

The Environment Quality and Economics Growth in China-A literature Review and Discussion

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**KTH Industrial Engineering
and Management**

Master of Science Thesis
Stockholm, Sweden 2012

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Master of Science Thesis INDEK 2012:15
KTH Industrial Engineering and Management
SE-100 44 STOCKHOLM

Master of Science Thesis INDEK 2012:15



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2012-03-20

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Abstract

Considering that the coordination of economic development and environmental protection has become a worldwide concern and that China's environmental pollution and ecological destruction are mainly attributable to limitation of its future economic development, this paper presents a discussion on the symbiotic relationship between the economic development and environmental protection. The presentation is based upon an extensive literature overview with a strong focus on Chinese research publications.

According to the overview China is facing a growing imbalance between economic achievements and the quality of the environment. In the paper, the Environment Kuznets Curve (EKC) and findings from the overview are used to provide explanations as to why China is facing this kind of problems. At last, the concept of a circular economy is presented and used to discuss possible policy measures that might be applied in order to mitigate the described conflicts.

Key-words Circular Economy; Environment Kuznets Curve; Externality

Table of Contents

Chapter1	Introduction.....	1
1.1	Research Background.....	1
1.2	Research purpose.....	3
1.3	Overview of this paper	3
Chapter 2	China’s Current Environmental Problems	4
2.1	Environmental Situation in China	4
2.1.1	Land Issue	4
2.1.2	Water Scarcity	6
2.1.3	Energy Waste and Shortage.....	8
2.1.4	Pollution and Gas Emission and its application to China	10
Chapter 3	Analysis on the Relationship between Environment and Economic Growth in China	13
3.1	Reviews on the Study of the Relationship between Economy and Environment.	14
3.2	Review of China's Economic Growth Mode and the State of the Environment	19
3.3	Environmental Kuznets Curve	20
3.4	Theoretical Framework	27
3.4.1	Growth Models	27
3.4.2	Externality of Social Cost Goods.....	28
Chapter 4	Environmental Issue Influences the Economic Development	31
4.1	Internalization.....	32
4.2	Comparative Advantages.....	33
4.3	External Pressure	34
4.4	Direct Economic Loss	35
Chapter 5	Major Reasons Explaining the Imbalance Relationship between Environment and Economic Development in China	37
5.1	Present Level of Economic Development	37
5.2	Limitation of Traditional Administrative System.....	38
5.3	Particularities of the Environmental Problems.....	40
5.4	Political Issues	41

5.5	Influence from Developed Countries	42
Chapter 6	Concluding Discussion	45
6.1	Build the Circular Economy	46
6.1.1	Specific measures for Developing Circular Economy	47
6.1.2	Develop Renewable Energy	49
6.2	International Cooperation on the Environment and Resources	50
6.3	Eco-tax System	51
6.4	Construction and Implementation of Green Accounting Methods GDP	52
Chapter 7	Conclusion	53

Chapter1 Introduction

1.1 Research Background

Statistics from the National Development and Reform Commission show that China's economic development has been very strong in the recent 50 years, particularly in the last 20 years, and is related to growing trade with overseas countries as well. Since 1949, China's GDP has increased by 10 times, which was a remarkable achievement, and consumption of mineral resources has also increased by over 40 times. According to the study Ren Haiping (2007), China's economic growth has gone through an unprecedented 20 years from 1985 to 2004, GDP's average annual growth rate is about 8.7 percent, and is still growing, a period often called the most glorious history of China. However, China has paid a high price for these achievements, particularly in the ultra-conventional use of natural resources and extraordinary loss of eco-environment. Since 1980, energy efficiency has always been China's national policy. Still, in the late 90's, the rate of increase in energy demand was 1.5 times that of economic growth per year, and China's energy consumption was more than three times that of the world average to produce per dollar of GDP. And Alice Hams den (1996) point out that the pollution of environment is uncontrollable, especial waterways pollution, include inland and coastal. And it also costs enormous to clean up the pollution. Furthermore, John Warburton and Leo Horn (2007) suggest that China has a bad prospect. The environmental crisis of China's threatens the domestic growth of future. According to research by the World Bank, the State Environmental Protection Administration (SEPA) and a team of international experts, the combined economic costs and human health impacts costs of outdoor air and water pollution for China's economy amounts to around \$US100 billion a year, or about 5.8 per cent of the country's GDP.. Other estimates range from 3 to 20 per cent, the comment from China's President, Hu Jintao, that China's economic growth is depended on an excessively high cost of resources and the environment.

Several other Chinese studies have reported negative environment effects of the rapid economic growth.

According to Yang Xingguan (2006), the rapid economic growth has resulted in over- use and over-exploitation of natural resources and destruction of the eco-system. And Xia Guang, Pei Xiaofei and Yang Xiaoming (2008) point out the economic growth in addition interacts with natural environment, population, industrialization, urbanization and energy. And its scale, speed and modes

have been closely related to the causes and characteristics of environmental problems. All these cause the severe environmental problems of China. Such problems as destructions of land and forests resources as well as waste of water resources are increasingly serious, plus environmental pollution caused by industrial and agricultural waste water and gas, and the emission of waste residue and the use of chemical fertilizer, are all closely related to the economic development.

Li Tie (1999) suggests that China's current economic development mainly depends on the added capital, labor, material resources and other production factors. Expanding inputs to increase output is called an extensive mode of growth, while an intensive growth mode is different in essence and implies that the economic growth mainly relies on the progress in science and technology, improvement in labor quality, implementation of modernization and scientific management.

China's industrialization begins after the developed countries. Yang Dongping (2006) point out, as China unilaterally supported economic growth during the traditional process of industrialization, and by long-term use of extensive economy growth mode which requires high material consumption, high energy consumption and high pollution, great damages was caused to the eco-environment. This extensive economic growth mode has resulted in an over-emission of waste and environmental pollution, and even aggravates shortage of energy and resources. In a study of study the relationship between the environment and economic growth, Tao song (2008) using Chinese provincial waste water and solid wastes and GDP data over 1985–2005, finds that economic growth is fast, but the problems of environmental pollution are becoming increasingly severe.

Though China has created a huge economic development at the cost of tremendous damage on the eco-environment, its eco-environment and economic development are developing out of phase. The parallel growth of consumption may also have exerted a negative impact on the environment, but this has been less studied and I will focus on production effects.

As for China, environmental pollution and ecological destruction have been mainly blamed for harm of our health, economic development and social stability. So it seems necessary and urgent to develop a symbiosis strategy to protect our environment and develop our economy.

1.2 Research purpose

I am writing this paper to shed light on the relationship between economic growth and the environment, to analyze reasons causing imbalance, and to shed light upon possibilities to improve the environment quality while keeping our current level of economic growth. This paper will summarize the perspectives of some scholars only rather than covering specific econometric models.

1.3 Overview of this paper

Chapter 1 is the introduction which describes the research background and purposes.

Chapter 2 presents facts about China's existing environment problems.

Chapter 3 analyzes the relationship between the environment and economic growth by the literature review and the Environmental Kuznets Curve.

Chapter 4 focuses on the converse impact of environmental protection cost on the economic development.

Chapter 5 discusses the reasons that cause the imbalance between economy and environment.

Chapter 6 proposes some tentative solutions for solving China's current problems.

Chapter 7 is the conclusion.

Chapter 2 China's Current Environmental Problems

In recent years, the impact of China's economic development on the environment has become increasingly serious, and the eco-environment even more fragile. Russell Smyth (2008) suggests that the welfare of Chinese people has been significantly impacted on the environmental factor. Nan Yangzi (2011) considers that present with economic growing, China's energy consumption and environmental pollution problems are huge. Zhe Dongfeng (2006) indicates that the environmental issues made China's economic growth lose the potential ability for sustainable development. Further, through China's economy is at rapid growth, its natural environment is seriously destroyed simultaneously. At present, China is paying the fiddler in respect of environment for the rapid development of the economy, and potential contradictions have emerged continuously, including environmental pollution and ecological imbalance. Ecological degradation puts China involved in environmental issues, constraining its sustainable economic development. Even in agriculture, it has done great damage on environment. Liangzhi You (2010) shows that with the increase in grain yields, it results in much environmental degradation. Furthermore, as the increasing demand of grain, it drives the intensive use of physical input. In return, the intensive use also leads to environmental degradation, such as soil degradation, water scarcity and severe pollution.

China needs a strategy to solve the rising environmental problems which could in turn change the current mode of economic development, and to adjust the economic structure to build sound basis for economic development.

2.1 Environmental Situation in China

Resources are not effectively used and protected in China.

2.1.1 Land Issue

Qu Yan (2009) said, in recent years, with the accelerated progress of industrialization and urbanization, more land resources should be objectively offered for industrial manufacturing, infrastructure and urban construction. But in terms of management, some local governments pursue political achievement unilateralism by abuse of land, and take land resources as a local "primitive

accumulation" and fiscal resources of government consumption, and also they take much advantages in the transform of land-use and a large number of added values of land capital for their primitive accumulation, resulting in the unreasonable utilization of land resources, especially in grim situation of farmland protection.

Qu Yan (2009) point, only about half of the area in China is habitable. so the most population among 1.3 billion lives around the arable land, which only accounts for 7% of the world. The development of industrialization and urbanization has exacerbated the seriousness of environmental problems. In the past 20 years, about 200 million people migrated from the rural to urban areas. It's estimated that by 2020, 300 million people will migrate, which will cause increase in demand of residential land and put land resources on unprecedented serious situation.

By using high-resolution Landsat Thematic Mapper and Enhanced Thematic Mapper data of 1989/1990, 1995/1996 and 1999/2000, Liu Jiyuan, Zhan Jinyan, Deng Xiangzheng(2005) map urban land expansion in China and analysis its expansion characters and the driving forces underlying this process during 1990–2000. They find that it adds 817 thousand hectares in China's urban land, and 80.8% of it occurs during 1990–1995 and 19.2% during 1995–2000. By the studies of the 13 mega cities data, it shows that the demographic change, economic growth, and changes in land use policies and regulations lead to urban expansion.

Li Xiubin and Sun Laixiang(1997) examine the major driving forces, which is behind the conversion of arable land to non-agricultural uses in China during 1978-1995, find that it has played an equally important role in reducing the gross quantity of arable land that industrialization and land losses due to land degradation have.

Using provincial data, Tan Shuhao (2008) examines the impact, of which cultivated land transform to agriculture and the environment. He finds that the center of grain production is gradually becoming more fragile and water scarce areas, and this put more pressure on the environment. In the 1990s, as land conversion, ecosystem service values have loss so much. But since 2000 large scale ecological restoration programs, which compensate for such losses, have been implemented.

China's current per capita cultivated land is about 1.5 Mu^①, less than half of the world average, and the arable land is still in decrease at the speed of ten million acres per year. According to the latest statistics by the Ministry of Land and Resources of P.R.C., during the last 7 years, China's total arable land has been reduced by 1 million Mu, and more than 600 counties and cities have less than 0.8 acres per capita which is below the warning level of the world per capita arable land.

As forests and water are closely related to human life, forest reduction and pasture land degradation caused by human's irrational economic activities trigger such environmental problems as scarcity of water resources, land desertification and global warming (Jiao Zhiyan, 2004). Those not only will affect people's life but also restrict the sustainable development of our society.

In the past 20 years, dozens of rivers in north China have dried up and caused the ecological destruction in large areas. Deserts covers 18% of China's land area, and now overspreads at a speed of hundreds of thousands of square kilometers per year. China's current forest area is about 16 million hectares, but the forest coverage rate and forest per capita are only 61.3% and 21.3% of the world average respectively.

The soil pollution in China is very serious, and has already become a threat to the eco-environment's sustainable development, food security and agricultural development. According to rough investigation, there are about 1.5 million Mu^① (Mu=0.165Ac) contaminated arable land across the country, most of which are concentrated in the economically developed areas.

2.1.2 Water Scarcity

Wang Jusi (1989) points out that in China, two of the most important environmental problems are water pollution and water shortage. In the 1950s, Water pollution started, and become worse in the 1970s. Rivers, lakes, oceans and groundwater have been all polluted to different extents. According to the survey of Liang Tao (2007), the situation of water resources is not optimistic. The water resource per capita is 2140 cubic meters in China, only a quarter of the world's average, ranking 110th among the world's poorest countries of low water resources per capita. Over 400 cities have

the problem of water supply shortage. The total urban water shortage is 60 billion cubic meters per year, i.e., 2/3 medium-sized cities are short of water currently and the irrigation of 1-2 million Mu of arable land cannot be guaranteed. Experts predict that China's population in 2030 will reach 1.6 billion, and water resources per capita volume will be only 1750 cubic meters, indicating China will face serious water shortage.

According to Deng Xiping (2006), water shortage is very serious in China, especially in the north and northwest of China, which occupies half of China, but has less than 20% of total national available water resources. And in this region, the efficiency of irrigation water use is only about 40%.

About one-third of the world's population has no source of safe drinking water. As for China, a developing country, water pollution has become the main factor that harms the public health. Pang Pengsha (2004) points out that in 2004, China reported 753 incidents of water pollution, for which industrial waste plays the main role, and meanwhile, the non-degradable and toxic chemicals in the agricultural waste, sewage and solid waste have caused serious damage to soil and underground water resources. Small rural industries cause a serious water pollution problem in China. In China, the water quality of over half of all river is unsafe for human, and the serious water pollution costs several per cent of GDP, estimated. Mark Wang (2007) argues that rural industry is the basis of the economic, but it plays the same important role that causes the serious water pollution problem in China.

Chou Baoxin (2005)'s work tell us, China's current water price is low when compared to the international level, which can be attributable to its low water utilization rate, and China is in shortage of water resources, so it still has to tackle water waste issues . Big gap exists between China's water resources utilization efficiency level and the international advanced level. In 2003, China's GDP water consumption was 465 million cubic meters, four times that of the world average. Integrated water utilization efficiency in agriculture is only 0.3-0.4, indicating 70% water is wasted. The country's industrial added value of water consumption is 5-10 times that of the developed countries. Only less than half of urban sewage could be used after recycling and about 20% of water gets wasted due to pipeline leakage in the urban water supply process.

Chinese government points out that the primary task in water pollution prevention and environmental protection is to assure people of safe drinking water, and to take the most stringent measures to resolve the hazards of polluted drinking water effectively. The official statistics show that more than half of China's surface water in seven major rivers is not safe to drink, and serious pollution problem makes water supply even more difficult. Further, about 320 million rural residents are facing shortage of drinking water, and some Chinese scientists also warned that if the temperature keeps rising by 2.8 degrees Celsius by 2030, China's grain output will be reduced by 10%.

2.1.3 Energy Waste and Shortage

As the first in the world to consume coal, steel, copper and the second to the United States in consumption of oil and electricity, China, is a big energy consumption country.

F. Gerard Adams and Yochanan Shachmurove (2007) use an energy balance framework to forecast future energy demands and import needs of China in 2010 and 2020, suggest that the imports of oil, coal, and gas will rapidly increase in 2020. They point out that as to increases in motorizations, the energy imports growth is not so sensitive to the rate of economic growth. Chinese petroleum imports will be likely to amount to almost 12 million b/d, almost 20% of world, coal amount to more than 50% of world trade, in 2020.

At present, China has entered the stage of heavy chemical industry. One of the features of this stage is that the energy and resources demand will rapidly increase for reason that the fast growing industries like machinery, automobile, iron and steel consume high energy. In the process of urbanization, after a large number of rural populations rushed into cities, demand of houses, cars and electrical household appliance was in increase, causing energy consumption per capita of the urban population 3.5 times that of rural areas, indicating that we entered a new phase of consumption structure. In a new distribution of global industries, China is becoming a large-scale global manufacturing base, and receiving relocation of some high-energy consumption manufacturing industries here.

Relatively speaking, China is in lack of resources. Pan Jiazheng(2006) pointed out in 2006 that as economic development is inseparable from the support of resources, the carrying capacity of resources also constrains economic development, and many resources are not inexhaustible. At present, the energy consumption of industrial sectors accounts for more than 70% of the total, while the energy-consuming industries such as iron and steel, nonferrous metals, chemicals, building materials consume 70% energy of the total, i.e. energy consumption of China's high-energy industries almost accounts for half of the total. The large-scale expansion of these low-level industry results in the intense situation of China's energy and important raw material supply. In addition to the consumption of energy and raw materials, the current development mode has also caused great damage to the environment. At present, the local GDP growth is at the cost of the sacrificing of natural environment.

Zhao Jingwen(2007) points out that fundamental problem of China's petroleum consumption is of low technological content and high-waste consumption pattern. China's petroleum dependence on foreign countries has more than one-third and "this trend" is still growing. This figure means that China's high dependence pattern on foreign oil has begun to show. China's shortage of resources has become increasingly exposed, in the future the domestic resources constraints playing a more and more important role in economic development. If China still relies on this development mode, it is bound to face bigger bottlenecks in the development in the future.

Hu Jinli and Wang ShiChuan(2006) use a newly introduced index to analyze energy efficiencies of 29 provinces in China during 1995-2002. Through the data envelopment analysis (DEA),they find the target energy input of every region at every particular year. In the DEA model, the four inputs respectively are labor, capital stock, energy consumption, and total sown area of farm crops used as a proxy of biomass energy; the single output is real GDP. According to the newly index rankings, they point out that the central area of China, whose total adjustment of energy consumption amount is over half of China's total, has the worst energy efficiency. The new indexes can be calculated as following:

$$TFEE(i,t) = \frac{TargetEnergyInput(i,t)}{ActualEnergyInput(i,t)}$$

TFEE is total-factor energy efficiency, and i denotes region, t denotes time.

$$TFEE(a,t) = \frac{\sum_{r \in a} TargetEnergyInput(r,t)}{\sum_{r \in a} ActualEnergyInput(r,t)}$$

In this equation, a covers r regions, so it means area a 's TFEE at time t is how many.

Use of the extensive production mode by many enterprises causes the grievous coal waste. Current coal recovery rate is only 40%, in particular that of small coal mines is only 15%. From 1980 to 2000, 28 billion tons of coals were wasted, and it's estimated that by 2020, approx. 56 billion tons of coal will be wasted.

Considering increase rate of generating capacity, Fan Jitao (2007) said that power shortage in China is the result of extensive use of electricity rather than supply shortage to a large extent. Power consumed by the vast majority of steel companies in China for production of per ton steel is much higher than that in the United States and Japan. Even hydropower plants, thermal power plants and other power supply companies waste a lot of energy themselves during production, for instance, hydro-electric power plant wastes 10% of electricity within the plant. Also, not high average level of quality of the population and low awareness of environmental protection, energy-saving and consumption reduction lead to excessive waste.

Whether the increasing demand of energy, or the high dependence on foreign imports of oil, iron or ore, all the information point to one thing: although China has achieved a rapid growth, the extensive mode of growth and high energy consumption makes it difficult to protect resources in the high economic growth, exacerbating the pressure on shortage of resources and energy, and bringing in utilization tension of coal, electricity and oil. The entire economy has been stretched too tight. So if we do not change the mode of current economic growth, it will not be difficult to maintain the speed of economic growth, but also may lead to economic downs.

2.1.4 Pollution and Gas Emission and its application to China

Charles I. Jones (1998) say, Goods that suffer "tragedy of the commons" are rivalries but have a degree of excludability. Hardin (1968) point the typical example of such goods is that cost of overgrazing common lands was shared by British peasants during the middle age. The cost of one peasant choosing to graze an additional cow on the commons is shared by all peasants, but the

benefit is captured solely by one peasant. The result is an inefficiently high level of grazing that can potentially destroy the commons.

As a result of the indivisibility of property rights of environmental resources, it is difficult to define cost or the defined cost is very high, the environment will become certain public goods and has public characteristic, thus we can use the environment resources without exclusion, and users may disregard the public nature of the environmental resources and the will of the community as a whole; also they may use and explore the resources without control. This would eventually lead to serious environmental pollution.

Through ‘intensity-of-use’ analysis in resource economics, S.M. de Bruyn (1998) estimates for three types of emissions (CO_2 , NO_x and SO_2) in Netherlands, UK, USA and Western Germany. He discovers that with the economic growth, these emissions increases and that while the structural and technological changes in the economy, the emission reductions may happen.

Shang Guan and Tie Liang (2000) found out that as a result of the irrationalism structure of energy use in economic development, the share of coal and oil is too large and the ratio of water, electricity, natural gas and nuclear energy is too low. In 2000, China's primary energy consumption was 1.17 billion tons of standard coal, the utilization share of energy use was that coal accounted for 61.03%, 26.69% of oil, 3.06% of natural gas, 8.98 % of hydropower and 0.24% of nuclear power. China is the only country that takes the coal as the dominated energy consumption of power structure in the world. The coal-dominated energy consumption structure will for sure form tremendous pressure on transport and ecological and geographical environment, and also will exert direct impact on the efficiency of energy use. This low-quality coal-dominated energy structure causes a series of problems, for example: air pollution in China is very serious. China's air pollution is mainly caused by burning coal, which will then produce dust and acid rain (sulfur dioxide).

The irrational emission method also exacerbates the severity of air pollution. There is a large amount of greenhouse gas emitted, so if amount of greenhouse gas emitted continues to increase, then the temperature will increase even high, and higher temperature will cause glaciers melted, and brings in flood and risk of freshwater resources shortage. Coal combustion emissions have led to

acid rain pollution nationwide, which caused a huge indirect economic loss. Therefore, the coal-dominated energy structure cost too much considering the environmental and ecological benefits. It is estimated that China's annual economic losses is as high as 95 billion U.S. dollars because of the air pollution.

In China, the current air pollution has become a threat to human health. More than 30% of China's area has an issue of acid rain. If the carbon dioxide, sulfur dioxide and nitrogen oxide emissions continue to rise at the present rate, then by the year 2010, air conditions in most China cities will be impossible to breathe.

Chapter 3 Analysis on the Relationship between Environment and Economic Growth in China

One rather general way to review the economic growth and the environmental quality is provided in the following diagram.

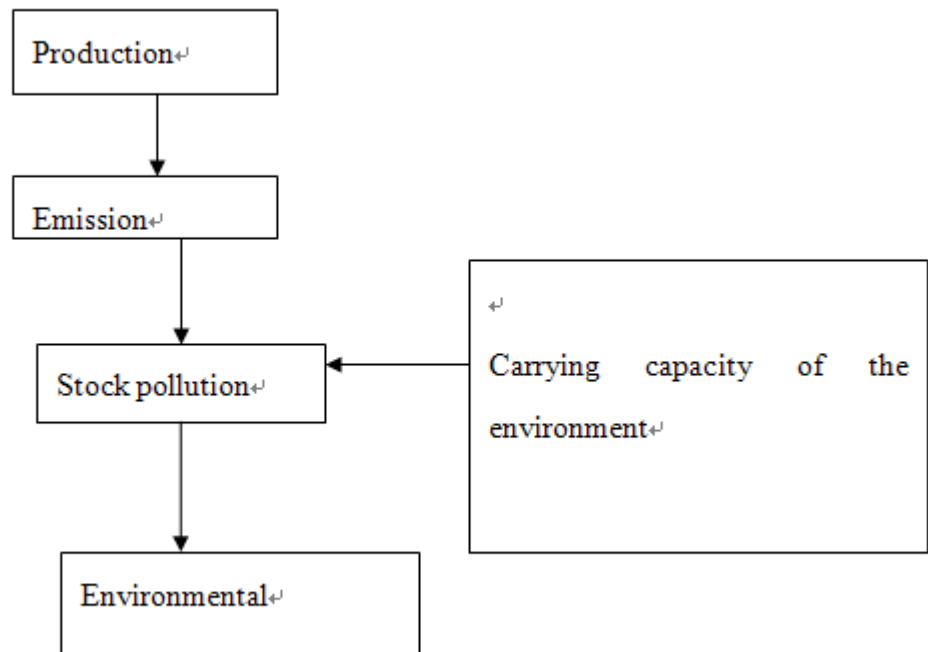


Fig. 3.1 Relationships between Production and Environment

Most of the literatures deal with the relationship between production and the environment which is also what I focus on.

For instance, I have used the following a box-figure to show the structure of the literature review that has mentioned in my thesis.

In this chapter I will analyze the relationship between the economic growth and environment quality by means of the literature review and Environmental Kuznets Curve.

3.1 Reviews on the Study of the Relationship between Economy and Environment.

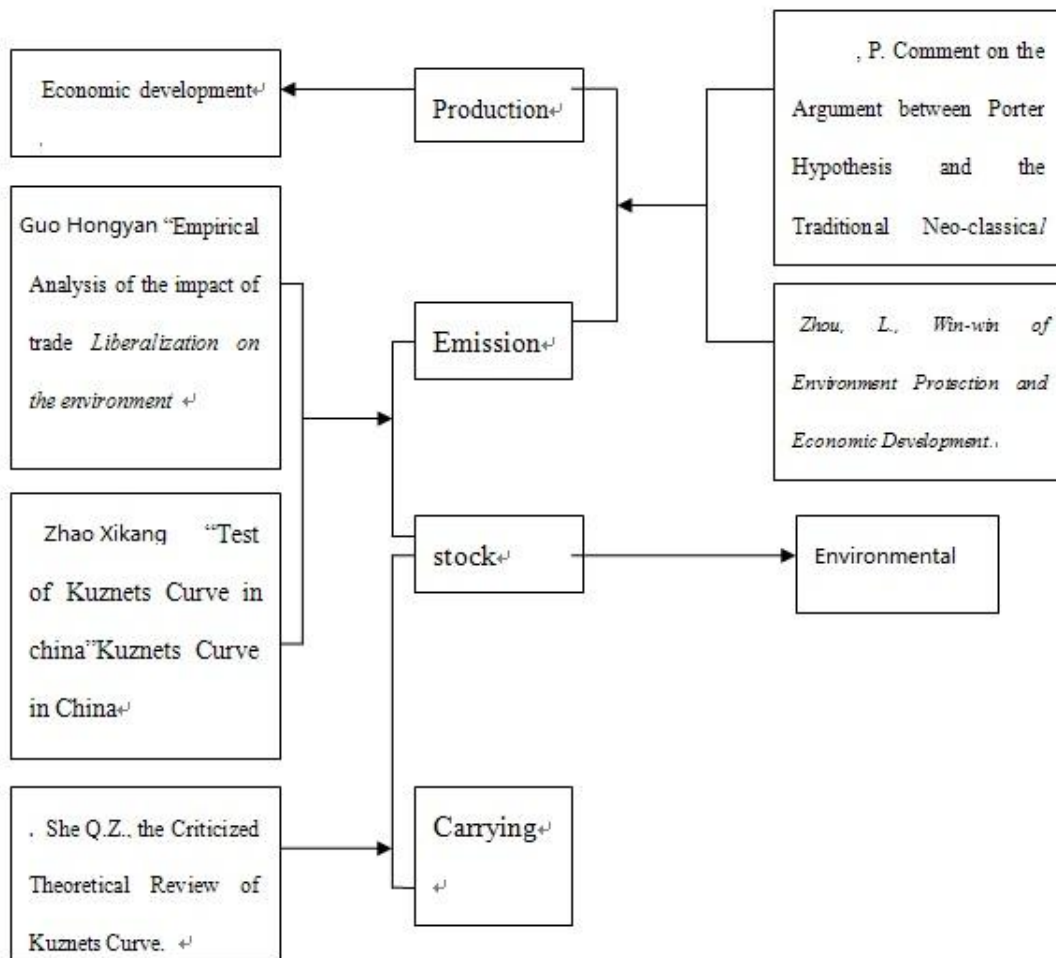


Fig. 3.2 Literature Review Structure

Besides, through analyzing of CO_2 emissions in the U.S. states, Aldy(2004) suggests that emissions-intensive trade leads to at least some extent the income-emissions relationship. He also finds that the estimated EKC's look different by state. And from study the non-stationary income and emissions data, he points out that the estimated income-emissions relationships could be spurious for some states. Anamika Barua (2009) finds it is temporary that the pollution falls during the process of economic growth. On the other hand, the pollution tends to rise with further income growth. Joseph E. Muhammad Shahbaz (2010) researches the relationship between CO_2 emissions, energy consumption, economic growth and trade openness in Pakistan. His result suggests that there is EKC in the variables in this country for long run.

Western economics has involved in study of the environmental resources from the classical economics which focuses on the production in the economic theory, and emphasizes the research on

the elements of production Jin Lan and Wang Gentang (1993). They emphasize the importance of labor and land resources in the reproduction, at the same time they began paying attention to the use of the renewable energy Statistics from the National Development and Reform Commission show that China's economic development is very important in recent 50 years, particularly in the last 20 years, and is concerned by overseas countries as well. Since 1949, China's GDP has increased by 10 times, which was a remarkable achievement, and consumption of mineral resources has also increased by over 40 times. According to the study Ren Haiping (2007), China's economic growth has gone through an unprecedented 20 years from 1985 to 2004, GDP's average annual growth rate is about 8.7 percent, and is still growing, which can be called the most glorious history of China. However, we paid a high price for these achievements, particularly in the ultra-conventional use of natural resources and extraordinary loss of eco-environment. Since 1980, energy efficiency has always been China's national policy. At the late 90's, the rate of increase in energy demand was 1.5 times that of economic growth per years, and China's energy consumption was more than three times that of the world average to produce one dollar GDP.

Xu Zhongming (2003) According to Ricardo's differential rent theory that diminishing return on resources is a natural law of restrict the economic growth. In Malthus's population theory, that the sustained growth of population is the biggest constraint for economic development. (Clark CW, 1973) The neo-classical economic theory which was developed in the latter half of 19th century advocates establishment of the balance systems between production and consumption, and keeping of the equilibrium of supply and demand to achieve Pareto Efficiency. However, this optimal system does not consider the natural resources their own.

The discussion of the relationship between economic growth and the environment has at least three different points of views, namely: pessimists, optimists and neutralist in environmental protection.

Xiong Peng (2005) argue that environmental protection pessimists represented by neo-classical economists believe that strict environmental protection measures will surely increase the private cost of the manufacturers, reduce their competitiveness, and bring the negative influence to a country's economic development. For example, Jaffe (1995) pointed out that U.S. went through a trade deficit for more than a decade all because of its government's environmental control policies.

Environmental Protection brings high economic cost, which seriously impedes productivity growth and enterprises' competitiveness in the international market.

Zhao Yan (2007) mentions that traditional economists generally agreed that the opportunity cost of protecting the environment is too high, which cause negative impact on the economic development. Pashign (1984) considered that companies have to increase investment in environmental protection, including the cost of purchasing the environmental protection equipment, managing these facilities and paying pollution taxes. In addition, as Brock and Evans (1986) say, the production process will become more complicated due to the pollution-cutting step for sake of protecting the environment, thus increasing the difficulty of management and expenses of administration, which will increase the enterprise cost.

According to Abdul Jalil (2011) , there is a negative coefficient relationship between financial development and environmental pollution in China. That means financial development has driven a decrease in environmental pollution. And this also points out three cases, which is national income, energy consumption and trade openness, determines the carbon emissions in the long run.

Study the Nan yingzi (2011), present china's economic growth is fast, but there is a huge energy consumption and pollution problems. He suggests that is necessary taking industrial ecology and green GDP accounting obtain the management targets for maintain long-term sustainable economic development, and achieve intensive economic growth.

In another aspect, enterprises' price raise will lead to lower demand plus lower output and profit Christiansen & Havelunan, 1981; Siegel & Johnson (1993). Feinck and Rowland (1991) conclude that any change of environmental factors that influence the marginal cost of production will affect enterprises' selection of new location.

More importantly, expense for investments in pollution prevention and control requires sacrifice of opportunity cost for other revenues from some more productive activities. The Government has also be required to pay on specified standards, inspection and enforcement, which will eventually be

paid by consumers and manufacturers (pointed by Xiong Pen (2005)). Jaffe (1995) also believes that the result of strict environmental protection will reduce net-export in short-term and seriously affect the trade balance, and if it is possible to improve in long-term, even serious price depreciation consequences will be difficult to measure in short period. In addition, re-allocation of production as a result of environmental protection in short term^① will increase the social costs, in particular, this "short-term" at least will last several years or even more than a decade, so the increasing cost in the so-called transition period which influences enterprises cannot be ignored.

On the other side, Professor Michael Porter put forward the claim of defending the environmental protection in 1991, and suggests that the strict environmental protection could lead to innovation to counteract the cost which can generate net income without increasing manufacturers' cost, so to make manufacturers more competitive in the international market, which is known as the "Porter Hypothesis"^②. The Porter Hypothesis provokes the theoretical framework on the environmental protection of the traditional neo-classical economics, resulting in exacerbated conflict between the economy and ecology.

Altman (2000) proposed the manufacturers' behavioral model to analyze the offset cost caused by the enterprises engaging in the pollution prevention and control. In his view, it will not lead to increase in the average cost if increase in input of pollution prevention and control can be offset by the increase in productivity factor as a positive effect, which can be attributable to the offset effect generated by the environmental protection through the upgrade productivity to offset cost, resulting in not only reduction in pollution but also manufacturers' ability to be more cost competitive. In addition, to prevent and control pollution requires large investment. Although the strict environmental protection will cause manufacturers to increase their short-term costs, this is only temporary in the transition period, and in the long term, they will spread the benefits of environmental protection based on the spillover effect to lower costs.

^① A short period: here means the period from pollution-intensive production to other industries.

^② Porter hypothesis: Environmental regulations can induce efficiency and encourage innovations that help improve commercial competitiveness. The hypothesis was formulated by the economist Michael Porter.

Salter and Angel (2000) considered that the companies who use environmental protection technology can also get a series of competitive advantages, including the innovation, efficiency and integration advantages.

Gable Sinciair--Desgagne (1998) believed that environmental protection would stimulate economic development, and can gain both the economic and environmental benefits under certain circumstances. They also believed that enterprises can adopt production of green products as a differentiation strategy to occupy the green market to gain extra revenue.

Due to precondition of the Porter Hypothesis and the theory of neo-classical economics according to different foundations, both have their own views to the environmental impact on economic development which is based on the distinct theoretical arguments and empirical evidence.

Based on neo-classical economic theory, the Chinese Government has implemented a strict environmental protection policy to shut down certain domestic manufactures to a certain extent. Since the purpose of environmental protection is to internalize the negative environmental externality so to increase the social benefits, this certainly will sacrifice the interests of manufacturers. Porter and others believe that the assumptions of traditional economic analysis does not take into account the conditions of incomplete information as well as the non-efficiency of manufacturers and the potential innovations, thus enterprises' cost of pollution control are over-estimated, productivity benefits promoted by the innovation which control department to induce manufacturers are ignored. Therefore, Porter and others are advocating the implementation of strict environmental protection policy to achieve industrial objectives, and they want to stimulate manufactures engaging in R&D to achieve technological innovation with appropriate environmental standards and strict implementation of the Government. This will lead to cost-offset effects, and enable manufacturers to reduce the pollution load and enhance their competitiveness at the same time.

The argument caused by the Porter Hypothesis and the traditional neo-classical economics of the relationship between environmental protection and economic development led to the thoughts of the China's status.

The representative in the research of the economy and environment in China's academic circles is Zhao Xikang(2006), who considered that the implementation of environmental protection policy is not conducive to the development of enterprises in the near future. But in the long run, the positive factors such as innovative technology and changes in macroeconomic conditions will offset the added cost and the adverse effects of environmental degradation by the industrial development.

3.2 Review of China's Economic Growth Mode and the State of the Environment

China, as a developing country, has a large population and rich natural resources. The comprehensive research on China's national conditions shows that since the 1980s China's economy has maintained rapid growth in GDP per capita GDP is higher than the past, but economic growth seem to have been gained by consuming a large number of resources and causing environmental damage.

From an economic perspective, we notice that China's rapid growth depends on increased capital investment in huge capital, promotion of international trade, a cheap and growing labor force, rich land resources, and a huge domestic consumer market. However, from the angle of environment and resource economics, China's rapid growth also is based on high energy consumption, high pollution emission and perhaps over-reliance on the increase in investment. High consumption of resources is the main reason for environmental pollution. In the production process, only parts of raw materials have been transformed into products, with the remaining parts being wasted and discharged into the environment, causing environmental pollution.

Foreign developed countries have adopted the strategy of "first pollution then control", which can be seen from the well-known Environmental Kuznets Curves^①. Panayotou (1993) pointed out that the extent of environmental pollution will get more serious if a country's economy is transmitted from agrarian to industrial. However, historical studies show that some developed countries also cause serious environmental problems in the process of achieving rapid economic growth.

^① Simon Smith Kuznets (April 30, 1901-July 8, 1985): He was a Russian American economist who discovered an inverted-U relationship between income and income inequality.

Zhang DongYong(2007) indicates that the low economic performance some extent resulted in its improved environmental performance with the study of Chinese state-owned enterprise (SOE) (Zhengzhou Abrasive Company (ZZAC)). However, other factors have had a positive impact by the economic performance. For example, investment in pollution abatement is influenced by the economic performance. At last Zhang suggests that it makes a significant difference to their perception of trade-offs between economic growth and the environment that the characteristics of the stakeholders, as well as their positions in the local economy. And the characteristics of the stakeholders, as well as their positions in the local economy, will finally affect environmental policy making in China.

China, as a developing country, is now at the different historical stage, in which the developed countries have already consumed a great deal of resources during their developing process. By studying the practice experience of the changing economic growth model is to govern environmental issues and find a fundamental solution to solve China's environmental problems.

3.3 Environmental Kuznets Curve

In the process of economic development, Niu Qianyuan(2005) argue that the environmental support capacity can be divided into three phases: During the industrialization phase, with the economic development, the load on environment increases continuously which causes the acceleration of environment deterioration. The situation continues till it enters stagnate phase when the economy develops to certain stage. Then the growth of environmental load slows down and inversely declines gradually once it reaches apex; In the third phase, the economy develops continuously in coordination with nature, this mode enables that load on environment reduces constantly till to a lower degree. The developed countries have now reached the third stage. This process is recognized as the Environmental Kuznets Curve (EKC), which indicates the degree of economic development impact on the environmental pollution through the per capita income and environmental index. i.e., in the process of economic development, the environmental conditions will first decline and then gradually improve.

Grossman and Kragman(1995) analyze the change of pollution emission in different regions of six countries over several years. They state that the relationship between environmental quality and per

capita income can be visualized as an inverted U-shaped curve, i.e. the Environmental Kuznets Curve (Figure 3.3). At the early stage of industrialization the environment is less affected by economic development, but when the industrialization speeds up, natural resources and waste emission are beyond self-purification capacity of the environment, causing more serious environmental deterioration. As a consequence, the contradiction between economic growth and the environment becomes more acute, resulting in negative impact to certain degree, which means the faster the economy grows, the much the environment will be destroyed.

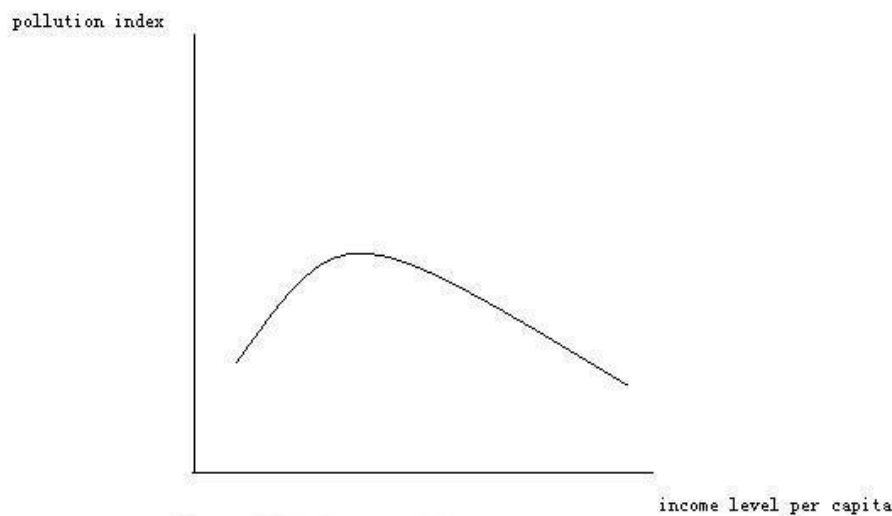


Fig. 3.3 Environmental Kuznets Curve

The Environmental Kuznets Curve (across-country) shows that when the economy shifts from a low level to a high level of income, that is when the per capita income increases from a lower level to a higher level, the pollution index will increase as well but when the per capita income continue to increase to a certain level, the pollution index will begin to decline with this income increased. Many economists have used the model for empirical analysis; some by means of cross-country or cross- regional data others by means of time series data. According to the estimates of World Bank (1992) and Grossman and Krueger (1995), the turning point of the pollutants emission is around 8000 U.S. dollars for the general pollutants. According to most studies from different countries or regions of the cross-sectional regression analysis (pointed by Hettige, Mani and Wheeler (1997)), the air and water pollution will continuously increase before the per capita income reach the point of 5000 ~ 8000 U.S. Dollar. Passing that income level, the pollution will began to drop and the environment quality will be gradually improved.

According to the Environmental Kuznets Curve, the environmental and economic development has a turning point between the "dilemma" and "win-win" range, but the turning point is of course not fixed but related to e. g the national policy adopted and the institutional set-up.

A relatively flat U-shaped curve indicates that the pollution caused by economic development is rather small and a relatively steep U-shaped curve indicates that economic development results in large quantities of pollution. The Environmental Kuznets Curve indicates that economic development is the fundamental way of improving the environment. With the growing national awareness of environmental protection, a relatively low turning point can be achieved in the Environmental Kuznets Curve at the lower economic development and less environmental damage level. This is because many industrialized countries in the early stages of industrialization neither pay enough attention to the environmental problems nor adopt any effective measures to promote a balanced development between the environment and economy. So the newly industrialized countries should learn from the developed countries' experiences to do so as early as possible. By doing so they will to reduce the maximum of the Environmental Kuznets Curve (as shown in Figure 3.1) and hence slow down the environmental degradation.

Wu Ruilin(2006) believes that China has no ecological conditions to solve environmental problems by relying on "Environmental Kuznets Curve". Any hypothesis of economics has stringent preconditions, and the "Environmental Kuznets Curve" implies an important one, i.e. the environment's carrying capacity is large enough. It's assumed that no matter how serious the pollution is, the eco-environment is reversible and recoverable, and thus turning point will always appear. If on the other hand the eco-environmental degradation is non-reversible it might be impossible to reach the turning point of the "Environmental Kuznets Curve" after passing a certain level of environmental degradation.

China's current environment is very fragile, and also its current national per-capita GDP is only 1,703 U.S. dollars, far beyond 8,000 US dollars^①. It is an open question if the environmental

① The turning point for United States is 10,000 U.S. dollars, and Japan is 8,000 U.S. dollars. (Schmalensee, Stocker and Judson 1997)

degradation in China is close to or has already passed the point making it possible to hope a turn down of the environmental Kuznets curve.

From the above views, we can see that the “Environmental Kuznets Curve” should be different across countries, especially among the developed and developing countries.

The Environmental Kuznets Curve should add the cross-country prediction. While Stockey(1998) shows the differences across countries make the model’s turning point relevant to the countries’ initial income level. The developing countries will reach the highest environmental deterioration at their peak. But the environmental quality across developed and developing countries will converge. Moses Abramovitz (1986) points out, at any given income level, the environmental quality will relatively higher in the developed country than in the developing country. The other pre-condition of the model is to range the pollutants by their characteristics such as permanence, toxicity and their instantaneous disutility.

William A. Brock (2004) shows the growth model could predict both rising incomes and falling pollution index by use of three elements, namely 1) scale - emission to economic activities; 2) composition; 3) technique - explanation of productivity.

Scale effect: With the increase of the per capita income, economies of scale have become larger and larger. As Grossman (1995) pointed out, a developing economy needs more resources investment.

Composition effect: Meanwhile, economic development has also produced a change to its economic composition. Panayotou (1993) pointed out that when a country's economy changes from a mainly agrarian model to industrial model, the extent of environmental pollution will deepen. The reason is that along with acceleration of industrialization, more resources are exploited and utilized, and that resource consumption rate begins to exceed the regeneration rate. The quantities of waste sharply increase resulting in a decline of environment quality. When the economy develops to a relatively higher level, the industrial structure will be transform from the energy-intensive heavy industry to a technology-intensive industry and services, Hence, the pollution will be reduced as a result of the changing composition of industries.

Technology effect: In fact, the composition effect implies the technology effect. Upgrading the industrial structure requires technical support; the technological progress makes the cleaner technology rather than polluting alternatives to improve the quality of the environment. It is precisely because of the balance between scale and technology effects that make the first upgrade industrial structure deepen the environmental pollution and the second upgrade industrial structure reduce the environmental pollution. So that environment and economic development relationship was appeared like the inverted "U"-shaped curve.

Using the above analysis, it might be possible to assess the main relationship between the environment quality and the economic production (applicable to the developing countries). The stock of pollution as well as waste emissions has negative effect on the environment quality and the carrying capacity is probably positively correlated with the environment quality. On the other hand, the output is decided by the scale, composition and the technology.

Zhang Lianzhong and Zhu Tan (2003) conducted an empirical analysis using a model suggested by Antweiler (2001). The results show that scale effect will aggravate the environmental pollution while the structural and technical effects will reduce it in China. Lan Tian (2004) has reached the same conclusion by his econometric models as well.

In order to examine the existence of the EKC in China, Groot, Withagen, and Zhou (2002) use a cross-section, time-series panel data set for Chinese industrial waste gas emissions to test for it. The data covers 30 provinces during the period 1982 to 1997. There are three ways (in per capita terms, in levels, and as a proportion of Gross Regional Product (GRP)) to measure emissions in the study. By the study, there are different curves in the gas emissions/per capita, income and per unit of output, and the curves are the typical EKC, N-shaped and U-shaped, respectively. Besides, Shen and Hashimoto (2004) use a provincial-level panel data set of one solid pollutant, four water pollutants and two air pollutants to examine EKC in China. They also find different shaped curves. For dust and industrial solid waste, the curve is an N-shaped curve, but for the water pollutants and SO_2 , it is an inverse-U shaped curve. But according to Zhao, Li, Wang and Zhou (2005), there is a weak inverted-U shape for soot emissions, and the expected EKC pattern is not observed for waste gas and SO_2 emissions, with per capita GDP during 1981-2001. And they point that the economic

growth is still on the rising position of the EKC in China, but there is no stable EKC relationship exists for these three pollutants.

According to Victor Brajer and Robert W. Mead (2011), the income-pollution relationship differs dramatically. Some pollutants potentially have periods of decline, but others may be continuously increasing.

However, China, as a developing country, is likely to give priority to a continued high level of economic growth implying an expanding production scale. The resulting scale effect will cause a negative impact on the environment and move China's carrying capacity closer to the critical point Wu Ruilin (2006). A counter action would be to improve the technology for clean production. The resulting abatement effects will release the environment pressure. (*Ceteris Paribus*).

Wei Ming Huang (2008) observes that there is a quasi-L-shape curve between the economic development and GHG emissions in Economies in Transition. That means it will generate a lot of "hot air" with the economic growth, which is important to carry out the Kyoto Protocol.

To study the relationship between environmental pollution and economic growth in China, based on the environmental Kuznets curve hypothesis, Tao song (2008) use Chinese provincial data over 1985-2005. In his study, the environment indicators are waste gas, waste water and solid wastes, and the economic is GDP. And he uses the homogeneous EKC model (as below) to examine if the EKC relationship between environmental pollution and economic growth exists. The results show that there are different shaped curves in Gas-GDP, Water-GDP and Solid-GDP (as below).

The homogeneous EKC model:

$$\ln\left(\frac{S}{P}\right)_{it} = \alpha_i + \theta_t + \beta_1 \ln\left(\frac{GDP}{P}\right)_{it} + \beta_2 \left[\ln\left(\frac{GDP}{P}\right)_{it}\right]^2 + \beta_3 \left[\ln\left(\frac{GDP}{P}\right)_{it}\right]^3 + \mu_{it}$$

Where the subscript i denotes a region index ($i = 1, 2, \dots, N$), and t stands for a time index ($t = 1, 2, \dots, T$), α_i represents the individual specific intercept, time dummy, θ_t is time (specific) effect, μ shows a stochastic error term which is in general allowed to be serially correlated. And

S stands pollutant, e.g. waste gas emission (in 100 millions of metric cubic meters), waste water emission (in ten thousands of metric tons), and solid wastes generated (in ten thousands of metric tons), GDP stands gross domestic product (in 100 millions of RMB yuan), P represents population (in ten thousand).

The different shaped curves:

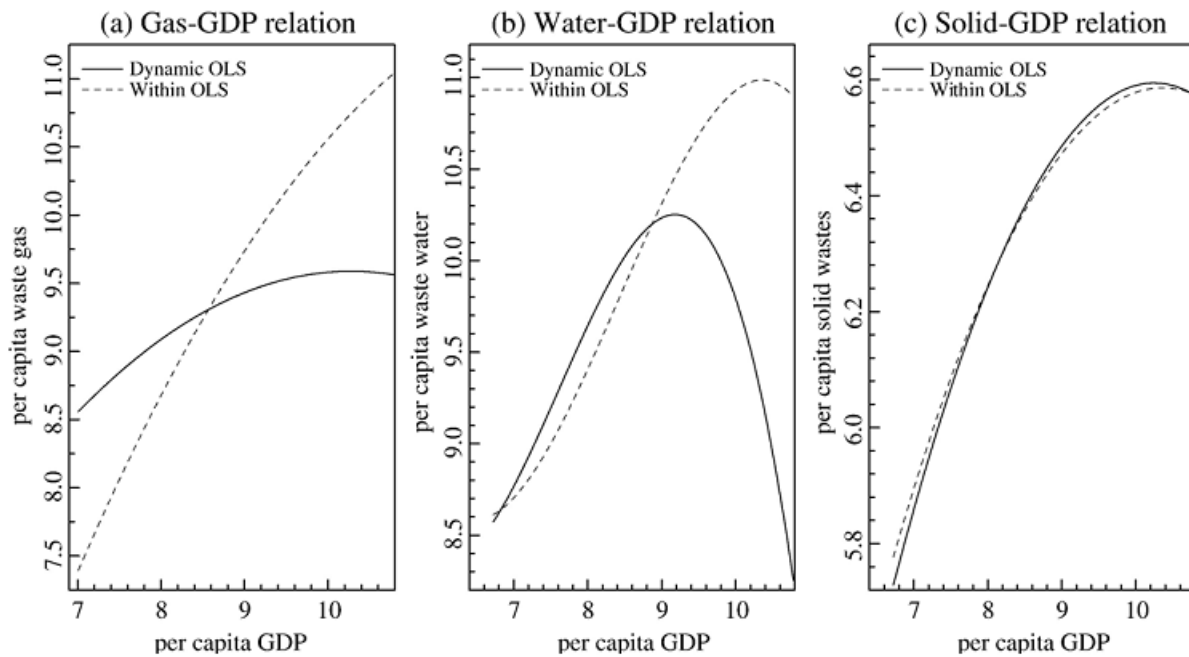


Fig. 3.4 Relationships between emission and per capita GDP

These inverse U-shaped curves indicate that the higher economic growth, the more waste gas, waste water and solid wastes created. When arriving at the turning points, they begin to decline. Although the estimates show that there is an inverse N-shaped relation, the Water-GDP relation seems an inverse U-shaped (see Fig. b). This is because another solution (=421 yuan) (sitting in the left) of the first-order derivative is too low. The curves of waste gas and solid wastes seem similar (see Fig. a and c), having two close turning points, while for waste water the turning point is lower than the former two. It is denoted that gas pollution and solid pollution has decreased much harder than water pollution.

So the conclusion is that: According to the curves the pollution first becomes increasingly severe. But after passing the maximum the problems become less severe.

3.4 Theoretical Framework

3.4.1 Growth Models

The earlier theory refers to the classical economic growth theory wrote by Adam Smith and Malthus. In 1776, Adam Smith proposed in "The Wealth of Nations," that the land is relatively large compared to the remaining population, in order to encourage the farming to stimulate the economic development by offering free land. So Adam Smith believed that labor is the only element in the economic growth, which was later developed into a theory titled Labor Theory of Value by other economists. In the less developed agricultural economy, Adam Smith's theory can well explain and guide the economy at that time.

After the appearance of industrial economy, the classical economic growth theory can not explain the new economic situation any more, resulting in emergence of the neo-classical growth theory which thanks to Solow (1956)^①. This theory recognizes that technological progress and capital accumulation can also speed up economic growth besides the contribution done by the labor force. Technological progress and capital deepening could overcome the law of diminishing marginal returns. The most influential representative of this neo-classical growth theory is MIT's Robert Merton Solow and Solow growth model as follows:

Macro-production function is “ $Y = AK^\alpha L^{1-\alpha} \Leftrightarrow y = Ak^\alpha$, $y = Y/L, k = K/L$ ”, which is a Cobb-Douglas function, where Y denotes the total production in an economy A stands for technology, K and L represents capital and labor, respectively. And y , k is the per production and per capita, respectively. Then saving function is given “ $I = sY$ ”, I is a portion s of the total production Y . And after that the capital change is given by “ $\Delta K = sY - Kd$ ”, where d stands for depreciation. And the end, the workforce change is “ $L_{t+1} = L_t(1+n)$ ”, and n is the rate of population growth.

So we can get the following diagram:

^① Robert Merton Solow (Agu.23th, 1924): He is well known of his contribution on the theory of economic growth that culminated in the exogenous growth model.

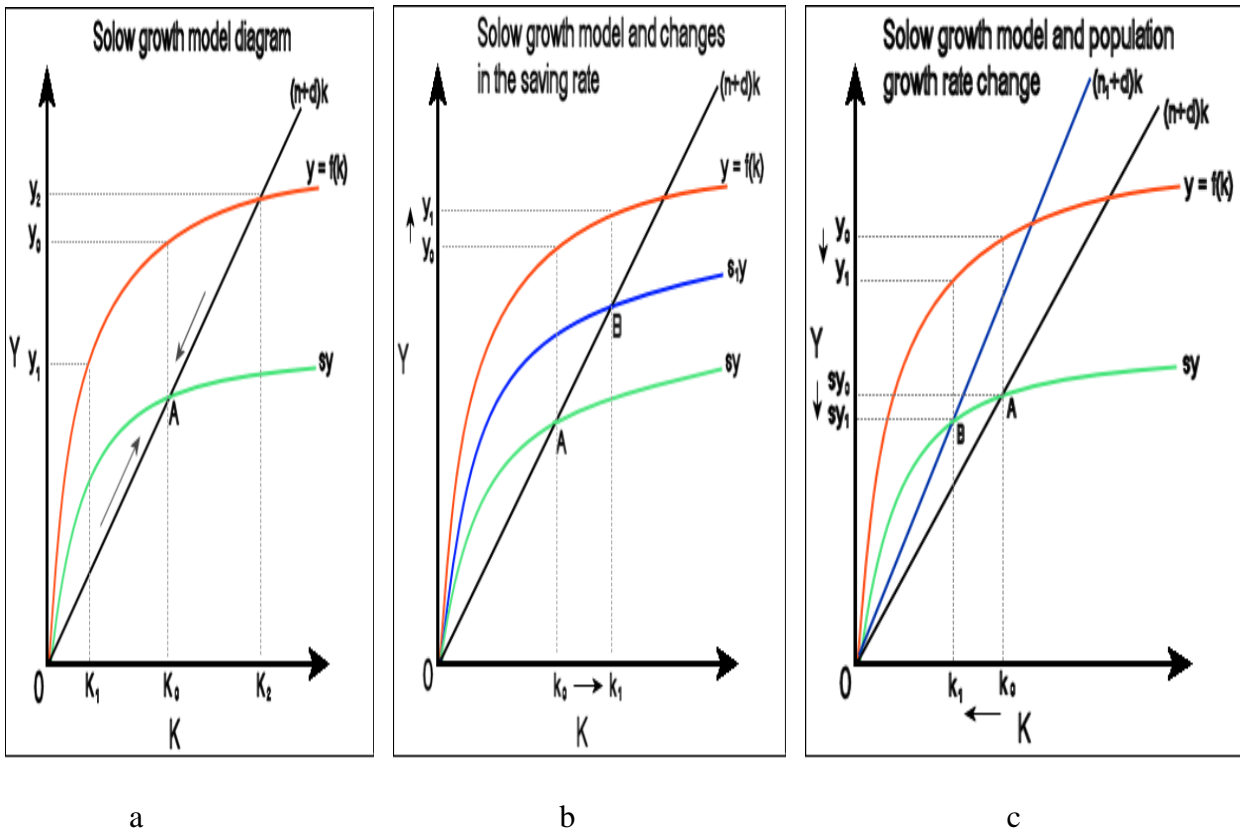


Fig. 3.5 external factor and new equilibrium

Those three figures indicate how the economy returns to the steady, how the equilibrium change facing the external factor differ. Figure a shows, when the k is not at the “right” point k_0 , how the economy return. When k is lower than the right one, the investment is bigger than depreciation which drive the k up. When k is higher than the right one, the investment is smaller than depreciation which drive the k down. Figure b show the k increase with the saving rat up. Figure c denote the negative relationship between the population growth rate and k .

3.4.2 Externality of Social Cost Goods

Natural resources are good with externality as its main feature. The cost to use this resource is considered as a social cost.

Externality theory was first proposed by the well-known economist Marshall in 1910 and then enriched by his students Pigou(1920)^①. When Pigou is analyzing the marginal social and marginal private net value of output, he found that the social cost and the private cost are different in the process of production. The gap between these two costs constitutes the externality.

Pigou (1920) in his book “The Economics of Welfare” said that economic externalities exist because when A provides services to B, often this will benefit or damage others, but A does not obtain compensation from the beneficiary and does not pay any compensation to the injured person". In other words, the existence of externalities makes some social costs or gains do not response on the market price of certain products or activities. The externalities can be divided into positive and negative external. The economic activity with negative externalities will have higher expected standards, because the society has undertaken part of its cost. The economic activity with positive externalities is inadequate because they cannot receive compensation. By analyzing perspectives of resources allocation, the externality is a phenomenon of low-efficiency that some benefits or costs are ignored by the decision-makers.

In the west economic theory, the externality explains the reason why the environmental problems occur. This theory considers that private use of resources and the environment will cause the negative external effect and prejudice the economic interests of the whole society. Such harm will damage the environment and reduce limited resources.

For example, the up-stream farm U of a river will damage the water quality if fertilizers are used, which affect the down-stream farms D and cause loss of production and daily life which constitute the social cost of the farm U. However, supply and demand equilibrium price in the traditional market system does not reflect the external social costs. This results in environmental problems that the sewage and other economic activities which damage the environment do not pay necessary social cost and lead to the excessive harm to the environment. The beneficial economic activity such as forest planting is shrinking without corresponding to the comparison compensation.

^① Arthur Cecil Pigou (Nov.18, 1877—Mar.7, 1959): He is an English economist whose work covered various fields of economics, especially in the area of welfare economics.

In an overlapping generation's model with environmental externality, Tetsuo Ono (1996) think three tax plans to internalize the negative effects of the consumption on the environment and the intergenerational long-run effects. And we can achieve the optimal allocation in every tax plan.

According to Erik T. Verhoef and Peter Nijkamp (2002), they develop a general spatial equilibrium model of a monocentric city. In the model, two types of externalities occur, one of them is environmental externalities, and the other is agglomeration externalities. They test free-market for first-best and second-best optimal spatial equilibrium, and suggest that the pursuit of environmental goals may sometimes lead to at the expense of reduced agglomeration economies, and on the other hand it may actually sometimes stimulate the economies.

Chapter 4 Environmental Issue Influences the Economic Development

Human's survival and development depend on natural environment, but meanwhile human's survival and development will in turn affect our natural environment. The relationship between economic development and natural environment is shown as follows: first is the impact of economic development on the natural environment, including extortion of natural resources and spaces to enjoy the eco-system services, discharge waste into the environment; second is the counteraction of natural environment on human being, including limitation of resources and environmental on human's economic development; negative impact of natural disasters, environmental pollution and ecological degradation on the economy.

In order to illustrate the relationship between economic growth and environment, Anastasios Xepapadeas (2003) did a great job.

Based on these Theoretical foundations, the author has an experimental test and then comes the conclusion. If a steady state for the undiscounted optimal growth exists, that means a sustainable state for the economy and the environment is possible. Furthermore, if it is possible that sustained growth without pollution accumulation; that stands for that there is also a sustainable state for the economy, since the environmental stock does not decline in the long run. So, optimal growth paths are also sustainable in that case.

Environmental issues could influence and constraint the economic development in two aspects: first, although the environmental protection will increase the social benefits but will also increase the costs of the private companies and degrade the competitiveness in the international market, this implicit offset effect will also bring negative effects of China's economic development, and this effect will primarily reflect in the international trade. As a developing country, China has its economic growth depended on the international trade to certain degree, so cost of environmental protection will certainly affect its partial economic development. On the other hand, the eco-environment is increasingly fragile; the negative effects from the limitation of resources will also constraints the healthy development of economy in China.

From Sherry Bartz (2007), some scholars believe the theory, which the inverted U-shape results from a corner solution in which less developed countries do not abate pollution; while others not think so. In order to analyze the causal relationships between economic growth, human development, Valeria Costantini and Salvatore Monni (2007) combine the RCH and EKC models,

and they find that in order to build a sustainable development path, it is importance of high institutional quality and investments for human capital accumulation. From Shi Baojuan (2010), we can't see an obvious EKC relationship between environmental indicators and GDP per capita besides industrial dark matter emission. And he considers that it will continue to rise that the emissions of industrial waste water and industrial solid waste.

Most environmental problems are caused by the market failure, and main failure is prices cannot reflect social benefits or real market cost for reason that we have to internalize the environment cost.

4.1 Internalization

Environmental costs mean the environmental damage and the resources wastage in the production process or mean the use of goods. Bring the environmental costs into the cost of production is defined as the internalization of environmental costs. The internalization of environmental costs in the international trade refers to bring the various environmental costs into the prices of trade goods and afforded by the producers and consumers in order to promote the rational use of resources and effective protection of the environment.

On one hand, trade policies that stimulate the economy may distort market structure, causing harm to the environment; on the other hand, the trade policies with too much emphasis on the protection of the environment may not be conducive to normal economic development, thereby affecting the benefits of the environment. For instance, as a developing country, China has its economic fundamentals which determine the government to lower its environmental standards, and the other way adopted by the developed countries is to transfer their pollution industries into the developing countries. At the same time, the developed countries may use the excuse of protecting the environment to create non-tariff barriers to constraint the economic development for the developing countries by trade barriers, whereby to whittle the national power of the developing countries.

The internalization of environmental costs in the international trade is a complicated issue. Not only because of the difficulty to evaluate worthiness of the environment but also irregular economic development level of each country. There are no unified model and index system to measure the

value of the environment. As a developing country, China may lose the economic interest by the internalization of environmental costs. For instance, this internalization may cause the rise of the prices of raw materials and primary products which will decline the export competitiveness. Finally, internalization of environmental costs will be likely to stand advantages by trade protectionism to call for China to carry out the internalization of environmental costs. China's environmental protection may have some positive effect but it would adversely affect the economic development in which the economic interests will be involved.

The conflicts between the developing and developed countries in the environmental and trade issue are due to the vary degree of economic development of each country. The industrialization level in the developed countries which has experienced the profound lessons of environmental pollution is very high. Therefore, they attach great importance to environmental protection during the economic development process and have more stringent environmental standards and environmental regulations. China has relatively low level of industrialization and put less emphasis on the environment, and also has backward technology to protect the environment and reduce the pollution. In this case, if the developed countries call for China to use the strict environment standard of export in the international trade, another new non-tariff barrier will be led to. So, when the issue of environmental protection combines with economic development, an opposite relationship between these two will be formed.

Peter H. May (1996) points out that despite competitive disadvantage, if we internalization of socio-environmental costs of such dislocation, the production would best have been left where it was. And Kostas Bithas (2011) thinks that their internalization or neutralization in the traditional way cannot lead to sustainability, if there are externalities prevail in the real world.

4.2 Comparative Advantages

The internalization of environment cost to some extent could explain that if China carries out the high standards of environmental control policies, high economic cost will be caused and competitiveness of manufacturers in the international markets will be reduced. After internalization of environmental costs, companies have to increase their investment in the environmental protection, including the cost for purchasing equipment and managing these facilities. Enterprises have to improve their existing production technologies to reduce the pollution in the production process, which makes the production flow more complicated and expensive. Those measures will increase

the management difficulty, and force the enterprises to raise commodity price, and lead to the lower demand. Finally, the profit will decline. So this will weaken the competitiveness of enterprises in the international market.

Traditional international trade theory does not take into account environmental costs, and the prices of tradable goods do not reflect the environmental costs. Environmental elements do not base on the price market factors, so that different countries have different environmental standards. As a developing country, China sets down lower environmental standards which cause lower environment cost. According to the theory of comparative advantage, China has the comparative advantage of the environment. This often leads to China's economic development structure depending on environment sacrifice and predatory exploitation of the natural resources to obtain competitive advantage in the international market. The developed countries have higher environmental standards, and they use trade measures to transfer pollution into the developing countries. Once China has also implemented high environmental standards, the competitive advantage in the international market will weaken or disappear. This will be a direct cost in the economic development as protection the environment.

According to Matthew A. Cole (2003) , as the global decline in trade barriers, the environmental regulations now potentially play a more and more significant role in a country's comparative advantage. As consistent with the Porter and van der Linde hypothesis, Valeria Costantini (2007) also suggests that environmental regulation stands for an important source of comparative advantages. Those strongly show that the environmental regulations now are very important in this society.

4.3 External Pressure

The developed countries should take responsibility for the current situation of pollutions such as "greenhouse effect". But that pollution situation gives the developed countries an excuse to restrict the environment protection to the developing countries. This is so unfair.

Difference level in the economy and technology of the North-South, together with the present production and trade structure between the North and South, will certainly make the developed

countries occupy a dominant position in the economic development. China, as a developing country, surely is at the subordinate status. The internalization of environmental costs will weaken the position of the developing countries in the international trade which could deteriorate the North-South trade relations. The asymmetry between the developed and developing countries realizing the internalization of environmental costs put the former in an initiative to occupy the dominant position, and the latter in a passive and cooperation status. This difference will generate a direct adverse impact on the environment in China, and will also cause the obstacle to the North and South in trade. This opposition will hamper the economic development in China.

From the study Hemamala Hettige (1996), the environmental pollution intensity is negatively associated with scale, productive efficiency, and the use of new process technology. According to Keith Brouhle (2008), if participation in the GPA, it will place several forms of external pressure, which is the regulatory threaten, industry trade association membership, the level of environmental giving in a state, and a number of neighborhood characteristics.

4.4 Direct Economic Loss

In case of relative shortage of resources, fragile eco-environment has gradually become a major problem in China's economic development.

First, the environmental problem is restricting the economic development. The World Bank estimated that China's air and water pollution caused it lose 8 percent of GDP in 1995; according to Survey Western Ecological report, the ecological destroy caused direct economic loss of 13% local GDP in 2001; experts from Chinese Academy of Sciences estimated that the environmental pollution and ecological destroy caused 15% GDP loss in 2003.

Experts from the Chinese Academy of Sciences estimated that the pre-development cost of energy, transportation, communications, environmental protection, ecological construction and other infrastructure construction is 1/4 higher than the world average, including 10% for inherent fragility of the environment, 7% for the environmental pollution, 4% for the irrational structure and mismanagement respectively. High development costs will for sure affect the economic development and competitiveness.

The second is that the environmental problems harm people's health and social stability. The environment is closely related to human health. According to the international research results, the level of environmental pollution is positively correlated with the cancer and respiratory system diseases. According to the *United Nations Development Program 2002 Human Development Report in China*, the population dying of lung cancer at the serious air-polluted regions is 4.7-8.8 times than that at good air regions.

In China, not only the air pollution but also the water pollution is a serious hazard to the public health. For example, in 2004, pollution incidents in three cities in Tuojiang Sichuan influenced millions of people's drinking water, and caused economic loss of about 200 million Yuan. Environmental degradation put residents at hard conditions for living in some area, and "ecological refugees" aggravates the burden of China's economic development.

By studying Wen Zongguo (2007), it is 435.2 billion Yuan, 4% of China's GDP that the total loss from air pollution in 2002; and for water pollution, it is 650 billion Yuan, 6.1% of GDP; for noise pollution, it is 1.6 billion Yuan. And the total cost of environmental pollution is 1092 billion Yuan, 10.2% of GDP in 2002. Using the "willingness-to-pay" metric, Wang Xiaoping (2005) find that total health damages due to year 2000 anthropogenic emissions from Zaozhuang, which in eastern China heavily depends on coal.

Chapter 5 Major Reasons Explaining the Imbalance Relationship between Environment and Economic Development in China

From the above analysis, we can see that although the level of economic development in China has been improved to certain extent, negative impact on the eco-environment by economic development has also beyond its carrying capacity. The relationship between China's overall environmental pollution index and the per capita GDP is still at the climb stage of the Kuznets Curve, indicating that China's economic development and environment are not in harmony, and many reasons can be attributable to such situation.

5.1 Present Level of Economic Development

China's present level of economic development determines its lower level in the environmental protection.

As China has just entered the take-off stage of economic development, so its economic development level is not high. The Environmental Kuznets Curve shows that China is still at the rising period on the inverted U-shaped Curve. Due to the limitations of the economic development level, the backward production technology and equipment determine that China has the extensive industrial production during this period. This high-consumption production will inevitably bring high pollution. China's low-level economic development constraints the environment in the following main areas:

Firstly, China has a large population which forms a great pressure on the resources and environment. Paul (Paul Ehrlich 1972) proposed the environmental impact equation in 1972, namely $\text{Impact} = \text{Population} \times \text{Affluence} \times \text{Technology}$, from which we may notice that the population size, economic development level, and technology are the three important factors that may affect the environment quality. Environmental issues are closely related to the population problems, which makes it difficult to solve the environmental problems. Victor Brajer's (2011) view was in favor of the inverted U type assumption and the use of aggregated indices. In order to make a research of the existence of an EKC for China, Shen and Hashimoto (2004) used a provincial-level panel data set of one solid pollutant, four water pollutants and two air pollutants. They come to the conclusion as

follows: for dust and industrial solid waste, they provided support of an N-shaped curve, while they gained the expected inverse-U shaped relationship for the water pollutants and SO.

Secondly, China's enterprises, especially the large state-owned, are at a lower level in terms of the technology equipment, management skills, and scientific research. The extensive mode of production has resulted in serious waste of resources during a long period, which aggravates the burden on the environment as well. There are nearly more than two thirds of industrial enterprises are small-sized. The township-run enterprises have developed rapidly in the last 20 years, but also have backward technologies and equipment, which seriously wasted raw materials and energies. As in the absence of proper environmental protection measures, reasonable layout and improved management skills, they caused serious environmental pollution.

Thirdly, Chinese government focus on economic development causes ignorance of its duty to protect the ecology and environment, and even failure to take adequate measures to ease rising confliction between the economy and environment subject to the related laws and regulations.

Fourthly, the poor level of economic development indicates China's low level in science and technology, and in education as well; weak environmental awareness of citizens makes it even harder to fulfill the environmental protection task.

5.2 Limitation of Traditional Administrative System

It's difficult to solve the contradiction between the environmental protection and economic development with China's traditional administrative system.

On one hand, the externality and cross-boundary of the environmental problems can be mainly attributable to aforesaid difficulty, and impact will then be caused by the environment pollution and ecological damage without geographical constraints or subjection relationship among administrative areas. Each administrative region will build "benefit plan" by considering its own interests jointly with the pollutant discharging units to a certain degree. They will transfer the cost of environmental

pollution to other regions and thus give rise to the pollution incident of "the upstream get rich and downstream get disaster".

On the other hand, the traditional environmental management in China mainly uses administrative measures, i.e. "economy relies on the market, and environmental protection counts on the government." indicating too much expectation on the government. While the executive function of government has multiple characteristics, which means the local government not only has to protect the public interest or promote the sustained and healthy social development but also has to do everything possible to protect the production and development of the local enterprises. When the conflict happens between environmental protection and economic goals, local government may sacrifice the environment for short-term economic interests.

The government's pursuit of economic goals puts the environment protection in shortage of financial support. Zhou li'an (2007) indicated that promotion tournament on basis of GDP growth is the sticking point to explain the amazing growth, which lack of environment protection. According to experts statistics, using 2%-5% of the GDP for ecological construction can curb the continuous deteriorate of the eco-environment; while using 5%-8% can improve the eco-environment. China has just ploughed into less than 2% of GDP on the ecological construction which clearly means that it's difficult to guarantee the sustainable development of the eco-environment. Besides Environmental policy efforts have lacked availability, which confirmed the persistence of a disjuncture between promise and implement. Olivia Bina (2010) made an analysis in her paper which reveals weaknesses in all three EPI-type responses: normative, organizational and proce-dural. The disjuncture is confirmed, but according to EPI's normative perspective, she advised that the reasons for this should lie as much in the framing of the promise as in the implementation.

The reason why the effect of environmental protection will be restricted to a certain degree is that the government lack of law enforcement strength, backward law enforcement equipment, unimproved environmental legal system and inadequate sector coordination mechanisms. Polluters and destroyers will objectively make a series of environmental pollutions and ecological destroys in ignorance of laws to maximize their economic benefits. The extent of administrative intervention measure which mainly depends on control system has defect itself. Therefore, it is difficult to

guarantee the efficiency; sustainability and equity of environmental management by solely counting on the administrative measures or reinforcing laws and regulations. In consideration of overall situation for a long-term, it's a must to use appropriate economic instruments based on market mechanisms to address environmental issues.

5.3 Particularities of the Environmental Problems

Particularity of the environmental problems adds it more difficult to solve.

As a result of externality of environmental pollution and the publicity of environmental protection, the balance between environment protection and the economic development is constrained by multiple factors.

First, the level of economic development, economic legal system and environmental protection awareness in China differs a lot from that of the developed countries. Graeme lang(2002) indicate in his paper that china has the least measures to protect the environment in most of these countries, but it is the only agency able to handle many reasons of deforestation.

Second, whether the environmental resources market could be effectively operated. We cannot account all of scarce environmental resources into the market, because the price determines supply and demand relationship. The external diseconomy of environmental pollution exists in various manufacturing enterprises, and the short-term behavior industrial production combining the irreversible environmental damages caused by some of the serious pollutions has determined that China is still unable to provide an effective market of resources and environment.

Third, whether the economic-environment coordinates with policies including the public item policies, industrial policies, economic incentives as well as emission control policies and macroeconomic policies. Furthermore, the industrial, economic and macroeconomic policies of China's environment-related industries have less coverage. On the other hand, the implementation power is also weak, bringing high management cost.

The economy and the environment, as a subsystem of large-scale social systems, are not only restricted by the natural environment and economic operation law inside the subsystem but also affected by technology, education, culture, or demographic and other social factors outside the subsystem. In order to promote the sustainable development of economy and environment, government should strengthen and improve the environmental management and economic policy, and meanwhile control the speed of industrial development, maintain an appropriate investment on environment, and improve business skills and technologies, so to technically solve environmental problems. The economy and the environment will develop coordinately only if all applicable policies and measures are combined for use by all means.

5.4 Political Issues

At present, the issue of environmental resources has become a global concern, and China's resources and environment also lead to a series of political and diplomatic issues which caused a huge pressure in turn and affect China's economic development.

Firstly, the rapid increase in demand of resources and raw materials in the economic development will inevitably lead to the tight supply and rising prices of raw materials and market-related resources in the international market, and then cause the global inflation. Acceleration of the economic development in China keeps the demand of resources and raw materials growing, which makes the developed countries feel the pressure of competition for resources, thus affecting the supply-demand and price level of market-related resources and raw materials in the international market, or even generating the linkage effect between the demand conditions in China and the international market price level. Increasing cost of production will for sure affect the economic development of other countries and cause other countries dissatisfaction on China's fast economic development.

Secondly, some developed countries have been aware of the fact that China has grown from the low-cost energy-export country into the import country. Based on the strategic point of view, energy is essential for a country's survival and development. China's rapid economic growth makes a lot of money and energy flows into China, breaking the original energy pattern which is a grave threat to the vested benefit of developed countries. China's positive efforts on oversea business have been treated as ulterior motives for the strategic expansion.

Thirdly, China's original economic development type is based on the resource consumption. National Bureau of Statistics show that China's heavy industry has developed rapidly in the first quarter of 2007, especially the high energy-consumption industry. The developed countries are beginning to focus on the responsibility for climate change and environmental degradation by economic development of developing countries, particularly China in the recent G8 summit (the group includes the US, Russia, Germany, France, Japan, British, Canada and Italy) which involved in climate issues. They attempt to limit China's economic development by the excuse of environmental and climate issues. Tao Song (2008) thinks that the environmental pollution are increasingly severe along with the rise of economic growth. Environmental degradation of most provinces has being still worse, and only few high-income regions have realized the importance of environmental improvement, especially for waste gas and solid wastes. Nan Yingzi (2011) conclude that China's economic growth is at the sacrifice of the huge energy and environment.

Fourthly, at present, China's low-cost of resources and the environment led to increasing China's favorable balance of trade to some extent. This caused the trade friction between China and other countries, especially the United States. The United States put continuous pressure on RMB appreciation of this issue.

These political and diplomatic pressures in turn affect China's economic development, and barriers directly lead to decline in trade export. The diplomatic pressure to the energy and environment forced us to adjust the industrial structure quickly. Many enterprises suffered heavy losses by lack of buffer capacity and the sharp appreciation of the RMB directly resulting a seriously interests damage to a huge number of export enterprises.

5.5 Influence from Developed Countries

First of all, in the early process of industrialization of western countries, a large amount of raw materials, energy and labor are easily available from the undeveloped countries with low price, and these western countries may adopt whatsoever ways that may result in high input, high consumption and high pollution without considering resources and environmental consequences. However, this

era has gone forever. At present, environment capacity of natural resources become increasing smaller to all countries in the world compared to the growing demand. Western industrialized countries are doing everything possible to economize the use of resources and energy to reduce environmental pollution. Developing countries such as China do not have conditions of resource-consumption growth any more, and we cannot get cheap natural resources and environmental capacity, so we must pay higher economic and social costs of environmental to cover damage. There exists relationship between FDI capital stock and SO₂ emission ,which is increasing 1% in FDI capital stock, industrial SO₂ emission will increase by 0.098%, in which the emission increase due to the impact of FDI on economic growth and composition transformation balances out the emission reduction result because of FDI's impact in reinforcing environmental regulation He Jie(2005). Dean (1998) used a simpler simultaneous system to research the relationship between international trade and industrial wastewater emission in China. She supposed that international trade increases pollution by “pollution haven” effect, but trade also conduces to economy growth, which reduces emission because higher income strengthens public exigency for a better environment.

Secondly, in the early process of industrialization in the West, some prevention and treatment of environmental issues have also been restricted by the period. They lack scientific understanding of environmental issues and have less preventive treatment measures in a long term. But the situation is completely different now, we can not only have scientific analysis of the dangers on environmental pollution but also have the necessary technology and corresponding policy instruments which can be done to balance economic development and the environment.

Thirdly, in the West, in the early process of industrialization, environmental problems were basically confined in one country which is not bound by the international community, but the situation is different now, environmental issues have become global issues. In order to protect the human environment, the international community has developed a number of legally binding environmental treaties. Anyone who violates the provisions of these treaties will be condemned or even sanctioned for major economic loss thus caused. China should strive for justice of the right to develop in the international community and to fulfill its international responsibilities undertaken.

Finally, the developed countries' development process of primitive capital accumulation depends on plundering of other countries' resources, especially those of undeveloped countries. However, the development of our country is mainly dependent on the domestic market, resources and environment. Major developed countries in the era of heavy industry relied on mass production, and consumed huge resources and energies, and even generated huge waste. However, China has no conditions to use this type of development model, on account that iron, ore, aluminum, copper, oil and other major means of production cannot be self-sufficient, and China experienced the energy bottleneck.

Chapter 6 Concluding Discussion

Through the afore-said analysis, China has to carry on the sustainable development to release the pressures on the environment and solve the contradiction between the economic growth and environment deterioration.

Wang, S.S and Zhou, D.Q and Zhou, P and Wang, Q.W (2011) investigate the relationships between CO_2 emissions, energy consumption and economic growth in China based on the panel data for 28 provinces over the period 1995-2007. And they find that the long-run co-integrated relationships between the three variables. They suggest that China government should attempt to change the coal-dominated energy consumption structure and reduce the shares of energy intensive industries in economy, and need a necessary policy option for reducing CO_2 emissions. And Nan Yingzi and Wang, S.S and Zhou, D.Q and Zhou, P and Wang, Q.W (2011) used the panel data for 28 provinces over the period 1995-2007 to study the relationship between CO_2 emissions, energy consumption and economic growth in China. And they find that among the three variables there has a long-run cointegrated relationship. They advised that China government should try to alter the coal-dominated energy consumption structure and reduce the shares of energy intensive industries in economy, and need to make some necessary measures to reduce CO_2 emissions. Nan Yingzi and Gao Yuying(2010) think that the government should set industrial ecology and green GDP accounting as the management targets ,so that we can maintain long-term sustainable economic development, and achieve intensive economic growth. Han Shangjuan and Zhu Jingping(2010) think that, we should take some measures to realize the coordinated development among energy, economy and environment. The policies are as follows: 1) Try our best to exploit new clean energy resources and gradually adjust Chinese energy consumption structure that coal is the main fuel. 2) Change current extensive economic growth way, and increase technical innovation inputs, especially R&D investment in manufacturing sectors. 3) Build thorough environment legislation system and environmental standard system, guaranteeing the implement of environmental laws, and establish a social supervision mechanism about environment.

Jonh Sterman(2009) suggested definition of the sustainability is as followed:

- 1) The renewable resources shall not be used as quickly as they are regenerated
- 2) The waste shall not be produced as quickly as they start to present damage

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- 3) The nonrenewable cannot be used during a long period

6.1 Build the Circular Economy

The essence of the so-called circular economy refers to eco-economy, abbreviation of the closed-loop flow of substances. Such economy is in compliance with material circulation of the natural eco-systems and law of the energy flow, advocates economic system reconstruction, and stands up for clean production, waste utilization, ecological design and sustainable development. Circular economy sticks to the policy of reduction, recycling and safety disposal of wastes, and features closed-loop cycle of the material energy utilization.

In the traditional economy, humans intensively extracted the Earth's resources and energy and then discharged a great deal of pollution and waste into water, air and soil. Extensive and disposable use of resources is to achieve increase in economic growth through the way that put resources into a waste. The circular economy is different from the traditional one. The former advocates the economic development model which is consistent with the environment, and requires forming of economic activity into a feedback process, like "resources - products - renewable resources", characterized by low exploitation, high-use and low-emission. All materials and energies in this economic circle must be reasonably and sustainable used to reduce the impact of economic activities on natural environment as less as possible. Characterized by the resource conservation and recycling utilization, the circular economy is also known as resource recycling-based economy.

The circular economy provides the strategic theory paradigm on how to transfer the traditional industrial economy into sustainable economy during the industrial period, which could solve the long-term sharp conflict between the environment and economic development. The circular economy not only concerns about GDP growth but also the quality of growth. This new-type economy put emphasis on saving and effectively using resources in the process of production and consumption in order to reduce non-effective and destructive growth. It uses the low-energy and high-utilization mode to maximize economic benefits with minimal resources and environmental costs.

China's annual environmental pollution, natural disaster and water shortage caused the economic loss cumulatively equivalent to 8% of the annual increase of China's GDP. The fossil energy and mineral industry account for a high proportion of the output value of the national economy,

indicating that the energy, resource, environment and disaster issues have crucial impact on China's sustained economic growth. The contradiction between the eco-environment and the economic growth cannot be resolved by the traditional economic development model.

In the 21st century, China's GDP still grows at the speed of 7% - 8% per year, which undoubtedly brings great pressure to the environmental protection. China's energy stock and environmental carrying capacity cannot burden the high intensity of resource consumption and environmental pollution under the traditional economy model. We have to change the current extensive economic growth as soon as possible and vigorously develop the circular economy, which is the best for breaking the bottlenecks to achieve sustainable development. Taking a new road of industrialization is an effective measure of protecting the national ecological safety to coordinate with the development between human and nature.

6.1.1 Specific measures for Developing Circular Economy

1) Transform the population concepts

Change concepts and foster ideas that development of circular economy is the fundamental way of creating a harmonious eco-environment and developing the circular economy. China is taking the development model as "first pollute and then control" for a long-term. At present, the "bottleneck of the resources and the environment become more and more prominent, we should completely left the process of industrialization behind and take the procedure of "treatment and pollution together", and implement the whole process control. Enhance education and training on the advantages of the circular economy to gradually turn the awareness of environmental protection into specific action. At the same time, intensify development of circular economy and China's long-term economy by combining the social development plan to achieve sustainable development.

2) Government function

Government is mainly responsible for developing the circular economy that could make full use of the administrative, legal, economic, financial and other means to settle the market imperfections and regulate the sustainable development of circular economy. First of all, strengthen policy guidance, study and formulate laws and regulations relevant to the direction of industrial structure; observe restrictions and encouragement to develop the low-resource consumption and high added-value industries, eliminate and restrict the "high consumption, high pollution" industries. Establish measures for financial, taxation, prices, emissions trading and environmental tax system in order to

form the new mechanism to protect the environment. Then, implement the conception of circular economy in all economic development plans, and finally change the current examination and computation economic system, and build a green accounting system to input the environment benefit index in.

3) Technology support

The progress of science and technology is important for development of circular economy. It is difficult to fundamentally achieve the economic and environment symbiosis growth without advanced technology. To promote the collaboration of the academic, industrial and governmental departments in the cycle of technology development in order to break the technical constraints of circular economic development as soon as possible, firstly it is necessary to increase investment in science and technology to enhance the level of technology and equipment. A considerable number of enterprises in China are still using outdated equipment and poor process to produce “old heavy crude” traditional products, which involves serious waste and low-added value. We have to change this situation by actively developing and applying new technologies, adopting advanced equipment and new materials to enhance technology integration, so to gradually increase the equipment level on recycling of energy. This step will promote products level and reduce consumption and emissions. Secondly, strengthen high-tech research and development, and constantly develop new technologies and materials to replace non-renewable scarce resources. Finally, enhance the international cooperation in science and technology, and actively introduce in advanced foreign technologies.

4) Law system construction

There is nothing wrong for enterprises to pursue profit, but it is unrealistic to rely on the initiative environment protection if in the absence of relevant laws and regulations as well as social pressure. It can be seen from the experience of the developed countries that the laws play an important role in restricting the governments, enterprises and citizens' fulfillment of their obligations of building a recycling-oriented community. In order to change the mode of economic growth, it is necessary to conduct a comprehensive reform of the system, allow people to freely establish an environment protection organization and promote the liberty of the press and independence of judiciary. China should also establish the circular economy legislation, and expressly specify the obligations and responsibilities of consumers, enterprises and governments, and take the environment as a resource in the government's public administration areas.

6.1.2 Develop Renewable Energy

In order to protect the environment, not only we have to reduce expenditure on extant resource but also to search alternative resources. Presently, China should make great efforts to develop the renewable sources of energy to reduce the burden on scarce resources.

Han Shangjuan and Zhu Jingping (2010) advised that the government should exploit new clean energy resources and gradually adjust energy consumption structure that coal is the main fuel, in order to achieve the object of the coordinated development among energy, economy and environment. Wang Hong (2010) also considered the renewable energy is not enough in China.

To solve the energy and sustainable development dilemma in China, Yuan JiaHai and Kang JianGang and Zhao ChangHong and Hu ZhaoGuang(2008) proposed that first of all we need to strengthen energy supply security and guarantee enough energy to supply, especially to afford adequate electric power supply and set up national strategic oil reserve in the short time; then, we should enhance energy efficiency and diversify energy sources, actively exploit renewable energy and draw out corresponding policies and measures; and finally the most important thing is altering development pattern and reducing reliance on resource-and energy-dependent industries in the long run. Li Fei and Dong Suo Cheng (2011) mentioned that in the future we must find new and important ways as soon as possible, to transfer the current economic growth pattern and develop low-carbon economy and circular economy actively. Above all, we should incorporate construction of resources-saving societies with environmentally-friendly societies for the construction of innovative countries.

The development and utilization of the renewable resources including solar energy, wind energy, geothermal energy and ocean energy, are important for the sustainable development of economy and energy. The renewable energy is abundant but generates fewer pollutants. This will be considered as an important complement of the energy recently and the basis of the future energy structure. A further increase in energy demand is unavoidable in China's economic growth. If we rely solely on coal, oil and other conventional energy sources, contradiction between supply and demand will be intensified. In order to ensure the support of energy, we should develop the renewable energy and promote the energy efficiency. In addition, China's coal-dominated energy structure causes great pressure on the environment and cost too much to realize the quality

utilization. Main consumption of oil and gas will inevitably lead to overfull reliance on the international market. The lack of inherent storage capacity of natural resource will cause high-risk by the international political and economy. In the long run, human is bound to transit consumption structure to a new one which mainly relies on the renewable energy.

6.2 International Cooperation on the Environment and Resources

The international cooperation experience tells us that active involvement in international energy and environmental cooperation would enable us to effectively ease domestic pressure on resources and environment by use of external resources.

Dimitrios A.Giannias and Joseph N.Lekakis(1996) tests input-output controls, social input prices, bilateral water trade, a water market for all water users, and a fixed water allocation agreement, as possible water policies for cross border river water sharing by using a simple economic-ecologic model. And the analysis implies that bilateral water trade can show a practicable, efficient and sustainable policy for cross border water sharing.

Ing-Marie Gren and Henk Folmer (2003) develop a simple model that explained uncertainty in the degradation of water quality and abatement impacts, which due to the diffusion of nitrogen pollutants in the drainage basins to the coastal waters as a result of coastal and marine transports of the deposited nitrogen and variation in background depositions. At the same time their empirical results for the Baltic Sea has also tested the theoretical results, and the higher risk aversion, the lower abatement and the smaller net benefits. There has been another important result that net benefit in each country has a positive effect. This means that there exists a major incentive for nitrogen abatement: no country will suffer a loss because of cleaning up its act. Nevertheless, no country will incur a loss, but some countries will acquire larger benefits than others. And this may lead to an implementation of a redistribution scheme of the increase of the net benefits owing to cooperation.

China should establish a good relationship with upstream-resource countries for economic co-operation, and meanwhile realize the diversification of import resources.

China should strengthen its efforts in coordinating and organizing the existing international environmental agencies to improve their efficiency and level.

6.3 Eco-tax System

Pigou (1920) has mentioned in his book *The Economics of Welfare* that government should assess tax according to the damage caused by the polluter's pollution level and levy taxes to make up the gap between the private and social costs. This kind of tax which equals the marginal social damage caused by the polluters is well known as the Pigouvain tax.

Zhang Huiping (2002) argues that externality theory provides a theoretical basis for the environmental taxes; one of the solutions is to internalize the externalities through taxation which could reflect the current actual level of demand. So, producers will assume the cost of pollution control by themselves to reduce its marginal revenue, and also will reduce production activities that may pollute environment, and put pollution activities under control.

N. Johnstone and K. Karousakis (1999) mentioned that the Pigouvain taxes used in combination with a fuel tax, would generate some outcomes that are more economically efficient than many of the other measures suggested or implemented. Meanwhile an analysis of vehicular emissions in the American vehicle stock supported the view. Shi-Ling Hsu and Joshua Walters and Anthony Purgas (2008) offered some empirical evidence for these theories by gasoline taxes; they thought that pollution taxes are the most cost-effective means of reducing pollution. And they also put forward an effective means of reducing opposition to gasoline taxes, which is "revenue recycling" the use of tax proceeds to reduce other taxes.

Following China's stylized status, there are several specific suggestions below to reform the tax policies:

- 1) Increase tax on utilization of water resources to solve the growing problem of water shortage.
- 2) Introducing tax on the land resources to regulate the utilization system of land resources.
- 3) Increase tax on forest resources and grassland to reduce or avoid ecological destroy
- 4) Reform the consumption tax

6.4 Construction and Implementation of Green Accounting Methods GDP

Included the environmental resources into the development costs to avoid the intentionally expense on environment to achieve economic growth of the local economy. The green accounting methods GDP could create a good macro-economic condition for the balanced development of the environment and economy.

Chapter 7 Conclusion

The relationship between economic development and environmental protection is not only unity but also inverse and contradictions between the two may be solved by a compromising solution. Economic development brings environmental problems on one hand, but on the other hand it enhances our ability to solve environmental problems, i.e. sustainable development of economy can be strengthened if environmental problem can be solved.

The Chinese and western literatures mentioned in this paper stand at different angles in viewing the relationship between the environment quality and economic growth in China. All those literatures have their own point of view based on different economic theories.

Combined with China's actual conditions, and based on literature reviews herein, I conclude that by regulating life and social production with economic instrument, environment could be properly protected and resource could be reasonably used without waste to some extent.

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