

HOW DO FIRMS RESPOND TO A RISING CARBON TAX? THE SWISS EXPERIENCE

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Overview

In this paper we examine how firms in Switzerland respond to the introduction of an increasing carbon tax. The literature on carbon taxes argues that tax rates have often been too low to have a significant impact on consumption patterns, that they have not been adjusted over time or that effects may have been lost in the “noise” of fossil fuel price changes (Hautes et al, 2018). We address all those issues in this paper as the Swiss context offers a unique opportunity to observe the reaction of firms to a carbon tax that increased by 400% between 2008 -2015 and which is today one of the highest in the world. The Swiss carbon tax can be classified as a hybrid-instrument combining quantity and price instruments as it is based on the standard-price approach developed by Baumol and Oates (1971). The initial level of the carbon tax was set at 12 Swiss Francs per ton of CO₂ emissions in 2008 and it was automatically raised as long politically defined emissions levels were not reached. In 2010 it was set at 36 CHF, in 2014 to 60 CHF, in 2016 to 84 CHF and lately, it was further increased to a level of 96 CHF in 2018 (see Table 1).

The following three research questions are addressed in this paper:

- How did firms reduce emissions (if any)?
- Did more heavily taxed firms due to a more carbon-intensive energy mix in the pre-policy period react more strongly on the carbon tax?
- Did the tax or the net fuel price changes effect the behaviour of firms?

Years	Tax	Light oil	Natural gas
	CHF/t CO ₂	CHF/TJ	CHF/TJ
2008-09	12	885	673
2010-2013	36	2654	2020
2014-2016	60	4423	3366

Table 1: Tax burden by type of fossil fuel

Methods

We use firm-level data from the Swiss Federal Office of Energy for the years 2001-2015. The data set offers detailed information on firm’s annual energy consumption and emission levels, as well as a series of firm characteristics including the number of employees, sector affiliation and floor size. We exclude firms from our analysis which are active in the (i) cement industry, as the sector is exempted from the CO₂ levy and (ii) firms which are only one year in the sample. Applying the described sample restrictions leaves us with an unbalanced panel of 44'909 observations from 10'290 firms active in the industry (52.5%) and service sector (47.5%) between 2001-2015.

Our empirical strategy is three-fold in order to address the three different research questions: In a first step, we estimate the effect of the carbon tax while accounting for a series of time-varying firm characteristics, business cycle indicators, energy prices, time-invariant unobserved firm heterogeneity and time trends to absorb technological and other policy interventions. In a second step, we approach the question whether firms with a more carbon- intensive fossil fuel mix respond more strongly to the carbon tax than firms exposed to a smaller tax burden. To this end, we estimate a series of difference-in-difference specifications. In a third step, we confirm the importance of the carbon tax effect by providing tax elasticity estimates of emissions.

Results

Our results show that the carbon tax led to a cumulative reduction in the energy consumption by about 4-6% for the average firm in the post-policy period. In addition, our estimates indicate significant reductions in CO₂ emissions as a response to the tax: In particular, we find that the typical firm reduced emissions by about 2% upon introduction of the tax in the first policy period (2008-2009). With the subsequent increase in the tax, the effect increased to reductions between 3-6% in the second post- policy period (2010-2012) and up to 12-15% in the third post-policy period (2013-2015) relative to the pre-policy years. Given that the average pre-policy emission level was at approximately 610 tons of CO₂, the estimated policy effects are sizeable and imply cumulative reductions in the magnitude of about 70-90 tons of CO₂ for the average firm in the sample.

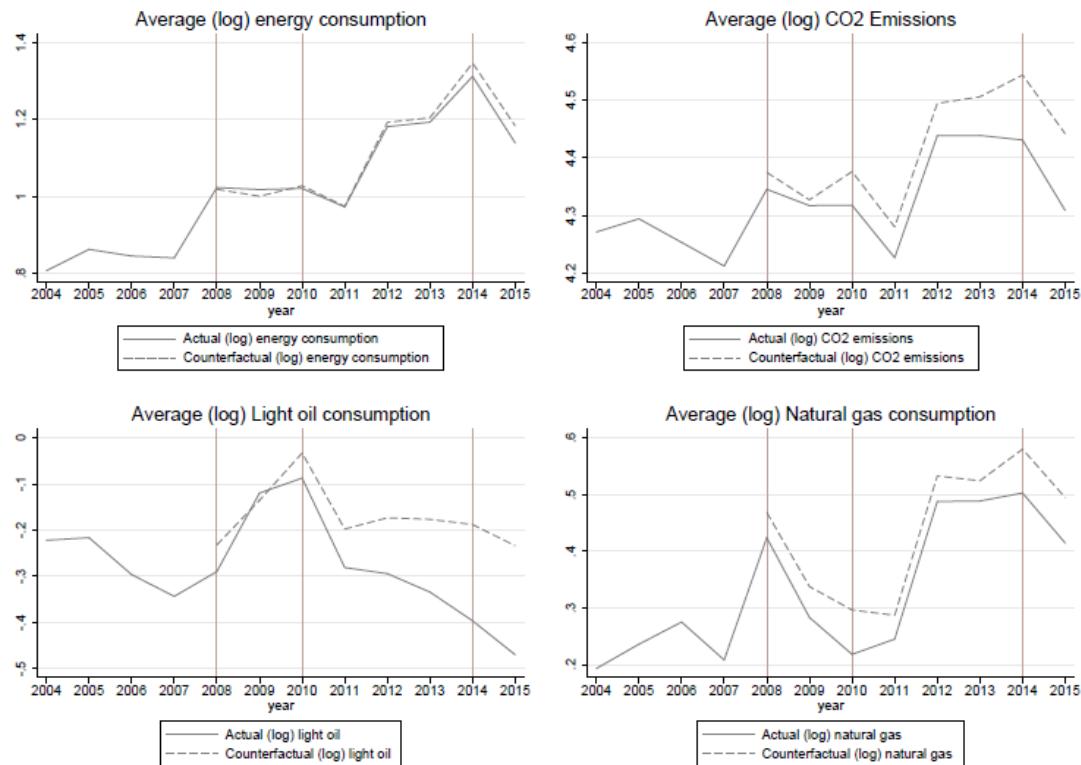


Figure 2: Counterfactual developments

Conclusions

Based on our empirical analysis we can answer the three main research questions. First, the Swiss carbon tax reduced CO₂ emissions and this decrease was mostly achieved by significant reductions in the consumption of both light oil and natural gas (Figure 2). There is heterogeneity in how emission reductions were realized across sectors: while we observe reductions in fuel consumption in both the industry and service sector, we additionally find extensive margin responses as firms in the industry sector increasingly switched to natural gas as a less carbon-intensive alternative. Second, we find that these emission reductions are driven by intensive and extensive margin adjustments primarily achieved by more heavily taxed firms with a comparably more carbon-intensive energy mix and by firms with above subsector-median emission levels prior to the policy change. Third, our analysis reveals that firms in both sectors hardly respond to changes in the net price of fossil fuels. Instead, they react to the tax itself: we estimate tax elasticities for light oil consumption between -0.1 and -0.23 and -0.17 for natural gas, the latter being mainly driven by firms in the service sector.

References

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