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Corporate behavior and competitiveness: impact of environmental regulation on Chinese firms

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ABSTRACT

This article presents a structural equation model for exploring the impact of environmental regulations—administrative-based environmental regulation (command-and-control regulation) (AER) and market-based environmental regulation (MER), on Chinese firm behavior and competitiveness on the basis of data collected from Chinese electric power and iron and steel firms (most of these firms are state-owned enterprises). Our results show that both AER and MER promote the firm behavior shift toward green development, and enhance firm competitiveness. However, AER and MER have different impacts on firm specific behaviors such as strategy choice, production decisions, technical progress, and environmental management and different extent of impact on firm competitiveness. In addition, whilst AER has a strong significant positive impact on technological innovation and plays a direct role in competitive improvement, MER does not. On the other hand, only MER plays significant roles in promoting the behavior shift of strategy toward green development. These findings signify that it is important for China to pursue the coordination between AER and MER, and to identify the line of playing roles between AER and MER.

1. Introduction

China had seen rapid economic growth at an average rate of 10% GDP from 1978 to 2011 (Yang et al., 2013). Meanwhile, its energy consumption had increased very quickly at an average rate of 6.23% from 1991 to 2011 when it reached 3480 Mtce (Wang et al., 2014), making China the second largest energy consumption country following the United States. China's industrial energy consumption accounts for about 70% of the national total energy consumption, and the top two sectors in terms of total industrial energy consumption increase are “ferrous metals processing” (iron and steel sector) and “electric power, gas and hot water” (power sector), contributing 34.85% and 11.36% of the total change in industrial energy consumption respectively (Zhao et al., 2010). With increasing concern about environmental pollution in the country, China is facing great challenges in coordinating economic growth and environmental improvement. To achieve such coordination, it is crucial for firms in key energy intensive sectors to shift toward environmentally friendly production.

However, firm greener development is in fact a public goods game. In such a game, whilst cooperators engage in clean production and contribute to the collective welfare at an agent cost, defectors choose not to do these (Perc and Szolnoki, 2010). This means that the agents, who do not contribute, also enjoy a cleaner environment. Hence, defectors have a higher payoff than cooperators (Brandt et al., 2006). To solve the strategy of the commons, it is important to exert environmental regulations as a powerful deterrence for improving the proportion of cooperators in a group (sustaining cooperation in public goods games) (Brandt et al., 2006).

China has issued a series of environmental regulations to improve its environmental quality. For example, *The Managerial Guidelines for Standards of Environmental Protection in China* promulgated in 1983 set standards for air, water and soil quality; and standards for pollutant discharge and environmental monitoring. The *Standards for Air Pollutant Discharge from Thermal Power Plants* issued in 1991, revised in 1996, 2003, and 2011 established the standards of upper limit for the emissions of soot, SO_2, NO_x, mercury and its compounds. The *Administrative Measures for Environmental Production in Power Industry* issued in 1996 set down three principles of environmental supervision mechanism in

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China's power industry: (1) The "three-simultaneity" system. Installations for the prevention and control of pollution at a construction project must be designed, built and commissioned together with the principal part. (2) Centralized environmental supervision system.[1] (3) The system of environmental administration at different levels.[2]

Based on the empirical analysis of the iron and steel sector and the power sector in China, the main purpose of this paper is to study whether the environmental regulations promote the firm behaviors shift toward cleaner production, and what the impact of environmental regulations on firm competitiveness is.

Researchers and practitioners have enthusiastically studied the issue of how environmental regulation affects firm competitiveness. Some academics demonstrated that environmental regulation had a detrimental impact on firm competitiveness (Walley and Whitehead, 1994; Jaffe and Palmer, 1997). They argued that environmental regulation increased compliance costs because firm economic goals were in conflict with environmental targets. Others illustrated that there was a win–win situation between firm competitiveness and environmental regulation (Porter and Linde, 1995; López-Gamero et al., 2010; Song and Wang, 2011) since environmental regulation could promote technological innovation and accordingly improve firm efficiency.

One of the main reasons for the differing results may be the differences in the sectors surveyed. The cost and change in innovation ability resulted from environmental regulation may differ for various sectors. For example, Bynoe (2004) concluded that environmental regulation reduced efficiency in the agriculture and agro-processing sector but improved efficiency in the manufacturing sector.

The different types of environmental regulation are also an important factor accounting for the different results. Environmental regulation can be broken down into various regimes. Milliman and Prince (1989) divided environmental regulation into five regimes: direct controls, emission subsidies, emission taxes, free marketable permits, and auctioned marketable permits. Using a neo-classical economic theory (marginal analysis method), they concluded that emission taxes and auctioned permits provided the highest firm incentives to promote technological change (these policies are dominated by market oriented), while direct controls (these policies are dominated by administrative oriented) usually provided the lowest relative firm incentives to promote technological change. Magat (1979) also categorized environmental regulation into five regimes: fees or taxes, non-technology-based effluent standards, market creation, technology-based effluent standards, and subsidies or tax-exempt financing. He systematically studied the impact of various environmental regulations on firm innovation, and found that all the five types of environmental regulation had significant positive effects on the rate and direction of firms' abatement technology innovation and their output-technology innovation. Meanwhile, technology-based standards provided the weakest incentives for innovation.

Downing and White (1986) broke environmental regulation down into four categories: effluent fees, subsidies, marketable permits, and direct regulation, and they analyzed the impact of the four types of environmental regulation on innovation. Using a model of pollution-control innovation by a profit-maximizing polluter who is subject to the various control methods, they concluded that effluent fees, subsidies, and marketable permits generally provided better incentives for innovation than direct regulation.

Williams (2012), Testa et al. (2011), López-Gamero et al. (2010) demonstrated clearly that two broad types of environmental regulation existed: command and control regulation (direct regulation) and incentive-based regulation (voluntary norms regulation or economic instruments and soft instruments). Williams (2012) argued that command and control regulation and incentive-based regulation at the federal level provided substantially different incentives for state regulation. Testa et al. (2011) presented that direct regulation had the positive impact on innovation and intangible performance while economic instruments negatively affected business performance. López-Gamero et al. (2010) concluded that the impact of command-and-control regulation on proactive environmental management and competitiveness was not significant, while the impact of voluntary norms regulation on proactive environmental management and competitiveness was positive.

Based on the current literature, we divide environmental regulation into two types: command-and-control regulation (administrative-based environmental regulation: AER), and incentive-based (market-based) environmental regulation (MER). Most studies argued that MER had stronger roles in promoting firm competitiveness than AER (Milliman and Prince, 1989; Downing and White, 1986; López-Gamero et al., 2010). Walley and Whitehead (1994) further pointed out that AER allowed managers very little freedom, while MER did not tell a company what to do, but instead provided a clear set of financial incentives that were designed to influence behavior positively, much like a capital market.

Moreover, the institutional economics theory—notably the Coase Theorem—argues that, since transaction costs (including negotiation costs, information discovery costs, supervision costs, contract violation costs, and dispute settlement costs) are not zero, the arrangement of institutional mechanisms (the initial allocation of property rights) matters to the efficiency of resource allocation (Coase, 1960). The different types of environmental regulations represent the various models of property rights allocation. As a result, different types of environmental regulations should have various impacts on firm behavior and competitiveness (Magat, 1979).

China's environmental regulation is dominated by AER. Meanwhile, MER is playing an increasingly important role. This study focuses on five types of AER: emissions standards, fines, supervision measures, environmental assessment systems, and production technology standards; and three types of MER: tax credits, clean development mechanisms (CDMs), and emissions trading systems. Our exploration of the various impacts of AER and MER on firm competitiveness is based on the data collected from China's iron and steel sector and power sector. One of the primary objectives of this study is to identify guidelines to help firms make environmental ethics decisions by providing evidence that the dual goals of economic performance improvement and environment concern can be compatible.

Our study makes two important contributions to the current literature. First, we examine the mediating roles of firm behavior in the link between environmental regulation and competitive advantage. We seek to find out which behaviors most significantly

[1] Prior to 1997, it was the Ministry of Power Industry which was responsible for environmental supervision. In 1997 when the Ministry of Power Industry was dismantled, the Environmental Protection Ministry began to take this responsibility.

[2] The Environmental Protection Ministry is responsible for making environmental legislations, as well as inspecting and dealing with major environmental issues across regions or drainage areas. Its affiliates—the provincial Environmental Protection Bureau and the Inspection Center are responsible for the approval of environmental protection projects and environmental inspection within its jurisdiction, and the environmental inspections and environmental disputes across provinces respectively.