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Abstract:
This paper investigates the productivity effects of inward and outward foreign direct investment using industry and country level data for 17 OECD countries over the period 1973 to 2001. Controlling for national and international knowledge spillovers we argue that effects of FDI work through direct compositional effects as well as changing competition in the host country. Our results show that there are, on average, productivity benefits from inward FDI, although we can identify a number of countries which, on aggregate, do not appear to benefit in terms of productivity. On the other hand, a country's stock of outward FDI is, on average, negatively related to productivity. However, again there is substantial heterogeneity in the effect across OECD countries.

Keywords: Foreign direct investment, inward FDI, outward FDI, productivity, competition

JEL classification: F23

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1 INTRODUCTION

The increasing globalisation of the world economy is of topical interest, not only to academic economists but also to policy makers and the media. Of all the outcomes of globalisation – trade, migration, and foreign direct investment (FDI) – the last is probably the most visible. It is also likely to be, at the margin, the most important aspect of globalisation in economic terms. For instance, over the last decades global FDI flows have grown at least twice as fast as trade, resulting in flows over USD 650 billion and a total FDI stock of about USD 9 trillion in 2004 (United Nations, 2005). Much research has been directed towards understanding the causes and consequences of the increase in FDI on the economies involved.

There are two related yet different aspects to investigating FDI. On the one hand, it is of interest to understand the implications of increasing inward FDI on the host economy. Here in particular much of the policy interest is geared towards the question whether inward FDI may be used as a vehicle for increasing productivity growth. The assumption on part of many policy makers seems to be that there are positive effects, a belief that manifests itself in frequently quite generous investment incentives offered by governments in developed and developing countries alike.[1] On the other hand, increases in outward FDI are of concern to the sending (home) economies. Here much public debate has recently questioned whether outward FDI brings benefits or does actually harm the home country through loses of output and jobs.

In the literature, much of the empirical work has focused on the effects of inward FDI. There is a large body of work investigating whether domestic firms benefit through so-called horizontal productivity spillovers, i.e., effects of FDI on domestic firms within the same broadly defined industry (see Görg and Greenaway, 2004 for a review). Recent micro level panel data studies for developing and transition countries produce evidence that inflows of FDI can actually harm the productivity of domestic firms in the same industry (Aitken and Harrison 1999, Konings 2001), a result that is mainly attributed to increasing competitive pressure crowding out

[1]For example, Girma et al. (2001) report that the British government offered the equivalent of $50,000 per employee to Siemens in the 1990s to locate a plant in the North East of England.

domestic firms. However, a number of panel studies using micro data for developed countries, show that FDI can indeed increase the productivity of domestic firms through horizontal spillovers (e.g., Keller and Yeaple 2003, Girma et al., 2001 for the US and UK, respectively). Also, recent studies of vertical spillovers (through, for example, customer-supplier relationships) provide evidence that this is an important channel through which domestic firms can benefit from FDI (e.g., Javorcik, 2004, Girma et al., 2008). Furthermore, there are a number of papers examining country level productivity growth which find that inward FDI can increase growth but only for certain types of countries, e.g., those that have a threshold level of human capital or developed financial systems (Borensztein et al., 1998, Alfaro et al., 2004) All in all, this evidence suggests that the jury is still out on whether or not inward FDI generally is conducive to domestic productivity growth.

Perhaps an even more controversial issue (at least in the public media) are the effects of outward FDI on the sending economy. Critics argue that outward investment leads to reductions of domestic output with resulting employment losses in the domestic economy, while others point out that outward FDI enables firms to access new markets or cheaper inputs abroad, which will increase their competitiveness domestically and internationally and, certainly in the longer run, lead to positive output, employment and productivity effects in the home country. While some studies have been completed on employment effects of outward investment (e.g., Konings and Murphy, 2006), there has been little academic work on the link between a country's outward investment and productivity. Exceptions are papers by van Pottelsberghe and Lichtenberg (2001) and Braconier et al. (2001) who investigate specifically whether outward FDI benefits the domestic economy through R&D spillovers - i.e., whether, by investing abroad, firms are able to access the foreign technology stock and transfer the knowledge back to the domestic economy. Van Pottelsberghe and Lichtenberg (2001) use aggregate country level data and find that outward FDI into R&D intensive countries is a significant channel for knowledge spillovers and that, thus, countries productivity is positively influenced through technology sourcing. However, Braconier et al. (2001) do not find such

evidence in Swedish industry and firm level data.[2] Both studies investigate only the effects of FDI as a channel for knowledge spillovers through R&D and neglect other potential effects – most importantly the competition effects as highlighted in some of the studies on inward FDI.

Given this somewhat unsatisfactory state of the literature, this paper provides new evidence on the link between productivity and FDI. To do this, we relate industry level output in a country to its inward and outward FDI stocks in a production function framework. By including the domestic as well as the foreign knowledge (R&D) stock we control for national and international knowledge spillovers. We also control for the potential impact of FDI through imported intermediates via including materials in the production function. Therefore, any impact of FDI we identify is due to direct compositional effects (e.g., foreign investors are more productive and therefore increase industry level productivity) and competition effects of FDI. Our paper is, to the best of our knowledge, the first to make this distinction explicitly.

Our paper uses data for 10 manufacturing sectors for 17 OECD countries covering the period 1973 to 2001. This long time window allows us to construct country level FDI stocks which we use in the empirical estimation. This is a novelty of our paper, as most previous studies use FDI flows rather than stocks.[3] Using FDI stocks allows us to pick up medium and long term effects rather than just short run effects that may be identified using FDI flows. Our economy-wide definition of FDI stocks also allows us to capture not only intra-industry spillovers, but also positive productivity effects through vertical input-output linkages. As pointed out above, this latter channel has been stressed in the recent literature on vertical spillovers from inward FDI (Javorcik, 2004). Furthermore, we are not confining ourselves to FDI in manufacturing industries, but capture the whole economy with this variable.

We make a number of further contributions to the literature. The papers on productivity spillovers from inward FDI cited above provide in each case evidence for one particular country, or cross country studies at high levels of aggregation.

[2]Both studies also do not find any evidence for knowledge spillovers through inward FDI.

[3]This is mainly due to data limitations, see, e.g., Alfaro et al. (2004), van Pottelsberghe and Lichtenberg (2001), Borensztein et al. (1998).

By contrast, we use sector level data for a number of OECD countries, thereby providing more general evidence. Also, having a fairly large number of countries allows us to investigate whether our results differ for different countries. This, as we discuss below, brings to the fore some interesting aspects of country heterogeneity. Furthermore, in contrast to most of the existing literature, our data set allows us to estimate the effects of inward and outward FDI on domestic productivity simultaneously in the same estimation equation.

Previewing the empirical results we find that, on average, inward FDI is positively associated with domestic productivity at the industry level, while this relationship is negative for outward FDI. However, we show also that this result hides considerable heterogeneity in the effects across countries. We find a number of examples where inward FDI is negatively associated with productivity (e.g., post-unification Germany, Spain, Italy and Norway), as well as countries where the relationship between outward FDI and productivity is positive (France, Poland, Sweden, UK, USA).

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 AND DATA

In order to evaluate the effect of inward and outward FDI stocks in country c at time t on total factor productivity in industry j we estimate the following transformed Cobb-Douglas production function

$$\begin{aligned} ln\ Q_{jct} &= \beta \ln K_{jct} + \gamma \ln L_{jct} + \delta \ln M_{jct} \\ &+ \theta \ln RDD_{ct} + \lambda \ln RDF_{-ct} + \tau \ln IDI_{ct} + \sigma \ln ODI_{ct} \\ &+ \mu_{jc} + \nu_t + \epsilon_{jct} \end{aligned} \tag{1}$$

where Q is gross production and K, L, M are the standard production factors capital, labour and materials, respectively.[4] These data are constructed at the industry level from the OECD STAN database.[5] The capital stock is calculated using the perpetual inventory method and investment data, assuming a ten percent depreciation rate. L is the number of employees and M is measured as the difference between gross output and value added.[6]

RDD and RDF are proxies for the R&D capital stock in country c and abroad (excluding country c), respectively. The variables are calculated using data from the OECD ANBERD database. Stocks are calculated using the same approach as for the physical capital stock.[7] The RDF variable is calculated as the sum of all R&D expenditures in OECD countries apart from country c and is included to capture international knowledge spillovers through R&D activity abroad. Von Pottelsberghe and Lichtenberg (2001) and Coe and Helpman (1995) weight the foreign R&D stock using either FDI or trade data, in order to capture knowledge spillovers transmitted particularly through these channels. By contrast, as proposed by Keller (1998) and Mohnen (1996) we do not place any restrictions in terms of weights on RDF, thereby allowing for a general effect of all R&D undertaken abroad on domestic production.

[4]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 TFP at least partly which, in turn, may influence the choice of factor input combinations in the same period (see, e.g., Levinsohn and Petrin, 2003). 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 not reported here to save space, indicate that we cannot reject the hypothesis of exogeneity of the regressors.

[5]A detailed description of all data used in the estimations is given in the appendix.

[6]Note that materials include imported intermediate inputs.

[7]The R&D capital stocks at time $t = 0$ were constructed using the standard procedure as described in Goto and Suzuki (1989) or Hall and Mairesse (1995).

The variables IDI and ODI are intended to capture the effects of inward and outward FDI respectively on industry productivity. Since RDF is assumed to capture international knowledge spillovers the FDI variables pick up any effects apart from such spillovers. Specifically, we expect these variables to capture competition effects of foreign direct investment as well as direct compositional effects. Inward and outward FDI stocks are calculated using flow data from the IMF International Financial Statistics database and applying a similar perpetual inventory method as used for the construction of the capital stock. The use of FDI stocks is preferred to flows, as stocks allow us to capture medium to long term effects through accumulating FDI flows.

While the expected signs of the coefficients for the traditional inputs – physical capital, labour, materials, domestic R&D – are straightforward positive, the expected coefficients for the other variables warrant some discussion. Turning first to the expected signs of the foreign R&D capital stock variable a positive as well as a negative sign is plausible. A positive sign indicates that on average a country benefits via international knowledge spillovers from R&D carried out in other countries. A negative relationship between RDF and industry total factor productivity (TFP), on the other hand may suggest that R&D carried out abroad has increased the competitiveness of foreign competitors. This may lead to reductions in domestic output as consumers prefer the foreign competitors with negative consequences for domestic productivity.

For the inward FDI stock the estimated coefficients might also be positive or negative. Recall that we control for both the impact of FDI through knowledge diffusion and that of FDI via purchased supplies. While we capture the first effect of FDI by incorporating the two R&D capital stock variables in the estimations we control for the latter by including materials in the estimation. Hence, the IDI variable measures, on the one hand, direct compositional effects of FDI, whereby the influx of more productive foreign firms raises industry level productivity.[8] On the other hand, however, in the short run the inflow of foreign firms can be expected to

[8]Lipsey (2004) cites evidence from micro data studies showing that foreign multinationals are generally more productive than domestic firms.

lead to a business stealing effect with foreign firms taking business away from domestic firms, hence reducing productivity for the latter.[9] In the longer run domestic firms should be able to adjust their production processes and improve productivity as a result of the increased competition, or leave the industry, hence leading to an increase in industry level productivity. Hence, a negative sign would indicate that the positive competition effect does not work but that, instead, domestic firms lose to their foreign competitors. This may be the case if firms are not able to adjust their production process, e.g., due to rigidities in factor markets which prohibits reallocation of production factors and the implementation of new technology.

To consider the expected impact of outward FDI it is useful to distinguish vertical and horizontal FDI, as in the standard theoretical models such as Markusen's (2002) knowledge capital model. If a firm engages in vertical FDI from a skill abundant developed country it is generally assumed to relocate the unskill intensive part of its production process in unskilled labour abundant countries. This, in the short run, will lead to reductions in home market value added. However, in the medium to longer run, the domestic firm improves its competitive position due to the access to cheaper inputs and, hence, will be able to raise domestic output and productivity. Another option for ODI is horizontal investment, where a firm relocates a plant at a similar stage of the production process abroad to serve foreign markets. This, similar to vertical investment, may lead to reductions in home output in the short run, in particular if the firm previously served the foreign market through exports. Outward investment should, however, enable the firm to raise its competitiveness through accessing new markets which, in the longer run should increase home market productivity. Hence, we would generally expect positive productivity effects of vertical and horizontal outward FDI in our analysis. Only if the firm is not able to adjust in the longer run to the reduction in home market output by failing to raise its competitiveness or due to plant level economies of scale (e.g., due to factor market rigidities) should we be able to observe a negative relationship between outward FDI and productivity in the domestic industry.

The data allow us to distinguish ten ISIC Rev. 3 manufacturing sectors, and are

[9]This argument was made by Aitken and Harrison (1999).

available for 17 OECD countries covering the period 1973 to 2001 (a list of countries can be found in the appendix).[10] The panel is unbalanced since the length of the available time series differ across countries due to data constraints. All nominal variables were converted into 1995 USD using the OECD value added deflator for the manufacturing sector.

The production function estimation also includes full sets of sector-country fixed effects (μ_{jc}) and time dummies (ν_t). The estimations have been carried out using a feasible GLS (FGLS) estimator with a correction for panel specific first order autocorrelation and panel heteroskedasticity, as tests based on residuals from equation (1) indicate that the error term follows an autoregressive process of order 1.[11]

3 ESTIMATION RESULTS

Table 1 presents the results of estimating three specifications of equation (1) using FGLS. While in column (1) the model is estimated without FDI, column (2) introduces inward FDI and column (3) estimates the fully specified model including in-

[10] Tests for unit roots indicate no evidence of unit roots in any of our variables. Test results are not reported here but can be obtained upon request.

[11] As a robustness check we also ran regressions using a standard fixed effects (within transformation) estimator. Results, which are not reported here to save space but that can be obtained upon request, are similar to the ones reported herein. A further concern with the estimation results from the fact that some of our covariates only vary at the country level, thus introducing contemporaneous correlation. A correction using within country clusters would be inadequate given our small number of country clusters (17) relative to the number of units in the cluster resulting in inconsistent coefficients (Wooldridge, 2002). However, since we carry out the estimations with sector-specific fixed effects, time dummies, heteroscedasticity-corrected standard errors, and a correction for panel-specific autocorrelation of form 1, we largely eliminate possible contemporaneous correlation within country clusters. As a robustness check we estimated all results reported below in Tables 1-3 also with bootstrapped standard errors which confirm the results reported in our paper. Results can be obtained from the authors.

ward and outward FDI. The coefficients reflect elasticities. Column (4) furthermore shows the marginal effects associated with the coefficients in column (3), evaluated at the median of the independent variables. In terms of factor inputs, we find that K, L, M return positive and statistically significant coefficients in all specifications, with magnitudes that appear reasonable and similar to what is generally found in the literature.

In terms of the knowledge stock, we find that the stock of domestic R&D capital is positively related to productivity, with an elasticity of about 0.03 to 0.04. Hence, a ten percent increase in the stock of R&D undertaken in the home country leads to an increase in TFP by 0.3 to 0.4 percent.[12] One may argue that such an elasticity is small in terms of economic significance, however, one should keep in mind that this variable captures R&D undertaken in all sectors in the entire economy. One would therefore arguably not expect strong effects from all types of R&D undertaken in the economy on a given industry.

The stock of foreign R&D capital also returns a positive and statistically significant coefficient. Its elasticity is 0.07 and is, thus, clearly higher than that of the domestic knowledge stock.[13] This can be explained by considering that the foreign R&D stock, which is the sum of all OECD countries except country c, is far higher than RDD. Hence, a one percent change involves a far larger absolute change. This becomes clearer when examining marginal changes evaluated at the median of the independent variable as reported in column (4). This indicates that, all other things equal, a one dollar change in RDD is associated with an increase of 0.03 of output while a one dollar increase in RDF leads to an 0.001 increase in output. Also, recall that RDF is not weighted by trade or FDI and hence represents a general effect of outside R&D not just that related to international flows of goods or factors.[14]

[12]This coefficient is well within the range of elasticities of domestic R&D estimated by van Pottelsberghe and Lichtenberg (2001) using country level data. They report estimates ranging from 0.02 to 0.14.

[13]As known from previous studies (cf. Mohnen, 1996 for an review) the point estimate is less robust to changes in the model specification as becomes apparent in Tables 2 and 3.

[14]As a robustness check we also estimate all equations reported in Tables 1 to 3 without the foreign R&D stock variable. The resulting coefficients on the other variables in the production

As regards inward FDI, we find a positive and statistically significant coefficient in both columns (2) and (3) with elasticities of about 0.013.[15] This provides, thus, evidence that FDI inflows have, on average, positive effects on productivity in the host country in our sample of OECD countries. The findings are, thus, in line with the recent evidence from single country studies for the US and UK (as cited in the introduction) and also supports the general perception on the part of many policy makers that inward FDI can increase domestic productivity.

The coefficients reported in Table 1 are, of course, averages over a number of countries and may hence hide differences across countries. As pointed out in the introduction, for example, single country studies of productivity spillovers from inward FDI based on micro data tend to find different results for different countries. Even though in our sample all countries are members of the OECD there is still cross-country heterogeneity due to, for example, differences in country size, membership in preferential trading agreements, etc.

In order to take this issue into account we allow the coefficient on FDI to differ across all countries. The results are reported in Table 2. It is now apparent that not all countries gain equally from inward FDI. Specifically, we do not find any positive coefficients for post-unification Germany, Spain, Norway and Italy. In fact, for the former three countries, we find statistically significantly negative impacts of inward FDI on domestic TFP at the industry level. How can we explain these negative effects for those countries? As discussed above, inward FDI may reduce output by domestic firms through a business stealing effect in the short run, leading to reductions in output and productivity (cf. Aitken and Harrison, 1999). In the longer run, however, domestic firms, through increased competitive pressure, should be able to improve their competitive position and increase productivity. Our results show that these positive effects did not materialise for these countries, perhaps indicating domestic firms' lack of competitiveness. This may be due to rigid factor markets which prevent firms from making the necessary adjustments. As Dewit et al. (2003) show, using an OECD indicator for the tightness of labour market

function are virtually unchanged in terms of magnitude and statistical significance. Results are not reported here to save space but can be obtained from authors.

[15] Recall that the FDI variables are also defined at the country level.

restrictions, the four countries identified here are among those with the highest labour market restrictions in the OECD.[16]

In contrast to the impact of inward FDI our estimation results suggest that outward FDI has, on average, a negative effect on home country productivity, with an average elasticity substantially less than the positive inward FDI effect (Table 1, column 3). This may reflect that the reduction in home market output associated with outward investment has not been reversed in the longer run through expansions due to increased competitiveness, as argued in the discussion above. However, before commenting on this further we explore the issue of country heterogeneity similar to our analysis of inward FDI.

We allow the coefficients on the ODI variable to differ by country, the results being reported in Table 3. In line with our previous results this shows that some countries benefit, while some lose in terms of industry level productivity from outward investment. Specifically, France, Japan, Poland, Sweden, the Czech Republic, the UK and USA show positive and statistically significant coefficients on ODI, indicating that increased outward FDI is associated with higher total factor productivity at the industry level. While our data do, unfortunately, not allow us to look in more detail at the sectoral and destination composition of the outward stocks, our results show that the benefits from ODI, which to some extent reflect decisions by firms to relocate part of the production process abroad, are heterogeneous across countries.

4 CONCLUSIONS

This paper investigates the productivity effects of inward and outward foreign direct investment using industry and country level data for 17 OECD countries over the period 1973 to 2001. Controlling for national and international knowledge spillovers

[16]However, according to that OECD indicator France also has very high labour market regulations, although we find positive effects for this country. Hence, a generalisation based on the link between factor market rigidities and productivity effects of FDI may not be possible. Unfortunately, the OECD indicator is only available for 1989 and 1998, preventing any meaningful use of the variable in the econometric analysis herein.

we argue that effects of FDI work through direct compositional effects as well as changing competition in the host country. The paper relates to a large recent literature on productivity, competition and growth effects from inward FDI, which mainly either uses micro level data for a particular country as case study evidence, or aggregate country level data. Extending this literature, we also consider the relationship between productivity and outward FDI in the same estimation equation.

Our results show that there are, on average, productivity benefits from inward FDI, although we can identify a number of countries which, on aggregate, do not appear to benefit in terms of productivity. On the other hand, a country's stock of outward FDI is, on average, negatively related to productivity. However, again there is substantial heterogeneity in the effect across countries, with a number of countries, namely, France, Poland, Sweden, the UK and the US, showing positive associations between total outward FDI and domestic productivity.

Thus, the main policy conclusion from this analysis is that the effects of inward and outward foreign direct investment can differ tremendously across countries. Investigating the sources of this heterogeneity is, unfortunately, beyond the scope of the current paper due to data constraints. It remains high on our future research agenda.

APPENDIX

Data description

The estimations have been carried out on the basis of data for ten manufacturing industries in the 17 countries Canada (CAN), Czech Republic (CZE), pre-unification (till 1990) West Germany (DEW), post-unification (1991 onwards) Germany (DEU), Denmark (DNK), Finland (FIN), France (FRA), Italy (ITA), Japan (JPN), South Korea (KOR), Netherlands (NLD), Norway (NOR), Polen (POL), Spain (ESP), Sweden (SWE), the United Kingdom (GBR) and the United States (USA). The data were taken from the OECD databases ANBERD and STAN and the IMF database IFS.

The annual time series are available for the years 1973 to 2001 in ISIC Rev. 3

classification. Due to data constraints the length of the available time series differ across countries. The panel is therefore unbalanced.

The data was deflated to constant prices of 1995 using the OECD value-added deflator for the manufacturing sector and was then converted into USD using the exchange rates from 1995. To this end, Euro-data was converted back into national currency. From this data, output Q is measured as gross production. All stocks, i. e. the physical capital stock, the R&D capital stock and the FDI stocks, are calculated using the perpetual inventory method where a depreciation rate of ten percent is assumed. Labor L is measured as the number of employees, and material/intermediate inputs M are calculated as the difference between gross output and value added.

REFERENCES

Aitken, B.J. and A.E. Harrison (1999), 'Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela', *American Economic Review*, 89, 3, 605-618.

Alfaro, L., A. Chanda, S. Kalemli-Ozcan, and S. Sayek (2004), 'FDI and Economic Growth: The Role of Local Financial Markets', *Journal of International Economics*, 64, 1, 89-112.

Baum, C.F., M.E. Schaffer and S. Stillman (2003), 'Instrumental variables and GMM: Estimation and testing', Working Paper No. 545 (Boston College).

Borensztein, E., J. De Gregorio, and J-W. Lee (1998), 'How Does Foreign Direct Investment Affect Economic Growth?', *Journal of International Economics*, 45, 1, 115-135.

Braconier, H., K. Ekholm and K.H. Midelfart Knarvik (2001), 'Does FDI work as

a channel for R&D spillovers? Evidence based on Swedish data', *Review of World Economics*, 137, 4, 644-665.

Coe, D.T. and E. Helpman (1995), 'International R&D Spillovers', *European Economic Review*, 39, 5, 859-887.

Dewit, G., H. Görg and C. Montagna (2003), 'Should I stay or should I go? A note on employment protection, domestic anchorage and FDI', GEP Research Paper 03/27 (University of Nottingham).

Girma, S., D. Greenaway and K. Wakelin (2001), 'Who benefits from Foreign Direct Investment in the UK?', *Scottish Journal of Political Economy*, 48, 2, 119-133.

Girma, S., H. Görg and M. Pisu (2008), 'Exporting, linkages and productivity spillovers from foreign direct investment', *Canadian Journal of Economics*, 41, 1, 320-340.

Görg, H. and D. Greenaway (2004), 'Much ado about nothing? Do domestic firms really benefit from foreign direct investment?', *World Bank Research Observer*, 19, 2, 171-197.

Goto, A. and K. Suzuki (1989), 'R&D Capital, Rate of Return on R&D Investment and Spillover of R&D in Japanese Manufacturing Industries', *Review of Economics and Statistics*, 71, 4, 555-564.

Hall, B.H. and J. Mairesse (1995), 'Exploring the Relationship Between R&D and Productivity in French Manufacturing Firms', *Journal of Econometrics*, 65, 1, 263-293.

Javorcik, B.S. (2004), 'Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages', *Ameri-*

can Economic Review, 94, 3, 605-627.

Keller, W. (1998), 'Are International R&D Spillovers Trade-Related? Analyzing Spillovers among Randomly Matched Trade Partners', *European Economic Review*, 42, 8, 1469-1481.

Keller, W., and S. Yeaple (2003), 'Multinational Enterprises, International Trade, and Productivity Growth: Firm-Level Evidence from the United States', NBER Working Paper No. 9504 (Cambridge, M.A.).

Konings, J. (2001), 'The Effects of Foreign Direct Investment on Domestic Firms: Evidence from Firm Level Panel Data in Emerging Economies', *Economics of Transition*, 9, 3, 619-633.

Konings, J. and A. Murphy (2006), 'Do multinational enterprises relocate employment to low-wage regions? Evidence from european multinationals', *Review of World Economics*, 142, 2, 267-286.

Levinsohn, J. and A. Petrin (2003), 'Estimating production functions using inputs to control for observables', *Review of Economic Studies*, 70, 2, 317-341.

Lipsey, R.E. (2004), 'Home and host country effects of foreign direct investment', in R.E. Baldwin and L.A. Winters (eds.), *Challenges to Globalization* (Chicago: University of Chicago Press).

Markusen, J.R. (2002), *Multinational firms and the theory of international trade* (Cambridge, M.A.: MIT Press).

Mohnen, P. (1996), 'R&D Externalities and Productivity Growth', *STI Review*, 18, 39-66.

United Nations (2005), *World Investment Report 2005* (New York: United Nations).

van Pottelsberghe de la Potterie, B. and F. Lichtenberg (2001), 'Does Foreign Direct Investment Transfer Technology Across Borders?', *Review of Economics and Statistics*, 83, 3, 490-497.

Wooldridge, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data* (Cambridge, M.A.: MIT Press).

Zellner, A., J. Kmenta and J. Dreze (1966), 'Specification and Estimation of Cobb-Douglas Production Function Models', *Econometrica*, 34, 4, 784-795.

Table 1: FGLS Estimation Results for Levels

Indep. var.	**Column 1**	**Column 2**	**Column 3**	**Column 4**
	dependent variable is $\ln Q$			**marginal prod.**
$\ln RDD$	0.0479***	0.0314***	0.0407***	$\approx$ .0364
	(0.0044)	(0.0043)	(0.0047)	
$\ln RDF$	0.0759***	0.0778***	0.0713***	$\approx$ .0012
	(0.0225)	(0.0221)	(0.0226)	
$\ln IDI$		0.0130***	0.0134***	$\approx$ .0158
		(0.0011)	(0.0011)	
$\ln ODI$			-0.0075***	$\approx$ -.0076
			(0.0018)	
$\ln K$	0.0358***	0.0310***	0.0273***	$\approx$ .0630
	(0.0031)	(0.0030)	(0.0030)	
$\ln L$	0.1434***	0.1512***	0.1496***	$\approx$ 16.4403
	(0.0056)	(0.0054)	(0.0054)	
$\ln M$	0.7905***	0.7878***	0.7899***	$\approx$ 1.2306
	(0.0037)	(0.0036)	(0.0037)	
Wald χ^2 (df)	4.35e+09 (203)	3.16e+09 (204)	2.06e+09 (205)	
p-value Wald χ^2	0.0000	0.0000	0.0000	
Obs.	3220	3220	3220	

Remarks: Fixed- and time-specific effects are included and groupwise significant at the one-percent level. Consistent standard errors in parentheses. ***, **, * indicate a significance at the 1%, 5% and 10% levels, respectively.

Table 2: FGLS Estimation Results on Inward FDI

Indep. var.	**Column 1** dependent variable is $\ln Q$
$\ln RDD$	0.0454*** (0.0078)
$\ln RDF$	0.0232 (0.0282)
$\ln IDI * D^{CAN}$	0.0342*** (0.0098)
$\ln IDI * D^{CZE}$	0.0262*** (0.0059)
$\ln IDI * D^{DEU}$	-0.0038* (0.0021)
$\ln IDI * D^{DEW}$	0.0378*** (0.0074)
$\ln IDI * D^{DNK}$	0.0098*** (0.0030)
$\ln IDI * D^{ESP}$	-0.0139*** (0.0043)
$\ln IDI * D^{FIN}$	0.0081** (0.0034)
$\ln IDI * D^{FRA}$	0.0307*** (0.0040)
$\ln IDI * D^{GBR}$	0.0639*** (0.0066)
$\ln IDI * D^{ITA}$	0.0032 (0.0042)
$\ln IDI * D^{JPN}$	0.0118*** (0.0015)
$\ln IDI * D^{KOR}$	0.0736*** (0.0092)
$\ln IDI * D^{NLD}$	0.0170*** (0.0037)
$\ln IDI * D^{NOR}$	-0.0097** (0.0049)
$\ln IDI * D^{POL}$	0.0530*** (0.0044)
$\ln IDI * D^{SWE}$	0.0251*** (0.0022)
$\ln IDI * D^{USA}$	0.0226*** (0.0024)
$\ln ODI$	0.0006 (0.0024)
$\ln K$	0.0104*** (0.0036)
$\ln L$	0.1759*** (0.0055)
$\ln M$	0.7881*** (0.0037)
Wald χ^2 (df)	1.16e+09 (221)
p-value Wald χ^2	0.0000
Obs.	3220

Remarks: Fixed- and time-specific effects are included and groupwise significant at the one-percent level. Consistent standard errors in parentheses. ***, **, * indicate a significance at the 1%, 5% and 10% levels, respectively.

Table 3: FGLS Estimation Results on Outward FDI

Indep. var.	**Column 1**
	dependent variable is $\ln Q$
$\ln RDD$	0.0446*** (0.0079)
$\ln RDF$	0.0389 (0.0294)
$\ln IDI$	0.0062*** (0.0013)
$\ln ODI * D^{CAN}$	-0.0065 (0.0058)
$\ln ODI * D^{CZE}$	0.1355*** (0.0436)
$\ln ODI * D^{DEU}$	-0.0233*** (0.0038)
$\ln ODI * D^{DEW}$	-0.0277*** (0.0059)
$\ln ODI * D^{DNK}$	-0.0088** (0.0044)
$\ln ODI * D^{ESP}$	-0.0196*** (0.0027)
$\ln ODI * D^{FIN}$	-0.0001 (0.0026)
$\ln ODI * D^{FRA}$	0.0124*** (0.0036)
$\ln ODI * D^{GBR}$	0.0500*** (0.0075)
$\ln ODI * D^{ITA}$	-0.0119*** (0.0032)
$\ln ODI * D^{JPN}$	0.0241*** (0.0035)
$\ln ODI * D^{KOR}$	-0.1077*** (0.0218)
$\ln ODI * D^{NLD}$	-0.001 (0.0060)
$\ln ODI * D^{NOR}$	-0.0220*** (0.0038)
$\ln ODI * D^{POL}$	0.0387*** (0.0066)
$\ln ODI * D^{SWE}$	0.0186*** (0.0043)
$\ln ODI * D^{USA}$	0.0115*** (0.0045)
$\ln K$	0.0141*** (0.0037)
$\ln L$	0.1719*** (0.0057)
$\ln M$	0.7840*** (0.0038)
Wald χ^2 (df)	1.01e+09 (221)
p-value Wald χ^2	0.0000
Obs.	3220

Remarks: Fixed- and time-specific effects are included and groupwise significant at the one-percent level. Consistent standard errors in parentheses. ***, **, * indicate a significance at the 1%, 5% and 10% levels, respectively.