ETR EVALUATION: APPROPRIATENESS AND EFFECTIVENESS OF ETR

Outline

1. Appropriate: assessing responses of energy demand to price and economic activity
2. Effective: assessing the impact of change in prices caused by ETR on energy and labour demand

Based on Agnolucci (2009) *Energy Economics* and Agnolucci (2009) *Energy Policy*

PART I: APPROPRIATENESS OF ETR

WHY INDUSTRIAL ENERGY?

ETR focused on industrial energy consumption (at least UK)

Industrial energy consumption more reactive to price signals (substitution)

Established interest in the academic community (Energy Economics 2007)

WHY PANEL ESTIMATORS (x_{it})?

Long enough series at the sectoral level

Assessing differences across sectors

Difficulty in estimating linear time series model on the industrial sector

Assessing common factors across sectors

Estimating dynamic models

DATA

Energy consumption: sum of fuel consumption
Price: weighted average of fuel prices
Economic activity: GVA
Sources: IEA, ONS, DUKES et similar German Publications
Sample I: 1978-2004 (UK only)
Sample II: 1991-2004 (D and UK)

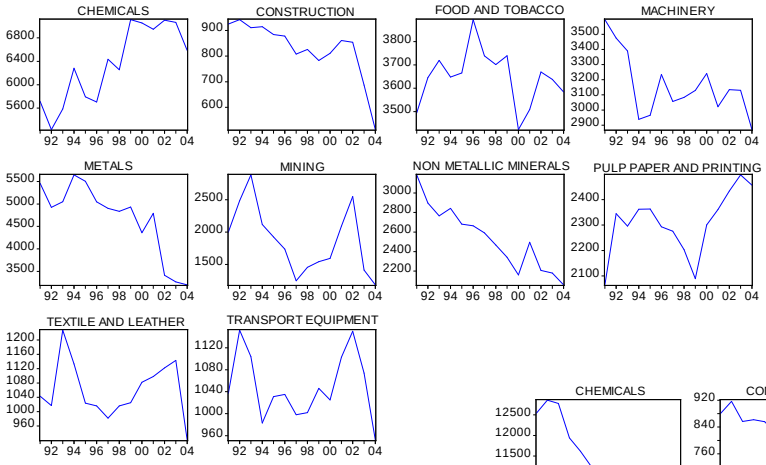
From the outset:

- Short Sample can affect statically significance
- Ability to estimate dynamic models
- No other choice for Germany

INDUSTRIAL SECTORS

Identifier		**Sectors**	**NACE Taxonomy**
1	MIN	Mining and Quarrying	13-14
2	FT	Food and Tobacco	15-16
3	TXT	Textile and Leather	17-19
4	PPP	Pulp, Paper and Printing	21-22
5	CHE	Chemicals	24
6	NMM	Non-Metallic Minerals	26
7	MAC	Machinery	28-32
8	TRA	Transport Equipment	34-35
9	CON	Construction	45
10	MET	Metals	27

ENERGY CONSUMPTION (1991-2004)



<< UK

Pay attention to scale

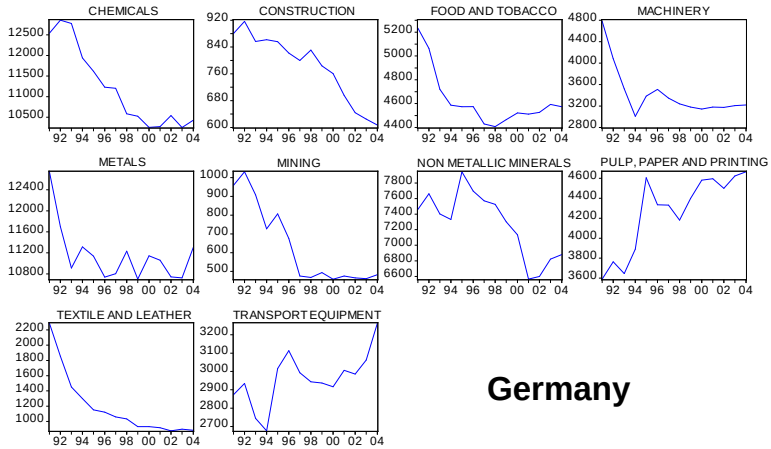
Quite spiky

Influence of big players in some sectors, e.g. Mining

Not decreasing in all sectors

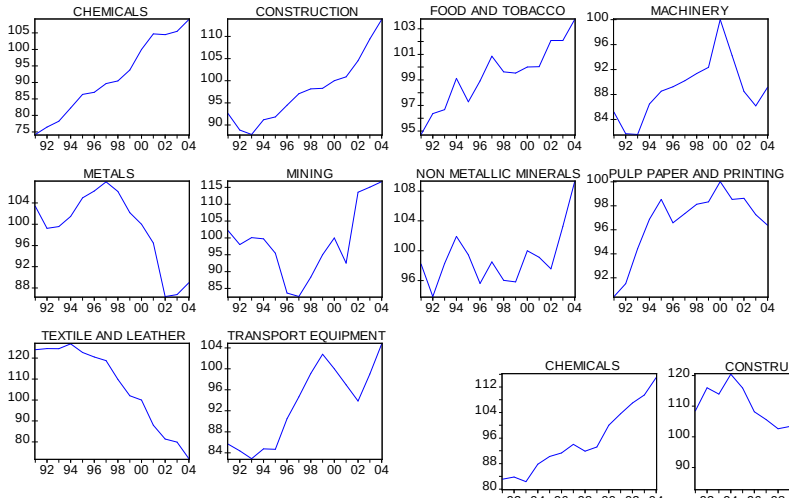
- Chemicals in UK, Transport in D

Similarities across countries:
- PPP - Construction
- Non-Metallic Minerals



Germany

GVA (1991-2004)



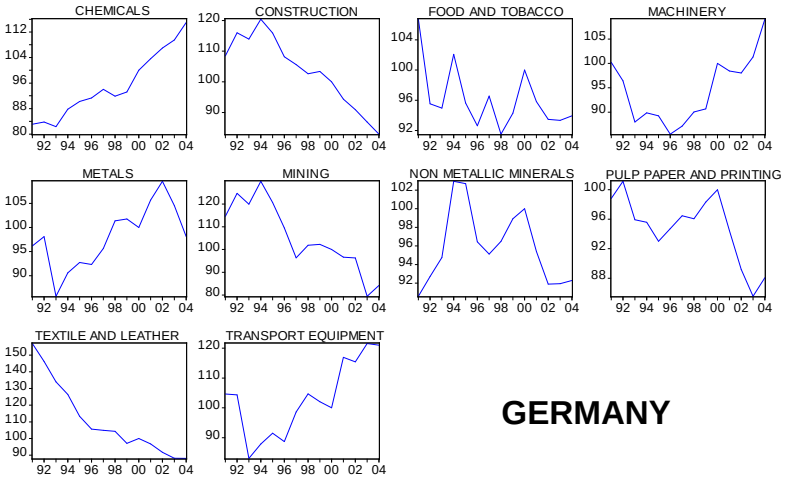
<< UK

Upward trend, contrary to common perception, Notable exceptions: - Textile and Leather (both countries)

UK doing better
- only TXT and MET decreasing

In Germany, fallers are: - CON, FT, MIN and PPP

Different countries, different trend: e.g. MET



GERMANY

TIME SERIES SECTORAL MODELS

ARDL models

Automatic estimation and selection based on AIC/SC

Twelve models per sectors

- Lags: Zero/One for each variable -> 6 models
- Linear Trend: with / without -> 2 models

Could have used GETS

TIME SERIES MODELS (1978-2004)

	FT	TXT	PPP	CHE	NMM	MAC	CON	MET	TOT
e_{t-1}	0.51 (3.41)	0.69 (4.75)	0.78 (9.82)	0.81 (7.40)	-0.14 (-0.76)	0.48 (3.82)	0.68 (3.46)	-0.29 (-1.50)	0.78 (7.38)
trend	-0.01 (-2.68)	-0.03 (-1.81)			-0.03 (-6.47)	-0.01 (-3.72)		-0.07 (-5.91)	
LRY	2.46 (1.87)	-0.92 (-1.22)	-0.34 (-0.46)	-1.89 (-1.54)	0.93 (8.63)	1.20 (3.19)	-1.65 (-2.22)	0.09 (0.65)	-0.02 (-0.03)
LR P	-0.42 (-1.63)	-2.92 (-1.76)	-2.12 (-1.87)	-3.62 (-1.39)	-0.30 (-2.92)	-0.44 (-1.90)	-2.41 (-1.90)	-1.09 (-5.22)	-0.12 (-0.15)

Selection of short- and long-run parameters

Two alternating adjustment processes

Half with trend

Not obeying economic theory: b<0 for price and b>0 for GVA

Odd values:

- LRY in FT and MAC: developing countries?
- LRP: all negative but oddly too sensitive

Heterogeneity in the values of the parameters

HOMOGENOUS ESTIMATORS

	Static FE/RE	FD	Dynamic FE/RE	AH	GMM
y_t	0.45 (2.95)	0.57 (5.21)	0.58 (3.01)	1.03 (0.82)	0.42 / 0.55 (1.55) / (3.43)
p_t	-0.39 (-2.87)	-0.43 (-4.82)	-1.18 (3.38)	-1.34 (-0.87)	-0.98 / -1.02 (-3.07)/ (3.47)
Trend	-0.02 (-9.44)	-0.02 (-4.77)	-0.03 (-5.37)	-0.02 (-1.11)	-0.01 / -0.01 (-4.22) / (-4.93)

Price coefficients, two groups:

- Static estimators (<0.40)

- Dynamic estimators (>1.00)

Shorter samples:

- lower coefficients (absolute value)

- non statistically significant

Over-estimation of Long-run effect when using pooled estimators in dynamic setting (Pesaran and Smith 1995)

Dynamic FE/RE, AH and GMM discarded

HETEROGENOUS ESTIMATORS

	Static MG	Dynamic MG	Static RC	Dynamic RC
y_t	**0.01 (0.06)**	**0.01 (0.02)**	**0.05 (0.18)**	**0.37 (0.19)**
p_t	**-0.78 (-5.61)**	**-1.65 (-3.36)**	**-0.78 (-4.37)**	**-1.03 (-0.50)**
Trend	**-0.03 (-2.55)**	**-0.02 (-2.13)**	**-0.03 (-2.69)**	**-0.01 (-1.76)**

Not much to report

N too small so that effect of outlier is not smoothed out (Hsiao et al 1999)

This influences both the value of the estimate and significance of estimates

Particularly strong in the case of dynamic estimators because of the way long-run effects are computed

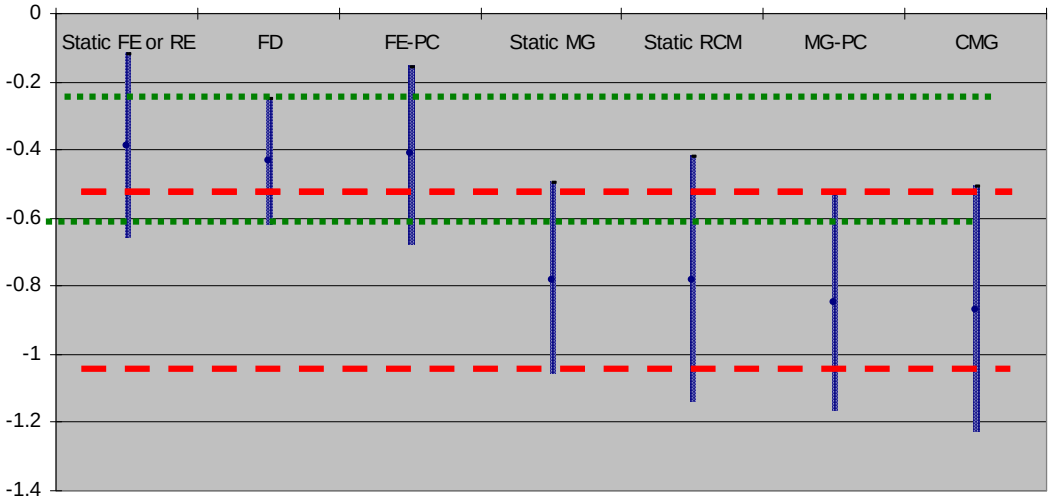
COMMON FACTOR ESTIMATORS

	FE	FE-PC	MG	MG PC	DMG	CMG
y_t	0.45 (2.95)	0.46 (3.06)	0.01 (0.06)	0.02 (0.08)	0.76 (2.42)	0.43 (1.14)
p_t	-0.39 (-2.87)	-0.41 (-3.30)	-0.78 (-5.61)	-0.85 (-5.38)	-0.80 (-2.86)	-0.87 (-4.89)
Trend	-0.02 (-9.44)	-0.02 (-8.88)	-0.03 (-2.55)	-0.03 (-4.16)		- 0.002 (-0.32)

Coefficient on price robust to applied methodology (CNG, DMH and MG PC)

Comparing results of Heterogeneous estimators implies assessing if outliers are taken care of: PC adding little

ESTIMATED VALUES: PRICE ELASTICTIES

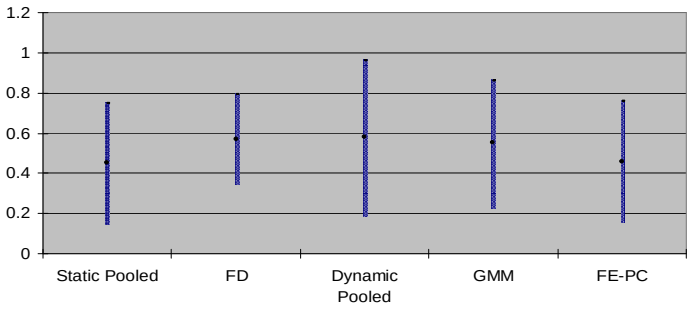


Two groups of values: homogenous vs. heterogeneous

-0.40 is a decently-sized value compared those seen in time-series studies (very low)

Considering drawbacks of both heterogeneous and homogenous (low N vs. not biased only asymptotically), average of the two groups seems advisable: -0.64

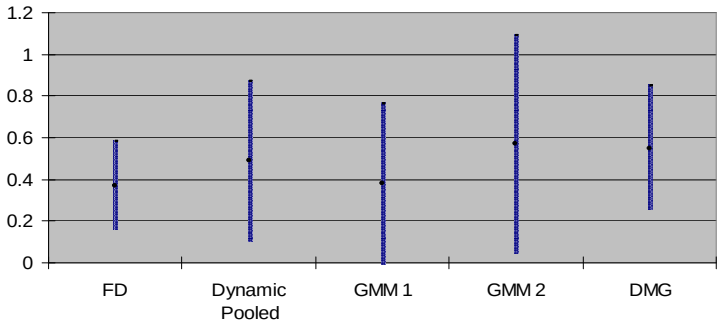
ESTIMATED VALUES: INCOME (UK and D)



UK (above): Not much uncertainty, range being 0.45 - 0.58

Simple Average: 0.52

Confirmed by results for Germany (below)



CONCLUSIONS

METHODOLOGY

- Allowing heterogeneity markedly increase values of estimate

- Heterogeneity present in time-series models

- Importance of implementing recently developed estimators in applied studies

POLICY

- Estimates in the literature maybe err on the low side, especially those using time-series models

- Negative side: Energy demand more responsive to economic activity than expected

- Positive side: Energy demand more responsive to price than expected -> ETR likely to be appropriate

- Linear trend: decreasing effect on energy consumption

PART II: ASSESSING ETR

ECONOMETRIC APPROACH

Simple translog cost function

Share equations are a function of:

- **time trend, i.e. non-neutral technological change**
- **economic activity, i.e. output bias**
- **price of production inputs**

$$s_{it} = \beta_i + \beta_{iT}\, t + \beta_{iy} \ln y_t + \sum_j \beta_{ij} \ln p_{jt} \qquad i, j = \text{cap}, \text{lab}, ene, mat, \text{serv}$$

From parameters and costs shares, get price elasticities

Given price elasticities and price change induced by ETR, find effect on demand

<u>Drawback</u>: no effect of ETR on output, trade, etc.

DATA

Sample: 1978 – 2004

Variables: capital, labour, energy, materials, and services (new component)

KLEMS database: published during petrE

Acronym	Sector	NACE Taxonomy	Assessed in
FT	Food and Tobacco	15-16	UK
PPP	Pulp, Paper and Printing	21-22	Germany
RP	Rubber and Plastics	25	Germany and UK
NMM	Non-Metallic Minerals	26	Germany and UK
MAC	Machinery	29	UK
ELE	Electrical and Optical Equipment	30-33	UK
TRA	Wholesale and Retail Trade	G	Germany
FIN	Financial intermediation	J	UK

Sectors choice: opposite motivation

- **Covering a wide range of NACE**
- **Comparison between the two countries**

RESULTS

Liner trend and output tends to be significant (often assumed away in published papers)

Linear trend tends to increase energy consumption (confirming Allen and Urga 1999 for UK) and decrease labour demand

Contrasting results with log-linear specifications, where trends has negative effect on energy demand

Would be useful to explore this further

RESULTS - UK

	Energy	Labour	Energy	Labour	Energy	Labour
	FT		**RP**		**NMM**	
Energy	-1.02	-0.02	-0.76	0.10	-0.43	-0.24
Labour	0.00	-0.19	0.01	-0.09	-0.06	-0.57
	MAC		**ELE**		**FIN**	
Energy	-1.05	1.17	-0.85	0.52	-0.22	0.81
Labour	0.07	-0.19	0.02	-0.66	0.04	-0.38

Sector in 1st column refers to equation

Sector in 1st row refers to variable

Energy price elasticities: some high values

Average in industrial sectors:

- 0.69 energy

- 0.29 labour

Cross-price elasticities much smaller, except MAC and FIN

RESULTS - GERMANY

	Energy	Labour	Energy	Labour
	PPP		**RP**	
Energy	-0.76	-1.22	-0.38	- 0.89
Labour	-0.21	-0.36	-0.10	-0.57
	NMM		**TRA**	
Energy	-0.22	0.07	-0.20	-0.28
Labour	0.02	-0.46	-0.01	-0.22

Energy price elasticities: overall, lower values

Average in industrial sectors:

- 0.31 energy

- **0.32 labour**

Surprising results, German firms as sensitive as UK firms to labour price

Risk in international comparison with KLEMS dataset

ETR ESTIMATION

UK			**Germany**		
	Energy	**Labour**		**Energy**	**Labour**
Food and Tobacco	-3.75	0.07	Pulp, Paper and Printing	-3.03	-0.82
Rubber and Plastics	-3.58	0.08	Rubber and Plastics	-1.18	-0.05
Non-Metallic Minerals	-2.28	-0.13	Non-Metallic Minerals	-0.73	0.40
Machinery	-3.36	0.26	Wholesale and Retail Trade	-2.82	-0.04
Electrical and Optical Equipment	-3.93	0.32			
Financial intermediation	-2.05	0.45			

Percentage change in energy price - sources: Bach (2005) and ONS(2008)

Taking into account of sector-specific exemptions

ETR ESTIMATION

UK			Germany		
	Energy	**Labour**		**Energy**	**Labour**
Food and Tobacco	-3.75	0.07	Pulp, Paper and Printing	-3.03	-0.82
Rubber and Plastics	-3.58	0.08	Rubber and Plastics	-1.18	-0.05
Non-Metallic Minerals	-2.28	-0.13	Non-Metallic Minerals	-0.73	0.40
Machinery	-3.36	0.26	Wholesale and Retail Trade	-2.82	-0.04
Electrical and Optical Equipment	-3.93	0.32			
Financial intermediation	-2.05	0.45			

Reduction in Energy Demand: UK 3.1%, Germany 2%

Results agree with Cambridge Econometrics (2005) AND Bach (2005) Percentage change in energy price - sources: Bach (2005) and ONS(2008)

Increase in Labour in UK: 0.17%

Decrease in Labour in UK: 0.12%, very influenced by PPP, dropping that sector -> 0.10 increase, the latter being closer to the resulst seen in the literature

CONCLUSIONS

Advantages: simple econometric approach, implemented in standard econometric packages with public dataset

Drawbacks: fixed output, no international linkages

Despite limitations, results confirms conclusions seen in the literature

About 2-3% reduction in energy demand

Small increase in labour: 0.10%

Environmental Tax Reforms:

- effective in decreasing energy demand and CO2 emissions

- at worst leaving employment unaltered

- successful in avoiding possible negative impact of stand-alone energy taxes