

Foreign direct investment and total factor productivity in OECD countries: evidence from aggregate data

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FOREIGN DIRECT INVESTMENT AND TOTAL FACTOR PRODUCTIVITY IN OECD
COUNTRIES: EVIDENCE FROM AGGREGATE DATA

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ABSTRACT

Foreign direct investment (FDI) can be a source not just of capital, but also of new technology and intangibles such as organisational and managerial skills, and marketing networks. In this study, a panel data approach is used to study the effects of FDI on aggregate Total Factor Productivity in a sample of 16 OECD countries. We have implemented a statistical descriptive model that allows us to show that FDI has a positive impact on TFP, possibly because FDI is a channel through which technologies are transferred internationally.

Keywords: Foreign direct investment, total factor productivity, royalties and licence fees, spillovers.

JEL Classification: C33; F21; F23

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INTRODUCTION

In recent years renewed attention has been paid to the deep analysis of Foreign Direct Investment (FDI) effects (see, for example, Blomström and Kokko, 2003). The main reason is that FDI often involves the transfer of knowledge from one country to another (*e.g.*, Carr *et al.*, 2001), making it a potentially important vehicle for international technology diffusion¹.

In FDI literature we find detailed case studies discussing various aspects of FDI in different countries, as well as statistical studies of spillovers. Although the case studies have provided much detailed information about the various channels for spillovers, they say little about the actual importance of such spillovers. The statistical studies of spillovers, by contrast, may reveal the overall impact of foreign presence on the productivity of local firms, but they are generally not able to say much about how the effects come about.

So, an important question is whether, and to what extent, the knowledge that multinationals transfer to affiliates diffuses to other firms in the host country. Theoretical models of foreign investment suggest that there should be a positive relationship between FDI and international diffusion of technology. Knowledge will move through demonstration effects, labour turnover, or reverse engineering.

The positive effects have been driving a considerable change in the attitude towards inward FDI over the last couple of decades, as most countries have liberalised their policies to attract investments from foreign multinational corporations (MNCs). In the expectation that some of the knowledge brought by foreign companies may spill over to the receiving country's domestic firms, governments across the world have lowered various entry barriers and opened up new sectors to foreign investment. An increasing number of national governments also provide a variety of forms of investment incentives to encourage foreign owned companies to invest in their countries.

¹ Of course, there are many other reasons why FDI has become a much-discussed topic. One is the dramatic increase in the global flow and the resulting rise in its relative importance as a source of investment funds for a number of countries.

Consequently, it is significant to examine whether the externalities from the FDI are strong and systematic enough to justify subsidising foreign investment with various fiscal and financial incentives. Particularly, if we are in face of both positive and negative spillovers, it's crucial to determine the net effect at country level. This purpose is also important because the theory has only provided limited guidance to the empirical work, making it very hazardous to draw policy conclusions from individual studies. On the other hand, because data problems are particularly acute with regard to service industries, most research on FDI at the firm level focuses on goods². Finally, empirical work on FDI is generally overwhelmed by the limited availability and quality of the data. As a result, empirical research on FDI at firm level is largely limited to firms from just a few countries.

This article proposes a statistical framework and, based on it, investigates how foreign investment affected the aggregate total factor productivity (TFP) of OECD countries. Section 2 reviews the FDI evidence on productivity growth, spillovers and learning. Section 3 presents a statistical model that helps to rationalise some possible linkages between FDI and TFP. Section 4 presents estimates on elasticities of TFP with respect to both FDI and R&L. Section 5 concludes.

2. EMPIRICAL EVIDENCE

Empirical literature on FDI is abundant and varied. For simplicity it is usually separated in two types: case studies and statistical analyses. Case studies have argued that positive FDI spillovers are significant. They have also documented the importance of local skills and in-house technological capacity for adapting and using techniques developed elsewhere (Lall, 1992; and Evenson and Westphal, 1995).

Early studies using industry-level data, such as Blomström and Persson (1983), find that foreign presence in an industry, measured by the foreign share of industry employment, positively influences domestic labour productivity. More recent studies using firm-level data are less supportive of the existence of spillovers. Aitken *et. al.*,(1997) and Haddad and Harrison (1993) find that foreign investment has a negative effect on the performance of

² This lack of empirical research on FDI in the services sector is increasingly troublesome, owing to the growing importance of services in production, trade and investment.

domestically owned firms. Haddad and Harrison (1993) have argued that forward linkages generally brought positive spillover effects, but that backward linkages appeared to be less beneficial (Aitken and Harrison, 1999). Harrison (1996) suggests that in imperfectly competitive markets entry by foreign investors implies that domestic incumbents lose market share, impeding their ability to attain scale economies³.

The earliest statistical analyses of inter-industry effects of FDI claim that technical progress did not only take place in the FDI own industries, but also in other sectors (Katz, 1969), but, in general, the results of statistical analyses have reached more ambiguous conclusions. On the one hand, some authors have reported positive effects: increases in capital stock owned by multinationals seem to stimulate new domestic investment in plant and equipment, and it appears that there is also a positive impact of FDI on the growth of total factor productivity in the receiving countries' manufacturing sectors (Nadiri, 1991). Furthermore, foreign presence seems to have a significant positive impact on the rates of growth of local productivity (Blomström and Wolff, 1994). Some more recent studies, as for instance Chuang and Lin (1999), Liu *et al.* (2000), Driffield (2001), and Lipsey and Sjöholm (2001), argue that inward investment has made an important and significant contribution to economic growth in the recipient countries.

With few exceptions, almost all of statistical analyses of spillovers have focused on horizontal externalities. The earliest statistical analyses of this kind (Caves, 1974; Globerman, 1979; Blomström and Persson, 1983) examine the existence of spillovers by testing whether foreign presence has any impact on labour productivity in local firms in a production function framework. These analyses have concluded that FDI spillovers are significant at the aggregate level, although they cannot say anything about how spillovers take place.

But, in contrast, there are several studies that find negative effects of the presence of multinationals on domestic firms. As Blomström (1986), Haddad and Harrison (1993) find, foreign presence lowers the average dispersion of a sector's productivity, but they also detect that the effect is more significant in sectors with simpler technology. This indicates that foreign presence forces local firms to become more productive in sectors where best practice technology lies within their capability, but that there are no significant transfers of modern

³ The result showing negative spillovers contrasts with the findings of case-study literature and may to some extent reflect the omission of important variables, such as the level of R&D spending, expenditures on training, and the percentage of employees with technical degrees (engineers, scientists).

technology. Furthermore, they find no significant effects of foreign presence on the rate of productivity growth of local firms, and interpret this as additional support to the conclusion that technology spillovers do not occur⁴.

So the results of these studies on the occurrence of positive effects of inward FDI seem to be mixed. Lichtenberg and van Pottelsberghe de la Potterie (1996) have analysed the importance of FDI for international technology diffusion in thirteen OECD countries with the same R&D weighting approach that Coe and Helpman (1995) and Keller (1998) use for imports. Lichtenberg and van Pottelsberghe de la Potterie (1996) find that a country's *outward* FDI gives access to foreign technology. At the same time, they do not find significant effects from *inward* FDI. Baldwin, Braconier, and Forslid (1999) find some positive inward FDI spillover effects in their industry-level study, but overall, the results are mixed.

3. DESCRIPTIVE FRAMEWORK

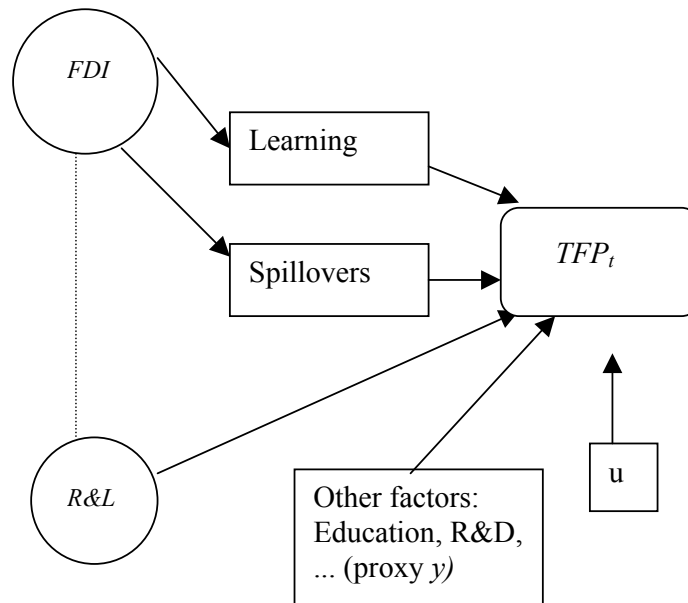
How does one come to know whether Foreign Direct Investment measure anything interesting? One way is to look for correlations between FDI and TFP. It is useful to introduce figure 1, which basically allows a more detailed discussion of the underlying assumptions of correlations between FDI and TFP.

Figure 1 draws the main channels of international technology diffusion that we shall review. We assume that international technology diffusion affects Total Factor Productivity (TFP_t) in t period because it promotes learning and generates spillovers. But, as both learning and spillovers are very difficult to measure we shall compute the effect of the activities behind such variables.

In the centre of figure 1 there are two unobservable variables: learning and (other) spillovers that are affected by FDI and that we presume affect TFP_t . We consider, on the other hand, that FDI effects may be associated to some forms of technology implying the payment of royalties and licence fees.

⁴ In the same way, Aitken and Harrison (1999) conclude that domestic firms exhibited higher productivity in sectors with a larger foreign share, but argue that it may be wrong to conclude that spillovers have taken place if FDI systematically locate in the more productive sectors. Also Perez (1998), and Cantwell (1989) argue that positive technology spillovers did not occur in all industries. However, Cantwell (1989) does not focus on productivity, but rather on changes in the market shares of foreign and local firms.

Figure 1. FDI and TFP



It is often observed that the assets possessed by MNCs include many that are “intangible”, consisting primarily of intellectual property, including technology, brand names and copyrights, plus the “human capital” embodied in these assets. Accordingly, some authors argue that FDI should be associated with the transfer of knowledge because, by definition, it is driven by intangible assets owned by the parent firm (Markusen 1995). The ownership of these assets makes FDI a potential source of productivity spillovers⁵.

Productivity spillovers from FDI take place when the entry or presence of multinational corporations increases the productivity of domestic firms in a host country, and the multinationals do not fully internalise the value of these benefits. Spillovers may take place when local firms improve their efficiency by copying technologies of foreign affiliates operating in the local market, either based on observation or by hiring workers trained by the affiliates. These are knowledge spillovers in nature. Another kind of spillovers occurs if multinational entry leads to more severe competition in the host country market and forces

⁵ FDI can also provide a stimulus to competition, innovation, savings and capital formation, and through these effects, to job creation and economic growth.

local firms to use their existing resources more efficiently or to search for new technologies (Blomström and Kokko, 1998)⁶.

We'll call horizontal spillovers when local firms benefit from the presence of foreign companies in their sector. When domestic firms compete with multinationals, the latter have an incentive to prevent technology leakage and spillovers from taking place. This can be achieved through formal protection of their intellectual property, trade secrecy, paying higher wages or locating in countries characterised by limited imitative capacities of their domestic firms.

On the other hand, the term vertical spillovers refers to productivity spillovers taking place due to linkages between foreign firms and their local suppliers. Such spillovers can operate through: (i) direct knowledge transfer from foreign customers to local suppliers⁷; (ii) higher requirements regarding product quality and on-time delivery introduced by multinationals, which provide incentive to domestic suppliers to upgrade their production management or technology; (iii) indirect knowledge transfer through movement of labour; (iv) increased demand for intermediate products due to multinational entry, which allows local suppliers to reap the benefits of scale economies, as in the theoretical model of Rivera-Batiz and Rivera-Batiz (1990). (v) competition effect — multinationals acquiring domestic firms may choose to source intermediates abroad thus breaking existing supplier-customer relationships and increasing competition in the intermediate products market.

Much of the literature on MNCs emphasises technology as a driving agent for the internationalisation of the operations of such firms. As powerful as technology might be in driving the internationalisation of firms, it is not the only intangible asset that firms may seek to exploit worldwide. Patents and copyrights can impart obvious competitive advantages to the firm that holds them. In some industries, the assets are in the form of brand names for which consumers world-wide are willing to pay a premium (for example, cola beverages).

⁶ While knowledge spillovers present a rationale for government action to subsidise FDI inflows, this is not the case when the improved productivity of local firms is due to increased competition, as inducing greater competition may be achieved by other means (import liberalisation, anti-trust policies, etc.).

⁷ As numerous case studies indicate (see Moran 2001), multinationals often provide technical assistance to their suppliers in order to raise the quality of their products or facilitate innovation. They help suppliers with management training and organisation of the production process, purchasing raw materials and even finding additional customers. Note that the existence of linkages does not necessarily guarantee that spillovers take place nor does the fact that multinationals may charge for services provided preclude the presence of spillovers. Spillovers take place when foreign affiliates are unable to extract the full value of the resulting productivity increase through direct payment or lower prices they pay for intermediates sourced from the local firm.

Firms owning such assets can, of course, license country-specific production rights, rather than choose to invest in foreign production facilities. This is particularly true because the wider and largely dynamic effects of FDI in the host country — such as the stimulus to competition, innovation, productivity, savings and capital formation — can be important. Since these and other FDI-related dynamic effects are likely to affect the level and product composition of the country's production it is evident that the relationship between productivity and FDI is considerably more complex than is often suggested.

As a matter of fact, TFP_t is also affected by the authorised use of intangible, non-financial, non-produced assets and proprietary rights, such as patents, copyrights, trademarks, franchises and industrial processes. The use of intangible assets and proprietary rights and the use of produced originals of prototypes through licensing agreements are controlled by royalties and licence fees (R&L). Of course that other factors affect TFP_t : education, R&D, infrastructures, quality of entrepreneurship, appropriate institutions, and so on. All these factors are associated to the level of development that country enjoys. We assemble all these factors in a single variable, y_{it} , termed level of relative development.

The importance of relative development is highlighted in both several analyses of individual host countries and in various statistical analyses. For instance, the results of the Blomström *et al.* (1994)'s wide-ranging cross-country study of 101 economies suggest that spillovers are concentrated to middle-income developing countries, while there was no evidence of such effects for the poorest developing countries. Similar results are reported in Balasubramanyam (1998). He concluded that only the most advanced developing countries are able to benefit from FDI, because only in the presence of a threshold of human capital, well-developed infrastructure facilities, and a stable economic climate, the positive effects of FDI might occur.

A number of extreme simplifications were made in drawing figure 1 and in defining the various terms. But the figure 1 is a statistical descriptive framework rather than a “theory” of FDI. It indicates that fact adding an error u to the determinants of TFP, and so making the figure 1 an imperfect measure of TFP⁸. For example, FDI and *R&L* are taken as exogenous

⁸ A “theory” would have to be explicit about the conditions (economic, technological, and legal) under which the benefits of FDI are transformed in TFP. Such a theory would start with the underlying notions of learning and spillovers and with the more precise mechanism driving the effects of FDI on TFP and likely feedbacks. Furthermore, a theory would give an unambiguous explanation to the patent change in attitude towards FDI over the last couple of decades, as most countries have liberalised their policies to attract foreign investments.

but, if as it is likely, *FDI* is correlated with *R&L*, then one might expect feed back in subsequent periods, making the relationship between TFP and FDI much more complex. So, what is depicted in figure 1 is, at best, a very crude reduced-form-type relation whose theoretical underpinnings have still to be worked out. But one has to start someplace. Nevertheless, figure 1 does provide a schema for both discussing much of the research in the effects of FDI and estimate some relevant elasticities.

4. EMPIRICAL TESTS: FDI AND R&L

Our empirical work has tried to estimate the effect of *FDI* and *R&L* on *TFP*, in a panel data of 16 OECD economies: Australia, Belgium, Canada, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Japan, Portugal, Spain, Sweden, United Kingdom, and United States. In the empirical tests we use the following variables and data, for the country *i* and the time *t*.

TFP_{it}	Total factor productivity;
FDI_{it}	Foreign Direct Investment, net annual inflows ⁹ ;
RL_{it}	Annual payment to the exterior of <i>Royalties</i> and Licence Fees ¹⁰ ;
Y_{it}	GDP per capita of country <i>i</i> over USA GDP per capita (PPP at constant 1995 international \$).

The total factor productivity (TFP) was calculated by the OECD for the purpose of international comparisons and it is based on harmonised prices for ICT capital goods (OECD, 2004). The annual value of *FDI* and *RL*, are from World Development Indicators and are collected from Balance of Payments at current US\$ (World Bank, 2004). *TFP*, *FDI* and *RL* are index numbers (base year = 2000).

⁹ Foreign direct investment is net inflows of investment to acquire a lasting management interest (10 per cent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the Balance of Payments.

¹⁰ *Royalties* and Licence Fees are payments between residents and nonresidents for the authorized use of intangible, non-produced, non-financial assets and proprietary rights (such as patents, copyrights, trademarks, industrial processes, and franchises) and for the use, through licensing agreements, of produced originals of prototypes (such as manuscripts and films).

In order to begin, it is helpful to write down the simplest possible model that might connect these three variables, in natural logarithm form, in the spirit of figure 1:

$$\ln TFP_{it} = \beta_0 + \beta_1 \ln FDI_{it} + \beta_2 \ln RL_{it} + u_{it} \quad (1)$$

Equation (1) is formalised assuming that TFP is independent of the level of development of country i . In table 1 we present the estimates of equation (1) calculated by three different methods. In column 1 and 1' we show estimates that are obtained by Pooled OLS. This specification estimates the model using system OLS method, and has implicit the verification of the assumptions of the classic linear regression model. So, it is only appropriate when the residuals are contemporaneously uncorrelated, and time period and cross-section homoskedastic. But when the residuals are cross-section heteroskedastic and contemporaneously uncorrelated it is more appropriate to use cross-section weights. Thus, the table reports GLS estimates, too (columns 2 and 2'). The table also reports (columns 3 and 3') Seemingly Unrelated Regression (SUR) estimates (Zellner, 1962). SUR is the feasible GLS estimator when the residuals are both cross-section heteroskedastic and contemporaneously correlated. The first of each pair of columns presents estimates with a common constant; the second presents estimates obtained by a fixed effects model.

Table 1
FDI and $R\&L$, OCDE, 1985-2002

	Pooled LS		GLS (cross section weights)		SUR	
	(1)	(1')	(2)	(2')	(3)	(3')
Constant	4.22* (123.4)	F. Effects	4.30* (200.1)	F. Effects	4.23* (462.0)	F. Effects
$\ln FDI$	0.029* (7.93)	0.024* (7.60)	0.023* (19.77)	0.021* (15.02)	0.028* (30.45)	0.022* (23.81)
$\ln RL$	0.054* (7.38)	0.056* (8.72)	0.040* (8.95)	0.047* (12.07)	0.052* (29.29)	0.057* (30.42)
T	18	18	18	18	18	18
N	16	16	16	16	16	16
Obs	241	241	241	241	241	241
\bar{R}^2	0.57	0.82	0.99	0.99	0.57	0.81

Source: Calculations based on OECD (2004) and World Bank (2004).

Notes: t tests are shown in brackets: *significant at the 1 percent level; **significant at the 5 percent level; Standard errors and covariance matrix are White (1980) heteroskedastic corrected.

With a common constant, the estimates presented in table 1 show statistically significant positive elasticities of *TFP* in order to both *FDI* and *R&L*. Depending on the method of estimation, 1 percent increase in FDI is associated with an increase in TFP ranging between 0.023 and 0.029 per cent, and 1 percent increase in R&L implies a percent increase in TFP included in the interval [0.040, 0.054]. The *t* tests indicate that the coefficients are significant at the 1 per cent level and the adjusted coefficient of determination shows that the equation (1) explains more than fifty percent of the TFP variation.

However the estimates shown in columns 1, 2 and 3, may be biased owing to estimation method do assume that the behaviour of the economy is time and cross-section invariant. But if the behaviour of the OECD economies varies in both dimensions, one form of getting away the total homogeneity of time and country behaviour assumed is to admit that elasticities are equal in every sample economy, but that there is some heterogeneity embraced by the constant in the regression, which becomes specific to each one of the economies. In this procedure, known as fixed effects model, individual effects result from several unobservable and time-constant factors. This procedure is consistent with studies such as Sjöholm (1999) and Kugler (2000) that have identified a geographical dimension of positive vertical spillovers.

Furthermore, other recent studies suggest that there is a systematic pattern where various characteristics of the host country influence the incidence of spillovers. For instance, foreign affiliates' levels of technology seem to influence the amount of spillovers to local firms. Foreign affiliates' levels of technology, in turn, appear to vary systematically with host country characteristics. Those levels seem to be larger in countries and industries where some requisites are filled. For instance, where the host country imposes fewer formal requirements on the affiliates' operations (Blomström *et al* , 1994).

It seems clear from the studies reviewed in section 1 that host country characteristics determine the impact of FDI, and that systematic differences between countries should therefore be expected. As Blomström and Kokko (2003) emphasise, there is strong evidence pointing to the potential for significant spillover benefits from FDI, but also ample evidence indicating that spillovers do not occur automatically. A reasonable conclusion from the mixed findings of earlier studies is that the ability and motivation of local firms to engage in investment and learning to absorb foreign knowledge and skills is an important determinant of whether or not the potential spillovers will be actualised.

So, table 1 presents estimates using the fixed effects model for equation (1) also. For simplicity the country specific effects are not reported in the table, but they are available from the author on request. Allowing for country specific fixed effects, as would be predicted, has turned the estimates of the elasticity in order to *FDI* lower and the elasticity in order to *R&L* higher, but both coefficients remain significantly positive. On the other hand the consideration of the fixed effects increase the explicative power of the equation, as measured by \bar{R}^2 . So in the remaining part of the paper we only use the fixed effects model.

However, the estimates shown in table 1, based on equation (1), may omit some relevant variables. The most obvious candidate is the level of development of the country *i* relatively to the technological frontier. This is consistent with the evidence of some recent studies that have addressed the hypothesis that the host country's level of technical development may matter as a starting point. If spillovers should not be expected in all kinds of industries, the level of technological development of the host country matters. In particular, in countries with a low level of development, foreign MNCs may sometimes operate in “enclaves“, where neither products nor technologies have much in common with those of local firms. In such circumstances, there may be little scope for learning, and spillovers may not materialise.

With these considerations in mind, it is now the time to introduce other relevant variables in the framework, as depicted in equation (2):

$$\begin{aligned} \text{LnTFP}_{it} = & \beta_0 + \beta_1 \text{LnFDI}_{it} + \beta_2 \text{LnRL}_{it} + \\ & + \beta_3 \text{Ln}y_{it} * \text{LnFDI}_{it} + \beta_4 \text{Ln}y_{it} * \text{LnRL}_{it} + \beta_5 \text{Ln}y_{it} + u_{it} \end{aligned} \quad (2)$$

The equation (2) adds to the equation (1) the level of development of the country *i* in log scale ($\text{Ln}y_{it}$) and two interaction terms $\text{Ln}y_{it} * \text{LnFDI}_{it}$ — interaction between the relative level of development and *FDI*, and $\text{Ln}y_{it} * \text{LnRL}_{it}$ — interaction between the relative level of development and *RL*.

If *FDI* is a *carrier* to come in technology, we expect that the lower the country's technological level is the larger the positive effects of *FDI* would be. Hence, resulting a negative signal for coefficient on interaction variable — $\text{Ln}y_{it} * \text{LnFDI}_{it}$. On the other hand, we expect, a positive signal of the interaction term between development level and *RL* indicating that the

increase of the development level will lead to a larger benefit of technology use licences, perhaps as a consequence of the improved benefit of complementarity among technologies.

Table 2 shows the elasticity's behaviour in face of the level of relative development and the interaction between this level and the basis variables. The introduced modifications have implied some alterations in the estimated coefficients. Let's begin by the estimation without interaction terms (columns 4, 5 and 6).

Table 2
FDI, R&L and level of development in OCDE, 1985-2002

	Pooled LS		GLS (cross section weights)		SUR	
	(4)	(4')	(5)	(5')	(6)	(6')
<i>LnFDI</i>	0.023* (8.68)	0.115** (2.16)	0.019* (15.59)	0.129* (5.87)	0.021* (22.43)	0.127* (5.41)
<i>LnRL</i>	0.041* (9.47)	-0.117** (-2.33)	0.040* (17.96)	-0.97* (-4.89)	0.041* (24.74)	-0.124* (-6.62)
<i>Lny</i>	0.325* (9.18)	0.234* (4.49)	0.406* (25.69)	0.345* (15.80)	0.333* (27.10)	0.242* (13.77)
<i>LnFDI*Lny</i>	---	-0.021*** (-1.74)	---	-0.026* (-5.05)	---	-0.025* (-4.58)
<i>LnRL*Lny</i>	---	0.038* (3.10)	---	0.032* (6.73)	---	0.040* (8.94)
T	18	18	18	18	18	18
N	16	16	16	16	16	16
Obs	241	241	241	241	241	241
\bar{R}^2	0.85	0.86	0.999	0.999	0.85	0.86

Source: Calculations based on OECD (2004) and World Bank (2004).

Notes: *t* tests are shown in brackets: *significant at the 1 percent level; **significant at the 5 percent level; ***significant at the 5 percent level. Standard errors and covariance matrix are White (1980) heteroskedastic corrected.

Estimates show the expected signals independently of the method of estimation. The elasticity of *TFP* in order to *FDI* is, in general, lower than in previous specifications, but its signal remains positive. On the contrary, the elasticity in relation to *RL* turned out to be negative. The estimates show, depending on the estimation method, that everything else constant, 1 percent increase in *FDI* is associated to percent increases in *TFP* in the interval [0.019; 0.023] and 1 percent increase in *RL* is associated to a increase ranging from 0.040 to 0.041 percent. On the other hand the level of relative development elasticity is significantly positive: *ceteris paribus*, 1 percent increase in the level of development implies an increase in *TFP* ranging from 0.325 to 0.406 percent.

Considering the interaction terms, the signal of the coefficient of $LnRL$ turn out to be negative. In our view this means that the level of development is crucial to determine the amount of profit that a country appropriates from the assets that originate the payment of royalties and licence fees.

5. CONCLUDING REMARKS

Although there is little doubt that technologies make their way across international borders, the mechanisms through which this occurs are poorly understood because most of the empirical evidence is subject to multiple interpretations. Technologies may be transferred through several channels. New technologies may be embodied in new varieties of differentiated products or capital goods and equipment. They may be transferred through FDI or through arm's-length trade in intellectual property, such as licensing contracts. In theory, firms will be adverse to unbundling and selling knowledge or products if there are important incentives for internalisation—in this case FDI may be the preferred channel for acquiring knowledge (Markusen, 1995).

In this study, we have tested the effects of FDI on the aggregate PTF in a panel data of 16 OECD countries in the 1985-2002 period. Our empirical tests show that inward FDI has a positive impact on host country TFP, possibly because FDI it is a channel through which technologies are transferred internationally. This result is consistent with the studies that show that FDI is a channel through which technologies are transferred internationally as is the case of Blomström and Kokko (1997).

Negative effect of RL on TFP, when we consider the interaction between the level of development and RL can help to explain the scarce use of patents by the less developed countries and consequently the scarce technological content of production and exports of these countries. The negative impact of RL provide some rationality to the behaviour of firms of those countries which invest more heavily in machines and equipment than in paying for ideas. But, dynamically, given the complementarity between development level and RL , corroborated by positive signal of respective interaction term, the use of foreign technologies can represent a way of technical renovation in countries that are not near the technological frontier.

Robustness of the estimates of FDI and *R&L* elasticities is re-enforced by the fact that the model used has allowed us to take apart the contribution of other factors that can help elucidate relative variation of *TFP*. As a matter of fact, other effects associated to relative development level, were object of statistical control.

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