Are energy market integrations a green light for FDI?

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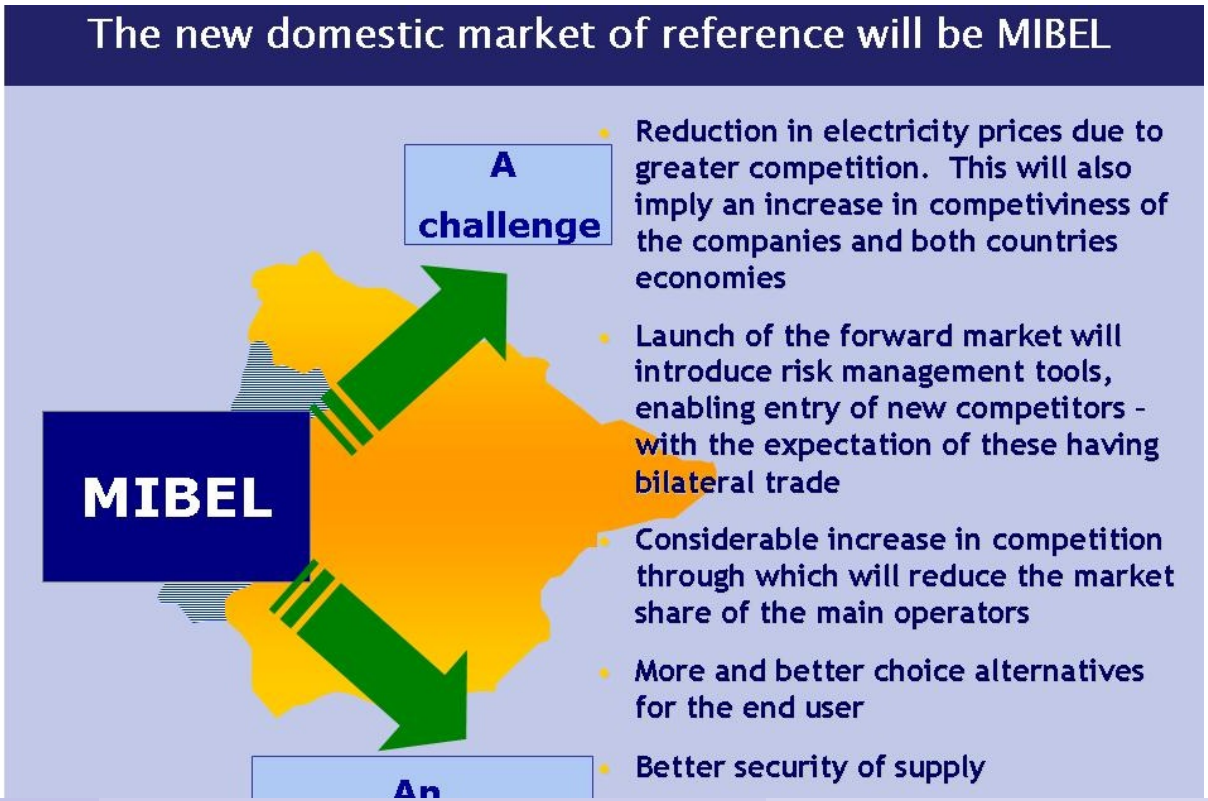

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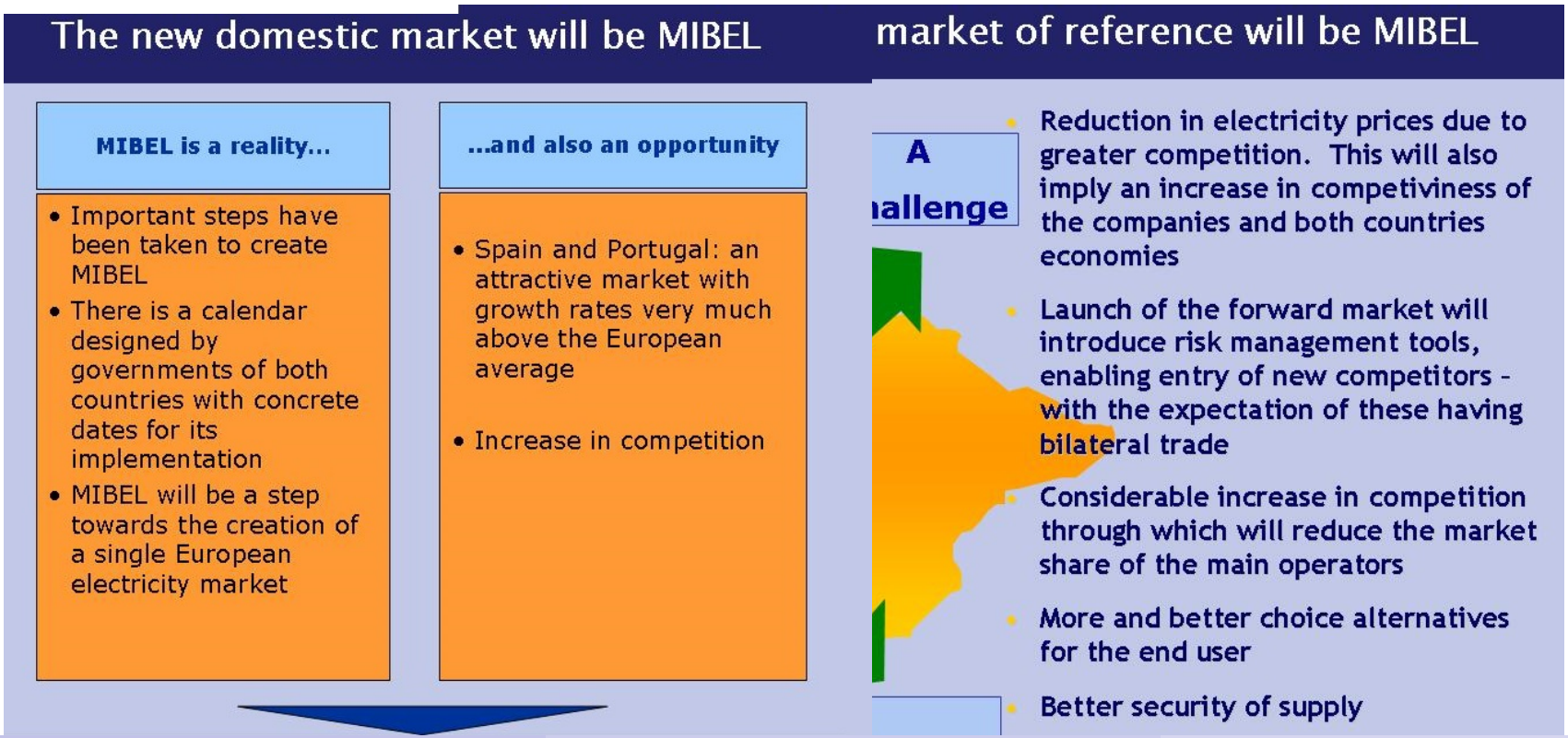

In 2006 (one year before 2007)

Endesa: Spain and Portugal

22,400 MW installed

101 TWh sold

12 million customers in the electricity market

9.5 gas bcms under medium term portfolio

Spain and Portugal Investments 2005–2009 : €10,300M

Data as of end 2005

23

The new domestic market w

MIBEL is a reality...

- Important steps have been taken to create MIBEL
- There is a calendar designed by governments of both countries with concrete dates for its implementation
- MIBEL will be a step towards the creation of a single European electricity market

...and a

- Spain attrac growt above the European average
- Increase in competition

...e to so ...ss of s ...ll

introduce risk management tools, enabling entry of new competitors - with the expectation of these having bilateral trade

- Considerable increase in competition through which will reduce the market share of the main operators
- More and better choice alternatives for the end user
- Better security of supply

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

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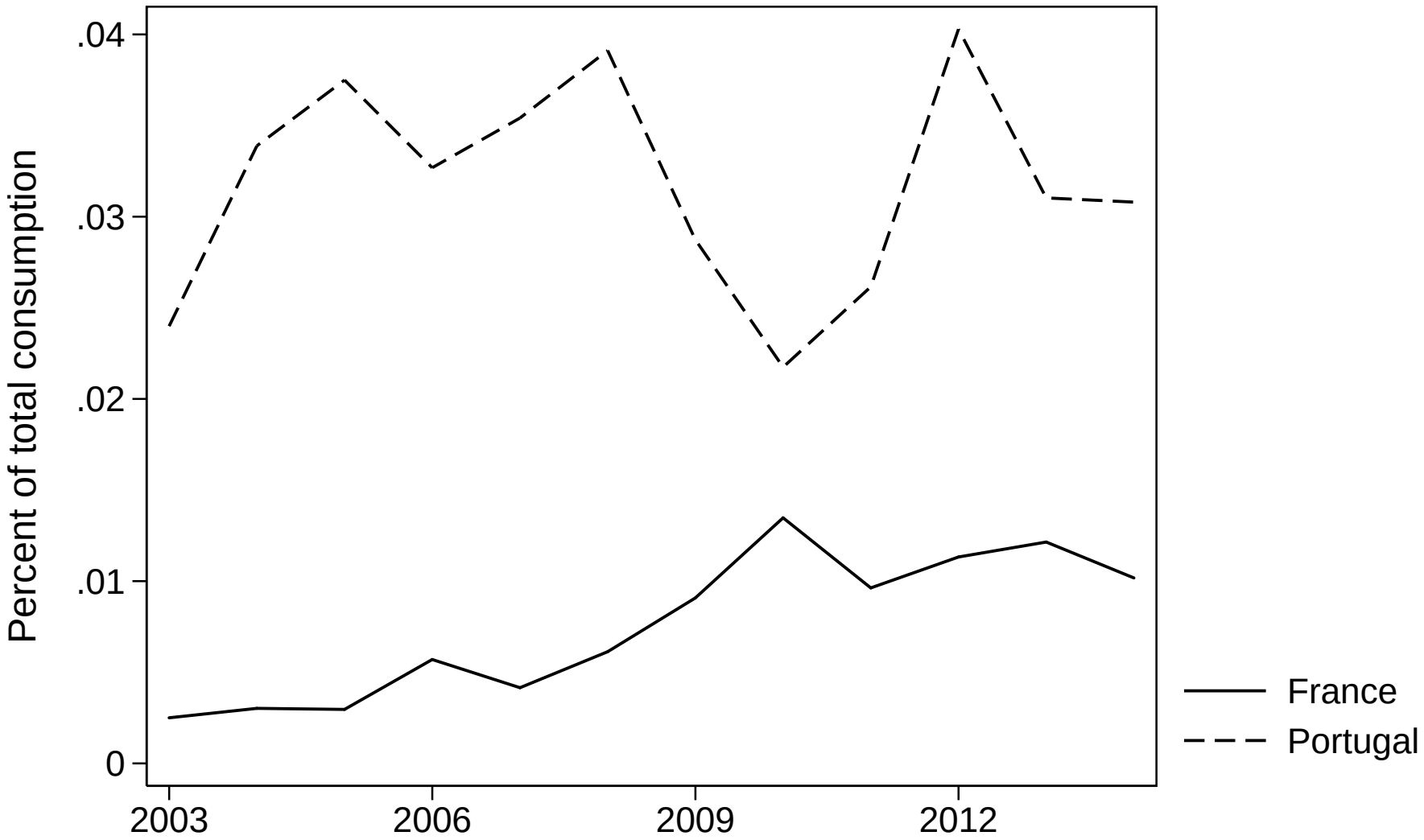
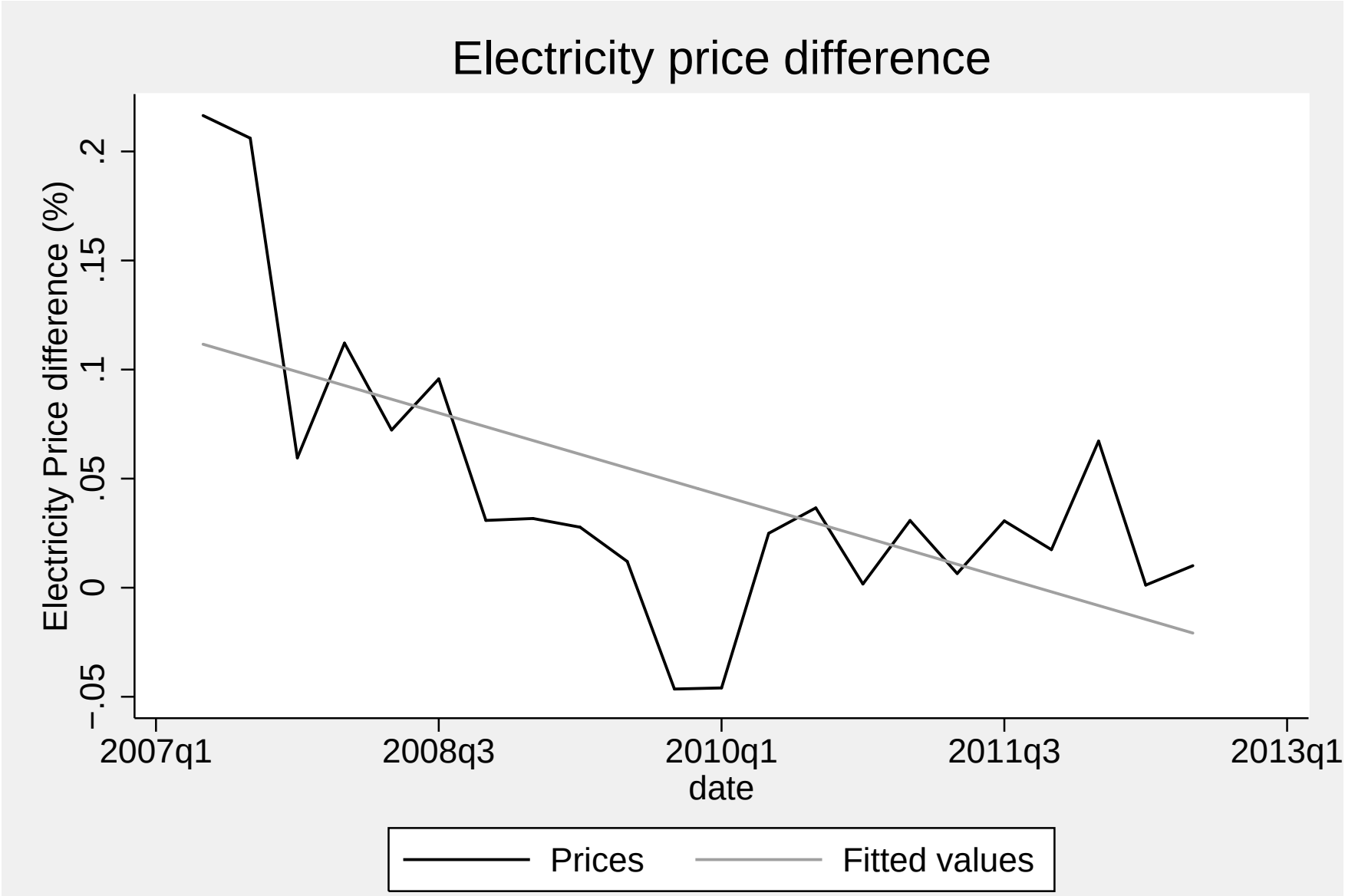
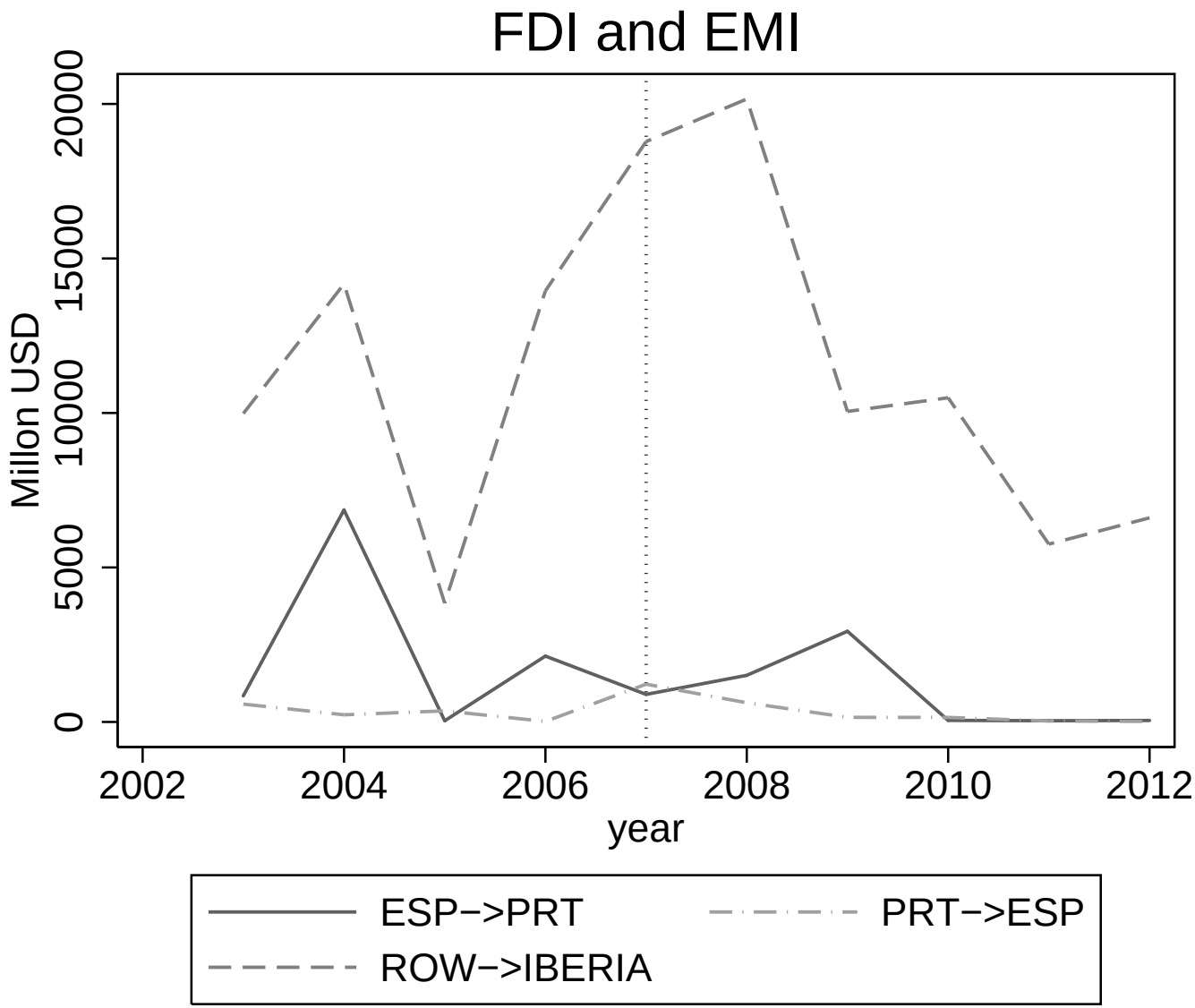
Electrical single market on the spot



MIBEL's Price evolution



FDI


FDI and EMI
Millon USD
0
5000
10000
15000
20000
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)

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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).
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   - Effect within the integrated market area

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Model in 33 words

- 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

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At home

- The firmz 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:

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

- 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:

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

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

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FDI & Energy

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

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

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

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.

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

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

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

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Long run

- The problem of exporting and FDI is,

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

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

$$K/L < (w_i - w_j)/(r_j - r_i).$$

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

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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

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

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Gravity equation

$$FDI_{ijt} = exp\left(\begin{array}{c}\beta_1 \ln(Y_{it} * Y_{jt}) + \beta_2 \ln(D_{ij}) + \beta_3 border_{ij} + \beta_4 colony_{ij} + \\ \beta_5 lang_{ij} + \beta_6 smctry_{ij} + \beta_7 rel_{ij} + \beta_8 locked_{ij} + \\ \beta_{10} BIT_{ijt} + \beta_{11} FTA_{ijt} + \beta_{12} crisis_{ijt} + \\ \rho_1 EMI_{ijt} + \rho_2 EMIROW_{ijt} + \rho_3 EMIFRA_{ijt} + \lambda_{it} + \lambda_{jt}\end{array}\right) + \varepsilon_{ijt}$$

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Results

	FDI			Extensive Margin		
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(Y_{it} \cdot Y_{jt})$	0.399***	-0.260		0.232***	-0.372	
	(0.147)	(0.248)		(0.0621)	(0.305)	
$\ln(D_{ij})$	-0.423***	-0.340***	-0.257***	-0.251***	-0.368***	-0.304***
	(0.0407)	(0.0560)	(0.0498)	(0.0222)	(0.0343)	(0.0401)
$border_{ij}$	0.0949	0.00509	0.217*	0.0558	-0.172**	0.0224
	(0.0909)	(0.132)	(0.123)	(0.0520)	(0.0709)	(0.0722)
$lang_{ij}$	0.556***	0.521***	0.495***	0.423***	0.643***	0.623***
	(0.0909)	(0.109)	(0.0890)	(0.0593)	(0.0817)	(0.0701)
col_{ij}	0.171**	0.490***	0.423***	0.172***	0.509***	0.377***
	(0.0763)	(0.110)	(0.0838)	(0.0446)	(0.0593)	(0.0580)
$smctry_{ij}$	0.173	0.409*	0.177	0.155	0.595***	0.181
	(0.169)	(0.245)	(0.210)	(0.0948)	(0.145)	(0.114)
rel_{ij}	0.500***	0.833***	0.122	0.227***	0.401***	-0.120
	(0.124)	(0.230)	(0.195)	(0.0606)	(0.130)	(0.154)
$locked_{ij}$	-0.00161	-0.119	-0.182**	0.00826	-0.0693	-0.108*
	(0.0584)	(0.0918)	(0.0890)	(0.0306)	(0.0560)	(0.0614)
BIT_{ijt}	-0.165***	-0.103	-0.116	-0.103***	-0.00809	-0.0202
	(0.0514)	(0.0742)	(0.0728)	(0.0280)	(0.0444)	(0.0558)
FTA_{ijt}	-0.00590	0.230**	0.162*	0.00896	0.250***	0.239***
	(0.0767)	(0.108)	(0.0913)	(0.0419)	(0.0697)	(0.0719)
$crisis_{ijt}$	0.0274	-0.0212	-3.404***	0.0194	-0.0780***	-4.026***
	(0.0492)	(0.0571)	(0.876)	(0.0190)	(0.0249)	(0.467)
$EMIROW_{ijt}$	0.148	-0.287	-0.943	-0.0148	-0.165	0.311
	(0.176)	(0.255)	(0.947)	(0.0773)	(0.149)	(0.524)
$EMIFRA_{ijt}$	0.737	0.402	-0.241	0.598	0.908***	1.346**
	(0.579)	(0.308)	(0.942)	(0.496)	(0.186)	(0.530)
EMI_{ijt}	0.495**	1.318***	1.318***	0.495*	1.431***	1.373***
	(0.245)	(0.311)	(0.295)	(0.258)	(0.305)	(0.382)
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

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	(0.579)	(0.308)	(0.942)	(0.496)	(0.186)	(0.530)
EMI_{ijt}	0.495**	1.318***	1.318***	0.495*	1.431***	1.373***
	(0.245)	(0.311)	(0.295)	(0.258)	(0.305)	(0.382)
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
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
	(0.254)	(0.924)	(0.148)	(0.515)
$EMIFRA_{ijt}$	0.402	-1.000	0.905***	1.931***
	(0.303)	(0.910)	(0.182)	(0.533)
$POR \rightarrow ESP$	1.154***	0.908**	1.014**	0.861**
	(0.340)	(0.357)	(0.402)	(0.426)
$ESP \rightarrow POR$	1.358***	1.716***	1.722***	1.928***
	(0.469)	(0.276)	(0.227)	(0.204)
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.

Lessons learned

- We develop a 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 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.

Policy

- Reformulate cross-border priority energetic investment plans to include the positive effects on FDI on the cost-benefits analysis.
- Future EMI

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