

Carbon pricing to fight climate change

A case study of France



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Introduction

This study presents the general framework of **carbon pricing as a climate change mitigation strategy**, making especial reference to the **case of France**, where the combination of different carbon pricing mechanisms prompted several conflicts, particularly arisen by these mechanisms leading to different carbon prices.

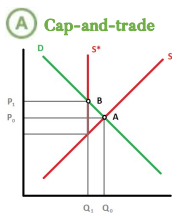
Our research will attempt to **econometrically** assess whether the introduction of these carbon pricing mechanisms in France has led to lowered emissions since their implementation.

But first, what is carbon pricing?

Carbon pricing consists fundamentally in putting a price on carbon emissions, to encourage their reduction and mitigate the effects of climate change. It encompasses two **different mechanisms** that allow to put that price on emissions:

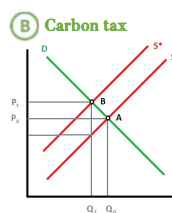
EMISSIONS TRADING

In emissions trading (cap-and-trade), authorities do not set a carbon price but a **cap** on the aggregate emissions level of a certain region. Emissions are auctioned in the form of allowances, that agents can **trade** in a market, which **determines the emissions price**. If demand remains unchanged, the unaccounted costs of emissions are internalised in the price (Figure A).



CARBON TAXATION

Carbon taxes are **levies** imposed generally on the burning of fossil fuels, aimed at reducing and eventually eliminating the use of these. The price of carbon-intensive goods and fossil fuels raise, causing consumption to decrease. Therefore, carbon emissions are also expected to decrease, but with **uncertainty on the extent** of the reduction (Figure B).



Data Analysis

France is a country that has adopted both emissions trading and carbon taxation as means to achieve a reduction in CO2 emissions, through the subjection of part of the French companies to the EU-ETS, and through the introduction of a carbon tax in France's tax mix addressing explicitly carbon emissions. Each of these will be analysed through two different econometric methods to assess on their effectivity within the French borders.

FRENCH COMPANIES IN THE EU-ETS

France, as a Member State, has some of its companies subject to the **EU-ETS**, the cap-and-trade emissions market created by the European Union, and has been pricing carbon for certain installations since its creation in 2005.

Our model took the **eight highest emitting French companies** for the **period 2008 – 2020**, and assessed, through a linear mixed model (LMM), whether its yearly verified emissions were correlated with the carbon market price. The model specification was as follows:

$$\log(\text{Emissions}) \sim b_0 + b_1 * \text{Price} + (1 | \text{Company})$$



CARBON TAXATION IN FRANCE

France implemented a **carbon tax** in the form of a carbon component on fossil fuels in 2014. Initially pricing carbon at 7 EUR/tonne of CO2, it has gradually been increased up to the current 44.6 EUR, frozen following the opposition from the Yellow Vests movement in autumn 2018.

Our model performed a regression analysis, assessing the trend on emissions for the **period 2010 – 2019**, for **total French emissions**, but also for **emissions in the road transport sector**, expected to be slightly more sensible, due to the effects of the carbon tax on the fuel price. The initial model specifications were as follows:

$$\log(\text{Emissions}) \sim b_0 + b_1 * \text{Price}$$

Yet, following the results, new models were designed, so the introduction of a **quadratic term** could be taken into account. The second model specifications were:

$$\log(\text{Emissions}) \sim b_0 + b_1 * \text{Price} + b_2 * \text{Price}^2$$

Results

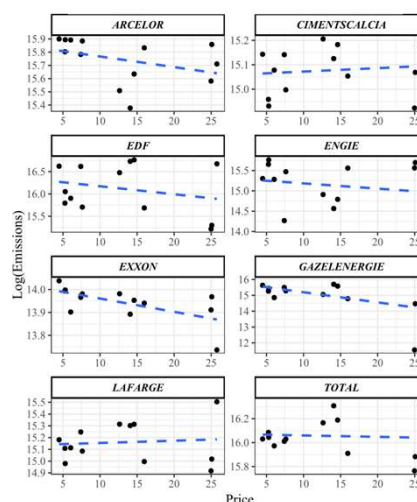
Each carbon pricing mechanism result has a different reading. However, both have pointed out the same: **the carbon price and the corresponding studied emissions were effectively inversely correlated**.

As for the results from the LMM that refer to the **French companies in the EU-ETS**, they showed that there was a significant inverse correlation between the EU-ETS carbon price, and the tonnes of CO2 emitted by these companies, for a significance level of 5% (Figure C).

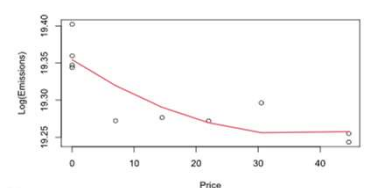
Regarding the **French carbon tax**, for total French emissions and emissions in the road transport sector, the results from the regression showed again that there were significant effects of the carbon component price on carbon emissions for both, for a significance level of 5%.

Nevertheless, the introduction of the **quadratic term** improved the model's adjusted R-squared, respective to the linear models (0.6544 versus 0.5933 for total French emissions, and 0.921 versus 0.7224 for road transport emissions), and it kept ratifying the inverse correlation between carbon emissions and the French carbon tax price (Figures D and E).

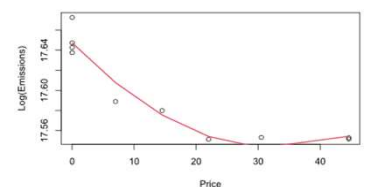
C Scatter plot and regression line between Price and log(Emissions) for each company



D Non-linear regression between the carbon tax price and the total emissions for the French economy (log transformation applied)



E Non-linear regression between the carbon tax price and the emissions from the French road transport sector (log transformation applied)



Conclusions



Carbon pricing is **essential** to allow the products in an economy to give a price signal on the carbon content, so that each economic agent capable of **making environmentally-sensible choices** to fight climate change.

As regards the **EU-ETS**, we have found that **there is a significant relationship, statistically talking, between emissions and price**. Yet, we cannot conclude that the price causes emissions to decrease, as the market price has been highly volatile, and allowances to companies have been initially granted for free. Thus, the **price signal** of the market carbon price is to no small extent questionable.

Regarding the price signal of the **French carbon tax**, it is clearer than in the EU-ETS, since the price was increased since its introduction in 2014, until 2018. However, aware of the **limitations** experienced in **number of observations**, future research down the line is advised, to fully assess the relationship.