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# The relation between Chinese economic development and energy consumption in the different periods

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## ABSTRACT

Since the 1980s, Chinese economy grew rapidly. With the rapid economic growth, Chinese energy consumption sharply increased. The relation between Chinese energy consumption and economic growth is focused on, and many researchers have studied this issue by applying the methods such as granger causality test. However, the results just reveal the relation in a very long period. In this paper, the history of Chinese economy is divided into four periods. And the relation between Chinese energy consumption and economic growth is examined by applying grey incidence analysis, which is one of the most important methods of grey system theory which can be applied to solve the problems with small samples. The results show that the relations in different periods are not the same. The degree of grey incidences between total energy consumption and values added of secondary industry is larger, and the degree of grey incidences between GDP and consumption of coal is larger too. And the policy implications of these results are explained.

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## 1. Introduction

China is one of the fastest growing economies in the world with an average annual GDP growth rate about 10%. In 2008, China was the third largest economy in the world just behind the United States and Japan with a nominal GDP of US \$ 4.6 trillion measured in exchange-rate terms. Chinese foreign trade has grown faster than its GDP for the past 25 years. As its role in world trade has steadily grown, its importance to the international economy has also increased.

Chinese energy consumption has quickly expanded as well. Nowadays China is the world's second largest energy consumer only behind the United States. In 2006, China was the world's third largest net importer of oil while it was a net oil exporter in the early 1990s. China will increase natural gas imports via pipeline and liquefied natural gas too. And China is also the world's largest producer and consumer of coal. China is becoming more and more influential in world energy market.

The recent global financial crisis has slowed down Chinese economic growth. On November 9, 2008, the four-trillion-Yuan (\$586 billion) economic stimulus package launched in China. National Development and Reform Committee (NDRC), the country's top economic planner, announced that the central stimulus package was roughly divided into seven parts, with 1.5 trillion Yuan going towards large-scale infrastructure projects such as railways, roads, airports and the national grid; areas most

affected by the May 12 earthquake in the southwestern Sichuan Province will get 1 trillion Yuan for reconstruction; the rest of the stimulus money will be spent on affordable housing, rural welfare and infrastructure, medical and cultural development, environmental protection and industrial restructuring. The fiscal stimulus will lead to economic development in the second half of 2009 and 2010. China had been the world's largest exporter by 2009. Urbanization in China and technological progress lag behind the developed countries. It will cost several decades for China to catch up with the developed countries. So there is ample amount of potential for China to maintain relatively fast economic growth in the medium term. Will Chinese energy consumption increase as fast as economic growth or not? The relation between Chinese economic growth and energy consumption should be researched.

Many researchers have investigated the relation between energy consumption and economic growth. The pioneer work of Kraft and Kraft (1978) with the application of a standard Granger test finds a unidirectional long run relationship running from GDP to energy consumption in the USA for the period 1947–1974. After that, researchers studied the issues of different countries or regions. Song et al. (2008) applied both linear and nonlinear Granger causality tests to examine the causal relationship between energy consumption and economic growth for a sample of Asian newly industrialized countries as well as the US Akinlo (2008) examined the causal relationship between energy consumption and economic growth of eleven countries in sub-Saharan Africa. Balat (2008) investigated the increasing energy demand with the growth of the economy in Turkey during the past two decades. Erdal et al. (2008) applied the causality test to examine the causal relationship between primary energy

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consumption and real Gross National Product of Turkey during 1970–2006. Paul and Bhattacharya (2004) examined the different direction of causal relation between energy consumption and economic growth in India for the period 1950–1996 by applying Engle–Granger cointegration approach combined with the standard Granger causality test. Nicholas and James (2009) examined the relationship between energy consumption and economic growth of six Central American countries for the period 1980–2004 within a multivariate framework. Yemane (2009) examined the causal relationship between energy consumption and economic growth of seventeen African countries in a multivariate framework by including labor and capital as additional variables. Valeria and Chiara, *in press*) analyzed the causal relationship between economy and energy by adopting a Vector Error Correction Model for non-stationary and panel data with a large sample of developed and developing countries and four distinct energy sectors. Paresh et al. (2010) examined the long-run elasticity of the impacts of energy consumption on GDP and GDP on energy consumption. Lee and Chang (2007) applied a new panel data stationarity testing procedure with panel VARs that employ the generalized method of moment techniques in order to re-investigate the dynamic interactions between energy consumption per capita and real GDP per capita in 22 developed and 18 developing countries. Lise and Montfort (2007) unfolded the linkage between energy consumption and GDP by undertaking a cointegration analysis for Turkey with annual data of the period 1970–2003. Soytaş and Sari (2003) studied the properties of energy consumption and GDP and re-examined the causality relationship between the two series in the top 10 emerging markets and G-7 countries. Belloumi (2009) used the Johansen cointegration technique to examine the causal relationship between per capita energy consumption and per capita gross domestic product for Tunisia during the period 1971–2004. Lee (2005) investigated the co-movement and the causality relationship between energy consumption and GDP in the 18 developing countries by using the data of the period 1975–2001. Oztürk and Acaravci, *in press*) investigated the causal relationship between energy and economic growth in Albania, Bulgaria, Hungary and Romania from 1980 to 2006 by employing energy use per capita, electric power consumption per capita and real GDP per capita variables.

The relation between energy consumption and economic growth in China is focused on. Zhang and Cheng (2009) investigated the existence and direction of Granger causality between economic growth, energy consumption and carbon emissions in China by applying a multivariate model of economic growth, energy use, carbon emissions, capital and urban population. Yuan et al. (2008) tested for the existence and direction of causality between output growth and energy use in China at both aggregated total energy and disaggregated levels as coal, oil and electricity consumption. Zhao and Fan (2007) took the lead to study the intrinsic structure relations between the economic growth and the energy consumption, which are profound and complex in China with the non-linear STR models which have been developed in recent years. Wang and Yao (2007) examined the relationship between energy consumption and economic growth by multivariate cointegration analysis and the vector error correction model from the new viewpoint of the production function. Wang et al. (2006) made empirical study on the relationship between China's economic growth and energy consumption by using data from 1953 to 2002.

These researches have studied the relation between energy consumption and economic growth in a long period because the methods applied require a large amount of data. Some of these researches reveal unidirectional causal relationship running from energy consumption to economic growth, some of these

researches reveal unidirectional causal relationship running from economic growth to energy consumption, and some of these researches reveal bidirectional causal relationship between economic growth and energy consumption. There are many factors which lead to the difference of the results. The levels of economic development of different countries are not the same, and even the economic systems of the countries are different; the economic situations in the same country in different periods will be different; the methods applied by the researchers have some pitfalls, too. The relation between energy consumption and economic growth is supposed to be linear in most of the researches, but it is not proved. And Engle–Granger causality test is sensitive to the stationarity of the variables, the mode of the model and the outliers and so on.

Some Chinese researchers (Su et al., 2007; Qu and Yuan, 2008; Yu et al., 2007; Chen, 2008; Gao and Wu, 2009) had examined the relation between Chinese energy consumption and economic growth by applying grey system theory and its models. But they just researched the relation in one short period.

But Chinese economy has different characters in different periods. In different period, the relation between energy consumption and economic growth may be different. The history of Chinese economy can be divided into several periods from the 1980s: (1) Period I: 1980s–1992; (2) Period II: 1993–1996; (3) Period III: 1997–2000 and (4) Period IV: 2001–present.

### 1.1. Period I: 1980's–1992

Since 1978, China began to make major reforms to its economy. The Chinese leadership reformed the economic policies to raise personal income and consumption and to increase productivity by introducing new management systems. In 1981, the government began to dismantle the collectively farmed land, and established the household responsibility system that these fields were contracted out to the private families to cultivate. Resource allocation by state planning was reduced and enterprises were made ultimately responsible for their own profits and losses. The private sector was allowed to compete with state firms in a number of service sectors, and then in the sectors such as construction. The government encouraged foreign trade to increase economic growth and permitted foreign direct investment in several small “special economic zones” along the coast. In the 1980s, the government created the Dual-Track Price System which tried to combine central planning with market-oriented reforms to increase productivity and living standards. During the 1980s, these reforms led to average annual growth rates of 10% in agricultural and industrial output.

### 1.2. Period II: 1993–1996

Deng Xiaoping, Chinese leader at the time, made a series of political pronouncements to give new impetus to the process of economic reform when he visited southern China in early 1992. The 14th National Communist Party Congress held later in the year backed up Deng's pronouncements, stating that China's key task in the 1990s was to create a “socialist market economy”. It was approved of establishment of more than 2000 special economic zones, and lots of foreign capital invested in the special economic zones. These accelerated Chinese economic growth in the period. The government approved the long-term reforms which try to give more play to market-oriented institutions and to strengthen central control over the financial system. State enterprises would continue to dominate many key industries. The growth rate was thus tempered, and the inflation rate dropped.

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