AEA Papers and Proceedings 2018, 108: 468–472
https://doi.org/10.1257/pandp.20181030

Institutions and Emissions Trading in China†

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Institutions—the formal rules and informal norms that shape human interaction (North 1991)—have the potential to influence the operation of an emissions trading system (ETS). For instance, preexisting economic regulation has been shown to affect firms' abatement decisions and costs (Fowlie 2010). Transaction costs can also interfere with cost-effective operation by reducing trading levels and increasing abatement costs (Stavins 1995). As China develops a national ETS for carbon dioxide (CO_2) covering multiple energy-intensive sectors, it is important to consider how its design will interact with prevailing institutional features of the country's economy. This paper focuses specifically on the role of state control of industry, one source of heterogeneity that will affect efforts to establish an ETS in China's vast and diverse economic system.

The role of the state and its channels of influence over firm behavior in China differ from the economies where emissions trading has been previously introduced. This paper describes several key features of state influence in China, and examines the potential for interactions with the country's proposed national ETS for CO_2. The system was formally announced in December 2017 and is expected to develop in stages through 2030, supporting national goals to reduce CO_2 emissions intensity by 60–65 percent relative to 2005 levels over the same period.

China's national ETS builds on almost a decade of command-and-control efforts to control energy use and CO_2 emissions, and the experience of seven regional pilot CO_2 markets that launched between 2013–2015. As currently proposed, the national ETS would be "rate-based" (firm permit allocation would be adjusted based on actual end-of-period physical output) and include approximately 7,000 firms responsible for over half (5 to 5.5 billion tons) of the nation's annual CO_2 emissions (Goulder et al. 2017). How rapidly to expand the system and to evolve the design is the subject of ongoing discussion.

This paper proceeds as follows. First, it characterizes the aspects of state ownership and control of industrial firms in China most likely to interact with the operation of an ETS. Second, the consequences of these interactions are analyzed and discussed. The paper concludes by considering which interactions may be most consequential for ETS operation, and some potential implications for program design.

I. State Control and China's National ETS

Decades of economic reform have transformed Chinese industry from almost completely state-owned to a mixture of state-owned or state-controlled, domestic private, foreign, joint venture, and a few remaining collectively-owned firms. Many of the poorest performing state-owned firms were merged into larger industry groups or privatized (Hsieh and Song 2015). This is reflected in the steady fall in the number of state-owned firms through 2012, followed by stabilization. It should be noted that state-owned firms are often classified based on whole or majority state shareholding. In practice, it is state control—whether or not the state is designated the controlling minority or majority shareholder—that determines how firms are treated by the state. In contrast to the decline in state-owned firms, the number of state-controlled firms has actually increased, both in absolute terms and as a share of the total, since the early 2000s (Meyer and Wu 2014).

While state-controlled firms differ from other firm types in many observed and unobserved ways, several attributes are worth noting. The government relies heavily on state-controlled firms to support the achievement of long-term

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† Go to https://doi.org/10.1257/pandp.20181030 to visit the article page for additional materials and author disclosure statement.

social and economic development targets, and may facilitate their access to low-cost credit, resources, and markets. Leaders of state-controlled firms are typically selected with the approval of the Communist Party, and are evaluated regularly on a range of economic and noneconomic criteria, including measures of "social responsibility" (*she hui ze ren*) (Chen 2013). The results of these evaluations affect resources or opportunities made available to the firm. Firms that do not meet targets may be denied permission to expand capacity or to access financing at low rates, or leaders may receive low scores on official cadre evaluations (Wang 2013).

State-controlled firms vary in their level of government oversight, from the most local (county) to the most central (national). At the national level, approximately 100 of the largest state-owned firms in strategic sectors such as energy, mining, and aerospace are overseen by the State-owned Assets Supervision and Administration Commission (SASAC). Level of oversight strongly correlates with firm size and geographic footprint, and can affect governance. For instance, production assets for national state-controlled firms are spread across many provinces, while at the provincial, city, and county levels, firms are typically (but not always) smaller and locally focused. In China, there are five levels of the governing hierarchy (central, provincial, prefecture, county, and township), and each level of government directly manages the level below it, in addition to laterally managing any associated state-controlled firms subject to their oversight. These reporting linkages directly affect the source and extent of pressure to implement environmental policy.

Several attributes of state control are proposed to interact with an ETS. First, lower capital costs may affect a state-controlled firm's optimal choice of abatement. Second, there is a widespread expectation that state-controlled firms will be more responsive to targets and directives to provide public goods, relative to private firms. Third, state-controlled firms face additional punishments for failing to cooperate, including the withdrawal of privileges or limiting the career advancement of firm leaders. The following paragraphs consider how each attribute may interact with an ETS. This list is not intended to be exhaustive, but to focus on aspects related to the direct influence of the state over firm decisions. At least two additional dimensions associated with state-regulated economic activity—monopoly power and administrative pricing—may also interact with ETS function, and have been considered in other work (Lanz and Rausch 2016; Teng, Jotzo, and Wang 2017).

II. Implications for ETS Function

A. *Subsidized Access to Capital*

To illustrate how subsidized access to capital may interact with an ETS, consider a simple case that builds on Stavins (1995) on transaction costs. An economy consists of two firm types: state-controlled firms and private firms.[1] Firm opportunities to abate CO_2 emissions require additional capital investment, which is subsidized for state-controlled firms at rate $S(r_i) > 0$. Emissions for a firm i equal the sum of unconstrained emissions u minus the quantity of emissions reduced r, and sum to E. The system allocates total emissions permits $\bar{E} \leq E$ with q_{0i} to each firm. The number of permits each firm trades equals:

$$t_i = u_i - r_i - q_{0i}.$$

Firms choose reductions to minimize costs subject to the emissions price:

$$\min_{r_i} \left[c_i(r_i) - S(r_i) + p(u_i - r_i - q_{0i}) \right]$$

$$s.t.\ r_i \geq 0.$$

Differentiating with respect to r_i and solving for the permit price, we find that when the ETS binds, state firms abate up to the point where marginal cost equals the prevailing permit price p inclusive of the subsidy per unit abatement:

$$\left(\frac{\partial c_i(r_i)}{\partial r_i} - \frac{\partial S(r_i)}{\partial r_i} \right) - p \geq 0.$$

While private firms abate up to marginal cost equal to the prevailing permit price p:

$$\frac{\partial c_i(r_i)}{\partial r_i} - p \geq 0.$$

[1] Joint venture, foreign, and the few remaining collective firms are ignored for illustrative simplicity.

It is straightforward to see that state-controlled firms would undertake a greater abatement effort than they would in the absence of a subsidy, as they face a higher effective CO_2 price, while private firms would abate until their marginal cost equaled the full CO_2 price p. In a system with a fixed cap, higher than optimal abatement by state-controlled firms could crowd out any available low-cost abatement by private firms. In this case, the prevailing CO_2 price would fall, total cost of the system would rise, and, in a system with free permit allocations based on historical emissions, private firms would purchase more permits from state-owned firms.

The above model is aimed at developing intuition and oversimplifies on several important dimensions briefly discussed here. If abatement activities require both labor and capital inputs, an emissions price would induce state-controlled firms to pursue more capital-intensive strategies, relative to private firms. The impact of a capital subsidy would depend on to what extent the prevailing CO_2 price called forth additional capital-intensive abatement in state-controlled firms, compared to an unsubsidized case. Extensions could also consider relevant cases closer to expected real-world implementation in which an ETS is not a fixed cap but based on physical output, in which capital subsidies interact with input as well as abatement decisions, and in which permits are allocated according to technology-based emissions-intensity benchmarks.

B. *Social Responsibility*

State-controlled firms are expected to carry out the priorities of the state, including state-led environmental protection efforts, while private firms face far less pressure. Prior state environmental protection initiatives focused on reducing local air pollution and raising energy efficiency have relied heavily on state-controlled firms directly overseen by central and provincial governments. A major state effort to raise the energy efficiency of China's industrial sector began by targeting approximately 1,000 of China's largest energy-intensive firms, almost all of which were state controlled. When the program, known as the Top 1,000 Firms Energy-Saving Program, was later expanded to include over 10,000 firms, including many domestic private firms, compliance dropped sharply (Karplus, Shen, and Zhang 2016).

Differentiated levels of social responsibility for state-controlled and private firms have several implications for ETS function. First, enforcement at the firm level should not simply be assumed (Van Rooij and Lo 2010). The probability of participation can have a large impact on cost effectiveness. If a nontrivial share of private firms does not participate (and report their nonparticipation honestly), while all state-controlled firms participate fully, the set of abatement opportunities will be significantly constrained compared to full participation. Government officials will need to determine whether or not to require participating firms to deliver reductions equal to the original aggregate target, or to reduce the level of ambition in proportion to nonparticipation. To the extent that state control increases the likelihood of participation, it provides a strong argument in favor of initiating the program in sectors with a higher share of cooperative firms, such as electric power.

Second, while social responsibility may encourage compliance, it may discourage firms from meeting their emissions reduction obligations by purchasing permits to the extent that they face overlapping obligations to reduce energy intensity, CO_2 intensity, or energy-related pollution within firm boundaries. One of the legacies of China's planned economy that has survived the reform era is the use of targets in planning, which may be especially binding on state-controlled firms. Targets are typically disaggregated to various levels of government, each of which negotiates targets with local firms. Within firms, responsibility for meeting targets is often further disaggregated to individual managers. State-controlled firms accustomed to implementing binding targets in this way may be likely to focus on meeting these obligations first, before engaging in trading. If firms continue to face targets to improve their energy intensity or energy efficiency within firm boundaries as they did during the Eleventh and Twelfth Five-Year Plans, many opportunities for improving cost effectiveness through trading may be foregone.

An example helps to illustrate these concerns. With the announcement of the ETS, the Top 1,000/10,000 Firms Energy-Saving Programs, which set firm-specific targets for energy intensity reduction, has been discontinued at the national level, however, elements of these programs may remain intact at the provincial level

and below. Meanwhile, air quality improvement efforts currently require absolute, rather than intensity-based, reductions in energy-related emissions of air pollutants, often at the level of individual firms. Prior research has suggested that these requirements may have rendered energy-intensity targets nonbinding during the Eleventh and Twelfth Five-Year Plans (Nam et al. 2013). This situation is likely to continue, given that command-and-control approaches to air pollution control have grown tighter since 2013. If state-owned firms in particular continue to follow historical norms inherent in the planned approach to environmental protection, they could over-abate CO_2 and thereby prevent the intensity cap from binding or delivering cost-effective reductions.

C. *Enforcement*

A third distinction between state-controlled and private firms involves the levers available to the state to enforce compliance with an ETS. Influence over the career paths of leaders and the ability to withdraw resources may be especially powerful deterrents of noncompliance in state-owned firms, as suggested by the case of the Beijing ETS (Karplus and Zhang 2017). In addition to participating in the system, China's ETS will require accurate data on a firm's CO_2 emissions and physical output for allocation and reconciliation of reduction obligations. Here, several differences related to state control may matter. Government links to state-controlled firms may facilitate easier access to data and allow for targeted efforts to improve data quality. Private firms, by contrast, may be less cooperative. Focusing the attention of managers of thousands of diverse firms on building and maintaining credible emissions inventories is a formidable challenge. Establishing capacity to collect CO_2 emissions data from all firms will require prioritizing the ETS among other demands on managers' time. In the meantime, inattention or deliberate falsification could undermine the system.

State-controlled firms may not uniformly face stronger pressure to comply, however. Their connections with various layers of state government may create opportunities to negotiate prolonged grace periods and mitigate scrutiny. In these negotiations, resolving the tension between economic growth and environmental protection remains a major challenge. Prior studies suggest that centrally-administered state-owned firms may at times ignore environmental regulations, due to protectionism and insufficient regulatory capacity (Eaton and Kostka 2017). The combination of the possibility of harsher punishment combined with greater opportunity for regulatory capture exerts opposing influences on the compliance pressure state-owned firms face.

III. Implications for China's National ETS

China's national CO_2 ETS is expected to launch in stages over the next several years. Current plans suggest that electric power will be the first sector covered, followed by cement and aluminum, before expanding to other sectors. These sectors differ sharply in the relative importance of state-controlled firms. The power sector has a very high share of state-owned firms (around 60 percent in 2016), while cement has only a few percent. While designations of state control and output-weighted measures suggest higher shares in both sectors, the gap persists and may be important for managing expectations of ETS performance. The analysis above leads to several recommendations for system design, taking into consideration China's unique institutional landscape.

First, capital subsidies for SOEs have the potential to reduce the efficiency and alter the distributional impacts of an ETS in China, but if targets bind, the system is still expected to reduce emissions. To the extent that the system discourages investment in energy-intensive productive capital and shifts it toward abatement capital, it may help to address overcapacity in energy-intensive industries. However, it is generally not advisable to counter one distortion with another. Removing the capital subsidy may have a similar effect on reducing energy intensity. Comparing this to the impact of introducing a CO_2 price in the subsidy's presence would be a worthwhile simulation exercise. However, a subsidy reduction would increase costs to state-controlled firms, which may be politically untenable.

Second, an unwillingness of firms to participate in emissions reduction or trading, for instance, because they face overlapping or redundant reduction obligations, or because they face differential enforcement pressure, poses a more serious challenge for emissions trading in China. Replacing old systems and practices with emissions trading will a be long-term effort,

requiring both greater awareness at the firm level and increasing policy coordination at the national level. One recommendation is to focus on separately developing an ETS with national coverage within individual sectors that vary in their degree of market orientation, e.g., in terms of ownership, market concentration, price formation, and government intervention. The electric power sector is heavily state controlled and subject to administrative pricing, suggesting a more constrained role for a market mechanism in reducing the cost of emissions reductions. Other sectors, such as cement and aluminum, have a much higher degree of private ownership, lower market concentration, and no administrative pricing in product markets.

The analysis here points to a trade-off at the core of ETS design in China: the firms most likely to comply may operate in the least market-oriented settings. To establish an integrated and cost-effective market, it will be important to address potential barriers to participation and compliance in the domestic private sector, while increasingly exposing state-controlled firms to market forces. Arguably, achieving the first goal will be more important to ETS effectiveness, given the scale of China's private sector. However, starting with the electric power sector, with its high share of state-controlled firms, may be a promising way to demonstrate program effectiveness, even if limited trading occurs. Given the unprecedented size and ambition inherent in any effort to build a comprehensive ETS in China, a gradual, adaptive approach to learning what works best in the country's unique institutional environment may hold the greatest promise for success in the long term.

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