Who really pays for EU Emission Trading System? The risk of shifting the tax burden from the firm to the final consumer

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Introduction

- The Emission Trading System is one of the main instruments of the EU's policy framework to reduce greenhouse emissions coming from intensive industries, in accordance with the Kyoto Protocol's targets, set in 1997.
- At the current date, more than 10.000 installations in the 27 Member States and more than one million allowances in circulation.
- Main features: emission cap and emission allowances, allocated for free or auctioned.
- "Cap and trade" principle

Introduction

From January 1st 2005, the EU-ETS has gone through different phases:

- Phase 1: 2005-2007. Number of installations to allocate on the national territory independently established by Member States. Most of the allowances given for free and based on historic emissions (grandfathering);
- Phase 2: 2008-2012. Emission cap lowered through the reduction by 6.5% of the number of emission allowances. Decreasing number of free allocations (slightly under 90%). Increasing penalties for non-compliance.
- Phase 3: 2013-2020. National caps replaced by a single EU-wide cap. Auctions as the principal method for the allowances allocation. More industrial sector and gases covered.
- Phase 4: 2021-2030. Revised in 2018, the European Commission established that by 2026 a full revision of the ETS Directive will be conducted. More industrial sector and gases covered.

Motivation

This paper aims to analyze the relationship between the net price of different fuels in the Italian market and EU emission allowances during phase 2, 3 and part of phase 4, taking into account each energy price as the dependent variable.

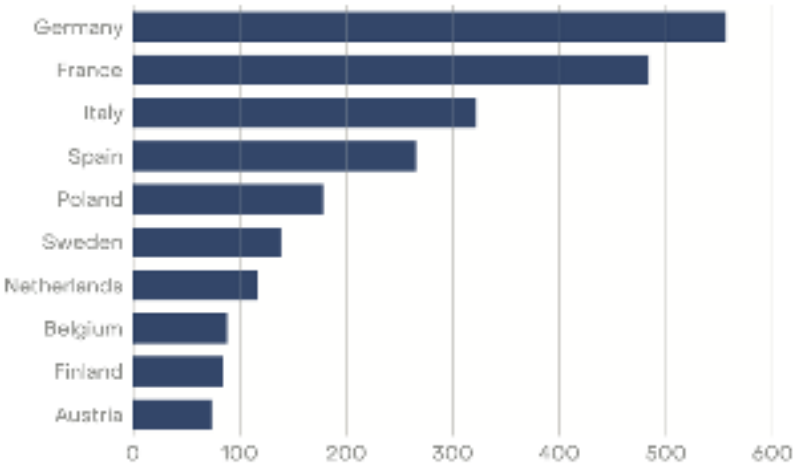
- Consider EU-ETS as a flexible tax regime
- Risk of shift of the tax burden
- Do consumers pay for firms' emissions?

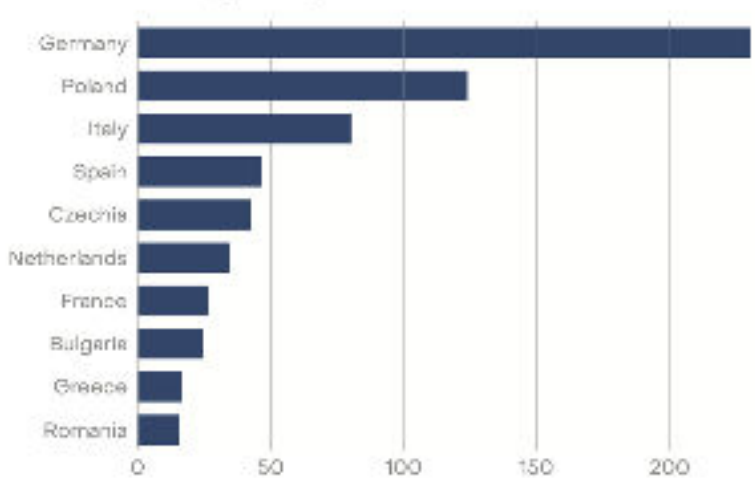
Motivation

Consequences of the shift of the tax burden:

- Redistributive impact on consumers (Gaarder, 2018)
- Inefficiency in the allocation of resources: deadweight loss
- Competitive implications for firms whose production function is highly dependent from the energy and transport sector: spill over effects (Oropallo, 2010)
- Reduction of the ETS impact on firms' emissions

Why the Italian market?





Source: European Electricity Review 2023, Ember Climate.

Literature Review

- J. H. Keppler and M. Mansanet-Bataller (2010): relation between the EU emission allowances and daily prices of electricity and gas during Phase I and part of Phase II;
- H. Fell (2010):impact of the EUA on the Nordic electricity market, estimating the relationship between spot EUA prices, spot electricity prices and the prices of different fuels in the Nordic region during Phase I;
- C. J. P. Freitas and P. P. da Silva. (2015): impact of the EU ETS on the electricity prices in Spain, proving the presence of a long-run cointegrating relationship between electricity price, carbon price and fuel prices during Phase II;
- M. Caporin, F. Fontini, and S. Segato (2021): relationship between electricity price, gas price and EUA price for the Italian market, to verify whether the EU ETS can be the main driver for the decarbonization of the power sector in Italy during Phase III.

Research Gap and Problem Statement

Most of the related literature investigated the relationship between energy prices and the EU ETS prices taking into account the latter as the dependent variable.

Moving from the work of Caporin et al., this work:

- Takes into account three phases of the EU ETS (Phases II-IV);
- Uses a different methodology (CCR);
- Investigates the presence of a cointegrating or causal relationship between the EUA and the energy prices of the Italian market.

Data

Dependent variables:

- Gasoline Net Price (GP)
- Heating Oil Net Price (HP)
- Diesel Net Price (DP)
- Brent Spot Price (BP)
- LPG Net Price (LPG)
- Heavy Fuel Net Price (HF)
- Residual Fuel Oil Net Price (RF)

Regressor:

- EU Emission Allowances (EUA)

Control Variables:

- €/$ Exchange Rate (ER)
- Total Inflation Rate in Italy (TI)
- Inflation rate related to the energy sector in Italy (EI)

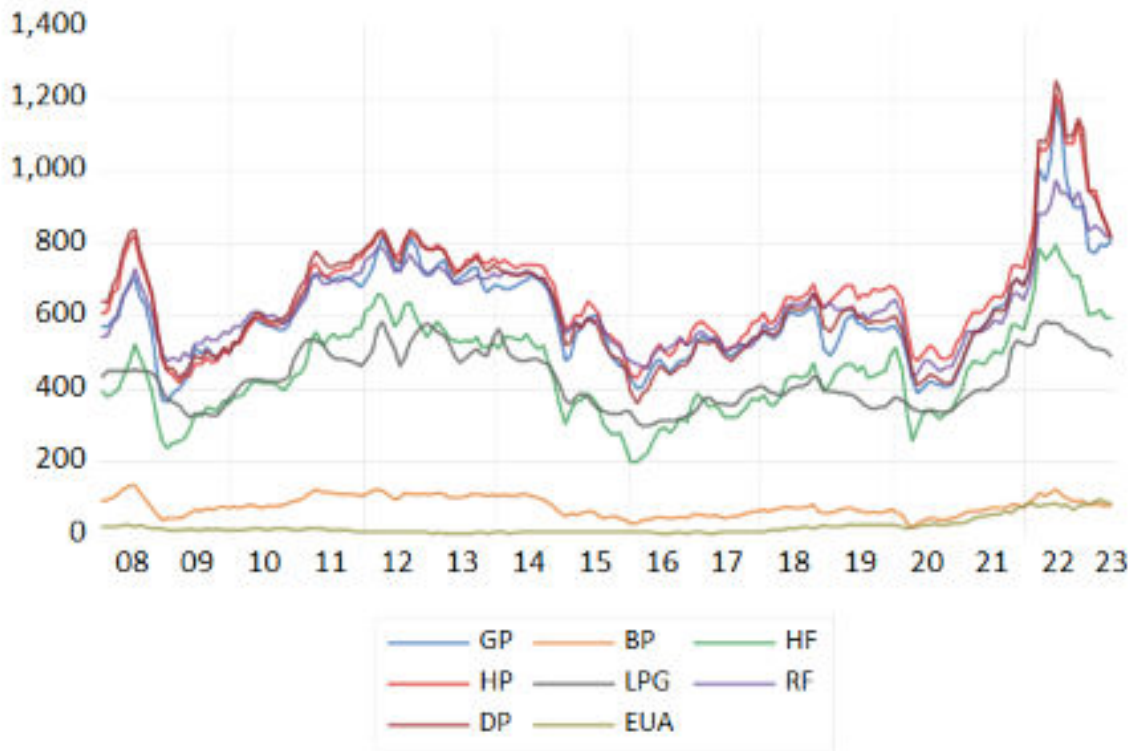
Data Sources

The following Open Data Sources have been used:

- Ministry of Environment and Energy Security
  - Gasoline Heating Oil, Diesel, LPG, Heavy Fuel, Residual Fuel
- SENDECO2
  - EU Emission Allowances
- Federal Reserve Economic Data (FRED)
  - Brent Price, Exchange Rate
- OECD
  - Inflation Rates

Data

- 184 monthly observations (January 2008 - April 2023)
- Non-stationary series
- 7 regressions estimated



Methodology

1. Unit Root Tests: DF-GLS and ERS
2. Gregory-Hansen Cointegration Test
3. Canonical Cointegrating Regression
4. Bootstrapped Quantile Regression
5. Pairwise Granger-Causality Test
6. Time varying LA-VAR Granger Causality Test

Empirical Results: Gregory-Hansen Cointegration Test

Variable	Constant	Constant and trend	Constant and slope	Constant, slope, and trend
GP	-4.27 (2010m4)	-5.70** (2015m10)	-5.95* (2016m9)	-6.92*** (2014m10)
HP	-3.91 (2011m4)	-5.12 (2015m10)	-4.87 (2016m9)	-5.97 (2015m4)
DP	-3.98 (2010m6)	-5.38* (2015m10)	-5.20 (2015m10)	-6.13 (2015m2)
BP	-4.92 (2010m6)	-5.80** (2016m11)	-5.74 (2014m12)	-7.99*** (2014m10)
LPG	-3.63 (2015m10)	-5.67** (2015m3)	-6.19** (2015m10)	-8.14*** (2014m11)
HF	-3.59 (2010m6)	-5.93** (2015m2)	-6.13** (2015m5)	-7.16*** (2014m10)
RF	-3.26 (2011m4)	-4.53 (2015m10)	-4.75 (2016m9)	-5.22 (2015m1)

Notes: Z_t statistics are reported. 5% CVs: -5.28; -5.57; -6.00; -6.32, respectively. Break dates are reported in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.10$.

- For four of the dependent variables (GP, BP, LPG, HF) there is cointegration with EUA and the control variables;
- Two recurrent periods for the structural breaks: 2010-2011 and 2014-2016;
- Financial crisis in 2008 and supply and demand shocks in the oil market in 2014.

Empirical Results: Canonical Cointegrating Regression

Variable	Coefficient	Robust Standard Errors
GP		
EUA	4.5186***	1.3842
TI	86.6183***	14.9975
EI	14.0257***	4.0373
BP		
EUA	0.3708	0.3309
TI	13.9896***	3.5716
EI	0.9476	1.1900
ER	301.5279***	99.7814
LPG		
EUA	3.6744***	0.8862
TI	72.7318***	10.9554
EI	10.6977***	2.9777
HF		
EUA	22.0679***	5.1219
TI	37.4367*	22.3856
EI	20.3255***	7.0779

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

- Positive relation of each dependent variable with EUA and the control variables;
- BP coefficient is not significant;
- In presence of a unit variation of the EU ETS allowances, gasoline net price, lpg net price and heavy fuel net price will grow by 4.512, 3.67 and 22.07 respectively.

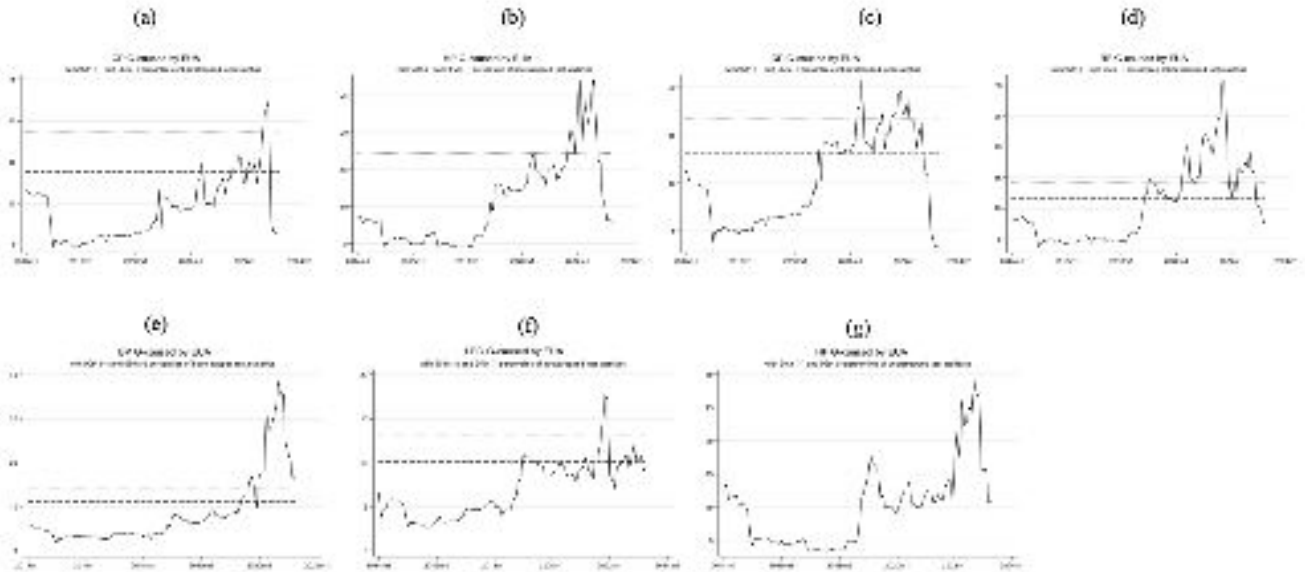
Empirical Results: Granger Pairwise Causality Test

Null Hypothesis	*F* Statistic	P-Value
GP ⇏ EUA	0.7046	0.4957
EUA ⇏ GP	3.5685**	0.0303
HP ⇏ EUA	3.2456**	0.0413
EUA ⇏ HP	6.7878***	0.0014
DP ⇏ EUA	2.6664*	0.0723
EUA ⇏ DP	2.5127*	0.0840
BP ⇏ EUA	0.8870	0.4137
EUA ⇏ BP	3.6847**	0.0271
LPG ⇏ EUA	4.3612**	0.0142
EUA ⇏ LPG	4.8365***	0.0090
HF ⇏ EUA	1.1028	0.3342
EUA ⇏ HF	5.5918***	0.0044
RF ⇏ EUA	1.0855	0.3400
EUA ⇏ RF	5.0005***	0.0077

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

- All the variables are Granger caused by EUA;
- Bidirectional Granger causality for HP, LPG and DP.

Empirical Results: Recursive Expandig Wald Test



Notes: authors' elaborations in STATA.

- Results lay between the 5% and 1% significance level only for the last part of the time series.
- 2018 - 2020: end of Phase III, when the auction mechanism has become the leading method for the allocation of the allowances.

Conclusions, policy implications and further extensions

- Presence of a significant positive and cointegrating relation with the EU ETS allowances for GP, LPG and HF;
- Presence of cointegration with EUA for GP, BP, LPG and HF;
- Positive and increasing effect of a change in EUA on GP, BP, HP, DP and RF along their distribution, while there is a positive but decreasing effect of a change in EUA on LPG along its distribution;
- EUA Granger causes all the dependent variables with at least a 5% significance level

The outcomes are consistent with the expected results. The presence of cointegrating relations and Granger causality between the variables may be validated: possible indicator of the risk of a shifting of the tax burden from the firm to the final consumer.

Thank you for your attention

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