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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- The (theoretical) purpose of ETS is to internalize the pollution cost
- Static effect: higher cost => higher end-price, given rigidity of demand = "pass-through"
- Dynamic effect: higher cost => substitution with less emitting technology in the long run

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paper	markets	pass-through rates	phases
Sijm et al 2006	DE, NE	60-117, 64-81	I
Fabra and Reguant, 2014	SP	70-140 (28-97)	I
Honkatukia et al. 2008	FI	75-95	I
Hintermann	DE	81-111	I and II
Bariss et al. 2016	NP	55 NP, 65 baltic	I and II
Bunn ard Fezzi 2008	DE, UK	42	I
Alamada and Kiraz 2015	FR, DE	18	II
Jouvet and Sollier, 2013	EU	*	I and II
* = large range, from negative to positive coeff.			

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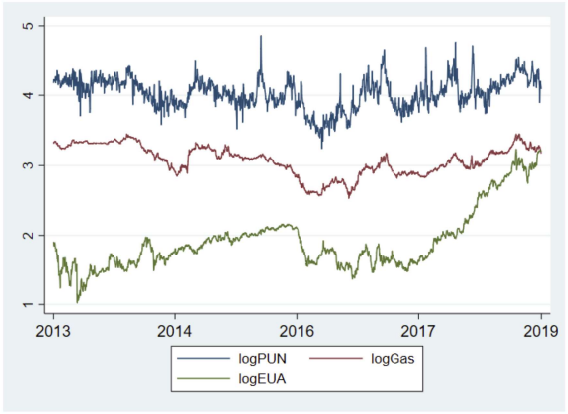
3. Dynamic analysis: has the pass-through rate changed overtime during the observation period? If so, how?
4. What about the causality order? do ETS and gas prices affect electricity prices, and/or vice versa?

Data

Figure 1. Grapnical representaion of electricity (PUN), Allowances and gas prices.



Sample period: 01/01/2013-31/.2/2018 (1565 observations). All data are in natural logs.

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- However, if two (or more) series are I(1), we can test if their liner combination is stationary = long-run relationship
- We first test for stationarity and cointegration, then apply the VECM

Data analysis

We run a KPSS, ADF and bound test (Pesaran et al 2001) to identify the existence of cointegration. Results justify the use of a VECM; there is a singe cointegrating relationship for the three-variate model, two cointegrating relationships for the four-variate model

Methodology: VECM

$$\Delta X_t = \alpha\beta' X_{t-1} + \sum_{j=1}^{p} \Phi_j \Delta X_{t-j} + \delta D_t + \varepsilon_t \qquad (1)$$

where X_t is the vector of the modeled variables (in logs), $\beta' X_{t-1}$ is the disequilibrium error, and β contains the cointegration coefficients. The vector α contains the adjustment coefficients to past disequilibrium. The summation monitors the short-run dynamic of the series growth rates. D_t contains a set of deterministic variables, namely a constant and a linear trend

Results. VECM, static analysis. Full-sample pass-through

Table 6. The cointegrating equation

		Models				
		1	2	3	4	4
Betas	LogPUN	1	-	-	-	-
	LogPUNp	-	1	-	1	0
	LogPUNop	-	-	1	0	1
	LogGas	-0.729*** (0.078)	-0.749*** (0.097)	-0.694*** (0.065)	-0.745*** (0.098)	-0.690*** (0.066)
	LogEUA	-0.069* (0.038)	-0.077* (0.047)	-0.061** (0.031)	-0.077* (0.047)	-0.061* (0.032)
Alphas	PUN	-0.140*** (0.017)	-	-	-	-
	PUNp	-	-0.151*** (0.019)	-	-0.193*** (0.031)	0.089** (0.043)
	PUNop	-	-	-0.145*** (0.018)	0.010 (0.021)	-0.156*** (0.029)
	Gas	0.005 (0.003)	0.002 (0.005)	0.010** (0.004)	-0.010** (0.004)	0.020*** (0.006)
	EUA	0.003 (0.006)	0.002 (0.002)	0.004 (0.007)	-0.003 (0.009)	0.008 (0.0 2)

*The table reports the values of the coefficients of equations 4 (nodels 1, 2, 3) and 5 (model 4), respectively, and the standard errors between parenthesis. We denote by ***, ** and * the coefficients which are statistically significant at the 1%, 5% and 10% confidence levels, respectively.*

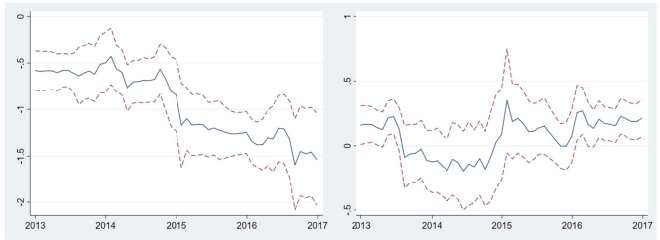
Results: Dynamic analysis. Rolling windows pass-through. Model 1

These graphs report the Betas and their confidence intervals of natural gas (left hand side) and allowances (right-hand side) obtained from the rolling analysis. Model 1: PUN

Results: Dynamic analysis. Rolling windows pass-through. Model 2

These graphs report the Betas and their confidence intervals of natural gas (left hand side) and allowances (right-hand side) obtained from the rolling analysis. Model 2: peak PUN

Results: Dynamic analysis. Rolling windows pass-through. Model 3



These graphs report the Betas and their confidence intervas of natural gas (left hand side) and allowances (right-hand side) obtained from the rolling analysis. Model 2:off- peak PUN

Results: Short-run adjustment: causality order. IRFs. Model1

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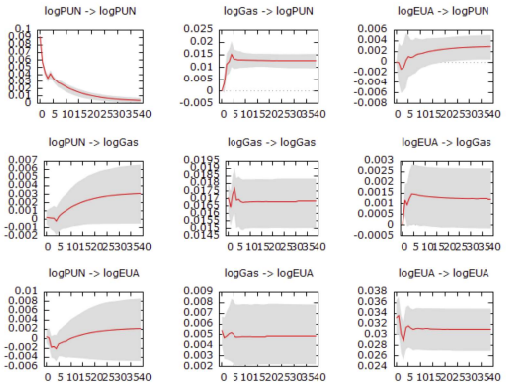

Figure 3: impulse response functions of the VECM model 1 (three variables, PUN, one cointegration relation). The shaded area represents the 90% confidence interval.

Results: Short-run adjustment: causality order. IRFs. Model4

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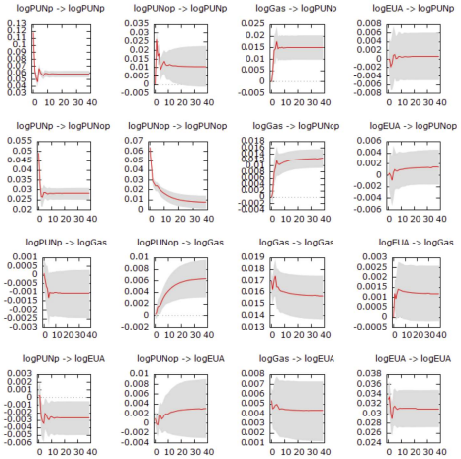

Figure 4: impulse response functions of the VECM model 4 (four variables, peek and off-peak PUN, two cointegration relations). The shaded area represents the 90% confidence inerval.

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- The IRF show that the substitution effect can hardly be claimed to be caused by the allowances' prices

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