**PASS-THROUGH OF CO2 EMISSION COSTS TO THE ITALIAN ELECTRICITY PRICE IN THE THIRD PHASE OF EU-ETS: A VECM ANALYSIS**

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## Overview

The CO2 Emission cost is a relevant component of the cost of producing electricity. Its cost can be allocated to power producers or passed through end consumers, depending on the rigidity of the load, the level of competitiveness of the market, the technology that generates power, the way costs are included into production functions. In Europe, Emission cost are endogenized in power production through the Emission Trading Scheme (EU-ETS). Several studies consider the pass-through of EU-ETS allowances’ prices on the electricity prices, focusing on the first two phases of the EU-ETS systems (See Sims et al., 2010, Huisman and Kilic, 2015, and references therein) and following either an ex-ante modelling approach or an ex-post empirical one. The latter is our focus. In particular, we measure the pass through of the third phase EU-ETS price in the Italian single national electricity price (Prezzo Unico Nazionale – PUN), which has not been studied yet.[[1]](#footnote-1) The Italian power sector is a gas dominated one with a large penetration of renewables. The natural gas fired plants are the marginal plats in most of the hours. Following Sijm et al. (2008) and Jouvet and Solier (2013) we identify Natural Gas as the marginal fuel for the Italian market in the third phase of the EU-ETS, Therefore, we take into account both natural gas prices and EU-ETS prices and try to establish if there is a long-run correlation between these two components and the electricity price. We do so by studying the long-run property of the time series and considering the impact that exogenous shocks on each of the three component has on the return to the long run equilibrium, providing the Impulse Response Function of each variable. By studying the impact that a change in price of each of the variable has on every other variable we can assess the causality order of the relationship between price changes.

## Methods

We use a Vector Error Correction Model to establish the degree of linear correlation among the logs of the three variables. In order to do so, we first show that the variables are nonstationary, and that they are cointegrated. Once cointegration has been detected we apply the VECM obtaining the following equation:

$∆logPun\_{t}=α\_{1}\left(β\_{1}logPun\_{t-1}-β\_{2}logGas\_{t-1}-β\_{3}logEUA\_{t-1}+μ\right)+\sum\_{i=1}^{p-1}ℾ\_{i1}∆logPun\_{t-i}+\sum\_{i=1}^{p-1}ℾ\_{i2}∆logGas\_{t-i}+\sum\_{i=1}^{p-1}ℾ\_{i3}∆logEUA\_{t-i}+ε\_{t}$ (1)

## Where logPun is the natural log of daily weighted average electricity National price, logGas is the log of future gas price measured at the Italian Natural Gas exchange (Punto di Scambio Virtuale - PSV) and logEUA is the log of futures daily settlement prices of EU-ETS allowances exchanged at the European Climate Exchange (EEX). Data ranges from 01 January 2013 to end of 2017. The model has been run with a lag length of 21 to take stock of possible time delays in the impact on the dependent variable. With such a long time span we are able to check if there is any monthly correlation between our variables of interest. We also study whether there is a short run impact of the change of the price of the EU-ETS on each of the variables, as well as a change of the PUN price on them. A significant relationship would show which price react to an external, orthogonal shock, thus establishing which variable adjust to the shock to bring the system back to the long run equilibrium.

## Results

Table 1reports the result of the VECM:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| beta | Coef. | Std. Err. | z | P>|z| |
| logPun | 1 | . | . | . |
| logGas | -0.7262246 | 0.1169063 | -6.21 | 0.000 |
| logEUA | -0.206151 | 0.120413 | -1.71 | 0.087 |
| \_cons | -1.445163 | . | . | . |

The Impulse Response Functions show the effect of a unit change of the PUN, Natural Gas and EU-ETS on the PUN price, (Figure 1) and on the EU-ETS one (Figure 2).



Figure 1. IRF of logPUN on logEUA (left) and on logGas (right)



Figure 2. IRF of logEUA on logPUN (left) and on logGas (right)

## Conclusions

Our methodology allows us to measure the pass-through in terms of average elasticities over the sample period. We see that that there is a 20% pass through of EU-ETS prices in the third phase of EU-ETS. Moreover, the result shows that PUN prices during the third phase of the EU-ETS can be explained by means of a constant-return to scale Cobb-Douglas function, which sees costs of CO2emisisons and Natural Gas purchases as the inputs. The analysis of the IRS show that a shock in the Natural Gas price has a clear positive effect on the electricity price. This is as expected, confirming the importance of this source in being the relevant marginal technology in the market. The effect of an orthogonalized shock in the allowances prices on the PUN is less clear, even though it appears (slightly) significant. On the contrary, an orthogonalized shock in the PUN variable does not influence the allowances price and the natural gas future price. This outlines the direction of the causality between our variables: while the allowances price and the natural gas price directly influence the Italian electricity price, the opposite is not true..

## References

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1. Chernyavs’ka and Gulli (2008) studied the pass-through in the Italian Market in the first phase of the EU-ETS, following an ex-ante modelling approach. [↑](#footnote-ref-1)