



Gravity model analysis: robust evidence from the Czech Republic and corruption matching

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Outline

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- Gravity Model
- Methodology
- Results
- Conclusion

Motivation and Contribution

Methodological

- Micro-founded x non micro-founded estimations
- Robust methods as control tools

Empirical

- Role of institutions on CZ exports

Hypotheses

- H1: Czech exports are significantly oriented towards nearby countries (proximity or the existence of common borders are important determinants, which boost mutual trade).
- H2: High quality institutions should promote mutual trade in general.
- H3: Non-European countries are trade outliers from the model's perspective.
- H4: There is a significant bias in the estimation in case of non-structural specification

Gravity Model

- Newton-inspired: $X_{ij} = \frac{Y_i Y_j}{D_{ij}}$
- Standard tool since Tinbergen (1962)
- Micro-foundation (Anderson and Wincoop, 2003 and Eaton and Kortum, 2002)
 - = model derived from micro-factors using GE concept
 - = model is based on (micro)economic theory
 - Structural gravity model
- Key difference: Multilateral resistance terms Ω_i and P_j (ignored in the old gravity model)
 - Unobservable → Dummy solution (Baldwin and Taglioni 2007)

Methodology

- Time period: 1995-2011 (17 obs.)
- No. countries: 177
- Dummy variable solution (time and country dummies)
- Log – log \rightarrow coefficients as elasticities
- Estimation procedure
 - 1) Fixed effects (Hausman test)
 - 2) Least Trimmed Squares – control for dataset heterogeneity

Methodology

The Least Trimmed Squares

- Outlier detection tool

$$b^{LTS} = \arg \min \sum_{i=1}^z r_{(i)}^2(b),$$

Where

$$r_{(1)}^2 \leq r_{(2)}^2 \leq \dots \leq r_{(z)}^2 \leq \dots \leq r_{(NT)}^2$$

- Model estimated on z observations
- We present 30 % exclusion

Methodology

Indicator	Variable	Unit	Source
X_{ijt}	Czech exports (the dependent variable)	mil. EUR	Eurostat
Y_{it}	GDP PPS (Czech Republic)	mil. EUR	Eurostat
Y_{jt}	GDP PPS (Partner)	mil. EUR	IMF and Eurostat
D_{ij}	Distance	km (adjusted)	CEPII
L_{jt}	Population (partners)	mil. Inhabitants	IMF
R_t	Recession dummy	dummy (0,1)	Own estimation
GEF_{jt}	Government Effectiveness	per cent (0-100)	World Bank
BUS_{jt}	Business freedom	per cent (0-100)	Heritage Foundation
TRA_{jt}	Trade freedom	per cent (0-100)	Heritage Foundation
FIS_{jt}	Fiscal freedom	per cent (0-100)	Heritage Foundation
GOV_{jt}	Government spending	per cent (0-100)	Heritage Foundation
MON_{jt}	Monetary freedom	per cent (0-100)	Heritage Foundation
INV_{jt}	Investment freedom	per cent (0-100)	Heritage Foundation
FIN_{jt}	Financial freedom	per cent (0-100)	Heritage Foundation
PRO_{jt}	Property rights	per cent (0-100)	Heritage Foundation
COR_{jt}	Freedom from Corruption	per cent (0-100)	Heritage Foundation
$BORD_{ijt}$	Common border	dummy (0,1)	Own estimation
PTA_{l-9ijt}	Preferential Trade Agreement intensity dummies	dummy (0,1)	WTO, UNCTAD & own estimate
C_{l-3ijt}	Euro dumm. (degree of exchange rate flexibility to EUR)	dummy (0,1)	Own estimation

Results (Fixed effects)

	Structural (FE, Within)			Non-structural, FE		
const	-9.6507	(5.0249)	***	-19.038	(2.2695)	***
Ln (Y_{jt})	1.5033	(0.1602)	***	1.4496	(0.2342)	***
Ln (Y_{it})	1.4627	(0.342)	***	0.5626	(0.3403)	*
R_{jt}				0.2596	(0.0538)	***
FIN_{jt}	0.0041	(0.0016)	***	0.004	(0.0026)	
COR_{jt}	-0.0057	(0.0021)	***	-0.0064	(0.0036)	*
C_{2ijt}	-0.1681	(0.0761)	***			
C_{3ijt}	0.2709	(0.0886)	***			
PTA_{1ijt}	0.1276	(0.0627)	***			
PTA_{2ijt}	0.2768	(0.0956)	***			
PTA_{3ijt}	0.6626	(0.1589)	***			
PTA_{7ijt}	-0.1188	(0.0747)	***			
PTA_{8ijt}	0.1655	(0.0939)	***			
No.obs.		2480			2480	
R^2 /within R^2		0.400			0.384	

Results (Fixed effects)

Semi-elasticities of institutional variables

	Structural estimation		Non-structural estimation	
Dep. Variable: Log(X _{ij})	Semi-elasticity (1 unit change in expl. variable)	Semi-elasticity (10 unit change in expl. variable)	Semi-elasticity (1 unit change in expl. variable)	Semi-elasticity (10 unit change in expl. variable)
FIN	0.411***	4.185***		
COR	-0.568***	-5.541***	-0.638*	-6.200*

Results (LTS)

LTS results: only differences to baseline estimation

	No exclusion (baseline estimation)		30 % exclusion		
	coeff.	s.e.	coeff.		s.e.
$\ln(L_{jt})$	0.379	(0.3201)	-0.7369 ***		(0.235)
GEF_{jt}	0.0028	(0.0032)	0.0045 **		(0.002)
FIS_{jt}	-0.0041	(0.0026)	-0.008 ***		(0.0016)
MON_{jt}	0.0017	(0.002)	-0.0051 ***		(0.0014)
COR_{jt}	-0.0056 **	(0.0022)	-0.006 ***		(0.0015)
C_{3ijt}	0.3088 ***	(0.1013)	-0.0494		(0.0744)
PTA_{4ijt}	0.2504	(0.1758)	0.7294 ***		(0.1767)
PTA_{6ijt}	-0.1024	(0.1165)	0.4201 ***		(0.1329)
PTA_{8ijt}	0.0979	(0.1269)	0.2441 **		(0.1009)
No. of obs.	2480		1734		
R^2	0.410		0.737		

- Richer picture : institutional variables and trade barriers
- Corruption effect remains the same

Results (LTS)

Excluded exports by continents

	Excluded exports as % of total Czech exports			Number of excluded observations		
	h=0.9	h=0.8	h=0.7	h=0.9	h=0.8	h=0.7
Africa	0.04%	0.16%	0.30%	122	202	291
N.America	0.01%	0.03%	0.47%	1	2	4
S. and C. America	0.03%	0.05%	0.11%	42	69	127
Asia	0.31%	1.02%	1.25%	64	152	197
Europe	0.26%	5.47%	11.75%	14	58	111
Oceania, Australia	0.00%	0.00%	0.01%	4	12	17
Total	0.66%	6.73%	13.88%	247	495	747

Note: The total exports refer to the total exports of our dataset consisting of 177 trading partners during the period 1995-2011.

Results

Corruption as export stimulator?

- Dual role of corruption (stimulating or deterring)
- Cuervo-Cazurra (2006): corruption level in target country of FDI attracts FDI from countries with similar institutional quality
- Brada, Drabek and Perez (2012): “middle” corrupt countries would be more engaged in FDI than low or highly corrupt countries
- “corruption matching” = corrupted countries prefer to trade with also corrupt countries

Conclusions

- Difference between structural and non-theory based estimations matters (H4 corroborated)
- European continent of crucial importance (H1 and H3 corroborated)
- Control for heterogeneity of high importance
- Core economic factors highly relevant (foreign demand)
- Institutions, trade barriers relevant but more sensitive to the dataset heterogeneity
- Corruption as the most interesting result: possible corruption matching explanation (H2 falsified)



Thank you for your attention.

Literature

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Appendix – PTA Dummies

PTA dummies	Meaning of the dummy if the value is 1. If the agreement is not present then the value is 0.
PTA_{1ijt}	EU member
PTA_{2ijt}	European Economic Area member
PTA_{3ijt}	Agreement on Customs Union
PTA_{4ijt}	Association Agreement
PTA_{5ijt}	Free Trade Area agreement
PTA_{6ijt}	Neighbourhood and partnership policies
PTA_{7ijt}	GSP+ and EBA (Everything but arms)
PTA_{8ijt}	GSP a MFN.
PTA_{9ijt}	The trade is without any special institutional reliefs.

Appendix - Gravity Model

Old gravity

$$\log X_{ij} = \log Y_i + \log Y_j - \log D_{ij}$$

$$(X_{ij} = \frac{Y_i Y_j}{D_{ij}})$$

Structural gravity

$$\log X_{ij} = \log Y_i + \log Y_j + (1 - \delta) \log D_{ij} + \log G$$

where

$$\log G = -\log \Omega_i - (1 - \delta) \log P_j$$

- Multilateral resistance terms Ω_i and P_j (ignored in the old gravity model)
- Theory reveal potential bias in non-theoretically based specifications due to the omitted G
- Ω_i and P_j unobservable \rightarrow Dummy solution (Baldwin and Taglioni 2007)

Appendix - Methodology

Dummy solution

$$\begin{aligned} \log(X_{ijt}) &= \beta_0 + \beta_1 \log(Y_{jt}) + \beta_2 \log(Y_{it}) + \beta_3 \log(D_{ij}) + \beta_4 \log(L_{jt}) \\ &+ \beta_5 R_{jt} + \beta_6 GEF_{jt} + \beta_7 BUS_{jt} + \beta_8 TRA_{jt} + \beta_9 FIS_{jt} \\ &+ \beta_{10} GOV_{jt} + \beta_{11} MON_{jt} + \beta_{12} INV_{jt} + \beta_{13} FIN_{jt} + \beta_{14} PRO_{jt} \\ &+ \beta_{15} COR_{jt} + \beta_{16} BORD_{ijt} + \sum_{w=1}^8 \rho_w PTA_{wijt} + \sum_{v=2}^3 \delta_v C_{vijt} \\ &+ \sum_{e=1}^T \mu_e TD_e + \sum_{n=1}^N \gamma_n CD_n + \varepsilon_{ijt} \end{aligned}$$

- Where $\varepsilon_{ijt} = \mu_{ij} + u_{ijt}$
- If explanatory variable in log, then coefficient = elasticity

Appendix: Conclusions

- H1: Czech exports are significantly oriented towards nearby countries (proximity or the existence of common borders are important determinants, which boost mutual trade).
 - corroborated
- H2: High quality institutions should promote mutual trade in general.
 - **Falsified**, institutional quality may have heterogeneous effects
- H3: Non-European countries are trade outliers from the model's perspective.
 - corroborated
- H4: There is a significant bias in the estimation that omits multilateral resistance terms.
 - corroborated