanken. Er hat mir viele Unterstützung, hilfreichen Anregungen, konstruktiven Vorschläge gegeben.

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Abstract

As the developing of trade liberation and economic globalization, free trade becomes the main trend of world economy. More and more countries have joined free trade agreement, especially WTO. Free trade plays an unreplaceable role in the development of economy and welfare in many countries. Environment is the basis and resources of the existence and development of a nation, but the growth of unsustainable production and consumption is gradually exceeding the withstanding ability of the nature, which causes its deterioration, and even threats to the existence and development of human beings. Meanwhile, the improvement of living standard raises people's concern about environment quality.

In the competition of oversea trade in the world market, a new trend of tariff barrier and green trade barrier is enforced. International trade disputes involve more and more issues about environment, which influence the normal development of international trade as well as global environmental protection. On one side, many countries are developing export-oriented economy and appealing to eliminating tariff barriers for free trade and fair competition; and on the other side, free trade is considered as one of the reasons of environment deterioration. Environmental protection has a strong connection with globalization and international trade, and becomes legalized or even institutionalized. It is involved in international trade rules and national export trading policies and laws. A basic way to realize efficient environmental protection is to internalize the environmental cost, i.e. to reasonably price the environmental resources based on a clear defining of its property rights, and to include environmental cost into the production or consumption cost, which leads to an efficient distribution of environment resources in the market.

With the guidance of sustainable development principle, trade liberation offers more advanced technologies for environmental protection. But when it exceeds the affordable range of environment and ecology, it causes damages of ecological

resources and pollutions. Furthermore, an improper measurement for environment protection can limit trade development. A good balance between trade liberation and environmental protection is a key issue in free trade development, which is the main topic to be studied and analyzed in this thesis.

The issues of trade liberation and environmental protection involve national relevant policies as well as international cooperation. Countries and corporations raise the environment standard by making rules and policies about trade and environment, to realize internalization of environment cost and sustainable economy development. International cooperation is an effective way to coordinate the connection between international trade and environmental protection. WTO is an efficient organization to solve the disputes in world multilateral trading system. With its international agreements, (for example, Rio Declaration on Environment and Development and Declaration of United Nations Conference on Human Environment,) WTO standardizes the behavior of its members and solves the issues about international environmental protection through coordination.

Part 1: Theoretical Analysis of Trade and Environment issues

Chapter 1: The relationship and interaction between trade and environment

Section 1: Environment Deterioration and free trade

It is well known, that there are many causes of environmental degradation: from the social aspect, the rapid population growth accelerate the consumption of natural resources, which cause the damage to the environment; from the economical aspect, the inefficiency of market is the economic reason for environment damage. The inefficiency lies in the fact that the market cannot properly price the environmental capital and results in the existence of external effect. External effect refers to the influence of a certain production or consumption activity affects the others or the society but not counted into the production or trade cost of the products. In this case, some individual cost of the activity is lower than the society cost, or the individual benefit is higher than the society benefit, which leads to the overdevelopment and overuse of natural resources as well as environment deterioration. Some environmental resources are public products, such as fishing resource in public sea, where overfishing destroys its fishing resource but no one takes the responsibility for the resource exhausting. As long as the individual marginal benefits is larger than the individual marginal cost, the fishing activity will not be stopped, till the fishing resource in the public sea is exhausted, i.e. the “Tragedy of Commons” happens. On this occasion, the solution to protect the environment is internalization of environmental cost, i.e. to reasonably price the environmental resources based on a clear defining of its property rights, and to include environmental cost into the production or consumption cost, which leads to an efficient distribution of environment resources in the market. Thereby the environment could be effectively protected.

In reality, as the product or labor price does not include all the environmental cost, international free trade may enlarge the inefficiency of market and therefore the

environment deterioration. The second reason why trade is related to environment is because many environmental problems are global or cross-border transferring. One activity in one country may affect the environment of another country; or the pollution may transfer from one country to another. Short of a strong and effective global environmental organization, it is hard for one country alone to treat the inland pollution caused by production or consumption activities of another country. Trade sanction or trade limit can affect those activities and indirectly protect the environment. WTO has important responsibility to solve the environmental problems. Through its effective dispute-solving agencies, WTO standardizes the behaviors of its members. The third reason that trade is related to environment is that the differences of environment standards in different countries. The countries with higher standards believe that the products from low-standard countries have the cost advantage in the international market because the products contain low environmental cost, which is called “ecological dumping” phenomena. They believe it is an unfair competition and they should take actions to limit the import of those products.

Section 2: Relevant problems on trade and environment

Relevant problems on trade and environment can be concluded as the following aspects:

1. Environmental effect on trade;
2. The effect of trade liberalization on environment;
3. Effect of environmental regulations on trade (the competitiveness problem);
4. The effect of standard relating to environment on trade;
5. Legality of trade measures for the goal of environment;

2.1. Environmental effects on Trade

First of all, environment is a basis and a necessary condition of international free trade, the reasons are as follows:

Firstly, nature environment provides rich sources and energy resources for international free trade.

Secondly, environmental differences in various districts lead to comparative benefits in various countries and differences in international work division. For examples, the Middle East exports oil; the USA exports wheat, South Africa exports gold and Africa needs to import rice.

Thirdly, environment policies affect the contents and ways of international free trade. In trade theories and practices, every country should consider the affordability of environment and environmental protection. For instance, policies on ozone preservation greatly reduces trade amount of cooling devices with Freon; unleaded gasoline is advocated in order to protect the atmosphere. On one hand, as the environmental protection measurement and technique standard regulate production process, craft, material, quality and component content, the labor, resource and financial costs in the enterprises to meet the requirement are transferred into production cost, and therefore price and competitiveness of the products are influenced. On the other hand, strict environment measurements may offer new opportunities. For example, an export enterprise meets a higher environment standard, becomes competitive than other competitors and gets into international market more easily. Besides, environmental protection brings demands for environment friendly products.

However, some measurements to protect environment could limit the development of trade. For instance, in order to reduce discharge of solid waste, product sellers in Germany are required to recycle and reuse certain portion of packages, which is a big burden for the foreign exporters, because compared with inland producers, it takes them more time to collect and recycle the package, and it is more difficult to transport the collected packages back on a much father journey.

Governments can influence the product cost and competitiveness and support environmental protection in financial ways such as offering green allowances.

Lastly, the situations of environment in different countries affect the development of international free trade. Because of the difference of acknowledgement of environmental problems, there are also differences of the attitudes and actions about environmental protections in different countries.

Some countries with higher environmental standards transfer polluting industries to the other countries on purpose, and developing countries make attractive policies for foreign investment and ignore the possibilities of environment deterioration.

Furthermore, the strict environment standards in developed countries are pressures for developing countries' trade policies. In order to meet these standards, developing countries may have loss from uncertainty and cost increase of export products. It is possible that some developed countries set up environmental trade tariff with the excuse to protect environment, i.e. environmental protection policies transformed into substitute of trade tariff, which affects development of international free trade.

Because of the comparative advantage of environment cost, products from developing countries have certain price advantages in international market. So some developed countries come up with issues about ecological dumping and propose to consider environment cost advantage as subsidies and to impose countervailing duties, when import products hurt or threaten domestic industries. Or when import products have low prices because of environment cost advantage and threaten domestic industries, anti-dumping duties are imposed to offset these cost advantages.

Recently, there are conflicts between the environmental policies and the multilateral trading systems, one of the reasons is the divergence between developing and developed countries. The more important reason is the lack of a global coordination policy. The trade policy, which is not coordinated with the environmental protection, will aggravate the environmental pollution.

2.2. The effect of trade liberalization on environment

Trade liberalization needs the cooperation of relevant resource and environmental management policy. It is the new consideration to fully protect environment and sustainable development in the field of environment through the effective resource allocation. Except scale effect, the environmental effect of trade liberalization also includes structure effect, technique effect, and regulation effect, which makes the problem of effect of free trade on environment be complicated. (Panayotou) From the perspective of scale effect, with the economic growth (adding of output), environmental problem is becoming increasingly severe, because the emission brought by unit output increases. Some developed countries such as EU and America propose assessment with sustainable effect should be added in the future trade negotiation. Trade liberalization is a helpful tool for the assessment of environmental effect, which can be used to promote policy coordination, define environmental policy and measure, and ensure that trade liberalization promotes sustainable development. But there will exist some problems if the assessment of environmental effect is done under multilateralization. If the assessment is done without considering the feature of country and district, it actually will increase the burden of developing countries, making trade liberalization is not beneficial to the development of developing countries. The problem of the effect of trade liberalization on environment is increasingly prominent in policy field, leading to various controversies.

- I. Scale effect. Trade liberation results in the enlarging of economic activities, and increase of consumption and income. The enlarging of economic activities raises the pressure of the withstanding capacity of ecological system and may cause direct damage to environment. And if the income is increased to a certain level, the government could have more financial investment in environmental protection and treatment to improve the environment.
- II. Composition effect. With the increase of trade liberation level, different countries tend to focus on specialized productions based on comparative advantages. Trade

composition tends to more environment-friendly products. The higher the economic development level is, the lower the trade turns the pollution level of the economic composition and speeds up the transform from production industry to service industry.

III. Technique effect. Trade liberation deepens the specialized labor division and the international flow of products, the transfer of techniques and spillover effects are more obvious. However, on the other hand, the technique of large-scale resource exploitation and environment damage could be widely applied. If the techniques, which are harmful to the environment, are more economically efficient, they would replace the traditional environment-friendly techniques and result in negative effects to the environment.

Trade's effect on environment is a sum of all above three effects. Copeland and Taylor are the ones who did the earliest study about the effects of trade on environment with trade mode. In the mode, they divided the countries into two groups: northern (developed) and southern (undeveloped) and categorize the products with the levels of pollution. It is assumed that the pollution problem caused by inland production is not global or cross-bordered and exists only within this country; it is also assumed that the governments of the above both groups control pollution per charging pollution tax; and the only difference between the two groups is the northern has high tax rate and the southern low. During trade between two groups, both sides will do some adjustment. Firstly, the industrial structure in every country will be changed. As income levels are different, the trends of adjustment in each group are also different. The northern will reduce the scale of polluting industry while the southern enlarge it. Composition effect results in decrease of pollution in the northern and increase in the southern. From the aspect of scale effect, trade enlarges economic activities, which has negative effects to the environment of both sides. What's more, trade raises welfare and income levels in every country, so the nations' will to invest in environment friendly products is also raised; governments increase pollution tax rate and enterprises must use more pollution

control and treatment devices. So from the aspect of technique effect, pollution caused by unit product is reduced.

The study states that if demand for a clean environment increases faster than that of income, technique effect may offset the influence of scale effect on environment. The southern has low environment standard and gets benefits from more polluting industries, but the negative influence to environment from scale and composition effects is larger than the positive influence from technique effect. The conclusion of the study is that trade liberation reduces the pollution in the northern group but enhances it in the southern one.

Another conclusion from this mode analysis is that a balanced trade increase between two groups cannot increase a worldwide pollution because both groups will increase the environment standards and the industry structure world widely will remain the same. However, if trade increases in northern group faster than it in southern group, the standard difference will be enlarged; polluting industry is cut down in northern while is increased in southern, which causes an increase of average pollution discharge in unit production as well as of pollution in the whole world. If trade increases in southern group faster than it in northern group, a contrary result will turn out, which means the environment situation worldwide will turn better. Therefore, if trade liberation can increase the income of both groups to a balanced direction, trade will help solve the global pollution problem. Usually an open economy develops faster than a closed one, and developing countries' tariff barriers is higher than developed countries' (exceptional cases such as agriculture and textile, will be referred in the following), so more trade liberation might be helpful to global environment.

In another study, it is assumed that environment pollution problem is not districted but worldwide, such as global warming. The hypothesis is that the measurement to control pollution discharge is discharge permit system and permit could be traded. The composition effect of trade between two groups is polluting industry scale in southern group is enlarged and so is clean industry scale in northern group. The market price for

polluting permit in northern decreases, while it in southern increases. Southern countries have to add permit issuing and northern countries withdraw the permit in order to reduce influence of global environment. But the add and minus from the two sides cannot offset each other, so compared to before trade liberation, trade development causes more pollution discharge.

According to the study, southern countries do not have a clear definition of property right of natural resources. A lack of motivation in resource reservation leads to overexploiting and abusing of resources. Trade between two groups can worsen this phenomenon. Because of the low cost of resource consumption, southern countries have advantage in resource intensive production but ignore the clarification of resource property right and sustainable management. A demand of above mentioned production in the world market may worsen environment deterioration. In this case, trade activities make environment deterioration even worse but the origin lies in a poor property right system and the related overexploiting of resources.

The basis of the above mentioned conclusion is a hypothesis that comparative advantages depend on different environment standards and resource management system in different countries, which is related to average income levels; usually rich countries prefer applying stricter standard and better system. Trade liberation improves the environment in developed countries but worsens it in developing countries and even it in the whole world. From this point of view, multilateral environment agreement should be in accordance to trade liberation on the purpose of global environmental protection. But environment cost takes a small percentage in production cost, other elements' influence on comparative advantage can easily exceed environment standard' influence on it.

2.3. Competitiveness problem

Environmental standards and competitiveness is one of the focal point of trade and environmental issues. The level of environmental standards may theoretically affect the

competitiveness of the production costs and the environmental cost of the product. Differences in environmental standards is very small impact on the comparative advantage, it does not change the pattern of comparative advantage by classical trade theory of the decision, because the abundance of factors of production determines the degree of comparative advantage of a country.

Since 1990s, the problem of environmental competitiveness has involved two relative aspects with different essences: the first is the problem relating to analysis, including the effect of trade liberalization on environment, the effect of trade measures relating to environment, and the effect of environmental regulations on trade form; the second is the problem relating to negotiation, including the relation between trade measures and trade rules in international environmental agreement, and the effect of domestic environmental measures on trade etc.

Environmental and competitiveness is the problem of analysis, but it involves negotiation problem when linking up with political concepts or a problem of fair trade. From the perspective of Letchumanan, with the economic development in industrial countries, the trend of environmental regulations is increasingly strict. The first reason is that environmental regulations are relevant to the level of economic development, and the second reason is that residents in developed countries have higher preference to high-quality environment. Developed countries argue that product cost is looser than environmental regulations, so they worry about their domestic manufacturing industry would transfer to countries with lower environmental standard, or various countries decrease environmental standard to attract foreign investment to let developed countries be in competitive weakness relative to developing countries on trade. They propose the assumption of “race to bottom” or investment transferring to “pollution haven” for world environmental standard. On the negotiation problem, developed countries insist taking compulsory measures, forcing developing countries to raise environmental standard, allow them taking punishment trade measures under international coordinating environmental standard or the framework of multiple trade,

and impose green anti-subsidy tax to products coming from areas of environmental standard to compensate the loss of competitiveness.

On international forum, some negotiations are generally based on the premise that environmental has direct effect on international competitiveness, so environmental standard needs to be regulated to avoid getting a ride for free. In this aspect, developed countries make policies, including anti-subsidy tax and environmental tax, import and export tax, environmental subsidy, coordination of environmental policy, bilateral trade/environment agreement, and integration of environmental/industrial policy etc. For example, OECD's negotiation of MAI had certain effect on international trade and international environmental management, although MAI failed to reach an agreement. Some countries suggest articles should be added in multiple environmental agreements to restrict countries with loose environmental standard, making them keeping up with international standard.

2.4. The effect of standard relating to environment on trade

In the past few decades, environmental regulations are becoming increasingly stronger with more wide content included. Environmental regulations almost involve the whole life cycle of one product, from raw material demanded by manufacturing to package, recycling and environmental logo. At the state level, environmental regulations are implemented through some measures, while environmental standard is the basis of these measures. Especially standards relative to trade are divided into product standard and method standard:

1. Product standard is the standard that regulates product preventing from doing harm to environment when being used or disposed. For example, paints should not include plumbum, and refrigerating products should not include CFC etc.
2. Method standard--- the standard of production engineering and PPMs, which regulates how product is produced and the possible effects of environment; PPMs will not cause problem when applied to one country, but when it is applied to trade

products, it equals to add the standard set for domestic economic activity to imported products, making imported products bear the extra cost which has important effect on international free trade.

The scope and content of environmental regulations and environmental measures in some industrial countries are continuously expanding, which causes some limits to trade, making that environmental measures are possible to become disguised protectionism. The problem of product standard is the main negotiation problem in round of Uruguay. The agreement of technical barrier of trade reached and animal and plant quarantine inspection measure agreement is aimed at the product standard, encouraging product standard to refer to international standard, which has further restriction to disguised trade barrier on law. WTO recognizes the product standard relative to product based on PPMs, but it doesn't allow PPMs to charge and make standard relative to non-product, because method standard is not easy to coordinate like product standard. In WTO, the problem of product standard relative to product, especially the standard problem depended by the making process of environmental logo has not been addressed reasonably.

2.5. The legibility of trade measures in order to protect environment

A lot of multilateral environmental agreements begin to arise in the world, a part of which becomes the article of trade limit measures in order to protect environment. (Multilateral environmental agreement makes trade limit measures to ban or restrict trade of targeted product or substance regulated by environmental agreement, to establish regulation framework to regulate product or substance trade in environmental agreement, to limit the sale of product that causes environmental pollution, and to encourage more countries to participate in environmental agreement to avoid getting a ride for free.) Meanwhile, there are multiple trade measures relative to environment in the legislation of many countries. In order to protect environment, the country can apply product regulations suitable to its own country in imported and exported product,

and can also take measures to keeping the production and process of domestic products from doing harm to environment, but now environmental agreement for environmental protection or unilateral trade restriction measures have conflict with the duty of multilateral trade system.

Porter hypothesis believes that pressure on environmental regulations is just like market competitiveness pressure which encourages enterprises to carry out cleaner production or innovation of cleaner products. The result of innovation is new products with commercial value or the generation of manufacturing technique. For example, owing to the serious destruction of the ozone layer, the international community required to phase out the production and use of ozone depletion substances CFCs in the 1990s. In this case, DuPont Company laid down a plan of development and production of CFCs substitutions, which put DuPont at the forefront of the development and production of CFCs substitutions and gave the company obvious advantages in international competition.

Of course, whether the Porter hypothesis is true still needs a lot of empirical test. Some eminent environmental economists (such as Palmer, Oates, Portney, etc.) partly affirmed the Porter hypothesis: enterprises give more attention to the good influence brought by the environmental issues for the following reasons. First, it can improve the pollution control technology; second technology innovation can be achieved in cost saving and quality improvement. However, environmental control actually increased the cost of enterprises. Environmental control is beneficiary for the society in improving people's quality of life.

Chapter 2: Free trade, environment and economy

Section 1: Economic growth and environmental protection

The connection between economic growth and environmental conditions is also a hot topic in trade and environment. On this issue, developed countries and developing countries have great disagreements which are also reflected in whether to include the issue of trade and environment in the new round of WTO negotiations. Developed countries hold that the issue should be included. On the one hand, they argue that environment pollution is a common problem faced by all countries. The degradation of environment is threatening the survival of human beings and shall be improved by taking up various measures through various channels; WTO, as the basis of the world multilateral trade system, must discuss this issue in its new round of negotiation. On the other hand, if WTO achieves special agreements on trade and environment through multilateral negotiations and requires its members to strictly implement unified environmental standards and regulations, developed countries could prevent products of low environmental standards from developing countries to enter their markets; at the same time, the developed countries would also occupy a leading position in the international environmental protection market by virtue of its own economic strength and science and technology advantages in environmental protection.

For developing countries, they believe that only through economic development could more resources be invested in environment protection. Today's global environmental pollution is largely caused by developed countries in the process of development. Therefore, developed countries should bear the main responsibility in pollution control and shall have the obligation to provide assistances to developing countries in capital and technology. Developing countries generally object to discuss the issue of trade and environment in the new round of WTO negotiations. They insist that although environmental protection would provide environmental resources for their sustainable development, the implementation of strict environmental standards and regulations is a severe challenge to them no matter in the improvement of production costs, or in the

restriction of export potential. They worry that once recognized by the WTO, the strict environmental standards and regulations advocated by the developed countries will be abused by them and turn into a new form of trade protection to hinder the products of developing countries to enter the market of the developed countries.

Section 2: Trade, economic growth and environmental protection (EKC)

Some people believe that there is a contradiction between economic growth and environmental protection, because the former will lead to the deterioration of the environment and the latter will hinder the development of economic growth. Trade, while promoting economic growth, also results in environmental degradation. For these reasons, some environmentalists suggest that we should maintain zero economic growth so as to protect the environment. Others hold the opinion that environmental conditions are related to the phases of economic development. That is to say, the environment will be improved when the economy reaches a highly developed phase. Based on the above-mentioned, there is a special relationship among trade, economic growth and environmental protection.

Environmental degradation is closely linked with poverty. Many developing countries can't afford the cost of environmental protection, or are reluctant to be responsible for the global environmental issues, which is mainly caused by the production and consumption of developed countries, at the expense of their economic development. This will bring about the further deterioration of the environment.

If poverty is the crux of the problem, then economic development, to some extent, will be beneficial to the environmental issue by shifting the focus of some countries from the current issues to the long-term sustainable development. Some empirical analysis shows that economic development in its primary stage will cause environmental degradation; however, once economic growth and the per capita income increase reach a certain level, economic development will benefit environmental improvement,. This is what the EKC (the Environmental Kuznets Curve) has revealed. EKC curve, an

inverted U-shape curve (see Figure 2.1) giving an illustration to the relationship between a country's per capita income and its environmental conditions, has shown that environmental pollution will be worse with the increase in the relatively low per capita income, but environmental conditions will be improved in line with a higher per capita income.

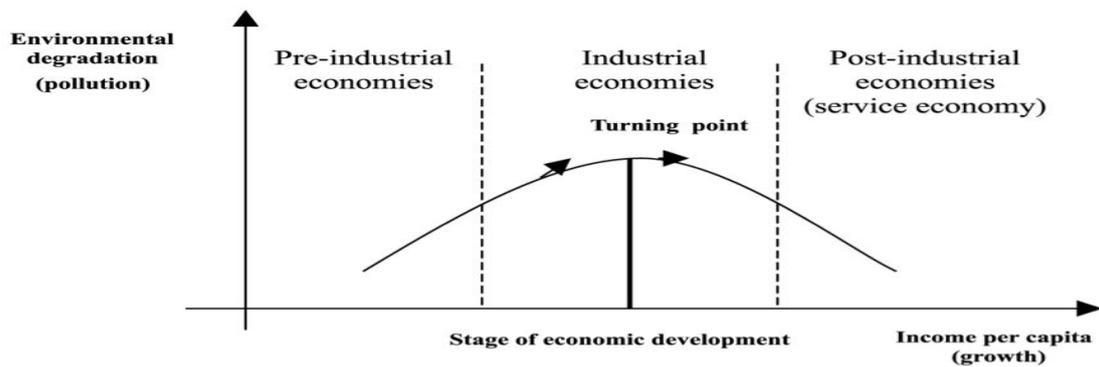
Nevertheless, some of the evidences are not consistent with the EKC curve. Analysis shows that the EKC hypothesis works in explaining some environmental issues for different reasons; but some other environmental issues do not comply with the hypothesis. Environmental problems corresponding to the EKC hypothesis are the domestic ones, such as urban environmental problems, air pollution and water pollution. Relatively speaking, the global environmental pollution, the CO₂ emission in particular, does not seem to be consistent with EKC hypothesis. All countries, in essence, paying little attention to the global environmental pollution issues, tend to focus on the domestic environment and are more willing to take measures to solve the pollution problems rising in their own country while paying little attention to global pollution. This proves the necessity and the importance of international cooperation in solving the global environmental problems. For example, the implementation of Montreal Protocol on Substances that Deplete the Ozone Layer contributes to the reduction of chlorofluorocarbons (CFCs), which has played an important role in the protection of the ozone layer.

In the relationship between economic growth and environmental conditions, trade serves as an engine to help promote economic growth. In the process of economic development, there are many factors that count, such as a perfect legal system, a reasonable allocation policy, stable macroeconomic environment, a well-coordinated fiscal and monetary policy, well-improved infrastructure and high-quality talents etc. In addition, an open trading system is also a very important factor.

The relationship between trade system and economic growth can be mainly reflected as follows: firstly, trade contributes to the promotion of the optimized allocation of

resources and improvement of welfare standard; secondly, trade barriers have distorted the commodity prices, offering an improper guidance to investment; thirdly, a closed economy system is not conducive to the technological development and innovation, and it's evident that, other things being equal, countries with opening-oriented economy has developed at a faster speed than the ones with a closed economy system. The second reason for the introduction of trade to the relationship between economic growth and environmental conditions is that many people believe international competition pressure has brought about or contributed to failure in the environment policy. Many people believe that the enhancement of international circulation of production factors, especially in such a case that trade and investment barriers have been greatly reduced, shall be accounted for the fact that some governments are less willing to improve the environmental standards. Consequently, economic growth resulting from the integration of the world economy and the liberalization of trade has made EKC invalid, for pressure from competition has kept the environmental standards from being improved and environmental conditions have not become better as the economy grows. As a matter of fact, economic growth itself will not be helpful to reduce the environmental pollution. The essential problem here is that with the increasing income, stricter environmental standards must be set to improve environmental conditions.

Another view related to this is that economic globalization may affect the shape and the correlation of EKC. Some believe that, the turning point emerging in the EKC in the developed countries can be partly put down to the phenomenon that pollution industries in these countries have been transferred to developing countries. If, in some sense, this point of view holds water, it will be more difficult for the countries at a middle-income level to cross the EKC vertex; and for the least developed countries, the difficulty will be much greater, since no place is good for them to transfer the pollution industries in their country. In a word, the inverted U-type pollution curve is neither suitable for the backward developing countries, nor for the global environmental issues.



Source: Panayotou (1993)

Figure 2.1: Shape of the EKC Curve

Here, this paper will elaborate the relationship between trade, economic growth and environmental conditions from the following aspects:

2.1. Theoretical analysis

An inspiration coming from his research made Kuznets put forward the EKC hypothesis. After studying the relationship between economic growth and income distribution, he found that when a country gets rid of poverty and backwardness there will be an increasingly widened gap in income, but once it reaches a certain stable middle-income level, the income gap will be narrowed as economy grows. With the increase in per capita income, the EKC curve shows an uptrend, but eventually comes down, in the course of which there are different factors at play individually or jointly, including a higher requirement for clean environment with the increasing per capita income, pollution control activities with scale economic effects, the restructuring of economy in the process of economic growth and so on.

The most common reason accounting for the inverted U- shape EKC curve is that people tend to require of high-quality environment as their income has been increased. Especially when the increasing demand for clean environment exceeds that for other goods and services, here comes the inverted U- shape curve of pollution. For example, a lower limit may exist in the income level, and once the income has been kept below it, there will be no resources available for environmental protection. In such case, the

dominant problem for people to solve quickly is how to have enough to eat, to wear and to live. Therefore, it's difficult for them to employ the limited resources for environmental protection. But with the income being increased, people will be more willing and more able to reduce consumption in order to protect environment. As a result, an income-related demand for clean environment is one of the causes bringing the curve of pollution to the final fall.

Some studies based on microeconomic analysis have suggested that a higher demand for clean environment will arise as the income increases. But people's willingness to pay for different environmental problems varies; this gives one reasonable explanation to the big difference in economists' estimating the turning point of different pollution problems. Other things being equal, the turning point of pollution issues exerting direct impacts on people's health and quality of life, taking drinking water problem as an example, is relatively lower, while in regard to other environmental problems, the turning point is relatively higher. If a pollution problem affects both people's health and their production activities, the pollution curve will drop at a faster speed. Acid rain resulting from SO₂ emissions will bring destruction to forestry, fishery and agriculture, which is such a typical example for this. Without control over such emissions, it will be harmful to economic growth. This is one of the reasons why some measures should be taken to have a good control of such emissions at lower-income levels.

The development of pollution control technology is another factor affecting the shape of EKC. Assuming that there is no relation between income and demand for clean environment, then only in the case that large-scale benefits from pollution treatment technology have been increasing (i.e., unit pollution control cost will be reduced with the expansion of production scale), does the EKC curve take the shape of an inverted "U". In contrast, under the condition that large-scale benefits from pollution treatment technology tend to decrease, will the EKC curve be in a "U" shape; and with a stable large-scale benefit, the EKC curve will be a uptrend one at all income levels.

Research on the basis of classical microeconomic theory has concluded that like most other economic activities, pollution control activities are also increasing along with the large-scale benefits on the rise. The pollution curve will show a downward trend after per capita income reaches a certain level. This is because the scale of enterprises has become larger and larger with the growing economy, thus little cost, accounting for a very low proportion of production costs and profits alike, is to be allocated to pollution control devices for the unit products. So many companies are able to afford the installment of pollution control equipment. With the enterprises rising like these mentioned above, environmental conditions will be improved.

Furthermore, setting trade activities has a positive impact on the environment. Trade activities have led to a specialized division of labor in the world as well as expansion of enterprise average production scale, so that the production and pollution control activities have characteristics of increasing large-scale benefits. In this sense, the specialized division of labor together with international trade is one of the ways to deal with the pollution problem.

The relationship between per capita income level and environmental conditions is not associated with income, but reflecting the invisible restructure of a country's economy in the course of its development. There are lots of reasons for the restructure of economy, including the specialized division of labor based on comparative advantage which is caused by trade liberalization. Trade liberalization has changed the distribution of the worldwide production activities, taking an indirect change to the distribution of pollution activities accordingly. From the perspective of an individual country, the domestic environment will be improved if the average pollution of its expanding export-oriented sectors keeps at a lower level than that of its downsizing import-oriented sectors; otherwise the domestic environment will become worse and worse. For one country's export means another country's import, and it is impossible that all countries have been specialized in the cleaning industry. Therefore, by transferring pollution from the countries with comparative advantages in cleaning

industry to those with comparative advantages in polluting industry, international free trade would allow countries to reallocate domestic pollution problems in the world. In some countries, even if more strict environmental regulations with the increasing income are conducive to offset the negative structure effects, together with which the scale effects may exceed the technical effects.

2.2. Economic growth and environmental improvement

Supposing that the EKC hypothesis is right ---- with the growth in economy per capita income will increase, and the EKC curve shows an uptrend, but eventually comes down, in turn making environment improved. Dependent on the specific policy measures, the EKC comes into being automatically. The normal market mechanisms can solve some environmental problems out of its own accord. For example, as their income is increasing, people are willing to buy products with an environment-friendly mode of production at a higher price, whereas for the producers, in order to secure the green market, they will accordingly adopt "green" production technology, reducing the effect of production activities on the environment. The government should make some interventions to guide the direction of market forces to sustainable development. By taking advantage of appropriate tax policies or environmental regulations, the government may have an influence on the enterprises' selection of technologies and lead them to adopt environment-friendly production techniques or methods. The shape of the curve in this case is determined by the political decision-making process, which includes two forms; one is that the open-minded government makes plans to control pollution through the implementation of environmental taxes or environmental regulations; the other is a popular vote by the public on environmental policy. In the first case, an optimal balance between environmental quality and production can be achieved at every point, and there will be a higher requirement for clean environment with the increasing per capita income, both of which will bring an adjustment to the equilibrium level, and then naturally comes a standard pollution curve in an inverted

"U" shape. As for the second form, the pollution curve takes the shape of an "N", which means that the curve first rises with the economy getting rid of poverty, and begins to fall after reaching a middle-income level, but it tends to uptrend again when the income is at higher level.

However, only the political decision-making process reflects the interests of the people, rather than gives more consideration to that of producers, the pollution curve thus shows a downtrend. Victims of pollution must have an equal right to participate in the political decisions, jointly formulate or implement appropriate environmental policies. Copeland and Taylor pointed out that in a dynamic model of multilateral trade, if countries have the power to independently develop their own environmental policies, global pollution problems won't be solved with increasing income. In case of "hitchhiker", international cooperation is required to address the global pollution issues. For the lack of such a powerful international organization to formulate and carry out the co-decisions, the turning point in global pollution is much higher than that in the regional pollution problems.

2.3. International free trade and EKC

International free trade and specialized division of labor have changed the distribution of the worldwide production. As the comparative advantage is dynamic and constantly changing, analyses for long-term consideration tend to be complicated. Not entirely dependent on changes in domestic and international trade barriers, pollution distribution of national output will change with time. For example, if a country attaches great importance to education by investing a lot of resources for the development of education, then the comparative advantage in this country will be shifted from primary products to high-tech ones, which can change the pollution intensity and structure of its production activities. This is not necessarily linked with the change in its trade system during this same period. Similarly, if a country's saving rate is 40%, far higher than the world average of 20%, a shift from labor-intensive products in the country's

comparative advantage to capital-intensive ones will take place, thereby the pollution intensity of production activities will also change accordingly. Trade is just one of the factors affecting the economic development process, so it's not advisable to make a separate or isolate analysis about the impact of trade on the pollution curve. In order to achieve long-term sustainable economic development, strategies for economic development have to take into account the environmental factors.

In short, the trade structure effect can bring changes in the shape and the relativity of EKC. In the past few decades, the global economic restructure has made some manufacturing industries a shift from developed countries to developing ones, thus affecting the pollution curves of the countries of two types. Since traditional manufacturing industry produces more pollution than the high-tech and service industry, restructure for developed countries, therefore, plays a certain role in crossing the EKC vertex. Meanwhile, the production structure in developing countries has been more polluted, the up-trending part of EKC in these countries will have a steeper slope and a higher vertex. In simple terms, trade is helpful to promote economic growth, increase income and make appropriate environmental policy implemented; the structure effect of trade makes it easier for some countries to cross the EKC vertices, but more difficult for others.

After an analysis about the reasons for the SO₂ emission reduction in industrial activities both in East Germany and the Netherlands during 1980 and 1990, Bruyn (1997) found that technological innovation resulting from higher environmental tax and stringent environmental regulations was the fundamental reason that contributed to improving environmental conditions. Restructure in domestic production further reduced air pollution in Germany, leaving Netherlands increasing in air pollution, which partially offsets the pollution reduction caused by technological innovation.

In the absence of proper environmental policy, distorted economic stimulus allows producers and consumers not to bear the full social costs of their production or consumption activities, leading to environmental degradation which has little to do

with trade. At the same time, economic globalization has degraded a country's policy-making autonomy, so there is a need for coordination among all countries to formulate corresponding policies.

2.4. Summary

Relevant literature studies have disclosed that the pollution curve will not automatically fall with income increasing. If there is not any change in economic incentive mechanism in which producers and consumers are involved as income grows, then pollution will further deteriorate with the expansion of economic activities. In other words, although the increasing income is essential to draw the focus of the public from the present economic and social problems to the long-term sustainable development issues, the income alone is not enough to reverse the trend of environmental degradation and corresponding changes in the environment policy are required. At this point, a democratic decision-making body is being at play. According to the research by Torras and Boyce, when comparisons are made among different countries with a similar per capita income, what's evident is that those countries with distorted income distribution, high illiteracy rate and lack of democracy in the process of policy-making and law enforcement keep a higher degree of pollution than others. Less on the per capita income, EKC depends more on the system and democratic reforms.

The analysis mentioned previously shows that global environmental problems, such as global warming caused by CO₂ and other greenhouse gases, have a much higher turning point than domestic ones do. One explanation for this phenomenon is that people show no concern about global warming and climate change issues; they prefer to be subjected to the consequences of global warming rather than to pay the cost for reduction in greenhouse gas emissions. Another accounting for the tardy and delaying political decision-making, on the one hand is, that motivation of "hitchhike" exists in terms of global environmental problems, and on the other hand is, that at the

international level there is neither powerful international institution to develop common decisions, nor effective enforcement mechanism. Due to the powerful dispute settlement mechanism safeguarded by trade sanctions, which can ensure the implementation of its decisions, WTO has become the focus in solving environmental disputes.

What should be noted is that EKC has no "natural" turning point. Only when political conditions are ripe for the development of appropriate environmental policies to ameliorate environmental degradation, will a turning point come into sight. In addition, as regards some pollutants, like heavy metals and toxic compounds etc., that can't be decomposed by nature, some actions based on the "precautionary principle" should be taken before the ecosystem is filled to its capacity of environmental pollution.

Not all the economic growth is good for environmental improvement. Environment will benefit more from such pattern of economic development driven by technological innovations for investment economization and reduction in pollution emissions of unit products. A reasonable economic incentive mechanism is conducive to promote technological innovation as well as guide economic growth to develop under the direction of sustainable development. Since environment-friendly technology has gained popularity all over the world through the international free trade, trade plays an active role in the process of sustainable development.

This section here will be ended with an authoritative assertion by Arrow et al (1995): *Economic growth is not a panacea for environmental quality; indeed, it is not even the main issue. What matters is the content of growth---the composition of inputs (including environmental resources) and outputs (including waste products). This content is determined by, among other things, the economic institutions within which human activities are conducted. These institutions need to be designed so that they provide the right incentives for protecting the resilience of ecological systems. Such measures will not only promote greater efficiency in the allocation of environmental resources at all income levels, but they would also assure a sustainable scale of*

economic activity within the ecological life-support system. Protecting the capacity of ecological systems to sustain welfare is of as much importance to poor countries as it is to those that are rich.

Part 2: The conflicts between trade and environment

The issue of trade and environment from the social division of labor, production and exchange activities began, along with the rapid development of accelerating the trend of global economic integration and international free trade, the contradiction between the increasingly prominent. How to realize the harmonious development of both, become an important topic in the development of the global economy. Therefore, it is necessary to produce starting from trade and environment conflict to find out the way to solve this problem. This chapter mainly introduces the conflict between trade and environment, the relationship between the two and mutual influence.

Chapter 3: The conflicts between free trade and environment

Section 1: The cause of links and conflicts

The links and conflicts between free trade and environment are mainly manifested in the following three aspects. Afterwards in this paper it will be mainly from this three aspects to discuss the possibility of reconcilability between environmental protection and free trade.

1.1. Market failure: Externalization of environmental costs

From the economical aspect, the inefficiency of market is the economic reason for environment damage. The inefficiency lies in the fact that the market cannot properly price the environmental capital and results in the existence of external effect. External effect refers to the influence of a certain production or consumption activity affects the others or the society but not counted into the production or trade cost of the products. In

this case, some individual cost of the activity is lower than the society cost, or the individual benefit is higher than the society benefit, which leads to the overdevelopment and overuse of natural resources as well as environment deterioration. Some environmental resources are public products, such as fishing resource in public sea, where overfishing destroys its fishing resource but no one takes the responsibility for the resource exhausting. As long as the individual marginal benefits is larger than the individual marginal cost, the fishing activity will not be stopped, till the fishing resource in the public sea is exhausted, i.e. the “Tragedy of Commons” happens. On this occasion, the solution to protect the environment is internalization of environmental cost, i.e. to reasonably price the environmental resources based on a clear defining of its property rights, and to include environmental cost into the production or consumption cost, which leads to an efficient distribution of environment resources in the market. Thereby the environment could be effectively protected.

But in reality, as the product or labor price does not include all the environmental cost, international free trade may enlarge the inefficiency of market and therefore the environment deterioration.

1.2. Global or cross-border transferring environmental problems

The second reason why trade is related to environment is because many environmental problems are global or cross-border transferring. One activity in one country may affect the environment of another country; or the pollution may transfer from one country to another. Short of a strong and effective global environmental organization, it is hard for one country alone to treat the inland pollution caused by production or consumption activities of another country. Trade sanction or trade limit can affect those activities and indirectly protect the environment. WTO has important responsibility to solve the environmental problems. Through its effective dispute-solving agencies, WTO standardizes the behaviors of its members.

1.3. The differences of environment standards

The third reason that trade is related to environment is that the differences of environment standards in different countries. The countries with higher standards believe that the products from low-standard countries have the cost advantage in the international market because the products contain low environmental cost, which is called “ecological dumping” phenomena. They believe it is an unfair competition and they should take actions to limit the import of those products.

Section 2: The genesis of the conflicts: raised issues

Since Adam Smith and Ricardo, economists have been free international trade as a source of wealth and welfare income. In their respective comparative advantage in producing the most effective products, thus the global and national output increased. But environmental activists from another angle to think, think that free trade is the most destructive factors of environment. Free traders argue that, environmentalists criticized the trade liberalization hinders the process of global economic integration, affected the open global market interest.

The first session of the United Nations Conference on human environment around the trade and environment issues first held in Stockholm in 1972 on the attention, with the acceleration of global economic integration and the world environment day by day worsening, two events in the last century 90's, the two questions foreground: the establishment of the United Nations held in Brazil in 1992 Conference on environment and development in 1994 and the Uruguay round negotiation of GATT and WTO. These two pieces of landmark event representing the two tide the peak of development: environmental protection trend and trade liberalization and globalization. The occurrence and development of the two trends are parallel and independent, but between the inseparable relation determines the two trend may develop in the conflict and fusion.

Section 3: The causes of the conflicts

The root of environmental problem is not free trade, deep-seated reason is the failure of external environmental costs and the resulting failed intervention system. Descriptive model proposed America scholar Hardin in his famous article "the tragedy of the commons", has now been as environmental studies paradigm. Environmental resources as indivisible, often belong to public goods, or have some degree of the public.

Failure of the system, including market failure and government failure. The market can not reflect the environmental value, is the market failure. Government policies can not be corrected even cause or exacerbate the market failure, government failure occurred. Government failure and market failure lead to differences in production and consumption of the social optimum rate and and one optimum rate and mode, so that the free trade worsen the environmental problems.

I. Market failure

Market failure occurs when the market is not the correct valuation and allocation of environmental resources, resulting in the price of goods and services can not fully reflect the environmental costs of their. Environmental cost externality and market environment related failure, improper valuation and property ecosystem are vague.

a) Environmental cost externalization

Environmental cost externalization means that the product or service price does not contain or not contain the environmental cost. For example, the traditional trade and investment theory merely considering the narrow economic interests without considering the broad social benefit especially ecological and environmental benefit of the environmental cost, which leads to the conflict of trade and environment.

As shown in Figure 3.1, According to the traditional international trade based on comparative advantage theory as the representative of the theory, before A country's trading. Balance between supply and demand of a product $E(Q_0, P_0)$,

Producer surplus is P_0EF Consumer surplus is P_0EA . The products price in the international market is P_1 , the domestic supply can't meet demand. So it must be the import of the product of the number of CB, after Trading, we find the producer surplus variable changes P_1FC , Consumer surplus alter P_1BA , The visible net welfare that trading after than trading before increase CEB. But because of the external characteristics without considering the environmental factors. May cause those who specialize in the production of pollution intensive products of the country under the free trade condition blindly pursue Comparative advantage of CEB. And the unlimited expansion of exports, which may seriously damage the national and even global environment, leading to a decline in the level of global social welfare. For example, from the view of the environment, trade activities will increase the consumption of natural resources and waste, increasing environmental degradation; in the course of carriage of goods waste emissions also causes environmental pollution.

b) Improper valuation of ecosystem

When people do not consider the social from the structure characteristics of ecosystem and environmental effects of economic value, market failure will occur. The total economic value can be divided into the following parts: direct use value, indirect use value, existence value and option value. The direct use of environmental assets value easily quantified, it is equal to the actual assets to provide products and services. Indirect use value, its support for economic development, the measurement method is the best contribution and benefit the environment to prevent harm. Value refers to the environment the existence of assets and its ability to maintain ecosystem benefits. Select value refers to the future use of the benefits of environmental assets.

Environmental degradation and resource configuration error occurs, in part because it has failed to correct valuation of environmental assets and due to its contribution to the overall economy.

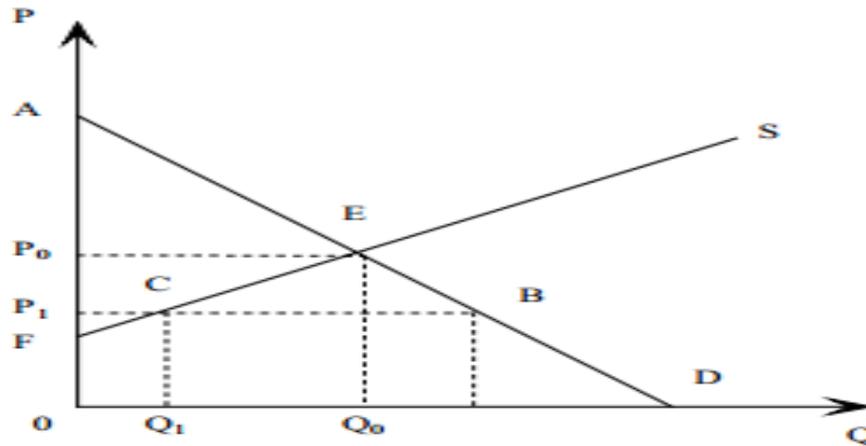


Figure 3.1: The welfare effects of trade

c) Fuzzy definition of property rights

Clear property right is the basic condition for the normal function of the market mechanism. Environmental assets vague definition will cause the invaluable resources low, leading to increasingly scarce resources, waste and excessive use of resources, and further lead to market failure. At the same time, one of the reasons for the fuzzy definition of environmental assets is transnational and global environmental problems of environmental resources: when one country property is not defined, no one will take the initiative to environmental degradation caused by the loss, resulting in its environment and resources, ecological system and will destroy the neighboring countries and cause economic losses. For example, there are rivers upstream countries which built a chemical plant, the discharge of sewage erodes e downstream neighbor's crops, but because the property is not defined, the upstream countries factories continue to discharge sewage and the neighboring residents without compensation. When a single country made resource usage decisions, in order to maximize the benefits tend to ignore it to global environmental benefits and costs, thus will choose not to governance in the

economic and trade interests, at the expense of the environment, the resources, global environmental problems.

In addition, the environment and resources as a kind of public goods has two characteristics of public goods: non-exclusive and noncompetitive, the hidden assets value has been ignored, resulting in "free rider" phenomenon. Therefore, the economic and trade activities are carried out at the lack of incentive mechanism to protect and improve environment quality.

II. Government failure

In the case of market failure, government intervention may be needed. Government failure mainly includes two aspects: one is the "failure of government intervention" or not appropriate action; two is due to the lack of government policy intervention and lead to failure or the failure of the government is to correct the market failure. From the system inside, the end result of political and administrative procedure make the price higher than the social optimal price will cause the government failure.

Intervention failure can be further divided into policy failure and management failure. The policy failure refers to certain policies to the private cost of environmental resource usage cannot correctly reflect the actual cost, private formulated according to the principle of profit maximization of economic policy on private is optimal, but not for the society. These policies and measures, including tax rate, finance, price, income and other policies, include the environmental policy. Management failure refers to the existence of government organizations at all levels of problems, these problems lead to the formulation of the policy cannot be implemented smoothly and correctly, including the labor department, a result of the traditional concept of rigid coordination problems, lack of enough strong method and instruction to achieve policy goals, to ensure that the policy can be lack of means or force implementation in in the course of the economy. In short, both the market and policy failure, which is the environment of asset prices did not reflect its true value, the price of the product from its social cost, the production or consumption activities with external, causing environmental degradation.

Part 3: The possibility of coordination between free trade and environment

Chapter 4: Internalization of environmental costs and the way of realization

From the above analysis we can know, the economic reasons behind conflict between environmental degradation, environment and trade is the environmental cost externalization. Because the producers or consumers can freely use public environmental resources without payment, or paying the fees lower than the value it created. Therefore, economic decision for the maximization of private profit often leads to over exploitation or abuse of resources, causing environmental degradation and "the tragedy of the commons". If we can solve the problem of environmental cost externalization and achieve the internalization of environmental costs, i.e. the price of the product contains the environmental costs, with the correct price signals as the guidance, and the market can allocate environmental resources effectively and solve the root causes of environmental degradation.

As previously mentioned, the root of environmental problem is the failure of external environmental costs and the resulting failed intervention system. Here the analysis on the environmental cost as well as the internalization of it will be carried out.

Section 1: The definition of environmental costs and the internalization

1.1. Definition of environmental costs

Environmental cost is one of the core of environmental economics, refers to the Protect environment, prevent ecological damage, in the commodity production activities, from resource extraction, production, transportation, use, recycling and disposal of waste to all the expenses needed. Mainly consists of two parts and the value of the natural environment to repair the value of natural resources. The former refers to manufactured products using the resource price, while the latter refers to the harm required remediation cost to the environment in the process of product manufacturing and use.

An important characteristic of environmental problems lies in the external non economy, namely the polluters get private interests, but the social cost ("externalities") but with air and water and other ecological environment contaminated revealed. In the export production and free trade if you ignore environmental asset value, trade may aggravate the market failure and deterioration of environment. So it must be due to market failure and negative effect of external economy "Internalization", which is internalized into the true cost of export commodities or services, in order to promote rational use of the resources and the effective protection of the environment.

1.2. The constitution of environmental cost

There is no uniform definition of environmental costs, environmental cost concept adopted by the system of integrated environmental and economic accounting issue in UNSD1993 years in two parts:

- To reduce the quantity of natural resources consumption and the quality loss caused by the value of natural resources;
- The actual expenditure on environmental protection.

For the calculation of the environmental cost, environmental cost accounting USA focuses on content, Japan on the cost accounting to material and energy circulation oriented, while the German pay attention to investment decision for cost accounting purpose and waste.

Pearce think, in order to fully reflect the value of environmental resources, product prices should reflect the environmental cost of complete three parts, one is resource acquisition cost; two is related with resource development, acquisition, use of environmental cost and environmental damage cost; three is composed of contemporary people use this part of the resources and not for the benefit of future generations to use loss, namely the user cost. Pearce believed that all the definition of capital should include not only the manufacturing capital (equipment plant and other infrastructure), also includes human capital (the knowledge, technology and so on) and environmental capital (land, forest). He put forward the concept of sustainable net

national product NNP^* or sustainable national income, said the value of environmental resources,

$$\text{Namely } NNP^* = GNP - D_m - D_n - R - A \quad (4.1)$$

with D_m expresses it manufactured goods capital assets depreciation. With D_n expresses it environmental capital depreciation. R is recovery of environmental capital needed expenses. A is in order to prevent environmental capital (air river water) pollution and damage to the expenses. The environment resources value formula of Munasinghe from the value angle of evaluation that the environment of all economic value (TEV) includes use value (UV) and none use value (NUV) the two part. NUV is the part of the human resources development will be possible to use value, also known as the present value namely:

$$TEV = UV + NUV = (DUV + IUV + OV) + NUV \quad (4.2)$$

DUV is the direct use value; IUV is the indirect use value; OV is the choice of value, is the contemporary people in order to ensure the future generations of resources that the willingness to pay. Environmental cost in general trade products should be included in the product exploitation, production, transportation, consumption and use, recycling, recycling process for and costs make up of resource depletion and ecological damage to the environment required. The constitution of environmental cost includes three parts: the first part is the manufacturer of the normal use of scarce environmental resources and the costs of environmental factors, namely price, remember to use the cost for the enterprise environment (EC_a), Abundance and environmental resources endowment of a country or region is inversely proportional to the second part is the cost of damage to the environment (EC_b), Refers to the environment damage should be borne by the enterprises cost, such as sewage charges, compensation, environmental control and protection equipment investment etc.. The third part is the environmental cost of prevention (EC_c) or "May" costs, including environmental damage prevention and

treatment after fee payment as well as contemporary people destroy the environment and to the ecological imbalance caused by man-made compensate for previous generations and generations bring welfare loss and the cost. Environment cost is the sum of the three:

$$EC = EC_a + EC_b + EC_c \quad (4.3)$$

The internalization of environmental costs into the price, products prices will be composed of the following parts:

- The prices of resources manufacturing products using P_1 ,
- The sum of production labor, capital cost and the expected profit P_2 ,
- Acceptable cost of manufacturing and the harms to the environment used in this product and the environmental restoration to the original state P_3 , the direct and indirect losses caused by pollution of the opportunity cost estimating. Therefore, the complete product price: $P = P_1 + P_2 + P_3$. (4.4)

1.3. The suggestion and definition of the internalization of environmental costs

The economic externality theory is also known as the "Pigow theory" Is the beginning of the last century by Marshall, the famous economist and Pigow is proposed. Relative to the market economy if the party activities have a direct impact on other parties benefits did not participate in the trading market. This impact is not from money or market reflected. It shows that there are differences between personal interests and social interests, resulting in inconsistent private cost and social cost, the private cost and social benefit. According to the nature of externalities can be divided into positive externalities (beneficial effects) and negative externalities (adverse effects). Externalities cause the difference between private and social costs. In the presence of positive externalities, marginal private cost is greater than the marginal social cost, the marginal private benefit is less than the marginal social benefit. The presence of negative externalities, and vice versa. In the field of environment, environmental

degradation and the conflict between trade and environment, economic reason behind is the negative externality caused by environmental costs. Because the producers and consumers can freely use public environmental resources without paying fees, price signals do not fully reflect the value of environmental resources, resulting in market failure.

Internalization of environmental costs is the effect on the external economic main production activities into the economic behavior of producers, the environmental cost is included in the cost of the product, so the price not only reflects the production costs and transaction costs, but also reflects the environmental pollution products with compensation. The core of cost internalization is the polluter pays principle, the pollution (including producers and consumers) should pay the full cost of their actions, which can ensure that the product and its price reflects the extent of the production and consumption-related environmental damage.

Section 2: Pigou method and Coase Theorem

2.1. Pigou method

Pigou put forward "welfare economics": "as the important economic source of environment is the external effect", so in order to eliminate the external effect, it should be a tax on produce negative external effects of a flat fee or to give subsidies, positive external effect unit. And through the research theory of Baumol et al., gradually produced the earliest environmental economic legal means -- "Pigou means": that is, through the national laws corresponding tax, charge pollution fees, financial subsidies and other environmental protection measures. "Pigou means" through the "visible hand" that government intervention to solve environmental problems, the core idea is by the government to the external economy does not determine a reasonable negative price, by making external diseconomy of bear all the external costs.

2.2. Coase Theorem

In 20 Century 70's famous scholar Coase "property rights theory" emerged, namely, "as long as the external effect is clear down as a kind of property right, and negotiation cost less, so the problem of external effects can be achieved by the internalization of resources between the transactions". Practice with voluntary negotiation, the emission trading as the representative of the "Coase means", the market spontaneous draw on the advantages and avoid disadvantages and market trading tools, the internalization of environmental costs, environmental protection. The internalization of environment cost theory has become mature, some environmental and economic policy, new means can be used, for example, environmental labeling system implementation, the promotion of ISO14000, the environmental costs into the audit project of green accounting system. Unlike Pigou's theories, new institutional economics does not think the externality is the inevitable result of market failure and must be compensated for by the power of the state, they think, the existence of external description of the existing system is not balanced, is an important source of institutional innovation. Process the essence of system innovation is a process of internalization of externalities, the system of the organization to make the internalization of externalities, emphasis on the deepening and improving of the market functions.

The specific method means using Coase theorem to solve the problem of pollution Coase, there are generally two kinds of methods:

1) voluntary negotiation method

The ownership of that environment give enterprises, while others are polluting his environment, he can to reach some sort of agreement, and have the right to sue, the market environment is formed;

2) The emission rights trading method

The emission rights will be the environmental capacity as a scarce resource in the market as other commodities traded freely. The government as the representative of the

society, the emission of certain pollutants rights sold to the highest bidder. Polluters can buy this right from the government, pollution can also to have the right to purchase the pollution discharge, between may sell or transfer of emission rights. Emission right initial issuance quantity and method of management according to the environmental protection goals, can exchange in accordance with the rules of free change.

2.3. Comparison between Pigou's means and Coase's means

Around the environmental cost internalization, Pigou and Coase successively put forward two kinds of ideas. Pigou thinks that externalities lead to inconsistency between private cost and social cost. Thus, we should internalize the external cost by charging the amount equivalent to the external cost. This rate is also known as the "Pigou tax" or "sewage charges". Based on the theory of property rights, Coase believes that unclear property right is the essential cause of environmental problems. So the solution to environmental issues is clear property. The resulting transaction is called "Coase trading". The core of Pigou is the internalization of environmental costs by charging. Therefore, it is very critical to determine the rate of fee. In order to know the level of fees accurately, theoretically, we should know the curve of marginal environmental cost and the curve of marginal revenue curve. It is very difficult for the government accurately knowing the marginal environmental cost because the environment is influenced by many factors, such as the level of economic development, personal preference, time factor etc. And the marginal revenue curve of enterprises is not easy to obtain because companies don't offer this data. In addition, Pigou means has problems such as the toll management, employment, supervision and implementation etc.

Compared with Pigou's means, Coase's means is more dependent on the market mechanism. Coase's theorem shows that the optimal Pareto can be realized regardless of the initial property rights belonging to which parties as long as the transaction cost is zero. Emission trading is dominated by the government to implement the total control

and emission permit system by making the pollutant emission permit trading between different enterprises. Therefore, enterprise with higher cost of management can reduce the work of treating pollution through purchasing emission rights and enterprises with lower cost of management can sell emission rights to achieve cost minimization on the premise of total pollution control. Different from emission trading between enterprises, some policies are practicing between enterprises and residents, such as compensation policy. By defining environmental property right in a certain range, enterprises and residents conduct negotiation to achieve the internalization of environmental cost.

There are some conditions for this method dependent on the market mechanism to solve environmental problems. First of all, it is based on the definition of property rights and the definition of the property right incurs cost. Some environmental property rights have higher definition costs, for example, the property ownership of air and river are difficult to define. Secondly, "Coase trading" implementation is based on the low transaction cost. But in real life, transaction costs may be higher, such as negotiation cost, execution cost, supervision cost, performance cost etc.

Theoretically, Pigou's means and Coase' means are internally consistent with each other, but their applicable conditions and the implementation cost are different. Pigou's means more relies on the power of the government while Coase' means more on the market mechanism. The latter enjoys more preference among countries.

Section 3: Approaches to the internalization of environmental cost

a) Reasonable pricing of environmental resources

The pricing of natural resources is the foundation of the internalization of environmental costs. To determine the price of environmental resources shall consider the following aspects: the scarcity and renewability of environmental resource; people's preference for a clean environment; the benefit to the enterprise or the consumer brought by environmental resources; loss due to environmental damage and cost

incurred by the restoration of environment etc. Some prices of environmental resources are easier to determine, like mineral resources such as coal, oil and so on; and some environmental resources, such as air, water, forest, are very difficult to be determined their prices.

b) The definition of the property right of environmental resources

The definition of the property right of environmental resources should base on the reasonable pricing of environmental resources. The ambiguous property right of environmental resources is also an important cause of environmental cost externalization. Because the property right is not clear, everyone can use environmental assets without paying. Driven by the goal of profit maximization, the self-employed will continue to develop and utilize environmental resources as long as the marginal revenue is greater than the marginal cost. Consequently, it leads to over exploitation and utilization of environmental resources, environmental pollution and degradation.

According to Coase's theory on property, there are several ways to define the property right of environmental resources. First, the environment resource property right belongs to the polluter (i.e. resource users); second, the environment resource property right belongs to the victim; third, the environment resource property right belongs to the third party. Theoretical, the above three ways can solve the environmental pollution.

Take river as an example to illustrate it. Suppose there is a section of river. In the upstream, there is a chemical plant (A) which discharges waste water into the river, causing pollution of the river; in the downstream, there is a pond (B) whose benefits is affected by the pollution. If the river property belongs to A, A have the right of discharging wastewater freely. If B doesn't want to let the river pollution affect his fish yield, B can pay a fee to A which is used to purchase pollution control equipment or to make up the loss of A. On one hand, the revenue of A should be higher than the cost due to the reduction of pollution; on the other hand, the fees paid to A should be lower than the revenue brought by the emission reduction. If the river property belongs to the B, B

has the freedom to utilize the river and keep it clean. Therefore, B has the right to request the A to stop polluting the river. If A want to continue to discharge wastewater into the river, A needs to pay the B. For A, its payment should be no more than the profit increased brought by the pollution discharge and the cost to deal with pollution control; for B, the payment received from A cannot exceed the loss due to the pollution of A. If the river property belongs to the third party (C), A want to discharge sewage, it need to pay C a fee, while if B do not want the river being polluted, he also need to pay a fee to C. The above three results of the arrangement of property rights are the same: A will install pollution control equipment or reduce the sewage to the river to ensure the river is in an acceptable state. Thus solve the problem of the pollution of river. The expense depends on the bargaining power and the balance of their costs and benefits. In the process of defining the property right of rivers, it relates to the pricing of river. Environmental resources like rivers are generally belong to the public. When determine the belonging of the property right, property rights of all parties must pay a fee by the management mechanism represented the interests of the public (or government) to obtain the property of the river. The cost has a direct link with the pricing of the river. In the above example, the price of the product of A and B includes the environmental cost. Under the effect of the market, the price will rise with the reduction of demand. Thus, it will eventually make A and B reduce production which is beneficial to the environment.

The example is the simplification of the environmental problems in reality which is in fact more complex. The environmental problems may even not be solved by way of pricing and definition of property right of environmental resources.

There are some hypothesis conditions in the Coase theorem: pollution sources are concentrated and the number of victims is easy to be determined; the cost in bargaining and performing executive decision cost is not too high. But, in reality, the polluting sources are too many and hard to be determined. The number of victims, including the river coast residents, and factories are too many to be determined. People's health will

also be affected once they consume the crops irrigated by polluted water. Therefore, it is very difficult for victims in great number to get together, especially the coastal residents whose interests are very difficult to be reflected.

c) The formulation of suitable environmental policies and measures

In reality, the definition of property rights can only solve part of the environmental problems. Most problems are solved by suitable environmental policies and measures formulated by the government. The optimum environmental policy should be aimed directly at the source of pollution to levy environmental taxes. Environmental tax is directly linked to the pricing of environmental resources and the pricing of environmental resources is affected by environmental standards set by all countries. Tax on pollution source is a specific form of the internalization of environmental costs.

d) Insist on “Polluter Pay Principle”.

Polluter must bear the cost of reducing pollution, in order to ensure that the environment is in a state that can be accepted. The principle requires that the polluter should pay the costs of pollution control, pollution eliminating, also the compensation for the victims. It encourage polluters to proactively manage self-generated pollutants, or else to face the economic sanctions. This principle aims to coordinate environmental policies in OECD countries, to prevent the distorting of comparative advantage and trade patterns due to different environmental provisions.

e) Internalization of the costs for maintenance, updating of environmental assets

Additionally, the value and the cost for the maintenance and updating of environmental assets should be internalized into the cost of the product. The producer and the consumer of the product should share the burden of the cost, which is the essence of the theory of internalization.

Section 4: The mathematical model of the internalization

According to the environmental cost, build the mathematical model of the internalization of environmental costs. Among them, the value of the resource itself according to the theory of land rent to calculate. Assume that R_0 is the basic unit of resource rent. α is equivalent coefficient of the abundance and development and utilization of natural resources (such as regional differences, differences in quality between varieties, and the grade coefficient). The natural resource rent is $R = \alpha R_0$ if it is set as the average interest rate, the calculation mode of the natural resource itself value is:

$$P_1 = \alpha R_0 / i \quad (4.5)$$

The new value of the natural resources of human labor input generated by is P_2 , the production price theory to determine. Let A be a payment in the natural resources property investment, Q is the benefit of the total amount of natural resources. N is the beneficial period, every unit of resources share resource industry overall input to the natural resources is A/NQ .

Consider the average profit rate of investment capital ρ , namely additional profit generated for social investment unit resource. It is equivalent to $(C+V+M)$ (C: Constant capital; V: Variable capital; M: Surplus value).

$$\frac{A}{NQ}(1+\rho) = C+V+M \quad (4.6)$$

When input is divided into several levels, and their coefficients and quantity:

$$Q = (\alpha_1 Q_1 + \alpha_2 Q_2 + \dots + \alpha_n Q_n) / (\alpha_1 + \alpha_2 + \dots + \alpha_n) \quad (4.7)$$

Then consider the interest rate, we can attain the value of available resources of human activities to increase P_2

$$P_2 = \frac{1}{i} \cdot \frac{A}{NQ}(1+\rho) = \frac{1}{i}(C+V+M) \quad (4.8)$$

$$P_3 = \sum_{i=1}^n K_i H_i M \quad (4.9)$$

Among them K_i is Loss coefficient, H_i is effects value of pollution factors of yield per unit of production, M is Product value. Formula 4.5, 4.8, 4.9 into 4.4 we will attain unit of the internalization of environmental cost value P .

$$P = P_1 + P_2 + P_3 = \frac{1}{i} [\alpha R_0 + C + V + M] + \sum_{i=1}^n K_i H_i M \quad (4.10)$$

Considering the scarcity of resources, the size of the relationship between supply and demand of value:

$$P_1 + P_2 = \frac{1}{i} [\alpha R_0 + C + V + M] \cdot \frac{Q_d E_d}{Q_s E_s} \quad (4.11)$$

Among them, respectively Q_d , Q_s are the demand and supply of resources. E_d and E_s is Supply and demand elasticity coefficient of resource. Because the capital should consider the time value, the discount rate is i ' resources in the t year value:

$$P_t = (1+i)^t \cdot P = \frac{(1+i)^t}{i} \cdot \left[\alpha R_0 + C + V + M + \sum_{i=1}^n K_i H_i M \right] \cdot \frac{Q_d E_d}{Q_s E_s} \quad (4.12)$$

The first step in the measurement of environmental costs of environmental impact for confirmation. Enterprises should not only concern about the environmental cost of the current, but also pay attention to the future and potential environmental costs.

Section 5: Environmental cost measurement method

Through the environmental cost in the model analysis, has obtained the key environmental cost internalization is the harm of environmental value estimate, in general, environmental pollution loss measurement is one from the environment destruction to environment loss monetary expression of the process. There are several measurement methods of environmental costs:

- 1) First, the market valuation method or productivity change method: the environment and resources as factors of production, according to the environmental quality change caused by productivity and changes in production

costs, to calculate the change of product value and profit caused by the economic losses caused by the external cost, to determine the market price.

- 2) Second, control the cost method or preventive expenditure approach: the basic idea is to prevent environmental hazards prevention and management fees paid to measure the loss of environmental pollution. Through calculation and comparison easy estimation of the installation, operation and maintenance costs of pollution control in the established standards to replace the environmental damage is difficult to measure the cost .
- 3) Third, recovery expense: the need for compensation or update resources cost measures environmental resource loss, purpose is to influence monetary physical destruction of environmental resources.
- 4) Fourth, the opportunity cost method: the opportunity cost of environmental resources, is a resource for a purpose and give up other uses are caused by the loss or expense. The use of the opportunity cost method is used in the sacrifice of alternative use of income to estimate environment pollution caused economic losses, the selected one scheme and give up the potential benefits of another loss.

Section 6: Analysis of the effects of internalization of environmental cost

In the absence of external environment, market forces can realize the social welfare, the private marginal cost is equal to the private marginal income, namely $MPC=MPB(PMR)$. The market-clearing price is P_p , Equilibrium output is Q_p .

When the external environmental costs of economic activities, the private marginal cost is less than the marginal social cost, and the gap is the marginal environmental cost MEC, namely $MSC=MPC+MEC$. At this time to the firm, to maximize the benefits of production is at the intersection of MPC and PMR output Q_p .For society, the optimal output should be private marginal benefit that equals marginal cost of production decision Q_s , the corresponding price is P_s , From the diagram: $Q_p > Q_s, P_p < P_s$

EF is the external environment cost, so it in market equilibrium generate the production of excess yield, Social economic surplus losses of area DEF.

When does not exist outside of economic, environmental external costs to produce manufacturer economic activities not by producers but borne by society. This is the excessive consumption of environmental resources, the allocation of resources is not the best situation, economy deviates from the Pareto optimal efficiency.

Take measures to internalize environmental costs, such as taxes on polluting products, Assuming the pollution tax is DH, according to the relative elasticity of demand and supply curves, tax borne by both producers and consumers, after tax, MPC rose to MSC, the market reach to new equilibrium D. This moment the equilibrium output and price

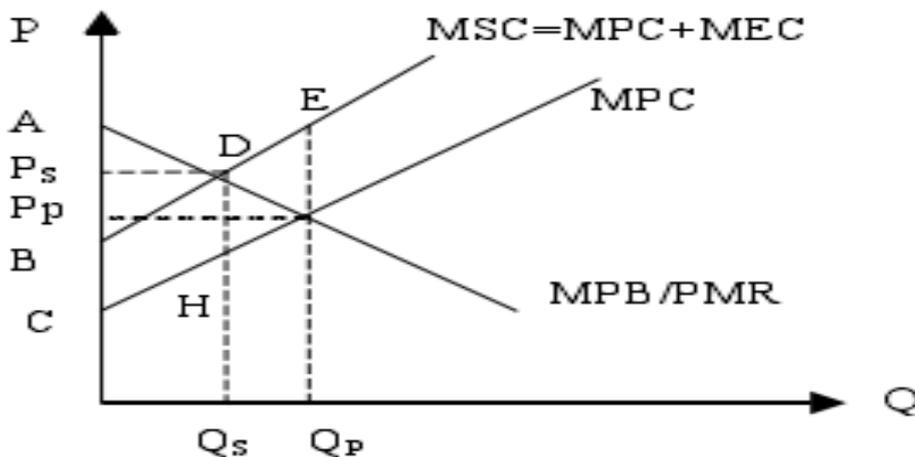


Fig 4.1 The existence of external equilibrium

respectively Q_s and P_s . If the definition of environmental property right of way, also can achieve the same equilibrium point D, then the producer surplus is the area AP_sD , consumer surplus is the area BP_pD , the area of the government tax is $BCHE$, the area of Social economic surplus is ABD . Therefore, take measures to internalize environmental costs, output to reach the social optimal level, not excessive consumption of resources or excessive pollution of the environment, the resources in the optimal allocation of state.

The graph represents a more general and realistic basis in the case. Because of the self-purification capacity of the environment, emissions when pollution is low, the unit cost of the product is rarely. But along with the increase of production, pollution emissions also increased, once more than the self-purification capacity of environment, pollution concentration increased rapidly. In the diagram the difference between the MPC and MSC is increased gradually, indicating that the environmental cost and external larger, when the level of demand in the lower position, the gap between the two is small, however, with the increasing of the degree of liberalization of trade and trade scale, the demand curve and gradually move up (from D1 to D2), external negative effects are gradually increasing.

Through the above analysis shows that, the external environmental costs led to trade products price distortions, so that environmental resources cannot be effectively configuration, which leads to the deterioration of the excessive use of environmental quality and ecological resources, the conflict of trade and environment. Therefore, the expansion of trade scale and at the same time, we must take measures to internalize environmental costs, economies of scale or trade will bring Home Furnishing environmental damage. At the same time, in order to make the enterprise the marginal revenue is equal to marginal cost, must the internalization of external costs, on one hand it makes the enterprises in the pursuit of their own development and benefits at the same time, the coordinated development of economy, society and nature to, on the other hand, it requires enterprises and establish economic goals to consider environmental factors, to avoid short-term behavior. The main reason for the current trade liberalization behavior contributing to the deterioration of the ecological environment and the over exploitation of resources is in trade is not to the development and utilization of natural resources and environmental damage cost properly reflected in the prices of products or services. As long as the environment resources damage value and compensatory reflected in trade in goods and services, trade itself does not aggravate the deterioration of the environment. Internalization of environmental costs

of the measures will affect the production and trade, the goods required for the processing of the production cost and environment cost at the same time into commodity value, more objectively reflect the value of products and prices, thereby affecting the international free trade, and to promote and enhance the resource utilization high, energy-saving and recycling the product gradually occupy the free trade market.

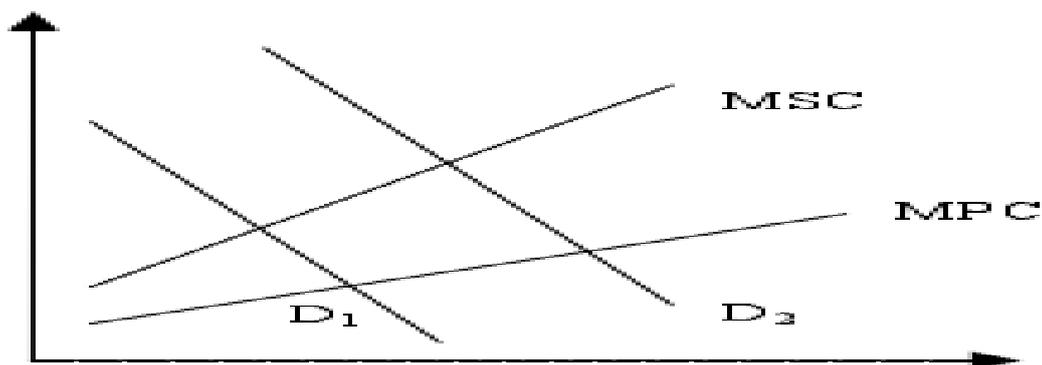


Figure 4.2: general situation

Chapter 5: The effect and coordinating of environmental standard on the trade

Theoretically, the level of environmental standard affects the environmental cost in production cost, which has also influence on product's competitiveness. The famous "Porter hypothesis" proposes that environmental control pressure is the same as the pressure of market competition, which encourages clean production or clean product's innovation of enterprise. The result of innovation tends to be the new product or production of manufacturing craft with commercial value.

Section 1: Effects of the environmental standards

1.1. Effects on the currency form of logistics

Accordingly, there are two basic forms that environmental standard affects the currency form of logistics. The first form is that product's environmental standard is discriminatively suitable for imported products and domestic products, that is to say

imported products and same domestic products apply the environmental requirements with different seriousness. For example, in the case that Venezuela accused ANAI Petroleum standards, WTO judged that American's standard suitable for imported fossil oil is higher than the requirement to domestic fossil oil, so it was discriminative. The second is that different environmental standards are applied to products that have same physical feature and final purpose with different production and processing methods. That is to say discriminative treatment is suitable for products that are produced by harmful production and processing methods.

Through the empirical analysis on environmental standard, the effects that are caused by different environmental standards included the following: First, under the circumstance that other conditions are same, running company in countries with loose environmental standard will be superior to company in countries with higher standard in sales volume, market share and benefit etc.; the enterprise will select to transfer industries to countries with lower environmental standard in order to cut environmental cost. Moreover, from the perspective of economics, different countries adopt different standards. For producers, it means they are burdened with different environmental standard or regulations of various countries, and they must lead to scattered market, increasing trade cost and leading to the result of diseconomies of scale. Third, the continuously fierce competition between countries will have effects on a country's environmental policy. When government officials face the scene of decreased profit, unemployment of workers, and shrink of investment, it usually doesn't choose increase environmental cost, but loose the implementation of current standards.

1.2. The classification affects free trade

The environmental standards affecting international free trade can be divided into two types: the first type is the environmental standard suitable for itself, and the other one is the environmental standard of product's production and processing method (PPMs).

PPM is short for Processing & Product Method. PPM environmental standard takes products produced by production method harmful to environmental protection as the

subject of control, making it comply with special environmental standard. For example, controlling to use Freon to wash computer elements, and controlling to use unsustainable measures to produce wood etc. PPMs complies with the trend of the development of international environmental protection, but in modern free trade, some developed countries tend to use one-side, which implement trade protection in the name of environmental protection, causing trade barrier. (PPMs is increasingly valued by international society. Especially in the negotiation of the round of Uruguay, it is regarded as a new barrier to be regulated in *AGREEMENT OF TECHNICAL BARRIERS TO TRADE* and *The Agreement on the Sanitary and Phytosanitary Measures*. *AGREEMENT OF TECHNICAL BARRIERS TO TRADE* regulates that imported country has the right to restrict the import of products doesn't comply with PPMs of the country, but the precondition is that the circumstance that doesn't comply with this standard will affect product's function. While *The Agreement on the Sanitary and Phytosanitary Measures* regulates imported country implements trade restriction measure according to PPMs, and it should be limited for protecting plants and animals or human life and health in its field. Meanwhile, except being involved in WTO, they are also included in some multilateral international conventions, mainly including *Vienna Convention for the Protection of the Ozone Layer*, *Montreal Protocol on Substances that Depletethe Ozone Layer*, *United Nations Framework Convention on Climate Change*, and *Brussel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* etc.)

However, except positive meaning, associating PPMs with international free trade also has negative meaning. From the positive perspective, it is the continuously deepening result of human to production, trade and environment. It is increasingly important to bring environmental protection into the decision of trade development. Because pollution produced in the production process of domestic products will use natural and geographical factors such as sea and atmosphere to transfer, leading to environmental

issues such as global warming, ozone hole and shortage of water resource which threaten human's survival.

From the negative perspective, the rising of trade protectionism is the important factor of integration of PPMs environmental standard and international free trade. With the promotion of the trend of trade liberalization, the application of customs barrier and traditional non-customs barrier is limited. The margin of using these limits becomes little, and the trade transparency improves. At the moment, trade protectors use the weakness of "exception clause of environmental protection" in WTO to associate PPMs environmental standard with international free trade, making it become the imperative link in the green trade barrier.

Section 2: The feature and effect of PPMs environmental standard

PPMs environmental standard has the following features:

- 1) It is reasonable in the perspective of environmental protection;
- 2) It mainly takes the article of "exception right of environmental protection" in relevant agreements of WTO as the basis, which is legal;
- 3) From the perspective of trade, developed countries have absolute utterance right and unilateral nature.

Currently, many developed countries use domestic legislation to make many PPMs aiming at different products, and take it as the form of trade barrier. They usually the following trade sanction measures to imported products which don't comply with their PPMs environmental standard:

- a) Trade ban or limit. It means when imported products don't comply with PPMs environmental standard or requirement of imported countries, they would take measures of ban or limit to imported products;
- b) Trade sanction. It refers to implement ban or limit to products out of products relative to PPMs environmental standard which produce environmental issues;

- c) Modification of tax of exit and entry. It imposes tax of exit and entry to imported products, making it identical with the imposing of domestic PPMs such as emission tax;
- d) It imposes anti-subsidy tax to “implicit environmental subsidy”. For the product that is produced by adopting the lower PPMs environmental standard, it is regarded as that the country implements “implicit environmental subsidy” to domestic products due to the lower cost;
- e) Compulsory or automatic eco-label. Imported products are required to put on the special eco-label to show the product complies with the special requirements of MMPs environmental standard. Products without eco-label would be eliminated in the market.

For example, when meeting the barrier of PPMs environmental standard set by developed countries, enterprises in developing countries suffered a loss. The exported furniture from China is required to show the certification of place of production of wood. Because according to the regulation of the country, enterprise must certify that wood used comes from sustainable forest but not by deforestation. As relevant certification could not be shown, these furniture could not export, leading to giant loss to the enterprise.

Section 3: The environmental standard of PPM in rules of WTO

3.1. Presentation of environmental standard in rules of WTO: TBT and SPS agreement

PPM standards involved in current rules of WTO are PPT standards relating to product. The regulations relating to PPM are mainly shown in TBT and SPS. WTO allows member countries to use PPMs relating to product to restrict product trade under the

premise of no violation of principle of non-discrimination and other principles. Under many circumstances, it leads to trade barrier.

3.2. The assessment to PPM under the rules of WTO

Legal system of WTO makes relevant regulations to environmental standard of PPM, making various countries achieve relevant environmental standards when opening trade activity, which plays a positive role to protect global environment. But WTO rules only limit the function and physical feature of product, it doesn't control those PPM unrelated to product, which is easy to cause the problem that pollution producing in processing of product fail to be controlled. It is unbeneficial to environmental protection. And some developed countries require products from exported countries must comply with their domestic PPM standard, which has conflict with non-discriminatory rule in WTO.

3.3. The implication of environmental trade barrier

Environmental Trade Barrier refers to a new trade protection measure uses ecological environment, natural resource, and human health as an excuse. One country sets barrier to products from other countries and areas to limit their import, thereby avoiding and restricting the lash of other countries' products to its own country to achieve the goal of protecting its own market. Due to the difference of history and productivity level, there exists many conflicts between developed countries and developing countries in environmental protection and trade, and conflicts becoming increasingly sharp. Green trade barrier is the main form of presentation of Environmental Trade Barrier, mainly including international and regional conventions of environmental protection, national environmental protection regulations and standards, volunteer measure such as ISO14000 environmental management system and environmental logo, production and processing methods and equal system of internalized requirement of environmental cost etc.

With the continuous development of science and technology, various issues involved in trade will more complicated, and meanwhile consumers 'requirement to quality, hygiene, and safety of commodity becomes more and more strict, and requirement of environment becomes higher continuously. While the constant development of test and quarantine inspection provides more accurate data for some countries to limit international trade and even trade discrimination by using technical trade barrier. Meanwhile, the continuously fierce international market competition brought by economic globalization also leads to the retrofit of ways of trade protection. All these factors continuously upgrade the issues of technical trade barrier, increasingly becoming the important factors affecting the development of international trade.

➤ **Main form of presentation of environmental barrier**

I. Standard of environmental technique

Developed countries have higher level of science and technology, being in the status of technical forestall. In the name of environmental protection, they use the way of legislation to make strict compulsory technical standard to restrict the import of foreign commodities. These standard are made according to production and technique level of developed countries. For developed countries, it is easy to achieve, but it is hard to achieve for developing countries.

II. Multilateral environmental agreement

Currently, there are more than 150 international multilateral environmental agreements, nearly 20 of which contain trade articles. Especially the international conventions relative to protection of ozone layer, it will ban the international trade of controlled substances and relevant products. Most of these controlled substances are elementary chemical raw materials, such as cryogen, chemical product of alkane, alkene, alkyne with wide usage, so their effect scopes are wide. With the improvement of implementation strength of multilateral environmental agreement, its effect on trade will be increasingly deep.

III. Environmental logo

Environmental logo is a graphic logo printed or pasted on product or its package. According to the definition of ISO, environmental logo refers to “wording or symbolized sign printed or pasted on product and its package for promoting environmental quality or feature”. After being pasted this logo, it shows the product’ whole process from production, to usage and recycling disposal complies with the requirement of protecting special environment, which does no or little harm to ecological environment and is beneficial to regeneration and recycling usage of resources. In 1978, Germany led to push the plan of “blue angel” forward, which uses the logo with logo of blue angel as the product to reach certain standards of ecological environment. Developed countries imitated it one after another, such as ‘environmental choice’ of Canada, and “ecological logo” of Japan. America began to implement the institution of environmental logo in 1988. 36 states legislated together to use green logo on plastic products, packing bags and containers, and then even led to use “regeneration logo”, showing it is recycling and reused. EU proposed European environmental logo officially in July 1993. Any who had this logo can have free passage in member countries of EU. Various countries can apply freely.

IV. Standards of environmental management system

ISO plays prominent effect of coordination in regulating green product and unifying environmental management of various countries. TC207 established by ISO makes a set of general standards of how to establish, implement and check environmental management inside of the organization---ISO4000 series of standards. The implementation of ISO14000 is to achieve the goals of saving resource, decreasing environmental pollution, and promoting sustainable and healthy development of economy in order to regulate organizations such as enterprise. This modern environmental management mode provides a set of systematic management tools for enterprises to fully use resource and energy, decline production cost, and lessen generation of waste and emission of pollutant.

There are 6 subsystems in ISO14000 series of standards, and ISO14001 is the most important one. ISO14020, ISO14022, ISO14024 and ISO14025 standards propose production of certification, test and check, and award three different forms of principle regulations of “environmental logo”. Therefore, the establishment of ISO international series of standards makes the development of green products have laws to depend on. A set of strict qualified assessment procedure (certification, recognition and check) is the treasure to avoid green deception and confused market.

ISO14000 is the standard of environmental management system made and issued by ISO based on absorbing the multiple-year environmental management experience of developed countries, which is generally valued and responded by various governments of countries and enterprises. Now international buyers are required to have ISO9000 quality certification and ISO14000 environmental certification, for enterprises with similar product quality, they usually prefer to choose buyers with both of certifications, because it shows product complies with the requirement of international environmental protection and is beneficial to the deal of international trade order. It is self-evident that products without ISO14000 certification will be in weakness in the market competition.

V. Green subsidy

In order to protect environment and resource, it is imperative to add environment and resource fees into cost, making the internalization of environment and resource cost. Developed countries transfer industries with serious environmental pollution to developing countries to decline environmental cost, so environmental cost in developing countries increases. What’s worse, most of enterprises in developing countries can’t afford to fees of administration of environmental pollution, although sometimes governments give some environmental subsidy. Hereto, developed countries use the violation of GATT and regulations of WTO as the excuse to limit the import of products from developing countries. For example,

America used the subsidy of environmental protection as the excuse to conduct the prosecution of anti-subsidy for man-made rubber shoes from Brazil and quick-frozen pork from Canada. The trend of “green subsidy” barrier is increasingly severe.

3.4. Thinking of breaking the barrier of PPMs environmental standard

In order to break the barrier of PPMs environmental standard, enterprises (mainly for enterprises in developing countries) should make every effort to achieve the following points:

- I. Enterprise should have the awareness of environmental cost, actively adopting PPMs environmental standards universally acknowledged to perform social responsibility including environmental duty. Enterprise should implement green strategy and green management, adopting clean technique to raise utilization rate of resource, develop circular economy, modify export structure of product, and achieve the sustainable development of foreign trade.
- II. Due to various countries’ PPMs environmental standard’ target and difference to product, enterprise or association of enterprise and industry should study PPMs environmental standard of targeted market, collect relevant information, pay much attention to production link and seek the concrete strategy of breaking environmental barrier according to feature of market and product.
- III. In the aspect of facing PPMs environmental standard barrier in international trade, enterprise should make full use of the following three principles in WTO: transparency principle, civil treatment principle and most-favored-nation treatment principle. Use the special treatment article for developing countries in relevant agreements of WTO. TBT Agreement proposes that developed countries should keep firmly in mind the special difficulties that members of developing countries met in making and implementing standard technical regulations and qualified assessment procedure, and allow members of developing countries to use some

technical regulations, standards and qualified assessment procedures according to their special technical and social economic circumstance, thereby keeping local technique, production method and craft coincident with their development requirement. When bearing relevant duties, if developing countries have special difficulties, they can timely make request to relieve from the whole or part obligation within certain time.

Except complying with international conventions and agreements, developing countries should also start from protecting domestic environment, protecting people's health, implementing scientific development view, and following new industrial road to make every effort to be in conformity with international level. Various governments should actively respond to perform international duty, and actively implement PPM environmental standard suitable for national condition by making domestic laws and regulations and environmental technique standard. When attracting foreign capital, various governments can't attract foreign capital at the cost of scarifying environment. Moreover, they should make full use of WTO, multilateral environmental convention, and *Brussel Convention on the Control of Trans boundary Movements of Hazardous Wastes and Their Disposal* to prevent developed countries to output industrial and domestic garbage. Meanwhile, they should constantly raise the investment to domestic environmental friendly industries especially clean production technique and production craft, and improve countries' PPMs standard at the moment of promoting the technical development.

For example, developed countries required that raw materials used by enterprise which use natural wood must pass forest certification to ensure the sustainable utilization of forest resource. Therefore, China issued furniture standard to definitely regulate wood used by furniture with over 10% of wood weight should not come from protected natural forest and rare trees, and it should be certified. It had significant meaning for

exported enterprises of Chinese furniture to create “green permit” and promote the export of furniture industry.

Section 4: Analysis under the framework of WTO

The relationship between international trade and environmental protection is an important issue in international economic field in recent years. Experts generally argue that environmental deterioration has become an extrusive problem of restricting the sustainable development of international trade. Environmental management is a big topic involving the global economic development. Only by making constant effort, can all members of WTO achieve results.

Trade is not the radical factor of environmental deterioration. In some degree, trade liberalization can improve environment quality. The difference of environmental standard is relative to level of economic development of various countries. It should be same with endowment, which is the source of comparative advantage. So even the difference of environmental standard has some influence, competitiveness is decided by a country’s economic structure and development level. If trade limit measures are used to compulsorily eliminate competitiveness advantage owing to environmental standard or people persist in coordinating product’s environmental standard, it is unnecessary, especially when environment has not trans boundary effect and is only the inner problem within one country.

Environmental protectors are inclined to that the care to environment should be shown in the design of trade policy. That is to say there should be a global approved environmental management and sustainable development principle. Besides, it requires to improve environmental standard, adopt payment principle of polluter in WTO, establish new trade and environment organization, and adopt trade limit measure allowed by WTO due to environment. If according to the willing of developed countries, associating trade with environment in WTO, it will need to change the current principles in multilateral trade system.

Owing to the problem of trade and environment, WTO have to involve non-trade problem, beyond the ability of WTO to some degree. In the aspect of international management of environment, although there are UN organizations such as UNEP, UNDP, and CSD and many multilateral environmental agreements, these organizations don't belong to super national organization, so their constraining force is limited and lacks unification and coordination in global environmental management. There exists common goal between environmentalist and free trade supporter----that is perfecting social welfare. Meanwhile, there exists common problem----it is necessary to promote multilateral cooperation to achieve the goal of increasing welfare. WTO is not the ideal organization to handle environmental problems, so international society needs the institution innovation. It needs to handle trade and environment issues in a brand new framework of institution. It needs an international environment organization to set regulations, and handle conflicts in environmental issues through negotiation of multilateral agreements.

There exist some defects in current multilateral environmental agreements. For example, trans boundary environmental externality cannot be handled well. Non-environmental motives are mixed in environmental negotiation. Some organizations in UN are weak in constraining force of environmental issue, which have no perfect dispute settlement mechanism. International society needs a global mechanism to promote nation-level environmental policy. WEO can draw environmental protectors' attention from trade policies, and transfer it to the implementation of more proper tools for environmental aim, reducing free trade supporters' pressure of environmental issues, and concentrating trade and environment policies on the common goal of sustainable development and improvement of living standard. Before establishing of WEO, there are many problems to be handled, among which is that who has the right of priority between WTO and WEO.

In the mechanism of WTO, economic policies of trade and environmental protection are mainly shown in:

- Commodity must comply with uniform or recognized environmental standards. Environmental standards in trade should not be double standards;
- Producing process, method and place must comply with standards of environmental protection. For example, the productive process pollutes atmosphere, and does harm to ozone layer and ecological environment, so members of WTO have the right to reject to import these kinds of products or impose environmental tax;
- The way which does harm to human health and ecological environment is banned in trade and investment activities. These policies show that purpose, content and measure of environmental protection occupies an important position in international trade system. Environmental protection under WTO mechanism takes environmental standard as entry point to regulate social consumption behaviors, and uses mechanism of environmental standard to adapt the global development of environmental protection.

In 1971, GATT had predicted the importance of environment to economy and trade and established the task group of “environmental measure and international trade” to open this job. During the negotiation of the round of Uruguay, *Decision on Environment and Trade* was passed. In 1995, after establishment of WTO, it established “Committee of Environment and Trade” to achieve the strategic goal of environmental protection, constant increasing of trade, and their promotion of each other.

In the regulation of the second article about imposing of tax to imported product, GATT regulates contracting party has the right to decide to impose environmental tax to imported products taking environmental protection as the aim in accordance with its own environmental plan under the premise of no violation of civil treatment. In TBT, it regulates that “any country should not be restricted to take imperative measures to ensure its quality of exported products, or protecting the life and health of human, animal and plant, and protecting environment in a proper degree.” There are also

similar regulations in GATS, *Agreement on Agriculture*, and TRIPs. There's no doubt that these agreements promote the harmonious development between international trade and environmental protection.

Main problems of trade and environment: there exists certain conflicts between the multilateral trade mechanism of WTO and environmental protection, which are mainly shown in application of main articles in WTO to environment. It should handle the problems of trade and environment, and WTO needs to reform articles, otherwise new international organization needs to be established to coordinate the relationship between trade and environment.

Environmentalists agree that free trade does harm to environment. Trade regulation places itself above policy of environmental protection. International trade that reducing environmental standard to attract investment and waste has negative effect on environment. Free traders argue that trade policy and environment policy should support each other, because the purpose of free trade and environmental protection is to increase efficiency and decline waste. The reason that there is conflict between environment policy and trade policy lies in the design of environment policy is not reasonable, but not that trade policy itself contains harmful factors of environment.

When adding the problem of environmental protection to WTO, as the feature of inner legal institution that WTO maintains the open trade fails to place environmental protection to the same important statues, disharmony causes between trade and environment. WTO is the main place of the dispute between trade and environment.

Environmental internationalization and free trade are the two main trends of current social development, which are interactive and conflicting with each other. Only achieving the coordination of both, can the sustainable development of society be achieved. Next, we will illustrate the main thought of environmental protection internationalization and free coordination, and will make an analysis on their coordinating thinking, proposing to make similar "environmental protection agreement

relative to trade” under the framework of WTO, enabling WTO and IEPOA to coordinate the relationship between free trade and environmental protection together. On the problem of environmental protection internationalization and free trade, they are interactive and conflicting with each other, but the final goal of each other is same. The goal of environmental protection is to provide a reliable and safe living space for human, while the goal of free trade is to let human acquire a higher-quality living condition. Coordinating the relationship of both is the goal for understanding their interaction and conflict.

Section 5: Application and coordination of international environmental protection measures and WTO principles

5.1. Application

A series of WTO principles are making effort to coordinate the relationship between environmental protection and free trade in fact, whose concrete presentation is that: it not only clearly regulates that members of party can take essential measures to protect human, animal, plant and natural resource, but also regulates that these measures should not become ways to discriminate and limit free trade in disguised form. Therefore, WTO should not only expand trade of goods and service, but also keep the goal of sustainable development to seek the coordinating development of trade and environment.

The original intention of international environmental protection measures about trade lies in relieving the environment pressure of importing country through controlling and even banning harmful product, production facility, and craft trade. Its essence is also to coordinate the relationship between environment and trade. From this meaning, WTO regulations are coincident with international regulations of environmental protection. But this consistency could not cover their evident differences at all. These differences are mainly shown in the following three aspects:

- I. The goal of international convention of environmental protection is to protect environment, whose trade usually has evident effect on environment and natural resource, while the purpose of WTO regulations is mainly free trade. Products themselves involved in trade are not obviously harmful to environment.
- II. International convention of environmental protection is the outcome of the activity of environmental protection, while WTO regulations are the outcome of free trade globalization.
- III. Environmental measures about trade use regulations and trade limit to protect environment, whose essence is to control the possible harm to environment that trade may bring. However, although WTO involves articles of environmental protection and allows for taking measures of trade limit to protect environment, its nature is to eliminate various trade barriers.

Due to the above differences, when environmental measures taken by international convention of environmental protection and WTO regulations enter into conflict, do they comply with environmental protection measures about trade from multilateral environmental convention, or comply with free trade principle in WTO regulations? The author agrees that, in general, as a new value, environmental protection is not being fully shown in WTO regulations. In other words, WTO regulations pay little attention to consider the harm of environment bringing by trade, while multilateral environmental protection convention is the restricted regulation which aims at the possible environmental harm bringing by trade. Therefore, international convention of environmental protection about trade should be put in priority for application.

However, as international conventions of environmental protection about trade are established by relevant countries, they don't belong to the system of WTO regulations, and it is hard to regard them as the special laws of WTO regulations. Under this circumstance, we should decide the problem of "application of law" according to the circumstance of contracting parties of convention. For countries of multilateral agreement of environmental protection and WTO members at the same time, even

under the principle that multilateral agreement of environmental protection may restrict trade and the principle of violation of free trade principle, it should implement trade limit measures of multilateral convention of environmental protection. Because the activities that these countries establish or join agreement show that they are ready to accept trade limit brought by multilateral convention of environmental protection. However, for countries who are not contracting countries of multilateral convention of environmental protection but only WTO members, they will face insurmountable conflict. The only solution to handle this conflict is to revise WTO Agreement, making its content compatible with environmental protection measure about trade regulated by multilateral environmental convention, not to cancel international environmental protection measure about trade.

For instance, many scholars propose to add an article in the article (0) of WTO Agreement, regulating that WTO acknowledges environmental measures about trade in multilateral environmental convention or remits the relevant duties in WTO Agreement obeyed by contracting parties of multilateral environmental convention.

5.2. Dominating thought of coordination

On the problem of environmental protection internationalization and free trade, they are interactive and conflicting with each other, but the final goal of each other is same. The goal of environmental protection is to provide a reliable and safe living space for human, while the goal of free trade is to let human acquire a higher-quality living condition. Coordinating the relationship of both is the goal for understanding their interaction and conflict.

I. Respect differences of departments

Environmental protection and free trade are two main factors of human's development. One is environmental field, and the other is economic field, which are not subordinate to each other. When handling the conflicting relationship between environmental protection and free trade, they don't expect to find reasons from the perspective of environmental protection unilaterally, and they don't expect to acquire comprehensive

solutions from the perspective of free trade. Although some solutions of individual cases of environmental protection and trade conflict are addressed with WTO rules and dispute settlement mechanism, it is not realistic for WTO regulations to provide rules or methods to settle their dispute.

As the largest economic organization, WTO makes some regulations on environmental problems about trade, but its top priority is to promote economic development, so it only pays attention to environmental protection under the premise of economic development. Even though WTO established CTE, it only studied issues when environmental policy had large effect on trade. WTO is not an environmental organization, so members don't hope to intervene various countries' or international environmental policy or make environmental standard. Other organization responsible for environmental problems are more suitable to bear this task, and solution must comply with principles of multilateral trade system of WTO.

On the contrary, we can not expect multilateral environment convention to solve the conflict between environmental protection and free trade by itself. They belong to different fields and shall develop respectively. Adopting the environmental protection method to adjust free trade policies is the same as adopting free trade method to change the measures on environmental protection, which both do not work.

Therefore, the main responsibility of WTO is to handle issues in free trade, so relevant issues of international environmental protection should be addressed by environmental organizations and relevant agreements. As the relationship between environmental protection and free trade is close, two parties should pay attention to dispute when addressing issues within the field, and should coordinate through establishing specialized mechanism, but not expect WTO to achieve the development of free trade and make effort to protect environment.

II. Respect the differences of national condition

Under many occasions, the nature of conflict between environmental protection and free trade is the relationship of interest dispute between developed countries and developing countries.

As developed countries which have got through the stage of development and accumulation and are in the vantage point in economy, they have more propensity measures about environmental issue; while developing countries are entering into the hard developing stage, and their top priority is survival and development, so they tend to be unable to do what they want to do about environmental issue. Therefore, when addressing dispute between environmental protection and free trade, we should fully respect actual national condition in different countries and fully consider the special situation of developing countries. We should not only consider developed countries' high requirement to environmental protection, but also consider developing countries' low-level achievement of environmental protection.

In the field of international environmental protection, many multilateral environmental agreements make principal regulations to special circumstance of developing countries, such as *UNFCCC*, *Vienna Convention for the Protection of the Ozone Layer*, and *Montreal Protocol* etc.; in multilateral trade system, special and differential treatment gradually become a basic principle for WTO to address issues of developing countries. At present, most of WTO regulations contain favorable regulations for developing countries and even special and differential treatment articles are listed, such as *Agreement on Agriculture* and TBT etc.

Although giving special care to developing countries is emphasized in the field of environmental protection and field of free trade, there are many articles which don't consider the special circumstance of developing countries in the cross field of environmental protection and free trade, so dispute of environmental protection and free trade develops into the dispute of developed countries and developing countries. Take technology and capital as an illustration. Relevant agreements or regulations in both fields take objective circumstance of developing countries into consideration, both

of which require give special favor and care to developing countries. But in integrating regions of environmental protection and free trade, on application of trade restriction measures, relevant articles of both WTO regulations and most of multilateral environmental agreements adopt equal standard to developing countries and developed countries. Therefore, when addressing the dispute of environmental protection and free trade, it should refer to the spirit of principle of “common and differential duty” of environmental protection and principle of generalized preferential treatment in WTO to apply special one-side standard or treatment to developing countries in the trade dispute about environmental protection.

III. Sustainable development is the guiding ideology for managing conflicts

Both environmental protection and free trade are elements of development. Human’s ration finds new thinking for development. The whole society enters into the new stage of development taking sustainable development as the strategy. Under the lasting goal of the future sustainable development, dispute of both should make effort to give due consideration and seek balance. The strategy of sustainable development shows the thought of balanced interest. With regard to the relationship between environment and trade, environmental protection belongs to the scope of “limit” without trade interest, which only emphasizes environmental interest, so environmental protection will lose the premise of development which only emphasizes trade interest. Although people’s actual income has raised, society and economy cannot make progress without environmental protection, and it is not the actual development.

It is the part of the strategy of sustainable development and the only way to achieve the goal of sustainable development to give consideration to both environmental and free trade for coordinate and manage their conflicts.

Section 6: Sustainable development

6.1. Government’s decision on sustainable development

- Accelerate the development on environmental protection industries.
- I. Bring environmental protection and maintenance of ecological balance into plan of national economy and social development. Establish ever-lasting system to make protecting ecological environment root in industry activity, and implement accounting system of resource and environment, bringing it into accounting system of national economy.
- II. Establish and improve mechanism of development of environmental friendly industry: to build the mechanism of development of environmental friendly which gives first place to economic modification, with legal and administrative ways as supplement; make a series of peripheral economic policy and management measure to promote environmental management to head for socialization, marketization, professionalization and enterprisation ; establish risk investment mechanism of environmental friendly industry; and open multi-level, multi-channel, and diversified social financing channel. To make favorable policies in the aspects of finance, credit and tax, support and encourage the development of environmental friendly industry, and regard the cultivation of environmental friendly industry as new economic growth point to lead the development of national economy.
- III. Implement exit-oriented development strategy of environmental friendly industry
 - a) The entrance of international environmental trade should focus on introducing advanced and short environmental technique. On introducing way, promoting the strategy of “using market to exchange technique”;
 - b) The entrance of international environmental trade should focus on introducing advanced and short environmental technique. On introducing way, promoting the strategy of “using market to exchange technique”;
 - c) International environment and trade policies should be introduced according to features of different types of countries;

d) International environment and trade policies should coordinate with international trade policies, international political policies and economic policies.

➤ Cultivate environmental friendly enterprise according to international standards

Environmental friendly enterprise is the base of producing and exporting environmental friendly product, while technique of environmental protection is the key to cultivate environmental friendly enterprise. Governments at all levels should support enterprise to build research and development organization of technique of environmental protection, and do well the research, development and application of technique of environmental protection. Environmental protection management is the guarantee to develop environmental friendly enterprise. All levels, fields and aspects required by environmental management show environmental protection always and anywhere.

➤ Grasp international dynamic state of environmental protection, and break environment and trade barrier.

I. Strengthen the studies on international and foreign standards of environmental protection certification; timely collect, arrange, and trace foreign environmental protection barrier; build environmental protection barrier information center and database; and timely take active defense measures to break barrier and expand exit.

II. Relying on scientific management and technical progress to improve quality and level of environmental friendly product. Make effort to pass international-standard environmental protection certification or environmental protection certification from exporting market; make effort to promote acknowledgment and coordination between the developing countries environmental protection logo and other countries' environmental protection logos, and the smooth implementation of institution on laws through signing conventions and agreements.

III. For developed countries' violation of discrimination principle and for environmental protection barrier that is set as domestic product regulations of the developing countries are higher than environmental standards of domestic

products, they can raise a plea according to civil treatment and most-favored-nation principles set in bilateral or multilateral trade agreements, and they can break developed countries' environmental protection barrier by negotiation according to regulations of special treatment to developing countries in environmental protection conventions and agreements.

6.2. Enterprise strategy of developing sustainable trade

- a) Establish strategic conception of sustainable trade, and transform enterprise's production and running goal.

In order to achieve ecologicalisation of modern enterprise, the single economic target must be transformed into the compound target with integration of ecology and economy. We should promote ecological environmental friendly design, clean production and implement ecological package.

- b) Develop ecological green products

As for weighing an enterprise's product competitiveness, except its price and non-price competitiveness (including price, quality, package, brand and service etc.), we should take environmental factor into consideration---environmental competitiveness. Therefore, we should improve the level of environmental protection technique, make every effort to increase added value of exported commodities, and improve products' technical standard, safety standard, hygienic standard and environmental protection standard. When developing products, we should support that environmental competitiveness participates in market competition, expanding wide green market for our foreign trade export in aspects of technical facility, production facility, product quality and package etc.

- c) Implement environmental marketing strategy

Compared with social marketing, environmental marketing pay more attention to environmental protection, whose main content includes collecting environmental protection information, developing environmental friendly product, design

environmental friendly package, fix environmental friendly price, establish environmental friendly sales channel, and open promotion of environmental protection etc. “Sustainable development strategy” made by nation and government and “environmental marketing” implemented by enterprise are twining strategic measures for coordinating development of economy, human and environment. None is dispensable.

d) Actively promote ISO14001 environmental management system

Enterprise getting ISO14001 certification means that enterprises have implemented a set of management system complying with international standard, and shows that enterprises have complied with relevant environmental protection laws, regulations, international conventions, and other relevant requirements. Implementing ISO14001 environmental management system certification has been an important factor which represents enterprise image, and has been condition of entering into international market and even domestic market. Therefore, somebody call ISO14001 certification as “green pass check”.

Chapter 6: Games of environment and trade subjects

Aiming at the situation that developing countries and developed countries have serious divergence in the aspects of environmental protection and trade benefit, the following chapters use the famous prisoner's dilemma model in game theory and carry out related researches on international trade subjects' games about environment and trade. According to research results, it is shown that environmental barrier and foreign trade are not a pair of irreconcilable conflicts and both parties of a trade have two stable Nash equilibriums in environment and trade. As long as two trade subjects cooperate with each other in the fields of trade and environment comprehensively, both of them can obtain profits from trade and environment.

Section 1: Game theory

The game theory is also called countermeasure theory and competition theory, which is a branch of mathematics and is widely applied to many subjects. It mainly studies interaction among formulized incentive structures and acts as a mathematic theory and method used to study phenomena with nature of struggle or competition. It is also an important subject of operational research. Behaviors with properties of competition or confrontation are called game behaviors. In such behaviors, each party taking part in struggle or competition has different goals or interests. To reach their own goals or interests, each party must consider all possible action plans of their opponents and make every effort to choose the most advantageous or the most reasonable scheme. Generally, it is thought that games are mainly divided into cooperative games and non-cooperative games. Non-cooperative games are a kind of games in which participants cannot reach binding agreements and study how people choose decisions to maximize their profits in the situation that their benefits affect one another, i.e., strategy selection. Each country's trade policies are featured by strategic interaction and have distinct game characteristics. Two countries' trade need keep 'cooperation strategy' in games and both parties should enhance mutual trust and cooperation and reach balance of interests in games in order to realize a win-win situation.

The prisoner's dilemma is a representative example in non-zero-sum games of the game theory, reflecting individuals' best choice rather than teams' optimal choice. In repeated dilemma of prisoners, games are carried out repeatedly. Thus, each participant has chances to 'punish' another participant's non-cooperative behaviors in the previous round. At this moment, cooperation may appear as a result of balance, which results in good cooperative consequence. As a number that approaches infinite repeatedly, Nash equilibrium tends to be Pareto Optimality. When two countries implement trade, they subconsciously get rid of the prisoner's dilemma and seek a relative stable long-term cooperative relationship. Thus, they change from non-cooperative games into cooperative ones, which makes both parties' welfare be maximum. For instance, both

parties will conclude trade agreements and reduce customs tariff and other trade barriers mutually to contribute to long-term implementation of international free trade and bind both parties' trade behaviors via agreements.

Section 2: A simple game model about environmental pollution

A basic model about games related to internal pollution abatement of a country mainly involves games happening between governmental supervision departments and pollution discharge enterprises indeed. Thus, the number of participants of a game is only 2, i.e., supervision department and pollution discharge enterprise, respectively. Strategies used by pollution discharge enterprises for pollutants are divided into two kinds, i.e., governance and no governance, and strategies of supervision departments involve two types including inspection and no inspection. There are two hypotheses.

- Problems can be verified as long as supervision departments carry out inspection.
- For enterprises, their pollution discharge does not have cost.

It is assumed that income of enterprises is u when they do not govern pollutants, governance cost is c_1 and treatment fine is f . According to the hypothesis, total income of enterprise's active governance is $u - c_1$ and total income of enterprises which are fined for they do not implement pollution abatement is $u - c_1 - f$. Besides, it is assumed that total income of supervision departments is v and cost for inspection on enterprises is c_2 . Thus, when income of supervision departments is $v - c_2$ when inspected enterprises govern pollutants, while the income of supervision departments is $v - c_2 + f$ when inspected enterprises do not govern pollutants. A matrix about incomes of both parties of the game can be expressed by using the following table.

Generally speaking, if $c_1 > f > c_2$, pure strategy Nash equilibrium will exist at this moment and equilibrium point will be (inspection and no governance). Obviously, this situation goes against pollution abatement. Thus, when $f > c_1, c_2$, pure strategy Nash equilibrium does not exist and the model is changed into games of incomplete information. It is assumed that probability of enterprises' governance is p and probability of supervision department's inspection is q .

| | | |
|-------------------------|-----------------------------|--------------------|
| Regulatory Companies | With Inspection | Without Inspection |
| With governance | $u - c_1 : v - c_2$ | $u - c_1 : v$ |
| Without governance | $u - c_1 - f : v - c_2 + f$ | $u : v$ |

Table 5.1: A basic model about games in the aspect of pollution abatement

2.1. Supervision departments' strategy selection

Supervision departments' strategy selection depends on pollution discharge enterprises' behaviors. In accordance with Table 1, incomes of enterprises without governance are:

$$u(1-q) + (u - c_1 - f)q \quad (6.1)$$

In case of governance, incomes will be $u - c_1$. At this moment, 'governance' strategies should be superior to the ones of 'no governance', i.e., the following should be satisfied:

$$u - c_1 > u(1-q) + (u - c_1 - f)q \Rightarrow q > \frac{c_1}{c_1 + f} = q^* \text{ with } q^* \in (0,1) \quad (6.2)$$

q^* refers to a critical value of supervision departments' inspection probability, which has no relationship with enterprise income, supervision departments' income and inspection cost. Whether supervision department carries out inspection depends on

enterprises' governance cost and supervision departments' fine. Under the situation that governance cost is definite, supervision departments' inspection probability has negative relationship with their fine. In another word, the higher the fine is, the lower the inspection probability will be (deterrent force of high fine). On the contrary, under the condition that fine is definite, supervision departments' inspection probability has positive relationship with enterprises' governance cost, i.e., the higher the governance cost is, and the lower enterprises' governance wish will be, which means supervision department should enhance degree of their supervision.

2.2. Enterprises' strategy selection

Pollution discharge enterprises' strategy selection depends on supervision departments' strategies. As shown in Table 1, income of supervision departments is v under the condition that they do not carry out inspection; when they implement inspection, income and inspection strategies should be superior to that without inspection, as shown in the following:

$$(v - c_2 + f)(1 - p) + (v - c_2)p > v \Rightarrow p < \frac{f - c_2}{f} = p^* \text{ with } p^* \in (0,1) \quad (6.3)$$

p^* refers to a critical value of enterprises' pollution abatement, which has no relationship with enterprise income, supervision departments' income and inspection cost. The enthusiasm that enterprises show for pollution abatement depends on supervision departments' inspection expenses and fine. In other words, the lower the inspection expense of supervision departments is and the higher the fine is, the higher the enthusiasm for pollution abatement will be.

The two situations basically accord with reality. From the perspective of the whole society, we hope an ideal situation of the equilibrium point (governance and no inspection) can be achieved under the condition that enterprises govern environmental pollution actively but supervision department need not carry out inspection. For this, we may reconstruct both parties' payoff function. For example, the government may

issue subsidies for pollution discharge enterprises for pollution control and strengthen degree of punishment to make pollution discharge enterprises get benefits from 'pollution abatement' and implement pollution control actively. This can be started from two aspects:

On the one hand, establish effective incentive mechanism. The government sector should enhance environmental protection publicity and education, guide the whole society to form the atmosphere in which all people pay attention to environmental protection and enterprises take part in environmental protection actively, although this will consumer some manpower, material resources and financial resources. The government may also give some subsidies to enterprises that carry out pollution control actively and achieve some performance via transfer payment from the exchequer. It is assumed that the cost of publicity and education and environmental protection subsidy, which is undertaken by supervision departments, is z . At this time, income of supervision departments is $v - z$. If cost of publicity and education and subsidy are less than inspection cost, i.e., $z < c_2 \implies v - z > v - c_2$, supervision departments will reduce inspection probability.

On the other hand, for enterprises that do not implement environmental protection, degree of punishment will be increased. In accordance with Formula (6.3), it is found that p^* has positive relation with f . Meanwhile, the probability that enterprises choose governance approaches 1 when $f \gg c_2$. At this moment, the equilibrium point is approached, which means there is an ideal situation (governance and no inspection).

Based on the foregoing model analysis, we may conclude it is essential to establish effective incentive mechanism, strengthen degree of punishment for pollution discharge enterprises and make enterprises carry out pollution control actively. Thus, it will be a kind of Pareto improvement for enterprises and the whole social benefit.

Section 3: Application of the game theory to trans-boundary pollution

As economic globalization and trade internationalization advance, trans-boundary environmental problems show a diversified and serious trend, such as atmospheric pollution and global warming etc. Internal contamination of a country can be solved by its internal organs of authority, while trans-boundary pollution has not been solved effectively all the time. Although there are international organizations, for instance, European Union, may issue environmental laws and ask their member states to follow them, degree of implementation is not consistent indeed. Internationally common solutions are shown as follows: enhancing cooperation, signing agreements and formulating conventions.

At present, a number of academic papers apply the game theory to trans-boundary environmental problems and usually draw the conclusion via analyses of cooperative games and non-cooperative games: cooperation among countries is an effective way to solve trans-boundary environmental problems and cooperative can make total social benefit optimal. To achieve equilibrium in cooperative games, two conditions need be satisfied: firstly, profit, i.e., each participating country can obtain profits in cooperation; and secondly, stability, i.e., each participating country will not deviate from cooperation for other inducements.

However, it is hard to reach an agreement among countries in reality. The reason for this is that total income of some countries is improved but that of some stages is reduced in cooperation although total social benefit is optimal. At this moment, it is necessary for countries with increased incomes to give some economic compensation to the ones with reduced incomes to make their cooperation can have Nash equilibrium solution. For instance, the CO₂ emission reduction model established by Maler in 1989 sufficiently states that countries like Finland and Britain must give other countries compensation and their cooperation can be carried on only in this way. Besides, he built a model about two countries' economic compensation in 1990 and gave theoretical demonstration. The most famous application of economic compensation is Rhine

Treaty signed between Holland and France, in which Holland agrees to compensate the loss that France suffers in pollution reduction and make both parties benefit.

Nevertheless, it is difficult to realize economic compensation in reality because the method economic compensation is that states injured by pollution make a payment, which violates the principle 'the person who causes pollution should make a payment'. This may reduce the reduction rate at which contamination-making countries reduce their pollutants. Especially when information of each country taking part in games is incomplete (expenses of pollution reduction and ambient level), victims of pollution may pay economic compensation excessively, which results in contamination-making countries may have the trend that they will increase quantity of discharged pollutants. As a result, the purpose improvement in environment cannot be realized.

Many scholars put forward that economic trade is related to environmental pollution, i.e., one country's pollution makes another country suffer losses. However, contamination-making countries may leech on to injured states economically. For example, contamination-making countries and many injured states are import and export trade partners. At this time, injured countries may ask contamination-making countries to govern pollution by using expansion of commodity imports as a condition to reach an agreement. Meanwhile, relevance games will be cited, i.e., the two games pollution abatement and economic trade are related to each other to solve problems (for instance, Relevance Games and International Environmental Problems of Hennfolmer).

Section 4: Correlation analysis via functional relationship

Here, we will use the functional relationship to carry out correlation analysis of international environment and trade. It is assumed that international environment and trade only involve games between two types of countries (state groups). To improve pertinence, we assume that the trade is carried out between developing countries and

developed countries and the total social income is z when their games reach equilibrium.

$$z = f(u, v) \quad (6.4)$$

$$u = \varphi(e, t) \quad (6.5)$$

$$v = \psi(e, t) \quad (6.6)$$

When games reach equilibrium, the total social income z can be expressed as:

$$z = f[\varphi(e, t), \psi(e, t)] \quad (6.7)$$

Where u stands for income of developing countries, v represents income of developed countries, e is an environmental factor (it is assumed that its changing interval is: [polluting the environment, protecting the environment]) and t refers to a trade factor.

Carry out derivation for Formula (4):

$$\frac{\partial z}{\partial e} = \frac{\partial z}{\partial u} \cdot \frac{\partial u}{\partial e} + \frac{\partial z}{\partial v} \cdot \frac{\partial v}{\partial e} \quad (6.8)$$

$$\frac{\partial z}{\partial t} = \frac{\partial z}{\partial u} \cdot \frac{\partial u}{\partial t} + \frac{\partial z}{\partial v} \cdot \frac{\partial v}{\partial t} \quad (6.9)$$

When games of both parties of the trade reach Pareto Optimality in games about environment and trade, i.e., the total social income is maximum, Formula (6.8) and Formula (6.9) need be 0. In another word,

$$\frac{\partial z}{\partial u} \cdot \frac{\partial u}{\partial e} = - \frac{\partial z}{\partial v} \cdot \frac{\partial v}{\partial e} \quad (6.10)$$

$$\frac{\partial z}{\partial v} \cdot \frac{\partial v}{\partial t} = - \frac{\partial z}{\partial u} \cdot \frac{\partial u}{\partial t} \quad (6.11)$$

It is assumed that $\frac{\partial z}{\partial u} = m$ and $\frac{\partial z}{\partial v} = n$. Then, m and n represent rate of changes in the total social income as incomes of developing countries and developed countries vary. In reality, the total social income z grows with increase in u the income of developing countries and v the income of developed countries rather than is summed simply. According to Formula (6.4), we may find the total social income z within a certain

range is an increasing function of u the income of developing countries and v the income of developed countries.

Formula (6.10) points out that incomes of developing countries and developed countries are contrary to make the total social income maximum under the condition that the trade factor is not considered. In reality, it is reflected by the situation that the process in which developing countries export products strictly should follow clean production standards and satisfy requirements of 'environmental barrier' provisions made by developed countries. Pollutants generated in production process should be governed comprehensively. As a result, environmental quality of the whole world is basically improved because of this. Developed countries obtain positive incomes from environment, and developing countries' net incomes are negative for their input into pollution control.

Similarly, according to Formula (6.11), we may know incomes obtained by developing countries and developed countries from trade are contrary to make the total social income maximum under the condition that environmental factors are not considered. In reality, it is reflected by this: the production process of developing countries' exported products does not consider environmental factors completely; global environmental quality worsens further; and the positive income that developing countries obtain from trade is larger than losses caused by environmental pollution and their net income is positive since they do not give input to pollution control. The positive income obtained by developed countries from trade is smaller than losses caused by environmental pollution and their net income is negative.

In accordance with respective analyses, it seems that conflicts of developing countries and developed countries are irreconcilable in environment and conflicts. However, comprehensive analyses show that it is the restriction between environment and trade that makes the total social income maximum. This kind of restrictive relationship may be analyzed and explained by using the 'selective excitation' factor that we will mention later. Sum of Formula (6.10) and Formula (6.11) is 0, which states that both

parties use a part of both parties' incomes in trade to improve environment and can make social income maximum further. In reality, a simple operating method is to make international rules specifying both parties of trade spend some of their incomes from trade on environmental pollution control of developing countries to improve quality of global environment and ensure both developing countries and developed countries benefit from environment.

Section 5: Analyzing relevance by using the payment function

Since most of disputes about trans-boundary environmental problems exist between developing countries and developed countries, we set P and R represent developing countries and developed countries, respectively. Order U_{jk}^i and B_{jk}^i represent payment in trade games and environmental games, where the superscript letter i=p or r, which stands for Country P and Country R, respectively; and the subscript letters j,k = c or d, which refers to strategies of Country P or Country R, respectively (c-cooperation and d=non-cooperation). Here, cooperation means 'various bilateral and multilateral trade agreements that are helpful for free trade are signed and performed in the aspect of trade and multilateral; bilateral environment agreements are signed and carried out in the aspect of environment; environmental cooperation is enhanced and all kinds of measures that benefit environmental improvement, for instance, generation and transfer of environmental pollution are reduced and controlled consciously, are taken.'

According to the foregoing expressive method, payment structure in 'prisoner's dilemma' about trans-boundary environment in common analyses can be expressed as:

$$B_{dc}^p > B_{cc}^p > B_{dd}^p = 0 > B_{cd}^p \quad (6.12)$$

$$\text{and } B_{cd}^r > B_{cc}^r > B_{dd}^r = 0 > B_{dc}^r \quad (6.13)$$

Theoretical basis of such an expression is that environment is a public product in the whole world and has externality. The pollution generated by one country not only

harms itself but also brings negative impacts on other countries. Similarly, other countries may share the benefit that one country obtained in the effort that it makes to reduce pollution for free. Besides, the effort that countries make to reduce pollution need cost generally. Thus, it is inevitable that prisoner's dilemma will appear in games about trans-boundary environmental problems.

Similarly, by using the foregoing expressive method, the assumed payment structure of cooperative trade games in common analyses is:

$$U_{cc}^p > U_{cd}^p > U_{dc}^p > U_{dd}^p \geq 0 \quad (6.14)$$

$$\text{and } U_{cc}^r > U_{cd}^r > U_{dc}^r > U_{dd}^r \geq 0 \quad (6.15)$$

The result of games will be that ‘cooperation’ is used as the only Nash equilibrium that both parties hold dominate strategies inevitably: ‘cooperation—cooperation’.

To approach reality to a larger extent, we assume the following payment structure:

The payment structure of environmental games is:

$$B_{dc}^p > B_{cc}^p > B_{dd}^p > B_{cd}^p \quad \text{and} \quad B_{dc}^r > B_{cc}^r > B_{dd}^r > B_{cd}^r$$

The payment structure of trade games is:

$$U_{cc}^p > U_{dc}^p > U_{dd}^p > U_{cd}^p \quad \text{and} \quad U_{cd}^r > U_{cc}^r > U_{dd}^r > U_{dc}^r$$

The reason why hypotheses about such payment structures are made is that developed countries hold initiative in the field of trade compared with developing countries, while the mutual cooperation between developed countries and developing countries is not absolutely optimal. Thus, some actions about trade sanction are taken. On the contrary, trade cooperation from developed countries is of great significance for developing countries and their mutual cooperation with developed countries in the field of trade brings them maximum income. Therefore, developing countries will not do things destroying cooperation unilaterally or easily in cooperation. However, the situation is contrary in environment. Because most developing countries are poor and backward, survival and development in reality become a primary task for most of countries and good and clean environment is luxury for people who do not have enough to eat or wear,

their attitudes towards environmental problems are softer compared with developed countries. Although cooperation benefits both parties, they are more willing to profit from others' conflict. On the contrary, the cooperation with developing countries in the aspect of environmental problems is of great significance for developed countries that pay much attention to life quality and have strong environmental awareness, so developed countries usually do not implement opportunistic practice in both parties' cooperation. Of course, the foregoing explanation is not absolute but appropriate for purposes of this chapter (with respect to the same question, the relevance theory is applied under the situation of different payment structures).

According to common relevance theory hypotheses in the aspects of environment and trade and with regard to prisoner's dilemma of trans-boundary environmental problems, all participating parties will be locked in environmental 'prisoner's dilemma' where pollution is a prominent strategy under the condition that there is not binding promise or effective punishment or incentive measures in accordance with Nash equilibrium theory. One thought to change this kind of dilemma is that we may consider using incomes that both parties obtain from trade games as 'selective excitation' (here, the result of trade games is that Nash equilibrium of 'cooperation-cooperation' where both parties use 'cooperation' as a prominent strategy) to change environmental dilemma. This equals that two games are combined to be an advanced 'compound' game, i.e., the said relevance (binding) game. Via relevance, cooperative strategies of two countries in the aspect of trade games only depend on their cooperative strategies in the aspect of environmental games and incomes brought by cooperative strategies in trade games will affect results of environmental games in return. Consequently, the situation that they may fall into 'prisoner's dilemma' will be changed and their cooperative strategies in environment will become strategies of Pareto Optimality. Similarly, if participants use opportunistic strategies (i.e., pollution strategies) in environmental games, the possibility that they may take noncooperation in trade games will be increased and thus Pareto Optimality of trade may not achieved.

As shown in Table 5.2 and Table 5.3, results of games after relevance form two stable Nash equilibriums, i.e., one Nash equilibrium is that both party adopt cooperative strategies and the other is that neither parties take cooperative strategies. In this relevance game, the other two kinds of strategy combination ('R cooperation — P noncooperation' and 'R noncooperation — P cooperation') are not equilibrium strategies, so they are excluded. In this way, relevance equals one promise or threat that one party or both parties make actually, indicating that they will not take the two disequilibrium strategies and the payment of games after relevance is accumulation of two independent games' payment. Thus, the game result formed after relevance shows that neither party will have motivation to deviate from the equilibrium to be opportunistic under the situation that both parties take cooperative strategies in the aspects of trade and environment in the very beginning. Results of relevance make the situation that both parties walks away from 'prisoner's dilemma' of environment become possible.

In accordance with the game theory, results of the two games environmental game and trade game are a 'prisoner's dilemma' Nash equilibrium of 'noncooperation-noncooperation'. Under the condition that both trade and environment stay in 'prisoner's dilemma', can we use relevance strategies and make use of both parties' differences in payment structures in the aspect of trade and environment to make the income that Country P obtains from mutual cooperation in trade games be the 'selective excitation' that changes environmental dilemma, let the income that Country R obtains from mutual cooperation about environmental games act as the 'selective excitation' that changes trade dilemma and then achieve the purpose that they walk away from the two dilemmas? Since the two countries have different benefits and attitudes towards environmental and trade problems, Country P stays in an active positive in the aspect of environmental problems but Country R holds an advantageous position in the aspect of trade problem. In fact, this creates conditions for both parties so that they can have equal negotiations and carry out fair trade between them,

according with the economic hypothesis that economic approaches are used to solve problems. More importantly, it will be easier for both parties to accept arrangement about environmental and trade relevance. It is assumed that both parties have this promise in their relevance agreement: non-cooperative behaviors that either party performs in the field of trade or environment or in both fields will incur the other party's non-cooperative attitudes in both aspects. Results of games after relevance are shown as follows.

Two results of games appear after relevance: one is definite 'noncooperation-noncooperation' prisoner's dilemma-type Nash equilibrium (which is expressed by adding underline), amounting to the original single game has no impact. Undoubtedly, appearance of this result is a result of relevance arrangement in essence. It is just such an equilibrium that can exert punishment or threat mechanism that may make relevance move to the direction that benefits cooperation and realize the purpose that opportunism is reduced.

The other result of games after relevance has uncertainty. According to assumed payment structure, we cannot affirm whether $B_{cc}^p + U_{cc}^p > B_{dc}^p + B_{cd}^p$ and $B_{cc}^r + U_{cc}^r > B_{dc}^r + B_{cd}^r$ are valid or not since $B_{cc}^p > B_{dc}^p, U_{cc}^r > U_{cd}^r$ although $U_{cc}^p > U_{dc}^p, B_{cc}^r > B_{cd}^r$. Nevertheless, it is the uncertainty that brings the possibility that relevance arrangement may be improved.

By transposing $B_{cc}^p + U_{cc}^p \geq B_{dc}^p + U_{dc}^p$ and $B_{cc}^r + U_{cc}^r \geq B_{dc}^r + U_{dc}^r$, respectively, we may obtain: $U_{cc}^p - U_{dc}^p \geq B_{dc}^p - B_{cc}^p$ and $B_{cc}^r - B_{cd}^r \geq U_{cd}^r - U_{cc}^r$.

According to this, we may find that comprehensive cooperative strategies in the fields of trade and environment can become a definite Nash equilibrium as long as two countries' net income in mutual trade cooperation (trade speculation is used as opportunity cost) is larger than or equal to the net income they get from environmental speculation (environment cooperation is used as opportunity cost) and the two countries' net income in mutual environmental cooperation (environmental speculation

is used as opportunity cost) is larger than or equal to the net income they achieve from trade speculation (trade cooperation is used as opportunity cost). In doing so, neither party has motivation to deviate from the equilibrium under the condition that both parties cooperate in both aspects in the very beginning and thus both parties can walk away from dilemmas in the aspects of environment and trade and realize purposes of relevance.

Cooperation among countries is an effective way to governance trans-boundary environmental problems and helps realize maximization of environmental governance. However, in cooperation, the behavior that medium and small countries thumb a lift may appear. Thus, it is necessary to relate environmental cooperation with other foreign economic policies and use other economic policies to prevent small countries from 'free rider' in cooperation.

Part 4: Conclusion

Chapter 7: Conclusion

Section 1: Importance: the internalization of environmental costs

From the above analysis we can know, the economic reasons behind conflict between environmental degradation, environment and trade is the environmental cost externalization. Because the producers or consumers can freely use public environmental resources without payment, or paying the fees lower than the value it created. Therefore, economic decision for the maximization of private profit often leads to over exploitation or abuse of resources, causing environmental degradation and "the tragedy of the commons". If we can solve the problem of environmental cost externalization and achieve the internalization of environmental costs, i.e. the price of the product contains the environmental costs, with the correct price signals as the guidance, the market can allocate environmental resources effectively and solve the root causes of environmental degradation. The core of cost internalization is the

polluter pay principle (Polluter Pay Principle), namely the polluter (including producers and consumers) should pay the full cost of their actions, which can ensure the product prices reflect environmental damage done by related production and consumption. Theoretically speaking, the internalization of environmental cost is the basic way to solve the environmental problems as well as the coordination of trade and environmental development.

In the short term, Internalization of environmental costs seems to increase the cost of product. But in the long run, it can promote the enterprises to improve product structure, increase research and development for technology, improve the technology content of products, reduce pollution and enhance product competitiveness objective. Internalization of environmental costs is bound to have a certain impact on the free trade which is manifested mainly in the breakthrough of marginal costs advantage. Admittedly, internalization of environmental costs will be more conducive to the rational allocation of resources and the elimination of trade barriers. Only taking the environmental cost into account, the enterprises will take many means to reduce the cost so as to guide the industry towards green development thus collapsing green trade barrier automatically in such circumstances. From this point of view, long-term win at the price of short-term benefits is of important significance. Along with the sustainable development strategy, the significance of environmental cost internalization lies in making up the defects of the free market economy and economic legal system tradition. Instead of the economic philosophy only considering directly and unsustainable development, it can truly put the concept of sustainable development throughout the whole process of international trade.

In short, the internalization of environmental costs in international trade has positive effects but also has a negative impact. In the long run, it will promote the internalization of environmental costs of trade liberalization process and world trade integration through the price. Maybe in the current circumstance where environmental cost has not

been fully internalized, those countries which chose to start the process of internalization will face the risk of reducing international market share. With the passage of time, however, the financial and investment required by the internalization of environmental costs will get extra pay to them through the establishment of a lasting competitive products and the improvement of the environment.

Section 2: Lack and prospect of studying on Trade and environment cost internalization

Research on improving the economists and scholars mainly focus on the relationship between trade and environment complex macro theory and environmental economic loss measurement methods, different perspectives on the study of trade and environment cost internalization have made much progress in the concepts, methods, however there is still lack of research:

- 1) For the measurement of environmental pollution loss is limited to the overall economic activity on the environment of the loss, but no single measurement of international free trade, the economic activities on the environment caused by the loss.
- 2) For the internalization of environmental costs just put forward the idea in theory, and the lack of t through which the environmental cost internalization of he mechanism
- 3) Research the model to calculate the economic loss, but for the influence of environmental cost internalization of trade may have no detailed theoretical investigation, the lack of theory and data support.

In solving the internalization of environmental costs, resulting in a series of trade barriers and friction problems, focus on how to determine the intrinsic value and how to achieve the internalization of environmental costs.

Section 3: View and advice for developing countries

As a developing country, namely encounter green trade barriers of developed countries damage, exports have been blocked, but also deeply influenced by the transfer of polluting goods, production technology and equipment. In order to reduce the elimination of these adverse effects, need to take active measures.

➤ *Strengthen international cooperation, promote compatible trade policy and environmental policy*

Seeking development in cooperation in trade, has become the new concept of the world, international cooperation mainly through strengthening multilateral cooperation, play WTO, ISO and other international organizations as the leading role, the development of international nongovernmental organizations, the Multi-National Corporation to strengthen responsibility and obligation, to establish a "unified standard environmental symbol system" management system the ways to realize. Through international cooperation can reach a consensus on the form of negotiation on different issues, namely, to safeguard the common interests of all parties, but also the maintenance of good development of the international trade order.

1) To improve the system of environmental and economic accounting and economic policies and regulations, to realize the balanced development of trade and environment

The establishment of environmental economic suitable analysis method and policy system, the environmental cost as the social costs included in the accounting system, commercialization, the price of resources and the environment and rational consumption of resources and environmental damage compensation to gradually achieve the intensive use of resources, and effective management, and take the road of sustainable development.

2) Innovation of the property rights system of environmental resources and environmental management system.

By dispersion and determination property right of environmental resources, establish corresponding responsibilities, rights and interests, establish the use, compensation and liability of effective bearing mechanism; establish the market of tradable emission permits and resources quota system based on.

- 3) The development of scientific and technological innovation of enterprises, the development of green products

Implementation of environmental cost internalization of the inevitable requirements of environmental factors price into products and services, green products will become the market mainstream. Therefore, enterprises should be encouraged to carry out green technology innovation, on the one hand in the production development of the use of saving and environment-friendly energy; improvement and innovation on the other hand, timely production technology, the environmental costs into the cost of production plan, implement the quality and environment monitoring system of science. In accordance with the needs of the international market, establishing the cooperation relationship between the industrial chains, to comply with international environmental standards as the goal, to provide high quality products.

- 4) To improve the environmental technical specifications and implementation and supervision and management system, promote the ecological environmental standard system.

Establishment of environmental technical standards with international standards and certification system, through the mutual exchange of information and technology from the developed countries to achieve mutual recognition, to vigorously promote clean production and recycling economy, improve the international competitiveness of products, spanning the "green trade barrier", at the same time limit and pollution related products, technology and equipment input.

Section 4: Conclusion from Game Theory

- Facing with problems about trade and environment, national governments should take active countermeasures (mainly for developing countries):

They should establish foreign trade strategies centering on sustainable development and develop green trade. For trade and environmental protection, implementation of sustainable development is a joint task and goal and sustainable development can be promoted via environment and trade. In fact, environment protection acts as material basis and sources for protection of sustainable development and development of trade provides fund and technical support for sustainable development.

- Meanwhile, each country should use International Law reasonably and take part in negotiation about trade and environmental problems actively. On the one hand, they should participate in discussions about trade and environment, which are held by related institutions and organizations of the United Nations, as well as related activities among non-governmental organizations like National Standardization Organization and International Chamber of Commerce actively, and try to exert their proper effect. Besides, they should follow the principle ‘joint but different responsibilities’ in *Rio Declaration on Environment and Development* and seek fair treatment and undertake responsibilities that are appropriate for their own countries in future negotiation. On the other hand, they should take part in environmental and trade negotiation within WTO multilateral trading system actively and formulate multilateral environmental protection and trade rules that really consider development status and reasonable requirements of different countries via joint effort of developed countries and developing countries.
- Perfect legislation of environment and trade. Developing countries should learn developed countries’ relative mature legal system about environment and trade and establish legal system that is appropriate for market economy and needs of international free trade.

- Make full use of WTO dispute settlement mechanism and solve trade disputes related to environment flexibly. All countries should build dispute settlement mechanism about complaints and responses to suits and take full advantage of methods like negotiation, conciliation and intermediation. As a multilateral agency, WTO advocates disputes should be solved by non-legal means like negotiation or mediation. Thus, when disputes are solved, it is essential to make full use of dispute-solving ways based on voluntariness, such as negotiation, conciliation and intermediation, especially, negotiation, and work hard to realize the result that both parties are satisfied with. Under the situation that disputes fail to be solved by negotiation, conciliation and intermediation, they may be submitted to expert groups or appeal bodies for solution.

REFERENCES

Letchumanan, Raman (1997). "Trade, Environment and Competitiveness: Testing the "Pollution-Haven" Hypothesis from the Technology Perspective", UNU/IAS Working Paper No.3

Wheeler, David (1999). "Racing to the bottom? Foreign Investment and Air Pollution in Developing Countries", memo, 1999. Development Research Group, World Bank, 1999.

Vimonen, P. and John Whally,. "Environmental Issues in The New World Trading System", Macilillan Press. 1997

Panayotou, Theodore. "Globalization and the Environment", CID working paper No.53. 2000

Copeland, B. and S. Taylor (1994). "North-South Trade and Environment", Quarterly Journal of Economics, August, pp. 755-787.

Copeland, B. and S. Taylor (1995). "Trade and Transboundary Pollution", American Economics Review, Vol. 85, pp. 716-737.

Copeland, B. and S. Taylor (1995). "Trade, Growth and the Environment", Journal of Economic Literature, Vol. XLII (March 2004) pp. 7-71.

Antweiler, W.,B, Copeland, and S. Taylor (1998). „Is Free Trade Good for the Environment? “ Discussion Paper No. 98-11, Department of Economics, University of British Columbia, Canada

Cole, M.A., A.J. Rayner and J.M. Bates (1998). "Trade Liberalization and Environment: The Case of the Uruguay Round", World Economy, Vol. 21(3), May, pp.337-347.

Esty, D. and D. Geradin (1998). "Environmental Protection and International Competitiveness: A Conceptual Framework", Journal of World Trade, Vol. 32(3). June. pp. 5-46

Lee, H. And D. Roland-Holst (1997). "Trade and the Environment," in J. Francois and K. Reinert (eds.) Applied Methods for Trade Policy Analysis, Cambridge University Press, Cambridge, UK.

Maler, K-G. (1990). "International Environmental Problem", Oxford Review of Economic Policy, Vol.6(1). pp. 80-108.

Robin, N. and S. Roberts (1998): "Environmental Responsibility in World Trade", International Institute for Environment and Development, London, UK.

Soras, P.(1994). "Competitiveness and Environmental Standards", Policy Research Working Paper No. 1249, the World Bank, Washington D.C., USA

Stern, D. (1998). "Progress on the Environmental Kuznets Curve?", Environment and Development Economics, Vol. 3, pp.173-196

WTO (1999). Special Report "Trade and Environment"

Duncan Brack (1998). "Trade and Environment: Conflict or Compatibility?". The Royal Institute of International Affairs, Washington D.C.

Peter Uimonen and John Whalley (1997). "Environmental Issues in the New World Trading System", The Ipswich Book Company Ltd, Great Britain.

Rajesh Chadha, Bernard Hoekman, Will Martin, Ademola Oyejide etc. (2000). "Developing Countries and the Next Round of WTO Negotiations", The World Economy, Vol.23, N0.4, April 2000

Housman, Robert and Zaelke, Durwood "Trade, Environment, and Sustainable Development: A Primer" 15 Hastings Int'l & Comp. L. Rev. 535 (1991-1992)

Gene M. Grossman and Alan B. Krueger (1995). "Economic Growth and the Environment", The MIT Press, The Quarterly Journal of Economics, Vol. 110. No. 2, pp. 353-377

M. Scott Taylor, Brian A. Copeland (1994). "North-South Trade and the Environment", Quarterly Journal of Economics 109.3 (1994); pp. 755-787.

Baomin Dong, Xin Zhao. "FDI and Environmental Standard: Pollution Haven or Race to the Bottom?"

Patrick W. Cooke. "Trade Implications of Processed and Production Methods (PPMs)". U.s.DEPARTMENT OF COMMERCE National Institute of Standards and Technology Office of Standards Services Standards Code and Information Gaithersburg, MD 20899

Wilhelm Althammer and Susanne Droege (2003). "International Trade and the Environment: The Real Conflicts". *Environmental Policy in an International Perspective Economy & Environment Volume 26*, Springer 2003, pp. 151-172

Martin J. Osborne, Ariel Rubinstein. "A Course in Game Theory" – MIT Press, 1994

Michael Hoel. "Game theory, international environmental problems, and international climate agreements"

Lorenzo Cioni. "Game theory as a tool for the management of environmental problems and agreements". Department of Computer Science, University of Pisa

Peter John Wood (May 2010). "Climate Change and Game Theory". *Environmental Economics Research Hub*. Research Report No. 62.

Attanasi, G., Gallego, A.G. , Georgantzis, N., & Montesano, A. (2010). "Non-cooperative games with confirmed proposals". Working Paper. LERNA Travaux No. 10.02.308.

Axelrod, R. M. (1984). "The evolution of cooperation". Basic Books, New York.

Barrett, S. (1994). "Self-Enforcing International Environmental Agreements". *Oxford Economic Papers*, 46. Pp. 878-894.

Barrett, S. (1997). "The strategy of trade sanctions in international environmental agreements". *Resource and Energy Economics*, 19, 345-361.

Carraro, C., & Siniscalco, D. (1993). "Strategies for the international protection of the environment". *Journal of Public Economics*, pp. 309-328.

Chander, P., & Tulkens, H. (1997). "The Core of an Economy with Multilateral Environmental Externalities". *International Journal of Game Theory*. 26(3), 379-401.

Finus, M. (2001). "Game theory and international environmental cooperation", in: Edward Elgar (ed.), *New Horizons in environmental economics*. Cheltenham, UK; Northampton, MA.

Osborne, M. J. (2003). "An Introduction to Game Theory". Oxford University Press. USA.

- Schelling, .C. (1970). "The Strategy of Conflict". Harvard University Press.
- Roger B. Myerson (1991). "Game Theory. Analysis of conflict". Harvard University Press.
- Tulkens, H. (1998). "Cooperation versus free-riding in international environmental affairs: two approaches". Pages 30-44 of: Hanley, N., & Folmer, H. (eds), *Game Theory and the Environment*. Edward Elgar. Cheltenham, England.
- Carlo Carraro, Johan Eychmans, and Michael Finus (2005). "Optimal Transfers and Participation Decision in International Environmental Agreements". FEEM Nota di. Lavarò 50. 2005.
- M.Hoel (1997), "Incentives to participate in an international environmental agreement", *Environmental and Resource Economics* 9, pp. 153-170. Section 1-3.
- R. Perman, Y. Ma, J. McGilvray and M. Common (2003): "Chapter 10: International environmental problems", *Natural Resource and Environmental Economics*, Pearson, 3rd edition, 2003.
- Nash, J.F. (1953). "Two-person cooperative games", *Econometrica* 21, pp. 128 – 140.
- Nash, J.F. (1951). "Non-cooperative games", *Annals of Mathematics* 54, pp. 289-295.
- Tijs, S, (2003). "Introduction to Game Theory", *TRIM 23. Hindustan Book Agency*
- Anke Thiedemann (2004). "WTO UND UMWELT: Die Auslegung des Art. XX GATT in der Praxis der GATT/WTO-Streitbelegungsorgane", Band 10, LIT Verlag Münster.
- Stefanie Pfahl (2000). "Internationaler Handel und Umweltschutz: Zielkonflikte und Ansatzpunkte des Interessenausgleichs", Springer Verlag
- Studenteninitiative Wirtschaft & Umwelt e.V.(1996). "Welthandel und Umweltschutz: wie handeln wir ökologisch?"
- Pilar Zumft Cortines (2001). "Welthandel und Umweltschutz: das Spannungsfeld von Welthandelsorganisation und Nichtregierungsorganisationen". Aachen, Verlag Shaker

Daniela Angelini (2003). "Die Vereinbarkeit von Handel und Umweltschutz". Universität Duisburg, Fachbereich Wirtschaftswissenschaften, Thema Nr.1, Trade and Environmental Protection.

Thomas Bernauer, Dieter Ruloff (1999). "Handel und Umwelt; Zur Frage der Kompatibilität internationaler Regime", VS Verlag für Sozialwissenschaften

Alfred Endres (1994). "Umweltökonomie: eine Einführung", Wiss. Buchges., Darmstadt

Hans Wiesmeth (2002). "Umweltökonomie: Theorie und Praxis im Gleichgewicht", Springer Verlag

Manfred J. Holler & Gerhard Illing "Einführung in die Spieltheorie", Springer Verlag

Bianca Rundshagen. (2004). "Strategische Verknüpfung von Umwelt und Handelspolitik", Springer Verlag

Harald Wiese (2005). "Kooperative Spieltheorie", Oldenbourg Verlag

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