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Decline in China's coal consumption: An evidence of peak coal or a temporary blip?

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ABSTRACT

Chinese coal consumption declined 3.7% year on year in 2015. Is this evidence of China's "coal peak" or a temporary blip? In this paper, we use a time series model to explore if further China's coal consumption will be higher or lower than the level of 2014. Before the modeling, we undertake a comprehensive analysis of data reliability, because problems with the accuracy of Chinese data have posed the main challenge to calculating its energy use. Our results show that annual Chinese coal consumption during 2016–2020 will be lower than the level of 2014 if the annual average GDP growth rate is less than 8.2%/year. Given that Chinese economy has been adapting to a "new normal" (slower but higher-quality economic growth) since 2014, and GDP growth target of at least 6.5% during 2016–2020 set by 13th Five Year Plan, we conclude that Chinese coal consumption peaked in 2014, which could translate into a big change in the global coal consumption and carbon emission.

1. Introduction

One of the biggest challenges in combating global warming over the past decades has been how China suppresses its insatiable appetite for coal. Driven by its rapid economic growth, Chinese coal consumption, tripling since 2000, has overtaken the combined global consumption outside China (BP, 2016). The unprecedented scale and breakneck growth of coal use has not only drained arid central and western China (coal resources are concentrated in the arid central and west) of precious water resources (Han et al., 2016; Kuenzer et al., 2007) and caused heavy smog in its cities (Wang, 2013a), but also added to the disruption of the global climatic system (Wang et al., 2013). China's burning coal produced 49% of the increase in the world's carbon dioxide (CO_2) emissions from the combustion of fossil fuel, and 82% of the increase in China between 2001 and 2012 (EIA, 2016). In 2012 alone, burning coal produced 80% of China's fossil-fuel carbon emissions, or a fifth of the world total fossil-fuel carbon emissions (see Fig. 1), contributing more to global warming than any other country (EIA, 2016). For anyone, anywhere worried about climate change, China's likely growing coal consumption has been the perennial problem.

Surprisingly, the Chinese Statistical Communiqué reported that its coal consumption declined 3.7% year on year in 2015 (NBS, 2016b), following a negligible increase in 2014 reported by China Statistical Yearbook-2015 (CSY-15) (NBS, 2015). Is this evidence of China's "coal peak" or a temporary blip?

The significance of peak coal studies includes, but is not limited to: (I). China burns half the world's coal, and coal accounts for about 70% of China's total primary energy consumption. The peak coal studies can serve to predict the coal market of both the China and the world. (II), the peak coal studies would facilitate to the peak of China's total carbon emission, because burning coal accounted for about 80% of China's total energy-related carbon emission. (III) Coal is the main reason why China accounts for about 30% of global greenhouse gas emissions. The peak coal studies thus can service to study the turning point of global carbon emission. (IV) Given the international political and economic structures we now have to manage climate change, the pake studies would have potential to influential on other countries to take further actions to curb carbon emission.

2. Brief overview of IEA's and EIA's views on China's declined coal usage

Both International Energy Agency IEA (2015) and U.S. Energy Information Administration EIA (2015) have attributed the decline in China's coal consumption to three key factors: economic deceleration, industrial restricting, and rapidly scaling-up non-fossil fuel energy.

The IEA said *"...Coal demand in China is sputtering as the Chinese economy gradually shifts to one based more on services and less*

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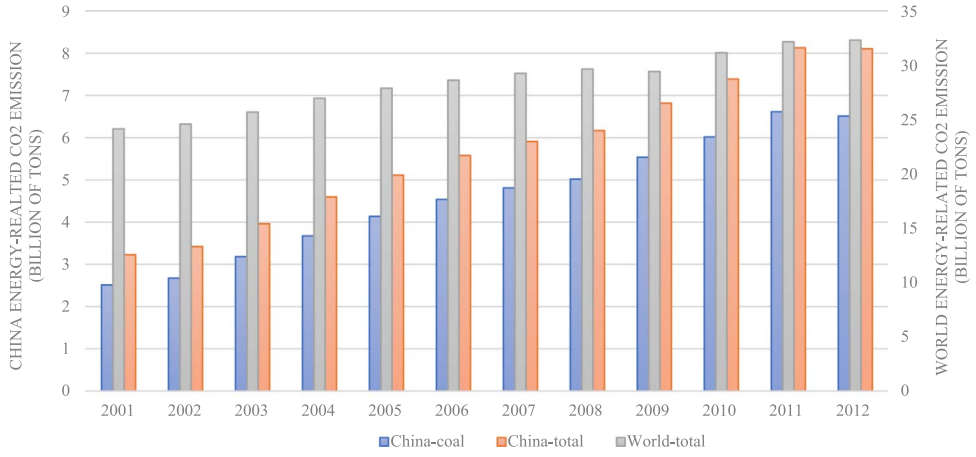

Fig. 1. Carbon dioxide from the combustion of energy in China and the world. Ref. (EIA, 2016).

on energy-intensive industries. New Chinese hydro, nuclear, wind and solar are also significantly curtailing coal power generation ...” (IEA, 2015)

The IEA said *“...Economic deceleration, industry restructuring, and new energy and environmental policies have slowed the growth of coal consumption in China and are also driving more centralized and cleaner uses of coal...”* (EIA, 2015).

Indeed, China's domestic gross product (GDP) grew by 6.9% in 2015, compared with 7.3% a year earlier, marking its slowest growth in a quarter of a century (see Fig. 2). Meanwhile, the economic growth increasingly was driven by the service sector and less energy-intensive industry. As shown in Fig. 3, the added value of tertiary industry share of GDP has continually increased. In 2014, the added value of tertiary industry share of GDP was 48%, which surpassed the added value of the second industry share of GDP (47%). Again, increase in China's energy production has almost entirely from non-fossil fuels. Renewables investment in China hit an all-time high in 2015 at $110 billion. Overall low-carbon electricity generation - hydro, wind, nuclear and solar - increased more than 20% in 2015. This has enabled China to cover its increase in power demand (Plumer, 2016; REN21, 2016).

In this study, we extend the works of IEA and EIA to use three independent variables (gross domestic product, G; percentage of tertiary industry in total GDP, T; and percentage of non-fossil in energy consumption, n-f) to forecast coal consumption (C). We first undertake a comprehensive analysis of data reliability, because of problems with the accuracy of Chinese data have become the first change to figure out what Chinese energy usage and carbon emission happen (Guan et al., 2012; Korsbakken et al., 2016). Next, we develop mathematical model to examine the long-run relationship between the fours variables, and develop their long-run equilibrium equation, using annual time-series data on G, T and n-f, and time-series forecast model (methods). Finally, using CSY-15 and 13th Five-Year Plan on National Economic and Social Development (FYP) covering 2016–2020, as two inputs, we run the long-term equilibrium equation to simulate and forecast coal consumption to explore whether further coal consumption will be higher or lower than the level of 2014.

3. Method and data

3.1. Method

We try to use time series analysis to forecast coal consumption during 2016–2020 based on the modeled time series energy consumption pattern during 1995–2014. Most of the changes in the economy are gradual, if these are changing and affecting the energy consumption that must also be evident in time series energy consumption patterns. What this means is that any change in energy consumption owing to economic factors should be reflected in time series data/patterns. Thus, time series models attempt to capture such patterns to the greatest possible extent. The time series model used in this work includes the following three steps:

3.1.1. Step I: unit root tests

We conduct unit root tests for the dependent variable and the three independent variables to avoid the problem of spurious regression and ensure that all variables are stationary before proceeding to the next step of our analysis. We perform four different unit root tests, namely Augmented Dickey–Fuller (ADF) (Dickey and Fuller, 1979), Phillips–Perron (PP) (Phillips and Perron, 1988), Kwiatkowski–Phillips–Schmidt–Shin (KPSS) (Kwiatkowski et al., 1992), and the Elliot, Dickey-Fuller GLS (ERS) (Elliott et al., 1996) in the EView 7.0 version.

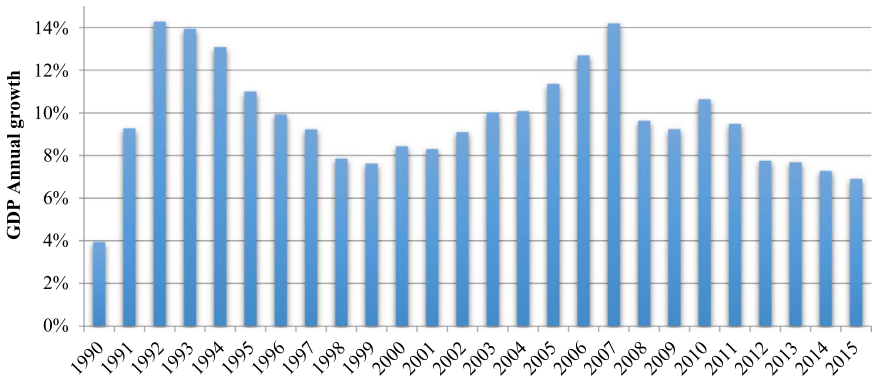

Fig. 2. Chinese annual GDP growth rate from 1990 to 2015. Data of 1990–2014 Ref. (WorldBandk, 2016). Data of 2015 Ref. (NBS, 2016b).