International Technology Diffusion and the Demand for Skilled Labor: Evidence from East Asia and Latin America

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Abstract

This paper presents new plant-level evidence on the effects of access to international technology diffusion on the demand for skilled workers using data from Investment Climate Surveys performed by the World Bank in Asia and Latin America. Our findings suggest that in Brazil, China and Malaysia foreign direct investment and technology licensing are associated with greater demand for skilled labor, probably because they act as a channel for the diffusion of skilled biased technology developed in industrialized countries. In contrast, exports are negatively related to the demand for skilled workers in China and Malaysia, and to a lesser extent in Brazil, which is consistent with international sales leading to a greater degree of specialization according to the countries' comparative advantage in unskilled labor intensive goods. Finally, imported inputs lead to greater demand for skilled workers in Brazil and Malaysia but the opposite occurs in China, reinforcing the possibility that the specialization of Chinese plants in the production of goods intensive in the use of unskilled labor has more than countervailed the greater access to foreign technology potentially associated with international sales.

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1. Introduction

Among the hypotheses that have been proposed for explaining the increase in earnings differentials between skilled and unskilled workers observed in the United States during the 1980s, two have received outmost attention: the increase in trade with developing countries and skill-biased technological change. The first hypothesis postulates that during this period industrialized countries witnessed considerable increases in imports of unskilled-labor-intensive manufacturing products from developing countries which were liberalizing their trade regimes and facilitating foreign direct investment (FDI).[1] The second hypothesis relates the increase in the demand for skilled workers to the intensification of the use of computers and other related technologies that are relative complements to skilled labor.[2]

From the point of view of developing countries, the hypothesis that globalization has caused an increase in specialization according to comparative advantage should lead to an effect that is opposite to the one observed in industrialized countries. Indeed, according to traditional trade theory, in developing countries a greater participation in international markets should be associated with the exploitation of comparative advantage in goods that are intensive in unskilled labor. This should cause a shift in demand towards this type of workers, and lead to a reduction in the wage differential with respect to their skilled counterparts. However, in the context of the second hypothesis highlighted above, the same international economic activities that are often associated with the exploitation of comparative advantage – the use of imported inputs, exports and FDI – could also act as channels for the international diffusion of skill-biased technologies developed in industrialized countries, which in principle could diminish or even compensate for the shifts in labor demand caused by increased specialization. In other words, while in industrialized countries the labor demand effects of greater international integration and those of skill-biased technological change can be safely assumed to reinforce each other, in developing countries both factors probably operate in opposite directions and empirical evidence is needed to determine which tends to prevail. The present paper attempts to provide evidence on that question, by estimating the net effect of the use of imported inputs, exports and foreign direct investment on the relative demand for skilled workers, using manufacturing plant level data from three developing countries – Brazil, China and Malaysia – which have recently experienced significant increases in their level of international integration.

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[1] See Wood (1994).

[2] See Berman, Bound and Griliches (1994), Autor, Katz and Krueger (1998).

Previous empirical work on the U.S. and other OECD countries has generally found skilled-biased technological change to be more important than trade as the main factor underlying the above mentioned labor demand shifts. Thus, a small share of the observed changes in the demand for skilled labor can be attributed to a reallocation of production towards skill-intensive sectors – as the trade hypothesis would predict. Rather, it appears that most of the shift away from unskilled labor has taken place within narrowly defined industries, a result that is consistent with the hypothesis of skill-biased technical change. Moreover, studies using industry and plant level data have found a direct link between the relative demand for skilled workers and investments in the adoption of computers or in research and development (R&D).[3] However, these studies have been less successful in uncovering the hypothesized effects of exports, imports and investment flows on the demand for skilled labor.[4]

The evidence for developing countries is more scarce. In Mexico, the relative wages of skilled workers increased dramatically after the country liberalized its trade regime and relaxed restrictions on foreign direct investment in the early 1980s. Feenstra and Hanson (1997) show that the states and industries that received more FDI exhibit a greater demand for skilled labor, a finding that they interpret as consistent with a model in which production outsourcing from an industrialized to a developing country raises the demand for skilled labor in both.[5] Using plant level data for the late 1980s, Harrison and Hanson (1999) find that Mexican exporters and foreign owned companies tend to employ a higher share of skilled workers, and so do plants that use more imported inputs and machinery. Pavcnik (2002) analyses panel data on Chilean manufacturing plants during the early 1980s. She finds that when fixed effects or time differencing are used, the use of imported materials, patented technology and foreign technical assistance appear to be unrelated to the demand for skilled labor. She also reports positive effects for those three

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[3] See Berman et al (1994), Autor et al. (1998), Machin and Van Reenen (1998), Doms, Dunne and Troske (1997), Dunne, Haltiwanger and Troske (1997), Haskel and Heden (1999).

[4] Slaughter (2000) and Bloningen and Slaughter (2001) find no important effects of respectively outward and inward FDI in the U.S. Feenstra and Hanson (1996) encounter a significant link between the demand for skilled labor and outsourcing (defined to encompass imports and contract work overseas) but this is not consistent with the findings of Autor et al. (1998), who obtain non-significant results for the link between skill upgrading and manufacturing imports and outsourcing – although a positive effect is found for exports.

[5] In the model proposed by Feenstra and Hanson (1996b), a single final good is produced with a continuum of intermediate inputs, which are traded between two countries, "North" and "South", with relative abundance of skilled and unskilled labor, respectively. The North specializes in inputs that are relatively intensive in skilled labor while the reverse is true for the South. A flow of capital from North to South leads to a shift of production activities to the South. Those activities are relatively intensive in unskilled labor by Northern standards, but they use more skilled labor than other inputs previously produced in the South, so that the relative wage of skilled labor increases in both countries.

variables when using the cross-sectional variation in the data, which she interprets as reflecting unobserved plant heterogeneity driven, for example, by different degrees of managerial ability which affect both the adoption of foreign technology and the demand for skilled labor. Finally, Gorg and Strobl (2001) use panel data on Ghanaian manufacturing plants to estimate the effect of exports and the use of imported machinery on the demand for skilled workers. They find that the latter is unrelated to export activity, but positively linked to the use of imported machinery that was purchased for the purpose of technological progress.

As mentioned above, this paper focuses on estimating the effect on labor demand of three types of international activities. The first type is the use of imported intermediate inputs, which are thought to act as a channel for the international diffusion of technology, provided that they embody state-of-the-art technologies not available domestically.[6] Moreover, in their contacts with foreign suppliers importers may gain access to tacit, non-codified forms of knowledge, which are not transferable by means of market transactions. However, as noted by Keller (2004), even though the use of imported inputs may give rise to international spillovers associated with the fact that they cost less than its opportunity costs – including the R&D cost of development – only the manufactured outcome of the technology, and not the technology as such, becomes available in the importing country, which makes this a "weak form of technology diffusion".[7] Moreover, as argued above, one could also expect that within a given industry, those firms that make a greater use of imported inputs also choose to concentrate in the stages of the production process in which the country has comparative advantage. For instance, companies located in export-processing zones tend to import skill-intensive intermediate inputs and concentrate on unskilled-labor-intensive assembly operations.

The second international activity on which we focus is exporting. As in the case of importers, one can also argue that within a given industry and in the context of a country with relative abundance of unskilled workers, exporters are more likely to "play to their strengths" and thus specialize in goods or stages of the production process that make a more intensive use of unskilled labor. On the other hand, exporters may be pressured by their foreign clients to produce according to quality standards that are higher than those prevailing in the domestic market, and they may also gain access to tacit information or even proprietary knowledge

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[6] See, for instance, the models of trade and endogenous growth in Grossman and Helpman (1991).

[7] Keller (2004), p. 8. The spillovers should be greater for imports from countries with larger R&D stocks, which has been to some extent confirmed in empirical studies. See, for instance, Coe, Helpman and Hoffmaister (1997), Xu and Wang (1999) and Lumenga-Neso, Olarreaga and Schiff (2001).

provided by their clients in order to help them meet those standards.[8] Thus, exporting may also act as a channel for international technology diffusion and, to the extent that the absorbed technology is biased towards skilled labor, firms with exporting activities could exhibit a greater demand for skilled workers – provided that this effect is not compensated by a greater degree of specialization according to comparative advantage.

In the case of foreign direct investment, international diffusion of technology can be expected to take place primarily through the sharing of firm-specific technology among multinational parents and subsidiaries.[9] In fact, the existence of knowledge-based firm-specific assets and the intrinsic difficulties associated with their market-mediated transfer – for instance through technology licensing – are factors that have been featured prominently in theories that attempt to explain the very existence of multinational enterprises.[10] A third factor that is often mentioned in order to explain the occurrence of FDI is the existence of location advantages in the host country. These advantages can be of two types: on one hand, high transport costs or tariff barriers are normally linked to the use of "horizontal" FDI as a substitute for exports, as means for reaching the markets of sufficiently large countries. On the other hand, when factor prices differ across countries, location advantages may also be related to the relatively low costs of unskilled labor or other factors of production, giving rise to the so-called "vertical" FDI.[11] As argued by Keller (2004), the extent of technology transfer to the host country is probably smaller in the latter type of FDI, which in the present context would imply a smaller impact on the demand for skilled labor.[12] However, as argued by Feenstra and Hanson, it is also possible that while the activities transferred through vertical FDI are unskilled-labor-intensive in the country where the headquarters are located, the affiliates' use of skilled labor is still higher than that of their domestic counterparts in the host country.

As mentioned above, multinational enterprises could also use licensing agreements with domestic companies as a way of reaching foreign markets without incurring in the costs of multinational production. However, although in our empirical exercise we also estimate the effects of this alternative on the demand for skilled labor, there are reasons to believe that its relative

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[8] See Clerides, Lach and Tybout (1998), Hallward-Driemeier, Iarossi and Sokoloff (2002), and Keller (2004).

[9] It is worth noting that even though FDI may lead to technology spillovers that benefit domestic firms and may thus affect their demand for skilled labor, the present paper focuses only on the direct effects of FDI and does not estimate spillover effects.

[10] See Markusen (1995).

[11] See Slaughter (2002).

[12] See Keller (2004).

importance as a form of international technology diffusion is limited. Indeed, the difficulties for fully codifying technological knowledge make its transfer particularly costly. In addition, both parts – the owner of the technology and the potential licensee – have incentives to reveal as little as possible of their private information regarding respectively the intrinsic virtues of the technology and its domestic market, which also increases the cost of writing technology licensing contracts.[13]

One factor that it is important to consider when analyzing the impact of international economic activities and other forms of international technology diffusion – and their possible effect on the demand for skilled labor – is the extent to which the firms developing those activities possess a sizable learning or absorptive capacity. As argued by Keller (1996), the lack of a minimum local critical mass of absorptive capacity may explain why some countries that have become outward-oriented have gained less than others in terms of access to international technology flows. As defined by Cohen and Levinthal (1989), the absorptive capacity of firms can be described as their "ability to identify, assimilate and exploit knowledge from the environment".[14] It encompasses both the ability to imitate new process or product innovations, and the capacity to use outside knowledge as the basis for internal innovative activities. The development of absorptive capacity, Cohen and Levinthal argue, is one of the motivations that firms have for investing in R&D. In accordance with this approach, we use the presence of R&D activities as a proxy for the existence of absorptive capacities at the plant level. In addition, in order to capture the learning capacity accumulated by firms in the processes of imitation and technology adoption – even if strictly defined R&D activities are not performed – we also consider the experience associated with the introduction of new product lines as a component of their absorptive capacity.

The rest of the paper is structured as follows. The next section presents both the theoretical model that we use as a framework and the empirical specification that we estimate. Section 3 describes the data and Section 4 reports regression results. Section 5 offers concluding remarks.

2. Theoretical Model and Empirical Specification

This section presents the theoretical framework that we use to investigate the effects of different forms of international technology diffusion on the demand for skilled labor. We assume that manufacturing plants choose their variable inputs - skilled and unskilled labor - by minimizing

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[13] See Markusen (1995) for a detailed review of the problems associated with technology licensing.

[14] Cohen and Levinthal (1989), p. 569.

a restricted variable cost function subject to an output constraint. For plant i, the minimum labor cost of producing value added VA_i given its capital stock K_i, which is a quasi-fixed input, its internal absorptive capacity, T_i^1, and its access to international technology diffusion, T_i^2, is given by:[15]

$$VC_i = f({w_i}^S, {w_i}^U, K_i, VA_i, T_i^1, T_i^2), \tag{1}$$

where ${w_i}^S$ is the wage paid to skilled workers and ${w_i}^U$ is the wage paid to unskilled workers.[16] We use a translog functional form for logarithmic variable costs as in Berman, Bound and Griliches (1994):

$$\begin{aligned} \ln VC_i \;=\;& \beta_0 + \beta_S \ln {w_i}^S + \beta_U \ln {w_i}^U + \beta_K \ln K_i + \beta_V \ln VA_i + \beta_{T1} T_i^1 \;+ \\ & \beta_{T2} T_i^2 + 1/2\phi_{SS}(\ln {w_i}^S)^2 + 1/2\phi_{UU}(\ln {w_i}^U)^2 + 1/2\phi_{KK}(\ln K_i)^2 + \\ & 1/2\phi_{VV}(\ln VA_i)^2 + 1/2\phi_{T1T1}(T_i^1)^2 + 1/2\phi_{T2T2}(T_i^2)^2 + \\ & 1/2\phi_{SU}(\ln {w_i}^S * \ln {w_i}^U) + 1/2\phi_{US}(\ln {w_i}^S * \ln {w_i}^U) + \phi_{SK}(\ln {w_i}^S * \ln K_i) + \\ & \phi_{UK}(\ln {w_i}^U * \ln K_i) + \phi_{SV}(\ln {w_i}^S * \ln VA_i) + \phi_{UV}(\ln {w_i}^U * \ln VA_i) + \\ & \phi_{ST1}(\ln {w_i}^S * T_i^1) + \phi_{ST2}(\ln {w_i}^S * T_i^2) + \phi_{UT1}(\ln {w_i}^U * T_i^1) + \\ & \phi_{UT2}(\ln {w_i}^U * T_i^2) + \phi_{KV}(\ln K_i * \ln VA_i) + \phi_{KT1}(\ln K_i * T_i^1) + \\ & \phi_{KT2}(\ln K_i * T_i^2) + \phi_{VT1}(\ln VA_i * T_i^1) + \phi_{VT2}(\ln VA_i * T_i^2). \end{aligned} \tag{2}$$

Differentiating the cost function with respect to $\ln {w_i}^S$, using Shephard's lemma and making the assumptions of (i) symmetry of the effect of relative input prices on input demands and (ii) homogeneity of degree one in input prices, one obtains the following equation representing the relative demand for skilled labor:[17]

$$\frac{d \ln VC_i}{d \ln {w_i}^S} = \frac{{w_i}^S L_i^S}{VC_i} = \alpha + \phi_{SU} \ln(\frac{{w_i}^S}{{w_i}^U}) + \phi_{SK} \ln K_i + \phi_{SV} \ln VA_i + \phi_{ST1} T_i^1 + \phi_{ST2} T_i^2. \tag{3}$$

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[15] For simplicity, we ignore the plant's choice of intermediate inputs. Hence, output is measured by value added and the plant's variable costs are simply labor costs.

[16] Note that for clarity in the exposition, we describe T_i^1 as a single variable. However in our empirical implementation, T_i^1 will be a vector of 2 variables: an indicator variable for plants engaged in R&D and an indicator variable for plants introducing new product lines. Also, T_i^2 is in most specifications a single variable but in Section 4.6, we also allow T_i^2 to be a vector including several international technology diffusion variables.

[17] Shephard's lemma states that the derivative of the restricted cost function with respect to input X's price equals input X's demand. If X is skilled labor, the lemma states that $\frac{dVC}{dw^S} = L^S$. Multiplying and dividing this equality by $\frac{w^S}{VC}$, an elasticity expression is obtained: $\frac{dVC}{dw^S} * \frac{w^S}{VC} = \frac{w^S L^S}{VC}$. For our case of logarithmic variable costs, the following equality holds: $\frac{d \ln VC}{d \ln w^S} = \frac{dVC}{dw^S} * \frac{w^S}{VC} = \frac{w^S L^S}{VC}$. The assumption of symmetry of the effect of relative input prices on input demands implies $\phi_{SU} = \phi_{US}$. The assumption of homogeneity of degree one in input prices implies $\phi_{SU} = -\phi_{SS}$.

The dependent variable in Equation (3) is the wage bill share of skilled workers. A positive ϕ_{ST1} suggests that the plant's absorptive capacity is skill biased and a positive ϕ_{ST2} suggests that international technology diffusion is skill biased. Finally, a positive ϕ_{SK} indicates that capital and skilled labor are complementary. Constant returns to scale are verified if $\phi_{SK} = -\phi_{SV}$. However, we do not impose constant returns to scale in our main specification. We modify the way in which capital and value added enter the equation and estimate directly a parameter representing returns to scale.[18] Note that since cost shares sum to one, it is enough to consider the skilled labor cost share to represent the plants' labor demand decisions. To obtain an estimable equation, we add a stochastic error ε_i to Equation (3) representing e.g., measurement or optimization error. The estimable equation is given by:

$$\frac{{w_i}^S L_i^S}{VC_i} = \alpha + \beta_1 \ln(\frac{{w_i}^S}{{w_i}^U}) + \beta_2 \ln(\frac{K_i}{VA_i}) + \beta_3 \ln VA_i + \phi_{ST1} T_i^1 + \phi_{ST2} T_i^2 + \varepsilon_i. \qquad (4)$$

An econometric problem for the estimation of Equation (4) is the difficulty in identifying the effect of relative wages on the demand for skilled labor. The cross-sectional variation in relative wages is generally not exogenous (i.e., due to variation in actual prices of labor) but instead is often due to variation in the unobserved quality of labor. This problem could be addressed by using instrumental variables estimation, if instruments for the relative wage term were available. Following Berman, Bound and Griliches (1994), most researchers have estimated variants of Equation (4) dropping the relative wage term.[19] We also focus on estimation results that exclude the relative wage term, but we include industry and region dummies which may correct for systematic differences in the excluded term across industries and regions.[20]

Better plant managers are likely to have more access to international technology diffusion (e.g., by being more able to engage in exports and to attract foreign investment), have more absorptive capacity to use these advanced technologies but also choose more skilled workers. Omitting manager quality from the estimation could lead to a correlation between the error term in Equation (4) and variables T_i^1 and T_i^2 and hence an upward bias in the main coefficients of interest. To avoid this bias, we include a proxy for managerial quality, MQ_i, in the estimable

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[18] The expression $\phi_{SK} \ln K_i + \phi_{SV} \ln VA_i$ in Equation (3) is rewritten as $\beta_2 \ln(\frac{K_i}{VA_i}) + \beta_3 \ln VA_i$ in Equation (4) with $\beta_2 = \phi_{SK}$ and $\beta_3 = \phi_{SK} + \phi_{SV}$. Returns to scale are given by β_3.

[19] See, for example, Autor, Katz and Krueger (1998), Machin and Van Reenen (1998), Haskel and Heden (1999), Slaughter (2000). When using panel data, researchers have argued that time dummies can account for the variation in relative wages.

[20] These dummies also control for other systematic differences in the demand for skilled workers across industries or regions.

equations.[21]

Our final estimable equation for plant i in industry j and region r is therefore given by:

$$\frac{w_{ijr}^{S}L_{ijr}^{S}}{VC_{ijr}} = \alpha + \beta_2 \ln\left(\frac{K_{ijr}}{VA_{ijr}}\right) + \beta_3 \ln VA_{ijr} + \beta_4 T_{ijr}^{1} + \beta_5 T_{ijr}^{2} + \beta_6 MQ_{ijr} + I^{i} + I^{r} + \varepsilon_{ijr}. \quad (5)$$

Although not directly derived from the theoretical framework, we also consider alternative specifications where the dependent variable is the share of skilled workers in total employment instead of their share in the wage bill.

3. Data and Cross Tabulation Results

3.1 Data

Our paper focuses on manufacturing plants from Brazil, China and Malaysia. In Table 1, we present some major economic facts for these countries. The countries differ substantially in their per capita income levels, in their growth record in the 1990s, in their degree of openness as measured by import and export ratios to GDP and by the amount of FDI received as a percent of GDP and in the average level of education of their population. So, it is interesting to analyze the link between international technology diffusion and the demand for skilled labor for this diverse set of development experiences and outcomes.

Our analysis draws on survey data collected by the World Bank from manufacturing establishments in Brazil, China and Malaysia under the *Investment Climate Assessment* initiative.[22] The surveys applied a (mostly) common questionnaire covering a variety of topics (e.g., infrastructure, finance, etc.) to random samples of establishments and were implemented in partnership with local statistical institutes or local consulting firms in China in 2001 and in Brazil and Malaysia in 2003.[23] The random samples were drawn from a sampling frame of manufacturing establishments in each country.[24] The exact sample design varied from country to country. In Brazil, stratified samples based on industry-state-size were drawn. In Malaysia, stratified samples based on industry-region were drawn. In China, the sample was randomly chosen for

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[21] Note that our approach is imperfect to the extent that other omitted factors remain unaccounted for.

[22] More information on the initiative can be found at http://www.worldbank.org/privatesector/ic/.

[23] The questionnaires also included some country specific questions. For our purposes, the relevant questions in the survey relate to the workforce, technology and innovation, production and costs, ownership and trade and manager characteristics.

[24] In Brazil, the sampling frame consisted of the listings of manufacturing establishments provided by IBGE (statistical office). In China, the sampling frame consisted of an electronic list of firms in each of the five cities covered: Beijing, Tianjin, Shanghai, Guangzhou, and Chengdu. In Malaysia, the sampling frame consisted of the listings of manufacturing establishments from the Department of Statistics updated during the Economic Census of 2000.

each of five cities, subject to pre-determined constraints on the distribution by industry and size.

Although in all countries the surveys cover the entire range of firm sizes and cover firms in different industries and regions, the exact composition of the samples differs across countries. In Table 2, we show the distribution of plants across industries (Panel A) and across size groups (Panel B) for each country.[25] The apparel and electronics industries are covered in all countries. Large plants represent about a half of the sample for Brazil and Malaysia whereas for China the majority of plants in the sample are small.

The estimation of Equation (5) presents several challenges in terms of measurement: i) the measurement of skills, ii) the measurement of absorptive capacity and, iii) the measurement of international technology diffusion.

3.1.1 Skills Measures

Measures of skills are needed to construct the dependent variables in the regressions: wage bill shares and employment shares of skilled workers. Our surveys provide information on employment, wages and average number of years of education for five types of workers (management, professionals, skilled production workers, unskilled production workers and other nonproduction workers).[26] For all countries, we consider total wages and salaries (not including bonuses or other benefits) as measures of wages. Our first measure of skilled workers is based on occupation: nonproduction workers are defined to be the sum of management, professionals and nonproduction workers.[27] Most previous studies use datasets for which the skilled/unskilled workers distinction can be proxied only by this nonproduction/production worker distinction but this is imperfect since e.g., some of the workers counted as nonproduction workers are in fact engaged in low skilled tasks. Our second measure of skilled workers is also based on occupation but improves upon the nonproduction/production worker distinction: workers in managerial, engineering and technical occupations, defined as the sum of management and professionals.[28] This measure excludes the type of workers called in our surveys other nonproduction workers i.e., those that are not directly involved in production but that are neither part of management nor classified

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[25] Size groups are defined according to a plant's total number of permanent employees.

[26] A detailed definition of these five types of workers is available from the authors upon request.

[27] In this case, unskilled workers are production workers defined as the sum of skilled production workers and unskilled production workers.

[28] In this case, unskilled workers are workers in other occupations defined as the sum of skilled production workers, unskilled production workers and other nonproduction workers.

as professionals.[29] Our third measure of skilled workers is based on education: workers with some years of college education i.e. workers with more than 12 years of education, which is the number of years needed to complete secondary school in all countries.[30] For China and Malaysia, we use information on average educational levels for each type of workers. Skilled worker wage bill shares (employment shares) are defined as the sum of wages (number of workers) of all types of workers which have an average number of years of education strictly larger than the number of years needed to complete secondary school divided by the total wage bill (total number of employees).[31] For Brazil, only employment shares are available for this education-based measure of skills defined to be the percentage of workers with some college education as reported by the plant when characterizing the education profile of its workforce.

In Table 3 Panel A, we present summary statistics on wage bill shares and employment shares of skilled workers according to our three definitions for all countries. By definition, wage bill and employment shares of nonproduction workers are larger than those of workers in engineering, technical and managerial occupations but these are in turn larger than those of workers with college education. Also, for any given definition of skills, the average wage bill share is larger than the average employment share. Brazil has the lowest average shares of skilled workers according to all measures and China the highest, except for wage bill shares of workers with college education which are highest in Malaysia.

3.1.2 Technology Measures

Our surveys provide information on several plant-level observable measures of technology. As measures of a plant's capacity and effort in absorbing technology we use an indicator variable for plants that perform R&D (which can be viewed as an input into the knowledge production function) and an indicator variable for plants that introduce new product lines (which can be viewed as an output from the knowledge production function).[32]

As measures of international technology diffusion, we use an indicator variable for plants that export, the plants' share of sales that are exported, an indicator variable for plants that are foreign owned, the plants' foreign ownership share, an indicator variable for plants that

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[29] Examples of such workers would be janitors.

[30] In this case, unskilled workers are workers with less than college education defined as those that have 12 years of education or less.

[31] The implicit assumption made in constructing this measure is that all workers of a given type have exactly the average level of education of that worker type. Although this assumption may be strong, it is worthwhile to make it and obtain estimation results for a measure of skills based on education.

[32] This classification of technology measures follows Chennells and Van Reenen (1999).

import inputs, the plants' imported inputs share, an indicator variable for plants that license technology, the share of computer-controlled machinery (available only for Malaysia) and the share of information technology (IT) investment in total investment (available only for China). For Brazil and Malaysia, we use data on direct exports, i.e. those not done through a distributor, whereas for China we use data on total exports since the survey does not allow us to distinguish between direct and indirect exports. In Table 3 Panel B, summary statistics are shown for the different measures of absorptive capacity and international technology diffusion across countries.

3.1.3 Other Variables

Estimating Equation (5) also requires the use of plant-level data on sales and materials costs to construct value added, the book value of machinery and equipment as the measure of the capital stock, industry and regional dummies. To reduce the influence of extreme values, we drop from the estimation the top and bottom 1% of observations for the ratio of capital to value added in each industry.[33] The industry dummies are based on the industries shown in Table 2. The regional dummies represent 13 states in Brazil, 5 cities in China and 6 states in Malaysia. Finally, we rely on information on the plants' main manager level of education as a proxy for manager quality. In Brazil and China, we use a dummy variable for managers with secondary education, a dummy variable for managers with college education and a dummy variable for managers with graduate education. In Malaysia it is impossible to disentangle managers with college education from managers with graduate education, so we use a dummy variable for managers with secondary education and a dummy variable for managers with post-secondary education.

3.2. Cross-Tabulation Results

Table 4 presents cross-tabulations between measures of absorptive capacity or measures of international technology diffusion and the wage bill shares of different measures of skilled labor.[34] More specifically, for each country we calculate the difference between the average wage bill share of skilled workers for plants with better absorptive capacity and the average wage bill share of skilled workers for other plants. Also, we calculate the difference between the average wage bill share of skilled workers for plants with more access to international technology diffusion and the average wage bill share of skilled workers for other plants. We also test whether those

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[33] The elimination is done for each industry separately since industries differ significantly in their capital intensity.

[34] For Brazil and workers with college education, Table 4 shows employment shares instead of wage bill shares which are unavailable.

differences in averages are statistically significant and include those results in the table. For dummy variables, "better" absorptive capacity or "better" access to international technology diffusion means that the dummy variable is equal to 1 for the plant.

The results are presented in Table 4 for Brazil (Panel A), China (Panel B) and Malaysia (Panel C). In each panel, the rows correspond to different measures of absorptive capacity or international technology diffusion and the columns correspond to different skills measures. In Brazil, there is a positive and significant relationship between absorptive capacity or the access to more advanced technologies and the wage bill share of skilled workers, however skills are measured. In China, we find a generally positive and significant association between the wage bill share of skilled workers and both absorptive capacity and access to international technology diffusion.[35] However, when international technology diffusion is measured by exports, the association is negative and significant. In Malaysia, we find a positive relationship between absorptive capacity or the use of more advanced technologies and the wage bill share of skilled workers for all skills measures. However, this relationship is significant only in selected cases for nonproduction workers and workers in engineering, technical and managerial activities. These cross-tabulations point out to important differences in wage bill shares depending on the plant's absorptive capacity and its degree of access to international technology diffusion, which are interesting to pursue in a regression framework.

4. Regression Results

In this section, we discuss the results from estimating Equation (5) separately for each country by ordinary least squares (OLS) with standard errors corrected for possible heteroskedasticity (White correction). We present the results in Tables 5 through 14 organized by measure of international technology diffusion. In each table, the columns represent the dependent variables in the regressions (wage bill share and employment share of skilled workers) and the rows show, for each country, the coefficients and standard errors of the following regressors: absorptive capacity measures, international technology diffusion measures, and the logarithms of value added and the capital to value added ratio. Also shown are the R-squared and the number of observations for each regression.

4.1. Imported Inputs

Table 5 presents regression results for the estimation of equation (5) using as measure of ac-

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[35] There is an exception for the wage bill share of non-production workers and imported materials.

cess to international technology flows an indicator variable for plants that use imported inputs. In the case of Brazil, that measure has a positive and significant effect on the wage bill and employment share of skilled workers, regardless of the definition used for skilled labor. Quantitatively, the magnitude of the effects is largest in the case of the employment share of workers with college education, which increases by about 22% for plants that use imported inputs, and lowest for the shares of non-production workers, which increase by about 10% for those plants.[36] When expressed as elasticities, the effects are somewhat larger on employment shares compared to wage bill shares, which suggests that the relative wages of skilled workers may be slightly smaller among plants which use imported inputs, thus partially compensating for the effect of the latter on employment.

Very different results are encountered for China, where the use of imported inputs appears to have a negative effect on the employment shares of non-production workers, and workers in engineering, technical and managerial occupations. This suggests that the Chinese plants that use imported inputs may be concentrating to a larger extent than their competitors in production activities that are intensive in unskilled labor. The magnitude of these effects is similar to that of those found for Brazil, although with the reverse sign: relative to other plants, those that use imported inputs have employment shares that are 15% lower in the case of non-production workers, and 8% lower for workers in engineering, technical and managerial occupations. The finding that the effects on the corresponding wage bill shares are negative but not significant indicates that while plants that use imported inputs employ relatively fewer skilled workers, the wages that they pay to those employees are higher than in other plants.

The results for Malaysia are closer to those found in Brazil, as the coefficients on the dummy variable for imported inputs are always positive. Although the estimated coefficients are significant only when the education-based definition of skilled labor is employed, the magnitude of the effects is large. Indeed, the wage bill and employment shares of the workers with some college education are respectively 33% and 46% higher in plants that use imported inputs. As in Brazil, the finding that these effects are larger for employment compared to wage bill shares indicates that while employment of skilled workers is greater in plants with access to this form of technology diffusion, the wages they pay to skilled workers are relatively smaller.

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[36] These and other elasticities reported below are calculated as the ratio of the coefficient on the relevant indicator variable to the average of the corresponding skill share in the group of plants for which the indicator variable is zero – e.g. the ratio of the coefficient on the imported inputs dummy to the average wage bill share of college educated workers of the plants that do not employ imported inputs.

As an alternative to the use of an indicator variable, and to test the robustness of the results with that approach, in Table 6 we use the share of imported goods as a measure of the plants' access to foreign technology through the use of foreign intermediate inputs. The results are qualitatively similar to those reported in Table 5. Indeed, the use of imported inputs is associated with a greater demand for skilled workers in both Brazil and Malaysia, and with a lower demand for those workers in China. Most of these effects are found to be significant in Brazil and China, but in Malaysia they are restricted to the demand for workers with some college education.

Although our focus is on the role of the access to different forms of international technology diffusion, it is worth commenting briefly on the coefficients estimated for the other variables included in Equation (5). The variables that measure the plants' absorptive capacity, for instance, are expected to be positively related with the various measures of skill demand employed in the paper. In Brazil and China this is indeed the case when the indicator variable for R&D activities is employed, as this variable is estimated to have a positive and significant effect on all measures of skill demand. The second variable used as a measure of absorptive capacity, an indicator of whether the plant developed a major new product line during the years preceding the survey, is also found to be positive in all specifications estimated for Brazil and China. However, it is significant only in the latter country, and for the measures of skills that are based on the share of workers in engineering, technical and managerial occupations. In Malaysia the two variables that measure the plants' absorptive capacity are found to be mostly non-significant. The only exception is the coefficient on the dummy for new product lines which, contrary to expectations, is estimated to be negative and significant when the dependent variable is the employment share of workers in engineering, technical and managerial occupations.

The results for the capital to value added ratio and value added variables can be summarized as follows. The coefficients on the capital to value added ratio are negative in Brazil and China indicating substitutability between capital and skilled labor. In Brazil those coefficients are significant only when the dependent variable is the wage bill share or the employment share of workers in engineering, technical and managerial occupations. In China, significant negative coefficients are found for all measures of skills. In Malaysia, the coefficients on the capital to value added ratio are generally positive but they are significant only when the dependent variable is the wage bill share of nonproduction workers, or when the definition of skills is based on education.

The results for value added are not clear cut, as the sign of the corresponding coefficients alternates according to the specific measure of skills that is used. In Brazil, those coefficients are negative and significant, indicating decreasing returns to scale, when the dependent variable is the employment share of either nonproduction workers or workers in engineering, technical and managerial occupations. However, the opposite result is found when the dependent variable is the wage bill share of nonproduction workers. In China, the coefficients are negative and significant for three out of six dependent variables. Finally, in Malaysia they are positive and significant when the dependent variable is the wage bill or the employment share of engineers, technicians and managers, but the reverse result is obtained for the employment share of workers with some college education.

Although the corresponding coefficients are not reported in Table 5, all regressions include indicators variables that measure the level of education of the plants' general manager. The results confirm that those variables are relevant determinants of the demand for skilled workers, as plants that have more educated managers generally employ a greater share of workers in occupations that require greater skills, as well as workers with higher levels of schooling. In Brazil, this effect is found to be significant even for the comparison of plants whose managers have secondary as opposed to primary education. In China and Malaysia, however, the effect of the managers' education becomes significant only when the latter includes respectively graduate studies, or at least some college education. The findings on the role of the general manager's educational level, as well as that of the plants' absorptive capacity, and the logs of value added and the ratio of capital to value added do not vary considerably when alternative measures of access to international technology flows are employed.

4.2. Exports

In Tables 7 and 8, we report the estimates of Equation (5) when an export dummy or export shares are used to measure international technology diffusion. In Brazil, we find different results depending on whether the export dummy or export shares are used. The results in Table 7 with the export dummy suggest that exporters demand in general more skilled workers. In elasticity terms, the positive and significant effect of the export dummy on skill demand is larger for the employment share of workers with college education (24%) than for the employment share of workers in engineering, technical and managerial occupations (13%) or the wage bill share of nonproduction workers (8%). These findings could be viewed as evidence of a role of exports in transmitting skill-biased technology. Note however that when the dependent variable is the employment share of nonproduction workers, the export dummy has actually a negative effect. Also, the results in Table 8 with export shares indicate that plants with higher export shares have lower wage bill shares and lower employment shares of skilled workers and the effects are significant when the dependent variable is either employment shares of nonproduction workers or employment shares of workers in engineering, technical and managerial occupations. This would suggest that, in fact, exporters are specializing in relatively unskilled labor-intensive products according to their comparative advantage. To gain a better understanding of these disparate results, we also estimate Equation (5) including a different set of export dummies: a dummy for plants exporting none or up to 10% of their output, a dummy for plants exporting between 10% and 50% of their output and a dummy for plants exporting more than 50% of their output. The estimates indicate that plants with export shares up to 50% demand relatively more skilled workers, while plants exporting a majority of their output demand relatively less skilled workers.[37] So, it appears as if the results with the export dummy in Table 7 are driven by "minority" exporters whereas the results with export shares in Table 8 are driven by "majority" exporters. Overall, we are unable to draw clear-cut conclusions for Brazilian exporters and the exploitation of these results is the subject of ongoing research.

In China the results are unambiguous compared to Brazil. We find evidence of a negative and significant effect of the export dummy and of export shares on wage bill shares and employment shares of skilled workers for all definitions of skilled labor.[38] Plants that participate in export markets demand relatively less skilled workers. More specifically, those plants have wage bill shares of nonproduction workers that are 50% lower than in non-exporter plants, and have employment shares of nonproduction workers and wage bill shares and employment shares of workers in engineering, technical and managerial activities that are more than 30% lower than those in non-exporter plants. This evidence suggests that Chinese plants are specializing according to their comparative advantage, in unskilled labor-intensive activities and this effect more than compensates for any impact that exporting may have in terms of technology diffusion. In elasticity terms, the effects of the export dummy are larger (more negative) for employment

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[37] These regression results are available from the authors upon request.

[38] Only one exception occurs in terms of significance when the dependent variable is the wage bill share of workers with some college and the export dummy is included.

shares than for wage bill shares which could indicate that while employment of skilled workers is lower their wages may be larger in exporter plants than in other plants.

The results for Malaysia are qualitatively similar to those for China and show generally a negative effect of the export dummy and of export shares on the relative demand for skilled workers. When significant, this effect implies employment shares of nonproduction workers and employment shares of workers in engineering, technical and managerial occupations that are 19% lower in exporter plants than in other plants. Hence, it appears as if exports have only a weak (if any) role as a vehicle for knowledge transfer, as the main effect of exports is the specialization in production that is relatively intensive in unskilled labor. The smaller size and the lack of significance of the effect of exports on wage bill shares suggests, in contrast to the findings for imported inputs in Section 4.1, that exporter plants employ relatively fewer workers but pay them higher wages than non-exporter plants.

As mentioned in Section 3, we use measures of direct exports for Brazil and Malaysia. Measuring direct exports is conceptually attractive if one is interested in capturing the potential effect of exporting activities as a channel for technology diffusion: if exporter plants are directly involved in the process of exporting, they are more likely to benefit from knowledge transmission and technology sharing from foreign buyers. So, our use of direct exports could be working in the direction of finding evidence of skill-biased technology diffusion through exports. But that does not seem to be the case in Brazil and Malaysia. Also, when we run the same regressions for Brazil and Malaysia using total exports (direct plus indirect), we obtain results that are very similar to those in Tables 7 and 8.

4.3. Foreign Ownership

The results for the specifications that employ a dummy variable for foreign ownership as a measure of access to international technology flows are reported in Table 9. In the cases of Brazil and China, the evidence shows that plants with foreign ownership exhibit a significantly larger demand for skilled workers, regardless of how the latter are specifically defined – the only exception being the specification with the employment share of nonproduction workers. The magnitude of these effects is large, particularly in Brazil and especially when the focus is placed on the demand for workers in engineering, technical and managerial occupations, or on the demand for workers with college education. As an example, for Brazilian plants the presence of at least some foreign ownership is estimated to be related with employment shares of those two types of workers that are respectively 52% and 65% larger than those in their domestic competitors. Similarly, Chinese plants that report having foreign ownership are estimated to have wage bill shares and employment shares of workers with college education that are respectively 38% and 29% larger than those found in domestically-owned plants.

In Malaysia, however, the foreign direct investment (FDI) indicator variable is not found to have significant effects on the demand for skilled workers. This suggests that in that country either the presence of foreign ownership is not an important channel for gaining access to foreign technology, or the technology that is transferred is not biased towards skilled labor. Alternatively, it is possible that plants with foreign ownership exploit to a greater extent than their competitors the country's comparative advantage in goods that are intensive in the use of unskilled labor, and that this counteracts the effect of FDI on technology transfer.

In order to test the robustness of these findings, we report in Table 10 the results of a specification in which the foreign ownership share is used as a measure of access to international technology flows. The results are qualitatively very similar to those obtained with the dummy for foreign ownership. Indeed, in Brazil FDI is still associated, in most cases, with a greater demand for skilled labor, and the same is true for China, although these effects are now significant for only two of the dependent variables. In Malaysia, the foreign ownership share now exhibits a positive and significant effect on the wage bill share of workers with college education, but its effect is still not significant for the other measures of skilled labor.

4.4. Technology Licensing

Table 11 shows the results from estimating Equation (5) using an indicator variable for plants that use licensed technology as a measure of international technology diffusion.

In Brazil, technology licenses have a positive but statistically non-significant effect on the demand for skilled labor, regardless of how the latter is defined.

In China, the results are very similar to those in Brazil, i.e., plants with technology licenses appear to have a relatively higher demand for skilled labor. This effect is significant for some dependent variables: wage bill shares of nonproduction workers or wage bill shares of workers in engineering technical and managerial occupations. Quantitatively, the effects suggest that plants using licensed technology have wage bill shares of nonproduction workers that are 9% higher than those in other plants and have wage bill shares of workers in engineering technical and managerial occupations that are 13% higher than those in other plants.

In the case of Malaysia, the impact of technology licenses on the demand for skilled workers is also generally positive. The effect is significant when the dependent variable measures skills based on workers' education. Quantitatively, the effects in Malaysia are much stronger than in the other countries: in plants using licensed technology, wage bill shares of workers with college education are 45% higher and employment shares of workers with college education are more than 100% higher than those in other plants.

4.5. Other Measures of International Technology Diffusion

Table 12 presents the results from estimating Equation (5) using two additional measures of international technology diffusion: computer-controlled machinery in Malaysia and the share of IT investment in total investment in China. The results indicate that Malaysian plants with higher shares of computer-controlled machinery have a higher demand for skilled workers, but the impact is significant only when the dependent variable is the employment shares of workers in engineering, technical and managerial occupations. Chinese plants with higher shares of investment in IT have a significantly higher demand for skilled workers for all skills measures. These findings suggest that the diffusion of computerized technology is biased towards skilled workers.

4.6. Multiple Measures of International Technology Diffusion

Our analysis in Sections 4.1-4.5 has considered the effect of each alternative channel of international technology diffusion on the demand for skilled labor in manufacturing plants in Brazil, China and Malaysia. Kraay, Soloaga and Tybout (2001) argue that these various channels for international technology diffusion are not independent, rather they are highly interrelated, so focusing on one channel of knowledge diffusion and ignoring the others may over or underestimate its true effects.[39] For this reason, we also estimate our main specification considering several measures of international technology diffusion.

Table 13 shows the results from regressions that include an imported inputs dummy, a foreign ownership dummy, an export dummy and a technology licensing dummy as measures of technology diffusion. In Brazil, the estimates indicate that imported inputs, exports, foreign ownership and technology licenses contribute to a higher demand for skilled labor. The signs and significance of these coefficients are very similar to those described in Sections 4.1-4.4 with

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[39] Also, Harrison and Hanson (1999) and Pavcnik (2002) include simultaneously different technology and international integration variables in their regressions of relative wages or wage bill shares.

individual knowledge transmitting measures. In China, there is a negative effect of imported inputs and exports on the demand for skilled labor but a positive effect of foreign ownership and technology licenses on that demand. Again these findings parallel those from the regressions including one measure at a time. In Malaysia, the findings suggest that imported inputs, foreign ownership and technology licenses have a positive impact on the demand for skilled labor whereas exports have a negative effect. However, many of the coefficients on international technology diffusion measures are not significant. So, both the direction of the effects and their significance are in line with those in Sections 4.1-4.4.

Table 14 presents the regression results where imported inputs shares, foreign ownership shares, export shares and technology licensing dummies are included as measures of international technology diffusion. In Brazil, we find that imported inputs, foreign ownership and technology licenses lead to a higher demand for skilled labor but exports lead to a lower demand for skilled labor. These findings are again very close to those in Sections 4.1-4.4. In China, the results suggest that there is a negative effect of imported inputs and exports on wage bill shares and employment shares of skilled workers and a positive effect of foreign ownership and technology licenses on those shares. Again these findings are similar to those with individual technology diffusion measures. In Malaysia, imported inputs and technology licenses affect positively the demand for skilled labor and exports affect it negatively. The findings for foreign ownership are mixed: in some cases the effect is positive in others it is negative and in all cases it is not significant. The results for FDI shares alone in Table 10 were also mixed. Hence, the findings are consistent with those for individual international technology diffusion measures.

5. Conclusion

Besides the static gains associated with increased international specialization, one of the most important benefits that developing countries can potentially reap from their increasing levels of integration in the world economy is the access to technologies developed in other countries. Indeed, the intrinsic difficulties associated with transferring technology through market transactions make international trade and investment the most important channels for the international diffusion of technology. Since most of the international income gaps are related to technology and productivity gaps, increases in international economic integration are expected to go a long way towards reducing the enormous inequalities existing between rich and poor nations.

But what about the effects of greater international integration on the high levels of inequality that are usually found in developing countries? The evidence from research conducted for the U.S. and other industrialized countries suggests that skilled biased technological change has been the main factor driving increases in inequality between skilled and unskilled workers. Thus, one could fear the same effects in developing countries, as they increasingly adopt technologies developed for the industrialized world. However, as firms based in developing countries expand their international economic activities, one could also expect a greater exploitation of their countries' comparative advantage in the production of goods that make intensive use of unskilled workers. This should lead to a greater demand for that type of labor, and could thus counteract the effects that a greater adoption of skill biased technologies could exert on local levels of wage inequality.

In order to investigate the relative weight of those two countervailing forces associated with increased international integration, this paper has obtained new plant-level evidence on the effects of access to international technology diffusion on the demand for skilled workers. Our findings suggest that in Brazil, China and Malaysia foreign direct investment and technology licensing are associated with greater demand for skilled labor, probably because they act as a channel for the diffusion of skilled biased technology developed in industrialized countries. In contrast, exports are negatively related to the demand for skilled workers in China and Malaysia, and to a lesser extent in Brazil, which is consistent with international sales leading to a greater degree of specialization according to the countries' comparative advantage in unskilled labor intensive goods. Finally, we find that the use of imported inputs leads to a greater demand for skilled workers in Brazil and Malaysia but the opposite occurs in China, reinforcing the possibility that the specialization of Chinese plants in the production of goods intensive in the use of unskilled labor has more than countervailed the greater access to foreign technology that is potentially associated with international sales.

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Table 1. Economic Facts

	Population (mil.) (2002)	GNI pc (US$) (2002)	GDP Growth (avg. 1992-2002)	Exports/ GDP (avg. 1993-2002)	Avg. Growth in Real Exports (1993-2002)	Imports/ GDP (avg. 1993-2002)	FDI/GDP (avg. 1991-2000)	Avg. Years Education of Population (2000)
Brazil	175	2830	2.7	9.5	7.5	10.3	2.4	4.9
China	1281	950	9.0	23.3	16.0	20.9	4.6	6.4
Malaysia	24	3540	5.3	103.9	9.3	93.9	6.1	6.8

Source: World Development Indicators, World Bank.

Table 2. Composition of the Samples

Panel A - Distribution of Plants across Industries

	Brazil	China	Malaysia
Food processing	8%		23%
Textiles	6%		3%
Apparel	27%	22%	12%
Shoes and leather products	11%		
Chemicals	5%		4%
Machinery and equipment	11%		9%
Electronics	5%	39%	8%
Auto-parts	8%	22%	4%
Furniture	19%		
Electrical appliances		17%	9%
Rubber and plastics			28%
N. observations	1603	994	879

Panel B - Distribution of Plants across Size Categories

	Brazil	China	Malaysia
Plants with less than 50 employees	19%	60%	24%
Plants with 50 to 150 employees	28%	27%	27%
Plants with more than 150 employees	53%	13%	48%

Note: the definition of size is based on the total number of permanent employees at a plant.

Table 3. Summary Statistics

Panel A. Measures of Demand for Skilled Workers

	Brazil		China		Malaysia	
	Avg.	St.dev.	Avg.	St.dev.	Avg.	St.dev.
<u>Wage bill shares of:</u>						
Nonproduction workers	0.32	0.18	0.46	0.24	0.40	0.20
Workers in engineering, technical and managerial occupations	0.22	0.15	0.39	0.23	0.29	0.19
Workers with some college			0.11	0.23	0.23	0.25
<u>Employment shares of:</u>						
Nonproduction workers	0.22	0.14	0.38	0.24	0.24	0.17
Workers in engineering, technical and managerial occupations	0.11	0.09	0.28	0.21	0.12	0.11
Workers with some college	0.08	0.10	0.09	0.19	0.12	0.19

Panel B. Measures of Absorptive Capacity and International Technology Diffusion

	Brazil	China	Malaysia
% of plants doing R&D	44.7%	42.4%	18.1%
% of plants introducing new product lines	67.5%	22.1%	28.2%
% of plants importing inputs	44.2%	41.4%	53.6%
Avg. imported input share	11.0%	13.8%	30.7%
% of plants exporting	27.0%	44.0%	54.4%
Avg. export share	6.4%	23.4%	30.8%
% of plants with foreign ownership	5.4%	31.1%	32.8%
Avg. foreign owership share	4.5%	18.1%	24.2%
% of plants licensing technology	7.3%	13.4%	6.1%
Avg. % of IT investment in total investment		7.9%	
Avg. % of computer-controlled machinery			23.8%

Note: Averages of imported input shares, export shares, and foreign ownership shares include the zeros.

Table 4. Differences in the Share of Skilled Workers, by Plants' Absortive Capacity and International Activities

Panel A. Brazil

Technology Variable	Wage bill sh. non-production workers		Wage bill sh. engin., techn. and managers		Empl. sh. some college	
R&D	0.05	***	0.03	***	0.03	***
New Product Lines	0.04	***	0.03	***	0.02	***
Use of Imported Materials	0.06	***	0.05	***	0.04	***
Exports	0.07	***	0.04	***	0.05	***
Foreign Ownership	0.17	***	0.14	***	0.11	***
Technology licensing	0.06	***	0.05	***	0.04	***

Panel B. China

Technology Variable	Wage bill sh. non-production workers		Wage bill sh. engin., techn. and managers		Wage bill sh. some college	
R&D	0.13	***	0.12	***	0.12	***
New Product Lines	0.09	***	0.10	***	0.09	***
Use of Imported Materials	-0.01		0.01		0.07	***
Exports	-0.06	***	-0.05	***	0.00	
Foreign Ownership	0.03	**	0.05	***	0.05	***
Technology licensing	0.08	***	0.08	***	0.08	***

Panel C. Malaysia

Technology Variable	Wage bill sh. non-production workers		Wage bill sh. engin., techn. and managers		Wage bill sh. some college	
R&D	0.04	**	0.02		0.09	***
New Product Lines	0.02		0.01		0.09	***
Use of Imported Materials	0.04	***	0.02	**	0.12	***
Exports	0.01		0.01		0.10	***
Foreign Ownership	0.02	*	0.01		0.12	***
Technology licensing	0.04		0.02		0.15	***

Note: The asterisks are the result of tests of equivalence of means in skill shares. * represents significance at 10%; ** significance at 5%; ***

Table 5. Imported Inputs Dummy as a Measure of International Technology Diffusion

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man. occ.	Empl. eng., tech. and man. occ.	Wage some college	Empl. some college
Brazil	R&D	0.028 ***	0.032 ***	0.019 **	0.018 ***		0.017 ***
		(0.010)	(0.008)	(0.008)	(0.005)		(0.005)
	New product line	0.012	0.012	0.010	0.006		0.008
		(0.010)	(0.007)	(0.008)	(0.005)		(0.005)
	Imported Inputs	0.026 ***	0.022 ***	0.020 **	0.015 ***		0.014 ***
		(0.010)	(0.008)	(0.008)	(0.004)		(0.004)
	K/VA	-0.005	-0.003	-0.006 **	-0.004 **		0.000
		(0.004)	(0.003)	(0.003)	(0.002)		(0.002)
	VA	0.012 ***	-0.005 *	-0.001	-0.011 ***		0.002
		(0.003)	(0.002)	(0.002)	(0.001)		(0.002)
	R squared	0.176	0.158	0.115	0.160		0.278
	N. obs.	1377	1387	1377	1387		1385
China	R&D	0.078 ***	0.062 ***	0.072 ***	0.048 ***	0.054 ***	0.042 ***
		(0.015)	(0.015)	(0.014)	(0.012)	(0.015)	(0.012)
	New product line	0.022	0.020	0.034 **	0.035 ***	0.018	0.020
		(0.016)	(0.016)	(0.015)	(0.013)	(0.018)	(0.016)
	Imported Inputs	-0.028	-0.060 ***	-0.004	-0.023 *	0.023	0.001
		(0.017)	(0.016)	(0.016)	(0.014)	(0.016)	(0.014)
	K/VA	-0.026 ***	-0.023 ***	-0.026 ***	-0.026 ***	-0.015 ***	-0.014 ***
		(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
	VA	-0.009 *	-0.004	-0.013 ***	-0.010 ***	0.001	0.005
		(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
	R squared	0.279	0.281	0.308	0.347	0.329	0.325
	N. obs.	899	902	899	902	899	902
Malaysia	R&D	0.023	0.009	0.019	0.008	0.014	-0.007
		(0.021)	(0.017)	(0.019)	(0.010)	(0.026)	(0.019)
	New product line	-0.005	-0.021	-0.012	-0.016 *	0.006	-0.008
		(0.018)	(0.014)	(0.016)	(0.008)	(0.024)	(0.018)
	Imported Inputs	0.021	0.015	0.010	0.000	0.053 **	0.037 **
		(0.018)	(0.014)	(0.016)	(0.010)	(0.021)	(0.016)
	K/VA	0.011 *	0.004	0.006	-0.001	0.028 ***	0.012 *
		(0.007)	(0.005)	(0.006)	(0.004)	(0.008)	(0.007)
	VA	-0.002	0.000	-0.012 **	-0.011 ***	0.013 **	0.007
		(0.006)	(0.004)	(0.005)	(0.003)	(0.007)	(0.005)
	R squared	0.128	0.109	0.112	0.111	0.256	0.137
	N. obs.	631	643	631	643	571	581

Note: All regressions include industry and region dummies and dummies for the level of education of the plant manager. Robust standard errors in parenthesis. * represents significance at 10%; ** significance at 5%; *** significance at 1%.

Table 6. Imported Inputs Share as a Measure of International Technology Diffusion

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man. occ.	Empl. eng., tech. and man. occ.	Wage some college	Empl. some college
Brazil	R&D	0.029 ***	0.033 ***	0.020 **	0.018 ***		0.018 ***
		(0.010)	(0.008)	(0.008)	(0.005)		(0.005)
	New product line	0.014	0.013 *	0.011	0.006		0.008 *
		(0.010)	(0.007)	(0.008)	(0.005)		(0.005)
	Imported Inputs	0.037	0.049 **	0.046 **	0.053 ***		0.024 *
		(0.026)	(0.021)	(0.022)	(0.014)		(0.013)
	K/VA	-0.005	-0.003	-0.006 **	-0.004 **		0.000
		(0.004)	(0.003)	(0.003)	(0.002)		(0.002)
	VA	0.013 ***	-0.004 *	-0.001	-0.011 ***		0.003
		(0.003)	(0.002)	(0.002)	(0.001)		(0.002)
	R squared	0.173	0.157	0.115	0.166		0.276
	N. obs.	1377	1387	1377	1387		1385
China	R&D	0.069 ***	0.050 ***	0.066 ***	0.041 ***	0.055 ***	0.043 ***
		(0.015)	(0.015)	(0.014)	(0.012)	(0.015)	(0.012)
	New product line	0.022	0.020	0.033 **	0.035 **	0.019	0.021
		(0.016)	(0.016)	(0.015)	(0.014)	(0.018)	(0.016)
	Imported Inputs	-0.107 ***	-0.131 ***	-0.064 **	-0.063 ***	0.015	0.005
		(0.028)	(0.026)	(0.026)	(0.022)	(0.027)	(0.023)
	K/VA	-0.024 ***	-0.023 ***	-0.025 ***	-0.026 ***	-0.015 ***	-0.014 ***
		(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
	VA	-0.008 *	-0.005	-0.011 ***	-0.010 ***	0.003	0.005
		(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)
	R squared	0.287	0.284	0.314	0.350	0.326	0.321
	N. obs.	893	896	893	896	893	896
Malaysia	R&D	0.023	0.012	0.018	0.009	0.023	0.001
		(0.022)	(0.018)	(0.020)	(0.010)	(0.027)	(0.019)
	New product line	-0.007	-0.020	-0.018	-0.018 **	0.002	-0.008
		(0.018)	(0.015)	(0.016)	(0.009)	(0.024)	(0.018)
	Imported Inputs	0.022	0.026	0.004	0.005	0.066 **	0.059 **
		(0.023)	(0.019)	(0.021)	(0.013)	(0.029)	(0.025)
	K/VA	0.013 *	0.005	0.007	0.000	0.032 ***	0.014 **
		(0.007)	(0.005)	(0.006)	(0.004)	(0.008)	(0.007)
	VA	-0.001	0.000	-0.012 **	-0.011 ***	0.014 **	0.006
		(0.006)	(0.004)	(0.005)	(0.003)	(0.006)	(0.005)
	R squared	0.134	0.111	0.118	0.113	0.260	0.143
	N. obs.	622	634	622	634	563	573

Note: All regressions include industry and region dummies and dummies for the level of education of the plant manager. Robust standard errors in parenthesis. * represents significance at 10%; ** significance at 5%; *** significance at 1%.

Table 7. Export Dummy as a Measure of International Technology Diffusion

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man. occ.	Empl. eng., tech. and man. occ.	Wage some college	Empl. some college
Brazil	R&D	0.030 ***	0.033 ***	0.020 **	0.019 ***		0.018 ***
		(0.010)	(0.008)	(0.008)	(0.005)		(0.005)
	New product line	0.014	0.014 *	0.011	0.007		0.008 *
		(0.010)	(0.007)	(0.008)	(0.005)		(0.005)
	Exports	0.025 **	-0.005	0.028 ***	0.004		0.016 **
		(0.012)	(0.010)	(0.010)	(0.006)		(0.006)
	K/VA	-0.005	-0.003	-0.006 **	-0.004 **		0.000
		(0.004)	(0.003)	(0.003)	(0.002)		(0.002)
	VA	0.010 ***	-0.003	-0.004	-0.011 ***		0.001
		(0.003)	(0.003)	(0.003)	(0.002)		(0.002)
	R squared	0.174	0.153	0.116	0.153		0.277
	N. obs.	1377	1387	1377	1387		1385
China	R&D	0.076 ***	0.060 ***	0.069 ***	0.046 ***	0.052 ***	0.040 ***
		(0.015)	(0.015)	(0.014)	(0.012)	(0.015)	(0.012)
	New product line	0.024	0.024	0.034 **	0.037 ***	0.017	0.020
		(0.016)	(0.016)	(0.015)	(0.013)	(0.018)	(0.016)
	Exports	-0.047 ***	-0.073 ***	-0.038 **	-0.048 ***	-0.016	-0.024 *
		(0.017)	(0.017)	(0.016)	(0.014)	(0.016)	(0.013)
	K/VA	-0.025 ***	-0.023 ***	-0.024 ***	-0.025 ***	-0.013 **	-0.013 ***
		(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
	VA	-0.007	-0.003	-0.010 **	-0.007 *	0.005	0.008 **
		(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
	R squared	0.283	0.286	0.313	0.355	0.328	0.327
	N. obs.	899	902	899	902	899	902
Malaysia	R&D	0.020	0.013	0.015	0.011	0.010	-0.008
		(0.021)	(0.017)	(0.019)	(0.010)	(0.027)	(0.019)
	New product line	-0.002	-0.019	-0.008	-0.013	0.004	-0.009
		(0.018)	(0.015)	(0.017)	(0.009)	(0.024)	(0.018)
	Exports	-0.004	-0.046 ***	0.000	-0.026 ***	0.003	-0.003
		(0.017)	(0.014)	(0.016)	(0.010)	(0.022)	(0.016)
	K/VA	0.009	0.004	0.007	0.000	0.030 ***	0.012 *
		(0.006)	(0.005)	(0.006)	(0.004)	(0.008)	(0.006)
	VA	0.002	0.005	-0.011 **	-0.008 ***	0.015 **	0.009
		(0.006)	(0.004)	(0.005)	(0.003)	(0.007)	(0.006)
	R squared	0.124	0.125	0.109	0.125	0.239	0.125
	N. obs.	633	646	633	646	571	582

Note: All regressions include industry and region dummies and dummies for the level of education of the plant manager. Robust standard errors in parenthesis. * represents significance at 10%; ** significance at 5%; *** significance at 1%.

Table 8. Export Shares as the Measure of International Technology Diffusion

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man. occ.	Empl. eng., tech. and man. occ.	Wage some college	Empl. some college
Brazil	R&D	0.029 ***	0.031 ***	0.021 ***	0.018 ***		0.018 ***
		(0.010)	(0.008)	(0.008)	(0.005)		(0.005)
	New product line	0.014	0.013 *	0.012	0.007		0.009 *
		(0.010)	(0.007)	(0.008)	(0.005)		(0.005)
	Exports	-0.029	-0.062 ***	-0.004	-0.016 *		-0.003
		(0.024)	(0.015)	(0.020)	(0.009)		(0.011)
	K/VA	-0.004	-0.003	-0.006 **	-0.004 **		0.000
		(0.004)	(0.003)	(0.003)	(0.002)		(0.002)
	VA	0.014 ***	-0.002	0.000	-0.010 ***		0.003
		(0.003)	(0.003)	(0.003)	(0.002)		(0.002)
	R squared	0.172	0.158	0.111	0.154		0.273
	N. obs.	1377	1387	1377	1387		1385
China	R&D	0.058 ***	0.036 **	0.058 ***	0.032 ***	0.042 ***	0.032 **
		(0.015)	(0.015)	(0.014)	(0.012)	(0.015)	(0.012)
	New product line	0.016	0.013	0.028 *	0.030 **	0.013	0.016
		(0.016)	(0.015)	(0.015)	(0.013)	(0.018)	(0.016)
	Exports	-0.142 ***	-0.191 ***	-0.094 ***	-0.109 ***	-0.073 ***	-0.068 ***
		(0.022)	(0.021)	(0.021)	(0.018)	(0.019)	(0.015)
	K/VA	-0.023 ***	-0.021 ***	-0.023 ***	-0.024 ***	-0.012 **	-0.012 ***
		(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
	VA	-0.003	0.001	-0.008 *	-0.006	0.008 *	0.009 ***
		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
	R squared	0.311	0.332	0.325	0.373	0.337	0.337
	N. obs.	899	902	899	902	899	902
Malaysia	R&D	0.021	0.011	0.016	0.009	0.011	-0.007
		(0.021)	(0.017)	(0.019)	(0.010)	(0.027)	(0.019)
	New product line	-0.001	-0.019	-0.007	-0.014	0.004	-0.008
		(0.018)	(0.015)	(0.017)	(0.009)	(0.024)	(0.018)
	Exports	-0.020	-0.071 ***	-0.013	-0.036 ***	-0.011	-0.030
		(0.022)	(0.015)	(0.021)	(0.010)	(0.028)	(0.021)
	K/VA	0.009	0.004	0.007	-0.001	0.030 ***	0.012 *
		(0.006)	(0.005)	(0.006)	(0.004)	(0.008)	(0.006)
	VA	0.003	0.006	-0.010 *	-0.008 ***	0.016 **	0.010 *
		(0.006)	(0.004)	(0.005)	(0.003)	(0.007)	(0.006)
	R squared	0.125	0.132	0.110	0.127	0.239	0.128
	N. obs.	633	646	633	646	571	582

Note: All regressions include industry and region dummies and dummies for the level of education of the plant manager. Robust standard errors in parenthesis. * represents significance at 10%; ** significance at 5%; *** significance at 1%.

Table 9. Foreign Ownership Dummy as a Measure of International Technology Diffusion

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man. occ.	Empl. eng., tech. and man. occ.	Wage some college	Empl. some college
Brazil	R&D	0.031 ***	0.033 ***	0.022 ***	0.019 ***		0.019 ***
		(0.010)	(0.008)	(0.008)	(0.005)		(0.005)
	New product line	0.014	0.014 *	0.012	0.007		0.009 *
		(0.010)	(0.007)	(0.008)	(0.005)		(0.005)
	FDI	0.076 ***	0.034	0.094 ***	0.054 ***		0.050 ***
		(0.026)	(0.021)	(0.023)	(0.015)		(0.014)
	K/VA	-0.006	-0.004	-0.008 **	-0.005 ***		-0.001
		(0.004)	(0.003)	(0.003)	(0.002)		(0.002)
	VA	0.011 ***	-0.005 *	-0.003	-0.012 ***		0.001
		(0.003)	(0.003)	(0.002)	(0.001)		(0.002)
	R squared	0.178	0.155	0.128	0.169		0.284
	N. obs.	1377	1387	1377	1387		1385
China	R&D	0.080 ***	0.064 ***	0.074 ***	0.050 ***	0.054 ***	0.043 ***
		(0.015)	(0.015)	(0.014)	(0.012)	(0.015)	(0.012)
	New product line	0.025	0.023	0.036 **	0.038 ***	0.018	0.021
		(0.016)	(0.016)	(0.015)	(0.014)	(0.018)	(0.016)
	FDI	0.027 *	-0.004	0.047 ***	0.028 **	0.036 **	0.022 *
		(0.016)	(0.016)	(0.015)	(0.013)	(0.014)	(0.012)
	K/VA	-0.028 ***	-0.027 ***	-0.027 ***	-0.028 ***	-0.015 ***	-0.015 ***
		(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
	VA	-0.013 ***	-0.010 **	-0.016 ***	-0.014 ***	0.002	0.004
		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
	R squared	0.279	0.270	0.317	0.349	0.332	0.327
	N. obs.	899	902	899	902	899	902
Malaysia	R&D	0.016	0.007	0.013	0.008	0.011	-0.008
		(0.021)	(0.017)	(0.019)	(0.010)	(0.027)	(0.019)
	New product line	0.000	-0.017	-0.006	-0.013	0.011	-0.003
		(0.018)	(0.015)	(0.017)	(0.008)	(0.024)	(0.018)
	FDI	0.007	-0.006	0.004	-0.009	0.032	0.010
		(0.018)	(0.014)	(0.017)	(0.009)	(0.024)	(0.018)
	K/VA	0.008	0.001	0.006	-0.002	0.029 ***	0.011 *
		(0.007)	(0.006)	(0.006)	(0.004)	(0.008)	(0.007)
	VA	0.000	0.003	-0.012 **	-0.010 ***	0.015 **	0.008
		(0.006)	(0.005)	(0.006)	(0.003)	(0.007)	(0.006)
	R squared	0.122	0.110	0.105	0.107	0.242	0.131
	N. obs.	627	639	627	639	566	576

Note: All regressions include industry and region dummies and dummies for the level of education of the plant manager. Robust standard errors in parenthesis. * represents significance at 10%; ** significance at 5%; *** significance at 1%.

Table 10. Foreign Ownership Share as a Measure of International Technology Diffusion

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man. occ.	Empl. eng., tech. and man. occ.	Wage some college	Empl. some college
Brazil	R&D	0.031 ***	0.034 ***	0.022 ***	0.019 ***		0.019 ***
		(0.010)	(0.008)	(0.008)	(0.005)		(0.005)
	New product line	0.014	0.014 *	0.012	0.007		0.009 *
		(0.010)	(0.007)	(0.008)	(0.005)		(0.005)
	FDI	0.092 ***	0.038	0.113 ***	0.066 ***		0.058 ***
		(0.030)	(0.025)	(0.027)	(0.017)		(0.016)
	K/VA	-0.006	-0.004	-0.008 **	-0.005 ***		-0.001
		(0.004)	(0.003)	(0.003)	(0.002)		(0.002)
	VA	0.011 ***	-0.005 *	-0.003	-0.012 ***		0.001
		(0.003)	(0.003)	(0.002)	(0.001)		(0.002)
	R squared	0.179	0.155	0.130	0.171		0.284
	N. obs.	1377	1387	1377	1387		1385
China	R&D	0.081 ***	0.063 ***	0.075 ***	0.050 ***	0.055 ***	0.043 ***
		(0.015)	(0.015)	(0.014)	(0.012)	(0.015)	(0.012)
	New product line	0.025	0.022	0.037 **	0.038 ***	0.019	0.021
		(0.016)	(0.016)	(0.015)	(0.014)	(0.018)	(0.016)
	FDI	0.035	-0.027	0.065 ***	0.032	0.049 **	0.028
		(0.025)	(0.025)	(0.024)	(0.021)	(0.023)	(0.019)
	K/VA	-0.028 ***	-0.026 ***	-0.027 ***	-0.028 ***	-0.015 ***	-0.015 ***
		(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
	VA	-0.013 ***	-0.009 **	-0.016 ***	-0.013 ***	0.002	0.004
		(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)
	R squared	0.278	0.271	0.315	0.347	0.331	0.326
	N. obs.	899	902	899	902	899	902
Malaysia	R&D	0.017	0.008	0.013	0.007	0.012	-0.009
		(0.021)	(0.017)	(0.019)	(0.010)	(0.027)	(0.019)
	New product line	-0.003	-0.020	-0.007	-0.014 *	0.008	-0.007
		(0.018)	(0.015)	(0.017)	(0.009)	(0.024)	(0.018)
	FDI	0.003	-0.003	0.011	-0.007	0.052 *	0.030
		(0.023)	(0.017)	(0.021)	(0.011)	(0.030)	(0.023)
	K/VA	0.009	0.002	0.007	-0.002	0.031 ***	0.013 *
		(0.007)	(0.006)	(0.006)	(0.004)	(0.008)	(0.007)
	VA	0.000	0.003	-0.012 **	-0.009 ***	0.014 **	0.007
		(0.006)	(0.004)	(0.005)	(0.003)	(0.007)	(0.006)
	R squared	0.122	0.109	0.105	0.105	0.246	0.136
	N. obs.	632	644	632	644	571	581

Note: All regressions include industry and region dummies and dummies for the level of education of the plant manager. Robust standard errors in parenthesis. * represents significance at 10%; ** significance at 5%; *** significance at 1%.

Table 11. Technology License Dummy as a Measure of International Technology Diffusion

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man. occ.	Empl. eng., tech. and man. occ.	Wage some college	Empl. some college
Brazil	R&D	0.030 ***	0.033 ***	0.020 **	0.018 ***		0.018 ***
		(0.010)	(0.008)	(0.008)	(0.005)		(0.005)
	New product line	0.014	0.014 *	0.012	0.007		0.009 *
		(0.010)	(0.007)	(0.008)	(0.005)		(0.005)
	Tech. Lic.	0.011	0.002	0.014	0.012		0.003
		(0.020)	(0.016)	(0.015)	(0.009)		(0.010)
	K/VA	-0.005	-0.003	-0.006 **	-0.004 **		0.000
		(0.004)	(0.003)	(0.003)	(0.002)		(0.002)
	VA	0.013 ***	-0.004	-0.001	-0.011 ***		0.003
		(0.003)	(0.002)	(0.002)	(0.001)		(0.002)
	R squared	0.171	0.153	0.112	0.154		0.274
	N. obs.	1377	1387	1377	1387		1385
China	R&D	0.075 ***	0.065 ***	0.067 ***	0.046 ***	0.049 ***	0.040 ***
		(0.015)	(0.015)	(0.014)	(0.012)	(0.015)	(0.012)
	New product line	0.022	0.023	0.032 **	0.036 ***	0.016	0.019
		(0.016)	(0.016)	(0.015)	(0.014)	(0.018)	(0.016)
	Tech. Lic.	0.040 *	-0.006	0.049 **	0.020	0.030	0.011
		(0.021)	(0.021)	(0.021)	(0.018)	(0.024)	(0.020)
	K/VA	-0.028 ***	-0.027 ***	-0.027 ***	-0.028 ***	-0.014 ***	-0.014 ***
		(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
	VA	-0.014 ***	-0.010 **	-0.017 ***	-0.013 ***	0.002	0.004
		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
	R squared	0.279	0.270	0.313	0.346	0.329	0.325
	N. obs.	899	902	899	902	899	902
Malaysia	R&D	0.020	0.006	0.017	0.007	0.009	-0.012
		(0.021)	(0.017)	(0.019)	(0.010)	(0.026)	(0.019)
	New product line	-0.003	-0.020	-0.008	-0.015 *	-0.003	-0.018
		(0.018)	(0.014)	(0.017)	(0.008)	(0.024)	(0.017)
	Tech. Lic.	0.017	0.001	-0.001	0.011	0.098 **	0.125 ***
		(0.031)	(0.031)	(0.025)	(0.018)	(0.043)	(0.043)
	K/VA	0.009	0.004	0.008	0.000	0.033 ***	0.015 **
		(0.006)	(0.005)	(0.006)	(0.004)	(0.008)	(0.006)
	VA	0.001	0.002	-0.011 **	-0.011 ***	0.015 **	0.008
		(0.005)	(0.004)	(0.005)	(0.003)	(0.006)	(0.005)
	R squared	0.128	0.110	0.109	0.110	0.256	0.160
	N. obs.	646	659	646	659	583	594

Note: All regressions include industry and region dummies and dummies for the level of education of the plant manager. Robust standard errors in parenthesis. * represents significance at 10%; ** significance at 5%; *** significance at 1%.

Table 12. Shares of Computer-Controlled Machinery and Investment in IT Equipment as Measures of International Technology Diffusion

Panel A. Share of Computer-Controlled Machinery

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man. occ.	Empl. eng., tech. and man. occ.	Wage some college	Empl. some college
Malaysia	R&D	0.020	0.004	0.017	0.007	0.012	-0.011
		(0.021)	(0.017)	(0.019)	(0.010)	(0.027)	(0.019)
	New product line	-0.003	-0.024	-0.009	-0.018 **	0.002	-0.014
		(0.018)	(0.015)	(0.017)	(0.009)	(0.024)	(0.018)
	Comp. Mach.	0.017	0.027	0.002	0.032 **	0.018	0.037
		(0.024)	(0.022)	(0.022)	(0.015)	(0.033)	(0.028)
	K/VA	0.008	0.002	0.008	-0.002	0.032 ***	0.013 **
		(0.006)	(0.005)	(0.006)	(0.004)	(0.008)	(0.006)
	VA	0.001	0.001	-0.011 **	-0.011 ***	0.016 **	0.008
		(0.006)	(0.004)	(0.005)	(0.003)	(0.006)	(0.005)
	R squared	0.130	0.115	0.110	0.118	0.248	0.139
	N. obs.	637	649	637	649	575	585

Panel B. Share of Investment in IT Equipment

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man. occ.	Empl. eng., tech. and man. occ.	Wage some college	Empl. some college
China	R&D	0.085 ***	0.071 ***	0.073 ***	0.048 ***	0.053 ***	0.041 ***
		(0.016)	(0.016)	(0.015)	(0.013)	(0.016)	(0.013)
	New product line	0.024	0.026	0.033 **	0.035 **	0.018	0.020
		(0.017)	(0.016)	(0.016)	(0.014)	(0.019)	(0.016)
	IT Inv.	0.117 ***	0.158 ***	0.086 **	0.136 ***	0.118 **	0.147 ***
		(0.039)	(0.046)	(0.038)	(0.042)	(0.053)	(0.051)
	K/VA	-0.029 ***	-0.027 ***	-0.027 ***	-0.026 ***	-0.014 **	-0.014 ***
		(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)
	VA	-0.012 ***	-0.011 ***	-0.015 ***	-0.013 ***	0.001	0.003
		(0.004)	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)
	R squared	0.309	0.318	0.331	0.381	0.346	0.357
	N. obs.	792	795	792	795	792	795

Note: All regressions include industry and region dummies and dummies for the level of education of the plant manager. Robust standard errors in parenthesis. * represents significance at 10%; ** significance at 5%; *** significance at 1%.

Table 13. Multiple Measures of International Technology Diffusion: Imported Inputs, Exports, FDI and Technology License Dummies

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man. occ.	Empl. eng., tech. and man. occ.	Wage some college	Empl. some college
Brazil	R&D	0.029 ***	0.032 ***	0.020 **	0.018 ***		0.018 ***
		(0.010)	(0.008)	(0.008)	(0.005)		(0.005)
	New product line	0.011	0.012	0.009	0.006		0.007
		(0.010)	(0.007)	(0.008)	(0.005)		(0.005)
	Imported Inputs	0.022 **	0.021 ***	0.014 *	0.013 ***		0.011 **
		(0.010)	(0.008)	(0.008)	(0.005)		(0.005)
	Exports	0.020	-0.009	0.023 **	0.001		0.013 *
		(0.012)	(0.010)	(0.010)	(0.006)		(0.007)
	FDI	0.067 ***	0.031	0.087 ***	0.050 ***		0.045 ***
		(0.026)	(0.021)	(0.023)	(0.015)		(0.015)
	Techn. lic.	0.006	-0.001	0.009	0.008		0.000
		(0.020)	(0.016)	(0.015)	(0.009)		(0.010)
	K/VA	-0.006	-0.004	-0.008 **	-0.005 ***		-0.001
		(0.004)	(0.003)	(0.003)	(0.002)		(0.002)
	VA	0.008 **	-0.005	-0.006 **	-0.013 ***		-0.001
		(0.003)	(0.003)	(0.003)	(0.002)		(0.002)
	R squared	0.183	0.160	0.134	0.174		0.289
	N. obs.	1377	1387	1377	1387		1385
China	R&D	0.073 ***	0.060 ***	0.067 ***	0.045 ***	0.051 ***	0.041 ***
		(0.015)	(0.016)	(0.014)	(0.012)	(0.015)	(0.012)
	New product line	0.023	0.022	0.035 **	0.037 ***	0.019	0.021
		(0.016)	(0.016)	(0.015)	(0.013)	(0.018)	(0.016)
	Imported Inputs	-0.024	-0.042 **	-0.004	-0.016	0.024	0.005
		(0.019)	(0.018)	(0.018)	(0.015)	(0.018)	(0.015)
	Exports	-0.047 ***	-0.061 ***	-0.049 ***	-0.051 ***	-0.032 *	-0.032 **
		(0.018)	(0.019)	(0.017)	(0.016)	(0.017)	(0.015)
	FDI	0.037 **	0.017	0.052 ***	0.040 ***	0.034 **	0.026 **
		(0.017)	(0.017)	(0.015)	(0.014)	(0.015)	(0.013)
	Techn. lic.	0.038 *	0.001	0.039 *	0.015	0.018	0.005
		(0.021)	(0.021)	(0.021)	(0.018)	(0.025)	(0.021)
	K/VA	-0.025 ***	-0.021 ***	-0.025 ***	-0.025 ***	-0.015 ***	-0.014 ***
		(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
	VA	-0.008 *	0.000	-0.013 ***	-0.008 **	0.001	0.006
		(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)
	R squared	0.291	0.291	0.328	0.363	0.337	0.331
	N. obs.	899	902	899	902	899	902
Malaysia	R&D	0.020	0.018	0.013	0.012	0.012	-0.005
		(0.022)	(0.018)	(0.020)	(0.010)	(0.028)	(0.019)
	New product line	-0.004	-0.018	-0.011	-0.015 *	0.009	-0.007
		(0.019)	(0.015)	(0.017)	(0.009)	(0.024)	(0.017)
	Imported Inputs	0.020	0.029 **	0.010	0.009	0.050 **	0.038 **
		(0.018)	(0.015)	(0.017)	(0.009)	(0.023)	(0.016)
	Exports	-0.012	-0.055 ***	-0.004	-0.028 ***	-0.023	-0.024
		(0.019)	(0.016)	(0.017)	(0.010)	(0.024)	(0.018)
	FDI	0.002	-0.010	0.002	-0.008	0.026	0.004
		(0.019)	(0.014)	(0.018)	(0.009)	(0.024)	(0.017)
	Techn. lic.	0.013	0.012	-0.002	0.015	0.100 **	0.137 ***
		(0.032)	(0.031)	(0.026)	(0.019)	(0.045)	(0.046)
	K/VA	0.009	0.004	0.004	-0.002	0.028 ***	0.011 *
		(0.007)	(0.005)	(0.007)	(0.004)	(0.008)	(0.007)
	VA	-0.002	0.004	-0.012 **	-0.008 ***	0.013 *	0.007
		(0.006)	(0.005)	(0.006)	(0.003)	(0.007)	(0.006)
	R squared	0.122	0.127	0.108	0.126	0.253	0.165
	N. obs.	603	614	603	614	546	555

Note: All regressions include industry and region dummies and dummies for the level of education of the plant manager. Robust standard errors in parenthesis. * represents significance at 10%; ** significance at 5%; *** significance at 1%.

Table 14. Multiple Measures of International Technology Diffusion: Imported Inputs, Exports, FDI Shares and Technology License Dummies

	Coefficients	Wage nonprod.	Empl. nonprod.	Wage eng., tech. and man.	Empl. eng., tech. and man.	Wage some college	Empl. some college
Brazil	R&D	0.029 ***	0.031 ***	0.021 ***	0.018 ***		0.018 ***
		(0.010)	(0.008)	(0.008)	(0.005)		(0.005)
	New product line	0.013	0.012	0.010	0.006		0.008 *
		(0.010)	(0.007)	(0.008)	(0.005)		(0.005)
	Imported Inputs	0.020	0.042 **	0.027	0.042 ***		0.014
		(0.025)	(0.021)	(0.021)	(0.014)		(0.013)
	Exports	-0.038	-0.065 ***	-0.014	-0.022 **		-0.008
		(0.023)	(0.015)	(0.020)	(0.009)		(0.011)
	FDI	0.092 ***	0.036	0.108 ***	0.059 ***		0.056 ***
		(0.031)	(0.025)	(0.027)	(0.017)		(0.016)
	Techn. Lic.	0.005	-0.002	0.008	0.007		0.000
		(0.020)	(0.016)	(0.015)	(0.009)		(0.010)
	K/VA	-0.006	-0.003	-0.008 **	-0.004 **		-0.001
		(0.004)	(0.003)	(0.003)	(0.002)		(0.002)
	VA	0.012 ***	-0.003	-0.003	-0.012 ***		0.001
		(0.003)	(0.003)	(0.003)	(0.001)		(0.002)
	R squared	0.181	0.164	0.131	0.182		0.285
	N. obs.	1377	1387	1377	1387		1385
China	R&D	0.053 ***	0.033 **	0.055 ***	0.030 **	0.045 ***	0.034 ***
		(0.015)	(0.015)	(0.014)	(0.012)	(0.015)	(0.012)
	New product line	0.018	0.014	0.031 **	0.033 **	0.017	0.019
		(0.016)	(0.015)	(0.015)	(0.013)	(0.018)	(0.016)
	Imported Inputs	-0.051	-0.041	-0.034	-0.018	0.052 *	0.042 *
		(0.032)	(0.027)	(0.029)	(0.025)	(0.030)	(0.025)
	Exports	-0.143 ***	-0.183 ***	-0.101 ***	-0.114 ***	-0.100 ***	-0.090 ***
		(0.026)	(0.023)	(0.024)	(0.021)	(0.022)	(0.018)
	FDI	0.066 ***	0.017	0.087 ***	0.057 ***	0.054 **	0.037 *
		(0.025)	(0.024)	(0.024)	(0.021)	(0.025)	(0.021)
	Techn. Lic.	0.034 *	-0.003	0.037 *	0.013	0.023	0.006
		(0.020)	(0.020)	(0.021)	(0.018)	(0.024)	(0.021)
	K/VA	-0.024 ***	-0.020 ***	-0.025 ***	-0.025 ***	-0.014 ***	-0.014 ***
		(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
	VA	-0.006	0.002	-0.012 ***	-0.007 **	0.004	0.007 *
		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
	R squared	0.322	0.331	0.343	0.379	0.346	0.340
	N. obs.	893	896	893	896	893	896
Malaysia	R&D	0.021	0.019	0.013	0.011	0.018	0.000
		(0.022)	(0.018)	(0.020)	(0.011)	(0.028)	(0.019)
	New product line	-0.010	-0.019	-0.017	-0.019 **	0.000	-0.012
		(0.019)	(0.015)	(0.017)	(0.009)	(0.024)	(0.018)
	Imported Inputs	-0.006	-0.005	0.007	-0.003	0.042	0.024
		(0.024)	(0.016)	(0.023)	(0.011)	(0.031)	(0.023)
	Exports	0.030	0.046 **	0.008	0.014	0.060 *	0.061 **
		(0.025)	(0.020)	(0.023)	(0.013)	(0.032)	(0.026)
	FDI	0.015	0.009	0.000	0.014	0.099 **	0.133 ***
		(0.033)	(0.030)	(0.026)	(0.018)	(0.044)	(0.046)
	Techn. Lic.	-0.028	-0.083 ***	-0.017	-0.040 ***	-0.033	-0.047 **
		(0.023)	(0.017)	(0.021)	(0.010)	(0.031)	(0.024)
	K/VA	0.012 *	0.004	0.006	-0.001	0.033 ***	0.014 **
		(0.007)	(0.005)	(0.007)	(0.004)	(0.008)	(0.007)
	VA	-0.001	0.003	-0.011 **	-0.008 ***	0.013 *	0.007
		(0.006)	(0.004)	(0.006)	(0.003)	(0.007)	(0.005)
	R squared	0.131	0.139	0.115	0.130	0.261	0.177
	N. obs.	599	610	599	610	543	552

Note: All regressions include industry and region dummies and dummies for the level of education of the plant manager. Robust standard errors in parenthesis. * represents significance at 10%; ** significance at 5%; *** significance at 1%.