“[…] in the words of Lord Kahn [1905-1989**]**, ‘when the flow of North Sea oil and gas begins to diminish, about the turn of the [21st] century, our island will become desolate.’ Any disease which threatens that kind of apocalypse deserves close attention.”
“The Dutch Disease,” *The Economist*, November 26, 1977: pp-82-83.

An Empirical Test of the Dutch Disease using a Gravity Model of Trade

JEAN-PHILIPPE STIJNS

QUESTIONS:

- Do natural resource boom tend to hurt a country’s manufacturing exports?
- How large, if any, is this effect?

STRUCTURE:

1. A quick review of the Dutch Disease
   1. Theory
   2. Empirical contributions
2. The test set-up
   1. Gravity Model of Trade
   2. Energy price shock exposition variables
   3. The data
3. Results
   1. Benchmark gravity estimates
   2. Baseline test results
   3. Sensitivity analysis
4. How and why do my results differ?
5. Conclusions and Areas of Ignorance

1.1 The Corden and Neary (1982) "core model" of DD economics

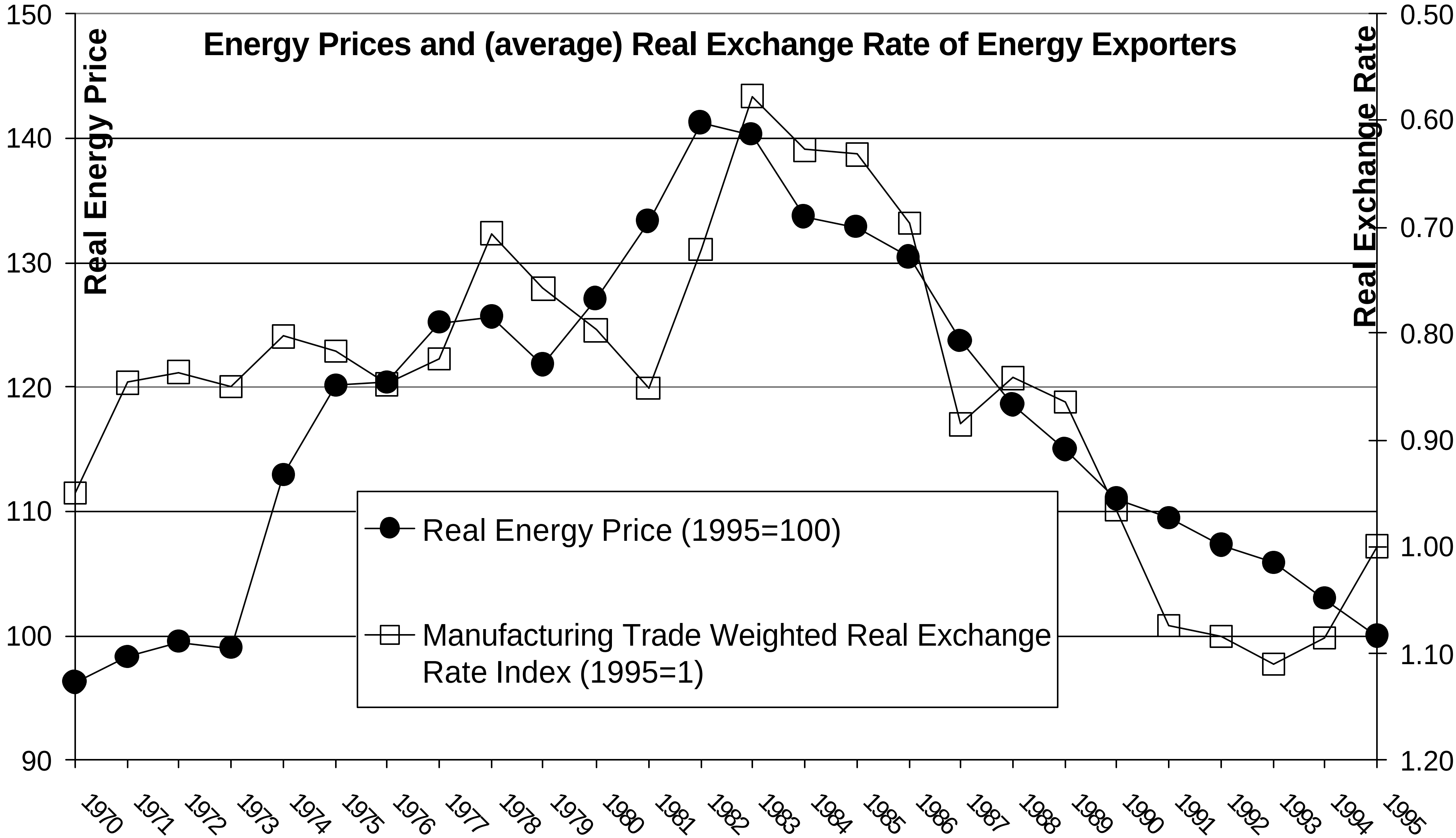
- small open economy;
- 3 goods: 2 traded at int'l prices, a third, non-traded good
- energy sector boom, say
  - *resource movement effect*
    - ⇧ MPL in energy sector,|
    - manufacturing and non-tradable labor ➲ the energy sector.
    - ⇩ **manufacturing sector output** *("direct deindustrialization")* ⇨
    - ⇧ price of non-traded goods ⇨ real exchange rate appreciation
  - *spending effect*
    - ⇧ income ⇨ demand for both tradables and non-tradables ⇧
    - ⇧ price of non-tradables ⇨ real exchange rate appreciation
    - manufacturing labor ➲ the non-tradable sector.
    - ⇩ **manufacturing sector output** *("indirect deindustrialization"*)

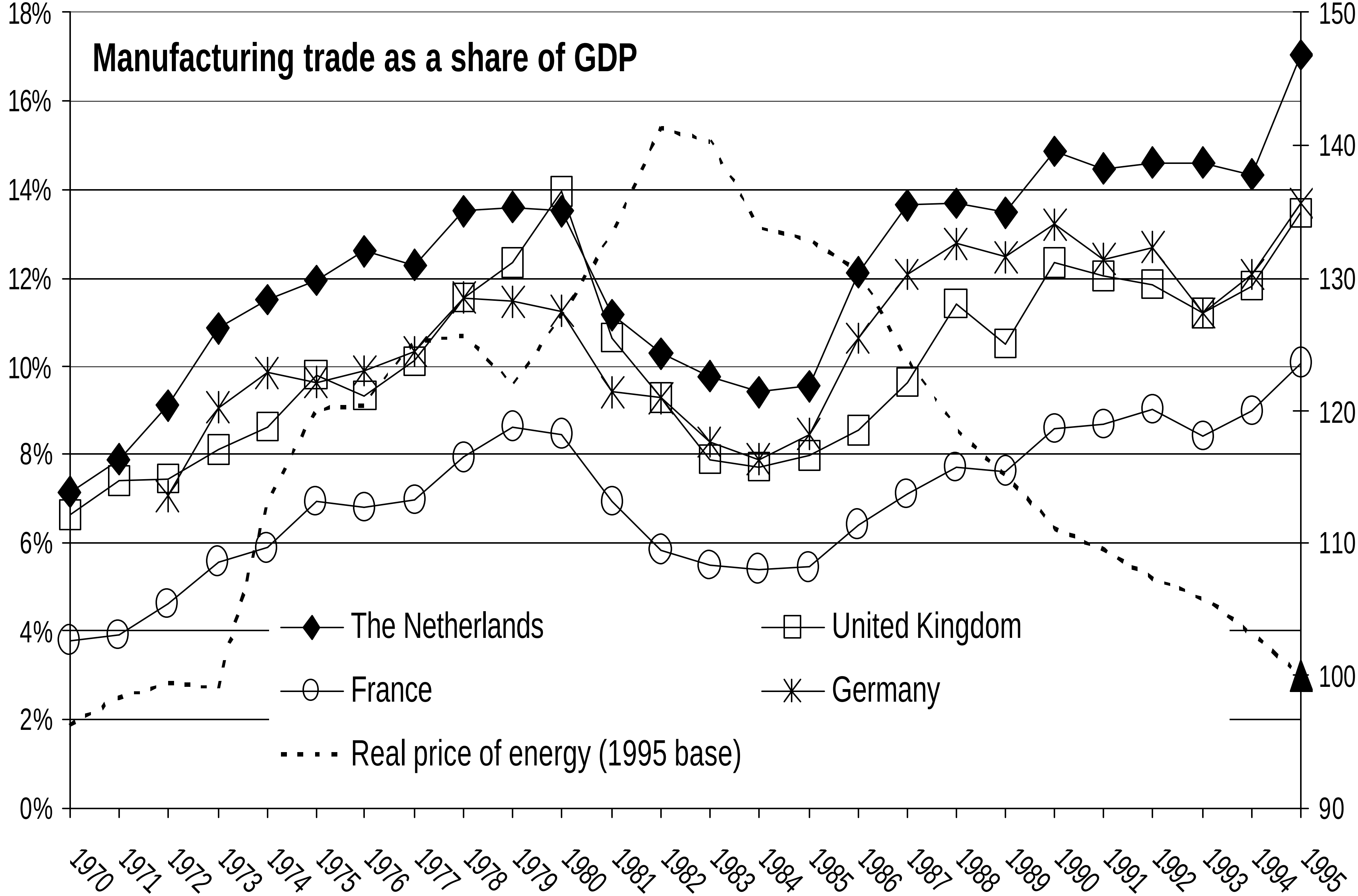
1.2 DD Empirics in OECD countries

- **The Netherlands**: Barker (1981), Corden (1984), Kremers (1985)
  - severe decline in several Dutch manufacturing industries (textiles, clothing, vehicles) **but…**
    - clearly other countries also experienced substantial growth in unemployment.
    - the decline between 1973 and 1977 was partly due also to stagnation in the EC, which is the main trading area of The Netherlands, and to the German recession in particular.
- **United Kingdom**: Forysth (1985), Ross (1986)
  - there is evidence of DD effects :between 1977 and 1980, the real exchange rate appreciated by 51-55 per cent.
  - Manufacturing output fell by four per cent altogether over 1973-79 and by 14 percent over 1979-82 **but…**
    - commercial production of UK North Sea oil did not begin after all until 1975 when the (first) recession was already well under way.
    - Simultaneously, very tight monetary policy was put in place, resulting in high nominal interest rates over the period 1979-81
    - by virtue of being a ‘petrocurrency’ at a time of high oil prices, the pound became a secure haven, especially when the country had a tough deflationary government.
    - Britain seemed to be reinforcing the structural effects by using up its benefits over a short period.

1.2 (cont.) DD Empirics in LDC's

- Many authors simply find little evidence of a DD in many of their case studies (Gelb 1988, Cuddington 1989, Davis 1983)
- Gary McMahon (1997): DD is induced by an inadequate policy response to a shock to the resource sector
- Gelb (1988) as well as Spatafora and Warner (1999) analyze the performance of oil boom countries. They find that favorable terms-of-trade shocks increase non-tradable output but that DD effects are strikingly absent.
- The effect of booms in other primary commodities has also been investigated. Most studies are inconclusive while Columbian coffee seems to be the exception (Cuddington 1989, Davis 1983, Kamas 1986 and Roca 1999)


Energy Prices and (average) Real Exchange Rate of Energy Exporters
Real Energy Price
Real Exchange Rate
150
140
130
120
110
100
90
0.50
0.60
0.70
0.80
0.90
1.00
1.10
1.20
Real Energy Price (1995=100)
Manufacturing Trade Weighted Real Exchange Rate Index (1995=1)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995



Manufacturing trade as a share of GDP
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
150
140
130
120
110
100
90
The Netherlands
United Kingdom
France
Germany
Real price of energy (1995 base)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995

2.1 A Gravity Model of Trade

- is a very simple empirical model that explains the size of international trade between countries.
- has a remarkably consistent (and thus, for economics, unusual) history of success as an empirical tool.
- can now claim theoretical foundations.

$$
\begin{aligned}
\ln(X_{ijt}) &= \boldsymbol{b}_0 + \boldsymbol{b}_1 \ln(Y_{it}) + \boldsymbol{b}_2 \ln(Y_{jt}) + \boldsymbol{b}_3 \ln(D_{ij}) \\
&+ \boldsymbol{b}_4 Lang_{ij} + \boldsymbol{b}_5 Cont_{ij} + \boldsymbol{b}_6 FTA_{ij} + \boldsymbol{b}_7 Landl_{ij} \\
&+ \boldsymbol{b}_8 Island_{ij} + \boldsymbol{b}_9 ComCol_{ij} + \boldsymbol{b}_{10} CurCol_{ij} \\
&+ \boldsymbol{b}_{12} ComNat_{ij} + \tilde{\text{ß}}\mathbf{DD} + e_{ijt}
\end{aligned}
$$

where *i* and *j* denotes countries, *t* denotes time

2.2 Resource shock indicators

EPE_{it} = *energy price exposure*

= [1(i *net* ***fuel*** *exporter*) - 1(i *net* ***fuel*** *importer*)] x log(*real price of energy*)

$EPED_{ijt}$ = *energy price exposure difference* = *EPE* of origin - *EPE* of destination

$= EPE_{it} - EPE_{jt}$

MPE_{it} = *mineral price exposure*

= [1(i *net* ***metal*** *exporter*) - 1(i *net* ***metal*** *importer*)] x log(*real price of* ***metals***)

$MPED_{ijt}$ = *mineral price exposure difference* = *MPE* of origin - *MPE* of destination

$= MPE_{it} - MPE_{jt}$

$$\Rightarrow \widetilde{\text{ßDD}} = b_{13} EPED_{ijt} + b_{14} MPED_{ijt}$$

2.2 (cont.) Putting it all together

$$\ln(X_{ijt}) = b_0 + b_1 \ln(Y_{it}) + b_2 \ln(Y_{jt}) + b_3 \ln(D_{ij})$$
$$+ b_4 Lang_{ij} + b_5 Cont_{ij} + b_6 FTA_{ij} + b_7 Landl_{ij}$$
$$+ b_8 Islandf_{ij} + b_9 ComCol_{ij} + b_{10} CurCol_{ij}$$
$$+ b_{12} ComNat_{ij} + b_{13} EPED_{ijt} + b_{14} MPED_{ijt} + e_{ijt}$$

where *i* and *j* denote countries, *t* denotes time

Fixed effects with year (*t*) dummies	Random effects with year (*t*) dummies
Fixed effects w/o year (*t*) dummies	Random effects w/o year (*t*) dummies

where *ID* = country pair

2.3 Data

- **Standard "gravity" controls** are taken from Glick and Rose (2002). Real GDP and population are taken from the World Bank (2002).
- **Manufacturing exports** are extracted from the World Trade Database (WTDB) assembled by Statistics Canada. It contains bilateral trade flows for all countries over 1970-1992, recently updated up to 1997, classified according to the Standard International Trade Classification. This data set is estimated to cover 98% of all trade.
- The series for the **world price of energy and metals** come from the International Financial Statistics the I.M.F. (2002). **Shares of fuel and metals exports** (respectively imports) **in merchandise exports** (respectively imports) are taken from the World Bank (2002).

  A country is defined as a net exporter of fuel (respectively metals) if its share of fuel exports (respectively metals) exceeds in all observed years its share of fuel imports in merchandise imports (respectively metals). Similarly, a country is defined as a net importer of fuel…
- Finally, for purposes of sensitivity analysis, data on **exchange rate regimes** is taken from Ghosh, Gulde, Ostry, and Wolf (1996). They classify regimes according to both *de jure* classification and a *de facto* classification).

  I mix their two criteria. For example, if a country has any publicly stated commitment but there are frequent changes in parity, it is classified as an effective floater in that year.

3.1

Dependent Variable: Real manufacturing exports

Method of estimation	Random Effects	Fixed Effects
	(1.1)	(1.2)
Log real GDP of origin	1.31 (0.01)***	1.91 (0.02)***
Log real GDP of destination	0.80 (0.01)***	1.40 (0.02)***
Log of distance	-1.23 (0.03)***	
1 (Common Language)	0.63 (0.06)***	
1 (Common Border)	0.37 (0.13)***	
1 (Regional Trade Agreement)	0.83 (0.11)***	
1 (Common colonizer)	1.06 (0.07)***	
1 (Colonial relationship)	1.46 (0.16)***	
1 (Same nation in the sample)	2.26 (0.43)***	
# of land-locked countries in pair	-0.15 (0.04)***	
Constant	-39.32 (0.36)***	-77.74 (0.81)***
Time dummies	p(F)=.00	p(F)=.00
Observations	136,073	137,755
Country pairs	9,736	102,32
R-squared	0.64	0.51
Breusch and Pagan	$p(X^2)=.00$	
Hausman	$p(X^2)=.00$	

3.2

Dependent Variable: **Real manufacturing trade between country of origin and country of destination**

Method of estimation	RE	FE
Log real GDP of origin	1.31 (0.01)***	1.92 (0.02)***
Log real GDP of destination	0.80 (0.01)***	1.38 (0.02)***
	[Unreported Variables]	
Metals price exposure difference	-0.02 (0.01)	-0.01 (0.01)
Energy price exposure difference	-0.65 (0.03)***	-0.58 (0.03)***
Time dummies	p(F)=.00	p(F)=.00
Observations	135,129	136,806
Country pairs	9,594	10,087
R-squared	0.65	0.58
Breusch and Pagan	$p(X^2)=.00$	
Hausman	$p(X^2)=.00$	

3.3

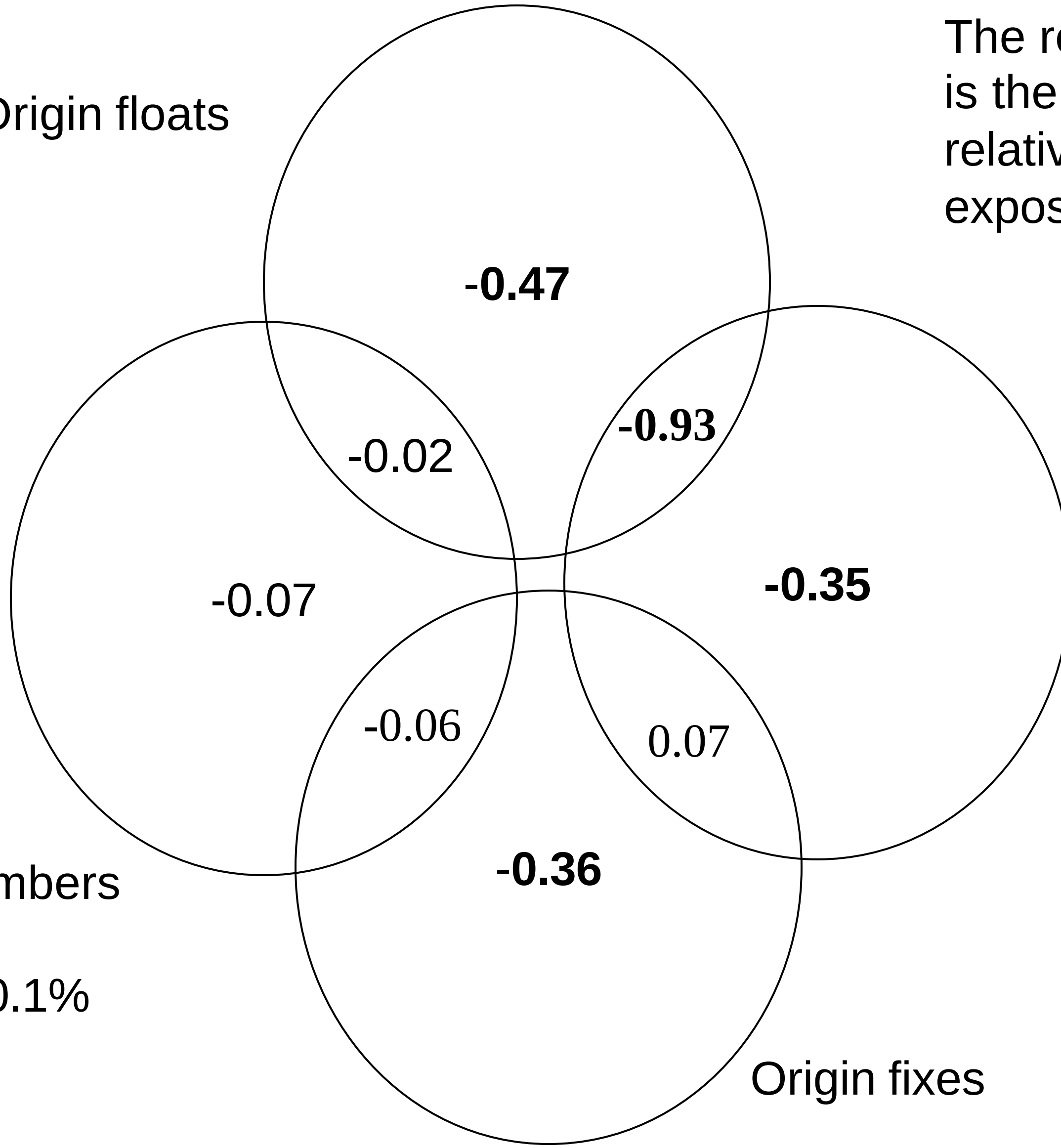
Dependent Variable: **Real manufacturing trade between country of origin and country of destination**

Fixed Effects w/ year dummies	Origin floats	Origin fixes
	(4.3)	(4.4)
Log real GDP of origin	0.57 (0.13)***	1.84 (0.08)***
Log real GDP of destination	1.61 (0.06)***	1.75 (0.05)***
Energy price exposition difference	-0.47 (0.08)***	-0.36 (0.07)***
Constant	-49.01 (3.54)***	-84.13 (2.33)***
Time dummies	p(F)=.00	p(F)=.00
Observations	26,114	29,373
Country pairs	4,482	3,343
R-squared	0.30	0.56

Diagram 1: Sensitivity Analysis

Segmenting the data according to effective exchange rate regime

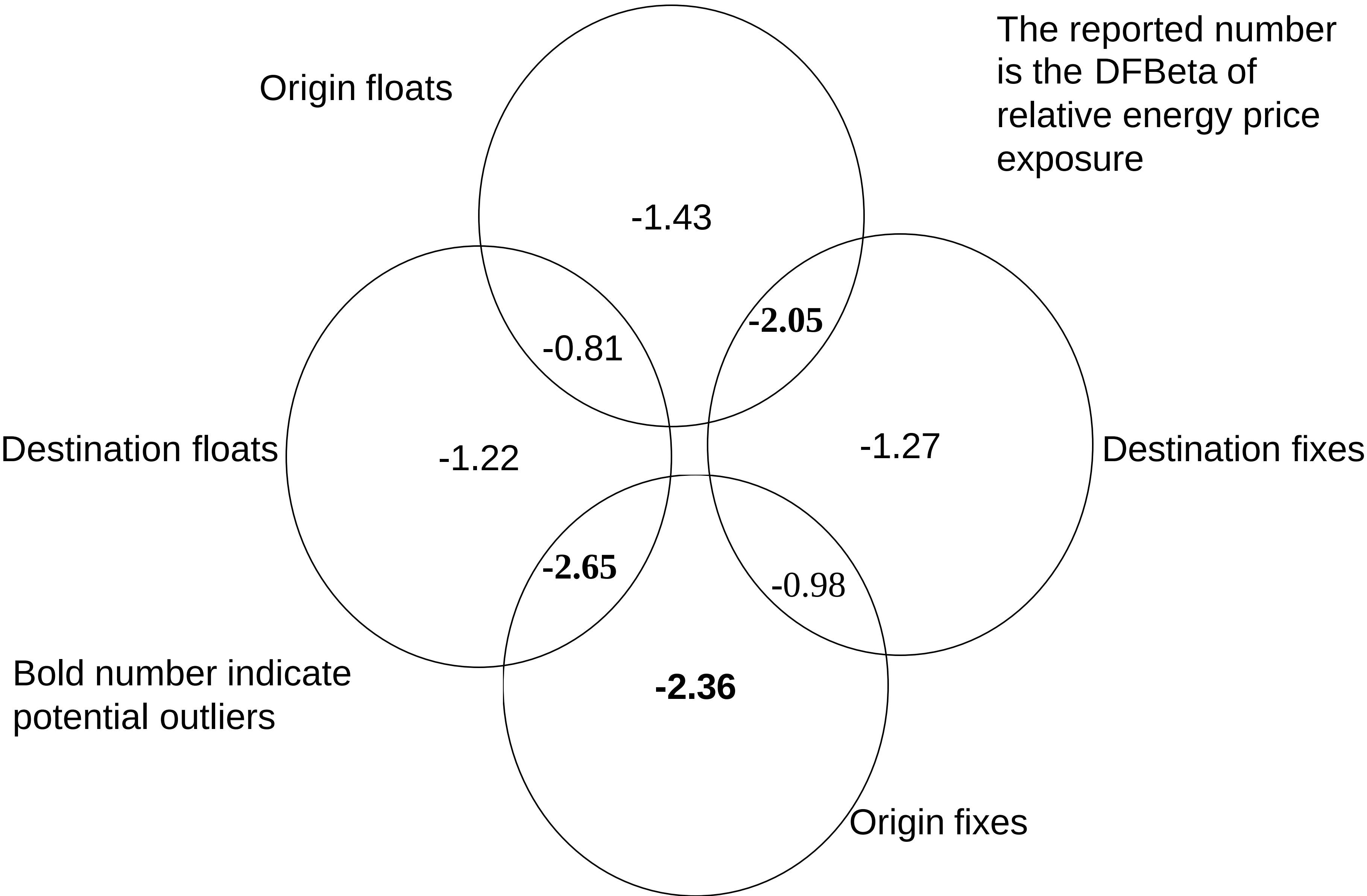
The reported number is the coefficient on relative energy price exposure



Bold number numbers are coefficients significant at a=0.1%

Diagram 2: Outlier Analysis

Excluding data according to effective exchange rate regime



The reported number is the DFBeta of relative energy price exposure

Bold number indicate potential outliers

3.3 cont. Decomposing the energy price variable

- ➲ $EPED_{ijt} = EPE_{it} - EPE_{jt}$.

- ➲ $EPED_{ijt}$

$$= [1(\text{I } \textit{net energy exporter}) - 1(\text{I } \textit{net energy importer})]$$

$$\text{x } \log(\textit{real price of energy})$$

$$- [1(\text{J } \textit{net energy exporter}) - 1(\text{J } \textit{net energy importer})]$$

$$\text{x } \log(\textit{real price of energy})$$

$$= [1(\text{I } \textit{net energy exporter}) - 1(\text{J } \textit{net energy exporter})]$$

$$\text{x } \log(\textit{real price of energy})$$

$$+ (-1)[1(\text{I } \textit{net energy importer}) - 1(\text{J } \textit{net energy import}$$

$$\text{x } \log(\textit{real price of energy})$$

$$= EPE_t^X + (-1)\ \text{EPE}_\text{t}^\text{M}$$

- ➲ $EPED_{ijt} = EPE_{it} - EPE_{jt}$

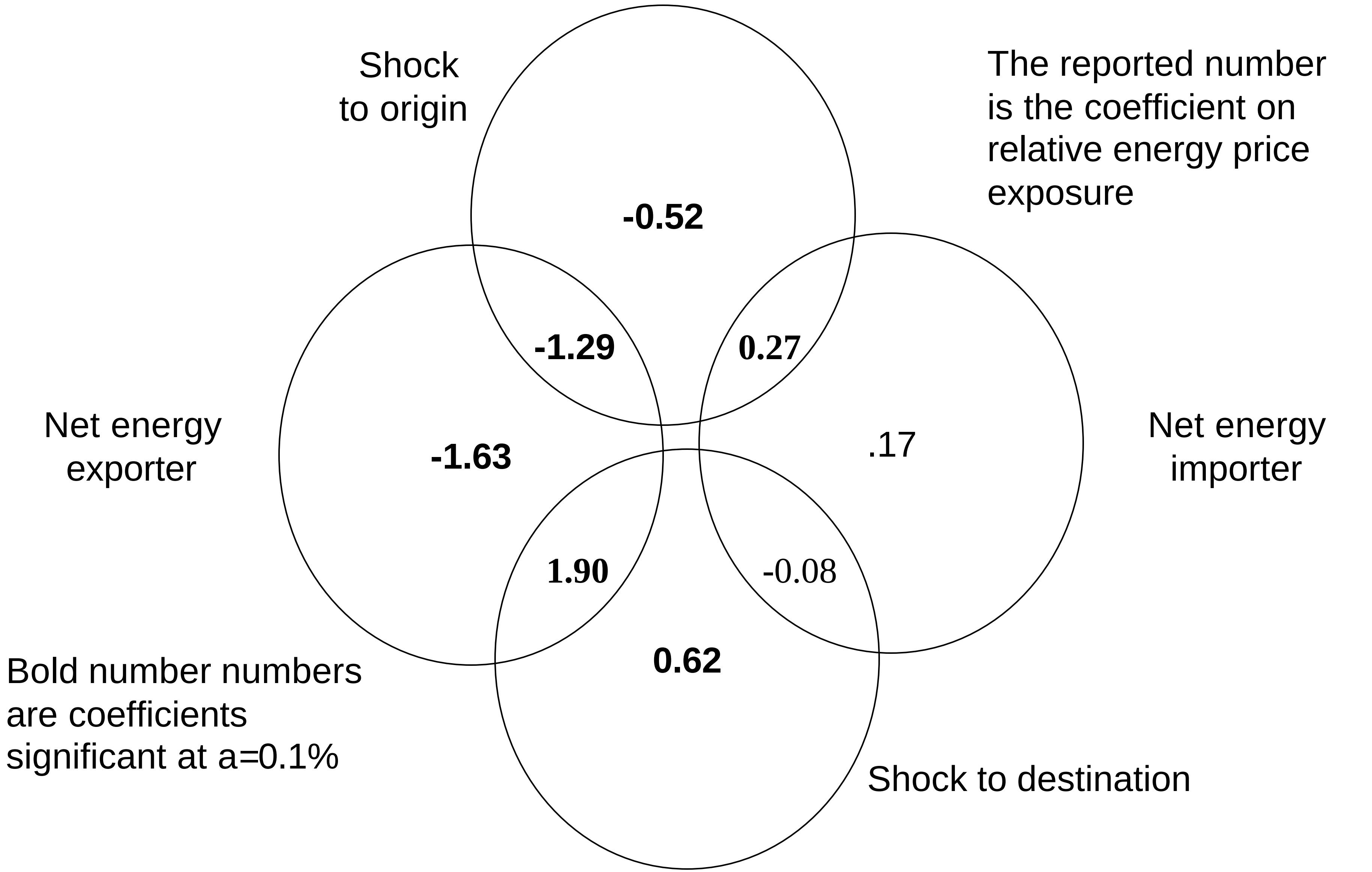
$$= EPEi_{it}^X + (-1)\ \text{EPE}_\text{jt}^\text{M} + EPE_{it}^X + (-1)\ \text{EPE}_\text{jt}^\text{M}$$

3.3 cont.

Dependent Variable:	Real manufacturing trade between country of origin and country of destination		
Method of estimation		Fixed Effects	
Energy price shock...		with year dummies	
… to origin	-0.52 (0.05)***		
… to destination	0.62 (0.04)***		
… to energy exporter		-1.63 (0.08)***	
… to energy importer		.17 (.04)	
… to energy exporter & origin			-1.29 (0.13)***
… to energy importer & origin			0.27 (0.06)***
… to energy exporter & destination			1.90 (0.11)***
… to energy importer & destination			-0.08 (0.06)
R-squared	0.52	0.52	0.52
H0: destination = - origin	0.11	N/A	0.00
H0: exporter = - importer	N/A	0.00	0.00
Joint Hypothesis	N/A	N/A	0.00
LR Test (H1 = (8.3))	0.00	0.00	N/A

Diagram 3: Sensitivity Analysis

Segmenting according to exposure variable components



3.3 cont.

Dependent Variable: **Real manufacturing trade between country of origin and country of destination**

Method of estimation	Random Effects	Fixed Effects
	(12.1)	(12.2)
Log real GDP of origin	1.41 (0.01)***	2.01 (0.03)***
Log real GDP of destination	0.84 (0.01)***	1.41 (0.03)***
	[Unreported Coefficients]	
Metals price exposition difference (net export position that year x Log P)	-0.01 (0.01)	-0.01 (0.01)
Energy price exposition difference (net export position that year x Log P)	-0.38 (0.02)***	-0.33 (0.02)***
Constant	-42.33 (0.41)***	-81.02 (0.91)***
Time dummies	p(F)=.00	p(F)=.00
Observations	102,267	102,550
Country pairs	8,015	8,179
Adjusted R-squared	0.66	0.53

3.3 cont.

Dependent Variable: **Real manufacturing trade between country of origin and country of destination**

Estimation Method	Currency Definition	Energy price	Standard errors	R^2
RE + T Dummies	Dollars	-0.65	(0.03)***	0.65
RE + T Dummies	Origin's currency.	-0.59	(0.03)***	0.68
RE + T Dummies	Destination's currency	-0.72	(0.03)***	0.71
FE + T Dummies	Dollars	-0.58	(0.03)***	0.52
FE + T Dummies	Origin's currency.	-0.46	(0.03)***	0.61
FE + T Dummies	Destination's currency	-0.68	(0.03)***	0.63
RE	Dollars	-0.67	(0.03)***	0.65
RE	Origin's currency.	-0.57	(0.03)***	0.68
RE	Destination's currency	-0.77	(0.03)***	0.71
FE	Dollars	-0.61	(0.03)***	0.52
FE	Origin's currency.	-0.42	(0.03)***	0.61
FE	Destination's currency	-0.81	(0.03)***	0.64

4

How and why do my results differ?

- Case-studies have recognized the need to control for the state of the business cycle in the country of focus as well in its trade partners;
- Case-studies always raise questions about how representative and reliable authors’ conclusions are. DD case-studies are no exceptions;
- My multivariate regressions deal with this concerns by using much more information coming from many countries’ experience, thereby allowing to control for all other major determinants of manufacturing exports.
- With this much more powerful test in hand, I estimate that a 1% increase in the real world price of energy, results in around .6% decrease in manufacturing exports for net energy exporters.
- This effect is both **statistically and economically significant**

5 Conclusions and Areas of Ignorance

•Price-led energy booms do crowd out a country's manufacturing exports. Evidence is inconclusive regarding price-led mineral booms.
•This effect is economically meaningful. The real energy price elasticity of manufacturing exports is about 60%.
•There is preliminary evidence that exchange rate management can help mitigate DD effects.
…BUT:
⍰ Deindustrialization does not necessarily imply slower productivity growth.
⇨ Testing this reduced productivity hypothesis is an important objective for future research.
⍰ Without the sector-specific capital assumption, changes in sectoral output are indeterminate.
⇨ Testing the long-run vs. short-run implications of a resource boom on deindustrialization is an other important objective for future research. But data availability is an issue.