Does industry-level analysis of trade-related technology spillovers support the conclusions obtained at an aggregate level?. Evidence for non-G7 countries

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Version: May 2008

Abstract

One of the main characteristics of endogenous growth theory is the possibility of international diffusion of technology, which in turn might have a positive impact on economic growth. A review of the literature shows a general agreement about the existence of global positive technology spillovers, but there is no unique or robust conclusion about their magnitude. In this sense, most of the literature focus on an aggregate level analysis of international technology spillovers, while few exceptions include a disaggregated perspective, all concerning the innovations leaders countries, and their findings are mixed. This paper contributes to the literature by analyzing, from an industry-level point of view, the international trade-related technology spillovers from the technology leaders (G7 countries) to a group of countries that lies behind them, providing new evidence of the key role of an industry-level analysis.

The paper focuses on the trade of intermediate inputs as a channel for international technology spillovers. In a first stage we estimate the technology embodied in the production of technology leader countries following the literature about intersectoral technology flows. Next, we calculate the exports from one industry in a technology leader country to each of the industries of a given trade partner. We estimate these flows using industry-level bilateral trade data and the import Input-Output tables of trade partners. The combination of both estimations results in a measure that captures the technology embodied in bilateral industry trade of intermediate inputs. Finally, we use an extended Cobb-Douglas neoclassical production function to analyze the impact of international trade-related technology spillovers on industries' productivity.

Keywords: trade-related R&D spillovers, industry R&D spillovers, international technology transfer, productivity.

1.- Introduction

The modern endogenous growth theory set up the framework for the recent literature concerning the key role of technology as a mayor driving force of economic growth (Romer, 1986, 1990; Grossman and Helpman, 1991, Aghion and Howitt, 1992). One of the main implications of these models is the possibility of international diffusion of innovations in an open economy setting[1]. The main idea is that innovations developed in one country might be transferred to other economies and have a positive effect over its economic growth. The literature refers to this indirect effect of the foreign innovation activity as international technology spillovers and points out several channels through which this might happen including trade of goods, use of patents, alliances between firms or institutions, transnational firm activities and mobility of R&D employees.

Coe and Helpman (1995) were the pioneers in analyzing the international diffusion of technology, focusing in the bilateral trade channel. They provide evidence of a positive and significant impact of foreign R&D over domestic productivity for OECD countries and Coe et al (1997) find similar evidence for developing countries, both at an aggregate level. This finding has been tested by several authors, who propose alternative approaches related to the measures and econometric techniques used (Keller, 1998; Lichtenberg and van Pottersberghe, 1998; Kao, Chiang and Chen, 1999, Lumenga-Neso et al, 2005). So far, only two papers have undergone industry level analysis, both focused on mainly technology leader countries. Keller (1997)[2] concludes that there are significant positive spillovers, but they are mainly domestic and intraindustry, although there is a small impact coming from foreign R&D. Moreover, Sakurai et al. (1997) study the industry and country differences finding mixed and heterogeneous results in both dimensions when running country and sector specifications.

The review of this literature shows that there is a general agreement about the existence of global R&D trade-related spillovers, but there is no unique or robust conclusion about the magnitude, the pattern of that diffusion and how they can be measure in order to be tracked. Moreover their effect on productivity is neither automatic nor costless and the results are sensitive to multiple factors and interactions that must be considered.

Besides the lack of adequate data, one of the explanations for the shortage of conclusive results concerning international R&D spillovers is that they do exist, but they are positive and significant only in some industries, and therefore the results for the aggregate economy might not the interesting ones, as they might reflect an average impact that gives a incomplete picture of the real influence of spillovers on economic performance. This actually is something that Sakurai et al. (1997) pointed out in their study for 10 OECD countries, but there is no evidence for countries outside that group.

This paper contributes to the literature by analyzing, from an industry level, the patterns of technology diffusion thought trade from the technology leaders in terms of R&D

[1] Authors as Masnfiel (1972), Terleckyj (1974) and Griliches (1979) had formerly made important contributions to the study of technology diffusion and economic growth, but from a domestic perspective.
[2] This refers to a working paper latter published in 2002 with the same title.

expenditures, to a group of countries that lies behind them in that sense, at least from an aggregate point of view. The new data allows constructing a more accurate measure of trade-related R&D spillovers and the country sample can shed some light on the patterns of technology transfer to a set of countries that shows different situations in terms of innovation activity and economic development and that so far haven't been studied from an industry perspective. In particular, the aim of the paper is to provide some empirical evidence about what can the industry level add to the aggregate economy analysis in terms of trade-related R&D spillovers.

The remainder of the paper is organized as follows. Section two summarizes some important theoretical considerations. Section three describes de methodology used to obtain the measure of trade-related R&D spillovers that will be tested in an extended Cobb-Douglas neoclassical production function to analyze the impact of international trade-related technology spillovers on industries' productivity. The empirical implementation is contained in section four, where I will describe the data set and present the preliminary results, included some preliminary conclusions, discussion of the caveats and suggestion for some directions for future work.

2.- Theoretical considerations

Technological progress is related to the development of innovations, meaning, the process of introduction of new or improved good in the market, as well as a reduction in the costs through improvements in the production process. This definition of innovation leads to a distinction between innovations related to products and those related to the productive process. In this sense, trade related spillovers defined above will, therefore, show mainly product innovations although in an empirical sense it is difficult to clearly delimitate the boundaries due to the interactions among product and process type of innovations.

From another point of view Griliches (1979) introduced an important distinction between rent and knowledge spillovers[3]. Rent spillovers arise because the price of a product doesn't fully adjust for quality improvements, leading to an increase in the ratio quality/price that results in spillovers for the firms that use that product as intermediate input. This is a consequence of two circumstances. First, due to the market structure, innovating firms, under competitive pressure, are not fully able to increase the prices of their products proportionally to the improvements in quality. Second, deflactors methodology shows measurement problems to adjust for the changes in quality/price ratio consequence of quality improvements. Therefore, these spillovers are related to economic transactions and, in that sense, they can be consider embodied spillovers, as they are implicit in the goods traded.

Knowledge spillovers are related to the fact that the knowledge associated to an innovation isn't fully appropriated by the innovation agents and others can "use" that knowledge without paying the full cost of it. They can happen through different channels as the use of patent information, researchers and skilled labor mobility, scientific publications and so on. Therefore, knowledge spillovers don't have to be

[3] Some authors refer to the knowledge spillovers defined by Griliches as pure knowledge spillovers.

necessarily related to economic transactions as in the case of rent spillovers and we can think about them as disembodied spillovers.

Once the concept of spillover is defined we need to construct an empirically measure innovation activity and hence the spillovers related to it. The pioneer works of Terleckyj (1974), Griliches (1980), Mansfield (1980), Scherer (1982) or Griliches and Lichtenberg (1984) for US case introduced the existing two basic approaches to the subject. The first one uses expenditures (or stock) of R&D as a measure of the effort that an agent does to improve the technology available. This is an input variable, it is related to the investment in developing new technologies but not in the results of that activity and, consequently, it has some drawbacks when used to capture technology spillovers. From the conceptual point of view, not all the R&D efforts turn out into innovations and, thus, we might be overestimating the innovation activity, moreover, this varies from industry to industry. But there are some aspects that imply an underestimation; first, R&D expenditures underestimate the technology efforts conducted by small firms where there this activity is not isolated in accounts or employee's functions. Second, the R&D efforts in service sector are still poorly covered by official statistics, although recent efforts have been done to improve the quality of theses data. The alternative approach uses an output measure of innovation activity like patents. But patents neither fully capture the innovations activity because, for instance, not all innovations are protected by a patent because this is not always the best option to protect the intellectual property of an innovation. Actually, there are different criteria among countries in the process and requirements for granting patents. Finally it should be stressed out that both, R&D expenditures or patents, fail to some extend to entirely capture the economic value of innovations as not all the patents or expenditures has the same value in terms of the innovations.[4]

Even though the theoretical distinction between rent and knowledge spillovers is clearly depicted, the literature shows some difficulties when trying to empirically identify them, mainly because the variables used to measure R&D spillovers captures both types to some extend. In this sense, R&D expenditures reflect primary embodied rent spillovers related to economic transactions, but these transactions also can involve some knowledge spillovers.[5] For instance, if we focus on international trade related spillovers, trade of goods that content innovations imply an improvement in the technology pool available in the host economy and therefore it can involve knowledge spillovers. Concerning patents, their use is closer to the analysis of knowledge spillovers although the can also reflect rent spillovers to some extend.

The interindustry dimension of technology spillovers raises the question of up to what point one sector can benefit for the innovations developed in the rest of the economy. The empirical literature includes different options to measure how the technology developed in the economy one particular industry's technology pool. The baseline equation defines the total technology efforts related to a particular sector "Si" as a weighted sum of the R&D efforts conducted in each sector of the economy (j).

$$S_i = \sum w_{ij} RD_j \quad (1)$$

[4] For a deeper discussion about the use of patents and R&D expenditures as a measure of the innovation effort see Griliches (1990), Naridi (1993) and Patel and Pavitt (1995).

[5] See Cincera and De la Potterie (2001) for a recent survey.

The key question is how to define the weight matrix wij. From the point of view of the type of information used, there are two general approaches, related to the use of either interindustry trade or patent information[6]. The first option estimates the relationships using input-output matrices (Terleckyj, 1974), implying that the transfer of technology among sectors is proportional to the intermediate (or capital) good trade. Therefore, we will be reflecting primary rent interindustry spillovers related to economic transactions. The approach focus in patents information can derive in different weight matrixes. Scherer (1982) construct an input-output table that contents the industry of origin of one patent and the user industries of that patent. This approach tends to stress transaction-based linkages and, therefore, captures mainly rent spillovers. Verspagen (1997) develops an alternative use of patent information that yields to a patent information input-output table that differs from Scherer one because it can be related to pure knowledge spillovers instead of rent spillovers[7]. Finally, Jaffe (1986) constructs a technological proximity matrix that relates the technological closeness (implying a higher probability of technological spillovers) of two firms or industries based on the coincidence of the classes of their patents. This kind of matrix tries to capture the non-traded knowledge spillovers.

Finally, the international perspective of technology spillovers brings up the issue of international relationships. Focusing in the trade related spillovers, the seminar work of Coe and Helpman (1995) defines the foreign technology advances available in a country as a import-share weighted average of the domestic R&D efforts conducted by trade partners, in a similar equation to the interindustry one (equation 1), but now referring to countries instead of firms or industries. Therefore, S_i is the host country R&D received from abroad embodied in goods, RD_j is the R&D efforts in the trade partner and w_{ij} is the weight matrix, that in the case of rent trade related spillovers will content bilateral import shares ($w_{ij}= M_{ij}/M_i$).

This approach has some disadvantages, quoted by Coe and Helpman themselves[8], related to the ability of w_{ij} to capture the intensity of the R&D embodied in trade relationships. Van Pottelsberghe de la Potterie (1997) suggest an alternative specification for the weighting matrix $w_{ij}= M_{ij}/Q_i$ in an attempt to better reflect the potential embodied technology spillovers related to international trade. In this paper I will follow this approach more appropriated for a sectoral analysis, in an attempt to control the differences in terms of size among sectors.

3.- Metodology

The literature focus on estimating technology spillovers is build on the hypothesis that R&D expenditures diffuses proportionately to the intensity of relationships between firms/sectors/countries.

That intensity is usually related to a weighting matrix, for which there are several options. In this paper we will use trade of intermediate inputs and thus, we will focus on trade of intermediate inputs as a channel of international technology diffusion.

[6] See Los and Verspagen (2007) for further detail on this classification.
[7] See Verspagen (1997) for a comparative analysis between both matrixes.
[8] Coe and Helpman (1995), pp. 863.

The aim of the methodology is to obtain a measure of the total R&D embodied in exports of country p from industry i to industry j in country d. The measure will be a combination of two dimensions: The particular R&D intensity of the production in each trade partner country and the bilateral industry trade intensity between country d and its trade partners. As there is no enough data available to take into account the intersectoral trade in capital goods, the paper will focus in intermediate goods trade.

In a first stage we estimate the technology embodied in the production of technology leader countries following the literature about intersectoral technology flows. Next, we calculate the exports from one industry in a technology leader country to each of the industries of a given trade partner. We estimate these flows using industry-level bilateral trade data and the import Input-Output tables of trade partners. The combination of both estimations results in a measure that captures the technology embodied in bilateral industry trade of intermediate inputs. Finally, we use an extended Cobb-Douglas neoclassical production function to analyze the impact of international trade-related technology spillovers on industries' productivity.

☞*R&D embodied in industry exports of G7 countries (by producer industry)*

Concerning the first dimension, we want to have a measure of the technology embodied in production, as exports are part of it. A first approach to the measurement of the R&D embodied in production is to calculate output's R&D intensity, assuming that the R&D embodied production is mainly conducted in the own industry.

$$r_j = {R\&D_j}/{x_j} \qquad (2)$$

But the literature about technology spillovers recognize the existence of intersectoral transmission of technology, so if we want to analyze the product-embodied international transfer of technology this should include not only the R&D related to industry's efforts but also the improvements incorporated through intermediate inputs.

This approach built on the literature about intersectoral R&D flows that uses Input Output tables to estimate the total content of R&D in one unit of final demand output (in this sense exports are part of this final demand production).

This approach assumes that technology can be transferred through intermediate inputs trade and, thus, the technology embodied in a final product can include some technology developed by other industries.

Taking into account this possibility there are two alternatives to measure the R&D content using as a stating point the square matrix of inter-industry trade of intermediate inputs: Input or output coefficients. The choice between them will depend on our assumption concerning the degree of public good that we assign to R&D[9].

In the first case, we assume that the gains that a sector j can obtain from the R&D conducted by suppliers is proportional to their relative importance, in terms of

[9] Wolff E. and Naridi, I. (1993) or Los, B. and Verspagen (2007) include a deeper analysis of the implicit assumptions of both types of direct coefficients.

intermediate inputs, in the sector j input structure. Thus, we assume that R&D is a "public good" in the sense that it can benefit several sectors simultaneously. The more important one particular input is in the productive function of one sector, the more it will benefit from the R&D conducted in the supplier sector.

Output coefficients assume that the R&D that one sector can transfer to another is proportional to the output that former sells to the latter. Contrary to the input coefficient, we presume that the benefits of R&D are "industry specific", in the sense that if one sector sells an amount of output to another sector, it implicitly transfers a proportion of its technology to that particular sector.

From another point of view, Input-Output tables, through the inverse matrixes of the direct coefficients mentioned, can take into account not only the first round of technology flows but also include the indirect and induced effects of intersectoral relations. In this respect, we are assuming that the technology embodied in one good is the result of an accumulation process of interindustry trade.

In this paper I will use input direct coefficients, focusing in the final content of R&D of a unit produced from the point of view of the user and its production function and trying to avoid overestimating the R&D content due to the reverse effect. Moreover, a priori it is less likely that second and following rounds of indirect transfer of technology will have a significant impact in the final technology content of production in one particular industry[10].

Therefore we can define the total technology content of one unit produced by sector j as the aggregation of the direct and indirect content:

$$tir_j = r_j + ir_j \qquad (3)$$

The direct content will be the industry R&D effort measured by the R&D intensity defined in equation 1, and the indirect content of technology of production in sector j will be a function of the R&D expenditures in sector i (relative to its output) and the importance in sector j's input structure (a_{ij}).

$$r_{ij}^* = \langle r_i \rangle * a_{ij}^* \qquad (4)$$

Where a_{ij}^* refers to the coefficients of the technical coefficients matrix A, but where we have set the principal diagonal equal to cero to avoid double counting. If we add up by columns the values for r_{ij}^*, we will obtain a measure of the indirect technology content in each unit produced by sector j.

Indirect R&D spillovers: $$ir_j = \sum_i r_{ij}^* \qquad (5)$$

The choice of embodied R&D intensity will be then multiply by the value of bilateral industry exports. For a given country "p", the total R&D embodied in its exports from industry j to country "d" (EXP_{jpd}) can be defined as:

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[10] This approach is used by Wolff and Naridi (1993), that only compute first (direct) and second-round of indirect input coefficients.

$$TRDE_{jpd} = tr_{jp} * EXP_{jpd} \tag{6}$$

☞***Industry imports by trade partner (G7) for non G7 countries***

The optimal approach will be to use the information content in bilateral import Input-Output tables, but these tables are not available. Thus, we will estimate the distribution of the imports of each non G7 country by user industry by means of the information included in the import IO table for each non G7 country.

Estimation of how much does industry "j" in country "c" imports from industry "i" of cuntry "p"

Using the Input-Output table for imports for a given country "d", we derive a similar matrix that shows the industry of use's share of total imports from each industry of origin:

$$W_d = \begin{bmatrix} w_{11d} & .. & w_{1kd} \\ .. & .. & .. \\ w_{j1d} & .. & w_{jkd} \end{bmatrix} \tag{7}$$

Thus, W_d shows by rows the distribution, by using industry, of imports produced in sector "j" overseas and by columns the imports done by each domestic industry. The shortcoming of this matrix for our purposes is that it accounts for the total imports and we need to have information about the sectoral breakdown by country (and industry) of origin of imports. We will assume that the distribution of imports by industry of use is common to all trade partners[11]. Note that this doesn't imply that the imports come in equal proportion from each trade partner. These differences are captured by industry exports statistics taken into account in the calculation of the R&D embodied in exports.

The calculated shares will be used as weights to distribute the total R&D content of each trade partner exports to country d, obtaining a matrix for each pair of trade partners (p and d) that shows the total R&D embodied in imports with an industry and partner dimension:

$$S_{pd} = \begin{bmatrix} S_{11pd} & .. & S_{1kpd} \\ .. & .. & .. \\ S_{j1pd} & .. & S_{jkpd} \end{bmatrix} \tag{8}$$

Where $S_{jkpd} = w_{jkd} * TRDE_{jpd}$

[11] This can be in some way interpreted as if there is perfect substitution among the country of origin of imports.

In this paper we focus on the industry perspective of international technology, and thus, we will add up the measure obtained to an aggregation that will show the global imported R&D by industry of use for each non G7 country:

$$TRD_{kd} = \sum_j \sum_p S_{jkpd} \quad (9)$$

☞ ***Framework for the impact analysis: Production functions***

The macroeconomic analysis literature follows two approaches to empirically address the impact of technology over economic performance, using production or cost functions[12]. In this paper we will follow the first option as it is more convenient for the data used.

Therefore we will relate a measure of economic performance (productivity) with the spillover measure previously calculated, besides de classical production factors, in line with the work of Griliches (1979), who introduced the technology spillovers as a source of technological change. Latter, Grossman and Helpman (1991) also take into account the role of trade in economic growth, setting the theoretical framework for the seminar empirical work on trade and technology spillovers developed by Coe and Helpman (1995).

We will use a production function approach based on an extended Cobb-Douglas neoclassical production function:

$$Y_{kdt} = A_{kdt} K_{kdt}^{\alpha_K} L_{kdt}^{\alpha_L} M_{kdt}^{\alpha_M} \quad (10)$$

where i refers to the industry and t to the period of time, Y is the gross output, K the capital input, L the labour input, M intermediate inputs and A the technology component.

If we divide both sides of the above equation by L and substitute production by value we can rewrite (10) in the following way[13]:

$$y_{kdt} = A_{kdt} (k_{kdt})^{\alpha} \quad (11)$$

where y_{kdt} is labour productivity and k_{kdt} is the labour-capital intensity.

Focusing again in the technology component or total factor productivity, A, we will defined it as $A_{kdt} = \phi e^{\lambda t} R_{kdt}^{\gamma}$, where $e^{\lambda t}$ is an exogenous parameter of technological change and R is a function of the measure obtained for the international technology spillovers (TRD_{kdt}).

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[12] For a discussion on the use of those approaches see eg. Nadiri 1993.

[13] In this equation the standard hypotheses apply and we have, homogeneous inputs and outputs, constant returns to scale (Σα=1), competitive behaviour and profit maximizing levels of factors of production other than R&D.

In this respect, we will divide TRD_{kdt} by the industry value added, leading to a measure of the share of foreign embodied knowledge related to the industry total value added[14].

$$trd_{kdt} = \frac{TRD_{kdt}}{GVA_{kdt}} \tag{12}$$

Taking logarithms we obtain

$$\ln y_{kdt} = \lambda + \gamma \ln trd_{kdt} + \alpha_K \ln y_{kdt} \tag{13}$$

4.- Empirical implementation

4.1.- Definition of variables and data sources

The data set employed in the implementation is obtained mainly from two sources, OECD Databases and Groningen Development Center EU KLEMS Database. In particular, OECD provides figures for R&D expenditures for G7 countries (ANBERD Database), bilateral trade (Bilateral Trade Database), Input Output tables (Input-Output Database). The structural variables variables used are derived using STAN Database from OECD and EUKLEMS Database[15].

For the employment data I have used the number of employees, as there are not complete data available for fulltime equivalent employees or worked hours with the desegregation used in the paper. The export data has been deflated using output prices due to the lack of industry proper deflators and Input-Output tables have been used in current terms and refers to 2000 or closer year.

Finally, physical capital stock has been calculated applying Permanent Inventory Method to Gross Fixed Capital Formation data (deflated by GFCF prices), assuming a depreciation rate of 10%, following the mainstream literature[16].

The sample of the empirical application is limited by the available data for some sectors, mainly in terms of R&D expenditure and Gross Fixed Capital Formation, and consist in nine OECD countries (Austria, Belgium, Denmark, Finland, Ireland, The Netherlands, Norway, Spain and Seden), besides the G7 countries used as source of

[14] The lack of proper rates of obsolescence of R&D capital and of the lag structure relating R&D expenditure to current increases in technological knowledge makes interesting to use alternative measures as R&D intensity. Griliches (1973) and Terleckyj (1974) reparametrize the standard model, common elasticities one, in terms of a common rate of return across industries. They show an equivalence between this concept and the use of the rate of growth of R&D capital, under the assumption of 0% depreciation rate for R&D capital.

[15] The main source of data is EUKLEMS due to the existence of quality corrected prices, although we have used alternatives sources to estimate some blanks.

[16] Verspagen (1996) and Lee (2006) are examples of papers that use the same rate for OECD countries.

technology transfer (Canada, France, Italy, Japan, UK and US), and covers manufacturing industries at a two digit level[17] over the period 1992-2002. All the prices are chain-price indexes, with reference year 1995.

Place table 1 here

4.2.- Preliminary results

Assuming a linear function of the equation defined and expressing the model in growth rates, we will estimate a panel data model for the following the final specification:

$$\Delta \ln y_{dt} = c_d + \beta_1 \Delta \ln k_{dt} + \beta_2 \Delta \ln trd_{dt} + \varepsilon_{dt} \quad (14)$$

Where c_d is the constant term, β_1 is the elasticity of labour-capital intensity, β_1 is the rate of return to the international technology spillovers measure, and ε_{kt} is the error term.

Table 2 shows the results obtained for each industry regression based on correlates panels corrected standard error estimations (PCSEs). I have run Wooldridge test for serial correlation, Modified Wald test for group heteroskedasticity and Breush and Pagan test LM of independence to test their presence on each industry. Most of them only show heteroskedasticity problems.

Place table 2 here

The results obtained show that in general terms the measure developed of technology potentially transferred through imports from G7 countries has a positive and significant impact over labour productivity in most of the sectors, but the explanation power of the regressions is relatively low.

In particular it results interesting that our measure is not significant for sectors 33, 34 and 35, which are high technology sectors and thus, one would expect to find the higher relationship in them. Although these results need a deeper analysis, one of the possible explanations is the lack of appropriate information to construct a stock measure of R&D, which could affect these sectors in particular. Also the lack quality adjustment of prices for several countries for GFCF industry deflator might cause a higher bias in these sectors. Finally, the lack of longer historical data (I only have data for ten years) affects the results, especially in terms of the significance tests.

[17] Due to the lack of data for several countries the application excludes industry 23 (Coke, Refined Petroleum Products and Nuclear Fuel).

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6.- List of tables

Table 1. Description of industry breakdown

ISIC code	*Description*
15-16	Food products, beverages and tobacco
17-19	Textiles, textile products, leather and footwear
20	Wood and products of wood and cork
21-22	Pulp, paper, paper products, printing and publishing
24	Chemicals and chemical products
25	Rubber and plastics products
26	Other non-metallic mineral products
27	Basic metals
28	Fabricated metal products, except machinery and equipment
29	Machinery and equipment, n.e.c.
30	Office, accounting and computing machinery
31	Electrical machinery and apparatus, nec
32	Radio, television and communication equipment
33	Medical, precision and optical instruments
34	Motor vehicles, trailers and semi-trailers
35	Other transport equipment
36-37	Manufacturing nec; recycling

Table 2. Estimation results

Industry		*Capital Stock per worker*	*Technology transferred by trade*	R^2
15-16	Food products, beverages and tobacco	0,63 (0,09)***	0,21 (0,08)***	0,48
17-19	Textiles, textile products, leather and footwear	0,36 (0,08)***	0,13 (0,08)	0,33
20	Wood and products of wood and cork	0,31 (0,09)***	0,20 (0,09)***	0,25
21-22	Pulp, paper, paper products, printing and publishing	0,26 (0,07)***	0,26 (0,07)***	0,28
24	Chemicals and chemical products	0,26 (0,09)***	0,17 (0,09)**	0,24
25	Rubber and plastics products	0,38 (0,11)***	0,21 (0,08)***	0,32
26	Other non-metallic mineral products	0,22 (0,08)***	0,19 (0,11)**	0,22
27	Basic metals	0,22 (0,08)***	0,28 (0,14)**	0,19
28	Fabricated metal products, except machinery and equipment	0,19 (0,08)***	0,37 (0,09)***	0,39

29	Machinery and equipment, n.e.c.	0,34 (0,10)***	0,37 (0,11)***	0,43
30	Office, accounting and computing machinery	0,24 (0,22)	0,92 (0,36)***	0,10
31	Electrical machinery and apparatus, nec	0,54 (0,13)***	0,27 (0,12)**	0,31
32	Radio, television and communication equipment	0,10 (0,14)	0,50 (0,16)***	0,11
33	Medical, precision and optical instruments	0,31 (0,09)***	0,10 (0,09)	0,18
34	Motor vehicles, trailers and semi-trailers	0,26 (0,09)***	0,31 (0,11)	0,28
35	Other transport equipment	0,44 (0,09)***	0,05 (0,04)	0,24
36-37	Manufacturing nec; recycling	0,26 (0,09)***	0,31*** (0,11)	0,28

Notes: t-test statistics reported in parentheses, *, 10% significance level, **5% significance level ***1% significance level