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The drag effect of coal consumption on economic growth in China during 1953–2013

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ABSTRACT

Rapid economic growth in China is largely dependent on coal consumption, so the scarcity of coal represents a major challenge for sustainable development in the country. A model predicting the drag effect of coal consumption on economic growth in China would be useful for decision-making. In this paper, we apply Romer's growth drag theory and estimate the drag effect of coal consumption on economic growth using a Johansen cointegration test, partial least squares regression, and a drag equation. The results show that the growth drag caused by coal consumption is 0.0252. This means that regardless of other factors, the economic growth rate will be 6.34% in 2020 due to the constraints of coal consumption. We also present suggestions for improving the efficiency and controlling the scale of coal usage during economic development.

1. Introduction

The reform and open policy implemented since 1978 have placed China as the biggest developing country and the focus of worldwide attention. China has a massive population of 1.36 billion people and the average annual GDP growth rate from 1978 to 2006 was approximately 9.8%. In 2010, China overtook Japan to become the second largest economy in the world after the USA. However, China is not only a newly emerging developing power but also a large consumer of energy. Owing to the extensive growth mode in the country, rapid GDP growth has been at the cost of high energy consumption and environmental pollution. According to the World Bank database and statistical data published by British Petroleum (BP), China accounted for approximately 23% of total world energy consumption and 13.28% of global GDP in 2014. In the same year, the increasing energy gap between supply and demand reached 660 million tonnes of standard coal (China Statistical Yearbook, 2015), with the dependence on foreign energy increasing, especially for oil (~60.21%; China Statistical Yearbook, 2015). The effect of uncertainty regarding international oil price movements on economic growth is gradually strengthening. Hence, the stability of energy supply is an increasingly serious issue in China.

Coal is the most important power source in China. Between 1978 and 2009, coal accounted for more than 70% of total energy consumption. Despite a slight decline in 2010, this proportion was still 67.4% in 2013. Owing to safety issues in coal production, high transport costs, and capacity constraints for high-quality coal, the supply–demand imbalance in the coal market can significantly hinder healthy development of the coal industry and negatively affect all aspects of the national economy. China became a coal-importing country in 2008, which pushed it ahead of Japan as the world's largest coal importer. Potential safety problems in coal production are of increasing concern. At present, China is in a unique historical period of industrialization and urbanization. Industries such as the vehicle, real estate, heavy chemical engineering, and electric power sectors, which are highly energy-intensive, are rapidly advancing. In addition, construction of urban infrastructure is accelerating. It is not surprising that energy consumption in China is still increasing and it is likely that the coal-based energy structure will not change in the medium term.

The dependence on coal not only limits economic growth but also increases carbon emissions. Haze pollution in China is a strong case in point. Widespread haze pollution in regions such as Beijing–Tianjin–Hebei and the Yangtze and Pearl river deltas is a grave threat to public health and the environment and exerts a negative effect on economic development. Because of the increasing seriousness of resource availability and environmental concerns, the Chinese government is highly aware of the coal issue. In 2014, the National Energy Development Strategy Action Plan

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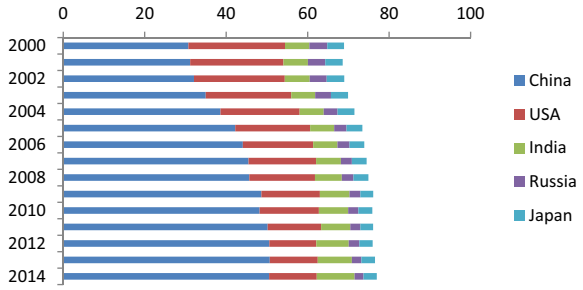

Fig. 1. Distribution of coal consumption in the world.

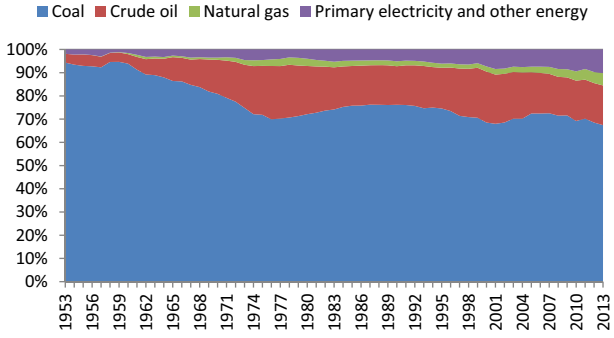

Fig. 2. Energy consumption structure in China during 1953–2013.

(2014–2020) included clear requirements to reduce coal consumption. By 2020, primary energy consumption and coal consumption should be less than 4.8 and 4.2 billion tonnes of standard coal, respectively. The proportion of coal in primary energy consumption is declining and the target for 2020 is 62%. In particular, coal consumption in Beijing–Tianjin–Hebei–Shanghai is down by 0.1 billion tonnes of standard coal, and the growth in coal consumption in the Yangtze and Pearl river deltas is negative.

1.1. Overview of coal consumption in China

Coal plays a critical role in economic growth in China. To better understand this issue, a brief overview of coal consumption is presented below.

Fig. 1 shows the five countries with the highest coal consumption (China, USA, India, Russia, and Japan), which together accounted for 77% of total coal consumption in 2014. According to BP data, global coal consumption was almost flat in 2014, rising just 0.4% compared to 2013, and global coal consumption accounted for 30% of total energy. The USA, Russia, and Japan showed a decreasing trend from 2000 to 2014, while the proportion in China and Japan gradually increased. As the biggest producer and consumer, coal consumption in China has accounted for more than half of the global market since 2011. Owing to energy efficiency improvements and strengthening environmental regulation, the rate of increase has been slowing down and the proportion of global coal consumption has also been gradually decreasing, although it has slightly increased since 2013. Besides China, coal demand in India is showing signs of increasing. Together, China and India accounted for nearly 60% of global coal consumption in 2014. According to BP forecasts, this will reach 87% in 2035. China is still the biggest coal consumer, accounting for approximately 51%.

As shown in Fig. 2, the annual average proportion of coal, crude oil, natural gas, primary electricity, and other energy is approximately 77.64%, 15.43%, 1.96% and 4.96%, respectively, over the 1953–2013 study period. The energy resource structure is rich in coal and poor in oil and natural gas, so coal plays a leading

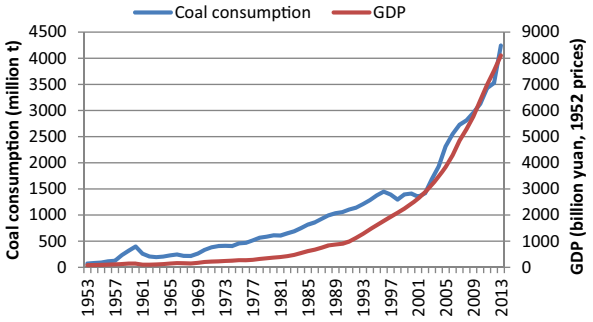

Fig. 3. Trends for coal consumption and GDP in China.

role in energy consumption. The proportion of coal consumption even exceeded 80%–95% during 1953–1970. The two oil shocks that occurred in the 1970s led to great concern regarding oil consumption and prompted the Chinese government to diversify the national energy consumption structure. Because of the discovery of a series of oil reservoirs and general improvements in oil exploration technology, consumption of crude oil is increasing and accounts for approximately 20% of total energy consumption in the 1970s. In recent years, China has pursued a new type of industrialization involving green and low-carbon development, and has stepped up efforts to conserve energy and reduce emissions to meet climate change targets. By 2013, coal consumption had decreased to 67.4% of total energy. The importance of natural gas has widely increased. Meanwhile, the promotion of renewable and alternative energy sources, including wind, solar, hydro, bio, and ocean energy, is another important initiative. By the end of 2013, the natural gas and the primary electricity and other energy shares increased to 5.3% and 10.2%, respectively.

As shown in Fig. 3, there is an upward trend for both coal consumption and GDP in China. Over the 60-year period from 1953 to 2013, coal consumption increased 60-fold from 0.71 million tonnes to 42.44 million tonnes, representing an average annual growth rate of 7.95%. Meanwhile, GDP soared from 7.85 billion yuan in 1953 to 810.63 billion yuan in 2013 at an annual growth rate of 9.29%. As stated earlier, economic growth involved significant increases in coal consumption. From 1953 to 1960, coal use increased 5.6-fold in just 7 years. Since then, coal use has exhibited fluctuating growth. After reform and opening up of the Chinese economy, rapid economic development led to huge coal consumption, especially after China joined the World Trade Organization (WTO). The annual average growth rate was as high as 10.33% during 2002–2010. These data indicate there is a correlation between coal consumption and GDP.

China has a large population and limited resources, and excessive dependence on coal consumption will become a severe problem. Many scholars have raised questions about the drag effect of coal consumption on the economy because of serious capacity issues in the coal industry. Because coal is a non-renewable resource, it will eventually run out, but the level of coal resources in China mean that the high proportion of coal consumption will not change in the near future. In addition, it is likely that clean and cheap energy will not be available in sufficient quantities to substitute for fossil fuels in the short and medium term. Although US success has demonstrated the utility of the development of shale gas, replication of this experience in China will be difficult because of the advanced exploitation technology required, a shortage of water resources, and environmental protection issues (Dong and Wang, 2013; Hu and Xu, 2013; Pi et al., 2015). If inefficient coal consumption continues, the supply may not be sufficient to meet demands. Faced with global warming increasing and domestic environment protection, controlling the high coal-consuming

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