Are energy market integrations a green light for FDI?

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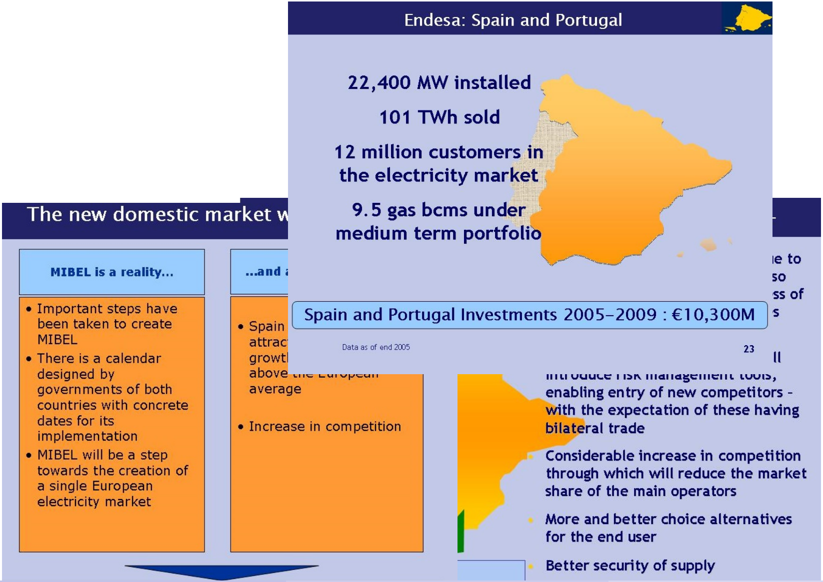
If I were a country...

1. United States 16,244,600
2. China 8,358,400
3. Japan 5,960,180
4. Germany 3,425,956
5. France 2,611,221
6. United Kingdom 2,471,600
7. Brazil 2,254,109
8. Russia 2,029,812
9. Italy 2,013,392
10. India 1,875,213
11. Canada 1,821,445
12. Australia 1,564,419
13. Spain 1,322,126
14. 14 Mexico 1,183,655
15. 15 South Korea 1,129,598

In 2006 (one year before 2007)

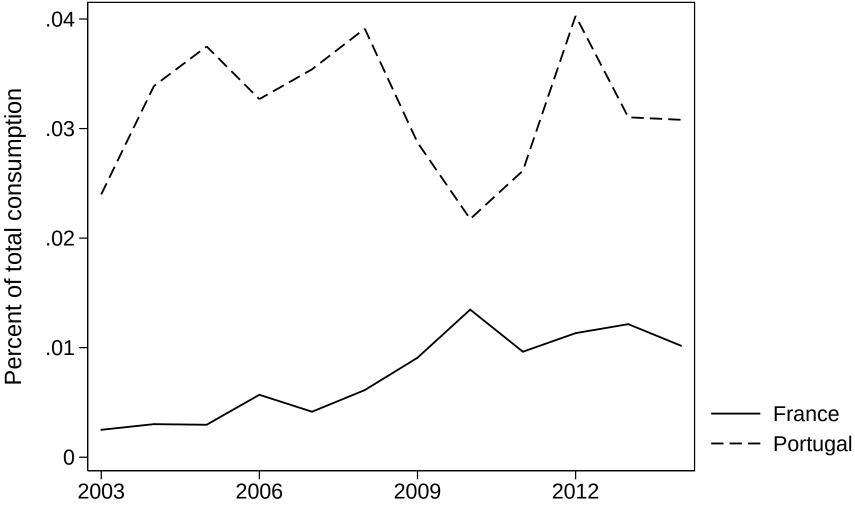


Outline

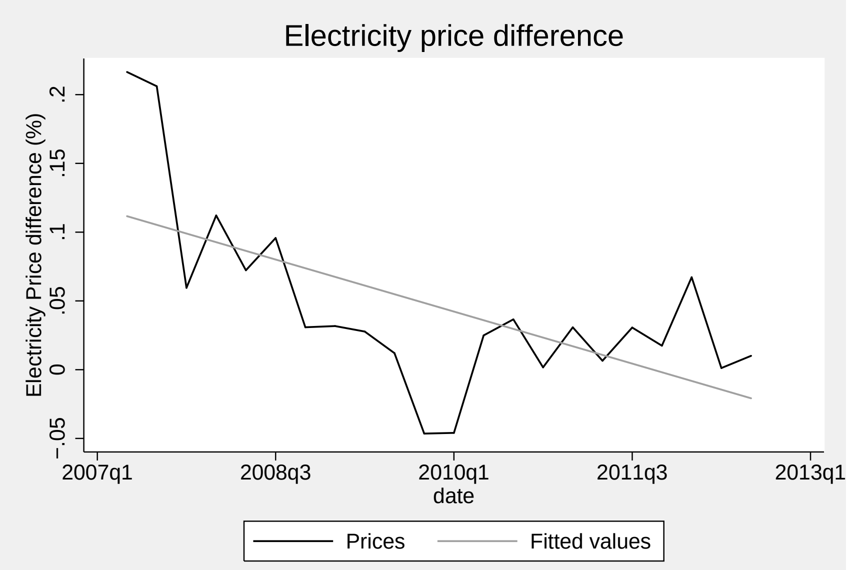
In this paper

1. we develop a stylized theoretical model to explain the effect of energy market integration on FDI
   - Includes energy as a production input in a Melitz framework
2. we provide empirical evidence of the MIBEL's effect
   - on inward FDI in Spain & Portugal
   - within Iberian Peninsula

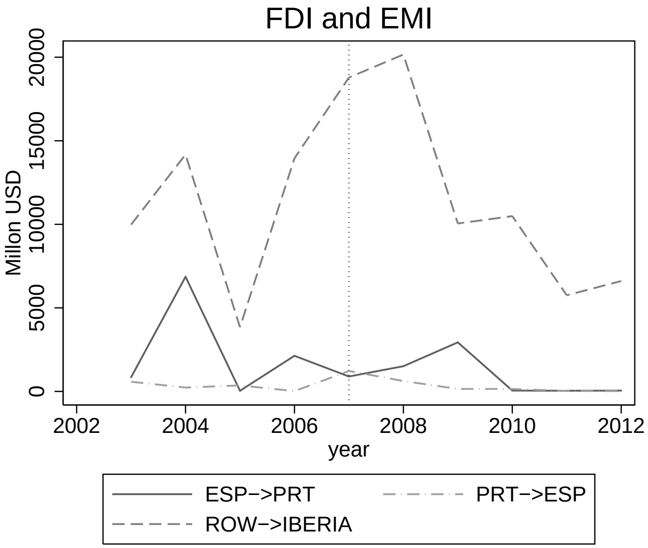
Electrical single market on the spot



MIBEL's Price evolution



FDI


FDI and EMI
Millon USD
20000
15000
10000
5000
0
2002
2004
2006
2008
2010
2012
year
ESP−>PRT
PRT−>ESP
ROW−>IBERIA

Previous work

1. The expected results of a single energy market are a harmonisation of energy prices and higher quality of service (Correlje and Van der Linde, 2006; Glachant, 2009).
    - Price convergence (Zachmann, 2008), prices dependence (Lindstrom and Regland, 2012), integration (Bunn and Gianfreda, 2010), and cross-border integration (Balaguer, 2011).
2. EMIs, influence various economic aspects, like insurance (Mahlberg and Url, 2003)
3. FDI-energy link is well established (Correlje and Van der Linde, 2006; Herrerias et al. 2013, 2015; Pao and Tsai, 2011)

Take Away: EMI effect on FDI

1. Electricity price dispersion reduction (De Jonghe et al., 2008)
    - Price stability & institutional credibility may have an effect on FDI (Aizenman et al., 2006).
2. Electricity price alignment (Correlje and Van der Linde, 2006; Glachant, 2009).
    - Effect within the integrated market area

Model in 33 words

- The model is very stylized. It's main aim is to discipline our empirical work
  - We obtain some testable predictions
- Setup:
  - The production is a standard Nerlove's Cobb-Douglas function
  - Greenfield firms choose between domestic and foreign production in a Melitz framework
- An energy market integration introduces a cost markdown after the integration.
  - increasing FDI

Gravity...(is this still economics?)

- Tinbergen (1962) is often credited as the empirical exploration of a gravity equation:

$$\ln X_{ij} = \alpha \ln Y_i + \beta \ln Y_i - \zeta \ln \tau_{ij}$$

- Anderson (1979), and Anderson and van Wincoop (2003) highlight how this simple gravity equation lacks theoretical justification:
    - It does not respect market clearing
    - It does not incorporate fact that consumers may view goods as substitutes.

$$X_{ij} = \frac{Y_j Y_i}{Y} \left(\frac{\tau_{ij}}{P_j \Pi_i} \right)^{1-\varepsilon}$$

Waves and ways to gravity

- Many models end up with a gravity equation:
- Neoclasical (Ricardian)
  - Eaton and Kortum (2002) with one industry and Costinot, Donaldson and Komunjer (2011) with many
- Monopolistic Competition
  - Krugman (1980)
  - Melitz (2003) with Pareto-distributed productivity (Chaney, 2008)

Why gravity?

- Gravity will arise whenever you have:
    - CES preferences
    - Iceberg trade costs
    - And a trade separable set-up: in which the decision of how much of a good category to consume is separable from the decision about where to buy it from.
- Gravity fits the data well
- Include real-world features (multiple countries and trade costs)

"New Trade Models, Same Old Gains?"

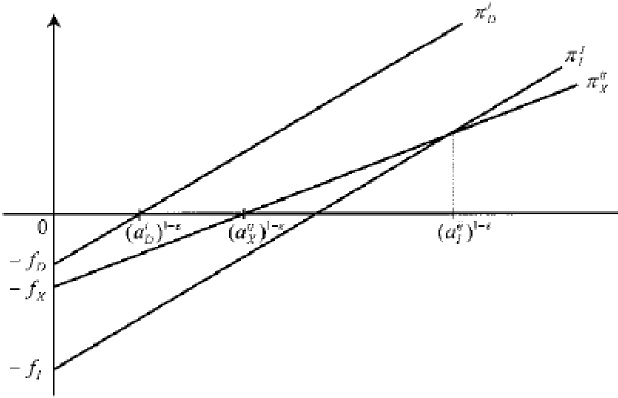
- Arkolakis, Costinot and Rodriguez-Clare (2012) show that the same gravity equation can be derived in many settings with or without heterogeneous firms.
  - The gains from trade in all models are the same
  - the response of any endogenous variable to a change in any exogenous variable will be the same in all models (with some conditions)
  - trade flows change between two equilibria is the same
- The idea is that the micro structure is common (Dixit-Stiglitz preferences, linear cost function and Monopolistic competition)
  - and assume some macro restrictions (Balanced trade, constant profit share, CES imports)

Healthy habits in economics

THE AMERICAN ECONOMIC REVIEW *MARC*

to country j are
g transport costs
ive to be shipped
one unit to arrive.
e in monopolistic

of product h have
n an elasticity of
· 1. These prefer-
unction $A^i p^{-\varepsilon}$ in
he product, where



Gravity for FDI

- Kleinert and Toubal (2010) also show that the same gravity equation can be derived in many settings with or without heterogeneous firms for FDI
  - extend Helpman, Melitz and Yeaple (2004) to allow for fixed setup costs that rise with distance and explain why FDI can fall rather than rise with distance as the earlier proximity-concentration trade-off suggested.
  - Factor proportions model of fragmentation
- Paniagua (2015) uses the KT(2010) setup to model reinvestment in foreign affiliates.

Demand

- The model follows closely standard trade and FDI setups like Melitz (2003), Helpman et al. (2004)
- A world of J countries with the assumption of a Cobb-Douglas utility function $U_j = X_{Aj}^{\mu} X_{Bj}^{1-\mu}$, for a two sector economy with goods A (non traded) and B (traded).
- The aggregate consumption of a good in the traded sector is $X_j = \left[\int {x_{kj}}^{\alpha} dk\right]^{1/\alpha}$, where $\sigma \equiv (1-\alpha)^{-1} > 1$.
- The demand is $x_{kj} = \frac{p_{kj}^{-\sigma}(1-\mu)Y_j}{P_j^{1-\sigma}}$, where price index is a CES function $P_j = \left[\int_k {p_{kij}}^{1-\sigma} dk\right]^{1/(1-\sigma)}$.

At home

- The firm z uses three inputs capital K, *energy* E, *and labor* L *in the production of the goods* x_{iz}:

$$x_{iz} = \theta_z (K)^a (E)^b (L)^c$$

- The problem of the firm at home:

$$\max_{K,E,L} \pi_{iz}^{Dom} = \max\{p_i \theta_z (K)^a (E)^b (L)^c - r_i K - e_i E - w_i L - f_i\}$$

- In equilibrium the market clears so that $L = 1$ and the firms determines the optimal level of capital investment and energy consumption

Abroad

- Let the firm consider a building a similar plant in country j. The firm faces the following problem:

$$\max_{K,E,L} \pi_{ijz}^{FDI} = \max\{p_{ij}\theta_z(K)^a(E)^b(L)^c - r_jK - e_jE - w_jL - f_j\}. \quad (1)$$

  - transfer prices that are assumed to face iceberg-type costs of $p_{ij} = p_j/\tau_{ij}$.
    - Transaction costs $\tau_{ij} > 1$ are proportional to the distance between the countries.
- As in Melitz (2003), the firms setups a foreign production plant if $\pi_{ijz}^{FDI} > \pi_{iz}^{Dom}$.
- Equation (1) has the first order conditions of:

$$p_j\tau_{ij}^{-1}\theta_z aK^{a-1}E^b(L)^c = r_j \quad (2a)$$

$$p_j\tau_{ij}^{-1}\theta_z aK^aE^{b-1}(L)^c = e_j. \quad (2b)$$

Gravity for FDI & Energy

- After the labor market clears, the optimal equilibrium for capital and energy yields,

$$K^*_{ijz} = \left(\frac{p_j \theta_z a \sigma^b}{\tau_{ij} (r_j)^{1-b} (e_j)^b} \right)^{\frac{1}{1-\mu}} \tag{3a}$$

$$E^*_{ijz} = \left(\frac{p_j \theta_z b \sigma^{-a}}{\tau_{ij} (r_j)^{a} (e_j)^{1-a}} \right)^{\frac{1}{1-\mu}}, \tag{3b}$$

- where $\sigma = b/a$. This parameter controls the relative intensity of each input.
  - Energy intensive firms ($\sigma > 1$) are relatively more constrained by energy costs than they are by capital costs.
- Foreign investment decreases with transaction costs τ_{ij}, capital costs r_j, and energy costs e_j.
- The firm gauges these costs to determine the productivity level at which it enters the foreign market

Gravity for FDI & Energy

- An energy market integration can be seen as the convergence of energy costs on both sides of the energy border.
- The energy prices on both sides of the border converge to a single energy price, which is equivalent to the energy costs of both countries.
- Due to economies of scale and efficiency in a larger energy market, the single energy price is expected to be lower in the long run for both countries after integration.

Proposition

An energy market integration affects bilateral investment flows between the country members. Foreign direct investment increases in countries which converge to a lower energy cost after the integration.

Proof.

Let the EMI energy costs at country j be a strictly decreasing concave function of time $e(t)$. The change in foreign capital invested (1) by our firm z during the converge is:

$$\frac{\partial K^*_{ijz}}{\partial t} = \frac{-b}{1-\mu} e'(t) \left(\frac{p_j \theta_z a \sigma^b}{(r_j)^{1-b} (\tau_{ij} e(t))^{b+1+\mu}} \right)^{\frac{1}{1-\mu}}$$

$\partial K^*_{ijz}/\partial t > 0$,since $e'(t) < 0$ for a strictly decreasing concave function. □

- The effect is governed by energy costs and a stability mechanism.

Long run

- The problem of exporting and FDI is,

$$\max_{K,E,L} \pi_{ijz}^{EXP} = \max\{p_{ij}\theta_z(K)^a(E)^b(L)^c - r_i K - e_{emi}E - w_i L - f_i\} \quad (4a)$$

$$\max_{K,E,L} \pi_{ijz}^{FDI} = \max\{p_{ij}\theta_z(K)^a(E)^b(L)^c - r_j K - e_{emi}E - w_j L - f_j\} \quad (4b)$$

- Applying the envelope theorem to equations (4a) and (4b), the firm decides to invest in country j if and only if

$$K > (w_j - w_i + f_j - f_i)/(r_i - r_j) \equiv \Theta. \quad (5)$$

- Energy costs are left out of the equation and reduces the Melitz threshold

The effect of EMI on the margins of FDI

- In equilibrium ($L = 1$), the capital threshold to invest abroad is governed by the differential wage to interest ratio in both countries.
- In the long run, the EMI removes the energy border between countries (extensive margin)
- After the integration is reached, the capital invested (intensive margin) is

$$K^*_{ijk} = \begin{cases} \rho \left(\frac{p_j \theta_z a \sigma^b}{\tau_{ij} \left(r_j \right)^{1-b} \left(e_j \right)^b} \right)^{\frac{1}{1-\mu}} & \text{if } K^*_{ijk} > \Theta \\ 0 & \text{otherwise.} \end{cases} \tag{6}$$

  where $\rho = (e_{j0}/e_{emi})^{\frac{b}{1-\mu}} > 1$ is the energy cost markdown after the integration.
- In sum, the EMI has an effect on both the extensive and intensive margins.

Gravity equation

- Our OLS baseline specification is the following augmented gravity equation:

$$lnFDI_{ijt} = \beta_1 \ln(Y_{it} * Y_{jt}) + \beta_2 \ln(D_{ij}) + \beta_3 border_{ij} + \beta_4 colony_{ij} + \beta_5 lang_{ij} + \beta_6 smctry_{ij} + \beta_7 rel_{ij} + \beta_8 locked_{ij} + \beta_{10} BIT_{ijt} + \beta_{11} FTA_{ijt} + \beta_{12} crisis_{ijt} + \rho_1 EMI_{ijt} + \rho_2 EMIROW_{ijt} + \rho_3 EMIFRA_{ijt} + \lambda_t + \lambda_i + \lambda_j + \varepsilon_{ijt},$$

- Zeros: PPML (Silva & Tenreyro 2006)
- Country-year fixed effects (CYFE).
- Extensive margin

Data

- FDIMarkets: covers firm level greenfield investments
  - 190 countries from 2003 to 2012
  - Database is efficiently constructed fro over 70% zeros (Paniagua, forthcoming)
- Database for systemic banking crisis: Laeven and Valencia (2013):
  1. Significant signs of financial distress in the banking system (significant bank runs, losses in the banking system, and/or bank liquidations)
  2. Significant banking policy intervention measures in response to significant losses in the banking system.

  - Why: The MIBEL integration period overlaps partially with that of the great recession period

Results

	FDI			Extensive Margin		
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(Y_{it} \cdot Y_{jt})$	0.399***	-0.260		0.232***	-0.372	
	(0.15)	(0.25)		(0.06)	(0.31)	
$\ln(D_{ij})$	-0.423***	-0.340***	-0.257***	-0.251***	-0.368***	-0.304***
	(0.04)	(0.05)	(0.05)	(0.02)	(0.03)	(0.04)
$border_{ij}$	0.095	0.005	0.217*	0.056	-0.172**	0.022
	(0.09)	(0.132)	(0.12)	(0.052)	(0.07)	(0.07)
$lang_{ij}$	0.556***	0.521***	0.495***	0.423***	0.643***	0.623***
	(0.09)	(0.11)	(0.09)	(0.05)	(0.08)	(0.07)
col_{ij}	0.171**	0.490***	0.423***	0.172***	0.509***	0.377***
	(0.08)	(0.11)	(0.08)	(0.05)	(0.06)	(0.06)
$smctry_{ij}$	0.173	0.409*	0.177	0.155	0.595***	0.181
	(0.17)	(0.25)	(0.21)	(0.10)	(0.15)	(0.11)
rel_{ij}	0.500***	0.833***	0.122	0.227***	0.401***	-0.120
	(0.12)	(0.23)	(0.20)	(0.06)	(0.13)	(0.15)
$locked_{ij}$	-0.002	-0.119	-0.182**	0.008	-0.069	-0.108*
	(0.06)	(0.09)	(0.08)	(0.03)	(0.06)	(0.06)
BIT_{ijt}	-0.165***	-0.103	-0.116	-0.103***	-0.009	-0.020
	(0.05)	(0.07)	(0.07)	(0.02)	(0.04)	(0.06)
FTA_{ijt}	-0.006	0.230**	0.162*	0.009	0.250***	0.239***
	(0.08)	(0.12)	(0.09)	(0.04)	(0.07)	(0.07)
$crisis_{ijt}$	0.027	-0.021	-3.404***	0.019	-0.078***	-4.026***
	(0.05)	(0.06)	(0.88)	(0.019)	(0.03)	(0.47)
$EMIROW_{ijt}$	0.148	-0.287	-0.943	-0.014	-0.165	0.311
	(0.18)	(0.26)	(0.95)	(0.08)	(0.15)	(0.52)
$EMIFRA_{ijt}$	0.737	0.402	-0.241	0.598	0.908***	1.346**
	(0.58)	(0.31)	(0.94)	(0.50)	(0.19)	(0.53)
EMI_{ijt}	0.495**	1.317***	1.318***	0.494*	1.431***	1.373***
	(0.25)	(0.31)	(0.30)	(0.26)	(0.31)	(0.38)
Observations	14176	38836	38253	14176	38836	38253
R^2	0.288	0.443	0.514	0.550	0.781	0.864
Method	OLS	PPML	PPML	OLS	PPML	PPML

Results

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R^2	0.288	0.443	0.514	0.550	0.781	0.864
Method	OLS	PPML	PPML	OLS	PPML	PPML
Year FE	Yes	Yes		Yes	Yes	
Country FE	Yes	Yes		Yes	Yes	
*Country*Year FE*			Yes			Yes

Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results

	FDI		Extensive Margin	
	(1)	(2)	(3)	(4)
$EMIROW_{ijt}$	-0.293	-0.223	-0.167	0.809
	(0.25)	(0.92)	(0.15)	(0.52)
$EMIFRA_{ijt}$	0.402	-1.000	0.905***	1.931***
	(0.30)	(0.91)	(0.18)	(0.53)
$POR \rightarrow ESP$	1.154***	0.908**	1.014**	0.861**
	(0.34)	(0.36)	(0.40)	(0.43)
$ESP \rightarrow POR$	1.358***	1.716***	1.722***	1.928***
	(0.47)	(0.28)	(0.23)	(0.20)
Observations	38253	36796	38253	36796
R^2	0.514	0.481	0.864	0.890
Year FE	Yes		Yes	
Country FE	Yes		Yes	
*Country*Year FE*		Yes		Yes

Robust standard errors in parentheses. PPML estimation.
Only variables of interest are reported.

The gravity results

- the gravity equation performs well when explaining bilateral FDI (as expected)
- The creation of an integrated electricity market between Spain and Portugal exerted a significant and positive effect on the countries' FDI, for both margins
  - The effect of the EMI was similar for both margins.
- The most conservative estimates indicate that the EMI increased bilateral capital investment in Iberia by 64% on average
- FDI from neighboring countries (France) also increased after integration (via extensive margin 148%)
- The EMI does not, however, appear to have affected FDI from the rest of the world.
  - Relative to other EU markets, the falls in electricity prices within the EMI might not have been sufficient to attract any significant FDI from the the rest of the world

The gravity results (cont'd)

- The theory underlying a gravity-like specification provides predictions on unidirectional bilateral trade rather than on two-way bilateral trade. This is the silver medal mistake in gravity 101 (Baldwin & Taglioni, 2006).
- We use unidirectional FDI data (i.e, $FDI_{ij} \neq FDI_{ji}$).
  - Our specification is not only more closely grounded in theory; it allows us to inspect the direction effect attributable to the MIBEL
- The estimated increase in FDI flows is stronger from
  - Spain $\Longrightarrow$ Portugal
- The country with the initially higher electricity price (Portugal) that obtains the highest gains.

Lessons learned

- This paper contributes to a better understanding of the relation between energy and international economics.
- We develop a simple model to explain the mechanisms by which EMI relate to FDI.
    - EMI alleviate the energetic costs in the foreign financial market, thus encouraging FDI through both margins
    - We test the model's predictions by means of the gravity equation and the EMI created by Portugal and Spain in 2007.
- Energy market design and the way in which such markets operate have a direct effect on the cost-driven investment choices made by foreign firms.

Policy

- Reformulate the methodology used in assessing cross-border priority energy investment plans so as to include the positive impact on FDI in the cost-benefits analysis
- Energy markets design and functioning have a direct effect on cost-driven investment choices by firms.
  - the policy implications relate to importance of considering broader effects of energy markets design.

Future

- Major public investment plans in energy infrastructure (e.g., the current EU Commission's programme) are expected to have a greater impact on the Member States' economies than initially thought
- Results from this paper suggest that the participation of supra-national financial institutions would be helpful in other contexts, such as the MENA or Latin American countries

Thanks!! Green light for Q&A!