Impact of Firm Heterogeneity on Direct and Spillover Effects of FDI: Micro Evidence from Ten Transition Countries

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Outline

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Motivation

Total inward FDI stock (in $US mln.)

Region/economy	1990	1995	2000	2005	2011
World	2,081.147	3,438.082	7,450.022	11,563.007	20,438.199
Developed economies	1,563.939	2,579.322	5,653.715	8,577.412	13,055.903
European Union	761.820	1,197.528	2,323.505	4,731.893	7,275.622
Bulgaria	0.112	0.445	2.704	13.851	47.653
Czech Republic	1.363	7.350	21.644	60.662	125.245
Estonia	0.000	0.674	2.645	11.315	16.727
Hungary	0.570	11.304	22.870	61.110	84.447
Latvia	0.000	0.615	2.084	4.929	12.109
Lithuania	0.000	0.352	2.334	8.211	13.921
Poland	0.109	7.843	34.227	90.877	197.538
Romania	0.000	0.821	6.953	25.816	70.328
Slovakia	0.282	1.297	4.762	23.656	51.293
Slovenia	1.643	1.763	2.893	7.259	15.145
Average EU-NMS	4.079	32.465	103.115	307.687	634.406
Share in EU (%)	0.5	2.7	4.4	6.5	8.7

Motivation

Share of inward FDI inflows in Gross fixed capital formation (%)

Region/economy	1991-95	1996-00	2001-05	2005-11
World	3.8	11.4	9.2	11.7
Developed economies	3.2	10.9	8.2	11.3
European Union	5.0	17.1	14.7	15.2
Bulgaria	4.5	35.0	47.1	51.0
Czech Republic	9.3	21.2	27.3	14.0
Estonia	15.1	22.6	33.2	30.5
Hungary	27.6	31.9	22.4	16.1
Latvia	17.0	30.9	12.0	16.3
Lithuania	2.5	19.4	16.1	14.7
Poland	8.8	16.9	16.8	17.6
Romania	3.2	15.5	21.9	17.1
Slovakia	21.3	12.2	32.6	13.8
Slovenia	3.9	3.8	11.7	6.4
Average EU-NMS	11.3	20.9	24.1	19.8

Evidence on spillovers from FDI in CEECs

- Existing empirical evidence focusing on spillovers from FDI is inconclusive (see Hanson, 2001; Greenaway & Gorg, 2001)
- Studies on CEE countries:

Study	Country	Period	Result	
Djankov & Hoekman (2000)	Czech Republic	1993-96	HS:	-
Kinoshita (2001)	Czech Republic	1995-98	HS:	? or + in R&D int. firms
Bosco (2001)	Hungary	1993-97	HS:	?
Konings (2001)	Bulgaria	1993-97	HS:	- (BG, RO); ? (PL)
Damijan et al (2003a)	8 CEECs	1994-98	HS:	? or -; + only for RO
Damijan et al (2003b)	10 CEECs	1994-99	VS:	+ only in CZ, PL, RO
Smarzynska-Javorcik (2004)	Latvia	1996-00	VS:	+
Murakozy (2007)	Hungary	1996-00	HS:	- ; VS: +
Gorodnichenko et al. (2007)	17 CEECs (BEEPS)	2002-05	HS:	? ; VS: +

Summary

- The evidence relies mostly on horizontal spillovers only
- One should differentiate between three effects of FDI at the firm level:
  - direct effects,
  - horizontal spillovers, and
  - vertical spillovers
- Firm heterogeneity is important

Aims

- Comparative analysis on importance of different FDI effects on a set of comparable countries
- Large firm-level dataset (90,000 firms) for 10 CEECs
- Using a common methodology and rigorous econometric approach
  - selection and simultaneity correction
- Controlling for firm heterogeneity
  - absorptive capacity, size, distance to technology frontier, technology gap

Benefits of FDI for CEECs

Direct effects on recipient firms

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- Transfer of technology
- Transfer of "management skills"
- Helping the strategic restructuring of firms
- Use of "intangible assets" of parent firms
- Improving corporate governance

Horizontal (intra-industry) spillovers

- **Positive effects**: intra-sector diffusion of technology, mainly through:
  - labor turnover (job reallocation),
  - imitation processes, and
  - entry of international supporting professional service firms (accounting firms, etc.)

- **Negative effects**: business stealing effects

Vertical spillovers (organisation of vertical supply-chains)

- **backward** linkages:
  - local firms serve as suppliers of inputs to FIEs (*downstream* FDI)

- **forward** linkages:
  - FIEs serve as suppliers of inputs to local firms (*upstream* FDI)

Measuring spillovers

- scope for **horizontal spillovers** defined as the share of industry k's output produced by the foreign affiliates:

$$HS_{kt} = \frac{\sum_i^n F_{ikt}}{\sum_i^n (F_{ikt} + D_{ikt})}$$

$$i = 1, ..., n$$

- scope for **backward linkages** defined as the sum of the output of industry r purchased by firms in industry k weighted by the share of total foreign output in industry k (HS_{kt}):

$$VSb_{kt} = \sum_{r,k}^{p} (\alpha_{rkt} * HS_{kt})$$

$$r, k = 1, ..., p$$

Empirical model

- Production function

$$Y_{it} = f(K_{it}^{\alpha}, L_{it}^{\beta}, T_{it})$$

- Taking logs and differentiating with respect to time

$$y_{it} = \alpha k_{it} + \beta l_{it} + t_{it}$$

- Technology shock T is a function of *internal technology* variables **G** and of various *spillover* effects **Z**

$$(F_{it}, H_{it}) \in \mathbf{G}$$

$$(HS_{it}, VSb_{it}) \in \mathbf{Z}$$

Empirical issues: Simultaneity

- Potential correlation between input levels and the unobserved firm-specific shocks
    - firms that experience a large positive productivity shock may respond by using more inputs, violating the OLS assumption of strict exogeneity between inputs and the error term
- Three ways of dealing with the simultaneity:
    - *Olley and Pakes* (1996):
        - investment expenditure as a proxy for unobservable technology shocks
    - *Levinsohn and Petrin* (2002):
        - materials as a proxy for unobservable technology shocks
    - *Blundell and Bond* (1998, 1999):
        - system-GMM approach (lagged levels and lagged first differences as instruments for equation in levels).

Olley - Pakes approach

Three-step approach

- *First* step: Simultaneity
  - unobserved productivity shocks estimated using the (firm-specific) investment equation
  - firms' FDI status as an additional state variable
  - obtaining an unbiased estimates of the coefficient on labor

- *Second* step: Survival and selection
  - survival probability (the probability that a firm will survive in the local market and, hence, in the sample)

- *Third* step:
  - NLS estimates of expanded production function
  - obtaining unbiased estimates of the coefficient of capital

TFP measure

- Finally, un unbiased estimate of the TFP

$$tfp_{it}^{OP} = y_{it} - \widehat{\alpha} k_{it} - \widehat{\beta} l_{it}$$

- Empirical model

$$tfp_{it}^{OP} = \gamma F_{it} + \delta HS_{it} \cdot w_{it} + \eta VSb_{it} \cdot w_{it} + \theta \lambda_{it} + (T, S) + u_i + \epsilon_{it}$$

- - λ_{it} - inverse Mills ratio
  - u_i, T, S - firm, year and sector fixed effects

Empirical issues: Selection bias

- Selection bias:
  - probability of "cherry" or "lemon" picking
- Heckman 2-stage procedure

$$P(FDI_{it} = 1 | FDI_{it-1} = 0, x_{it-1}) = \alpha + \beta controls_{it-1} + v_{it}$$

- controls: size, capital intensity, initial labor productivity, ROA
- estimated *inverse Mills ratios* included in the empirical model

Empirical issues

- Model estimated using FE estimator
- Controlling for simultaneity and selection bias
- Controlling for sources of firm heterogeneity:
  - absorptive capacity (interaction with wages)
  - size
  - distance to domestic technology frontier
  - technology gap wrt foreign-owned firms
- HS and VS accounted for at the Nace 2 and Nace 3-digit

Data

- Amadeus data (accounting data) from BvD for 9 CEECs
  - BG, CZ, EE, HR, LT, LV, PL, RO, UA
- population data for Slovenia (AJPES)
- Period: 1995 - 2005
- up to 315,000 effective observations

Data sample

	#Firms	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	#Total	# obs.
BG	For	31	94	48	59	284	325	387	151	148	100	76	**9,549**	**24,809**
	Dom)	1,301	2,958	1,483	1,482	7,025	8,032	9,162	3,252	3,156	2,624	2,019		
CZ	For	87	95	100	140	161	200	217	239	244	238	137	**8,496**	**19,940**
	Dom)	933	996	1,052	1,543	1,877	2,374	3,022	5,074	7,075	8,258	3,367		
EE	For			71	89	110	133	139	156	145	153	148	**4,145**	**13,935**
	Dom)			1,086	1,433	2,753	3,100	3,109	3,519	3,833	3,992	2,484		
HR	For	0	8	15	59	64	78	80	84	88	91	95	**3,179**	**18,817**
	Dom)	3	112	246	2,711	2,856	2,934	2,989	3,004	3,102	3,088	3,004		
LT	For		3	5	7	8	16	15	36	49	48	23	**1,567**	**4,080**
	Dom)		112	192	226	293	350	398	984	1,518	1,278	661		
LV	For	0	6	13	21	24	28	37	43	47	49	25	**723**	**3,176**
	Dom)	20	137	219	283	314	350	454	552	676	641	374		
PL	For	97	442	497	601	688	701	770	868	809	576	144	**6,074**	**12,059**
	Dom)	478	2,265	2,386	3,129	3,966	4,197	4,780	5,311	5,629	5,498	1,470		
RO	For	131	926	1,094	1,368	1,667	2,070	2,318	2,542	3,170	3,696	3,554	**48,495**	**171,270**
	Dom)	1,920	16,053	18,272	20,378	22,273	24,965	25,637	27,207	34,578	42,103	44,941		
SI	For	121	200	217	230	239	252	268	264	285	296	321	**3,829**	**27,908**
	Dom)	2,756	2,964	3,090	3,311	3,464	3,536	3,406	3,539	3,544	3,653	3,722		
UA	For				0	10	17	44	50	53	55	56	**5,446**	**18,750**
	Dom)				1	1,131	2,920	5,158	5,275	5,393	5,198	5,010		
Total													**91,503**	**314,744**

Direct effects

	All	Micro	Small	Medium	Large	Q1	Q2	Q3	Q4	Q5	Gap1	Gap2	Gap3
		Firms by size classes				Firms by quintiles of productivity					Gap of domestic vs. foreign firms in productivity		
BG	0.046	0.231	0.062	-0.094	-0.041	0.399	0.013	0.041	0.083	0.011	0.077	-0.058	0.056
	[0.87]	[1.83]*	[0.70]	[0.87]	[0.23]	[1.66]*	[0.09]	[0.40]	[0.82]	[0.09]	[0.65]	[0.45]	[0.71]
CZ	0.090	0.171	0.137	0.037		0.002	0.076	0.139	0.047	0.04	0.111	0.108	0.03
	[2.74]***	[1.39]	[2.72]***	[0.84]		[0.02]	[1.10]	[2.09]**	[0.70]	[0.55]	[2.32]**	[1.42]	[0.45]
HR	0.033	0.002	0.059	0.012	-0.14	0.036	0.011	0.072	0.03	0.066	-0.003	0.046	0.022
	[0.98]	[0.02]	[0.87]	[0.24]	[1.50]	[0.48]	[0.14]	[0.59]	[0.48]	[0.83]	[0.04]	[0.82]	[0.34]
EE	0.083	0.228	0.085	-0.087	0.027	-0.414	0.439	-0.026	0.104	0.075	0.062	-0.003	0.252
	[1.19]	[0.98]	[0.88]	[0.94]	[0.08]	[0.99]	[1.37]	[0.16]	[0.70]	[0.76]	[0.76]	[0.01]	[1.20]
LT	0.050	1.322	-0.14	0.147	0.08	0.132	-11.103	0.228	0.314	-0.08	0.044	-0.599	0.009
	[0.97]	[0.69]	[0.98]	[2.50]**	[0.68]	[0.61]	[0.90]	[0.54]	[2.26]**	[0.90]	[0.69]	[1.19]	[0.08]
LV	0.072	-0.147	-0.122	0.094	-0.043	-0.022	-0.033	0.327	0.025	0.048	0.096	0.029	0.12
	[1.61]*	[0.16]	[0.93]	[1.65]*	[0.33]	[0.17]	[0.22]	[1.82]*	[0.16]	[0.62]	[1.37]	[0.11]	[1.42]
PL	0.029	0.187	0.066	-0.003	0.044	0.157	0.041	0.028	-0.05	0.067	0.021	0.009	0.07
	[1.07]	[0.72]	[0.87]	[0.09]	[0.98]	[1.62]	[0.55]	[0.53]	[0.98]	[1.10]	[0.57]	[0.14]	[1.07]
RO	0.024	-0.009	0.018	0.025	0.093	0.04	0.03	0.017	-0.004	0.044	0.033	0.002	0.07
	[1.51]	[0.29]	[0.75]	[0.77]	[1.84]*	[0.55]	[0.69]	[0.47]	[0.14]	[1.65]*	[1.53]	[0.08]	[1.19]
SI	0.066	0.064	0.057	0.113	0.068	-0.037	0.101	0.039	0.106	0.088	0.053	0.073	0.035
	[2.12]**	[0.84]	[1.18]	[2.44]**	[1.13]	[0.31]	[1.43]	[0.57]	[1.67]*	[1.68]*	[1.02]	[1.59]	[0.29]
UA	0.076	3.77	0.01	0.099	-0.039	-1.539	-0.257	-0.005	0.223	0.127	0.143	1.073	-0.144
	[0.90]	[3.42]***	[0.04]	[0.57]	[0.25]	[0.47]	[0.55]	[0.01]	[0.78]	[0.95]	[1.01]	[2.07]**	[0.99]
sig.	3	2	1	3	1	2	0	2	2	2	2	2	0

Horizontal spillovers
Example of results for Slovenia

		All	Firms by size classes				Firms by quintiles of productivity					Gap of domestic vs. foreign firms in productivity		
			Micro	Small	Medium	Large	Q1	Q2	Q3	Q4	Q5	G1	G2	G3
SI	hs	-0,023*	-0,019*	-0,035*	-0,022*	-0,054*	-0,001*	-0,050*	-0,056*	-0,050*	-0,029*	-0,004*	-0,046*	-0,074*
	hsw	0,015*	0,013*	0,020*	0,017*	0,039*	0,002*	0,033*	0,035*	0,027*	0,015*	0,012*	0,020*	0,020*
	hsf	0,042*	0,025*	0,053*	0,019*	0,044*	-0,124*	0,145*	-0,016*	0,120*	0,057*	0,021*	0,052*	0,263*
	hsfw	-0,022*	-0,027	-0,025*	-0,013	-0,031	0,113	-0,094	0,012	-0,068*	-0,026*	-0,019*	-0,024	-0,089

Horizontal spillovers
Number of significant coefficients

		All	Firms by size classes				Firms by quintiles of productivity					Gap of domestic vs. foreign firms in productivity		
			Micro	Small	Medium	Large	Q1	Q2	Q3	Q4	Q5	G1	G2	G3
Domestic-owned firms														
#pos.	no w.	0	0	0	1	0	0	1	0	0	0	2	0	0
	with w.	6	5	7	3	5	4	4	4	7	5	5	6	2
#neg.	no w.	4	4	4	1	3	4	4	3	5	1	2	3	1
	with w.	1	0	0	2	0	0	1	0	0	1	1	0	1
Foreign-owned firms														
#pos.	no w.	1	1	3	2	1	0	1	1	2	1	2	1	2
	with w.	1	0	1	1	0	0	1	1	1	0	0	0	1
#neg.	no w.	1	0	1	0	0	1	2	1	0	0	0	0	0
	with w.	3	0	3	2	2	0	0	0	1	3	2	0	1

Vertical spillovers
Number of significant coefficients

		Firms by size classes				Firms by quintiles of productivity					Gap of domestic vs. foreign firms in productivity		
	All	Micro	Small	Medium	Large	Q1	Q2	Q3	Q4	Q5	G1	G2	G3
Domestic-owned firms													
#pos. no w.	2	1	2	0	1	0	1	2	1	1	0	3	0
with w.	3	0	2	3	0	4	1	1	1	2	3	0	3
#neg. no w.	4	0	2	3	0	2	2	0	1	0	4	0	1
with w.	3	0	2	2	2	1	1	1	1	3	2	4	1
Foreign-owned firms													
#pos. no w.	0	0	0	0	0	0	0	0	0	0	0	0	0
with w.	2	1	2	1	1	0	2	2	2	2	0	1	1
#neg. no w.	0	0	2	0	0	0	2	2	2	1	0	1	1
with w.	0	0	0	1	0	0	1	0	2	0	1	0	0

Conclusions

- Heterogeneity of firms is important
- Horizontal spillovers have become increasingly important over the last decade
  - even more important than vertical spillovers
- Positive horizontal spillovers:
  - equally distributed across size classes
  - in medium or high productivity firms with higher absorptive capacities
- Negative horizontal spillovers:
  - in smaller firms
  - in low to medium productivity firms