Does foreign direct investment transfer technology across borders? New evidence ☆

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Abstract

Based on industry-level data of seventeen OECD countries we examine FDI as a potential channel for knowledge diffusion. We find that FDI-receiving countries benefit strongly from FDI-related knowledge spillovers. We do not find evidence for positive outward-FDI-related technology sourcing effects.
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1. Introduction

The analysis of potential channels for international knowledge diffusion has a long history. Since the early nineties, an increasing number of empirical studies have attempted to determine the extent to which trade is a source for knowledge spillovers (e.g. Coe and Helpman, 1995; Keller, 1999; Bitzer and Geishecker, 2006, to mention only a few). But the question of whether FDI is a channel for knowledge diffusion has received comparatively little attention. Research on this topic has remained limited to country studies (e.g. Blomström, 1986; Kokko, 1994) and micro-econometric analyses (e.g. Aitken and Harrison, 1999; Javorcik, 2004; Görg and Strobl, 2003).[1] To the best of our knowledge, the only panel country study analysing the role of FDI in international knowledge diffusion is that of van Pottelsberghe de la Potterie and Lichtenberg (2001) hereafter referred to as PL2001. Their most striking result is that inward FDI does not affect host country productivity via international R&D spillovers, while outward FDI into R&D-intensive countries, on the other hand, creates significant technology spillovers. Thus, based on their data, they conclude that FDI transfers knowledge in only one direction.

Using a newly compiled data set on ten manufacturing sectors in seventeen OECD countries during the period 1973–2000, we provide new evidence on the question of whether FDI transfers knowledge across boarders. Furthermore, we expand the approach of PL2001 in two directions. First, to account for FDI-related spillovers which might occur only in the medium or long run, we use FDI stocks instead of FDI flows for constructing our FDI-weighted foreign R&D capital stocks, as suggested by PL2001.[2] Second, we expand the focus of PL2001 beyond bilateral FDI-related spillovers to account for third-country effects, capturing, for example, knowledge flows from country C into country B, and then via country B's FDI

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[1] For reviews of the literature, see Görg and Greenaway (2004), Keller (2004).

[2] See PL2001, p. 492.

into country A.[3] Our main finding is that it is inward FDI that acts as a channel for knowledge spillovers. In contrast to PL2001, we do not find evidence for positive FDI-related technology sourcing effects. In addition, we are able to show that for non-G7 countries, the output elasticity of outward-FDI-weighted foreign R&D capital is negative.

2. Empirical implementation and estimation technique

In order to answer the question of whether FDI transfers technology across borders, we use industry data on seventeen OECD countries in the time period 1973–2000.[4] We apply the following standard Cobb–Douglas production function approach:

$$\ln Q_{cit} = \alpha_i + \beta_1 \ln S_{ct}^{d} + \beta_2 \ln S_{ct}^{fm} + \beta_3 \ln S_{ct}^{ff} + \beta_4 \ln S_{ct}^{ft} \qquad (1)$$
$$+ \beta_5 \ln K_{cit} + \beta_6 \ln L_{cit} + \beta_7 \ln M_{cit} + \alpha_t D^{t} + v_{cit},$$

where Q is gross output, S^{d} is the domestic R&D capital stock of the manufacturing sector, S^{F} is the external foreign R&D capital stock, L is labour, K is physical capital, M is material and intermediate inputs and D^{t} is a full set time dummies. Subscripts i, c, and t denote sectors, countries, and years respectively.

The physical, domestic R&D and FDI capital stocks are constructed using the perpetual inventory method with an assumed depreciation rate of 10%. The initial stocks are estimated using the procedure described in Goto and Suzuki (1989).

The import-weighted R&D capital stock S^{fm} is obtained using the following formula:

$$S_{ct}^{fm} = \frac{m_{ct}}{Q_{ct}} \sum_{l \neq c} S_{lt}^{d}, \qquad (2)$$

where m_{ct} denotes imports.

We use FDI capital stocks rather than flows in the construction of the FDI-weighted foreign R&D capital stocks because stocks capture medium and long-run effects of knowledge diffusion. We take third-country effects into special consideration. Take for example a situation where a multinational's headquarters is in country B, but its R&D department is at a subsidiary in country C. Even if country C does not invest in country A, its knowledge may be transferred to country A via FDI from country B.[5] We account for this effect by weighting the world-wide foreign R&D capital stock with the overall investment activity of foreigners in the receiving country. The overall investment activity of foreigners is measured as the ratio of the total inward FDI capital stock (f_{ct}^{in}) to the total domestic physical capital stock (k_{ct}). Formally, the inward-FDI-weighted foreign R&D capital stock is constructed as follows:

$$S_{ct}^{ff} = \frac{f_{ct}^{in}}{k_{ct}} \sum_{l \neq c} S_{lt}^{d}. \qquad (3)$$

Besides third-country effects, inter- and intrasectoral spillovers from FDI are captured.[6]

The outward-FDI-weighted foreign R&D capital stocks are constructed analogously to the inward FDI-weighted foreign R&D capital stocks so as to capture third-country effects in knowledge absorption. We measure a country's investment activity abroad as its total outward FDI capital stock (f_{ct}^{out}) in relation to its total domestic physical capital stock (k_{ct}) and use this relation to weight the foreign R&D capital stock:

$$S_{ct}^{ft} = \frac{f_{ct}^{out}}{k_{ct}} \sum_{l \neq c} S_{lt}^{d}. \qquad (4)$$

The empirical assessment is based on the model given by Eq. (1). The estimations have been carried out as FGLS, with a correction for panel-specific autocorrelation of the form AR(1) and panel heteroscedasticity, fixed effects and a set of time dummies. Unit root tests indicated that all time series are trend-stationary. Furthermore, endogeneity tests could not reject the hypothesis that inputs are exogenous.[7]

3. Results

We estimate Eq. (1) using different specifications (see Table 1). In Column I, the sole transmission channel is assumed to be imports. In Column II inward FDI is added, and in Column III inward and outward FDI are added as further transmission channels. Furthermore in columns IV to VI, we control for the possibility that G7 countries face different output elasticities than other countries, as proposed by Coe and Helpman (1995). To this end, all transmission mechanisms are interacted with a dummy variable, which takes on the value of one if the country is one of the G7 countries.

The output elasticities of the traditional input factors physical capital (K), labour (L), and material and intermediate inputs (M) have the expected signs and are highly significant in all specifications. The same is true for domestic R&D capital stock (S^{d}), but columns IV to VI show that non-G7 countries benefit more from the domestic R&D capital stock than G7 countries. One possible interpretation of this result is that knowledge exhibits decreasing returns to scale. In accordance with other studies (e.g. Coe and Helpman, 1995; Bitzer and Geishecker, 2006),

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[3] A similar point is made by Lumenga-Neso et al. (2005) regarding trade.

[4] A detailed description of the data is given in an appendix available upon request.

[5] Consider the following real-world example. Opel, a former German car manufacturer and today a subsidiary of GM, has its European headquarters in Switzerland, where no R&D is carried out. The majority of Opel's R&D is carried out in Germany. If Opel invests in Eastern Europe the FDI would be accounted as coming from Switzerland. However, no R&D is carried out at the headquarters. Indeed, any positive knowledge spillover via the FDI would be due to the R&D carried out by Opel in Germany. This indirect impact would not show up in a specification using bilateral FDI shares.

[6] The use of alternative weighting schemes as proposed for example by Lichtenberg and van Pottelsberghe de la Potterie (1998) and in Guellec and van Pottelsberghe de la Potterie (2004) cannot be implemented, because bilateral industry-level FDI data are not available for the time period and aggregation level used.

[7] The details of the unit root and endogeneity tests performed, as well as the test results, are described in an appendix available upon request.