



Are capitalists green? Firm ownership and provincial CO₂ emissions in China

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ABSTRACT

In China, a large private sector has evolved alongside a still sizeable state-owned sector that is subject to government control. Several studies have found that in this mixed economy, the private sector is economically more efficient than the state-owned sector. In this paper, we investigate whether private firms are also more carbon efficient than state-owned firms. Using a macroeconomic panel data model with provincial data from 1992 to 2010, we confirm that private firms emit less carbon dioxide than state-owned firms. Our results imply that future reforms, such as ongoing privatization, introduced to increase the economic efficiency of state-owned companies will also mitigate emissions growth. The policy lesson, not only for China but for developing countries maintaining a large state-owned sector, is that economic efficiency and energy efficiency are conjoined mutual benefits.

1. Introduction

Within the last four decades, China has emerged from one of the world's poorest agricultural economies to a major manufacturing economy. As a result of its remarkable economic transformation and high growth strategy, China is today the largest single emitter of carbon dioxide (CO₂) (Andersson, 2018). Projections of future emissions suggest a continuously upward-sloping trajectory until 2035/2040 (Andersson and Karpestam, 2013; Yuan et al., 2014). Clearly, any attempt to combat global warming depends critically on China's growth trajectory and a better understanding of the distinct drivers of domestic CO₂ emissions. It is easy to point to China's extensive growth strategy as a root cause. Yet the country has simultaneously undergone a deep structural diversification of ownership of productive assets, which leaves the question open, whether the new capitalist private firms or the traditional socialist state firms are at the heart of China's pollution problem. In this paper we ask how firm ownership affects CO₂ emissions. Specifically, we test whether emissions differ systematically between private firms, foreign firms and state-owned firms.

There is a broad consensus that China's leadership prioritized economic growth over environmental concerns throughout most of the reform period after 1978, thereby causing severe air, water and land pollution (He et al., 2012). It was, in fact, not until the 11th Five Year Plan (2006–2011) that the government began to emphasize environmentally sustainable development (Eaton and Kostka, 2017; He et al., 2012). Paralleling China's high growth strategy, however, the

country also underwent a gradual capitalist transformation from a fully state-owned economy to a hybrid economy that increasingly relied on private production and mixed ownership firms (Nee and Opper, 2012). This begs the question of whether the country's opening up to capitalist forms of production either reinforced or possibly even mitigated accumulating environmental costs, and if so, to what extent.

A focus on firm ownership as a potential factor to explain pollution levels is well aligned with the structural policy approach to environmental policies that aims at improving the economy's overall economic efficiency in terms of both total factor productivity and domestic material consumption. However, the effect of firm ownership on emissions has received relatively little scholarly attention, which is surprising given the broad evidence confirming that cross-ownership differences regarding economic efficiency specifically point to higher energy consumption by state-owned enterprises (Talukdar and Meisner, 2001; Wang and Jin, 2007). Though there are a few studies using firm level data to identify the effect of ownership on the level of pollution caused during production processes, the results of these studies are inconclusive (Fisher-Vanden et al., 2004; Jiang et al., 2014; Wang and Jin, 2007; Wang and Wheeler, 2005).

In this study, we shift the analytical focus from direct production-based emissions as commonly explored in firm-level studies to the macroeconomic level to gain a better understanding of the link between firm ownership and emission levels. A macroeconomic approach captures both the direct effects and indirect emissions. The latter include for example consumption of energy produced outside the firms,

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emissions of transport services consumed by the firms, and raw materials and intermediate goods the firms use in their production. Thus, a macro-approach promises a more complete account of the link between firm ownership and carbon emissions.

Our analysis benefits from China's regionally uneven progress of ownership diversification and the timing of her capitalist transformation, with coastal provinces typically taking the lead and the hinterland provinces lagging somewhat behind, specifically during the early reform period (Andersson et al., 2013). Private ownership of fixed assets in the manufacturing sector, for example, was as high as 40% in some provinces (e.g., Zhejiang) in 2010, while state-owned firms remain dominant in other provinces with ownership shares exceeding 90% (e.g., Xinjiang).¹ In our analysis, we exploit these differences in ownership across provinces to determine whether ownership of productive assets affects regional emission levels. Our data set covers the period from 1992—the year when the leadership committed to transform the country into a socialist market economy—until 2010. The results indicate that provinces with a rapidly growing private sector exhibit lower emissions growth. This difference is, as our analysis reflects, not due to cross-sectoral differences in the output mix of the private and state-sectors. Rather, behavioral differences are likely the main drivers of these results.

Our results carry important policy implications, not just for China but also for other developing and transition economies with a sizeable state-owned sector, as they support the view that productivity enhancing market-based economic reforms will also reduce emission intensities. In contrast, a reform-halt, possibly as a response to growing discontent with environmental degradation, would have a counter-productive effect. According to our results, emission growth can be reduced by between one and two percentage points per year by improving the productivity of the state-owned sector, for instance, by continuing privatization efforts. In order to fully decouple growth and emissions, however, additional policy reforms targeting energy production will be essential.

The remainder of the paper is organized as follows. In Section 2, we discuss the causal channels linking firm ownership and CO₂ emissions, and we introduce our statistical methodology in Section 3. The data are presented in Section 4, which is followed by a discussion of the empirical results in Section 5. Section 6 concludes the paper.

2. Firm ownership and the carbon footprint

2.1. Firm ownership and the carbon footprint – a theoretical background

Behavioral differences in the management of private and state-owned enterprises have been subject to a long-standing debate regarding the relative advantages of both ownership forms (Shleifer, 1998; Shleifer and Vishny, 1994). While the comparative study of performance effects has played an important role in the study of established market economies (Boardman and Vining, 1989; D'Souza and Megginson, 1999; Dewenter and Malatesta, 2001; Megginson, and Netter, 2001) and transition economies (Djankov and Murrell, 2002; Estrin et al., 2009; Frydman et al., 1999), second-order effects on environmental outcomes have only recently gained attention. While it is not possible to identify and disentangle the distinct behavioral strategies leading to differences in carbon emissions, it is useful to briefly highlight the two causal channels—most prominently discussed in the literature—through which ownership can affect pollution levels. First, private and state-owned firms have different objective functions (*functional perspective*). Second, owners and managers of private and state-owned firms face a different institutional and resource environment, which invites distinct behavioral responses (*institutional or*

resource-based perspective).

The *functional perspective* typically suggests that private enterprises adhere to a single objective, specifically profit maximization, whereas state-owned enterprises are assumed to pursue multiple objectives that reflect the policy-makers' complex priorities with respect to social, economic, political and even environmental preferences. The environmental net effects of the objective functions are ambiguous. For example, pure profit maximization of private firms may rely on waste avoidance or minimization, energy efficient technologies, and highly effective resource use, all strategies that would also reduce pollution levels as a second-order effect (Kikeri et al., 1992; Schmid and Robin, 1995). However, the opposite effect could occur if profit maximizers pursue their objective function by not internalizing production externalities or by undercutting technology and environmental standards (Eiser et al., 1996). The overall environmental impact naturally depends on the relative strength of both effects and is therefore dependent on a whole range of factors, such as the enforcement of environmental standards, the influence and monitoring by NGOs and the preferences of shareholders.

With respect to state-owned enterprises, the net environmental effects are equally difficult to predict. On the one hand, the multifaceted objectives of state-owned firms may include the advancement of environmental protection to help government bodies comply with aggregate environmental targets (Grout and Stevens, 2003; Liu and Wang, 2011; Wang and Jin, 2007). On the other hand, weaker profit orientation may contribute to less efficient resource use and higher pollution levels (Andrews and Dowling, 1998; Boycko et al., 1996; Djankov and Murrell, 2002).

The *institutional perspective* adds to these differences, as both types of ownership are typically embedded in different institutional and resource environments. Politically well-connected state-owned firms often enjoy soft budget constraints (Kornai, 1980) due to the generous provision of tax benefits, subsidies, and government guaranteed low-interest loans (Bunkanwanicha and Wiwattanakantang, 2009; Ding et al., 2014; Faccio, 2006). Whether these softer financial constraints and the competitive pressure translate into strengthened ecological responsibility or into inefficient resource use has yet to be determined through empirical testing. Similarly, managers of state-owned enterprises may either exploit their close political ties to lobby for lighter environmental regulations and to avoid environmental penalties in the case of non-compliance (Wang and Jin, 2007), or they may experience closer scrutiny by monitoring agencies focused on upholding fair standards. The exact outcome depends on the insulation of government bodies and the importance of political capital in the regulatory economy (Evans, 1995; Nee et al., 2007).

2.2. The case of China

2.2.1. Firm ownership forms

Firm ownership in China is complex. In addition to purely private and state-owned firms, there are collective firms, foreign firms, and a set of hybrid firms with varying degrees of state-ownership. Hybrid firms are commonly former state-owned firms that have been transformed into limited liability companies or joint stock companies with partial, and oftentimes dominating, state ownership. Although formally no longer state-owned, the state's continuing ownership involvement ensures that these firms are still subject to high degrees of state interference (Landry, 2014).² Given data restrictions, we consider four ownership types in our analysis, specifically i) purely private firms, ii) state- and collectively owned firms, iii) foreign firms, iv) and hybrid firms. According to the official definition, private firms are either established by a natural person or the majority shares are held by one or

¹ Ownership shares are calculated using fixed assets in the manufacturing sector.

² See, e.g., Landry (2014), for a detailed discussion on firm ownership in China.

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