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RESEARCH BRIEF

A Green Bargain? The Impact of an Energy Saving Program on Productivity Growth in China's Iron and Steel Industry

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The impact of environmental regulation on firm productivity has been long been debated, however, mainly for western economies and with limited firm-level evidence. We study the impact of a large-scale national energy saving program in China on firm productivity in the iron and steel industry and find positive effects on productivity growth.

To improve the energy efficiency of China's rapidly-growing industrial sector, China's central government launched the national Top-1000 Energy-Consuming Enterprises Program (T1000P) during the Eleventh Five-Year Plan (FYP) (2006-2010). At that time, the T1000P was the most ambitious effort ever made in China in terms of its coverage of energy-intensive firms and state resources allocated to reduce industrial energy use. It was designed to support a national goal of reducing energy intensity by 20 percent nationwide during the Eleventh FYP. The program targeted about 1000 of the country's most energy demanding firms, i.e. the firms consuming a minimum of 180,000 tons of coal equivalent in 2004 (Price, Wang et al., 2010). Due to its high energy consumption, the highest share of firms targeted by this regulation belonged to the iron and steel industry.

In this paper, we study the impact of the T1000P on the total factor productivity (TFP) growth of iron and steel firms included in the program. TFP growth is a measure of the efficiency with which firms turn inputs into outputs. It is critical for maintaining international competitiveness and sustaining high long-term growth rates. Finally, it represents a foundation of social welfare and living standards (Greenstone, List et al., 2012; Krugman, 1997).

Previous literature has found that firm productivity is adversely affected by environment regulations (Gollop and Roberts, 1983; Gray and Shadbegian, 2003; Greenstone, List et al., 2012). We measure the impact of the program in China and find the opposite: that firms included in the program experienced greater productivity growth that those not included. The benchmark specification finds the

regulation positively affected TFP change in treated firms by 3.1 percent on average between 2006 and 2008. Technical change and scale efficiency change contributed about equally to this overall effect. Observed positive effects are robust to alternative methods of constructing a comparison group, and instrumenting for selection into the program. The average economic benefit of the program to each treated firm is estimated to be 148.7 million Chinese renminbi in 1998 values, before accounting for the economic value of any improvements in environmental integrity.

The positive effect of the policy on productivity growth is noteworthy as it differs from findings of negative effects in prior studies of developed countries. We suggest at least two reasons for this finding. First, firms involved in the T1000P were able to access subsides to improve the efficiency of their facilities, transfering a large share of compliance costs to the state. Second, the policy may have focused firm energy and effort on low hanging fruits related to energy saving that delivered benefits in the form of operational efficiencies and reduced costs.

Several features of this study stand out. First, it is one of only a few studies to estimate TFP change using a cost function approach. Second, to our knowledge, this is the first study of its kind for China. Third, our specification enables us to distinguish between the subcomponents of technical change and scale efficiency change using parametric methods. Such decomposition allows for a more detailed analysis of the effects of the regulation than what has been common practice in the literature. Fourth, we include muliple robustness checks to address concerns about selection bias and time-varying potentially cofounding factors. Fifth, the study uses a uniquely detailed firm-level data set. Detailed information from the Chinese Industrial Census was used to construct an unbalanced panel of 20,076 unique observations of 5,340 firms over the period 2003 to 2008. Effects of the T1000P on TFP change are analyzed by applying a difference-in-difference research design.

Our results are robust to alternative empirical strategies. We control for temporal, spatial, sub-industry and firm-specific heterogeneity when assessing the impact of the regulation on productivity. Results are robust when stratifying the sample along several dimensions, when accounting for sample attrition, when instrumenting for T1000P exposure and when accounting for a potentially confounding regulation that required closure of certain small, inefficient iron and steel producers over the same period.

References

M. Filippini, T. Geissmann, V. Karplus and D. Zhang. (2017). "A Green Bargain? The Impact of an Energy Saving Program on Productivity Growth in China's Iron and Steel Industry," MIT CEEPR Working Paper 2017-005.

Gollop, Frank M. and Mark J. Roberts. 1983. Environmental regulations and productivity growth: The case of fossil-fueled electric power generation. The Journal of Political Economy, 654-74.

Gray, Wayne B. and Ronald J. Shadbegian. 2003. Plant vintage, technology, and environmental regulation. Journal of Environmental Economics and Management, 46(3), 384-402.

Greenstone, Michael; John A. List and Chad Syverson. 2012. The effects of environmental regulation on the competitiveness of US manufacturing. NBER Working Paper Series No. 18392. Cambridge, MA, USA: National Bureau of Economic Research.

Price, Lynn; Xuejun Wang and Jiang Yun. 2010. The challenge of reducing energy consumption of the Top-1000 largest industrial enterprises in China. Energy Policy, 38(11), 6485-98.

Krugman, Paul R. 1997. The age of diminished expectations: U.S. economic policy in the 1990s. Cambridge, MA, USA: MIT Press.

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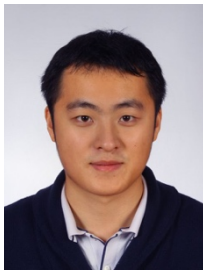

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