Transition énergétique et performance des firmes à l'exportation: une étude micro-économique

27 Nov. 2013 - Séminaire PSE – MEDDE

What we do

- Combine:
  - Report for the French "Conseil d'Analyse Economique", joint with *Philippe Martin & Dominique Bureau*
  - More technical paper: "French Exporters and the Energy Costs", joint with *Philippe Martin & Gianluca Orefice* – work in progress
- Give stylized facts on competitiveness, energy prices and taxation
- Estimate impact of energy prices on exports
  - Model how electricity prices impact exports
  - Estimate impact using:
    - Data on energy consumption (IO tables) at sector level
    - Firm level data on exports (firm $\times$ product $\times$ destination $\times$ year)
  - Report point estimates used in the "Note du CAE"
  - Estimate impact of announced increase in French electricity prices on exports
  - Perform additional estimations and robustness

Motivation

- World prices of energy will increase:
  - Oil + 50% next 2 decades, coal +15% (cf. International Energy Agency, 2012, World Energy Outlook)
  - Supply/technology: Shale gas might relax temporarily this constraint
  - Demand: Oil prices $\times$ 7 since 2000 (in USD)
  - Policies: Environmental concerns (emissions) will $\uparrow$ prices
- France: diversification of energy mix ("trans° énergétique")
  - +30% increase in the price of electricity for households at 2017 horizon
  - Between +16% "green contract" and 24% "yellow contract" for business (*Commission de Régulation de l'Energie*)

Motivation (cont.)

Impact of energy prices on competitiveness

- Gallois 2012 report on competitiveness: "Le prix de l'énergie électrique pour l'industrie est relativement bas en France et représente un avantage qu'il est primordial de préserver."
- Distortions:
  - Energy is cheaper in France
  - Labor is more taxed
- French export market shares fell
  - 11% (2006 to 2011) and even more rapidly over 2003-08.
  - Comparison with Germany. + the 2 countries compete head-on
- Short & long run impacts of energy price differ
  - Short run: technology is given, energy price is a cost
  - Long run: energy price is a signal to consumers and producers: technology $\rightarrow$ adjusts Dynamic comparative advantages
- Sectoral dimension
  - Energy dependence of sectors differ largely
  - Energy is one cost – other determinants of price competitiveness play a role

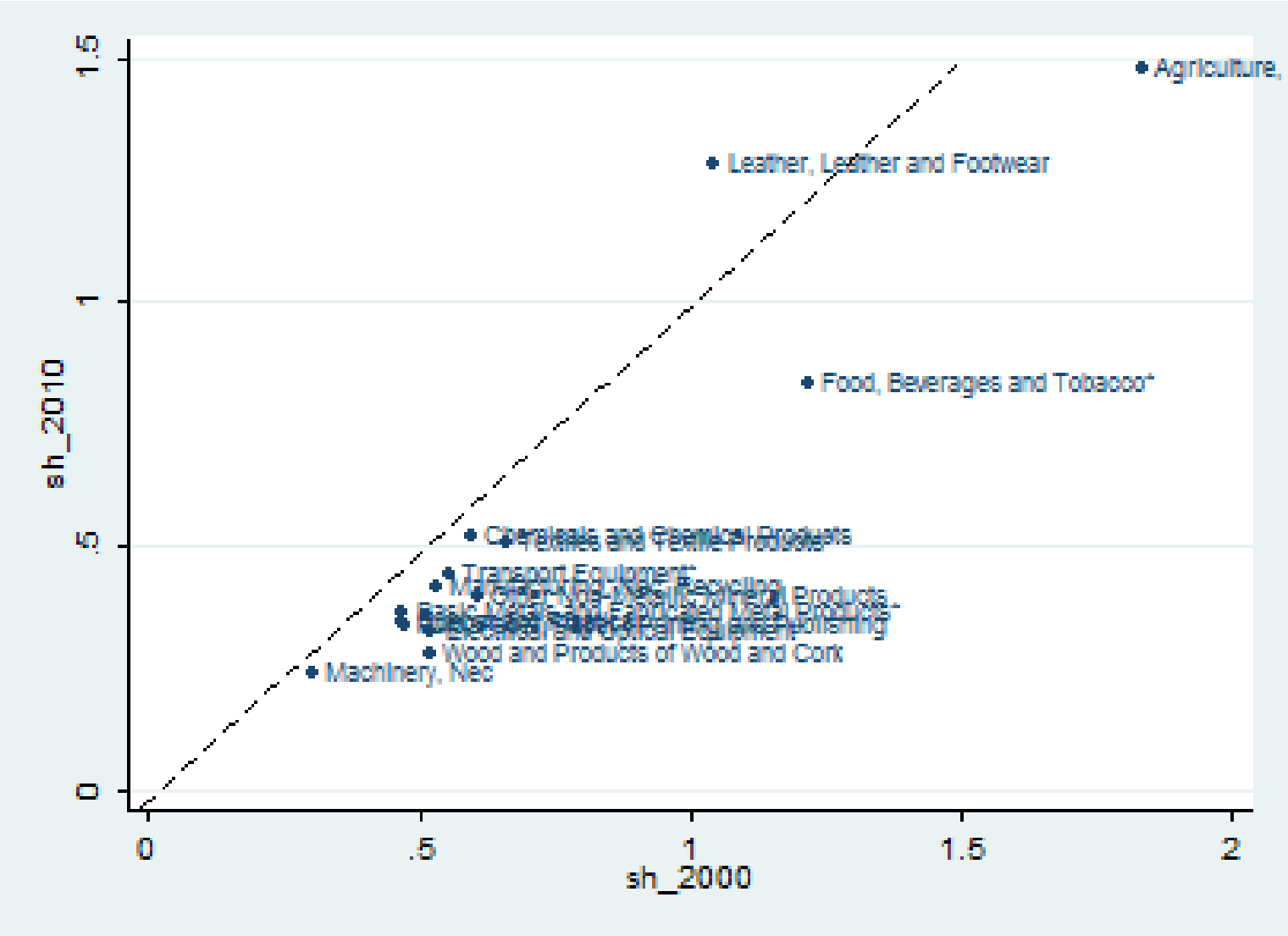

Figure: Ratio of world market shares in France and Germany: 2000 and 2010

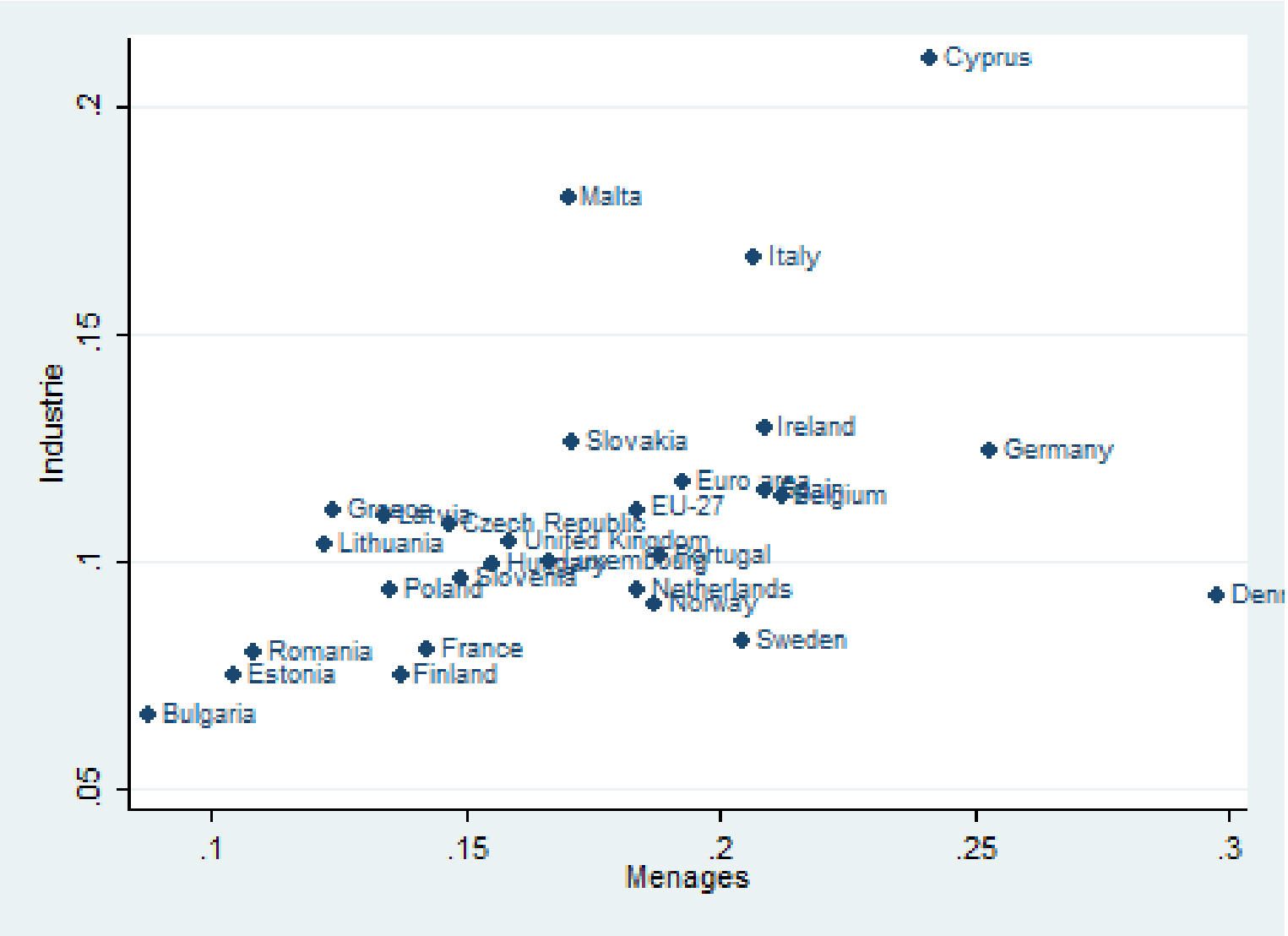

Figure: Eurostat electricity price 2011, households (2,500 to 5,000 kWh) and firms (500 MWh to 2,000 MWh), euro per Kwh

Table: End-use *mean* industrial energy prices: in national currency per ToE (IEA Energy Prices and Taxes Statistics database)

	2008	2011
Italy	3370	3248
Japan	1620	2082
Germany	1499	1828
Ireland	2162	1772
Spain	1455	1730
Portugal	1527	1618
Turkey	1614	1612
Belgium	1612	1611
Hungary	1973	1561
Switzerland	1090	1531
united Kingdom	1697	1481
Greece	1306	1460
Poland	1387	1416
France	**1219**	**1413**
netherlands	1545	1378
Denmark	1510	1339
Finland	1127	1321
Sweden	1109	1212
New Zealand	831	857
United States	794	809

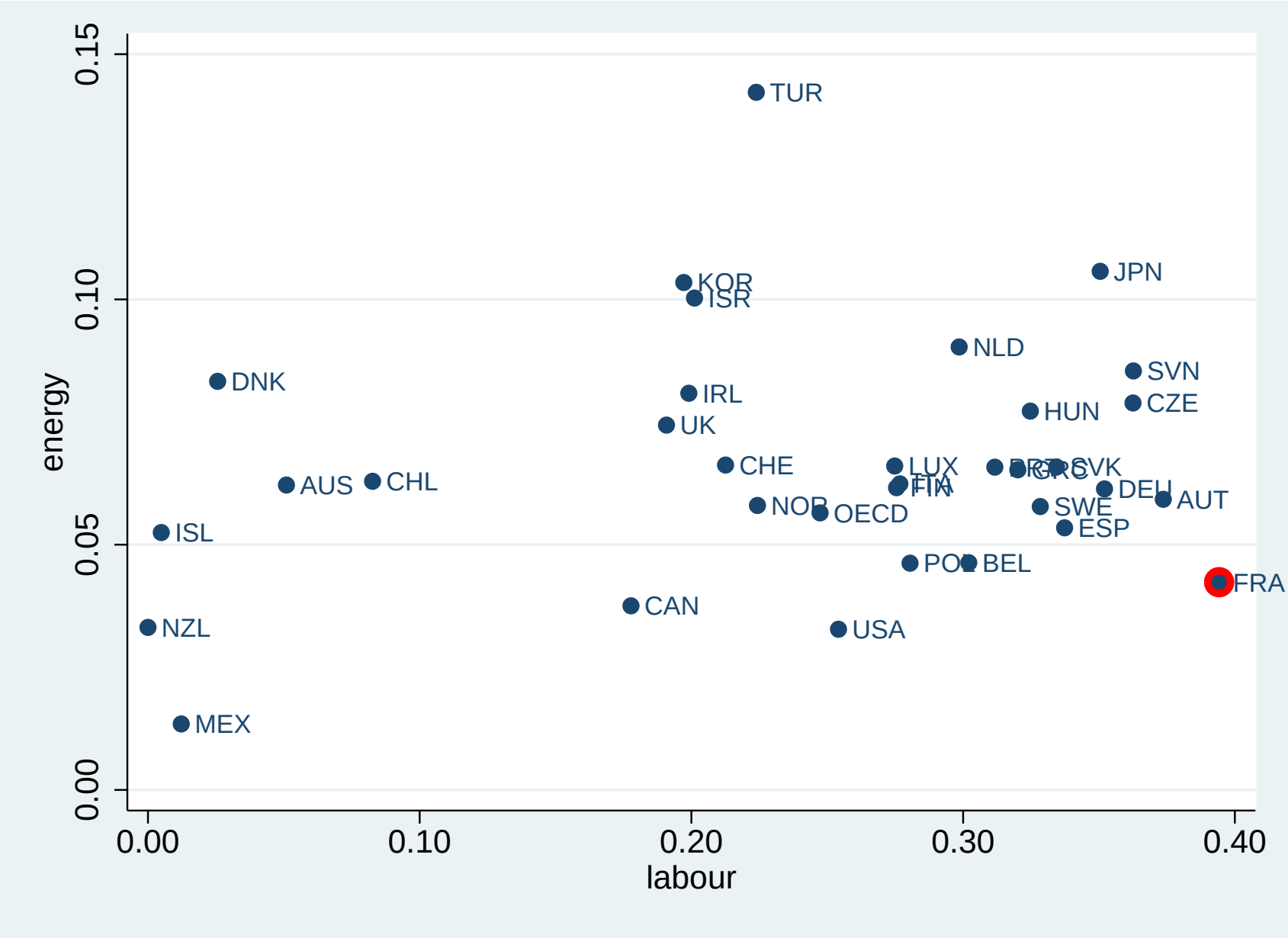

Figure: France taxes heavily labor not energy: Share of taxes on energy and labor in total public receipts (OECD)

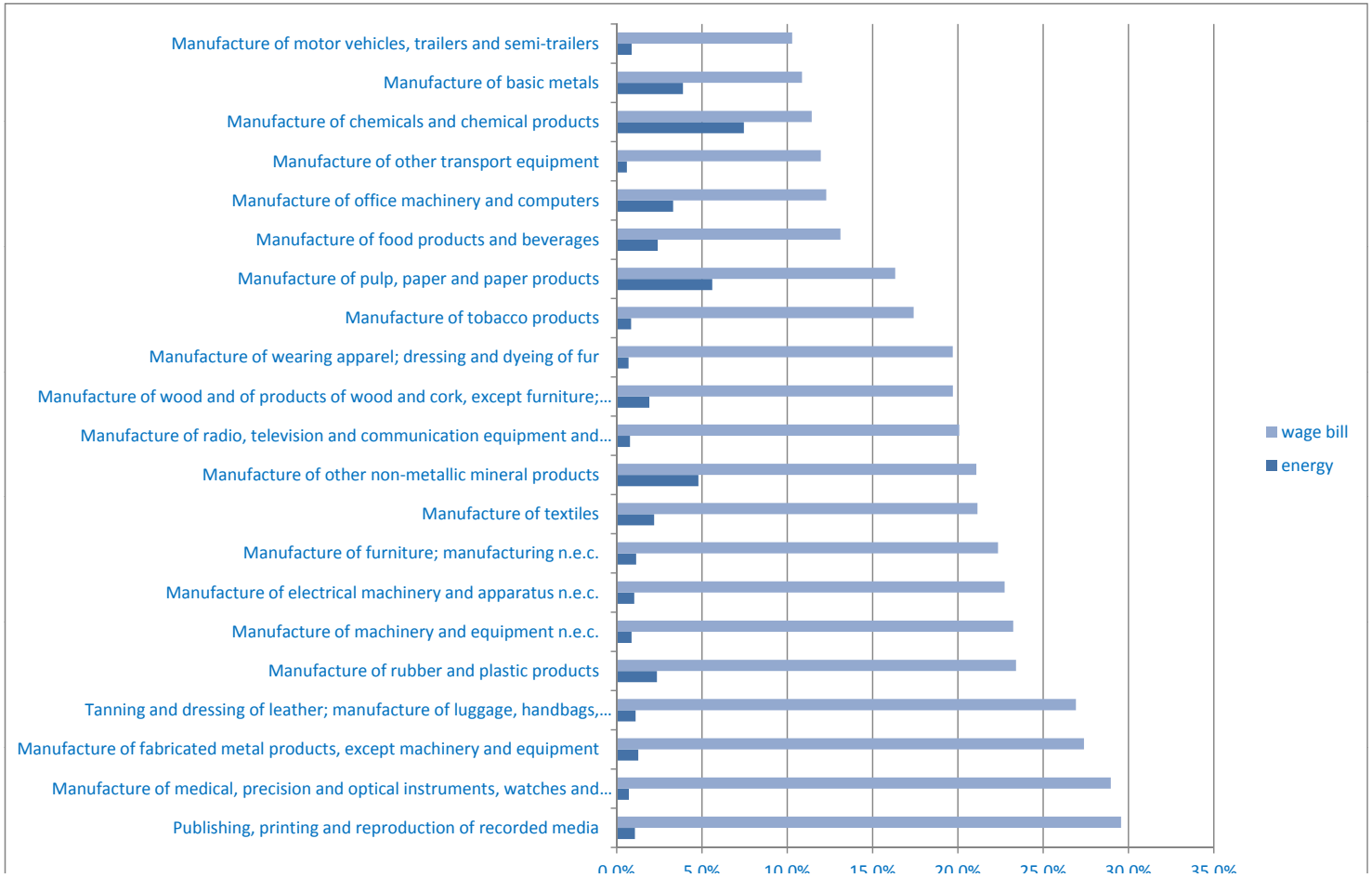

Figure: For most industries, problem n°1 is labor cost not energy: (direct) share of energy and salaries in production prices in France 2007

Competitiveness and energy prices in the short run

- Price-cost competitiveness imperfectly predicts changes in (French) market shares
  - Sector & destination composition effects
  - Non-price competitiveness (quality, design, innovation, etc.)
- However at the product-destination level quantities and values exported respond to prices
- Energy is a cost, that will be passed on the consumer
- Similar issue as for (real effective) exchange rate
- Exporters are firms, not countries
- Impact can be differentiated among firms
  - Exporters close to threshold can exit
  - Exporters can reduce their mark up

Previous estimates

- Evidence on aggregated data: Sato M. & A. Dechezlepretre, 2013, (Asymmetric industrial energy prices and international trade, LSE working paper)
- Panel 21 years 51 exporting countries (80% of world trade)
- Energy prices at country level for oil, gaz, electricity
- Bilateral trade explained by usual controls & energy price differential
- US energy dependence applied to each country
- A 10% increase in energy price reduces exports by 2%

Our approach

- Focus on firms
- Start with simple monopolistic competition model
- Use individual firm data
- Direct content in energy of production at sectoral level (first year)
- Exclude refineries
- Impact of energy prices on individual firm exports at sector-destination level
- Conditional on energy dependency of the sector the firm belongs to
- Conditional on firm size

Predictions

In a model without heterogenous elasticity of demand, we get that:

- Unit values in euro should increase with the price of energy but not with the exchange rate
- Volumes should decrease with both an appreciation and an increase in energy prices.
  - The first effect should be larger than the second as the share of energy is less than 1
  - The effect should be larger for sectors more energy dependent
- Values should decrease with both an appreciation and an increase in energy prices.

Trade data

- *Douanes* database provided by French custom for the period 1995-2008 (used at the CEPII)
  - Export flows of French firms by destination country, product (CN8 classification) and year
  - All trade flows by firm-product-destination that are above 1,000 euros for extra EU trade and 200euros for intra-EU trade
  - $\simeq$ 100,000 exporting firms per year and 200 destination markets; restrict sample of destination countries to 32 OECD countries
  - We also aggregated products lines from CN8 up to NACE (2 digit) level
  - Final sample reduces to 2001-2008 (energy dependency var. starts in 2001)
- Allows us to be consistent with the IO tables used to compute sectors' energy dependency measures
- Sector coverage is from 01 to 40 NACE 2 digit classification
- Total imports by country are from BACI (CEPII) dataset

Other data

- GDP by destination countries and energy prices (both electricity and gas) come from OECD.stat dataset
- No balance sheet information $\rightarrow$ size dummy built on firm's export flows in 2000 + FE
- Energy dependency measured (so far) at sector level:
  - French IO tables most disaggregated level (used at BdF)
  - No distinction by energy source
  - Usual computation based on Leontief inverse of interindustry matrix
  - Computed year before start analysis (2000) to avoid endogeneity

Estimation strategy: basic setting

We start by estimating the following equation:

$$
\begin{aligned}
ln(exp_{i,j,k,t}) \quad = \quad & \alpha + \beta_1 ln\left(Energy_t\right) + \\
& \beta_2 \left(ln\left(Energy_t\right) * ln\left(EnergyDep_{k,2000}\right)\right) + \\
& \beta_3 \left(ln\left(Energy_t\right) * SizeFirm_{i,2000}\right) + \\
& \beta_4 X_{i,j,t} + \phi_j + \phi_k + \varepsilon_{ijkt}
\end{aligned} \tag{1}
$$

where subscripts i, j, k and t stand respectively for firm, destination market, sector and year.

- We used $log(exp + 1)$ to keep zero trade flows
- We run separated regression for electricity and gas price (high correlation between electricity and gas price $\rightarrow$ we could not include both in the same regression) – and show electricity only

Issues

- Energy price can be French price or difference with destination.
- Trade models with heterogeneous firms: exporters react differently to an increase in the variable costs (energy cost)
  - Large firms (total export value $>$ median in 2000) may be more productive.
  - Large firm may be more capitalistic and more energy dependent
  - Include a further interacted variable between the price of energy and a firm's size dummy (*SizeFirm*)
- To control for any sector and country specific (time invariant) omitted variable we include sector (ϕ_k) and destination country (ϕ_j) fixed effects in equation (1)
- Since our main regressor is year specific, we could not include year fixed effects. To solve (partially) this omission in all regressions we include a time trend and some country-year specific variables ($X_{i,j,t}$).

Table: OLS estimation results on electricity price. Dep. var. values

	(1)	(2)	(3)	(4)
Elec. price	-0.196***			
	(0.00706)			
Elec. price x En. dep.	0.0181			
	(0.0284)			
Elec. price x Firm Size				
Firm Size	1.226***			
	(0.00215)			
Imports	0.400***			
	(0.0137)			
GDP destination	0.549***			
	(0.0362)			
Sample of firms	All			
En. price def. as:	French			
Fixed Effects				
Country	yes			
Sector	yes			
Country-year	no			
Time trend	yes			
Observations	4609481			
R-squared	0.135			

Robust standard errors in parentheses. *** $p < 0,01; ** p < 0,05; *p < 0,1$.

Results of basic setting

- A 10% increase in the electricity price in France reduces the value exported by firms (on average) by 1.9%
  - Expected 20% increase for industrial sector horizon 2017
  - $\rightarrow$ -1.8% exports $\rightarrow$ euro -16 bn (excl. energy exports).
  - Double this figure in case of accelerated replacement of nuclear plants by alternatice sources (before 2030)
- Similar evidence for gas price estimation, where a 10% increase in the price of gas reduces exports by 1.1%.
- Interaction for heavily energy dependent sectors is not significant
- Other controls as expected

Results differentiated by firm size

- Next we want to focus on the effect of energy prices on the bigger firms.
- As a first step in this direction we include an interacted variable between the energy price and the size of the firm in 2000 $\rightarrow$ Significant.
- We re-estimated on a sub-sample of big firms (top 15% exporting firms) $\rightarrow$ Confirms previous results.
- Finally we consider price difference: need to control for destination-year specific (omitted) variables (indeed the price of energy in the destination country may be affected by several factors that we do not observe) using a country-time FE. Incidentally controls for RER. $\rightarrow$ confirms previous results.

Table: OLS estimation results on electricity price. Dep. var. values

	(1)	(2)	(3)	(4)
Elec. price	-0.196***	-0.127***		
	(0.00706)	(0.00827)		
Elec. price x En. dep.	0.0181	0.0190		
	(0.0284)	(0.0284)		
Elec. price x Firm Size		-0.0845***		
		(0.00764)		
Firm Size	1.226***	1.765***		
	(0.00215)	(0.0488)		
Imports	0.400***	0.401***		
	(0.0137)	(0.0137)		
GDP dest°	0.549***	0.561***		
	(0.0362)	(0.0363)		
Sample of firms	All	All		
En. price def. as:	French	French		
Fixed Effects				
Country	yes	yes		
Sector	yes	yes		
Country-year	no	no		
Time trend	yes	yes		
Observations	4609481	4609481		
R-squared	0.135	0.135		

Robust standard errors in parentheses. *** $p < 0,01; ** p < 0,05; *p < 0,1$.

Table: OLS estimation results on electricity price. Dep. var. values

	(1)	(2)	(3)	(4)
Elec. price	-0.196***	-0.127***	-0.229***	
	(0.00706)	(0.00827)	(0.0207)	
Elec. price x En. dep.	0.0181	0.0190	-0.236**	
	(0.0284)	(0.0284)	(0.0918)	
Elec. price x Firm Size		-0.0845***		
		(0.00764)		
Firm Size	1.226***	1.765***		
	(0.00215)	(0.0488)		
Imports	0.400***	0.401***	0.412***	
	(0.0137)	(0.0137)	(0.0358)	
GDP dest°	0.549***	0.561***	1.888***	
	(0.0362)	(0.0363)	(0.0956)	
Sample of firms	All	All	Top 15%	
En. price def. as:	French	French	French	
Fixed Effects				
Country	yes	yes	yes	
Sector	yes	yes	yes	
Country-year	no	no	no	
Time trend	yes	yes	yes	
Observations	4609481	4609481	966227	
R-squared	0.135	0.135	0.124	

Robust standard errors in parentheses. *** $p < 0,01; ** p < 0,05; *p < 0,1$.

Table: OLS estimation results on electricity price. Dep. var. values

	(1)	(2)	(3)	(4)
Elec. price	-0.196***	-0.127***	-0.229***	
	(0.00706)	(0.00827)	(0.0207)	
Elec. price x En. dep.	0.0181	0.0190	-0.236**	-0.214***
	(0.0284)	(0.0284)	(0.0918)	(0.021)
Elec. price x Firm Size		-0.0845***		-0.034***
		(0.00764)		(0.005)
Firm Size	1.226***	1.765***		1.135***
	(0.00215)	(0.0488)		(0.003)
Imports	0.400***	0.401***	0.412***	
	(0.0137)	(0.0137)	(0.0358)	
GDP dest°	0.549***	0.561***	1.888***	
	(0.0362)	(0.0363)	(0.0956)	
Sample of firms	All	All	Top 15%	All
En. price def. as:	French	French	French	Difference
Fixed Effects				
Country	yes	yes	yes	yes
Sector	yes	yes	yes	yes
Country-year	no	no	no	yes
Time trend	yes	yes	yes	yes
Observations	4609481	4609481	966227	3832472
R-squared	0.135	0.135	0.124	0.160

Robust standard errors in parentheses. *** $p < 0,01; ** p < 0,05; *p < 0,1$.

Conclusion

- Energy prices to increase
- Energy is a cost
- Additional costs reduce exports cet. par.
- Energy dependent sectors more affected
- Large firms more affected
- Competitiveness issue concentrated on a limited number of firms or even plants
- Pending issues
  - Cyclicality of energy price
  - Do not observe firm level energy dependency
  - Next step: use firm level data on energy dependency (EACEI)

Merci pour votre attention