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Does Carbon Pricing Affect Firm Level Carbon Dioxide Emissions?

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It is now almost 30 years since Sweden introduced a carbon tax (1991). We assemble a unique and comprehensive dataset and track manufacturing firm-level carbon dioxide (CO2) emissions since 1990. Based on this firm population, we test how carbon pricing (carbon taxation and the EU emission trading system, EU ETS) affects firm-level CO2 emissions abatement.

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We begin by describing how carbon pricing works and how CO2 emissions are distributed across the Swedish manufacturing sector. We then document that the ten percent most carbon-intensive sectors account for the vast majority of CO2 emissions originating from manufacturing.

Next, we compute the marginal cost of emitting CO2 for each firm and year. In our statistical analysis, spanning 26 years and including about 4,000 manufacturing firms, we document a statistically robust and economically meaningful inverse relationship between CO2 emissions and the marginal carbon tax rate. Using our preferred method, we estimate that a one-percent increase in the marginal cost of emitting CO2 is associated with a decrease in firm carbon intensity (CO2 emissions relative to output) of 3.4 percent.

Finally, we show that aggregate Swedish manufacturing CO2 emissions have decreased by about 31 percent since 1990. About one third of this decrease can be attributed to a changing composition of the manufacturing sector toward less CO2-emitting subsectors. The remaining part, about two thirds, is due to technological change enabling manufacturing firms to produce a certain amount of output at a lower CO2 intensity than what was possible in 1990.

The introduction of the Swedish carbon tax during the period before the EU ETS (1990–2004) created a situation in which firms with higher CO2 emissions faced a lower marginal cost of emitting CO2. (It was only during the period of 1993–1996 that CO2 emissions were uniformly taxed regardless of the identity of the emitter.) Consequently, during most of the time before the introduction of the EU ETS, the incentive to transition away from fossil fuels has been lower for firms where a reduction in CO2 emissions is the most crucial from a perspective of climate change mitigation.

During the same time period, these firms have paid significant amounts of carbon taxes, with an average tax payment of six percent of earnings before interest and taxes (EBIT). The exemptions and ceilings capping the amount of carbon taxes paid were likely necessary for these firms to survive foreign competition. However, the introduction of the Swedish carbon tax led to a situation in which the average tax rate of CO2 emissions was higher than the marginal tax rate. In other words, this resulted in a scenario in which firms with high CO2 emissions faced a significant increase in costs (due to high average carbon tax rates). At the same time, however, the incentives to lower these costs through CO2 emissions abatement were low, since the magnitude of their CO2 emissions far exceeded the thresholds to qualify for exemptions.

Since 2011, when the installations regulated under EU ETS were phased out of the Swedish carbon tax, the largest CO2 emitters are instead regulated under EU ETS. The average tax rate in the EU ETS is close to zero but the marginal cost of emitting CO2 is relatively high (depends on the market price of emission allowances). The exemptions in the Swedish carbon tax system were removed in 2015, which means that the average and marginal cost of CO2 emissions is now the same.

We argue that the results from our study offer important insights in terms of how an effective (and hopefully global) carbon tax should be designed. The crucial factor is not the size of the average tax payments, since they have a limited incentivizing effect on CO2 emissions abatement. What matters for whether or not a climate change mitigating project is profitable for the firm is rather the marginal tax rate. A more efficient carbon tax rate with the same marginal cost of emitting CO2 for all firms in combination with, for instance, a reduction of other non-climate-related taxes (green tax shifting) in order to maintain firm competitiveness would likely lead to a more rapid transition toward a climate-neutral and competitive Swedish manufacturing sector.