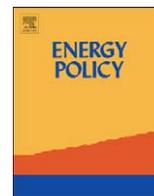




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## Viewpoint

## Research on the energy-saving effect of energy policies in China: 1982–2006

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## ABSTRACT

This paper summarizes the main energy policies of China from 1980, and divides them into three groups of policies. Two methods, with and without antitheses and linear regression, are created to evaluate the energy-saving effects of the energy policies. And the energy-saving effects of these three groups of energy policies of China are evaluated by the two methods, respectively. It is concluded that with and without antitheses is used to evaluate short-term effects and linear regression is used to evaluate long-term effects.

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## 1. Introduction

Since 1980s, economy grew rapidly in China, meanwhile energy consumption grew along with economy. Since 1982, energy intensity declined significantly. Energy intensity of China in 1982 was 2.96 tce per  $10^4$  RMB, and in 2006 was 1.16 tce per  $10^4$  RMB (energy intensity is that energy consumption divides GDP, and GDP are calculated at a constant price of 2006).

But economic growth is increasingly depending on energy consumption. Elasticity ratio of energy consumption in the first years of 21st century is larger than that in the whole 1990s, as shown in Table 1. It indicates Chinese economy growth needs more energy. Because of the lack of energy, energy issues become more serious. And China has to import more energy. In 2006, China imported  $19,453 \times 10^4$  ton oil, exported  $2626.23 \times 10^4$  ton oil, and consumed  $34,875.9 \times 10^4$  ton oil. Forty-eight percent of petrol consumption depended on import. The lack of energy will seriously influence the sustainable development of China.

The Chinese government has created many energy policies to save energy. So it is necessary to evaluate the effects of these policies which will decrease the energy intensity.

## 2. The main energy policies of China

Since 1980s, Chinese government has implemented many energy policies. The main energy policies are as shown in Table 2. Because of the interaction of the energy policies, it is difficult to evaluate the effects of individual energy policy. In this paper, therefore, these policies are divided into three groups

according to the relationship between a principal policy and subordinate policies that the effects of each group of energy policies in a period could be evaluated.

In 1991, the State Planning Commission promulgated several suggestions to further reinforcement of energy saving, which regulated the State Economic and Trade Commission should supervise the implement of energy saving of key energy-using units. In the following years, the energy-saving policies of China were constituted and enacted under this document.

Law of the People's Republic of China on Energy Conservation, amended and adopted on October 28th 2007, was promulgated in 1998, including general provisions, energy-saving management, rational and economical use of energy, technological advances in energy conservation, legal liabilities and supplementary provisions. This law had established the main energy-saving legal system and formalized the energy-saving management. Thereafter, this law was regarded as legal warrant of all following energy-saving policies.

In 2004, National Development and Reform Commission compiled Medium- and Long-Term Specific Schema on Energy Saving which programmed the development aim and priorities till 2010 and announced development aim till 2020. In this schema, it emphasized energy saving should be related to adjustment of industrial structure, technological progress and sustainable development. Connection between energy saving and economy development was highly taken into account and performed as essential guidance of government.

Several suggestions to further reinforcement of energy saving, Law of the People's Republic of China on Energy Conservation, Medium- and Long-Term Specific Schema on Energy Saving are three signal energy-saving policies, and represent three different energy-saving period. So all the energy policies are divided into three energy policy groups: energy policy group 1, the energy policy group of several suggestion to further reinforcement of

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energy saving; energy policy group 2: the energy policy group of Law of the People's Republic of China on Energy Conservation; energy policy group 3, the energy policy group of Medium- and Long-Term Specific Schema on Energy Saving.

### 3. Model

In this paper, two models are applied to evaluate the energy-saving effects of energy policies, respectively, which are with and without antitheses and linear regression.

**Table 1**  
Elasticity ratio of energy consumption.

Year	Growth rate of energy consumption over preceding year (%)	Growth rate of gross domestic product (GDP) over preceding year (%)	Elasticity ratio of energy consumption
1990	1.8	3.8	0.47
1991	5.1	9.2	0.55
1992	5.2	14.2	0.37
1993	6.3	14	0.45
1994	5.8	13.1	0.44
1995	6.9	10.9	0.63
1996	5.9	10	0.59
1997	-0.8	9.3	
1998	-4.1	7.8	
1999	1.2	7.6	0.157895
2000	3.5	8.4	0.416667
2001	3.4	8.3	0.409639
2002	6	9.1	0.659341
2003	15.3	10	1.53
2004	16.1	10.1	1.594059
2005	10.6	10.4	1.019231
2006	9.61	11.1	0.865766

Resource: China Statistical Year Book (2007). <http://www.stats.gov.cn/tjsj/ndsj/2007/html/G0708e.htm>.

**Table 2**  
History of comprehensive energy-saving policy.

Time	Energy policy
1986	Interim regulation of energy-saving management.
1990	Plan of energy saving in the eighth five.
1991	Regulation of energy saving for thermal power plant.
1991	Several suggestion to further reinforcement of energy saving.
1991	Regulation of grading and upgrading of energy-saving management for enterprise.
1992	Several suggestion to acceleration of house wall materials innovation and energy-saving architecture.
1994	Several suggestion to reinforcement of saving and utilization of natural resources.
1996	Regulation of technological innovation projects of energy saving and utilization.
1995	Plan of energy saving in the ninth five.
1996	Regulation of supervision of energy saving of the ministry of coal industry.
1997	Design standards of energy saving of civil construction.
1998	Law of the People's Republic of China on Energy Conservation.
1999	Regulation of energy saving of key energy-using units.
2000	Regulation of energy-saving utilization of civil construction.
2001	Regulation of electricity saving.
2004	Medium and long term specific schema on energy saving.
2005	Notification to implementation of design standards of energy saving of new-build civil construction.
2005	Guidance of promotion of energy-and-land saving civil construction and public building.
2005	Several suggestion to further promotion of house wall materials innovation and energy-saving architecture.
2005	Regulation of energy-saving utilization of Civil construction (2005), abolishing regulation of energy-saving utilization of civil construction (2000).
2006	Implementation plan of performing energy saving of a thousand of enterprise.
2006	Notification to preventing blind re-expansion of high energy-consuming industries.
2006	Decision to reinforcing energy-saving issue.
2006	Administrative reply of plan of reduce energy intensity indexes of every region in the eleventh five.
2006	Implementation suggestion of the top ten key energy-saving projects in 'the eleventh five'.
2007	Suggestions to energy saving and emission reduction of coal industry.
2007	Advice of comprehensive operation scheme on energy saving and reduce of pollutants emission.
2007	Emergent notification to reinforcement of industrial structure adjustment and preventing blind re-expansion of high energy-consuming industries.

#### 3.1. With and without antitheses

Given that the effects of all the factors are stable except energy policies, this method works well. The first step is to collect the data of the energy intensity including historical data before implementing the energy policies and real values after implementing the energy policies. Here, real values refer to the energy intensity under the implementing of the energy policies. The second step is to predict the energy intensity according to the historical data and get the predicted values referring to the energy intensity without the effects of energy policies. The predicted values indicate the energy intensity under the hypothesis that all the influence of all the factors is stable. This study involved a long time span, lots of influencing factors, so the older data cannot reflect recent tendency, while the new data can. So the data of recent years are used to predict the energy intensity. GM(1,1) model is an important method of Grey System Theory, which can be used to predict with small sample (Liu and Lin, 1998). It means that the predicted values can be obtained by GM(1,1) with the several newer data and the predicted values can reflect the tendency of energy intensity more accurately. The calculating steps of GM(1,1) are as shown in the Appendix A. Then, the third step to calculate the differences between real values and predicted values. The real values refer to after implementing-energy-policies energy intensity. So that the differences are the energy-saving effects of energy policies. The principle of with and without antitheses is shown as Fig. 1.

#### 3.2. Linear regression

Many researchers have studied the factors on Chinese energy intensity. Economy growth and energy consumption in China have strong correlations (Yuan et al., 2008). Energy intensity of China declined, and efficiency effects contributed to a majority while structure effect contributed less (Lin and Polenske, 1995; Liao et al., 1997). It is similar in Chinese industrial sectors (Sinton and

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