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Energy intensity and investment ownership across Chinese provinces

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ABSTRACT

The main objective of this paper is to investigate whether openness and investment ownership are key factors in explaining the diffusion of energy-saving technologies in China. Compared with previous studies, the novel aspect of this work is the use of a rich dataset at provincial level, which allows the high level of regional heterogeneity to be taken into consideration. The unbalanced regional growth has been translated into differences in the need for energy resources across the vast territory of China. A detailed analysis of these issues may provide new insights into the energy situation in this country. The analysis is also disaggregated by type of energy: coal, electricity and petroleum. We estimate the models by panel-corrected standard errors, developed by Beck and Katz (1995), over the period 1985–2008. Results obtained confirm the hypothesis that both foreign and non-state investments play a leading role in the decline of energy intensity across Chinese regions, whereas there is no evidence of a positive contribution of state investment. The findings also reveal differences in energy intensity across regions, thus confirming the importance of accounting for the regional dimension when analyzing energy consumption in China.

1. Introduction

Since the opening-up policy was implemented at the end of the 1970s, China has undergone a fast process of modernization and economic growth. Consistent with this performance, in 2009 China overtook the United States to become the world's largest energy user (IEA, 2010). However, this growth in the consumption of energy resources is a relatively recent phenomenon since, in 2000, Chinese energy use was only half that of the United States. The increase in China's energy consumption between 2000 and 2008 was more than four times higher than in the previous decade. The projections of this growth remain strong due the current lower per-capita consumption compared to other countries and the size of the population. Thus, a detailed analysis of the energy sector in this economy may provide new insights into the current debate in the energy-economics literature. Firstly, it is because China is an energy-dependent economy (Yuan et al., 2008). Secondly, its large demand for energy resources and its possible repercussions on climate change have drawn greater attention from scholars and policymakers because of its implications in both the domestic economy and international markets. Finally, energy-saving measures to protect the environment undertaken in China will have a significant influence on the global effort to reduce energy demand.

In the case of China, the most important debate on energy aspects during the last two decades has been focused on the causes of the decrease in energy intensity[1] (see Fig. 1). Indeed, energy intensity has fallen since 1978, coinciding with the introduction of market-oriented and open-door reforms[2]. Furthermore, as has been pointed out by Fan et al. (2007), since China accelerated its market oriented economic reforms at the end of 1992, its energy intensity has declined 3.6% annually over 1993–2005. These authors concluded that the accelerated marketization contributes substantially to energy efficiency improvements since 1993. Fisher-Vanden et al. (2006) claimed that these reforms can lead to lower energy intensity in two ways. On the one hand, reforms may result in changes in industrial composition. Opening up to international trade has altered the relative profitability of certain industries – particularly heavy industry – which would explain the gradual move away from energy-intensive heavy industries (structural change). On the other hand, market reforms may also lead to energy-saving innovations, thus raising energy productivity at the firm level (technological progress).

There seems to be general agreement in the relevant literature about the key role played by technological progress in explaining China's declining energy intensity, although the role played by structural change

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[1] This variable refers to the amount of energy consumed relative to GDP.
[2] However, it should be noticed that the decreasing trend in energy intensity has not been constant during the analyzed period (see IEA, 2007; Zhao et al., 2010).

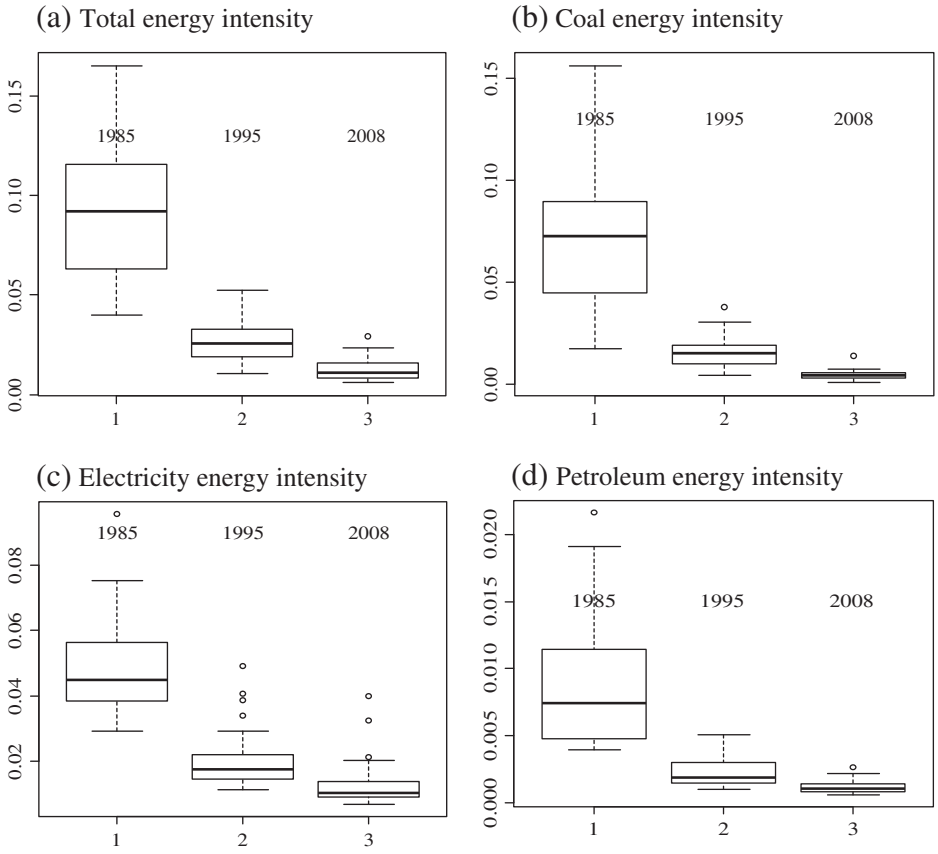

Fig. 1. Box plot of total energy intensity, coal energy intensity, electricity intensity, and petroleum intensity, 1985, 1995 and 2008.

remains a controversial issue (Fisher-Vanden et al., 2004; Liao et al., 2007; Ma and Stern, 2008; Zhang, 2003). However, most studies failed to identify the channels through which technological progress has caused the decline in energy intensity. Moreover, although energy efficiency rose during the 1980s, China's overall energy efficiency in 1990 continued to lag behind that of other countries with similar levels of per-capita income (Fisher-Vanden et al., 2004). Hence, there is much room for improvement and development in China's energy situation.

The main objective of this paper is to investigate whether reforms undertaken by China since 1979 have been a significant driving force in the diffusion of energy-saving technologies and, in turn, in reducing the energy intensity. We focus on both openness and reforms to investment ownership. On the one hand, both openness to foreign direct investment (FDI) and imports have been widely recognized by the literature as key mechanisms for the diffusion of technology. Foreign ownership has been regarded as a major vehicle for the transfer of advanced technology from developed to developing countries. China is a particularly interesting case to study due to the role played by technology transfer via FDI. Since opening up its economy in 1979, China has absorbed an increasing amount of FDI and is now among the world's largest hosts of FDI inflows. Imports of machinery and equipment are another important channel for improving the efficiency of domestic production due to the technology embodied in these goods.[3] It is well known that China has developed its innovation strategy by combining imports of technology with domestic research and development. In this strategy, technology spillovers coming from FDI seem to be more significant than those of imports.[4]

On the other hand, reforms to investment ownership within China have included a rapid expansion of various ownership classifications outside the state sector, both through new entry and through the conversion of state-owned enterprises (see Fisher-Vanden et al., 2004). Despite the rapid growth of foreign investment and non-state investment activities, state ownership still represents the major share in physical capital (see Li, 2009; Luo, 2007). Wholly foreign-owned firms are uncommon in China; most firms are joint ventures between local (frequently state-owned) and foreign enterprises (see Harrison and Rodriguez-Clare, 2010). The promotion of joint ventures has been the core of China's policy to benefit from inward investment. Over a certain period, China required joint venture as a condition for FDI inflows. The goal was to create linkages between foreign and local firms (see Fu et al., 2011). Girma et al. (2009) highlight the fact that foreign capital participation in state-owned enterprises is associated with higher innovative activity.

An additional feature to be considered in the case of China is regional heterogeneity. There are several reasons for considering the regional dimension in the case of this country. Firstly, the varying stages of development of coastal and inland provinces have been translated into differences in the need for energy resources, the former being the ones that require more energy, compared to central and western provinces (see Fisher-Vanden et al., 2004). Secondly, due to preferential policies (special economic zones), FDI has often been concentrated along the coast (see Fig. 2). Thirdly, the high level of heterogeneity across Chinese regions also refers to the distribution of resources. These are unevenly distributed across regions, the producers being located in the North and South of China, while the consumers are to found mostly on the coast. Moreover, there are important deficiencies in energy transportation. Regions that produce electricity or coal distribute their resources to other more developed regions through the upgraded transmission grid and the three main corridors in the

[3] For a recent survey about the channels through which international technology is spread, see Keller (2004).
[4] See Lai et al. (2006).