



Is the price elasticity of demand for coal in China increasing?



Paul J. BURKE^{a,*}, Hua LIAO^{b,c}

^a Australian National University, Canberra, ACT 2601, Australia

^b School of Management and Economics, Beijing Institute of Technology, Beijing 100081, China

^c Center for Energy and Environmental Policy Research, Beijing Institute of Technology, Beijing 100081, China

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ABSTRACT

China's dependence on coal is a major contributor to local and global environmental problems. In this paper we estimate the price elasticity of demand for coal in China using a panel of province-level data for 1998–2012. We find that provincial coal demand has become increasingly price elastic. As of 2012 we estimate that this elasticity was in the range -0.3 to -0.7 in point estimate terms when responses over two years are considered. The results imply that China's coal market is becoming more suited to price-based approaches to reducing emissions. The elimination of coal consumption subsidies could reduce national coal use and related emissions by around 2%.

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1. Introduction

China accounts for half of global coal consumption, a share that the International Energy Agency ([International Energy Agency, 2014a](#)) expects to remain relatively stable over coming decades under current policies. The country's coal use is a substantial contributor to local and regional environmental problems, accounting for more than one-fifth of annual global carbon dioxide (CO₂) emissions from all energy sources ([International Energy Agency, 2014b](#)). China is currently trialing carbon pricing schemes in an effort to reduce greenhouse gas emissions, and has announced a move to a national scheme. Yet relatively little evidence exists on how responsive China's coal demand has been to coal prices in recent years, especially using sub-national data. Given the role of coal in China's emissions profile, for emissions pricing to work well it is important that coal use is responsive to prices.

In this paper we use data on provincial coal prices and coal use to estimate the price elasticity of demand for coal in China. We construct a panel covering 30 provincial-level divisions ("provinces") for the 15-year period 1998–2012, and control for province fixed effects and other factors possibly affecting coal demand. We use sample splitting and interaction terms to explore whether the price elasticity of coal demand has changed over time. Our results suggest that provincial coal demand is becoming increasingly price sensitive, and as of 2012 was in the order of -0.3 to -0.7 when responses over a period of two years are considered.

* Corresponding author. Tel.: +61 2 6125 6566.

E-mail address: paul.j.burke@anu.edu.au (P.J. Burke).

China's economy and coal sector have marketized over recent decades, a process that may have contributed to the increasing price elasticity of demand as prices gradually take on a greater role in rationing China's coal consumption. The paper adds to a growing body of research using provincial-level data on energy use in China (e.g. Cattaneo, Manera, and Scarpa, 2011; Du, Wei, and Cai, 2012; Hao, Zhang, Liao, and Wei, 2015; Li and Leung, 2012; Ma and Oxley, 2012).

Coal is not a homogenous commodity. The metallurgical industry mainly uses coking coal, whereas electricity generators use thermal coal. Within any broad classification there is substantial variation in coal grades and types, and in the prices for these products. While the price elasticity of coal demand may vary for different types and uses of coal, data restrictions mean that we focus on total provincial coal use, aggregated in tonnes. An advantage of adopting a panel approach is that we can control for some unobserved characteristics of coal consumption, including the period-average quality of the coal consumed in each province.

Our finding that China's provincial-level coal price elasticity of demand is increasing has several implications. One is that price-based approaches to reducing the environmental impacts of coal use are becoming increasingly relevant in the China context. This paper's results are also useful for informing parameter choices in energy models.¹ We also estimate the reduction in coal use and related emissions that would result from a phase-out of coal consumption subsidies in China.

The paper is organized as follows. Section 2 provides an overview of China's coal sector, including a brief history of its ongoing marketization. Section 3 discusses our method, and Section 4 describes our data. Section 5 presents our results, and we compare our estimates to earlier studies in Section 6. The final section concludes.

2. China's coal sector

2.1. China's coal use and emissions

China's appetite for coal has grown at an extraordinary rate. Fig. 1 shows annual coal use, aggregated in energy content terms, by China and the rest of the world for 1965–2013. In 1965, China accounted for only 8% of global coal consumption. Over the 48 years to 2013, China's coal use increased at an average of 6.1% per annum. This has seen China's share of global coal consumption reach around 50% (BP, 2014). Coal use in the rest of the world has grown more slowly, averaging 0.8% per year over 1965–2013. China's growth in coal use is perhaps coming to a turning point, however: in a historic change, China's coal consumption was relatively flat in 2014 in energy equivalent terms (data not shown; Doyle and Stanway, 2015).

The most rapidly growing use of coal in China has been for electricity generation. Fig. 2 shows primary coal consumption by China's electricity, manufacturing, and other sectors for 1994–2012. As of 2012 electricity generation accounted for half of all coal use in China, with manufacturing directly consuming 38%. Coal-fired electricity output expanded at an average rate of 9.3% per annum over 1971–2012. In 2012, 76% of China's electricity generation was coal-fired, up from 70% in 1971 (International Energy Agency, 2015). Residential coal consumption, included in the "Other" category in Fig. 2, has fallen as a result of factors such as the installation of central heating systems and electrification. China's rise has involved a huge expansion of energy-hungry sectors such as the steel industry, the output of which has increased more than 30-fold over the last four decades (CEIC, 2014).

Coal dominates China's CO₂ emissions. Fig. 3 shows China's total energy-based CO₂ emissions by fuel for 1971–2012. In 2012, 83% of China's energy-based CO₂ emissions were from coal, a share that has remained quite steady since the early 1970s. 14% of China's energy-based emissions were from oil, and only 3% from natural gas. Coal is also the primary contributor of other atmospheric emissions in China, including sulfur dioxide and particulates, and so has large health implications. Outdoor air pollution, mostly from coal, has been estimated to cause around 1.2 million deaths per year nationally (Wong, 2013).

Fig. 4 presents China's output price index for the mining and washing of coal, the coal price measure we use at the provincial level in our empirical estimations. The index almost tripled over the first decade of the new millennium in nominal terms, before falling in 2012 (the last year of our empirical analysis). Coal price increases outstripped the modest rise in China's aggregate industrial producer price index, meaning that in real terms coal prices more than doubled over the decade. The 2012 downturn in the coal price index extended into 2013, a year for which nominal coal prices were recorded as falling by around 11%.² Fig. 4 also shows a coal import price at Qinhuangdao port, China's largest coal shipping port. The Qinhuangdao price is positively correlated with the coal sector's output price index, but displays greater volatility.

Substantial geographical variation in per-capita coal use is shown in Fig. 5. The highest reliance on coal is in China's north, where the largest coal reserves and a large share the country's heavy industry can be found. Southern provinces are smaller users of coal. Our method addresses persistent differences in coal dependence via the use of province fixed effects and estimates in differences.

2.2. Marketization of China's coal sector

The ongoing marketization of China's coal sector as the country continues its transition from a planned to a more market-based economy might mean that prices are now playing a more important role in rationing coal use. If so, this may have translated to an increase in the price elasticity of coal demand. In this section we provide details about the marketization process.

During 1949–1978, the production, transportation, and use of coal and other "strategic resources" were primarily allocated by the central government, and coal prices were maintained at a low level (Thomson, 2003; Wright, 2000, 2012; Xiao and Wu,

¹ Mischke and Karlsson (2014) provide a recent review of models of China's energy-economic system.

² The decline in coal prices has extended into 2014 and 2015; data not shown.

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