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Working Papers of Eesti Pank
No 13, 2005

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ISBN 9949-404-45-2
ISSN 1406-7161

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December, 2005

Abstract

The aim of this paper is to study the effects of both inward and outward foreign direct investment (FDI) on productivity. The main novelty is the analysis of the spillover effects of outward FDI that may occur outside the investing firms on the rest of the home country. The effects are addressed both for the manufacturing and services sectors. To our best knowledge there have so far been no studies based on enterprise-level panel data analysing the spillovers of outward FDI in the production function estimation framework. We find that engaging in outward FDI or receiving inward FDI is positively related to the productivity of the parent firm in Estonia or the subsidiary in Estonia. We do not find much evidence of positive spillovers via outward or inward FDI that is robust to the specification of the model or does not depend on the sector being studied. The results on spillover effects vary according to different specifications of the spillover variable, sector or the model, being either statistically insignificant or, in some cases, positive.

JEL Code: F10, F21, F23

Keywords: foreign direct investment, spillovers, home country effects, productivity

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The views expressed are those of the authors and do not necessarily represent the official views of Eesti Pank.

*The authors are grateful for valuable comments and suggestions by all seminar participants from the Research Department and the Economics Department of Eesti Pank, Holger Görg, Urmas Varblane, Harald Lehmann, Kalev Kaarna and participants of seminars held in Halle (Germany) and Kääriku (Estonia). We thank Piret Anton from the Balance of Payments Department of Eesti Pank for substantial help with data on outward and inward FDI in Estonia. Jaan Masso acknowledges also financial support from the Ministry of Education and Research of the Republic of Estonia - for the target financed project No 0182588s03.

Contents

1. Introduction

An increasing number of studies have engaged in analysis of the effects of foreign direct investment (FDI) on productivity in the host country of the investment. Both direct effects (also known as "own-firm effects"') on a subsidiary of a multinational enterprise (MNE) and spillover effects on domestic enterprises in the host economy have been quite thoroughly addressed in the literature. There is a general consensus that FDI improves the productivity of the firms that receive it, although part of the effect can be attributed to FDI selecting better firms (Bellak 2004). However, papers studying spillover effects from FDI in the host country show a multitude of different results (Görg and Strobl 2001, Smarzynska Javorcik 2004, Schoors and van der Tool 2002).

Compared to the analysis of the effects of inward FDI (i.e. host country effects), the home country effects of FDI have been researched to lesser extent. Still, this issue has provoked significant interest among the policy makers in advanced countries. Outward FDI (OFDI) has often been (very often with no reason) blamed for adverse effects on the home economy, including, for example, the argument about exporting jobs. The studies that discuss the effects of FDI in the home country[1] focus their analysis overwhelmingly on the effects on the investing parent firm[2] (on its employment, output, exports and productivity). In their recent publication, Barba Navaretti, Venables et al. (2004) stress that so far the spillovers of FDI in the home country of the investor are mostly left out of the analysis and this gap needs to be closed soon.

The aim of this paper is to study and compare the effects of both inward and outward FDI on the productivity of firms. The main novelty of our study is the analysis of the spillover effects of outward foreign direct investment that may occur outside the investing firms on the rest of the home country. Another novelty is that we concentrate on the effects both in the manufacturing and the services sector. Most of the former studies (except e.g. Griffith et al. 2004 on UK) only consider the effects of FDI in the manufacturing sector.

We use a rich enterprise-level panel dataset of the population of all Estonian firms (up to approx. 41,000 firms per year) from the Estonian Business Register from the period 1995 to 2002. We combine this database with the unique dataset from the Department of Balance of Payments at Bank of Estonia on firms in Estonia with outward FDI. To our best

[1] I.e. the source country of FDI.

[2] Examples, among others, include Lipsey (2002), Criscuolo and Martin (2003).

knowledge there have so far been no studies based on enterprise-level panel data analysing the spillovers of outward FDI in the production function estimation framework. This can be explained mainly by the lack of data for relevant analysis in former studies. The majority of the related empirical studies still concentrate on host country effects and those looking at home country effects deal with the effect on the investing firm itself. Thus there is a clear need to fill this gap.

Estonia is a transition economy that has witnessed rapid economic reforms and growth during the transition period and has attracted substantial amounts of inward FDI per capita. Moreover, the outward FDI from the Central and Eastern European (CEE) countries in general and from Estonia in particular to its neighbouring countries has risen significantly in recent years. Estonia ranked first in 2001–2003 among the CEE countries by the ratio of its outward FDI to the total capital formation (UNCTAD: WIR 2004). Thus there is reason to expect, in addition to inward FDI spillovers, that some spillovers occur from firms that have undertaken outward FDI.

We follow the methodological tradition of estimating the effects of FDI on total factor productivity (TFP) in the host country as specified by several authors using the augmented production function framework (e.g. Aitken and Harrison 1999, Schoors and van der Tool 2002) and apply similar methods to investigate the effects of outward FDI in the home country as well. Additionally, to check the robustness of the estimation results of augmented production function, we employ a two-step estimation, where in step 1, the TFP is estimated by using the Levinsohn-Petrin (LP) procedure for estimating the Cobb-Douglas production function separately for all 2-digit sectors; and in step 2, the estimates of TFP are pooled together again and TFP is regressed on FDI variables and other control variables. The Levinsohn-Petrin procedure controls for the endogeneity of inputs that could bias the coefficients in regression analysis (Levinsohn and Petrin 2003). In this way we can also allow for more heterogeneity as the coefficients of inputs like capital and labour can vary for different sectors.

Our finding is that both receiving FDI into the firm and making outward FDI is associated with the higher productivity of the firm. Foreign owned firms have higher productivity than domestic firms, even if differences in other relevant firm specific or sector specific variables that may affect productivity (e.g. higher capital intensity etc) are taken into account. The same holds when comparing MNEs and firms that have not engaged in outward FDI. Significant self-selection effects are also found among firms; yet, there are significant differences in this matter between

the manufacturing and services sectors.

We do not find any evidence of positive spillovers via outward or inward FDI that is robust to the specification of the model or does not depend on the sector being studied. The results vary according to the different specifications of the spillover variable, being either not statistically significant or, in some cases, positive.

This paper is structured in the following way: Section 2 provides an overview of relevant literature related to the "own-firm" and spillover effects of both inward and outward FDI. Section 3 describes the methodology used in the paper. Section 4 gives a short overview of outward and inward FDI in Estonia. Section 5 describes data and provides descriptive statistics based on enterprise level panel data. The results of our econometric analysis are presented in Section 6. Section 7 concludes.

2. Home and Host Country Effects of FDI

It is well known from the theory of host country effects of FDI that in order for FDI to occur, the multinational enterprise (MNE) must have some firm specific advantages compared to enterprises in the host economy (Caves 1996, Markusen 2002). Or similarly, according to the well-known OLI framework by Dunning (also called the eclectic paradigm), the enterprise's decision to invest abroad is determined by ownership, location and internalization advantages (Dunning 1988). It must be beneficial for the firm having ownership advantages to exploit them internally rather than through arms-length transactions, e.g. via licensing or co-operation agreements with other firms. It must be lucrative to use those advantages in a foreign country rather than in their own country (Dunning 1988). Based on the OLI framework we can conclude that investing abroad may also improve productivity of the MNEs headquarters or the overall productivity of the MNE in all its locations as these three different types of advantages are combined.

Usually, the authors discuss technology transfer (due to firm specific advantages of the MNE) from the MNE to its affiliate in the host country and related spillover effects[3] in the host economy. The presence of an

[3]Spillover effects – in the context of home country effects; these are effects from the presence/proximity of multinational enterprises that have invested abroad upon other local enterprises (that have not invested abroad) in the home country. In the context of host country effects of FDI, FDI spillovers measure how the presence of firms with foreign owners in the country affects other firms in this host country. We can say that spillovers in the home country take place when the MNEs cannot reap

MNE in a host country can lead to technology transfer to domestic firms, i.e. to spillovers of inward FDI to local enterprises (e.g. Aitken and Harrison 1999). If foreign firms introduce new products and/or processes in their affiliates in a host country, domestic firms and other foreign owned firms may benefit from a faster diffusion of new technology through worker mobility between foreign owned and domestic firms, demonstration effects and through increased incentives to adopt state-of-the art technology in domestic firms due to increased competition in the product market (Blomström and Kokko 2003). Spillovers are said to take place as MNEs, due to the public good characteristics of their firm specific assets, cannot reap all the benefits of their activities in a foreign location (Caves 1996). This is the well-known story about host country productivity effects. The similarity with home country effects is arguably very significant.

We can, in the same way, also conclude that the presence of a home plant of an MNE or the rise in the number of firms that engage in outward FDI can lead to knowledge transfer to other firms in the home country — that is, to spillovers of FDI to local enterprises in the home country. The transferred knowledge may concern technology[4], marketing, foreign market related information, information that will also make it easier for other firms to become multinational, etc.

In addition to technology transfer from the parent to its subsidiary, foreign subsidiaries themselves can be important sources for the transfer of technological knowledge and host market and foreign linkages related knowledge to the parent in the home country as well. This may occur, especially, if the affiliates are located in places with a lot of innovative activities.

Also there are some papers (e.g. Driffield and Love 2003) that mention reverse knowledge spillovers from purely domestic enterprises in the host economy to the MNE affiliate, this reverse technology transfer (sometimes called technology sourcing) can lead to knowledge/technology upgrading in the MNE's plant(s) in the host and in the home country as well. If there is indeed such reverse technology transfer, the productivity of the MNE's home country plant may rise as well, increasing also the potential for spillovers to other firms in the home country as a consequence of the

all the benefits that follow from making outward FDI abroad, some of these benefits "spill over" to the national firms in the home economy.

[4]In the case of Estonia, technology related know-how from outward investment is probably not very important, as the technological level of the main host countries of Estonian FDI, Latvia and Lithuania, is not significantly different from Estonia. We would, in this context, rather expect spillovers in the form of improved host market related know-how (e.g. the knowledge about local customers).

outward FDI.

The beneficial effects — positive spillovers to the rest of economy — may also, to some extent, result from the fact that MNEs may simply be better firms than the rest — that is, due to the selection effect. A recent and increasingly popular model of exporting and FDI by Helpman, Melitz and Yeaple (2004) that assumes heterogeneous firms predicts that the least productive firms sell only to the domestic market, that relatively more productive firms export, and that the most productive firms engage in FDI. They also provide some empirical evidence for that (Helpman et al. 2004). One reason why firms that engage in OFDI have higher productivity is the need to be able to cover sunk costs related to FDI. Only "good" firms are able to do that.

This idea calls for a cautious interpretation of the results if the researcher finds, by doing a simple productivity comparison, that the home firms of MNEs indeed have higher productivity (as it is found in several studies) than the purely national firms. The causal effect can act in both ways (Barba Navaretti et al. 2004). It can be that "going multinational" causes a rise in the firms' productivity at home or that firms with high productivity[5] self-select themselves into investing abroad. This causality issue is crucial here and not taking the non-random selection of MNEs into account may result in overestimating their positive effects on productivity (e.g. see Damijan et al. 2003, Smarzynska Javorcik and Arnold 2005 for inward FDI; Barba Navaretti et al. 2004 for outward FDI).

Generally, we can in the same manner as with host country effects[6], divide the home country effects into two parts. The first is the so-called "own-firm effect" — the effect of making outward FDI (or receiving inward FDI) on the performance characteristics of the subsidiary (or the home firm) of the MNE. We can assume this effect to be positive. The second part is the various external effects. These are *horizontal* or *vertical spillover effects*[7] from the presence of multinational firms on the performance of other local firms and other MNEs active in the home economy. In the context of spillovers in the home economy, we can assume these effects to be positive (unless, for example, there is some adverse effect on former suppliers in the home economy due to switching to new suppliers

[5]These could also be firms with better absorptive capacity (Cohen, Levinthal 1989), i.e. better learning abilities.

[6]For earlier studies on productivity related host country effects in Estonia see e.g. Sinani and Meyer 2004, Damijan et al. 2003 or Vahter 2004.

[7]Horizontal spillovers are the effects of FDI on other firms in the same sector (to the competitors), vertical spillovers are the effects on suppliers and clients of the firm that has FDI.

from the host economy). For articles on host country spillovers see e.g. Aitken and Harrison 1999; Blomström and Kokko 2003, 1996. One important assumption is that the magnitude of spillovers may depend a lot on the absorptive capacity of firms in the host or home country[8].

So far the literature on home country effects has focused mainly on the effects on the investing firm (see e.g. Lipsey 2002). There are some empirical papers that could be considered as studies of spillover effects. They concentrate on examining a part of the spillover effects of outward FDI by analysing patent citation data (e.g. Globerman et al. 2000). The previous patent citations in the patent acquisition processes of MNEs and other local enterprises are compared in these papers, and based on this information some conclusions on external effects are made. Unfortunately, these studies only look at a small number of firms — they consider firms that have patents. Thus a sizeable share of the potential spillover effects is left out of the analysis as only some knowledge can be patented. In addition, this approach cannot be used for Estonia due to the extremely low patenting activity among local firms in this country. Contrary to the spillovers of inward FDI, there is so far a lack of broader empirical studies about the spillover effects of FDI in the home country context[9].

In the following paragraphs we will briefly outline the "own-firm" productivity effects of outward FDI. We show the hypothetical productivity trajectories for different types of firms in the home economy of direct investment, following Barba Navaretti et al. (2004), Clerides et al. (1998) and Bernard and Jensen (1999). Exactly the similar analysis can be performed for the study of the effects of inward FDI. In this case, instead of MNEs' home firms and national firms, we can compare foreign owned and domestic owned firms.

[8]It is possible that the amount of positive effects of OFDI in the home economy may increase as the home country's economy grows and the absorptive/learning capacity of national firms grows as well. A sufficient level of absorptive capacity among national firms may be a necessary condition for benefiting from possible positive spillovers from outward FDI in Estonia and in the home countries in general (see e.g. Cohen and Levinthal 1989). This may be the reason for distinguishing between domestic and foreign owned or national firms and home firms of MNEs, as the foreign owned firms or home plants of MNEs may have higher absorptive capacity due to having activities in more than one country.

[9]One recent exception is a paper by Bitzer and Görg (2005). They investigate the productivity effects of both inward and outward FDI. However, they do not use enterprise level data, but instead use country and sector level data from OECD countries. They find, on average, a negative correlation between a country's stock of OFDI and productivity. However, this is the average effect. Also, a positive relationship is found for several OECD countries in their article. Their results underline that the effects of FDI depend a lot on the characteristics of the home (or host) countries of investment.

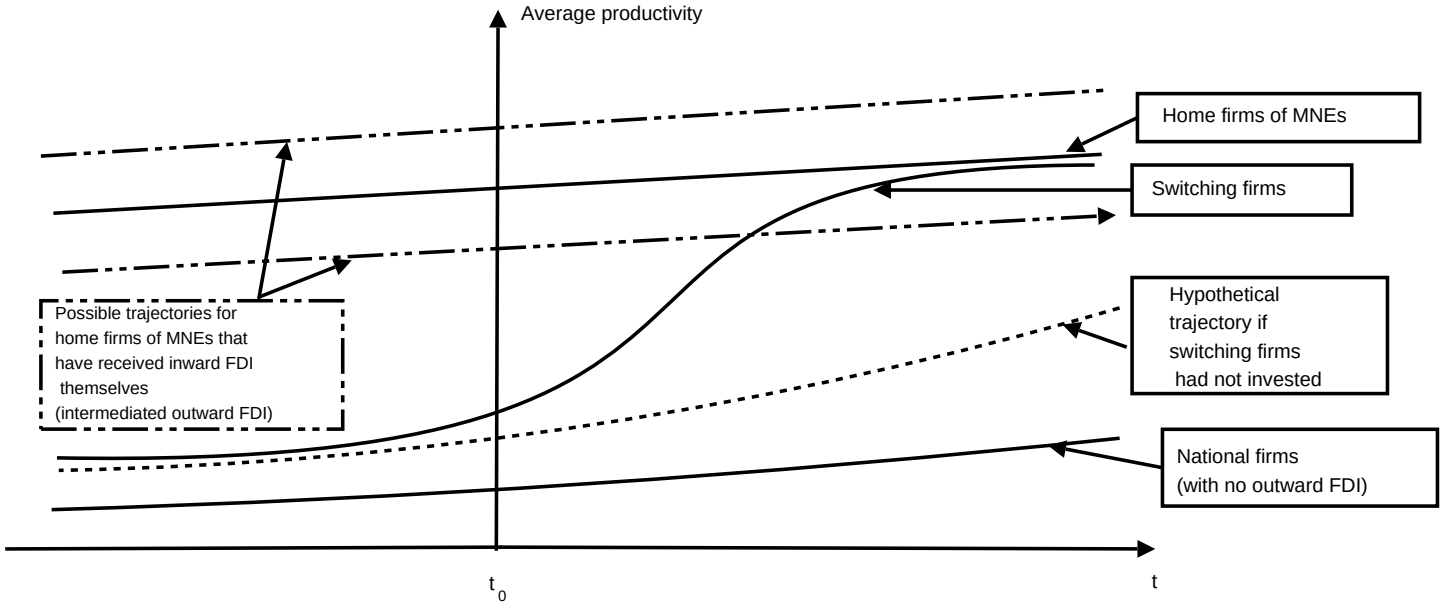

Figure 1: Productivity trajectories in home firms, direct and intermediated outward FDI
Source: Barba Navaretti et al. 2004 with minor additions from the authors.

In Figure 1 we plot hypothetical productivity trajectories for different types of firms. Those who have at least one foreign subsidiary during the whole period studied (denoted as *home firm of MNEs* in Figure 1), those that never have a foreign subsidiary (*national firms*) and those that become multinational — that is, open their first foreign subsidiary at time t_0 and in doing so switch from being a "national" to a "home firm of an MNE" *(switching firms*). It is assumed within this framework that the average productivity trajectory of the home firms of MNEs always lies higher than that of national firms. This means according to the predictions of the Helpman, Melitz and Yeaple (2004) model, that only the most productive firms engage in outward FDI. The main framework for Figure 1 has been taken from Barba Navaretti et al. 2004. As an addition to their discussion, it would also be worthwhile considering the intermediated outward FDI. This is especially relevant in the context of Estonia, as a large part of outward FDI from Estonia is in fact made by foreign (Finnish or Swedish) owned firms[10].

The phrase *intermediated outward FDI* in Figure 1 means that a firm in country A makes an investment in country B and this investing firm in country A is itself a subsidiary of a firm from country C. Such *indirect MNEs* (the upper dotted line in Figure 1) may have higher productivity than MNEs that do not have parent firms in some other country. This may be the case when there is substantial technology transfer from the parent abroad (in C) to the local subsidiary (in A) that has invested itself abroad (in B). However, the results depend on the competitive advantages of this home country A compared to C and B. If A's competitive advantages involve cheap labour and not capital or human capital, then FDI from C to A may intend to use the locally abundant resources more, and thus the productivity effect of having a parent, for example in Sweden may not translate into significantly greater "own-firm" effects. Thus, in some special cases the productivity trajectory for indirect MNEs may not be higher than that for the other MNEs.

Let us now consider the switching firms in Figure 1. If there is a sample selection bias in the sense that more productive firms are more likely to become multinational, then the productivity trajectory of switching firms lies above that of other national firms even before time t_0. Outward FDI from this type of firms further contributes to higher productivity growth (the trajectory gets steeper after t_0). The problem in the empirical estimation is how to distinguish between the self-selection effect and the true OFDI effect.

[10] According to our calculations based on Estonian panel data about 29 per cent of Estonian firms investing abroad have foreign owners themselves.

3. Methodology

In order to find out how inward and outward FDI influence total factor productivity we at first estimate an augmented Cobb-Douglas production function in logs with measures of the presence of either inward or outward FDI at firm level and sector level included:

$$\ln Y_{ijt} = \alpha + \beta_1 \ln K_{ijt} + \beta_2 \ln L_{ijt} + \beta_3 \ln M_{ijt} + \beta_4 X_{ijt} + \\ + \beta_5 OUTFDI\_firm_{ijt} + \beta_6 OUTFDI\_spillover_{ijt} + \\ + \beta_7 OUTFDI\_firm_{ijt} \cdot OUTFDI\_spillover_{ijt} + \alpha_j + \alpha_t + \epsilon_{ijt}$$

where:

$$OUTFDI\_spillover_{ijt} = \frac{\sum\limits_{i \ for \ all \ i \in j} Assets_{ijt}^{OUTFDI} - Assets_{ijt}^{OUTFDI}}{\sum\limits_{i \ for \ all \ i \in j} Assets_{ijt}},$$

$$Assets_{ijt}^{OUTFDI} = \begin{cases} \text{Assets}_{ijt}, \text{ if } OUTFDI\_firm_{ijt} = 1 \\ 0 \ else. \end{cases}$$

Here the log of the output for firm i in industry j at time t is regressed on inputs like capital (K), labour (L), intermediate inputs (M), a vector of possible other control variables X and two measures of the presence of multinationals. $OUTFDI\_firm_{ijt}$ is an MNE status dummy that is equal to 1 if a firm has subsidiaries abroad at time t; otherwise it is equal to 0. Variable $OUTFDI\_spillover_{ijt}$ captures horizontal spillovers of outward FDI to those firms that are in the same sector in the home economy as the MNE. In order to test the robustness of the results to the specification of the spillover variable we have used three different versions of it — either based on the assets, sales or number of employees of the firm. The only difference between these spillover measures is the base variable. If we take the assets of the firm as a base variable, then the spillover variable is measured for different sectors in the form of the ratio: the assets of the *home firms of MNE* (with each outward FDI firm's own assets subtracted) to the sum of all firms' assets in the sector. Including its interaction variable with $OUTFDI\_firm_{ijt}$ into our econometric estimation allows us to study the spillover effects to other home firms of MNEs in the economy[11] separately from national firms. Also, sector specific control variables, such as sector dummies and Herfindahl index, are included in order to take account of industry specific productivity differences and the fact that MNEs may originate from sectors with relatively high productivity. Additionally, the region dummies are also included. The specification for estimating the effects of inward FDI is similar to the one above. The difference is that instead of the MNE status dummy we use a dummy variable that is equal to 1 if the firm has received inward FDI, otherwise it is

[11] This effect is given by the sum of β_6 and β_7

0. Another difference is that instead of the outward FDI related variable $OUTFDI\_spillover_{ijt}$, we use a similar variable, $INFDI\_spillover_{ijt}$, for capturing the intra-industry spillovers of inward FDI. $INFDI\_spillover_{ijt}$ represents the share of foreign owned firms in a sector, measured by the ratio: the sum of the assets of the foreign owned enterprises in a sector (with each foreign owned firms' own assets subtracted) to the sum of the assets of all firms in the sector.[12] Sectors and spillover variables are defined at either the NACE double-digit or three-digit level.

As mentioned before, one important concern is the selection bias due to better enterprises being acquired by foreign firms or better enterprises making outward FDI. We try to examine this question at first by including one additional independent variable into the regression analysis of total factor productivity. This is the dummy variable that, depending on the framework, indicates either the future targets of foreign acquisition during the two years before the ownership change ($INFDI\_change_{ijt}$) or future home plants of multinationals ($OUTFDI\_change_{ijt}$) during the two years before engaging in outward FDI[13]. For the purpose of the econometric analysis of the effect at the subsidiary level, we exclude those firms from the sample that stay foreign owned firms (or home firms of MNEs) for the whole period. For spillover analysis these firms are included in the analysis.

As we do not have much confidence in the applicability of conventional measures of vertical spillovers in our context, we look at the "horizontal" ones. A more thorough discussion of the applicability of vertical spillover analysis for Estonian data is left to Appendix 1. Notice, however, that at the 2-digit level of aggregation, we are in fact including a lot of vertical

[12]There is a caveat in estimating the model as specified in this section, if the variable $INFDI\_spillover_{ijt}$, instead of being defined as in this paper, were defined as simply the ratio of the sum of foreign owned firm's assets to the sum of total assets of the sector (or if $OUTFDI\_spillover_{ijt}$ were defined as the ratio of the sum of all MNE's assets in home country firms to the sum of total assets of the sector). In that arguably inferior case, there might be difficulties in separating the "own-firm" and spillover effects wholly from each other. This would particularly be a problem for the sectors with a small number of firms and one or a small number of foreign owned firms (or firms with OFDI) making up large proportion of that sector, or in the case of one very large foreign owned firm entering the sector. Naturally, this new sector level FDI penetration variable has different values for different firms, not only for different sectors. This ought to improve the results by establishing a more clear difference between the "own-firm" and spillover effects in the analysis.

[13]For example, if the firm makes outward FDI for the first time in 2001, the corresponding dummy variable would take the value of 1 for 1999 and 2000. Smarzynska Javorcik and Arnold (2005) have taken similar steps with regard to inward FDI analysis. They found, based on Indonesian data, a positive effect from being a future target of inward FDI on the productivity of a firm.

relationships between firms in our measure of spillovers. The 3-digit level spillover measure is in fact more "horizontal".

We estimate a Cobb-Douglas type production function in order to find out the effects of FDI (incl. the externalities) on TFP. There are a lot of problems associated with the estimation of the production function (see e.g. Griliches and Mairesse 1995, Levinsohn and Petrin 2003). Some of the most important are those problems related to the data, the specification of the model, the simultaneity/endogeneity bias and the selection bias. The problems with data could be, for example, measurement errors of inputs or output, and the issues surrounding the measurement of capital can also be troublesome (Griliches and Mairesse 1995). One important question in the literature is how to tackle the endogeneity bias problem. In the context of the Cobb-Douglas production function (in logs) we have, for example:

$$\ln Y_i = \alpha \ln K_i + \beta \ln L_i + \omega_i + e_i,$$

where ω_i is the part of the error term that represents those inputs that are unobserved for the econometrician (e.g. managerial abilities), but may be known by the firm and thus may affect the optimal choice of other observed inputs K and L. If indeed ω_i is known to the firm when making decisions on $(K;\ L)$, then K and L will be correlated with ω_i and an OLS estimation will yield biased results. Recent contribution to tackling the problem include semi-parametric estimation procedures, particularly, the methods developed by Olley and Pakes (1996) or Levisohn and Petrin (2003). The latter of these will also be used in this paper.

One simple way to address the endogeneity problem is to use panel data instead of cross-section data and to control for firm specific time invariant effects by employing, for example, fixed effects model. Then one estimates ω_i as fixed effects, and provided that we have enough reason to think that ω_i (managerial abilities etc) is something firm specific and invariant over time, K and L are no longer correlated with the error term (Levinsohn and Petrin 2003). However, this last assumption is usually not a credible one. A better way to control for the endogeneity bias is probably by using the Levinsohn-Petrin semi-parametric estimation method, with materials as a proxy for accounting for ω_i. Also, we note here that often the fixed effects model underestimates the coefficient of capital in the estimation of a Cobb-Douglas type of production function (Levinsohn and Petrin 2003).

As a robustness check on the results from estimating TFP effects via the augmented production function (i.e. in one step), we follow a two-step approach. At first, we estimate the TFP as a residual from the

logarithmic form of the Cobb-Douglas production function by using the Levinsohn-Petrin (2003) procedure and allowing different coefficients of logs of capital and labour in the production function for different sectors (at NACE 2-digit level)[14]. In the second step, we regress the log of TFP on a FDI dummy, spillover variable(s) and other control variables.

4. Estonian Outward and Inward FDI

Estonia is a transition economy that has implemented radical economic reforms, witnessed rapid economic growth and attracted substantial amounts of inward FDI per capita. The average yearly GDP growth rate in Estonia in the period 2001–2004 reached 6.2 per cent. The total stock of inward FDI in Estonia is 6,986 billion EUR as of 31 December 2004. The ratio of inward FDI stock to GDP reached 77.6 per cent in 2003 (UNCTAD 2004). By its ratio of inward FDI stock to GDP (and by per capita stock of FDI) Estonia is ranked ahead of other attractive locations for FDI in the CEE region. In other two attractive destinations of FDI in the region, the Czech Republic and Hungary, the ratio of the stock of inward FDI to GDP is lower, being 51.8 and 48 per cent respectively in 2003. The corresponding figure for the CEE region on average was 23.7 per cent; even this is a rather high figure internationally.

The share of reinvested earnings in FDI inflows has increased substantially over recent years. Indeed, in 2004, the majority of FDI inflow in Estonia was made up of reinvested earnings. The legal framework for FDI includes equal rights with local businesses, and unrestricted profit repatriation. Unlike many other CEE countries, there are no special incentives provided for foreign investors, domestic and foreign investors are treated equally. Estonia is an open and liberal economy and ranked 4^{th} in the world according to the Heritage Foundation's Index of Economic Freedom 2005. The attractive features of Estonia for foreign investors have been its geographical proximity to Sweden and Finland, relatively low costs of production and since year 2000 a special tax regime with zero corporate income tax on reinvested earnings.

Moreover, in recent years, outward FDI from Central and Eastern

[14]The dependent variable is then value added, we use the Levinsohn-Petrin semi-parametric procedure to estimate these separate production functions for all sectors, and we employ expenditure on materials as a proxy for the unobserved productivity shocks as suggested in Levinsohn and Petrin (2003). This approach thoroughly addresses the endogeneity bias problem. By estimating separate production functions for all sectors, we can also consider in a more consistent manner the individual heterogeneity in the data.

European (CEE) countries in general and from Estonia in particular to its neighbouring countries has also risen significantly. The total stock of Estonian outward FDI was 1,024 billion EUR as of 31 December 2004. In 2001–2003, Estonia ranked first among CEE countries on the basis of its ratio of outward FDI to total capital formation (UNCTAD: WIR 2004). This clearly shows the reason why Estonia can be a suitable case for studying the home country effects of FDI.

There are still a limited number of studies addressing the issue of why firms in the Baltic States (or in CEE in general) invest abroad (e.g. Varblane et al. 2001; Liuhto and Jumpponen 2002). The survey conducted by Liuhto and Jumppinen (2002) on outward expansion of firms in Estonia, Latvia and Lithuania suggested that the driving force behind starting operations abroad was getting a foothold in a larger market. The reason of "securing the availability of raw materials or skilled labour" was much less important. Lower production costs in host countries and investment incentives offered by the host economy played virtually no role in outward FDI decisions of firms in Estonia, Latvia and Lithuania. The survey by Varblane et al. (2001) confirms that market related motives appeared to dominate among the causes for Estonian firms to invest abroad. Indeed, we can argue that the evidence of resource seeking or strategic asset seeking FDI is limited mostly to wood processing industry and banking sector related FDI from Estonia to Latvia or Lithuania. The study by Varblane et al. (2001) confirms again that the role of labour costs and other cost-related motives (e.g. transportation costs, taxes or tariffs) tended to be comparatively unimportant in investing abroad. Reasons suggested for explaining why cost related motives are less important are, for example, that the share of Estonian investments in the manufacturing industry has been relatively small compared to investments in the services and financial sectors; also most of the investments that go to Latvia and Lithuania have quite a similar cost level as Estonia (Ibid. 2001).

5. Data and Descriptive Statistics

For the estimation of our empirical model as outlined in Section 3, we use yearly balance sheet and income statement data for the population of Estonian firms from the Business Register of Estonia for the period 1995–2002. We have information on up to 41,000 firms per year. This data includes information indicating whether each firm has foreign (majority) ownership or not. In order to study the effects of outward FDI, we have linked this panel data with a unique dataset on firms with outward FDI

in Estonia compiled by the Balance of Payments Department of the Eesti Pank. Our panel data allows us to assess the effects of FDI on total factor productivity both in the manufacturing (NACE 2-digit code between 15 and 37) and services sectors (NACE 2-digit code between 50 and 74). The overwhelming majority of related studies in the world have so far concentrated on analysing manufacturing industry data only (except e.g. Griffith 2004). It needs to be mentioned, however, that the commercial banks and construction firms have been excluded from the analysis of the services sector.

We have introduced the inward FDI dummy variable in Section 3. The traditional definition of FDI recipient firms from the Balance of Payments Manual of the IMF is as follows: "*FDI recipient firms are defined as firms with foreign share equal to at least 10 per cent of ordinary shares or voting power*" (IMF 1993). For Estonia, however, due to the nature of our data we have to apply the 50 per cent share instead, in order to distinguish between foreign owned and domestic firms. The FDI dummy variable based on the IMF definition would have been beneficial for the analysis since foreign direct investment less than the majority share can still influence the performance of the firm to a significant extent. However, the annual surveys of FDI, "Foreign Investor", conducted by the Estonian Investment Agency and Tartu University during the second half of 1990s and the beginning of this decade have indicated that the share of foreign owned firms in Estonia that have a minority share in a local firm is not very large (Varblane 2001).

We measure capital as the sum of tangible and intangible fixed assets minus goodwill. The following deflators are used to correct for inflation. Output, valued added and intermediate inputs are deflated by respective deflators of the system of national accounts provided by the Statistical Office of Estonia. The deflators are available for 16 sectors (that corresponds to the top level in ISIC Rev. 3.1). Capital is deflated using the gross capital formation price index (available only for the total economy). The deflators are based on the following price indices: consumer price indices according to commodity groups and fields of activity, producer price indices according to fields of activity, construction price indices and export and import price indices. It is assumed that production and value added change in the same way (single deflation; double deflation assumes the compilation of input-output tables). For more information, see also the National Accounts of Estonia (2003).

The share of firms with a) inward FDI or b) outward FDI in the number of firms in our panel has grown during the period 1995–2002 (see Table 1). There were 477 firms that had majority foreign ownership in

the services sector in 1995 and these firms made up 4.2 per cent of all the firms in this sector. However, by 2002, the total number of foreign majority owned firms in Estonia's services sector had risen to 2,052 (7.3 % of all firms in the sector). The number of foreign owned firms active in manufacturing is smaller than in the services sector. However, the share of foreign firms and the growth of the share of foreign owned firms have been faster in the manufacturing sector. The number of foreign owned firms in the manufacturing sector amounted to 155 in 1995 (5.5 per cent of all the firms of the sector) and had risen to 496 by 2002 (10 per cent of the total number of firms in the sector). The majority of foreign direct investments originate from neighbouring Nordic countries — from Sweden and Finland. As at 31 December 2004, these two countries accounted for 70 per cent of the stock of inward FDI in Estonia. The share of investments in the financial sector is substantial and has been rising (from 21.9 per cent in the total FDI stock by 31 December 1998 to 33.3 per cent by 31 December 2004) since 1998 when a large share of the stocks of two large Estonian banks were acquired by Swedish transnational commercial banks. The share of the manufacturing sector in inward FDI stock amounted to 17.7 per cent as at 31 December 2004.

The number of firms in the manufacturing and the services sectors, based on our panel data for Estonia, are presented in Table 1. This table and the following similar tables on other descriptive statistics describe the distribution of firms between four types of firms:

- domestic owned firms that have not invested abroad;
- domestic owned firms that have invested abroad;
- foreign owned firms that have not invested abroad from Estonia;
- foreign owned firms that have invested abroad from Estonia.

The number of firms making outward FDI from Estonia is still significantly smaller than that of firms that have received FDI themselves. This has also been the case in other transition economies in Central and Eastern Europe and corresponds to the predictions of the investment development path framework by Narula and Dunning (1996), where countries in the lower levels of economic development at first attract inward FDI and then later, as the economy grows and firms accumulate more knowledge and more means to cover sunk costs related to outward FDI, local firms also start investing abroad. At first, these firms start investing in adjacent markets that are relatively well known due to former, pre-entry trade

Table 1: Number of firms (by sector, by presence of foreign investor and outward FDI)

Inward FDI	Outward FDI	Sector	1995	Per cent 1995	1998	2002	Per cent 2002
No	No	Services	10,949	*95.59*	21,077	25,883	*92.13*
No	Yes	Services	28	*0.24*	73	159	*0.57*
Yes	No	Services	473	*4.13*	1183	1990	*7.08*
Yes	Yes	Services	4	*0.03*	29	62	*0.22*
No	No	Manufacturing	2676	*94.19*	4215	4433	*89.27*
No	Yes	Manufacturing	10	*0.35*	21	35	*0.7*
Yes	No	Manufacturing	151	*5.32*	369	480	*9.67*
Yes	Yes	Manufacturing	4	*0.14*	13	18	*0.36*

Source: own calculations, Estonian enterprise level panel data 1995–2002.

relations, cultural proximity, similar business culture, etc. The number of firms in Estonian manufacturing and services sectors that have invested abroad from Estonia increased from 46 in 1995 to 274 in 2002 (see Table 1). The services sector clearly dominates in such investments — for example, in 2002, the ratio of the number of firms that had invested abroad from the services sector to the number of outward investors in the manufacturing sector was 4.2. The majority of Estonian outward FDI (about 70 per cent of the stock of outward FDI as of 31 December 2004) went to the other two Baltic countries — Latvia and Lithuania. As with inward FDI, the financial sector dominates in outward FDI as well. By the end of 2004, 39.9 per cent of the stock of Estonian outward FDI was into this sector. This was the result of large investments from Swedish owned Estonian commercial banks in Latvia and Lithuania — that is, from intermediated outward FDI. The other important sectors in Estonia's outward FDI are real estate, business services and the transport sector. The manufacturing and construction sectors lag behind the others.

The share of intermediated outward FDI in total outward FDI is quite high: in the manufacturing industry the share of foreign owned firms in the total number of firms with outward FDI was 33.9 per cent, the corresponding figure for the services sector was lower at 28 per cent.

Calculations based on our panel of the population of Estonian enterprises show (see Table 2) that foreign owned firms, and especially the firms engaging in outward FDI, are on average larger and have higher wages or sales per employee than the rest. The share of foreign owned firms was only 7.3 per cent of the total number of firms in the services

sector and 10 per cent in the manufacturing sector. However, the corresponding shares on the basis of employment were 11.77 and 31.75 per cent and were even larger on the basis of labour costs, sales or value added. As former studies have shown, foreign owned firms in Estonia are also more capital intensive and tend to be more export oriented than their domestic counterparts (see Vissak 2001). The results concerning home firms of MNEs in Estonia are similar to those for foreign owned firms. The share of home plants of MNEs in the total number of firms is around or less than 1 per cent. However, their share on the basis of employment or labour costs or sales is much larger. Thus, despite their relatively small number, these firms are significant for the Estonian economy.

Table 2: Share of firms with inward or outward FDI in the Estonian economy in 2002

Inward FDI	Sector	Firms	Employees	Labour cost	Value added	Assets
No	Services	92.7	88.23	81.95	82.25	81.36
Yes	Services	7.3	11.77	18.05	17.75	18.64
No	Manufacturing	89.97	68.25	59.87	57.86	53.13
Yes	Manufacturing	10.03	31.75	40.13	42.14	46.87

Outward FDI	Sector	Firms	Employees	Labour cost	Value added	Assets
No	Services	99.21	94.74	93.19	93.07	75.69
Yes	Services	0.79	5.26	6.81	6.93	24.31
No	Manufacturing	98.93	91.94	91.78	89.95	85.56
Yes	Manufacturing	1.07	8.06	8.22	10.05	14.44

Source: own calculations based on panel data of Estonian firms 1995–2002.

Some new results can be found by taking a look at the probabilities of transition between different types of firms. Based on panel data, one can estimate the probability that $x_{i,t+1} = v_2$, given that $x_{i,t} = v_i$ by counting transitions from v_1 to v_2 and dividing the resulting number with v_i. For example, one can find the probability that a firm at time *t+1* becomes the type "firm with both inward and outward FDI" if in the previous period it was of the type "firm with inward FDI but no outward FDI". The rows in the following table reflect the initial group of firms at time t, and the columns reflect the final corresponding groups of firms at time *t+1*.

We perceive, from the row for group 4 in Table 3, that the probability that a domestic owned firm will become a firm that has received inward FDI in the next period is 2.29 (2.27+0.02) per cent and that the

probability that a national firm will become a firm that has undertaken outward FDI in the next period is 0.18 (0.16+0.02) per cent. Interesting results can be noted from those related to disinvestments — situations when outward FDI is withdrawn from its host country. The probability that outward FDI is reversed in the next period is 17.04 (16.57+0.47) per cent for home firms of MNEs that are based on Estonian capital. The corresponding probability for foreign owned MNEs is 11.63 (9.97+1.66) per cent. Thus the probability of "failure" in investment activities may be lower for those MNEs that have foreign owners themselves — that is, for intermediated outward FDI.

Table 3: Transition probabilities (%) between four groups of firms from time *t* to *t+1*

		At time t+1				
	Group	1	2	3	4	Total
At time t	1	72.76	9.97	15.61	1.66	100
	2	0.67	84.02	0.16	15.15	100
	3	7.46	0.47	75.5	16.57	100
	4	0.02	2.27	0.16	97.54	100
	Total	0.18	6.08	0.49	93.25	100

Definition of groups: 1 - with inward FDI, with outward FDI; 2 - with inward FDI, without outward FDI; 3 - without inward FDI, with outward FDI; 4 - without inward and without outward FDI. Source: own calculations based on panel data of Estonian firms 1995-2002.

One can often find extreme values for observations due to, for example, measurement errors in a firm level panel data like ours. We have controlled for the outliers by excluding these observations from the calculations where labour productivity (calculated either as the ratio of sales to employment or the ratio of value added to employment) fell below the 1^{st} percentile or above the 99^{th} percentile of all observations.

We have calculated the descriptive statistics such as average productivity of labour, log of TFP, wages and capital intensity (Table 4 and 5) for the previously defined four types of firms. The findings in Tables 4 and 5 confirm that firms with outward FDI that have themselves received inward FDI have higher productivity than those outward investing firms that are not foreign owned. The highest level of productivity (incl. TFP[15]), wages and capital intensity in the manufacturing industry can be

[15]The log of TFP is estimated as a residual from the log-linear Cobb-Douglas production function, estimated separately for all 2-digit level industries. Thus,

found in foreign owned firms that have themselves invested abroad from Estonia.

Table 4: Average labour productivity, capital intensity, log of TFP and wages in 2002 for different groups of firms (in EEK)

Inward FDI	Outward FDI	Sector	Wage	Ranking by wage	K/L	Ranking by K/L	Log(TFP)	Ranking by log(TFP)
No	No	Services	31,218	4	173,455	4	9.646	4
Yes	No	Services	80,640	3	280,528	3	10.544	3
No	Yes	Services	92,286	2	995,754	1	11.022	2
Yes	Yes	Services	113,608	1	499,886	2	11.1	1
No	No	Manuf.	38,056	4	54,153	4	9.329	4
Yes	No	Manuf.	70,596	3	190,220	2	9.806	3
No	Yes	Manuf.	82,235	2	164,103	3	10.146	2
Yes	Yes	Manuf.	90,194	1	231,963	1	10.639	1

Inward	Outward	Sector	Y/L	Ranking	VA/L	Ranking
No	No	Services	394,819	4	112,104	4
Yes	No	Services	839,018	3	233,738	3
No	Yes	Services	1,031,352	2	301,373	2
Yes	Yes	Services	1,262,919	1	359,582	1
No	No	Manuf.	292,396	4	99,271	4
Yes	No	Manuf.	536,768	3	170,028	3
No	Yes	Manuf.	728,844	2	221,482	2
Yes	Yes	Manuf.	1,040,622	1	366,901	1

Note: VA/L – value added per employee; K/L – capital intensity, Y/L – sales per employee; 1 EUR = 15.6466 EEK. Source: own calculations based on panel data of Estonian firms 1995–2002.

The second group on the basis of productivity (both by labour productivity calculated as sales per employee or value added per employee and by log of TFP; see Table 4) is domestic owned firms that have invested abroad themselves. Foreign owned firms that have not invested abroad from Estonia rank third. The lowest level of productivity can be found in domestic owned firms that have not invested abroad from Estonia. All the top three ranking groups have much higher labour productivity than the domestic owned firms operating only at the national level. The productivity differential with that group is larger than in former studies in

the coefficients of capital and labour were allowed to differ according to the sector. The dependent variable is the log of value added. The estimation procedure that we used, is the Levinsohn-Petrin semi-parametric model, that takes account of a possible endogeneity problem.

Estonia, as in our study we consider all of the firms in the respective sectors. Former studies (e.g. Hannula and Tamm 2003; Vahter 2004) did not include small firms in the analysis, and looked at a comparison of domestic owned vs foreign owned firms, thus aggregating both outward oriented domestic firms (with high productivity) and national domestic firms (with low productivity) together.

If we only look at the differences between foreign owned and domestic owned firms, then we see that foreign owned firms had 2.14 times higher sales per employee and 2.10 times higher value added per employee than domestic firms in the services sector in year 2002. The corresponding figures for the manufacturing sector reached 1.87 and 1.75 in that year.[16]

[16]Previous studies about the manufacturing sector's FDI in Estonia using sample data have found these ratios to be smaller than we do based on the data of the whole population. Based on a former smaller panel of manufacturing sector's enterprises (326 per year), the foreign owned to domestic owned firms ratio of sales per employee was found to be 1.61 for 1996 and 1.34 for 2001 (Vahter 2005). Thus the inclusion of small firms and in general having data of the whole population of the firms in manufacturing yields new results on the gap between foreign owned and domestic owned firms.

Table 5: Labour productivity of Estonian firms in respect to the base group (national and domestic owned firms), in EEK

Productivity	Inward FDI	Outward FDI	Sector	Indicator	1995	1996	1997	1998	1999	2000	2001	2002
Y/L	No	No	Services	Abs.	281,083	315,926	404,959	387,428	382,040	392,724	398,750	394,819
Y/L	Yes	No	Services	Ratio*	2.56	2.13	2.17	2.21	2.18	2.28	2.08	2.13
Y/L	No	Yes	Services	Ratio*	4.10	2.74	2.12	2.45	2.48	2.78	2.71	2.61
Y/L	Yes	Yes	Services	Ratio*	4.85	1.91	2.93	2.61	2.82	2.47	2.77	3.20
Y/L	No	No	Manufacturing	Abs.	173,250	188,742	223,390	255,290	250,168	273,902	272,498	292,396
Y/L	Yes	No	Manufacturing	Ratio*	1.90	2.26	2.12	1.60	1.67	1.57	1.62	1.84
Y/L	No	Yes	Manufacturing	Ratio*	5.58	2.49	1.80	3.21	3.19	3.31	2.66	2.49
Y/L	Yes	Yes	Manufacturing	Ratio*	3.76	3.18	2.86	2.93	3.45	3.72	3.90	3.56
VA/L	No	No	Services	Abs.	70,399	79,769	98,613	95,669	96,340	104,969	108,599	112,104
VA/L	Yes	No	Services	Ratio*	2.63	2.38	2.51	2.34	2.24	2.25	2.09	2.09
VA/L	No	Yes	Services	Ratio*	4.03	2.44	2.24	2.50	2.10	2.31	2.85	2.69
VA/L	Yes	Yes	Services	Ratio*	…	5.43	3.78	2.42	2.63	2.83	2.57	3.21
VA/L	No	No	Manufacturing	Abs.	57,902	62,570	81,723	83,583	83,081	92,540	93,764	99,271
VA/L	Yes	No	Manufacturing	Ratio*	2.07	2.24	1.94	1.74	1.67	1.67	1.56	1.71
VA/L	No	Yes	Manufacturing	Ratio*	4.66	2.32	2.17	2.20	2.43	2.08	2.19	2.23
VA/L	Yes	Yes	Manufacturing	Ratio*	3.26	2.71	2.28	2.01	2.86	3.47	4.32	3.70

*Note: * ratio to the productivity level of domestic owned firms that have not undertaken outward FDI. 1 EUR = 15.6466 EEK*
Source: own calculations based on panel data of Estonian firms 1995–2002.

Table 6: Labour productivity of foreign owned and domestic owned firms in Estonia, in EEK

Productivity	Indicator	Inward FDI	Sector	1995	1996	1997	1998	1999	2000	2001	2002
Y/L	abs.	No	Services	283,204	317,938	407,252	390,302	385,896	397,830	403,743	399,870
Y/L	abs	Yes	Services	727,152	671,427	887,566	862,181	840,219	897,935	841,342	857,614
Y/L	ratio	Yes/No	Services	2.57	2.11	2.18	2.21	2.18	2.26	2.08	2.14
Y/L	abs	No	Manufacturing	176,652	189,692	224,695	260,098	255,246	278,464	276,760	296,757
Y/L	abs	Yes	Manufacturing	338,079	430,626	480,851	422,239	442,788	456,840	460,481	556,335
Y/L	ratio	Yes/No	Manufacturing	1.91	2.27	2.14	1.62	1.73	1.64	1.66	1.87
VA/L	abs	No	Services	71,044	80,195	99,216	96,281	96,952	105,872	110,074	113,502
VA/L	abs	Yes	Services	184,817	191,601	249,776	224,407	216,581	238,456	229,419	238,459
VA/L	ratio	Yes/No	Services	2.6	2.39	2.52	2.33	2.23	2.25	2.08	2.1
VA/L	abs	No	Manufacturing	58,464	62,781	82,207	84,283	83,903	93,080	94,665	100,272
VA/L	abs	Yes	Manufacturing	121,921	140,779	159,438	146,420	144,207	162,030	152,177	175,689
VA/L	ratio	Yes/No	Manufacturing	2.09	2.24	1.94	1.74	1.72	1.74	1.61	1.75

Note: 1 EUR = 15.6466 EEK Source: own calculations based on panel data of Estonian firms 1995–2002.

6. Econometric Analysis of the Effects of FDI on Total Factor Productivity

By using panel data, it is possible to account for the individual heterogeneity of objects of the analysis. However, the possible time-invariant firm specific effects that are typical for enteprise level panel data, have to be taken into account in the econometric analysis. Just running OLS for pooled data could lead to biased and inconsistent estimation results. The common remedy could be using random effects (RE) or fixed effects (FE) models instead. The FE model assumes that differences across units can be captured in the differences in the constant term. In the case of a random effects model, individual/firm specific constant terms are viewed as randomly distributed across cross-sectional units (Wooldridge 2002).

When choosing between the RE or FE model, we have, in addition to formal tests, to keep in mind that for the FE model we cannot find the effect of these variables that are constant for the object over the panel range as these are differenced out[17]. In the case of the random effects model, one can also find these effects. The FE model excludes a large number of firms from the analysis of the effect of FDI at the subsidiary level, it excludes all those firms by definition that do not have time variant values for the FDI dummy. Thus, both firms that have FDI during the whole period 1995–2002 and firms that stay domestic/national firms for the whole period are not taken into account, and this has to be considered when interpreting the coefficient of the FDI dummy in that model.

The double-digit level sector dummies, year dummies and location dummies (we distinguish between five different regions) are included in pooled LS and RE model. In the FE model, these sector dummies and location dummies are already taken account of by the inclusion of time-invariant fixed effects.[18] An additional sector level[19] variable, the Herfindahl index, was included in order to account for high concentration related effects. The estimation of the effect of FDI on TFP is performed separately for manufacturing and services sectors and separately for the effects of inward FDI and outward FDI.

In the following, we at first estimate the effects of engaging in FDI

[17]The FE estimator uses only the across time variation, which often tends to be much lower in enterprise level panel data than the cross section one (Levinsohn and Petrin 2003).

[18]We remind the reader, that the number of firms that change their field of activity is small in our panel.

[19]At NACE double-digit or three digit level.

on the subsidiary of the MNE or the home firm of the MNE. For that purpose we regress the log of TFP on a dummy for firms with a majority foreign ownership at time t and a dummy variable for future FDI firms equal to 1 over the two years before the ownership change from "a non FDI firm" to "a firm with FDI". The positive value of this coefficient would indicate that these *switching firms* (as in Figure 1 in section 2) exhibit higher productivity than domestic or national firms already before receiving/making FDI. We exclude from our estimation in Table 7 those firms that were foreign owned firms/MNEs during the whole period. In this way we can better differentiate between the effect of FDI on the productivity of the subsidiary (or the productivity of the home firm of FDI) and the self-selection effect.

The estimation results (see Table 7) confirm that foreign majority owned firms have higher TFP than domestic firms and also that firms with OFDI have higher productivity than national firms. This finding is true for both manufacturing and services sectors and persists if both inward FDI dummy and outward FDI dummy are included in the same estimated equation[20]. We also find that firms in manufacturing and services sectors that receive inward FDI during the next two years have higher TFP than the rest. This indicates that MNEs choose good firms as their acquisition targets. The coefficient of the dummy indicating firms that will engage in OFDI during the next two years is positive, but statistically significant only for the services sector. Thus we find empirical support for some of the predictions of the Helpman-Melitz-Yeaple (2004) theory in the services sector, namely that firms with above average productivity are able to engage in outward FDI. Interestingly, we do not find a similar statistically significant effect in the manufacturing[21] sector. The TFP premium of firms that have FDI, as indicated by the coefficient of the FDI dummy, is significantly larger than the TFP premium two years before FDI. This suggests that both inward and outward FDI are likely to have a positive effect on the TFP of the firm.

Year and location dummies are significant in all specifications, both in this framework and in the augmented production function framework

[20]This last specification in Table 7 confirms the finding from the unconditional mean analysis (as in Table 4). It now implies that, ceteris paribus, firms that have both inward and outward FDI have the highest TFP (even if controlling for other characteristics of firms). This TFP premium is given by the sum of the three coefficients given in the last section of Table 7. We can also conclude from Table 7 that the OFDI of indigenous Estonian firms is positively related to the TFP of the firm, however, to a lesser extent than the combination of outward FDI with foreign ownership.

[21]This may have to do with the fact that, unlike in the services sector, the number of MNEs of the manufacturing sector is relatively small (53 firms with OFDI in 2002).

in the next tables, also indicating, for example, that the TFP of firms outside Northern Estonia is significantly lower than in Northern Estonia.

The evidence for a selection bias can be checked for its robustness via an alternative way of assessing the effects of FDI. We estimate the effects of FDI also in one step, with the log of sales as a dependent variable and production inputs such as capital, labour and materials included on the right hand side of the equation (together with the FDI related variables). However, in this augmented production function framework, we take the heterogeneity of firms into account to a lesser extent, because we do not allow for different coefficients for capital and labour (as we did in the 2-step approach for quantifying the effects of FDI).

According to the RE model or pooled LS model, we find again (see Tables 8–11) that receiving FDI or making outward FDI is positively related to the productivity of the firm and these findings are similar for both the manufacturing and services sectors. Now the firms with inward FDI, based on RE model, have 16.8 per cent higher TFP than the remainder of the firms in the manufacturing sector. Using this approach, the corresponding gap in TFP in the services sector was found to be 17.16 per cent. This difference in TFP is now smaller than in Table 7, where the corresponding figures were 31.2 per cent and 33.2 per cent respectively. A similar difference is found by comparing the coefficients of variables indicating the existence of outward FDI. This difference can probably be attributed to the different framework used when estimating these effects. The model in Table 7 does not include the Herfindahl index as an independent variable and the log of TFP is calculated using a value added based approach (log of value added[22] is the dependent variable in the production function that is used for deriving the log of TFP) whereas in Tables 8–11 the dependent variable in the production function is the log of sales.

[22]This value added based approach means that the increase in productivity due to more efficient use of materials is not taken into account here.

Table 7: Effect of FDI or selection bias — productivity premium before and after FDI

Log TFP as dependent variable		
Inward FDI:	Manufacturing Coefficient	Services Coefficient
Foreign majority ownership dummy	0.312***	0.332***
	(0.039)	(0.028)
Firm will receive inward FDI during the next 2 years	0.153***	0.214***
	(0.054)	(0.04)
Sector dummies	Yes	Yes
Year dummies	Yes	Yes
Location dummies	Yes	Yes
Note: Firms that are foreign owned for the whole period are excluded from the analysis.		
Outward FDI:	Manufacturing Coefficient	Services Coefficient
Firm has outward FDI	0.292***	0.402***
	(0.07)	(0.045)
Firm will engage in outward FDI during the next 2 years	0.05	0.127***
	(0.051)	(0.034)
Sector dummies	Yes	Yes
Year dummies	Yes	Yes
Location dummies	Yes	Yes
Note: Firms that have outward FDI in all years of the period are excluded from the analysis.		
Both outward and inward FDI:	Manufacturing Coefficient	Services Coefficient
Foreign majority ownership dummy	0.267***	0.271***
	(0.03)	(0.021)
Firm has outward FDI	0.288***	0.401***
	(0.09)	(0.052)
(Foreign majority ownership dummy)*(Firm has outward FDI)	-0.068	-0.201**
	(0.15)	(0.102)
Sector dummies	Yes	Yes
Year dummies	Yes	Yes
Location dummies	Yes	Yes
Note: Firms that have outward or inward FDI in all years of the period are excluded from the analysis.		

*Note: The robust standard errors are in parentheses. The random effects model has been used. ***, **, * denotes statistical significance at the 1, 5 and 10 per cent level, respectively. Source: own calculations based on panel data of Estonian firms 1995–2002.*

Table 8: Effect of inward FDI on TFP in Estonia (incl. instantaneous spillovers), augmented production function with spillovers defined at NACE 2-digit level

	Manufacturing			Services		
	Pooled LS	FE model	RE model	Pooled LS	FE model	RE model
LnK	0.0868***	0.1027***	0.0944***	0.1089***	0.0945***	0.1078***
	(22.81)	(15.71)	(29.95)	(57.13)	(31.40)	(62.75)
LnM	0.5684***	0.5043***	0.5544***	0.5520***	0.4730***	0.5271***
	(84.33)	(38.44)	(165.82)	(141.96)	(63.56)	(289.79)
LnL	0.3497***	0.3107***	0.3435***	0.3556***	0.3177***	0.3530***
	(52.01)	(22.08)	(61.25)	(84.69)	(41.08)	(100.82)
Herfindahl index	-0.1402	-0.2027	-0.1183	-0.7881**	-0.2098	-0.7947***
	(0.77)	(1.73)	(0.94)	(2.15)	(0.96)	(3.63)
INFDI_firm	0.1671***	0.0500	0.1683***	0.2450***	-0.0136	0.1716***
	(4.67)	(1.37)	(6.58)	(5.96)	(0.32)	(6.14)
Fdi_change	0.1142***	-0.0260	0.0981***	0.1207***	-0.0458	0.1124***
	(3.83)	(0.81)	(4.11)	(6.12)	(1.94)	(6.70)
INFDI_spillover (based on sales)	0.3142***	0.2408***	0.3121***	1.2429***	0.4432***	0.9446***
	(6.96)	(6.13)	(8.59)	(14.69)	(6.44)	(15.75)
INFDI_firm*INFDI_spillover (based on sales)	0.1076	-0.0952	-0.0099	-0.0822	-0.0221	0.0485
	(0.99)	(0.95)	(0.15)	(0.44)	(0.11)	(0.35)
Sector dummies	Yes	No	Yes	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies	Yes	No	Yes	Yes	No	Yes
Constant	4.9748***	5.5279***	5.0201***	4.6259***	6.1862***	5.0703***
	(38.90)	(38.22)	(44.85)	(106.37)	(71.47)	(172.87)
Observations	15226	15226	15226	56143	56143	56143
R-squared	0.93	0.98		0.89	0.97	

*Source: own calculations based on panel data of Estonian firms 1995–2002. Note: Spillovers are defined at NACE 2-digit level. The robust t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1, 5 and 10 per cent level, respectively.*

Table 9: Effect of outward FDI on TFP in Estonia (incl. instantaneous spillovers), augmented production function with spillovers defined at NACE 2-digit level

	Manufacturing			Services		
	Pooled LS	FE model	RE model	Pooled LS	FE model	RE model
lnK	0.0916***	0.1022***	0.0976***	0.1126***	0.0950***	0.1108***
	(23.54)	(15.76)	(30.86)	(58.69)	(31.52)	(64.34)
lnM	0.5705***	0.5052***	0.5566***	0.5552***	0.4744***	0.5297***
	(83.84)	(38.60)	(165.49)	(142.23)	(63.92)	(290.27)
lnL	0.3483***	0.3081***	0.3417***	0.3494***	0.3164***	0.3477***
	(51.09)	(22.03)	(60.63)	(83.08)	(41.01)	(98.95)
Herfindahl index	0.0338	-0.1818	0.0109	-1.5448***	-0.5449**	-1.5193***
	(0.18)	(1.61)	(0.09)	(4.12)	(2.48)	(6.88)
OUTFDI_firm	0.1753***	0.0588	0.1549***	0.2835***	0.1026**	0.1958***
	(5.61)	(1.86)	(2.80)	(6.34)	(1.99)	(4.17)
Out_change	0.1338***	-0.0216	0.0457	0.1740***	-0.0348	0.0660***
	(3.92)	(0.76)	(1.82)	(7.98)	(1.69)	(3.78)
OUTFDI_spillover (based on sales)	0.2748***	0.3359***	0.3033***	0.4529***	0.2384***	0.3951***
	(3.72)	(6.04)	(5.19)	(4.48)	(3.15)	(5.79)
OUTFDI_firm*OUTFDI_spillover (based on sales)	0.0071	-0.1515	-0.1842	-1.5635***	-0.3751	-0.6452
	(0.04)	(1.56)	(0.67)	(3.70)	(0.66)	(1.38)
Sector dummies	Yes	No	Yes	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies	Yes	No	Yes	Yes	No	Yes
Constant	4.8047***	5.5530***	4.9041***	4.7832***	6.2215***	5.1895***
	(36.97)	(38.28)	(43.73)	(112.39)	(71.64)	(184.86)
Observations	15226	15226	15226	56143	56143	56143
R-squared	0.93	0.98		0.89	0.97	

*Source: own calculations based on panel data of Estonian firms 1995–2002. Note: Spillovers are defined at NACE 2-digit level. The robust t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1, 5 and 10 per cent level, respectively.*

Table 10: Effect of inward FDI on TFP in Estonia (incl. lagged spillovers), augmented production function with spillovers defined at NACE 2-digit level

	Manufacturing			Services		
	Pooled LS	FE model	RE model	Pooled LS	FE model	RE model
lnK	0.0891***	0.1012***	0.0970***	0.1084***	0.0895***	0.1062***
	(22.66)	(15.45)	(29.43)	(55.31)	(28.78)	(59.60)
lnM	0.5647***	0.4843***	0.5463***	0.5442***	0.4640***	0.5175***
	(79.68)	(36.52)	(156.23)	(134.31)	(60.17)	(274.15)
lnL	0.3499***	0.2983***	0.3451***	0.3648***	0.3247***	0.3656***
	(49.35)	(21.20)	(59.15)	(83.39)	(40.19)	(100.82)
Herfindahl index	0.0296	-0.0159	0.0788	0.0179	-0.0642	-0.0758
	(0.14)	(0.14)	(0.57)	(0.04)	(0.27)	(0.32)
INFDI_firm	0.1637***	0.0264	0.1610***	0.205***	-0.0164	0.1744***
	(7.19)	(0.89)	(9.14)	(12.21)	(0.79)	(13.16)
Fdi_change	0.0919***	-0.0328	0.0924***	0.1124***	-0.0463	0.1192***
	(2.94)	(0.95)	(3.70)	(5.51)	(1.89)	(6.80)
(INFDI_spillover)lag1 (based on sales)	-0.0856	-0.0281	-0.0541	-0.0852	-0.0087	-0.0582
	(1.80)	(0.74)	(1.48)	(1.17)	(0.14)	(1.13)
(INFDI_firm*INFDI_spillover) lag1 (based on sales)	0.1653**	0.0320	0.0901**	0.1970**	-0.0564	0.1557**
	(1.98)	(0.58)	(1.96)	(2.52)	(0.88)	(2.57)
Sector dummies	Yes	No	Yes	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies	Yes	No	Yes	Yes	No	Yes
Constant	5.1471***	5.9656***	5.2639***	5.0729***	6.4873***	5.4714***
	(23.00)	(38.93)	(20.68)	(107.19)	(70.50)	(175.50)
Observations	14091	14091	14091	52639	52639	52639
R-squared	0.93	0.98		0.89	0.97	

*Source: own calculations based on panel data of Estonian firms 1995–2002. Note: Spillovers are defined at NACE 2-digit level. The robust t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1, 5 and 10 per cent level, respectively.*

Table 11: Effect of outward FDI on TFP in Estonia (incl. lagged spillovers), augmented production function with spillovers defined at NACE 2-digit level

	Manufacturing			Services		
	Pooled LS	FE model	RE model	Pooled LS	FE model	RE model
lnK	0.0938***	0.1013***	0.1002***	0.1114***	0.0894***	0.1080***
	(23.29)	(15.48)	(30.30)	(56.53)	(28.81)	(60.50)
lnM	0.5658***	0.4844***	0.5468***	0.5455***	0.4638***	0.5183***
	(78.93)	(36.54)	(155.40)	(134.17)	(60.19)	(273.86)
lnL	0.3508***	0.2995***	0.3465***	0.3626***	0.3244***	0.3644***
	(48.72)	(21.24)	(59.03)	(82.55)	(40.19)	(100.06)
Herfindahl index	0.0040	-0.0229	0.0624	-0.0122	-0.0710	-0.1049
	(0.02)	(0.20)	(0.45)	(0.03)	(0.31)	(0.44)
OUTFDI_firm	0.1444***	0.0277	0.1160***	0.1939***	0.0845***	0.1534***
	(4.94)	(0.98)	(2.58)	(6.58)	(2.75)	(5.09)
Out_change	0.1499***	0.0064	0.0771***	0.1688***	0.0009	0.0800***
	(3.73)	(0.19)	(2.76)	(6.99)	(0.04)	(4.23)
(OUTFDI_spillover)lag1 (based on sales)	-0.0345	-0.0195	-0.0325	-0.1707**	-0.0083	-0.0454
	(0.54)	(0.41)	(0.62)	(2.43)	(0.14)	(0.91)
(OUTFDI_firm*OUTFDI_spillover)lag1 (based on sales)	0.1796	-0.0225	0.0720	-0.7433**	-0.2559	-0.1738
	(0.82)	(0.25)	(0.26)	(2.44)	(0.67)	(0.56)
Sector dummies	Yes	No	Yes	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies	Yes	No	Yes	Yes	No	Yes
Constant	5.1497***	5.9586***	5.2830***	5.0352***	6.4868***	5.4493***
	(19.85)	(39.14)	(20.53)	(110.26)	(70.57)	(183.50)
Observations	14091	14091	14091	52639	52639	52639
R-squared	0.93	0.98		0.89	0.97	

*Source: own calculations based on panel data of Estonian firms 1995–2002. Note: Spillovers are defined at NACE 2-digit level. The robust t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1, 5 and 10 per cent level, respectively.*

The inward FDI dummy is positive and significant in the pooled LS and RE model, however, in the FE model this dummy is not significant, thus there appears to be no robust evidence of a positive effect on productivity if we only consider firms that switch from being a purely *domestic firm* to a *foreign owned firm*. This could raise indeed some questions about the effects of FDI at the firm level, for example, whether that effect is found because of selection bias in the FE model. As presented in Table 1, Section 5, the number of firms with OFDI is relatively low. Also, the large increase in inward and outward FDI in Estonia is only reflected in a small increase in the actual number of firms with outward FDI (the percentage growth is, however, large). Thus the exclusion of firms that have no change in OFDI dummy variable leaves us with a relatively small number of enterprises. Also, controlling for the self-selection effect with the dummy variable indicating firms that will engage in OFDI over the next two years may further make finding positive "own-firm effect" less likely with the FE model. A general relevant comment on estimating the effects of FDI in the production function framework would be the following. It is vital to note that because the effect of FDI is, in fact, to some extent included also in the other inputs in the production function (e.g. by an increase in K[23] due to FDI), this finding implies only that there is no additional return to FDI beyond that expected from spending/investments of other types and this finding holds for this small number of firms that have time variant values for the (O)FDI dummy.

An extension of this analysis that could be performed in the future and that could potentially shed more light on the issue of the causal effect of (outward) FDI on TFP, could be estimating the average treatment effects on the treated (ATT) by using propensity score matching methods. However, the problem that we encountered in our efforts to employ propensity score matching was building a sufficiently appropriate control group so that the necessary (balancing) properties would hold in order to estimate the ATT. Thus these results have so far been omitted from our paper.

Our results from the augmented production function framework (see Tables 8–11) confirm the previously mentioned findings about self-selection

[23]Note also that we might not capture all production input *capital* with our definition of K in the production function. Thus some effects of an increase in K may be still included in the residual term (i.e. in the log of TFP). One finding that may be relevant here is by Mickiewicz et al. (2004). They tested whether liquidity constraints (the inability to finance profitable investment opportunities) inhibit the investments of Estonian firms. They found that domestic companies were more inhibited by financing constraints than foreign owned companies

effects.

The findings on spillovers of inward and outward FDI in Estonia (as in Tables 8–13) are considerably less straightforward than the results on "own-firm" effects. It is difficult to put forward definite conclusions about spillover effects based on the results of our regression analyses. We have studied the spillover effects with different specifications of the regression model, the spillover variable and with different definitions of sectors. Different specifications of the model were: a) models with a spillover variable as either the current period's or the lagged period's variable (see Tables 8–11); b) models with a dependent variable as either the log of TFP (found as the residual from the Cobb Douglas production function, see Tables 12 and 13) or log of sales as in the augmented production function (see Tables 8–11). Different specifications of the spillover variable were calculated based on: a) sales, b) total assets, and c) number of employees. Spillover variables were calculated either as corresponding to the NACE 2-digit or 3-digit classification of sectors.

The different specifications indeed give rather different results based on Estonian panel data as the significance or the signs of the spillover variables differ depending on the model or the variable or the definition of the sectors used. Hence, we cannot find robust conclusive evidence of spillovers that exists regardless of the model or the specification of the variable we use. Thus, based on these results, we cannot say with confidence that "there are or are not strong spillovers from FDI", but have to be much more cautious about interpreting the signs of these variables.

Starting from the augmented production function, sales based spillover variables and 2-digit sector classification as in Tables 8–11, the results are diverse depending on whether the current period's spillover variables[24] or spillover variables lagged by one period are included. The reason for including lagged values of spillover variables in the analysis is that it may take time for the spillovers from inward or outward FDI to take effect. One might even expect to find more and positive spillovers in the long run. Therefore, the framework with lagged spillover variables could be preferred for our analysis.

However, the findings from Tables 8–11 do not confirm this expectation from the previous paragraph. In the framework with instantaneous spillovers that are calculated based on the sales of firms, we find positive and significant coefficients for spillover variables $INFDI\_spillover_{ijt}$ and $OUTFDI\_spillover_{ijt}$. Yet, we do not find significant coefficients for their interaction variables with FDI dummy ($INFDI\_firm_{ijt}$*$INFDI\_spillover_{ijt}$)

[24]Thus assuming instantaneous spillovers.

or outward FDI dummy ($OUTFDI\_firm_{ijt}$*$OUTFDI\_spillover_{ijt}$). These last two interaction variables let us study whether the spillover effect to other foreign owned firms or other firms with outward FDI is different from the effect to domestic firms or firms with no outward FDI. Thus, it seemed at first glance that there was no statistically significant difference in spillover effects for domestic owned and foreign owned firms or firms that had not undertaken outward FDI and firms that had made outward FDI. Multinationals did not seem to absorb spillovers more easily than the remaining firms (in the instantaneous spillover case), as the researcher might expect.

In the next stage of the analysis, the lagged spillover variables were included instead of instantaneous spillovers. The rest of the specification of the model remained the same as before. The findings in both the manufacturing and services sectors were that the coefficients of lagged spillover variables for outward or inward FDI proved to be insignificant, but the coefficient of the interaction variable $INFDI\_firm_{ijt}$*$INFDI\_spillover_{ijt}$ spillovers was found to be positive in the framework of inward FDI. Thus it seemed to indicate a positive lagged productivity spillover effect to other foreign owned firms, but no such spillover effect to the domestic owned firms in Estonia. In the case of outward FDI, no lagged spillover effect either to firms that had not invested outside Estonia or those that had invested outside Estonia was found in this framework.

Such differences in these results on instantaneous and lagged spillovers are surprising because one might expect the spillovers to be positive especially in the longer run. In the short run the effect might be due to the negative competition effect[25] expected to be even negative or insignificant. In the long run, positive demonstration and worker mobility effects from foreign owned firms upon local firms might be expected to compensate for a negative competition effect.

[25] As, for example, the entry of a new foreign owned firm might push some domestic firms out of the market.

Table 12: Effect of inward FDI on TFP in Estonia (incl. lagged spillovers) with dependent variable TFP found by using the LP model, spillover variables are defined at 3-digit NACE level

	Manufacturing		Services	
	Spillover definition variable		Spillover definition variable	
	assets	employees	assets	employees
INFDI_firm	0.296***	0.311***	0.322***	0.335***
	(0.039)	(0.032)	(0.029)	(0.022)
Fdi_change	0.162***	0.158***	0.231***	0.227***
	(0.045)	(0.045)	(0.03)	(0.03)
(INFDI_spillover)lag1	0.009	-0.006	0.213***	0.521***
	(0.037)	(0.048)	(0.033)	(0.048)
(INFDI_firm*INFDI_spillover) lag1	0.191**	0.336***	0.227**	0.404***
	(0.089)	(0.079)	(0.092)	(0.095)
Sector dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Location dummies	Yes	Yes	Yes	Yes
Constant	3.663***	3.712***	21.393***	21.1175***
	(0.172)	(0.203)	(0.289)	(0.289)
Observations	14104	14094	49028	49005

*Note: results from the RE model, models also included the Herfindahl index as an independent variable. Source: own calculations based on panel data of Estonian firms 1995–2002. Note: Spillover variables are defined at 3-digit NACE level. The robust standard errors are in parentheses. ***, **, * denotes statistical significance at the 1, 5 and 10 per cent level, respectively.*

Table 13: Effect of outward FDI on TFP in Estonia (incl. lagged spillovers) with dependent variable TFP found by using the LP model, spillover variables are defined at 3-digit NACE level

	Manufacturing		Services	
	Spillover definition variable		Spillover definition variable	
	assets	employees	assets	employees
OUTFDI_firm	0.307***	0.354***	0.381***	0.407***
	(0.082)	(0.084)	(0.052)	(0.052)
Out_change	0.049	0.123**	0.131***	0.147***
	(0.049)	(0.057)	(0.032)	(0.037)
(OUTFDI_spillover)lag1	0.108	-0.796	0.351	0.997
	(0.45)	(0.721)	(0.371)	(0.772)
(OUTFDI_firm*OUTFDI_spillover)lag1	-0.052	-0.071	0.097*	0.194*
	(0.088)	(0.138)	(0.058)	(0.103)
Sector dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Location dummies	Yes	Yes	Yes	Yes
Constant	6.436***	6.302***	21.408***	6.099***
	(0.171)	(0.19)	(0.311)	(0.173)
Observations	14065	11497	48919	39728

*Note: results from the RE model, models also included the Herfindahl index as an independent variable. Source: own calculations based on panel data of Estonian firms 1995–2002. Note: Spillover variables are defined at 3-digit NACE level. The robust standard errors are in parentheses. ***, **, * denotes statistical significance at the 1, 5 and 10 per cent level, respectively.*

In fact, these effects in Tables 8–11 cannot be regarded as robust to different specifications of the model or variables of spillovers. In the next step, these considerations were assessed. Some tentative general conclusions based on all of the models or specifications are drawn. Some of the results using the log of TFP as the dependent variable and using the 3-digit NACE level definition of spillovers are included in Tables 12 and 13.

The general results about inward FDI spillovers in the manufacturing sector are the following. We were unable to detect the robust spillover effect of inward FDI to domestic owned enterprises. The positive effect suggested by the positive sign of the current period's $INFDIspillover_{ijt}$ variable[26] is not maintained if lagged values of the spillover variable and different specification of the model [27] are used. However, there indeed appears to be some evidence of the positive spillover effect of increased penetration of inward FDI for other foreign owned firms in Estonia.

We find some indication of positive spillovers via inward FDI in the services sector. The results again depend on the specification of the model. At the 2-digit level the finding that there may be positive effect for other foreign owned firms appears to be robust, still at the 2-digit level we do not find positive effect on domestic enterprises. The picture looks different when using a 3-digit level definition of sectors — then there does appear to be positive spillover effects, also for domestic owned enterprises, that are also robust to the choice of a 1-step or 2-step estimation procedure and the choice of a base variable in the definition of the spillover variable.

If we take a look at the lagged spillover effects, there appears no significant spillover effect of outward FDI in the manufacturing sector. This finding is also robust (at least for the 3-digit level) for different ways of calculating this lagged spillover variable.

In conclusion, the findings about spillover effects of outward FDI depend on which spillover variable or estimation framework has been used. The coefficient is either statistically insignificant or in some specifications statistically significant and positive. Thus, no confident conclusions can be made, except that, at least, the positive effect seems to be more likely than the negative ones. The results of this paper do not indicate that Estonia should change its policy towards FDI — so far domestic and foreign investors have been treated equally. We do not find strong support to the idea of providing special incentives for foreign investors in particular.

[26] At 2-digit level definition of the sectors, in the augmented production function framework.

[27] The augmented production function estimation vs the 2-step approach where the log of TFP as the dependent variable is found with the Levinsohn-Petrin model.

7. Conclusions

In this paper we have examined the productivity effects of FDI from both the host and home country perspective. We have studied the effects of inward FDI on the total factor productivity of foreign owned firms and via productivity spillovers on the rest of the industry (incl. other foreign owned firms) in Estonia (as a host country of investment). The effects of outward FDI on the home firm of the MNE in Estonia and via productivity spillovers of outward FDI on the rest of the firms in Estonia (as a home country of investment) have been investigated here. The main emphasis has been on the effects of FDI on the total factor productivity of the firms. We have addressed these issues not only in the manufacturing industry, as most of the literature on the effects of FDI does, but also in the services sector.

Our results show that both inward and outward FDI are positively related to the productivity of the firm ("own-firm effect"). There seems to exist a significant self-selection effect for firms receiving FDI (both in the manufacturing and services sectors) or for enterprises undertaking outward FDI (only in the services sector) in the sense that firms with higher productivity attract inward FDI or are more likely to engage in outward FDI. This corresponds well to the implications of the recent model created by Helpman, Melitz and Yeaple (2004) which shows that lower productivity firms stay in the home country (and higher productivity firms export) whereas the firms with the highest productivity engage in outward FDI.

The results on the spillover effects are quite diverse for different specifications of the model or the spillover variable. These mixed results show that much caution is needed when interpreting the coefficients of spillover variables and especially when considering the policy implications about special incentives to FDI or generalizing these results for other countries.

However, there also seem to be some robust results. We find that foreign owned firms seem to benefit from the presence of other foreign owned firms in Estonia, both in the manufacturing and services sectors. The evidence of positive spillovers of inward FDI to domestic owned firms is relatively robust to different specifications in the services sector (in the case of lagged spillovers), but not in manufacturing. With regard to the positive effects of outward FDI, these seem to be significant for the investing firm itself. However, we were unable to find robust evidence of substantial beneficial effects via productivity spillovers to other firms in Estonia.

The lack of robust statistical evidence about the spillover effects via

outward FDI based on our data does not mean that there are no positive effects at all. The effects of FDI are certainly quite diverse for different host or home countries, different sectors and in different time periods, and are most likely to depend on the type of FDI. Favourable effects from the proximity of some types of multinationals are likely to be found for some groups of firms with particular characteristics.

In the future, better availability of input-output tables could potentially shed more light to the analysis of vertical spillovers of FDI. However, we would argue that for that different detailed input-output table for different years of the panel are needed, the use of only one input-output table and thus the assumption that these input-output relations do not change much in time is most often not likely to be a viable one.

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Appendix 1. Vertical Spillovers

A method intended for capturing vertical spillovers[28] (i.e spillovers not to competitors but to suppliers and clients of a foreign owned firm in the host country) involves using the coefficients from the input-output table of the host country to construct the variables for the analysis of vertical spillovers (e.g. Smarzynska Javorcik 2004, Sinani and Meyer 2004). This method has been increasingly used in the literature since Schoors and van der Tool's paper on the effects of FDI in Hungary (2002). In its simplest form this measure is found as the product of the relevant coefficient in the input-output table of the economy and the measure of horizontal spillover.

An important issue involves the question of whether we are able to capture the vertical spillover effects in a correct manner with this method? The issue of distinguishing between horizontal and vertical spillovers may seem straightforward, however, the reality may be different. Distinguishing between horizontal and vertical spillovers is not an easy task. The results of econometric analysis may largely depend on the choice of the division of sectors, and the latter, however, is crucially dependent (in analysis of vertical spillovers) on the availability of detailed input-output tables.

There are about 14 different sectors inside the manufacturing industry if the NACE double-digit division of sectors is used. Examples include textiles industry, food processing industry, wood processing industry, etc. The two-digit level division of sectors has often been used by different authors in host country effects literature that deals with vertical spillovers. A well-known example is the article by Smarzynska Javorcik (2004). However, arguably, if only a small number of sectors are available for the analysis of vertical spillovers, then it may not be enough to study this type of spillovers in the correct way, as arguably most of the spillovers may take place within each of these individual sectors — that is, more inside the wood processing industry[29] than, for example, between the wood processing and chemical industries.

Thus, by using small input-output tables, the researchers may only be looking at a rather small percentage of all possible vertical spillover effects. Unfortunately, for many countries (including Estonia) more detailed input-output tables are not available. Also, most often the input-output tables are available for only one year in the time series of the

[28] I.e. spillovers not to competitors, but to the suppliers and clients of a foreign owned firm.

[29] In the case of the 2-digit division of sectors, the wood-processing sector appears as one single sector.

panel. Hence, the researcher actually assumes that the proportion of the output of one sector provided to another stays the same over the years in the study. This may not be a very plausible assumption for transition countries, especially if the time dimension of the panel that is used is larger than just a couple of years. One recent exception that uses several input-output tables is the paper by Merlevede and Schoors (2005) based on data from Romania, the input-output tables they use exhibit considerable variation in input-output coefficients over time. Thus we do not have great confidence in the applicability of conventional measures of vertical spillovers in our context and investigate the "horizontal" ones instead.

	lnY	lnK	lnM	lnL	Herfindahl index	INFDI_firm	Fdi_change	INFDI_ spillover	OUTFDI_firm	Out_change	OUTFDI_ spillover
lnY	1.000										
lnK	0.639	1.000									
lnM	0.903	0.509	1.000								
lnL	0.720	0.630	0.595	1.000							
Herfindahl index	0.009	0.111	-0.029	0.112	1.000						
INFDI_firm	0.180	0.144	0.132	0.095	0.021	1.000					
FDI_change	0.060	0.051	0.047	0.035	0.016	0.051	1.000				
INFDI_spillover	0.107	-0.038	0.135	-0.004	0.038	0.083	-0.012	1.000			
OUTFDI_firm	0.149	0.119	0.127	0.115	0.007	0.074	0.025	0.017	1.000		
Out_change	0.065	0.054	0.050	0.041	0.015	0.143	0.490	-0.026	0.008	1.000	
OUTFDI_spillover	0.107	-0.038	0.135	-0.004	0.038	0.083	-0.012	1.000	0.017	-0.026	1.000

Appendix 2. Correlation matrix of the variables

Source: own calculations based on panel data of Estonian firms 1995–2002