



# Did China's coal mine regulation positively affect economic growth?



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## ABSTRACT

In response to high mortality rates and low productivity in coal mining, China began regulating coal mines in the 1990s, reshaping its coal economy. We investigate the relationship between coal mine regulation and economic growth. Using the difference-in-difference approach to compare the pre- and post-regulation periods as well as regions heavily and lightly affected by regulation, we find that regulation positively affects a regional economy. Results are illustrated by estimations that use mortality rates in coal mining as a proxy for measuring regulation quality. Regulation effects are not limited to the intra-coal industry but also apply to spillover by relieving the crowding-out effects of coal abundance.

## 1. Introduction

Coal is the dominant primary energy source in China. In 2014, coal accounted for approximately 65% of China's energy structure (Chinese Academy of Social Sciences, 2015), and 91% of the consumption is provided domestically (National Bureau of Statistics of P.R. China, 2015). China's coal output accounts for 47% of global production (BP Global, 2015). Coal mining and the coal industry are therefore crucial for China's social economy.

However, with high coal production and consumption, coal mine accidents were frequent in China and had been more widely publicized in the recent past. China's coal industry was long regarded as the most dangerous industry in the world (Wright, 2004). In the mid-1990s, victims in coal mines accounted for over 50% of total mortality accidents in national social production (data sources: China Work Safety Yearbook, various years). Overall coal mine labor productivity (measured by ton/worker) was also low, reaching only approximately 2% of that of the United States and Australia in 1998 (China Coal Information, 2010). One of the main reasons for these problems is that small coal mines (SCMs)<sup>1</sup> were once extensively developed in China (China Coal Information, 2010).

These poor conditions stimulated the Chinese government to promote regulation in the coal industry. China has regulated the coal

industry since the late 1990s by expanding fixed-asset investments and by closing SCMs with low productivity and high mortality rates. The mortality rate in coal mining (death toll/ton) has declined by 80% in the 1997–2009 period, although in 2008, the coal mine death toll in China still accounted for 70% of the world total; labor productivity (ton/worker) also improved by 205%, and national coal output increased by 123% (data sources: Statistical Communiqué of the National Economic and Social Development and the China Coal Industry Yearbook, various years).

In this study, regulation is evaluated in terms of regional economic growth. According to the existing arguments on resource abundance and its effect mechanism on economic performance, the crowding-out effect (which suggests that resource abundance crowds out investment, human capital, and innovation in non-resource sectors and thus hinders economic growth) is a main cause of the lagged economic development in many regions rich with natural resources (see, e.g., Sachs and Warner, 1995; 2001; Frankel, 2010). By upgrading the regulation and management of coal mines, coal mining productivity is improved and the crowding-out effect is expected to be relieved. Under this background, we investigate whether China's coal mine regulation since the late 1990s has positively affected the economic growth of regions with high coal industry dependence.

Our analysis is as follows. To guide our empirical investigations, we

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<sup>1</sup> SCMs in this paper refer to those mines with a production capacity below 30,000t/year. Most SCMs are township- and village-owned enterprises (TVEs). To simplify the discussion, SCMs and TVE coal mines are used interchangeably in this paper.

develop a simple framework that shows the relationship between the resource crowding-out effects of entrepreneurs and regional economic growth. Without reasonable regulation, entrepreneurs tend to flock to the coal mining industry because of the possibility of earning large profits without having to bear the associated social costs of SCMs; this lowers the overall productivity of both the coal mining industry (with economies of scale) and other industries (with economies of agglomeration).

Regarding the empirical strategy for estimating the effects of regulation on regional development, first, we apply two difference-in-difference (DID) approaches. The first is a comparison between the pre- and post-regulation periods as well as between regions with and without rich SCMs, and we find that regions with rich SCMs are more affected by the regulation. The second is a comparison between the pre- and post-regulation periods as well as between regions rich in coal mines and those rich in other mines (excluding coal mines). We find positive economic spillover effects of regulation on both the whole regional economy and the non-coal based economy. Then, using a robustness check of the regulation effects, the key and most difficult procedure is finding a reliable measurement for coal industry regulation. Because regulation is a complex and comprehensive policy, a computable official indicator is not available. We argue that mortality rate in coal mining is a qualified proxy for the quality of coal mine regulation. Using provincial-level panel data from 1995 to 2009, we confirm that coal mine regulation positively improved the economic performance of related regions. The results remain stable under various settings and are strengthened using indicators for the real wage instead of for per capita GDP. The positive effects are observed not only in the coal industry but also in other economic activities, and we address these spillover effects on the moderation of natural resource crowding-out effects.

This study contributes to two bodies of literature. First, James and Aadland (2011) and Deaton and Niman (2012) argue that in the United States an area dependent on coal mining is likely to experience deep poverty because of weak local governance, lack of entrepreneurship, and the availability of few other economic opportunities. However, they did not confirm this using the dynamic improvements of coal mine management.<sup>2</sup> In this study, we attempt to empirically show that improving the management of natural resources can positively affect the social economy of related regions. Second, this paper provides a quantitative evaluation of the economic consequences of China's coal mine regulation, which extends the related studies of regulation impacts on coal industry structure (Shen and Gunson, 2006), coal-related corruption (Jia and Nie, 2015), and production safety in the industry (Shi, 2009; He and Song, 2012; Jia and Nie, 2015). Andrews-Speed et al. (2005) examine the economic consequences of China's SCM closure policy by focusing on Chongqing, China, but their study is largely qualitative unlike the present study that provides quantitative estimates.

The remainder of this paper is organized as follows. Section 2 presents an introduction to China's coal industry regulation, and Section 3 shows the theoretical framework. Sections 4 and 5 provide the empirical results on regulation effects. Section 6 presents the mechanisms of regulation quality affecting regional development, and Section 7 concludes.

## 2. China's coal mines and coal mine regulation

In the 1980s, to meet the increasing demand for coal in society, the central government of China began encouraging unrestrained coal mining. A coal mining license, once not permitted for non-state-owned

enterprises (non-SOEs), became available to town and village enterprises (TVEs). Thus, TVE coal mines (of which most are SCMs), which are generally small and have inferior production equipment, began flourishing countrywide. China had more than 84,000 operating coal mines by the end of 1996, 81,000 of which were SCMs with an annual coal output of less than 30,000 t; in contrast, the United States, whose total coal production was similar to China's in 1997, had only 2196 coal mines at that time (Pan, Pu, and Xiang, 2002). In the 1990s, almost 45% of the national coal output in China was generated by SCMs (Shen and Andrews-Speed, 2001).

SCMs played an important role in China's economy at the time because of the need for coal as an energy source and the promotion of rural development (Shen and Andrews-Speed, 2001), but their disadvantages were also significant. Serious problems concerning workers' safety (Shi, 2009; Jia and Nie, 2015), environmental damage (Andrews-Speed et al., 2003), and low productivity were highlighted throughout the coal resource-rich regions. The typical exploitation rate of SCMs was approximately 10–15%, while that of state-owned key coal mines has generally been approximately 50%; thus, in SCMs, each ton of coal mined wastes approximately eight tons of coal and discards resources that cannot be mined repeatedly (Wang, 2006a). In addition, coal mining licenses have created significant rent-seeking and corruption opportunities in the local economy (Guangming Daily, 2005; Song and Mu, 2013). Because of the large number of SCMs, coal industry management has become very difficult.

Further, the prosperity of SCMs indirectly reduces the competitiveness of large-size SOE coal mines. SOE mines are generally operated under the typical planned economic system, and they suffer from a series of problems, such as blurred objectives and unclear ownership roles; furthermore, SOE mines are under less pressure to minimize costs than are SCMs because profit maximization is not the overriding objective of SOE activity (Shen and Andrews-Speed, 2001).

As a result, SCMs flourished but caused serious social problems; however, SOE mines were unprofitable and uncompetitive (non-profitability of SOEs was found across many industries in China in the 1990s; since then, China has experienced large-scale reform of SOEs countrywide). China's coal industry had become disordered, coal mine accidents were increasingly frequent, and the regional economy had been negatively affected. In the late-1990s, the central government decided to regulate the coal industry. Most coal mine accidents occurred in SCMs, which lacked investments in production safety and mainly employed individuals from the surrounding agricultural population (i.e., they lack knowledge and training in coal mining); thus, most SCMs have been gradually closed since the regulation, and coal mining licenses have been restricted to SCM entrants. The remainder of the SCMs has been required to improve their technology and facilities or to merge with large-size SOE coal mines.<sup>3</sup>

Policy outcomes have been satisfactory. As discussed in Section 1, the coal mining mortality rate was reduced by 80% and productivity improved by 205% during the 1997–2009 period. Although SCMs have been largely closed, total national coal production has consistently increased. Hence, the degree of industry concentration has increased rapidly. The production share of the largest four or eight enterprises within an industry (C4 and C8, respectively) is a general indicator of industry concentration in a country. The degree of coal industry concentration is high in almost all major coal-producing countries, whether they are developed or developing economies: The United States (C4 is 45%), South Africa (C4 is 87%), Germany (C4 is 65%), and Australia (C4 is 50%); in India, more than 90% of total coal is produced by one enterprise (data sources: Authors' own collection from various sources). Although still low, the degree of industry concentration (C4) in China increased from 6.9% in 1996 (Pan et al., 2002) to 20% in 2009

<sup>2</sup> From a cross-country perspective, Angrist and Kugler (2008) and Sala-i-Martin and Subramanian (2003) confirm that a relationship exists between poor institutions and poor economic performance in resource-dependent countries.

<sup>3</sup> More detailed discussions of SCM closure policy are found in Shen and Andrews-Speed (2001) and Shi (2013).

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