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Carbon Pricing in Switzerland: A Fusion of Taxes, Command-and-Control, and Permit Markets

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Like other European Nations, Switzerland has signed the Kyoto Protocol and the Paris Agreement. Not being part of the European Union, however, it has pursued a different approach to climate policy than the rest of Europe. The cornerstone of Swiss climate policy is carbon pricing, but this comes in three versions that involve different actors and carry different price tags. In addition, a number of support schemes are in place, e.g., for the development of renewables and insulation of buildings. In this article, however, we focus on Swiss carbon pricing.

Switzerland has one of the highest carbon taxes in place worldwide. Currently, this tax is CHF 96 per ton of CO_2 equivalent.[1] The tax is levied on fossil fuels as they cross the Swiss border. However, there are important exemptions. Importantly, the tax applies to combustion fuels but not to transportation fuels. There are ongoing discussions in the Swiss parliament about extending carbon pricing to the transport sector, which is responsible for a third of total greenhouse gas emissions in Switzerland, and which is the only sector where emissions have remained constant (FOEN 2020).

With the aim of protecting the interests of energy-intensive firms, the Swiss government has introduced two programs that allow firms to be exempt from the CO_2 tax. The first was established in 2008 and can be described as a collaborative command-and-control instrument coupled with an abatement subsidy. To join the program, firms in energy-intensive industries subject themselves to a set of specific abatement measures and emissions targets that are developed in cooperation with energy experts. If a firm's emissions are below its target in a given year, it can sell the difference as "over-abatement" for a fixed fee. This program is known as "nonEHS"[2] and currently includes around 1,200 firms.

The second exemption program is an emissions trading scheme, which was introduced in 2013 and currently includes 53 plants. The system is called CH EHS and has been designed to link it with the European Union's Emissions Trading Scheme (EU ETS). Due to lengthy political negotiations, the linking of the systems was delayed for several years, but it finally took place on January 1, 2020.

In this article, we describe the three competing carbon pricing programs that co-exist in Switzerland and the limited information that is available about their effects on emissions. We furthermore provide preliminary results about the relati ve effectiveness of the CH EHS and nonEHS programs based on our ongoing work.

THE CO_2 TAX

Swiss climate policy is based on the Federal Act on the Reduction of CO_2 Emissions ("CO_2 Act"),[3] which has been updated several times since its inception in 2000. Originally, the CO_2 Act focused on meeting the Kyoto Protocol commitment of overall GHG emissions reductions of eight percent during the 2008–2012 period, relative to the 1990 baseline. There have been a number of updates to the CO_2 Act, and it is currently in the process of revision to shape climate policy after the year 2020. The agency in charge of implementing the CO_2 Act is the Swiss Federal Office for the Environment (FOEN). For additional scientific and political background related to Swiss climate policy, see Brönnimann et al. (2014).

Figure 1 shows the sectoral distribution of GHG emissions in the EU and in Switzerland. This difference in the emissions portfolio is important for understanding the diverging approaches to climate policy. Emission trading schemes are well suited for large, stationary emission sources such as power plants. Because Switzerland has only few installations that are large enough to be in-

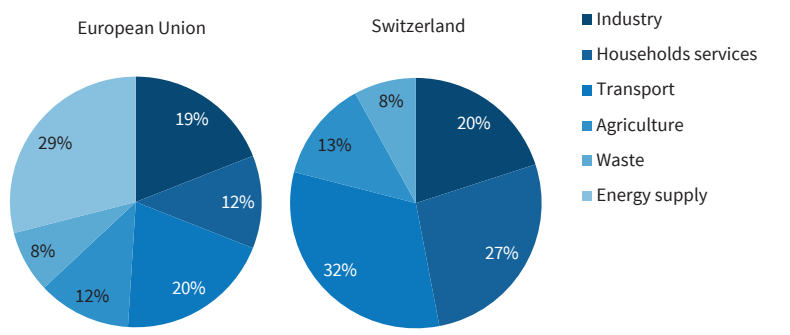
[1] At the time of writing, the Swiss Franc (CHF) is close to par with the US Dollar (1 CHF = 1.03 USD).

[2] EHS is the German acronym for Emissionshandelssystem, or emissions trading system. The system is called nonEHS to differentiate it from the CH EHS.

[3] This is known as the "CO_2 Gesetz" (SR 641.71). For more information, see https://www.admin.ch/opc/de/classified-compilation/20091310/index.html.

Figure 1

Sectoral Emissions in the EU and Switzerland



Source: Swiss Federal Office for the Environment; European Environment Agency.

Table 1

Fuel Prices and CO_2-Related Surcharges

		Unit	2008	2009	2012	2014	2016	2018
CO_2 tax		(CHF/tCO_2)	12	24	36	60	84	96
Heating oil EL	Market price	(CHF/kg)	0.990	0.560	0.894	0.766	0.385	0.612
	Surcharge	(CHF/kg)	0.038	0.076	0.114	0.190	0.265	0.303
Natural gas	Market price	(CHF/kg)	0.519	0.240	0.394	0.334	0.201	0.347
	Surcharge	(CHF/kg)	0.032	0.064	0.096	0.160	0.224	0.256
Hard coal	Market price	(CHF/kg)	0.158	0.076	0.087	0.069	0.058	0.090
	Surcharge	(CHF/kg)	0.028	0.057	0.085	0.142	0.198	0.227
Propane	Market price	(CHF/kg)	0.836	0.510	0.811	0.617	0.286	0.532
	Surcharge	(CHF/kg)	0.036	0.072	0.108	0.179	0.251	0.287

Note: The market prices reflect international exchange prices and do not include the Swiss CO_2 tax.

Source: Prices from Thomson Reuters Datastream (Heating oil: Gasoil 0.2% sulphur FoB ARA; Coal: API2 Cif ARA; Gas: TTF; Propane: North Sea NWE FoB). Surcharge computed based on emission factors from FOEN.

cluded in an ETS, its main climate policy instrument is the CO_2 tax.

The CO_2 tax on fossil heating and process fuels was introduced in 2008. It is collected by the Federal Customs Administration at the border crossing (there are no fossil fuels produced in Switzerland). Two-thirds of the collected revenue is redistributed to households (on a per capita basis) and to firms (in proportion to their payroll). The remainder is used to pay for a building energy efficiency program and a technology fund. The tax was introduced at a level of CHF 12 per ton of CO_2, along with a set of interim abatement targets. Compliance with these targets is assessed periodically, and non-attainment triggers an automatic increase in the CO_2 tax in multiples of CHF 12 per ton of emissions. Table 1 shows the tax rate evolution, along with the prices for some of the most important fossil fuels.

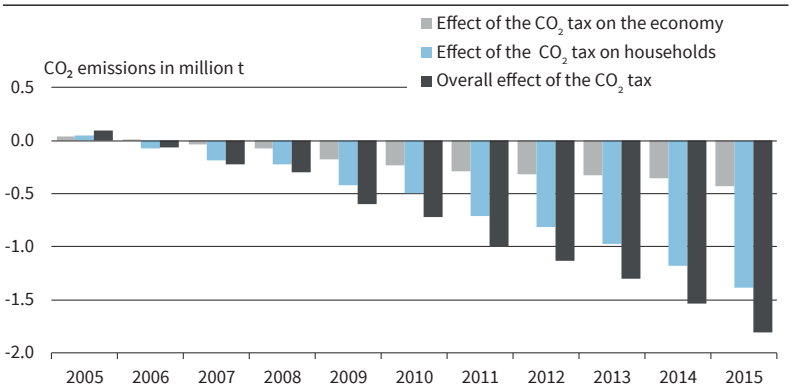
It is difficult to measure the effectiveness of the CO_2 tax. Since everyone is affected either by the levy or one of the two exemption programs, no control group exists that could provide a credible counterfactual. Furthermore, the fuel use of firms and households subject to the tax is only recorded on aggregate because the levy is imposed at the border and simply becomes part of the total price. Individual quantities of fuel use are recorded only for firms that are exempt from the tax.

The most recent quantitative analysis of the effect of Swiss CO_2 tax on emissions is by Ecoplan (2017). This study estimates the effect of the CO_2 tax on firms and households by means of a time series analysis. The authors conclude that from 2008 to 2015, the tax led to a reduction of 6.9 million tons of CO_2, which corresponds to 4.4 percent of the relevant combustion emissions during that period. Figure 2 shows the emissions reductions based this model. The estimated effect of the tax increased over time. In 2015, the reduction was computed as 1.8 million tons, corresponding to just over 10 percent of the relevant emissions. About two-thirds of the reduction is due to households, whereas the remainder originates from firms that are not exempt from the tax.

These results rely on the assumption that the time trend (capturing demographic changes, technological progress, etc.) before the introduction of the tax also applies to the period after 2008, and that no important drivers of emissions are included. Both assumptions are essentially not testable. For example, if issues related to climate change became more salient during the Kyoto period of 2008–2015, then the trend in the absence of the tax may have steepened, which would lead to an overestimate of the effect. If, on the other hand, unobservable variables (such as a shift in demand unrelated to the tax) led to a relative increase in emissions, then the effect of the tax would be understated. At any rate, the tax appears to have an effect, whatever its exact size, and this effect increases as the tax is adjusted upwards.

Figure 2

Emission Reductions as Computed by Ecoplan



Notes: The solid line shows the results obtained by the time series analysis, and the dashed line those from the CGE model. The vertical axis measures the reduction in CO_2 emissions in million tons.

Source: Ecoplan (2017) in collaboration with EPFL and FHNW.

THE CH EHS

The Swiss Emissions Trading Scheme (CH EHS) was introduced in 2013. By 2018, it included 53 plants that together emitted 4.577 million tons of CO_2 (FOEN 2019a). According to the Swiss Greenhouse Gas Inventory (FOEN 2020), this accounts for 27 percent of the emissions from combustion that are subject to the CO_2 Act and for 13 percent of total emissions in Switzerland. By sector, the largest emitters are cement plants, followed by plants in the chemical, refining, district heat, metal, and paper sectors. The majority are mandatorily included in the CH EHS, whereas four additional plants have opted into the system.[4] More details about the CH EHS are provided by FOEN (2018a). In what appears to be a design flaw, CH EHS firms received some of the redistributed revenue from the CO_2 tax (along with households and small firms), despite being exempt from it (EFK 2017).

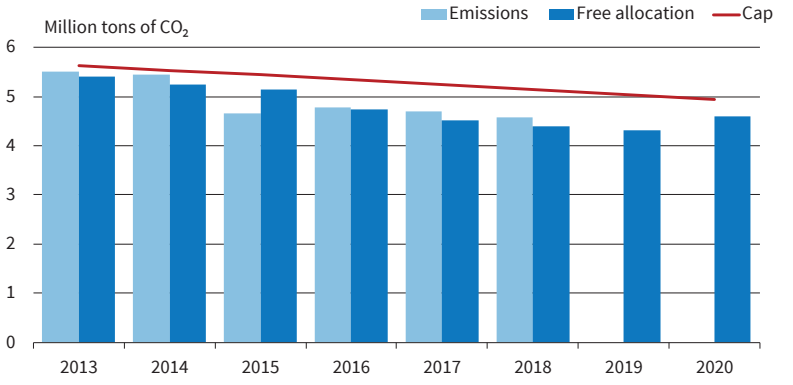
The cap is set relative to the Kyoto period and reduced by an annual factor of 1.74 percent (this corresponds to the reduction rate in the EU ETS). EHS firms receive most of their emission allowances allocated for free. The distribution of free allowances across sectors is guided by harmonized allocation rules based on the benchmarks of emissions performance. Five percent of the annual cap is retained as a reserve for new entrants, whereas the remaining 95 percent is distributed at no cost. Plant closures lead to an adjustment of free allocation but not of the total cap, as these allowances are added to the reserve. Any unused allowance reserve is auctioned in the following year. Figure 3 shows the cap, free allocation, and emissions in the CH EHS.

As no secondary allowance market has emerged in Switzerland, the clearing prices from the biannual auctions are the only price signal available in the CH EHS. The auction prices are shown in Figure 4, along with the price of EU allowances. Despite the planned linking of the two systems, the price in the CH EHS does not closely track the price in the EU ETS for much of the sample period. A likely reason for this is the absence of a secondary market, making it difficult for financial intermediaries to exploit arbitrage opportunities between the Swiss and European carbon prices. Firms in the CH EHS were allowed to cover some of their emissions using international offsets, which further contributed to the system's over-allocation and to the low auction prices. The recent increase in the allowance price is most likely due to the reforms in the CH EHS and the linking that took place in January of this year. Despite the over-allocation and the low financial incentives to abate, however, emissions in the CH EHS did decrease over time, as can be seen in Figure 3. In 2018, the total emissions within the CH EHS were 17 percent lower than in 2013. A part of this decrease may have been due to the fact that many of the included firms face additional command-and-control measures at the cantonal level.

[4] These are plants owned by firms that also have other plants in the CH EHS.

Figure 3

Cap, Emission and Free Allocation in the CH EHS



Information about the cap available at https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/climate-policy/emissions-trading/swiss-emissions-trading-scheme--ets-.html.

Source: FOEN (2019a).

THE NONEHS PROGRAM

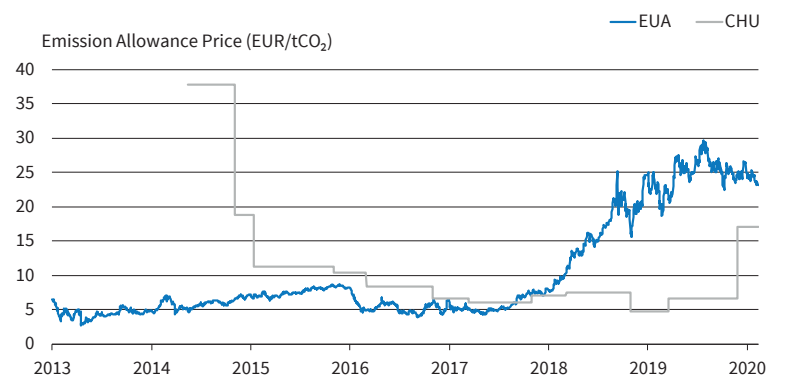
There are three conditions a firm must meet in order to be eligible for the nonEHS program: First, it must belong to a pre-defined set of energy-intensive industries. Second, its emissions must not be too large, as otherwise it would be included in the CH EHS (see above). And third, its emissions must not be too low. More specifically, if a firm has a sufficiently large installed heat capacity or emits at least 100 tons of CO_2 per year, it can apply for an exemption from the CO_2 tax.[5] The process of exemption from the CO_2 tax is shown in Figure 5.

There are two subtypes of the nonEHS program. In the first, firms agree to subject themselves to a particular set of abatement measures, whereas in the second, they additionally agree to specific emissions targets. Both the abatement measures and the emission targets are developed in close cooperation with energy experts from the Energy Agency of the Swiss Private Sector (EnAW) and the Cleantech Agency Switzerland (act). The proposed measures and targets are then submitted for approval to FOEN. Only the abatement measures and emission paths that are deemed "economically viable" are included in the agreement, thus ensuring that firms are not forced to engage in very costly

[5] This inclusion threshold is currently being revised. According to the most recent proposal by the Swiss senate, firms are eligible to join the nonEHS program if their CO_2 tax expenditure exceeded CHF 10,000 in the previous year. As the CO_2 tax increases, this means that the inclusion threshold in terms of emissions is lowered.

Figure 4

Allowance Prices in the CH EHS and the EU ETS, 2013–2020



Note: The EUA prices are daily, whereas the CHU prices only change in bi-annual auctions. The conversion rate is 0.94.

Source Bundesamt für Umwelt (2020).

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abatement measures.[6] In 2018, the number of firms in the nonEHS program was 659, of which 505 had explicit emission goals, whereas the remaining 154 firms were subject to specific abatement measures (FOEN 2019b).

Firms are legally required to carry out the agreed measures and to reach their emission targets in order to be exempt from the CO_2 tax. The nonEHS program is therefore a firm-specific command-and-control approach. Such an approach could, in theory, perform as well as a market-based measure in terms of aggregate abatement costs, and even outperform it if the process of defining the abatement measures informs firms about their available options. On the other hand, developing firm-specific measures and targets can be costly. Since firms pay for the services provided by EnAW and act, the costs to the government accrue in the form of lost revenue from the CO_2 tax. Table 2 shows emissions and the foregone tax revenue by year. Through 2018, the total loss in tax revenue was CHF 1,017 million.

In addition to the foregone tax revenue, the government actively subsidizes firms to over-comply. If participants in the nonEHS program reduce their emissions by more than what is mandated in their agreement, they can sell the surplus in the form of certificates to a government-owned fund. The rate at which the certificates were purchased ranged between CHF 40 and CHF 100 during the first five years of the program but has been fixed at CHF 100 since 2013.[7] Through 2018, the total amount of over-compliance was 3.8 million tons of CO_2, which corresponded to a total subsidy payment of CHF 296 million (column 5–6 in Table 2). In addition to the foregone revenue and the subsidy costs, the nonEHS also has administrative costs as FOEN regularly needs to monitor and verify compliance of all participating firms (Rütter soceco 2016).

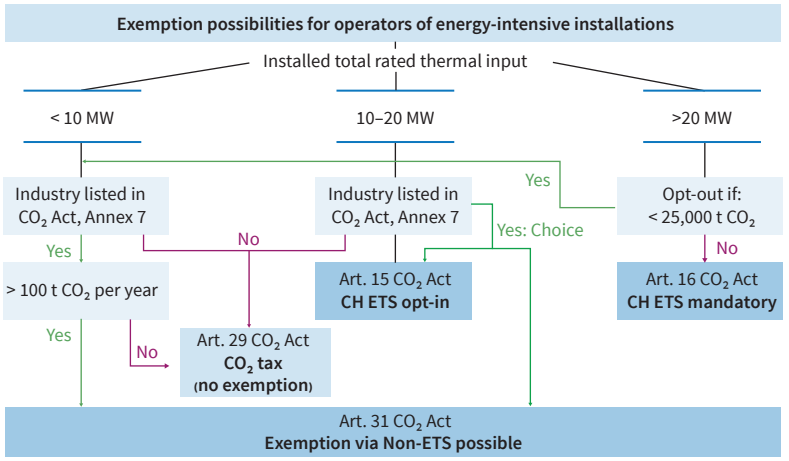
The effectiveness of the nonEHS program in terms of emissions reductions is difficult to assess, both in absolute terms (as there is no untreated control group) and relative to non-exempt firms (as no emissions information is available for the latter). To obtain indicative results, we can refer to two sources. The first is a report commissioned by FOEN (TEP Energy 2016), which surveyed firms subject to the tax or one of the exemption mechanisms with respect to climate-relevant decision-making. Exempt firms reported that they carried out more measures for emissions reductions than firms paying the tax. However, large firms and firms with a high emission intensity were more likely to both seek exemption and to engage in significant abatement measures. This self-selection of "motivated" firms into the nonEHS program means that we cannot assign a causal interpretation to these results.

Second, we can focus on engineering estimates pro-

[6] For production and processing facilities, a measure is deemed economically viable if the investment pays for itself within four years, based on the investment cost and the energy prices, including the CO_2 tax. For investments in building insulation and heating equipment, the required payback-period is eight years (FOEN 2018b, p. 80).

Figure 5

Exemption Possibilities for the Swiss CO_2 Tax



Source: Translated from the Swiss Federal Office for the Environment: https://www.bafu.admin.ch/bafu/de/home/themen/klima/fachinformationen/klimapolitik/co2-abgabe/befreiung-von-der-co2-abgabe-fuer-unternehmen.html

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[7] If firms exceed their emissions goal, they can cover up to eight percent of their emissions using international offsets (FOEN 2018b). No firm in the program emitted in excess of 108 percent of their emission target.

Table 2

Emissions, Lost Tax Revenue, and the Value of Subsidies Paid to nonEHS Firms

Year	Emissions ($Mt\ CO_2$)	Tax (CHF/tCO_2)	Revenue loss (Million CHF)	Offset amount ($Mt\ CO_2$)	Offset value (Million CHF)	Government cost (Million CHF)
2008	2.95	12	35.4			
2009	2.70	24	64.7			
2010	2.89	24	69.4			
2011	2.77	24	66.6			
2012	2.69	36	96.7			
2013	1.57	36	56.7			
2014	1.49	60	89.3			
2015	1.62	60	97.4			
2016	1.65	84	138.9			
2017	1.67	84	140.7			
2018	1.68	96	161.4			
2008-2012	14.0		332.7	3.1	220.7	553.5
2013-2018	9.7		684.3	0.8	75.4	759.7
Total	23.7		1'017.1	3.8	296.1	1'313.2

Notes: The offset amount and value is only available by compliance period, not for individual years.

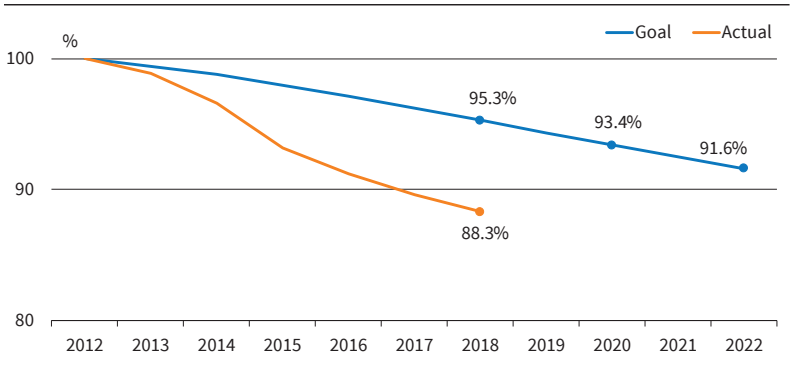
Source: Authors' calculations.

vided by EnAW (2019) that are the basis for determining the abatement measures and emissions goals. Figure 6 shows the target emissions path for nonEHS firms (blue line) and their actual emissions (yellow line), both indexed to 2012. This graph suggests that the nonEHS program was responsible for an emissions reduction of 11.7 percent between 2012 and 2018. However, it is not clear that the engineering estimates appropriately reflect the emissions in the absence of the nonEHS program, because some the abatement measures would probably also have been carried out if firms were subject to the CO_2 tax or in the course of general technical change. For example, the installation of LED lights is the most frequent abatement measure agreed to by firms, but LED lighting is becoming ubiquitous. In general, it is not clear that the agreed measures are additional in the sense they would not have happened if firms had to pay the tax. After all, implementing these measures would currently reward non-exempt firms by CHF 96 per ton of emissions, and this value is set to further increase in the future. For this reason, not all of the emissions reductions implied by the EnAW model can be interpreted as the effect of the nonEHS program per se.

Figure 6

Reduction Goals and Over-Compliance in nonEHS

CO_2-Intensity



Source: ENAW (2019).

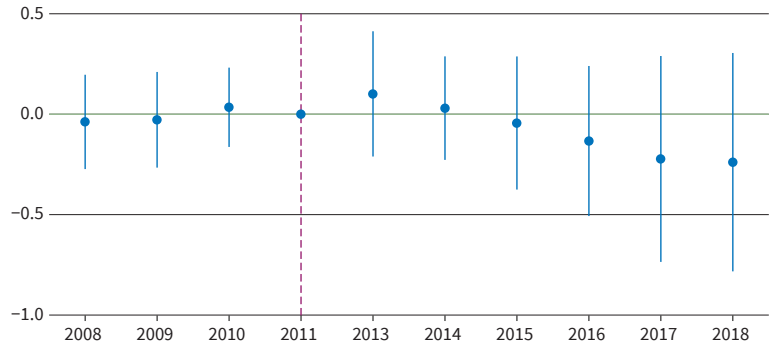
THE DIFFERENTIAL IMPACT OF THE EHS VS. NONEHS PROGRAMS

As mentioned above, it is impossible to cleanly identify the effect of either the tax or one of the exemption programs due to data availability. What is feasible, however, is to compare the effect of the EHS vs. nonEHS programs on emissions. In an ongoing and yet unpublished study, we focus on firms that were part of the nonEHS program in 2008–2012. A subset of these firms was transferred to the CH EHS in 2013, whereas the others remained in the nonEHS program. This allows for the identification of the differential effect of these programs using a "difference-in-differences" framework. Because nonEHS firms receive CHF 100 for every ton of CO_2 that they abate, whereas EHS firms obtain only the value of an allowance (which is much less), we expect nonEHS firms to engage in a greater effort to abate emissions than EHS firms. To ensure comparability across years, we focus only on emissions that were regulated throughout the sample period.[8]

[8] We restrict the emissions to "regular" fossil fuels. In contrast, process emissions have been regulated only since 2013, along with emissions associated with process heat and waste.

Figure 7

Differential Treatment Effect on Emissions (EHS vs. nonEHS)



Note: To generate this figure, we regressed the log of firm emissions on a set of firm fixed effects, year fixed effects, and year by treatment interaction dummies. The points in the graph show the coefficient estimates on these interaction dummies. The year 2012 was removed due to anticipation effects. The bars represent 95 percent confidence intervals.

Source: Hintermann and Zarkovic (2020). © ifo Institute

Figure 7 shows the differential treatment effect on emissions (EHS minus nonEHS) by year. Although we do find a positive coefficient (i.e., a lower abatement effort) for a subsample of EHS firms, the average effect for the full sample is close to zero and not statistically significant. The results suggest that the nonEHS program may be no more effective than a regular EHS in terms of reducing emissions. However, we stress that this is work in progress.

DISCUSSION

Switzerland exempts firms in energy-intensive sectors from paying the carbon tax with the argument of protecting their competitiveness and thus saving domestic jobs. Whereas the introduction of the CH EHS is consistent with EU climate policy, the tax and the nonEHS program are special to Switzerland. This program benefits firms in two ways: (i) They do not have to pay the CO_2 tax, and (ii) they receive a subsidy for reducing their emissions below an emissions target that was not particularly stringent. It is thus not surprising that industry representatives favor this program and would like to see a reduction in the threshold to join, but it is also clear that the nonEHS program imposes significant costs on society. Between 2008 and 2018, the monetary costs from the foregone revenue and the subsidy payments amounted to CHF 1.3 billion, and additional costs accrue every year in the form of monitoring and compliance. These costs have to be compared to the benefits of the program.

Whereas firms in the nonEHS program indeed reduced their emissions, the available empirical evidence does not imply that the program per se was more effective in terms of abating emissions than the CH EHS or the tax. This is not surprising from an economics point of view as the opportunity costs of emitting CO_2 are identical for a tax and a subsidy of equal size: If a firm in the nonEHS reduces emissions by one ton, it receives the subsidy. If a firm subject to the tax reduces emissions by the same amount, it saves the tax. The marginal incentive to reduce emissions is therefore the same, so it is not clear why the nonEHS program would be expected to perform better in terms of emission reductions. Whether it has saved jobs is not obvious either given the high level of employment in Switzerland. In any case, we are not aware of any empirical work that investigates the employment effects of the nonEHS.

Proponents of the nonEHS argue that there is a value of informing firms about available abatement options and providing expertise (e.g., via agencies such as EnAW and act). We very much agree, but this expertise could also be provided without a tax exemption, because firms should be interested in reducing emissions to avoid paying the tax. By 2018, 266 firms had used the energy consulting services from EnAW to define voluntary emissions targets without becoming exempt from the tax (EnAW 2019). A different argument holds that firms pay more attention to money they can earn than to tax payments they can avoid. This is possible subject to some behavioral assumptions, but such a clear preference for realizing gains rather than avoiding losses should materialize in measurably greater emissions reductions by nonEHS firms relative to firms in the CH EHS. However, we do not find this to be the case in our ongoing work.

For these reasons, we argue that current proposals to reduce the inclusion threshold for the nonEHS program should be considered with caution. Exempting more firms from paying the tax not only adds to the regulatory cost, but it further concentrates the burden of climate policy on households and small firms in exchange for uncertain benefits. We believe that distributional concerns should be considered when fighting climate change and that energy-intensive firms are expected to share at least some of the cost of climate policy.

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