Decoupling Analysis of Economic Growth and Resource and Environment Pressure

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Abstract: The study of the relationship between economic growth and resource environment is of great practical significance to the rational formulation of energy conservation and emission reduction policies, which promotes the sustainable development of the economy and society. The Tapio decoupling index method of elastic analysis refinement decoupling based on the relationship of Shanghai from 2001 to 2016, the economic growth and the pressure on resources and the environment, consumption index and environmental pollution index to measure the pressure of resources and environment for the integration of resources entropy method, in-depth analysis of Shanghai resources environment overall decoupling. Research shows that Shanghai's economy is getting rid of the "high consumption and high pollution" development mode, and the dependence of economic growth on resources and environment is decreasing but not eliminated. Finally, it provides a reference for decision making.

1. Introduction

Since the industrial revolution, the rapid economic development has led to the rapid increase in the demand for resources in human society, which brought about various problems, such as resource exhaustion, environmental pollution, and ecological imbalance. China is in a period of rapid economic development, and its consumption of resources is increasing. Strengthening resource conservation and management has become one of the important topics for China to achieve sustainable development.

Most of the current decoupling studies use single indicators, which can not reflect the relationship between economic growth and the overall resources and environment. In view of this, considering the consumption of various resources and the emission of various pollutants, the entropy weight method is used to get comprehensive index to measure the overall pressure of resources and environment. We explore the decoupling state of economic growth and resource and environmental pressure in Shanghai from 2000 to 2015, with a view to providing useful suggestions for the construction of Shanghai Two Types Society.

2. Theoretical Model

With the rapid expansion of Shanghai's economic scale, the main functions of economic growth and environment are as follows: on the one hand, economic development promotes population agglomeration, continuous expansion of urban scale, rapid development of non-agricultural industry, increasing scale and level of population consumption, while economic development coercion resources and environment. On the other hand, the government, enterprises and residents respond to the system through their own behavior, which can directly feedback the improvement of the economic development pressure and the ecological environment to promote the decoupling of environmental pressure and economic development.

3. Decoupling Theory and Data Description

3.1 Decoupling Theory.

Decoupling is a concept borrowed from physics to represent the weakening or disappearance of the relationship between two or more variables with response relationship. The concept was first proposed by The Organisation for Economic Co-operation and Development (OED) and applied to the field of agricultural policy. Later, the world bank introduced this concept into the field of resources and environment to analyze the relationship between economic growth and resource consumption and environmental pollution. In this paper, Tapio decoupling elastic analysis is used, which is:

$$\varepsilon = (\Delta E / E) / (\Delta G / G)$$

Among them, εis the decoupling index; ΔE indicates consumption of resources and environment and ΔG menas GDP at the end of the year.

Since the reform and opening, the economy of Shanghai has maintained a rapid growth state, and there is no state of economic recession. Therefore, this paper adjusts the evaluation standard of decoupling state according to the actual situation of Shanghai.

Table 1. Decoupling state discrimination of economic growth and resource and environment pressure of Shanghai

Decoupling state	ΔE	ΔG	Decoupling index	Mean
Absolute decoupling	＜0	>0	ε＜0	Ideal state: economic growth and pressure drop
Relative decouplingI(benign)	>0		0≤ε＜0.5	Relative ideal state: economic growth and slow growth of pressure
Relative decouplingII(malignant)	>0		0.5≤ε＜1	Negative state: economic growth and accelerated pressure growth

Among them, we will subdivide the relative decoupling into benign and malignant. Because economic growth brings certain resource consumption and environmental pollution is inevitable. When the pressure of resources and environment is acceptable in a certain range ($\varepsilon < 0.5$), the relationship between economic society and nature is relative ideal. But when the pressure of resources and environment is accelerated, we have $0.5 \leq \varepsilon < 1$. The vicious trend reminds us that we should take timely measures to prevent the situation from deteriorating and the coupling between economic growth and resources and environment, resulting in even worse effects.

3.2 Data Source and Processing.

Considering the availability of data, this paper chooses the fastest growing period (from 2001 to 2016) of energy consumption as the analysis period, which will be divided into five years as a time section. The period includes "10th Five-Year", "11th Five-Year" and "12th Five-Year". The gross domestic product of this paper uses the actual value and is converted in 2001.

Table 2. Index system of resources and environment pressure of Shanghai

First level index		Second level index	
Index name	Weight	Index name	Weight
Resources consumption（R）	0.5	Total energy consumption (R1)	RW1
		total electricity consumption (R2)	RW2
		Annual water supply (R3)	RW3
Environmental pollution（E）	0.5	Industrial wastewater discharge (E1)	EW1
		Industrial sulfur dioxide emissions（E2)	EW2
		Total emission of industrial waste gas (E3)	EW3
		Production of household waste(E4)	EW4

4. Decoupling State Analysis of Economic Growth and Resource and Environment Pressure of Shanghai

4.1 Decoupling State of Economic Growth and Resource and Environment Pressure of Shanghai.

Table 3. Decoupling result of economic growth and resource and environment pressure Shanghai from 2001 to 2016

Year	Resource		environment		resource and environment	
2001	0.618152952	Relative decouplingII(malignant)	1.353245081	Coupling	1.036349021	Coupling
2002	0.539090394	Relative decouplingII(malignant)	0.01738803	Relative decouplingI(benign)	0.333239236	Relative decouplingI(benign)
2003	0.717659087	Relative decouplingII(malignant)	0.032152322	Relative decouplingI(benign)	0.377365904	Relative decouplingI(benign)
2004	0.443129149	Relative decouplingI(benign)	0.455480431	Relative decouplingI(benign)	0.41330599	Relative decouplingI(benign)
2005	0.739565928	Relative decouplingII	0.189719162	Relative decoupling	0.569143441	Relative decouplingI(malignant)
2006	0.48398311	Relative decouplingI(benign)	0.168104363	Relative decouplingI(benign)	0.326043616	Relative decouplingI(benign)
2007	0.432085006	Relative decouplingI(benign)	0.00256393	Relative decouplingI(benign)	0.217324468	Relative decouplingI(benign)
2008	0.363150695	Relative decouplingI(benign)	-0.530273822	Absolute decoupling	-0.083561552	Absolute decoupling
2009	-0.062128175	Absolute decoupling	-1.308596688	Absolute decoupling	-0.685302431	Absolute decoupling
2010	0.727494353	Relative decouplingII(malignant)	0.670963634	Relative decouplingII(malignant)	0.699228993	Relative decouplingII(malignant)
2011	0.189234575	Relative decouplingI(benign)	-0.171379367	Absolute decoupling	0.008927604	Relative decouplingI(benign)
2012	-0.094396079	Absolute decoupling	-0.366659163	Absolute decoupling	-0.230521621	Absolute decoupling
2013	0.367461138	Relative decouplingI(benign)	-0.575261843	Absolute decoupling	-0.103900352	Absolute decoupling
2014	-0.323496583	Absolute decoupling	-0.629338157	Absolute decoupling	-0.59521737	Absolute decoupling
2015	0.25834974	Relative decouplingI(benign)	-1.589777302	Absolute decoupling	-0.665713781	Absolute decoupling
2016	0.271786092	Relative decouplingI(benign)	-1.735252919	Absolute decoupling	-0.731733413	Absolute decoupling

With the economic development, the pressure of resources and environment will gradually decrease after reaching a peak, thus the "U" relationship with the economy is presented. The first step in the improvement of state is relative decoupling, which is eventually transformed into absolute decoupling through human control. However, under some special circumstances, the pressure of resources and environment will rise again after a period of decline and rebound. Therefore, the ultimate realization of absolute decoupling requires a long process of repeated development. In the Five Year Plan, the phenomenon of "two heads high and middle low" basically appeared, showing a cyclical nature. It can be seen that the basic national policy of conserving resources and protecting the environment can not be relaxed for a moment.

4.2 Decoupling Features of Resource Pressure.

Before 2005, its decoupling index has fluctuated on the coupling state. Electricity consumption has almost kept pace with economic growth, and electricity consumption is increasing at a faster pace. On the contrary, when the economy is developing slowly, the growth rate of electricity consumption is also greatly reduced, reflecting the formation of the two valleys in 2009 and 2014. The total consumption and economic development of electricity have been basically coupled before 2001, which reflects the strong dependence of economic growth on electric power. It is very necessary for Shanghai to refresh historical electricity records continuously, and to strengthen electricity management to save electricity.

The decoupling index of the total amount of water supply in Shanghai has gone through the state of malignant decoupling in the peak of 2009 and 2003, and there is no over coupling state. The rest basically realized the relative decoupling state of absolute decoupling or benign pointing, which is the best co scheduling of the three resources. From 1920s, China began to implement various kinds of water saving measures in China in 1990s. For many years, we have taken strict measures to save water and set up a government led and public participation mechanism for water use. The water saving consciousness has been deeply rooted in the hearts of the people, and the increase of water consumption has been slow.

Due to the impact of the financial crisis in 2008, the two indicators of energy and electricity in Shanghai were relatively low in the year and 2009. With the recovery of the economy, the demand for all kinds of resources has been greatly improved. In 2010, the power to restore the economy, the index of each index increased rapidly, and in 2010, the energy saving situation in Shanghai was grim. The energy saving early-warning and control will be launched immediately within the city. The energy consumption early-warning "control line" should be set up to ensure the steady and continuous development of energy conservation. But the energy saving space of the industry is limited and the continuous improvement of the level of urbanization will lead to the sustainable growth of residents' living. The energy saving task in Shanghai is still arduous during the "13th Five-Year" period.

4.3 Decoupling Features of Environmental Pollution Pressure.

Since the "11th Five-Year", Shanghai has grasps economic construction and ecological construction in the face of severe challenges facing the economic situation. The government has strengthened the comprehensive renovation of the environment, strengthened the construction of the ecological protection capacity, accelerated the construction of a resource-saving and environment-friendly society, and achieved remarkable results in the harmonious development of human and nature.

Most of the industrial waste water is in the absolute decoupling state throughout the period, which indicates that Shanghai has great supervision over the discharge of waste water, and the development of the economy does not bring too much waste water. The data obtained from the statistical yearbook also show that the discharge of industrial wastewater is decreasing year by year. The output of domestic waste is basically in a state of benign decoupling, and economic growth is accompanied by slow garbage production. However, in recent years, due to the acceleration of growth in Shanghai, the decoupling index of domestic waste has a rising trend, so the government should advocate the healthy life of the residents and minimize the discharge of garbage.

With economic growth and population expansion, the situation remains very severe. The improvement and protection of the environment is a long-term and arduous task.

5. Conclusion

Shanghai's industrial structure has been constantly optimized and upgraded, and a series of industrial slant and restrictive policies have been adopted. The government has accelerated the development of the legal equipment manufacturing industry, technology intensive industry, modern service industry and financial industry and the traditional industries such as high energy consumption and high polluting industries are restricted. Shanghai should continue to increase investment in

environmental protection industry, promote industrial wastewater treatment standards, strengthen garbage disposal, and effectively curb the unordered exploitation and utilization of the resources and environment. The whole society advocates a good style of saving water and electricity and forms a social atmosphere of conscientiously saving energy and reducing emissions. In short, we must set out on a of resource conservation and environment-friendly path centered with efficiency enhancement and guided by scientific and technological innovation.

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