

Does Foreign Ownership Encourage Technological Transfer and Spillovers in Estonia?

Some Lessons from Eastern Europe

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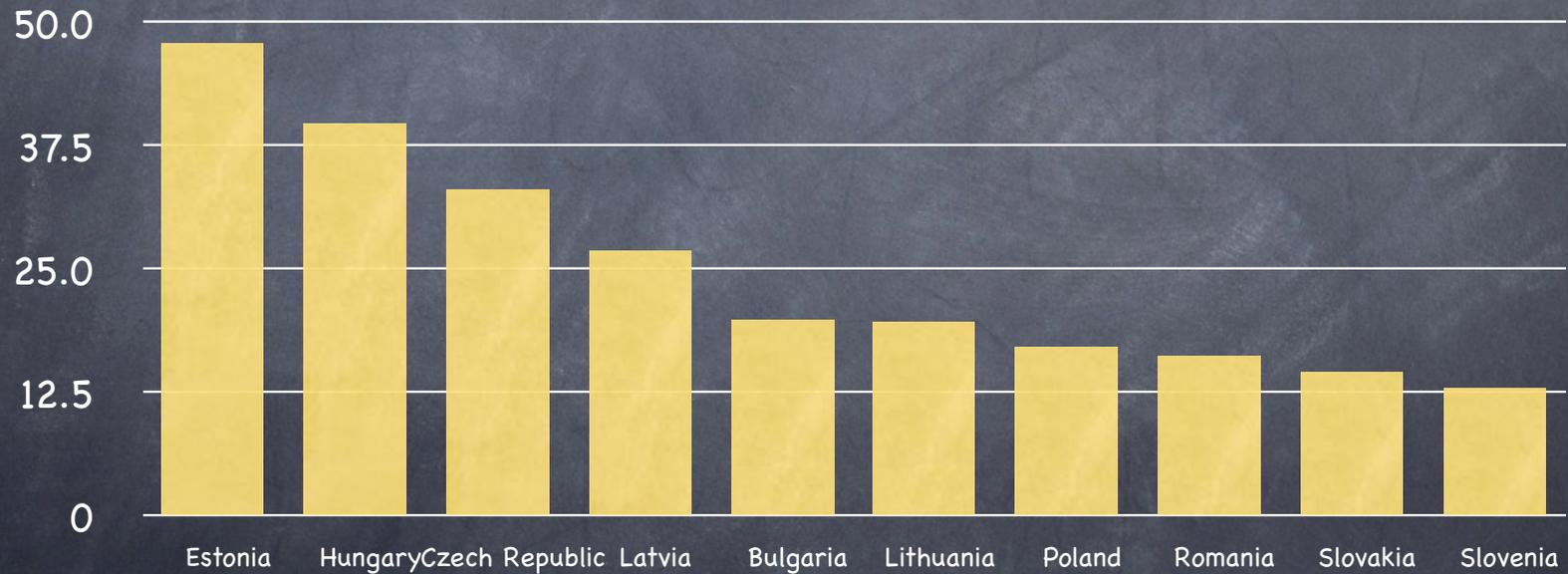
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Why Estonia and Slovenia?

Inward stock as percentage of GDP in 1999



Why is FDI important?

- It can be an important catalyst for the economic restructuring.
- It provides finance for the acquisition of new plant and equipment.
- It can transfer technology directly to foreign affiliates.
- And it can defuse or 'spillover' indirectly to the local economy.

Spillovers from FDI can occur because of . . .

- Competition (intra-industry)
- Cooperation (inter-industry)
- Labour mobility
- Imitation
- Exports

. . .but they can also be negative.

Host country characteristics and spillovers

- Backwardness (technology gap)
- Contagion (supply chains)
- Geography (distance from EU)
- Method of privatization
- Absorptive Capacity

Vertical or inter-industry spillovers

- Backward or supplier linkages: local firms serve as suppliers of inputs to foreign affiliates.
- Forward or customer linkages: foreign affiliates serve as suppliers of inputs to local firms.

Key Questions

- Does technology transfer directly to affiliate?
- Can we disentangle intra-industry spillovers from inter-industry spillovers?
- Does the absorptive capacity of firms matter?
- Is there disembodied technology transfer through trade?



Modeling technology transfer and spillovers

$$Y_{it} = F^i(K_{it}^{\alpha} L_{it}^{\beta} N_{it}^{\gamma} T_{it})$$

$$\dot{Y}_{it} = \alpha \dot{K}_{it} + \beta \dot{L}_{it} + \gamma \dot{N}_{it} + \dot{T}_{it}$$

$$\dot{T}_{it} = f^i(\mathbf{F}_{it}, \mathbf{Z}_{it}) + e_{it}$$

$$e_{it} \sim (\sigma^2, 0)$$

Econometric method: OLS approach; Data in log first differences



Disentangling the spillover effects: intra-industry spillovers, or horizontal spillovers

$$HS_{kt} = \frac{\sum_{i=1}^n FA_{ikt}}{\sum_{i,j=1}^{n,m} (FA_{ikt} + DF_{jkt})}$$

$$\overline{HS}_{kt} = \frac{\sum_{i=1}^n FA_{ikt}}{\sum_{i,j=1}^{n,m} (FA_{ikt} + DF_{jkt})} * \left(1 - \sum_{i=1}^n \frac{EX_{ikt}}{Y_{ikt}}\right)$$



Inter-industry spillovers or backward and forward linkages

$$\overline{BL}_{i,jkt} = \sum_{r=1}^p \alpha_{krt} * \frac{IM_{i,jkt}}{MC_{i,jkt}} * HS_{kt}$$

$$\overline{FL}_{i,jkt} = \sum_{r=1}^p \beta_{krt} * \frac{EX_{i,jkt}}{Y_{i,jkt}} * \overline{HS}_{kt}$$

The data

- Industrial surveys carried out by the Statistical Office of Estonia and the Finance Ministry of Slovenia plus Input-output tables.
- 363 manufacturing enterprises in Estonia for the period 1995 to 1999.
 - 106 enterprises are foreign owned (30%)
- 1093 enterprises in Slovenia from 1994 to 1999.
 - 116 enterprises are foreign owned (10%)



Structural characteristics of foreign versus domestic manufacturing firms in 1994-1999 (mean average)

<i>Variable*</i>	<i>Estonia</i>		<i>Slovenia</i>	
	<i>Firms with FDI</i>	<i>Domestic firms</i>	<i>Firms with FDI</i>	<i>Domestic firms</i>
Number of firms <i>Domestic firm = 100</i>	257	106	977	116
Size (assets)	165	100	134	100
Capital intensity (Assets/Employee)	306	100	138	100
Skill intensity (Labour costs/employee)	141	100	114	100
Wage	123	100	114	100
<i>Percentage</i>				
Labour intensity I (Labour costs/value added)	70.3	81.8	65.5	76.5
Labour intensity II (Labour costs/total costs)	43.3	47.9	21.7	29.2
Export propensity (Exports/sales)	58.2	40.1	56.7	41.6

Testing for technology transfer and spillovers

- Does FDI represent a significant channel of technology transfer?
- Does FDI generate significant spillovers for domestic firms?
 - Data show that technology transfer occurs in both Estonia and Slovenia, but intra-industry spillovers occur only in Estonia.



The Results: Direct effects of foreign ownership

(Sample of foreign owned and domestic firms)

	<i>Estonia</i>		<i>Slovenia</i>	
<i>Const.</i>	-0.268	(-2.46)***	-0.094	(-2.83)***
<i>Capital (K)</i>	0.111	(6.77)***	0.037	(6.28)***
<i>Capital_FDI (FK)</i>	-0.038	(-0.83)	0.001	(0.03)
<i>Labour (L)</i>	0.602	(11.62)***	0.382	(24.42)***
<i>Labour_FDI (FL)</i>	0.694	(11.94)***	-0.107	(-2.21)**
<i>Materials (N)</i>	0.007	(1.41)	0.296	(41.41)***
<i>Materials_FDI (FN)</i>	0.011	(1.31)	0.118	(4.94)***
<i>FDI dummy (F)</i>	0.854	(3.45)***	0.222	(3.32)***
<i>Majority FDI (MF)</i>	0.020	(0.42)	-0.024	(-1.35)
<i>Hor_Spill (HS)</i>	0.000	(-0.02)	0.002	(0.81)
<i>Hor_Spill_FDI (FHS)</i>	-0.035	(-0.84)	-0.006	(-0.88)
<i>Backward_Spill (BL)</i>	-0.015	(-0.65)	0.003	(0.52)
<i>Backward_Spill_FDI (FBL)</i>	-0.058	(-1.22)	0.010	(0.50)
<i>Forward_Spill (FL)</i>	0.020	(1.43)	0.000	(-0.02)
<i>Forward_Spill_FDI (FFL)</i>	-0.001	(-0.04)	-0.007	(-0.59)
<i>Sector size (S)</i>	0.022	(2.74)***	0.002	(1.05)
<i>Sector size_FDI (FS)</i>	-0.019	(-1.19)	0.000	(0.00)
<i>Mill's ratio</i>	-0.405	(-4.04)***	-0.121	(-3.05)***
<i>Number of obs.</i>	1053		5175	
<i>Adj R-squared</i>	0.799		0.435	

t-statistics in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent levels of significance (two-tailed tests)

$$\begin{aligned} \dot{Y}_{it} = & b_{it} + \delta F_i + \kappa M_i + \alpha \dot{K}_{it} + \beta \dot{L}_{it} + \gamma \dot{N}_{it} + \chi F_i \dot{K}_{it} + \phi F_i \dot{L}_{it} + \varphi F_i \dot{N}_{it} + \mu HS_{jt} + \\ & + \pi BL_{jt} + \tau F_i BL_{jt} + \rho FL_{jt} + \omega F_i FL_{jt} + \upsilon S_{jt} + \theta_j d_j + \psi_t d_t + e_{it} \end{aligned}$$

Testing for innovative and absorptive capacity

- Does R&D in domestic firms enhance productivity growth?
- Do spillovers depend on the absorptive capacity of firms?
 - Data show that absorptive capacity was important in Estonia.



Results: Importance of absorptive capacity (Sample of domestic firms only)

	<i>Estonia</i>		<i>Slovenia</i>	
<i>Const.</i>	-0.138	(-1.51)	-0.089	(-4.45)***
<i>Capital (K)</i>	0.050	(5.33)***	0.278	(32.61)***
<i>Labour (L)</i>	0.677	(15.47)***	0.647	(37.01)***
<i>Materials (N)</i>	0.010	(2.33)**	0.342	(36.81)***
<i>Accumul_R&D (RD)</i>	0.040	(2.43)***	0.005	(0.98)
<i>Hor_Spill (HS)</i>	0.047	(2.84)***	0.002	(0.68)
<i>Hor_Spill_R&D (RDHS)</i>	-0.001	(-0.14)	-0.001	(-1.28)
<i>Backward_Spill (BL)</i>	0.008	(0.28)	0.002	(0.32)
<i>Backward_Spill_R&D (RDBL)</i>	-0.10	(-0.41)	-0.001	(-0.11)
<i>Forward_Spill (FL)</i>	0.013	(0.75)	0.007	(0.39)
<i>Forward_Spill_R&D (RDFL)</i>	0.000	(-0.01)	-0.011	(-0.66)
<i>Sector size (S)</i>	0.030	(2.26)**	0.008	(0.38)
<i>Sector size_R&D (RDS)</i>	-0.001	(-0.10)	0.012	(0.59)
<i>Number of obs</i>	816		4886	
<i>Adj R-squared</i>	0.342		0.844	

t-statistics in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent levels of significance (two-tailed tests)

$$\dot{Y}_{it} = b_{it} + \alpha \dot{K}_{it} + \beta \dot{L}_{it} + \gamma \dot{N}_{it} + \eta RD_{it} + \mu HS_{jt} + \lambda RD_{it} HS_{jt} + \\ + \pi BL_{jt} + \sigma RD_{it} BL_{jt} + \rho FL_{jt} + \sigma RD_{it} FL_{jt} + \nu S_{jt} + \theta_j d_j + \psi_t d_t + e_{it}$$

Testing for technology transfer through trade

- Does technology transfer occur through trade?
- Do international R&D spillovers depend on the absorptive capacity of local firms?
 - Data show that trade was an important channel of technology transfer in Slovenia.



Results: Knowledge spillovers through trade

(Sample of domestic firms only)

	<i>Estonia</i>		<i>Slovenia</i>	
<i>Const.</i>	-0.051	(-1.00)	-0.061	(-4.69)***
<i>Capital (K)</i>	0.053	(5.58)***	0.277	(32.47)***
<i>Labour (L)</i>	0.674	(15.32)***	0.651	(37.23)***
<i>Materials (N)</i>	0.010	(2.38)***	0.338	(36.27)***
<i>Accumul_R&D (RD)</i>	0.046	(2.88)***	0.005	(1.07)
<i>Exports/Sales (X)</i>	0.006	(0.79)	0.005	(3.77)***
<i>Exports/Sales_R&D (RDX)</i>	0.001	(0.19)	0.001	(0.73)
<i>Imports/Mat.costs (M)</i>	0.012	(1.47)	0.002	(2.04)**
<i>Imports/Mat.costs_R&D (RDM)</i>	-0.004	(-1.01)	-0.002	(-1.72)*
<i>Number of obs</i>	816		4886	
<i>Adj R-squared</i>	0.332		0.844	

t-statistics in parentheses. *, **, *** denote significance at the 10, 5 and 1 percent levels of significance (two-tailed tests)

$$\dot{Y}_{it} = b_{it} + \alpha \dot{K}_{it} + \beta \dot{L}_{it} + \gamma \dot{N}_{it} + \eta RD_{it} + \nu X_{it} + \omega RD_{it} X_{it} + \iota M_{it} + \xi RD_{it} M_{it} + \theta_j d_j + \psi_t d_t + e_{it}$$

Can Estonia and Slovenia close the technology gap?

- Estonia relied more on FDI to get access to technology, whereas Slovenia relied more on trade.
 - Method of privatization mattered.
- Labour productivity growth was much higher in Estonia.
 - There was an advantage of backwardness.

Why are there so few spillovers?

- Limitations of data.
- Input-Output data only at 2-digit level.
- Linkages take time to develop.
- Weakness of local (formally state-owned) firms.
- Problem: Creation of 'enclave economy' and regional inequalities.

Is there a role for policy?

- Can policy influence the level and composition of inward FDI?
- Do targeted policies increase positive spillovers?
- Policies: Macroeconomic environment, competition policy, innovation policy, education and training, taxation and subsidies, and multilateral agreements (TRIMS, etc.)
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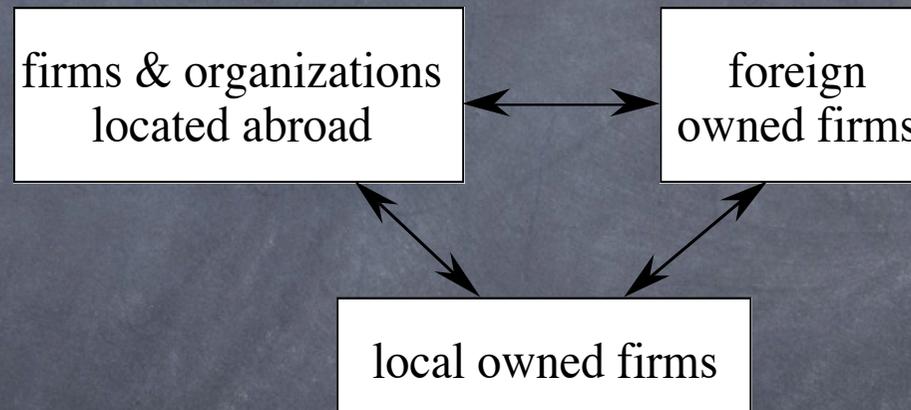
Innovation cooperation and foreign ownership: Evidence from innovative firms in the Czech Republic

Main question for Estonia:
Does technology cooperation matter for
technology transfer and spillovers?

Unpublished paper written together with Martin Srholec,
University of Oslo

Cooperation in technological activities

- Cooperation can lead to technology transfer between the parent, affiliate and local firms.



- Cooperation is one way that local enterprises can access knowledge in the global economy.

Three direct influences that TNCs can have on technology transfer

Veugelers and Cassiman (EER, 2004)

- Effects of foreign ownership on internal R&D activity.
- Importance of foreign-owned firms for international technology transfer.
- Role of foreign ownership for local technology diffusion.

The data

- We are interested in the sources of innovation
- Data from the 2002 Czech Innovation survey.
 - The survey was modeled on the CIS-3 survey carried out in the EU member States, Norway and Iceland.
 - Over 3,800 firms responded to the questionnaire.
 - About 38 percent introduced new products or processes
 - We focus only on non-financial and incorporated manufacturing firms that innovated.
 - Our sample includes 729 firms.

A probit model

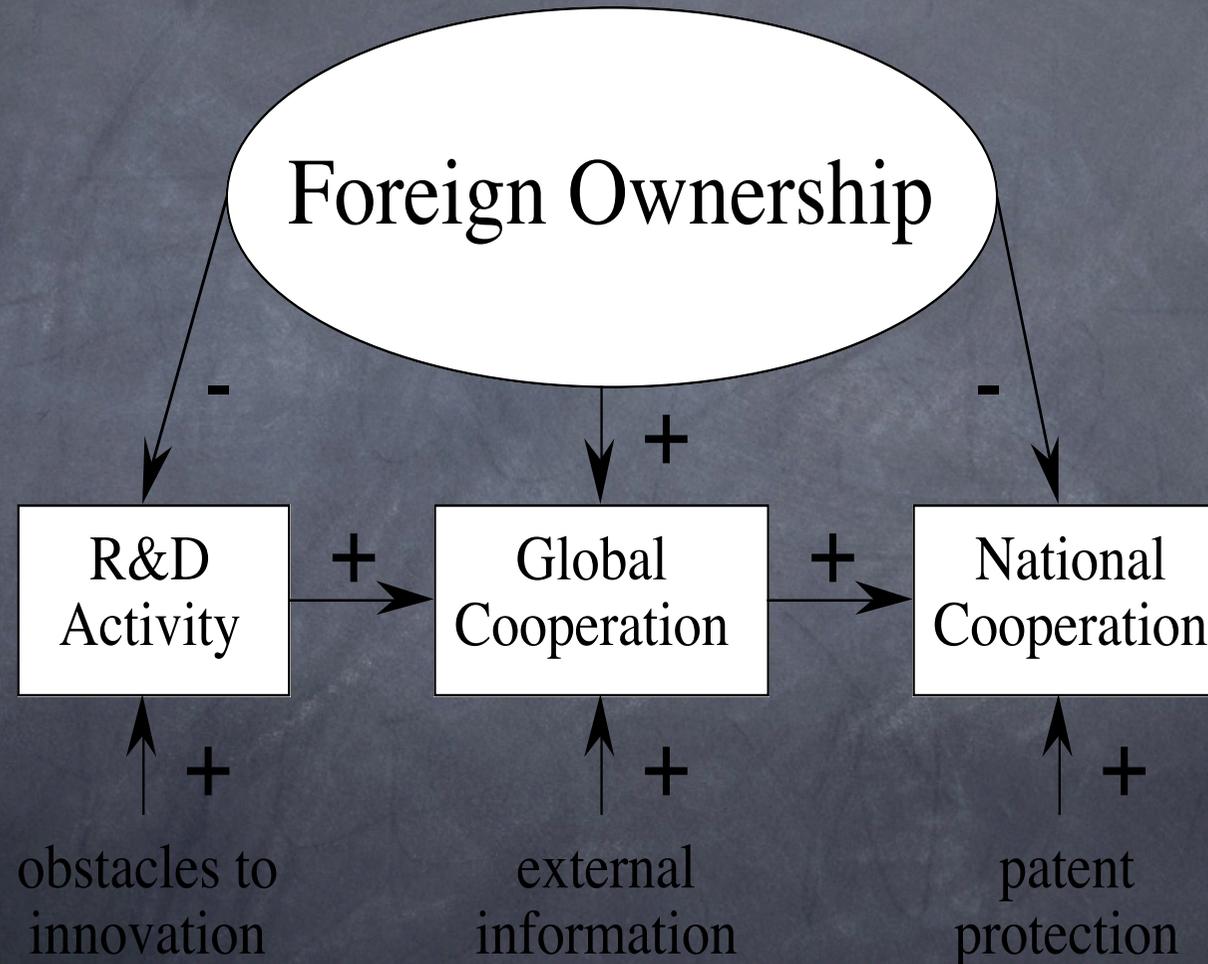
- (1) $R\&D_{internal} = a_m + b_m \ln(\text{size}) + c_m \text{FOREIGN} + d_m \text{OBSTACLES} + e_m \text{INDUSTRY dummies} + e_{R\&D_{internal}}$
- (2) $COOP_{global} = a_n + b_n \ln(\text{size}) + c_n \text{FOREIGN} + d_n \text{EXTinfo} + e_n R\&D_{internal} + f_n e_{R\&D_{internal}} + g_n \text{INDUSTRY dummies} + e_{COOP_{global}}$
- (3) $COOP_{national} = a_p + b_p \text{LP}(\text{size}) + c_p \text{FOREIGN} + d_p \text{PROTECT} + e_p COOP_{global} + f_p e_{COOP_{global}} + g_p \text{INDUSTRY dummies} + e_{COOP_{national}}$
- (4) **Reduced form:** $COOP_{national} = a_{mn} + b_{mn} \text{LP}(\text{size}) + c_{mn} \text{FOREIGN} + d_{mn} \text{PROTECT} + e_{mn} \text{EXTinfo} + f_{mn} \text{OBSTACLES} + g_{mn} \text{INDUSTRY dummies} + e'_{COOP_{national}}$



The Results

Equations	1	2	3	4
	R&D Activity	Global cooperation	National cooperation	Reduced form
Constant	-1.91***	-2.71***	-0.74**	-2.24***
Size	0.32***	0.1	-0.12	0.25***
Foreign-ownership	-0.37***	0.48**	-0.65***	-0.20*
Obstacles	0.14***			0.17***
External information		0.56**		1.01***
Patent protection			0.26*	0.41***
R&D activity		0.40***		
Residuals of eq. (1)		1.69		
Global cooperation			1.39***	
Residuals of eq (2)			3.98***	
High-tech industry	0.62***	-0.36	-0.03	0.11
Medium-high-tech ind.	0.66***	-0.53*	0.06	-0.03
Low-tech industry	-0.22*	0.13	-0.30*	-0.28*
Chi2	131.63***	60.71***	190.02***	93.78***
Pseudo R2	0.14	0.12	0.26	0.13
Number of observations	726	666	666	669

Summary of the Results





Direct and indirect effects of foreign ownership on local cooperation

(a)	Marginal probability for the foreign ownership coefficient in eq (3')	-0.067*	(-1.69)
(b)	Marginal probability for the foreign ownership coefficient in eq (3)	-0.204***	(-4.96)
(c)	Marginal probability for the global cooperation in eq (3)	0.509***	(10.68)
(d)	Marginal probability for the foreign ownership coefficient in eq (2)	0.134**	(2.23)
(e)	Marginal probability for the R&D activity coefficient in eq (2)	0.103***	(2.98)
(f)	Marginal probability for the foreign ownership coefficient in eq (1)	-0.147***	(-3.27)

<u>Effects of the foreign ownership:</u>	
Total effect = (a)	-0.067
Direct effect = (b)	-0.204
Indirect effect via eq (2) = (c) * (d)	0.068
Indirect effect via eq (1) = (e) * (f)	-0.015

Concluding remarks on the Czech Case: What can be learned in Estonia

- Improve incentives for foreign affiliates to cooperate more with local firms.
- Assist local firms to cooperate with foreign partner even if they do not have a local affiliate.
- Limitation: study does not capture intensity or quality of the technology transfer involved in cooperation.