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Productivity spillovers through vertical linkages: Evidence from 17 OECD countries

by

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Abstract

This paper extends the literature on productivity spillovers from inward FDI. We use comparable industry level data for 17 OECD countries and investigate the importance of horizontal and vertical spillovers, and differences between CEEC and other OECD countries. Results show that there is evidence for spillovers through vertical backward linkages between multinationals and domestic firms for all countries, but that this effect is much higher for CEEC than other OECD countries. We also find some evidence for positive effects from horizontal FDI, but these do not differ between the two country groups.

JEL classification: F23

Keywords: Foreign direct investment, productivity, vertical linkages, spillovers

Outline

Non-Technical Summary

Attracting inward foreign direct investment (FDI) is high on the agenda of many governments, be it in developing or industrialised countries. One reason for this is the expectation of positive external effects of inward FDI fuelling growth of the domestic economy. The evidence to support this policy approach comes mainly from two literatures. Considering the relationship between FDI and growth at the macro level, recent studies find that there is a positive link only if countries have certain characteristics, such as high levels of human capital or developed financial systems. When considering the relationship between inward FDI and domestic firm-level productivity at the micro level, evidence is much more mixed. While some recent panel data studies for industrialised countries support the notion that domestic firms benefit from horizontal spillovers from inward FDI, there is some evidence that what is more important is spillovers from FDI in vertically related sectors, through input-output linkages. Research showing the importance of vertical linkages generally use micro level data for one particular country. It is therefore difficult to generalise from these particular case studies.

Our paper tries to tackle this issue by examining the importance of vertical linkages for productivity spillovers using comparable data for a number of OECD countries. This, hence, allows us to come up with more general conclusions on the importance of vertical linkages for productivity benefits from foreign direct investment. Specifically, we use industry level data from the OECD STAN database combined with input-output tables for OECD countries and information on FDI at the industry level. To the best of our knowledge, this is the first paper to study the relative importance of vertical and horizontal linkages using such cross country data. A further contribution of our paper is that we investigate explicitly whether, among OECD countries, Central and Eastern European Countries (CEEC) benefit differently from inward FDI. This reflects the particular interest that has been paid to these countries in the empirical literature.

Our main conclusion is that the evidence for spillovers from backward linkages is indeed strong, and that there are important differences between CEECs and more industrialised OECD countries. In particular, results show that there is evidence for spillovers through vertical backward linkages between multinationals and domestic firms for all countries, but that this effect is much higher for CEEC than other OECD countries. We also find some evidence for horizontal effects from FDI, but these do not differ between the two country groups.

1 Introduction

Attracting inward foreign direct investment (FDI) is high on the agenda of many governments, be it in developing or industrialised countries. One reason for this is the expectation of positive external effects of inward FDI fuelling growth of the domestic economy. The evidence to support this policy approach comes mainly from two literatures. Considering the relationship between FDI and growth at the macro level, recent studies find that there is a positive link only if countries have certain characteristics, such as high levels of human capital or developed financial systems (Borensztein et al., 1998; Alfaro et al., 2004). When considering the relationship between inward FDI and domestic firm-level productivity at the micro level, evidence is much more mixed. While some recent panel data studies for industrialised countries support the notion that domestic firms benefit from horizontal spillovers from inward FDI , there is some evidence that what is more important is spillovers from FDI in vertically related sectors, through input-output linkages (see Görg and Greenaway, 2004).

Research showing the importance of vertical linkages generally use micro level data for one particular country. The most often cited paper in this literature by Javorcik (2004), for example, uses data for Lithuania. It is therefore difficult to generalise from these particular case studies. An exception is a recent paper by Damijan et al. (2003) who use firm level data for 10 European transition countries. They find only in three cases (Czech Republic, Poland and Slovenia) evidence for spillovers through vertical linkages. However, their analysis is hampered by the data sources, which for eight countries are commercially provided samples of large manufacturing firms while for two countries micro data come from official sources.[1] Hence, the comparability of the results across countries is difficult in the Damijan et al. paper, and even more so when trying to come to conclusions using the results of other studies such as Javorcik (2004).

Our paper tries to tackle this issue by examining the importance of vertical linkages for productivity spillovers using comparable data for a number of OECD countries. This, hence, allows us to come up with more general conclusions on

[1] This implies that for the eight countries, data are biased towards large firms.

the importance of vertical linkages for productivity benefits from foreign direct investment. Specifically, we use industry level data from the OECD STAN database combined with input-output tables for OECD countries and information on FDI at the industry level. To the best of our knowledge, this is the first paper to study the relative importance of vertical and horizontal linkages using such cross country data. A further contribution of our paper is that we investigate explicitly whether, among OECD countries, Central and Eastern European Countries (CEEC) benefit differently from inward FDI. This reflects the particular interest that has been paid to these countries in the empirical literature.

The rest of the paper is structured as follows. Section 2 discusses the empirical approach and introduces the data used. Section 3 presents the empirical findings while section 4 concludes.

2 Empirical methodology

For the empirical analysis we combine industry level data from the OECD STAN database and OECD industry-level FDI-stock data. Our panel consists of 17 countries and eight manufacturing industries for the years 1989 to 2003.[2] A detailed description of the data is provided in the appendix.

As is standard in the literature we specify variants of the following logarithmic value added production function

$$\begin{aligned} \ln Y_{ict} &= \alpha + \beta \ln K_{ict} + \gamma \ln L_{ict} \\ &+ \delta \ln FDI^{H}_{ict} + \eta \ln FDI^{D}_{ict} + \tau \ln FDI^{U}_{ict} \\ &+ \iota_t + \nu_{ic} + \epsilon_{ict} \end{aligned} \tag{1}$$

[2]Countries are Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Slovakia, Sweden, United Kingdom, United States of America. Industries are listed in the appendix.

which are estimated by pooling over industries i, countries c and time t.

Y represents value added, K the capital stock and L labour input. The physical capital stock is constructed using the perpetual inventory method with an assumed depreciation rate of 10%. The inital stocks are constructed using the standard procedure described e.g. in Goto and Suzuki (1989).

In our fully specified model we include three measures of FDI to capture different potential transmission channels for the effects of FDI. FDI^H denotes the horizontal FDI-stock, thus it captures spillovers within the same industry, as well as the direct effect of FDI on aggregate industry level productivity. FDI^D denotes the weighted FDI-stock in downstream industries and captures productivity spillovers through backward linkages, i.e. through supplies of domestic firms to multinational enterprises in the respective downstream industries. More formally we construct FDI^D as follows:

$$FDI^D_{ict} = \sum_{j \neq i}^{J} FDI_{jct} \times \Omega_{ijc} \tag{2}$$

where j represents a downstream industry and Ω_{ij} denotes the share of supplies of industry i to industry j in total supplies of industry i. Ω_{ijc} is constructed using domestic supply-use tables from the OECD input-output statistics.

FDI^U denotes the weighted FDI-stock in the respective upstream industries capturing potential spillovers through forward linkages, i.e. through purchases by domestic firms from multinationals. We construct FDI^U in a similar fashion as in equation 2 again utilising OECD input-output data:

$$FDI^U_{ict} = \sum_{k \neq i}^{K} FDI_{kct} \times \Omega_{kic} \tag{3}$$

where k denotes a upstream industry and Ω_{kic} represents the share of purchases of industry i from industry k in all purchases of industry i.

To account for common time effects we include a full set of time dummies ι_t. Furthermore we allow for country specific industry fixed effects to control for industry unobserved heterogeneity. In addition the remaining error terms ϵ_{ict} are allowed to be heteroscedastic and correlated across industry-country panel groups ic and time.

For firm or plant level productivity studies it is frequently argued that factor inputs should be considered endogenous. This is because firms/plants may observe total factor productivity at least partly which, in turn, may influence the choice of factor input combinations in the same period. Hence, there would be a correlation between the error term and the contemporaneous levels of factor inputs, leading to biased estimates of the coefficients.[3] However, following Zellner et al. (1966) one could argue that output at the industry level is stochastic, as the data for individual plants/firms are aggregated up. For the case that output is stochastic Zellner et al. (1966) show that OLS regressions of a Cobb-Douglas production function yields consistent estimates of the output elasticities. However, to be sure, we perform a test for endogeneity of inputs using the approach outlined by Baum, Schaffer and Stillman (2003). The results, which are reported at the bottom of Table 1, indicate that we cannot reject the hypothesis of exogeneity of the regressors.[4]

3 Estimation results

Table 1 presents the results of estimating Equation 1. We estimate the model using OLS , allowing for unspecified heteroskedasticity and contemporaneous and serial correlation and include a full set of time dummies and country specific industry dummies. Column I of Table 1 shows the basic model without controls for vertical linkages, replicating the specification commonly used in the micro level literature on horizontal spillovers from FDI within the same industry. The estimated coefficients

[3]See, for example, Levinsohn and Petrin (2003) for discussions of the problem and solutions for analyses using micro level data.

[4]For labour inputs we use lagged output and fdi inward stocks as instruments. For horizontal, downstream and upstream fdi stocks we use one and two year lagged values as instruments.

on capital and labour are as expected, both taking positive signs.

With regard to horizontal FDI, we find a statistically significant and positive coefficient. However, if, as we would expect, vertical spillovers are indeed important, than the model reported in column I suffers from omitted variable bias. We therefore, in a next step, add FDI in downstream and upstream industries into the equation to capture spillovers from backward and forward linkages respectively. The results of this exercise are reported in Column II.

We still find evidence for positive effects from horizontal FDI, although the coefficient size is somewhat reduced. The coefficient on downstream FDI is also statistically significant and positive, suggesting the there are indeed spillovers through backward linkages, while there is no evidence that upstream FDI affects productivity. These findings are in line with the evidence from Lithuanian micro data by Javorcik (2004) and shows that this result also holds more generally when considering other countries. Taking the point estimates at face value our results suggest that an increase in the weighted FDI-stock in downstream sectors by ten percent is associated with a productivity increase by about 0.25 percent.

The estimations in Table 1 constrain the coefficient on FDI to be the same for all countries. This may not be a reasonable assumption, as even within the group of OECD countries economies are heterogeneous. Specifically, we may expect the benefits from FDI to differ for CEEC as these have undergone a process of substantial economic transition and structural changes over the analysed period. Indeed, much research at the micro level has focussed on such transition countries (e.g., Javorcik, 2004, Damijan et al., 2003, Konings, 2001). We therefore allow the coefficients on the FDI variables to differ for CEEC countries. To do so we calculate a dummy variable which is equal to one for the Czech Republic, Hungary, Poland and Slovakia, and zero otherwise, and interact this with the FDI indicators included in Equation 1.

The results of this are reported in Table 2. Note that we find that there are larger horizontal effects for CEEC countries when not controlling for vertical linkages. However, this effect disappears in column II. Also, we find in column II that backward linkages generate larger spillovers in CEECs than in other OECD countries. This underlines the conlcusion by Javorcik (2004) that vertical linkages are indeed important to boost the potential for benefits from inward FDI, especially in

less industrialsed transition economies. We also find that there are no statistically significant spillovers from FDI in upstream sectors on domestic firms in CEECs or other OECD countries.[5] This is also in line with results reported in Javorcik (2004) where she also finds no effects of multinationals' forward linkages on domestic firms' productivity. This may perhaps be indicative of domestic firms' not being able to fully utilise the higher quality inputs that are supplied to them by multinationals.

4 Conclusions

This paper extends the literature on productivity spillovers from inward FDI. The literature is generally based on micro level data for particular countries and the evidence provided therein is therefore difficult to generalise. To overcome this problem we use comparable industry level data for 17 OECD countries and investigate the importance of horizontal and vertical spillovers, and differences between CEEC and other OECD countries. Our main conclusion is that the evidence for spillovers from backward linkages is indeed strong, and that there are important differences between CEECs and more industrialised OECD countries. In particular, results show that there is evidence for spillovers through vertical backward linkages between multinationals and domestic firms for all countries, but that this effect is much higher for CEEC than other OECD countries. We also find some evidence for horizontal effects from FDI, but these do not differ between the two country groups.

[5] One concern with the estimations is that the CEEC dummy more generally picks up an effect of low income countries in the OECD, rather than anything specific to transition economies. In order to investigate this we defined a dummy equal to one if an economy is a low income country which, in addition to the four CEECs also includes Greece. The most striking difference in results is that the interaction between this dummy and the backward linkage indicator is statistically insignificant, while all other coefficients are similar to the earlier estimations. Hence, the interaction effect is specific to CEECs rather than low income countries more generally. Results are not reported here to save space.

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Data Apendix

Value added, labour input and investment are derived from the OECD STAN database. Industry level FDI data are obtained from the OECD's International Direct Investment Statistics and are made comparable across countries with respect to coverage by applying the industry classification as presented in Table A1. All variables are converted into real values using the respective countries' producer price index obtained from the OECD main indicators database.

In order to construct FDI stocks weighted by vertical linkages we utilise the most recent OECD input-output statistics for domestic intermediate inputs. However, as input-output statistics are not provided annually we only use tables from the mid 1990s and hold Ω_{ijc} in Equations 2 and 3 constant over the observation period.

In order to maximise the number of observations we chose an unbalanced design for our panel of 17 countries and eight manufacturing industries for the years 1989 to 2003 yielding a total of 1076 observations.

Table A1: Industry Classification

Industry	**ISIC-Code**
Food and Tobacco	15 to 16
Textiles, Apparel, Leather	17 to 19
Paper, Printing, Publishing	20 to 22
Petroleum, Chemicals, Plastic, Rubber	23 to 26
Basic Metals	27 to 28
Engineering	29 to 33
Cars, Transport Equipment	34 to 35
Manufacturing nec., Recycling	36 to 37

Tables

Table 1: Dummy OLS regression with autocorrelation robust standard errors

	I	II
$\ln K$	0.077	0.080
	[10.36]***	[11.17]***
$\ln L$	0.967	0.965
	[38.69]***	[37.84]***
$\ln FDI^H$	0.016	0.010
	[10.20]***	[2.67]***
$\ln FDI^D$		0.025
		[2.15]**
$\ln FDI^U$		-0.015
		[1.49]
Constant	3.335	3.302
	[26.13]***	[23.81]***
Observations	1076	1076
$adj.R^2$	0.998	0.998
Year Dummies (ι_t)	included	included
Industry Dummies (ν_{ic})	included	included
Exogeneity/Orthogonality Test		
C-Statistic ($\ln L$)	0.905	
p-value	0.342	
C-Statistic ($\ln FDI^H$)	0.367	
p-value	0.545	
C-Statistic ($\ln FDI^D$)		0.070
p-value		0.791
C-Statistic ($\ln FDI^U$)		0.471
p-value		0.492

Notes: t-statistics in parentheses, * significant at 10%, ** at 5%, *** at 1%.

Table 2: Dummy OLS regression with autocorrelation robust standard errors, CEEC Interaction

	I	II
$\ln K$	0.072	0.071
	[7.15]***	[10.06]***
$\ln L$	0.971	0.968
	[37.63]***	[37.07]***
$\ln FDI^H$	0.014	0.009
	[11.58]***	[3.58]***
$\ln FDI^H \times CEEC$	0.021	-0.004
	[1.65]*	[0.15]
$\ln FDI^D$		0.017
		[1.81]*
$\ln FDI^D \times CEEC$		0.107
		[1.83]*
$\ln FDI^U$		-0.010
		[1.18]
$\ln FDI^U \times CEEC$		-0.070
		[1.42]
Constant	3.382	3.381
	[26.37]***	[24.84]***
Observations	1076	1076
$adj.R^2$	0.998	0.998
Year Dummies (ι_t)	included	included
Industry Dummies (ν_{ic})	included	included

Notes: t-statistics in parentheses, * significant at 10%, ** at 5%, *** at 1%.