

An Analysis of The Influence of the Chinese Economic Development on the Environment

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Abstract: The Chinese economic development has achieved remarkable success in recent decades. However, various environmental problems have gradually become a barrier to the improvement in people's living conditions and China's sustainable development. There exist huge disparities between the eastern, middle and western part of China from the perspective of economic development, education, natural resources and the environment. Different development pattern constitutes distinct problems and solutions. This paper aims to analyze the relationship between regional economic development and the environment, and raise suggestions for each specific area.

Keywords: economic development, pollutant emission, natural resources.

INTRODUCTION

In recent years, environmental problem is becoming a threat for many industrialized countries. During the industrialization of Chinese economy, haze, sand storm, acid rain and many other natural disasters happen much more frequently. At the beginning of this thesis, the status quo of Chinese economy and environmental problems are illustrated. The main body of this thesis focuses on regressing the pollutant emission on several economic variables, including GDP per capita, added value of secondary industry and the trade volume of foreign-invested companies. Section 4 studies the necessity of protecting environment when improving economy from the point of the EKC model and the relationship between environment and economy. In Section 5, different solutions to solve the environmental problems for three areas of China are put forward on the bases of regressions. Section 6 is a conclusion of the whole thesis.

Foreign scholars are dedicating to find a proper combination of environment, economy and society from a general view, which have laid an excellent reference for researches on certain countries. Domestic studies on Chinese economic development and environment focus on three perspectives. Gao Song and Xian Ying analyze the relationship between environmental protection and economic development in their articles, while scholars like Wu yang and Han yujun study the relationship by statistical analysis. In addition, there are many papers concentrating on a particular province and give relevant suggestions on how to achieve a win-win economic and environmental result. Recent studies, such as

Optimizing the Structure of Foreign Investment, Promoting the Development of Green Economy written by Shen Encheng, gradually recognize the importance of regulating foreign investors and supporting green industries.

STATUS QUO OF CHINESE ECONOMY DEVELOPMENT AND ENVIRONMENT

"New Normal" of Chinese Economy

China, as a developing country, has seen a rapid increase in GDP for many years. However, in recent years, as we can discover from table 1, the average development speed measured by GDP index decreases to about 7%, and several industries have experienced huge transformation. Primary industry and tertiary industry are both growing smoothly at about 4% and 8% respectively; while the growth rate of secondary industry decreases 5% from 2010 to 2014. Chinese secondary industry usually relies on natural resources and cheap labor cost, but neither of the comparative advantages on these resources will last forever. In the past decades, Chinese economic development used to depending on high rate of investment, large energy consumption and huge environmental pollution. Nevertheless, Chinese urbanization, industrialization and infrastructure construction still need continuous investment. To some extent, Chinese traditional development pattern has reached its limit. Since high investment may lead to high inflation; large energy consumption reduce the independence and innovation of traditional industry; and huge environmental pollution has constituted a threat on human health and pollution control investment.

Table 1: Economic Index

		2010	2011	2012	2013	2014
GDP Index (Last Year=100)		110.6	109.5	107.7	107.7	107.4
Value Added (Last Year=100)	Primary industry	104.3	104.2	104.5	103.8	104.1
	Secondary industry	112.7	110.6	108.2	107.9	107.3
	Tertiary industry	109.7	109.5	108.0	108.3	108.1

Resources: National Bureau of Statistics of China

<http://data.stats.gov.cn/easyquery.htm?cn=C01&zb=A0201&sj=2014>

On the other hand, we can also find many positive characteristics displayed by such “New Normal”. As for consumption, according to table 2, although there still exists a gap between rural and urban consumption, the consumption level and disposable income of both rural and urban residents keep growing. Service industry, such as education, health care, insurance and finance, is upgrading and gradually playing a leading role in

stimulating economic growth. Especially E-commerce, taking full advantage of its less investment, high speed and large scope of service, encourages the establishment of many small and private enterprises, which help diversified Chinese economic structure. The traditional industries are accelerating the process of intelligence and information network construction.

Table 2 Consumption and Income (Unit: yuan)

		2010	2011	2012	2013	2014
Urban residents	Consumption level	17,104	19,912	21,861	23,609	25,315
	Disposable income (per capita)	19,109.4	21,809.8	24,564.7	-	-
Rural residents	Consumption level	4,941	6,187	6,964	7,773	8,680
	Net income (per capita)	5,919.0	6,977.3	7,916.6	-	-

Resources: National Bureau of Statistics of China

<http://data.stats.gov.cn/easyquery.htm?cn=C01&zb=A0201&sj=2014>

Current Situation of Chinese Environment

Generally speaking, Chinese industrialization has consumed so much resources and created a great deal of pollutant. Smoke and acid rain caused by coal industry are becoming more and more serious, especially in Central China. Water pollution in industrial cities is endangering not only the animals and plants, but the drinking water of residents. Statistics show that 2/3 of Chinese river and more than 10,000,000 hectare farmland are polluted. Taking SO₂ and smoke as indicators of pollutant gas (table 3), neither of them

has seen a great decrease from 2010 to 2014. The emission of waste water even raised a lot in recent five years. However, according to the statistics in table 4, Chinese government invests millions of money in industrial pollutant governance and environmental protection. Nearly all the investment in industrial pollution has been finished, so do investment in waste water and exhaust air governance. Thus, the results of government investment in pollutant governance is far from satisfactory and such huge pollution will definitely drag the sustainable development of Chinese economy.

Table 3: Pollutant Emission

	2010	2011	2012	2013	2014
SO ₂ (ton)	21,851,000.00	22,179,081.69	21,180,000.00	20,439,000.00	19,744,000.00
Smoke (ton)	-	12,788,255.37	12,357,747.79	12,781,410.76	-
Waste Water (ten thousand tons)	6,172,562.00	6,591,922.44	6,847,612.14	6,954,432.70	-

Resources: National Bureau of Statistics of China

<http://data.stats.gov.cn/easyquery.htm?cn=C01&zb=A0201&sj=2014>**Table 4: Investment in Pollutant Governance (Unit: hundred million yuan)**

	2010	2011	2012	2013
Total investment in pollutant governance	7,612.19	7,114.03	8,253.46	9,516.50
Investment in industrial pollution sources governance	396.98	444.36	500.46	867.67
Finished investment in industrial pollutant governance	396.98	444.36	500.46	867.67
Finished investment in waste water governance	129.55	157.75	140.34	124.88
Finished investment in exhaust gas governance	188.19	211.68	257.71	640.91

Resources: National Bureau of Statistics of China

<http://data.stats.gov.cn/easyquery.htm?cn=C01&zb=A0201&sj=2014>

INFLUENCE OF ECONOMIC DEVELOPMENT ON ENVIRONMENT

The analysis in this thesis will be divided according to the traditional division of Chinese provinces, which are eastern, middle and western areas. Since different areas have shown distinct development pattern and environmental problem, mixing up all the statistics may enlarge the statistic error [1]. Moreover, separating regression analysis can help better figure out policy suggestions for each area.

Variables Selected

In order to hold other factors fixed, the regressions will utilize multiple independent variables, including economic growth, population, industrial structure, technology and investment on pollutant governance to interpret several environmental factors.

Economic Variables

Not only the GDP per capita, but also industrial structure and foreign trade may influence environment condition. GDP per capita is a usual indicator for measuring economic growth and people's living condition. Cities relying on secondary industries especially heavy industries will face higher environment pressure. In contrast, service industry is more environmentally friendly. In addition, it is inevitable that some polluting manufacturers may come to China through foreign trade and foreign direct investment and thus bring disaster to natural environment and resources.

Population Variables

People with different educational background, together with population size have different effect on environment. China has the largest population in the world. Larger population requires more living necessities and larger space, which will lead to scarcity and destructive use of resources. Educated people tend to use more intensive and high-tech production methods and are aware of the importance of environmental protection. Consequently, cities with higher education rate may emphasize more on sustainable development and enjoy healthier living environment.

Technological Variables

With the development of technology and production mode, survival needs can be satisfied in many areas. The key points of innovation turn to improve the efficiency and effectiveness of manufacture in order to achieve a "greener" production process. Technology improvement can be separated into three categories. The first kind of technology improvement focuses on research and production but will cause environmental problem; the second category of improvement has the function of optimizing and saving environment; the last kind of technology improvement can serve as a combination of both economic and environmental functions. So, the stage of a country's technology improvement also determines the results of its environmental governance.

Investment Variables

Environment and most natural resources are public goods. In order to wiser utilize these goods and minimize negative externality, government plays a crucial role in regulating resources allocation and pollutant governance. The most obvious index to measure the policy and attention of government should be the volume of annual finished government investment on environment.

Environment Variables

Environment factors are the dependent variables in the following regressions. Since waste water emission and SO₂ emission are both major pollutants to Chinese environment, these variables will be regressed by all the independent variables separately.

Conclusion

According to the analysis, the regression variables are chosen as follows,

Dependent variables

Economic growth x_1 : GDP per capita

Industrial structure x_2 : Value added of secondary industry

Foreign investment x_3 : Export and import of foreign-invested enterprises

Population x_4 : Total population

Educational level x_5 : Number of college graduate students

Technology x_6 : Total energy consumption

Investment x_7 : Finished investment in industrial pollutant governance

Independent variables

Waste water discharge y_1

SO₂ emission y_2

Regression Analysis on Chinese Eastern Area

According to traditional division of Chinese area, eastern area consists Beijing, Tianjin, Hebei province, Liaoning province, Shanghai, Jiangsu province, Zhejiang province, Fujian province,

Shandong province, Guangdong province and Hainan province. Following regressions will utilize the sum of all these cities and provinces under each variable.

Suppose the regression model is multiple linear, and not all variables are significant according to the regression beforehand. In the following process, stepwise regression method will be used to find out the most proper regression equation and the most significant variables. Also, in order to unify the units of each variable, all the statistics are standardized before putting into regression. The significant level is 95%.

Table 5: Testing Environment-Economy Relationship for Chinese Eastern Area

Dependent Variable: Waste Water Discharge (y_1)							
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP per capita	1.74	13.46			24.73	16.19	26.59
Value added of secondary industry	9.83	4.21					
Population						129.55	
Export and import of foreign-invested enterprises				0.001			
Number of college graduate students						-2642.60	
Total energy consumption			11.11				0.26
Finished investment in industrial pollutant governance		0.02	0.04	0.007			
R ²	0.98	0.98	0.96	0.87	0.98	0.98	0.98
Dependent Variable: SO ₂ Emission (y_2)							
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP per capita	-21.02	-424.54			-62.89	-0.42	-29.69
Value added of secondary industry	31.17	133.45					
Population						-137.28	
Export and import of foreign-invested enterprises				-0.002			
Number of college graduate students						-13145.50	
Total energy consumption			-22.40				-15.12
Finished investment in industrial pollutant governance		0.66	0.50	0.107			
R ²	0.85	0.89	0.84	0.56	0.86	0.92	0.79

From the regression results shown in table 5, we can find that the waste water discharge and SO₂ emission in Chinese eastern area demonstrate totally different features. The discharge of waste water are positively related to all the three economic factors, named GDP per capita, value added of secondary industry and foreign-invested enterprises, among which increase in GDP and the production value of secondary industry have larger influence on the volume of waste water in eastern area. Moreover, waste water discharge also shows identical trend with energy consumption, population and finished investment in industrial governance. But it's only negatively related with number of college graduate students.

According to the regression on SO₂ emission, among the economic factors, both increase in GDP per capita and the activities of foreign-invested enterprises can reduce the emission of SO₂; while prosperity in

secondary industry still stimulates the emission. The same as waste water discharge, SO₂ emission increases with pollutant governance rise and decreases with growth in college graduates. In addition, population and energy consumption in eastern area have negative effects on SO₂ emission.

Regression Analysis on Chinese Middle Area

Samples of Chinese middle area include all the provinces lie in the middle part of China. They are Shanxi province, Jilin province, Heilongjiang province, Anhui province, Jiangxi province, He'nan province, Hubei province and Hu'nan province. The regression process use the sum of the statistics from all these provinces under each variable. Suppose the regressions are multiple linear and the significant level is 95%.

Table 6: Testing Environment-Economy Relationship for Chinese Middle Area

Dependent Variable: Waste Water Discharge (y_1)							
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Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP per capita	17.14	66.72			24.08	37.19	32.69
Value added of secondary industry	3.05	18.11					
Population						265.46	
Export and import of foreign-invested enterprises				0.007			
Number of college graduate students						-905.25	
Total energy consumption			10.11				3.64
Finished investment in industrial pollutant governance		-0.07	-0.13	-0.052			
R ²	0.98	0.98	0.92	0.96	0.98	0.99	0.97
Dependent Variable: SO₂ Emission (y₂)							
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP per capita	-112.41	-213.25		-44.86	-87.46	-79.65	
Value added of secondary industry	29.69	72.73					
Population					-3188.66		
Export and import of foreign-invested enterprises							
Number of college graduate students					-4503.84		
Total energy consumption			19.48				15.00
Finished investment in industrial pollutant governance		-0.15	-0.16				
R ²	0.76	0.72	0.58	0.79	0.95	0.68	

As we can see from table 6, both waste water discharge and SO₂ emission positively related with secondary industry and energy consumption. With growth in GDP per capita, waste water increases and SO₂ drops. The activities of foreign-invested companies only have little positive influence on waste water discharge. In addition, GDP per capita has the largest effect on pollutant emission.

As for factors other than economy, rising college graduates and finished governance investment can cut down pollutant emission, but increase in finished governance investment only has a little influence on pollutant. And the more energy people consume, the more waste water and SO₂ will be created. Population

variable has different effects on waste water and SO₂. Population positively influences waste water discharge but negatively affects SO₂ emission.

Regression Analysis on Chinese Western Area

Variable of western area includes data of the Inner Mongolia Autonomous Region, the Guangxi Zhuang Autonomous Region, Chongqing, Sichuan province, Guizhou province, Yunnan province, Tibet Autonomous Region, Shaanxi province, Gansu province, Qinghai province, the Ningxia Hui Autonomous Region, and Xinjiang Uygur Autonomous Region. Suppose the regressions are multiple linear and the significant level is 95%.

Table 7: Testing Environment-Economy Relationship for Chinese Western Area

Dependent Variable: Waste Water Discharge (y₁)							
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP per capita	25.43	52.54			11.64	3.89	19.74
Value added of secondary industry	-7.25	-20.44					
Population						113.23	
Export and import of foreign-invested enterprises				0.003			
Number of college graduate students						1857.04	
Total energy consumption			2.74				2.31
Finished investment in industrial pollutant governance		-0.04	-0.10	-0.01			
R ²	0.82	0.79	0.74	0.65	0.84	0.84	0.74
Dependent Variable: SO₂ Emission (y₂)							
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP per capita	-102.52	-406.65			-59.28	-26.65	-42.64
Value added of secondary industry	22.72	170.78					
Population						-518.352	
Export and import of foreign-invested enterprises				-0.02			
Number of college graduate students						-7529.09	
Total energy consumption			-19.13				-5.24
Finished investment in industrial pollutant governance		0.50	0.22	0.11			
R ²	0.85	0.85	0.78	0.63	0.87	0.86	0.78

As it shown in table 7, the three economic variables have totally distinct effects on waste water

and SO₂ emission. Increasing secondary industry production value can lift the creation of SO₂ to a larger

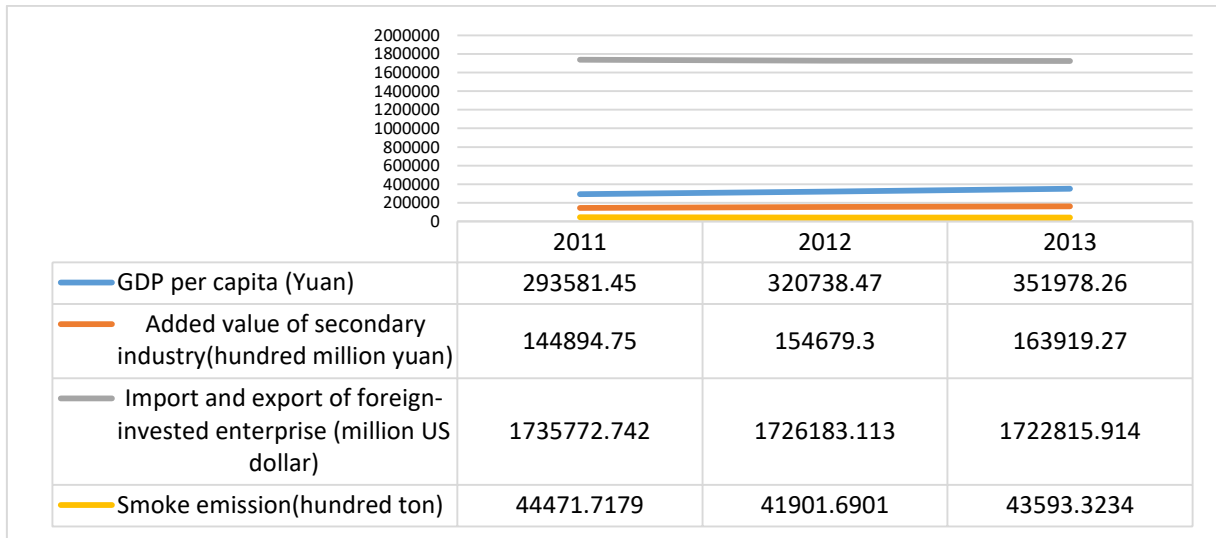
volume while drag the discharge of waste water. On the contrary, GDP per capita negatively related to SO₂ and positively related to waste water discharge. The import and export value of foreign-invested companies has the same function with GDP per capita, but much less significant than GDP per capita.

On one hand, technology improvement represented by energy consumption here is negatively correlated with SO₂ emission but positively related with waste water discharge. Improvement in education and growth in population factors also decrease SO₂

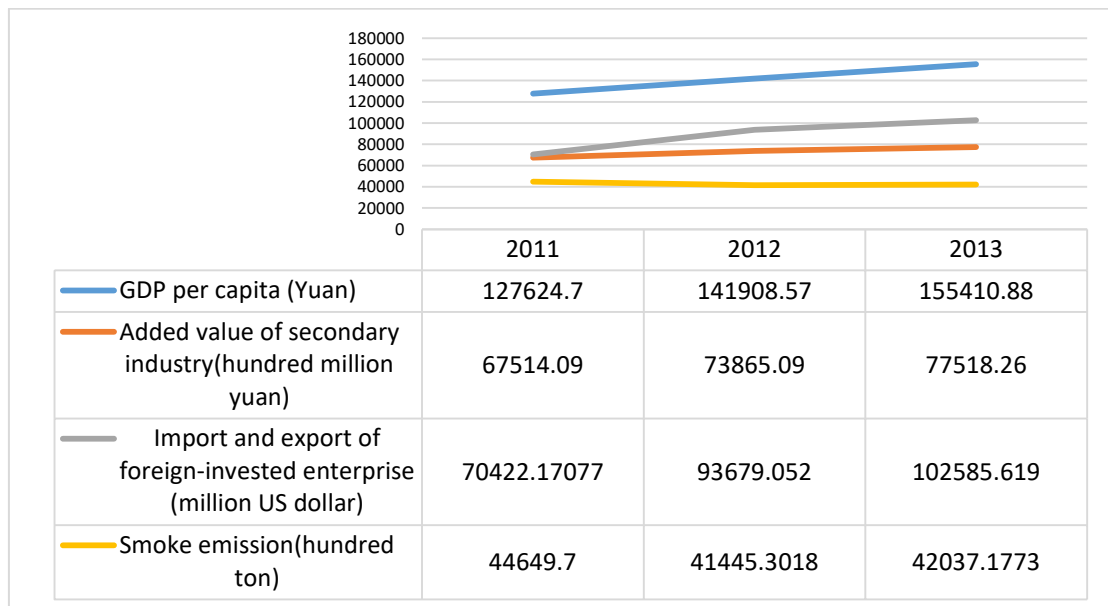
emission and increase waste water discharge. On the other hand, higher finished investment in pollutant governance will reduce waste water discharge but raise the emission of SO₂.

Descriptive Analysis on Smoke Emission

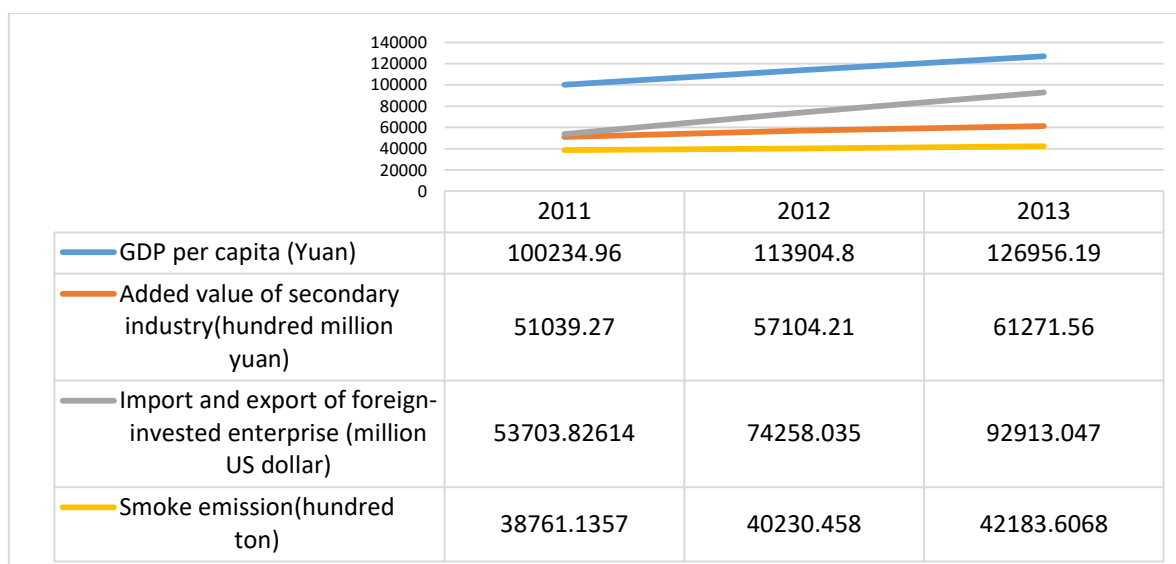
Smoke and dust also consists a relatively significant part in exhaust gas, however, the official statistical data are too limited to carry out regression analysis. The general trend of smoke emission and the relationship between smoke emission and economic factors can be discovered from descriptive analysis.



Graph 1 Descriptive Analysis on Smoke Emission of Chinese Eastern Area
 Resources: National Bureau of Statistics of China. <http://data.stats.gov.cn/index.htm>



Graph 2 Descriptive Analysis on Smoke Emission of Chinese Middle Area
 Resources: National Bureau of Statistics of China. <http://data.stats.gov.cn/index.htm>



Graph 3 Descriptive Analysis on Smoke Emission of Chinese Western Area

Resources: National Bureau of Statistics of China. <http://data.stats.gov.cn/index.htm>

As it depicted in graph 1, the economic factors including GDP per capita, value added of secondary industry and foreign-invested companies remain constant from 2011 to 2013, and the smoke emission of Chinese eastern area also keeps at a fixed level. In the meantime, Chinese middle and western area have both seen growth in economic variables during the three years' period. Smoke emission decreases in middle area, while increases greatly in western area. Compared with eastern and middle area, Chinese western area still suffers from low GDP per capita and little foreign investment. The development pattern of western provinces heavily depends on resources and enjoys less-developed technology. As a result, the smoke emission is supposed to increase with the economic development of this area. On the contrary, the education and investment in middle and eastern areas are relatively developed, which have not only facilitated regional economy, but raised the awareness of environmental protection as well.

THE NECESSITY OF PROTECTING ENVIRONMENT DURING ECONOMIC DEVELOPMENT

The Environmental Kuznets Curve Model

According to the Environmental Kuznets Curve model, the relationship between environmental pollution and economic development can be explained by an inverted U curve, which means that environment gets worse with economic improvement until a certain point, then becomes better with residents' average income increases [2]. EKC analyzes such relations from the perspectives of the scale and structure effect of economy, the function of technology, demand for environment and government regulation. Although it may not suit all regions or all types of pollutants, it still

indicates a general trend of environment and a choice for policy-making [3]. A useful conclusion can be drawn from the regressions and analysis in former Sections; that is, Chinese total pollutant emission keeps increasing with its economic development, taking all the three areas into consideration, which means Chinese development is on the way to the turning point of EKC. The degradation of Chinese environment will not stop if long-term measures are not carried out as soon as possible.

The Relationship between Environment and Economy

It seems that environment and economy are contradictory and economic prosperity is at the cost of natural resources and environment. Many developed countries follow the "pollute then clean up" development pattern and have also caused huge damages to global environment, so do some parts of China [4]. However, when economic development exceeds the capacity of environment, severe environmental disaster will be brought out and thus restrict economy and people's daily life. In fact, protecting environment is an effective method of maintaining and promoting economic development [5].

Natural environment is an indispensable support for human development, which provides almost all basic factors for living beings on the earth. But the resources can be utilized is limited and some are even irreversible within a short time. Moreover, environment helps absorb and dispose the products of economic society, including pollutants. From another point of view, certain kinds of environmental problems can be solved or worsened with economic development. Taking starvation and illness as examples, a highly

developed economy will eliminate poverty and fight for illness efficiently and effectively, so that the whole world will benefit from economic development. But industrialization often worsen the environment by discharging pollutants and overexploiting resources.

Fortunately, judging from previous experience, if environmental problems come out of economic development, it will also be solved by further development, especially technology improvement. But such idea will not realize automatically. In a word, healthy economy helps improve environment and a good ecological environment is the basic of sustainable economic and social development [6].

SUGGESTIONS FOR ENVIRONMENTAL PROTECTION

General Methods for Environmental Protection

According to former regressions, there are some characteristics in common among the three areas, which can be solved by similar measures. In the first place, SO₂ emission can be reduced but waste water can be accumulated by economic development. In the second place, secondary industry lifts both SO₂ and waste water discharge. From the official statistics in *2014 Report on the State of the Environment of China*, about half of the waste water is discharged from industrial source and agricultural source following closely. More than three-fourths of the exhaust gas is emitted by industrial production, and the air quality in only 16 cities around China conforms to the official standard.

There is no doubt that Chinese economic development cannot be realized without secondary industry. Thus, finding a healthy development pattern suitable for each area and making use of its demonstration effect should be a practical method. Although it might take a long time to establish a successful model, local governments can accelerate this process by encouraging and awarding innovative and

localized development ideas. In the meantime, supervision departments should accelerate the marketization of pollutant emission and environmental governance responsibility. Coase Theorem has told us that “a clear delineation of private property rights is an essential prelude to market transactions”. Emission rights and governance responsibility belong to public goods; therefore, clear transaction and transfer systems will be of great help to environmental protection. A mature emission market will also force companies and households to take environment into consideration and ensure a fair living environment. Considering current Chinese environmental industry, learning existing regulations and experience from developed countries and then adjusting them according to Chinese condition might be the fastest and most convenient way of establishing transaction systems. Furthermore, all kinds of industrial companies should be included into the transaction system whether they are public-owned, private-owned or foreign-invested.

Specialized Suggestions for the Three Areas

Since GDP per capita is used to measure the average economic development of a certain area, the quotient of GDP per capita and total emission can be explained as environmental efficiency of this area. Similarly, the quotient of finished investment of pollutant governance and total emission can serve as a measurement of governance efficiency. Taking year 2013 as an example, we can find a huge gap in GDP per capita between Chinese eastern and western area, but the pollutant emission and economic development is disproportional. Even though eastern area has created much more pollutant than middle and western area, its efficiency of governance and production shown in the last two column of table 8 is higher than the other two areas. Facing such disparity in economic development and environmental protection condition, targeted measures are needed to help regulate pollution and protect the environment during economic improvement.

Table 8: Comparison of Environmental and Governance Efficiency

	GDP per capita (yuan)	Total emission (ton)	Finished investment (ten thousand yuan)	GDP per capita/total emission	Finished investment/total emission
Eastern area	62,619.63	10,829,743.1	3,789,493	0.005782	0.349915
Middle area	36,420.73	7,575,740.89	2,349,834	0.004808	0.310179
Western area	34,652.52	8,988,166.6	2,537,320	0.003855	0.282296

Resources: National Bureau of Statistics of China. <http://data.stats.gov.cn/index.htm>

Thanks to its geographical advantages, Chinese eastern area is the earliest developed and opening area around the country. Till now, these coastal cities have attracted a great deal of investment and established into relatively mature economic belts. Some of their manufacturing and heavy industries are gradually moved to inland China, and tertiary industries such as tourism, consulting, advertising and public relations are playing an increasingly important role in promoting local economy. However, at the same time, secondary industry still accounts for major parts of its economic structure and causes serious pollutions. Cities in eastern area can further improve their industrial structure by attracting more tertiary industry and developing low-carbon manufacturing technology in the meantime. According to the regressions on the pollutant emission of Chinese eastern area, restructuring and improving the production secondary industry contributes to decrease in SO₂ emission. What's more, effective publicity of clean energy and subsidies on environmentally friendly technology import is supposed to accelerate the process of industrial improvement and upgrading. After adjusting the input and output mix of secondary industry, factories can substitute current materials with more environmentally friendly inputs and find out a low energy-consumption, low pollutant-emission and high recycling production mode, which can minimize pollution on the premise of ensuring production and trade.

Regulating Pollutant Discharging of Foreign-invested Companies

Most of foreign investors choose to put their money into Chinese eastern cities and Chinese economy has benefit from them for many years. Considering the industry of foreign investment, it is not hard to discover that a large portion of investment concentrates on high-pollution industries. In the past, solving poverty and starvation problems was the primary task of Chinese development, so all kinds of foreign investment are warmly welcomed. But in recent years, Chinese eastern area is becoming more and more prosperous, and food and clothing does not constitute barriers to its development. People emphasize more on environment and spiritual needs, so it is time to focus on regulating environmental pollution.

Foreign-invested companies used to be neglected by governments in pollutant emission regulation because of their contribution to local economy. Consequently, the primary task now is to bring foreign companies into environmental regulation and inspect their current condition on pollutant discharge and resources use. Secondly, a set of strict rules considering receiving investment should be carried out to guarantee the original direction of investment, which will prevent some overseas companies planned to transfer pollution

to China [7]. In the short run, Chinese eastern might face the problem of lacking foreign investment, but this financing gap can be offset by increasing government investment and private investment. If combined with industrial upgrading, its economic development will not be weakened in the future. Last but not least, administrative departments should also be alert for removing polluting factories to inland China. Such beggar-thy-neighbor measure is of no use for China's integral development, and even ruins people in other area's health and safety.

Suggestions for Chinese Middle Area Utilizing Natural Resources Properly and Efficiently

Chinese middle area is rich in natural resources, but the problem of over and irrational exploitation are more serious there. With the implementation of the Rise of Central China Plan, investment in infrastructure construction keeps increasing, which has raised the consumption of energy and eventually increased the emission of carbon dioxide, which is also shown in former regressions. A possible solution for middle area is to develop low-carbon and energy conservation industries on the basis of existing natural resources. Furthermore, through technological improvement, factories can use less polluting input materials per unit of their output as well as discharge less pollutant in per unit of resources input.

Improving Environmental Laws and Strengthening Supervision

The effectiveness of governmental management, to some extent, directly influence the success of economic development and environmental protection. In order to strengthen and match with the first strategy, strong measures must be taken to restrict the behavior of companies. For years, environmental protection departments are dedicated in designing relevant laws and regulations. The punitive measures and information disclosure provisions are becoming more detailed and comprehensive. According to the *2014 Report on the State of the Environment of China*, about 100,000 illegal companies are discovered, 2,177 cases are supervised and handled, and altogether 4,200,000,000 yuan are invested in treating for heavy metal pollution. At the same time, antecedent supervision in major natural resources-abundance provinces and those industrial powerhouses still need to be enhanced. Governance and punishment are always remedies, whereas effective inspection and technological reform are long-term solutions for sustainable development in both economy and environment [8].

Suggestions for Chinese Western Area

Importing Advanced Technology and Boosting Investment

The primary concern of some western cities is satisfying people's basic living demand including food and infrastructures. Some mountainous areas still suffer from alienation, illness and poverty. Therefore, local governments and companies in western area should find a way to improve the economic situation of residents and minimize the gap in GDP per capita with middle and eastern areas instead of designing complex environmental regulations. But this does not mean western area do not need to care about their environment, on the contrary, western area is prone to natural disasters, which makes it more vulnerable to industrial pollution and soil erosion. As a result, western cities should learn to maximize the products from limited natural resources.

To begin with, western area should provide preferential policies for technology input and innovation. Through upgrading exploiting and manufacturing technique, factories in Chinese western area can catch up with the productivity of middle or even eastern area. In the meantime, local governments and companies should expand the market of their products in case of the emergence of over-capacity. Technology improvement cannot be realized without enough investment; thus central government should further invest in the strategy of China Western Development and encourage coastal companies give priority to investment in western area instead of foreign countries if possible.

Attracting Talents and Raising People's Awareness of Environmental Protection

Number of college graduates are negatively related to pollutant emission for several reasons. Firstly, people with high educational level are less inclined to manufacturing or exploiting work but work on tertiary industry. Thus, there might be less heavy industries in those educational developed areas. Secondly, technicians and engineers are capable of improving the productivity and reducing energy consumption. Besides, people received higher education are more aware of the importance of environmental protection, so that they will care more about their surroundings. From these perspectives, attracting highly skilled talents can improve the regional average capability in environmental engineering, environmental consultation and service. Forming a talent bank with professionals in management, technology and environment is a crucial step in achieving a win-win outcome in western economy and environment [9].

Current situation in Chinese western area is not optimistic. There are far less universities and training institutions in western area than other parts of China,

but workers and peasants in this area are more urgent in technical trainings. What's more terrible, students growing up in western area are dreaming of leaving their hometown one day. So the only goal of their study is to enter a university in middle or eastern cities in order to find a job and settle down there. Consequently, almost none of the students or young workers leaving their hometown is willing to come back before retirement. Similarly, very few college graduates grown up in other areas of China choose to work for years in western cities voluntarily. Service of volunteer students for western program can only solve short-term shortage of talents, but it cannot guarantee the stability of talents. It is of utmost emergency to retain those talents coming to western cities with favorable welfare for themselves and their families. Meanwhile, more attention shall be paid on persuading western students coming back to contribute to their hometown after graduation.

CONCLUSION

In this thesis, Chinese economic development and environment are studied by regression analysis of eastern, middle and western areas separately. Waste water discharge and SO₂ emission are chosen to be indicators of environmental pollution and independent variables include economic, educational, population, energy-consumption and governance investment factors. According to the different characteristics shown in regressions, specialized solutions are given after considering the current situation and comparative advantages of each area.

The highlight of this thesis is dividing the analysis according to regions, studying the relationship and raising suggestions for each region. However, the statistics used are still limited and independent variables cannot cover all the relevant factors that affect environment; thus the results of regressions only show a general trend of the relations, which is the major part needed to be further studied in the future.

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