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There will be exports and licensing: The effects of patent rights and innovation on firm sales

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Previous work has focused on how intellectual property rights affect inward technology transfer. This paper is among the first to study whether patent rights contribute to outward technology transfers. Patent protection can affect the ability of firms to be sources of technology through its effects on innovation and commercialization. Using micro data, this paper finds that patent rights and innovation are positively associated with the exporting and licensing of firms, controlling for other determinants of technological capacity, although the effect is not symmetric across firms in all countries. Patent rights have a strong impact on the export and licensing activities of firms in developed countries, and only on the licensing activities of firms in developing countries. Moreover, transfers of technology develop sequentially – namely, exporting before licensing – due to the differing sunk costs of each type of entry. The results have implications for how innovation policies and activities contribute to the outward orientation of firms.

Keywords: patent rights; trade; technology transfer; licensing; productivity; R&D

JEL Classifications: O34, F13, O50, L24

1. Introduction

Previous research on intellectual property rights (IPRs) and technology transfers has focused primarily on inward flows – that is, on the extent to which stronger IPRs in a country help attract imports and licensing.[1] This paper examines the reverse flows; that is, the extent to which stronger IPRs – specifically patent rights – affect the outward technology transfers of firms. We focus on the transfers of technology via the exports of firms to the rest of the world and the licensing of firms locally and abroad. Both exporting and licensing are ways in which a firm can profit from its innovations. This shift in perspective from inward technology

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transfers to outward is important in that the literature thus far has viewed IPRs as a means to attract technology, but firms must pay fees or royalties for it, whereas with outward technology transfers, firms derive income. Thus, IPRs can be viewed as a means for strengthening a firm's position in technology trade.

Stronger patent protection, particularly in middle- and low-income countries, helps facilitate technological spillovers from foreign patents (Xu and Chiang 2005), which expands the innovative capacities of domestic firms. But the intuition as to why patent rights relate to the outward orientation of firms goes beyond the fact that patent protection influences domestic knowledge accumulation and innovation; stronger patent protection also has a direct influence on exports and licensing by encouraging the commercialization of innovations (Mazzoleni and Nelson 1998; Arora, Fosfuri, and Gambardella 2001). Holding other factors constant, more secure IPRs give firms greater incentives to bring their products to the marketplace, whether via domestic sales, foreign sales, or licensing. Indeed, recent theoretical research by Yang and Maskus (2009) suggests that stronger patent protection may aid in creating export platforms.

Beyond Yang and Maskus's (2009) theoretical exploration, the literature directly linking patent rights to measures of outward technology transfer, such as exports and licensing, is quite limited. In fact, to our knowledge, this is the first empirical study to examine the effects of patent protection on outward orientation. However, a more significant literature exists exploring the steps along the way; namely, linking IPRs and innovation[2] and linking innovation and trade.[3] Access to foreign markets may enhance firm profits, thereby providing incentives for firms to invest in productivity-enhancing activities (Lileeva and Trefler 2010), such as R&D and the adoption of new technologies. In that regard, the local environment for intellectual property protection should be important. However, in studying the incentives for innovation generated by access to foreign markets, we must recognize the causality problem – namely, that it is the most productive firms that engage in exporting (Melitz 2003). Thus, it is important to control for the bias in which high-productivity firms self-select into foreign market participation. We address this bias by allowing firm productivity to be endogenous to exporting and licensing.

Our paper contributes to the existing literature on global IPRs in several ways. First, as mentioned, this study is among the first to provide empirical evidence on the reverse dimension of technology transfer, where technologies are transferred from firms in patent-strengthening countries to others, whether domestically or abroad. We conduct this analysis by considering a firm's aggregate exports and aggregate licensing regardless of the intended destination. Second, we analyze the role of patent rights while controlling for the direct impact of a firm's R&D and productivity level on its exports and licensing. Firm productivity is endogenously estimated so as to take into account selection biases; namely, that it is the more productive firms that engage in outward technology transfers. Third, we examine not only a wide cross section of countries over time, but also compare firms in developed and developing country subsamples. The overall significance of this study is that it analyzes whether IPRs affect the capacity of firms to develop and market products and become providers of technology.

To conduct this analysis, we use a unique database of foreign affiliates of US multinational parent firms from 1982–2009. From this source, we select affiliate firms that demonstrate some measure of decision-making autonomy, the purpose of which is to estimate the decentralized responses of firms to local policies. This database provides a number of advantages for our study. First, it provides detailed information on technology transfers. Second, affiliate firms vary in productivity levels and are located in diverse markets and institutional regimes, allowing us to study the variations in their outward orientation due to variations in local regulations. Third, the firm-level data enable us to identify if firms substitute between exporting and licensing as the level of patent rights changes; a firm may start out producing for the local market, then export, and then incorporate licensing as patent rights are strengthened. These shifts in firm strategies cannot be detected using more aggregated data.

As a preview, our results show that patent policy and innovation can positively influence the capacity of firms to be sources of technology transfer. In developed countries, patent rights are positively associated with the exports and licensing of firms, controlling for other factors. In developing countries, however, patent protection is positively associated with firm licensing but not with firm exporting. This can be attributed to the relatively lower technological content of developing country exports in the recent past. R&D and firm productivity are consistently strong, positive influences on a firm's outward orientation. In addition, we find that the outward orientation of firms develops in phases; as patent rights and innovative capacities increase, firms transition from selling locally to exporting, and eventually to licensing. This arises because there are entry costs associated with exporting and licensing – and the costs associated with licensing tend to be greater than those associated with exporting.

The next section discusses our conceptual framework and Section 3 our estimation strategy. Section 4 discusses our data, Section 5 our findings, and Section 6 concludes.

2. Conceptual framework

This section describes how patent protection, R&D, and firm-level productivity relate to the outward orientation of a firm. The purpose here is not to derive a structural model for estimation but to provide a qualitative guide for our estimation model. We extend the exporting model of Aw, Roberts, and Xu (2011) to incorporate licensing. The ith firm chooses $\theta_{it} = \{\theta_{it}^D, \theta_{it}^X, \theta_{it}^L\}$at time t to maximize its firm value V, where θ denotes the levels of different modes of sale, with superscript D indicating *domestic sales*, X *exports*, and L *licensing* contracts. Let $s_{it} = (\omega_{it}, x_{it-1}, l_{it-1})$ be the state vector, where ω is a measure of firm productivity, and x and l are indicator variables of whether or not a firm participated in exporting and licensing, respectively. (Firm productivity ω is endogenous, and we specify later how productivity evolves.)

The firm has four options: sell domestically; export and sell domestically; license and sell domestically; and export, license, and sell domestically. There exist

fixed and sunk costs of participating in exporting and licensing, such as gathering information on foreign requirements, negotiating contracts, and establishing distribution networks. Although all firms are assumed to sell domestically, the firm will export and/or license only if the current and expected gain from such activity exceeds these fixed and sunk costs, taking into account that its decision to participate in that activity affects its future productivity and firm value. Hence, the following dynamic Bellman equation reflects the four options described for the firm:

$$V_{it}(s_{it}) = \max_{\{\theta_{it}\}} \left(\pi_{it}^{D} + \max\left\{V_{it}^{D}(s_{it}), \hat{\pi}_{it}^{X} + V_{it}^{X}(s_{it}), \hat{\pi}_{it}^{L} + V_{it}^{L}(s_{it}), \hat{\pi}_{it}^{X} + \hat{\pi}_{it}^{L} + V_{it}^{XL}(s_{it})\right\}\right) \tag{1}$$

where π denotes profits, and $\hat{\pi}$ profits net of sunk and fixed costs:

$$\hat{\pi}_{it}^{X} = \pi_{it}^{X} - (x_{it-1}\gamma^{F} + (1 - x_{it-1})\gamma^{S})$$
$$\hat{\pi}_{it}^{L} = \pi_{it}^{L} - (l_{it-1}\phi^{F} + (1 - l_{it-1})\phi^{S})$$

where $x_{it-1} = 1$ if the firm participated in the export market in the previous period (and zero otherwise), in which case it incurs a fixed cost of γ^{F} to remain in the export market. Otherwise, if a firm did not participate in the export market in the previous period and it is in the export market at time t, it incurs a sunk cost of γ^{S} to enter the export market. Similarly, $l_{it-1} = 1$ (and zero otherwise) if the firm had participated in the licensing market. The fixed and sunk costs of engaging in licensing are given by ϕ^{F} and ϕ^{S}, respectively.

In (1), the expected discounted future values to the firm associated with the different modes of sales V_{it}^{D}, V_{it}^{X}, V_{it}^{L}, and V_{it}^{XL} are defined as follows:

$$V_{it}^{D}(s_{it}) = \delta E_t V_{it+1}(s_{it+1}|x_{it} = 0, l_{it} = 0)$$
$$V_{it}^{X}(s_{it}) = \delta E_t V_{it+1}(s_{it+1}|x_{it} = 1, l_{it} = 0)$$
$$V_{it}^{L}(s_{it}) = \delta E_t V_{it+1}(s_{it+1}|x_{it} = 0, l_{it} = 1)$$
$$V_{it}^{XL}(s_{it}) = \delta E_t V_{it+1}(s_{it+1}|x_{it} = 1, l_{it} = 1)$$

where δ is the time discount factor and E the expectations operator. The profit functions are:

$$\pi_{it}^{m} = (1 - h(\text{IPR}))\pi(\omega_{it}, \theta_{it}, \Phi_{it}), \qquad m = \{D, X, L\}$$

where h is the hazard rate of imitation and/or infringement and IPR the index of patent rights. Stronger patent rights help reduce the hazard of imitation and infringement ($h' < 0$) and thereby increase the ability of the firm to appropriate its

profits.[4] Since exportable goods are produced locally, they rely, in part, on local IPRs to protect a firm's ownership of the technology embodied in the product or used in the production process. Also, stronger local patent rights encourage domestic firms to incur additional expenses, beyond R&D, to commercialize their innovations or bring their products to the marketplace – such as expenses related to test trials, certification, prototypes, product launches, and financing – which could also be difficult to recoup in the absence of adequate patent protection.[5] Of course, the profitability of exports and licensing will also depend on patent rights abroad. However, our analysis considers only the aggregate outflows (i.e. aggregate exports and licensing) of firms and does not distinguish between the different country destinations of these outflows. Therefore, the level of IPR protection in the importing countries is not considered.[6]

Profits also depend on firm productivity, the mode and level of sales, and other factors, Φ. The latter include the capital stock, k, which affects a firm's capacity to produce, investments in R&D, r, which affect the quality and variety of a firm's products, and other cost and demand shifters: $\Phi_{it} = \Phi(k_{it}, r_{it},.)$.

This model captures the idea that more productive firms are more likely to find exporting and licensing profitable, and therefore are more likely to engage in export and licensing. Furthermore, experience in exporting and technology contracting provides a source of knowledge and know-how that can enhance future firm productivity (Bernard and Jensen 2004; Greenaway and Kneller 2007). As in Aw, Roberts, and Xu (2011) and Doraszelski and Jaumandreu (2008), equation (2) below models the evolution of firm-level productivity such that past productivity, past investments in innovation, and past participation in foreign markets (either through past export and/or past licensing participation) each contributes to a firm's current productivity level:

$$\omega_{it} = g(\omega_{it-1}, r_{it-1}, x_{it-1}, l_{it-1}) + \xi_{it} \tag{2}$$

where ξ is an iid error. Appendix 1 provides greater detail on the estimation of equation (2), which is the first-stage regression model used to estimate the fitted values of ω that are to be incorporated in the export and licensing equations.

The solution to the dynamic programming problem in equation (1) yields two decision rules for the firm:

$$X_{it} = X(\hat{s}_{it}, \text{IPR}_{it}, \Phi_{it}) \tag{3}$$

$$L_{it} = L(\hat{s}_{it}, \text{IPR}_{it}, \Phi_{it}) \tag{4}$$

where $\hat{s}_{it} = (\hat{\omega}_{it}, x_{it\ -1}, l_{it-1})$ is the revised state vector and Φ the vector of other determinants.

3. Estimation strategy

Equations (5) and (6) below are log-linear adaptations of the firm-level policy functions (3) and (4), respectively, and are the benchmark estimation equations in this paper:

$$\ln \text{Export}_{it} = \alpha_0 + \alpha_1 \ln \text{IPR}_t + \alpha_2 \ln r_{it} + \alpha_3 \ln k_{it} + \alpha_4 \ln \hat{\omega}_{it} + \alpha_5 C_{it} + \sum_{j=1}^{3} \alpha_j^E \text{Choice}_{it-1}^j + \mu_{it} \quad (5)$$

$$\ln \text{License}_{it} = \beta_0 + \beta_1 \ln \text{IPR}_t + \beta_2 \ln r_{it} + \beta_3 \ln k_{it} + \beta_4 \ln \hat{\omega}_{it} + \beta_5 C_{it} + \sum_{j=1}^{3} \beta_j^L \text{Choice}_{it-1}^j + \varepsilon_{it} \quad (6)$$

As in the previous equations, k_{it} is the firm's physical capital, $\hat{\omega}_{it}$ the firm-level endogenous productivity estimate, r_{it} firm-level R&D expenditures, IPR_t the country-level index of patent rights, and Choice_{it-1}^j a series of dummy variables such that for $j = 1$ the dummy is equal to one if the firm *exported* in the previous period and zero otherwise, for $j = 2$ the dummy is equal to one if the firm *licensed* in the previous period and zero otherwise, and for $j = 3$ the dummy is equal to one if the firm *exported* and *licensed* in the previous period and zero otherwise. These choice dummies capture the impact of the lagged export and licensing decision on the current export and licensing decision. As noted in Caldera (2010) and Roberts and Tybout (1997), the dependence of export and licensing status on past participation in exporting and licensing suggests the presence of sunk costs in exporting and licensing. Sunk costs generate persistence in export and licensing participation. Firms tend to wait (for profitability to be high enough) before entering into exporting or licensing if sunk costs are substantial and likewise to wait (for profitability to be low enough) before exiting, thereby generating some hysteresis in their choices (Dixit 1989).

C_{it} is a vector of other control variables including: real gross domestic product (GDP) to account for local market size, tax rate to account for the market incentives of creating export and licensing bases in the host country,[7] and economic and trade agreement dummies to control for the effects of trade liberalization on exporting and licensing.[8] The tax rate is computed as the ratio of income taxes paid by the firm to the firm's (pre-tax) net income.[9] Time, industry, and country fixed effects are also included in the estimation model.

Firms may engage in different forms of technology transfer simultaneously or engage in them sequentially. We consider both possibilities. First, we examine the behavior of exporting and licensing, abstracting from any sequential pattern to them. The exporting and licensing equations are estimated jointly using a Bivariate Tobit regression censored at zero. The joint estimation of equations (5) and (6) is useful since their errors may be contemporaneously correlated due to common shocks (for example, macroeconomic events). A censored model is relevant here

due to a threshold effect. If firm profitability is too low relative to the entry costs of exporting or licensing, no exports or licensing will be observed. Under these circumstances, a Bivariate Tobit estimation ensures that the resulting coefficient estimates will be unbiased and consistent. In the empirical results, we report the estimated correlation coefficient, *rho*, between the residuals of the export and licensing equations. A statistically significant *rho* indicates that a joint estimation procedure is appropriate for correcting a potential bias. However, estimating the export and licensing equations jointly when *rho* is not statistically significant does not create a bias, but suggests that individual Tobit regressions would provide unbiased results as well.

We next empirically test for an ordered response by firms. Given the sunk costs of participating in foreign trade and technology contracting, firms may begin by selling domestically, and then proceed to export and/or license, once a sufficient level of firm profitability is reached. As shown in Ethier and Markusen (1996), firms often act sequentially when choosing between the different modes of technology transfer, with licensing arising after exporting. We therefore model the following ordered choices: (1) neither export nor license (implying local sales only); (2) export (without licensing); and (3) license (either with or without exporting). Firms switch out of (1) and into (2), for example, if firm profitability is high enough to compensate for the fixed and sunk costs of exporting. Our theoretical model supports this sequence of exporting before licensing so long as the fixed and sunk costs of licensing are greater than those of exporting – that is, $\phi^F + \phi^S > \gamma^F + \gamma^S$. This assumption is supported by the fact that goods can be exported without directly revealing know-how, whereas licensing requires the licensor to share enough information for the licensee to replicate the good, including tacit knowledge, and often requires the licensor to provide the licensee with technical support to maintain quality. Sharing or revealing intellectual property therefore results in a large sunk cost to the licensor, thereby making licensing the riskier choice between these two modes of technology transfer.

Furthermore, exporting can be less expensive than licensing as a means for firms to market their goods, since exporting builds on a firm's existing production capacities, and a modest amount of additional resources are required to export the goods abroad (Ajami et al. 2006). Licensing, however, entails significant additional costs, such as contracting costs (legal representation and monitoring) and risks of rent dissipation (whereby the licensor may lose its market to the licensee over time). Thus, a firm chooses licensing if the benefits associated with it exceed its cost. The benefits are greater if the innovative or technological content of a firm's product is greater, as that would attract demands for a license. To the extent that stronger patent rights result in greater investments in product quality and appropriability, we should observe firms to choose licensing when patent rights are sufficiently strong (to help compensate for the higher costs associated with licensing); otherwise, they would choose exporting (all else equal).

In the ordered probit analysis, we empirically implement the following:

$$\pi^* = z'\psi + \varepsilon_\pi \tag{7}$$

where π^* is a latent variable measuring the profitability of a good, z a vector of explanatory factors, and ε_π a normally distributed error term. Different modes of marketing the good are chosen as π^* crosses particular thresholds:

$$\begin{aligned}
&\Pi = 1 \text{ (No licensing, no exporting)} && \text{if } \pi^* \leq \nu_1 \\
&\Pi = 2 \text{ (Exporting, no licensing)} && \text{if } \nu_1 < \pi^* \leq \nu_2 \\
&\Pi = 3 \text{ (Licensing, with or without exporting)} && \text{if } \pi^* > \nu_2
\end{aligned}$$

where ν_1, ν_2 are the thresholds (or cutoffs) to be estimated along with the parameter vector ψ. Throughout the choices, there are local sales as well. As we discuss in the next section, the sequence above is supported by the stylized facts observed in the data. For example, over time, a smaller percentage of firms in the sample rely on local sales only, indicating that more firms eventually chose to export and/or participate in licensing. Also, a relatively small percentage of firms in each period engage in licensing (whether in conjunction with exporting or without), which conforms to the view that licensing is a relatively costly mode of marketing.

4. Data-set and descriptive statistics

The data-set consists of firm-level data from the *U.S. Direct Investment Abroad* surveys conducted annually by the U.S. Bureau of Economic Analysis (BEA), with the most extensive data provided in the benchmark years 1982, 1989, 1994, 1999, 2004, and 2009. The surveys provide comprehensive data on the technology transfers of foreign affiliates of US multinational firms. The foreign affiliates are business units that are consolidated within a country if the units are in the same industry. Affiliate exports are given by an affiliate's foreign sales, and affiliate licensing by its royalty and licensing receipts. Data on licensing receipts are not broken down between receipts from licensees in the host country and those from outside the host country. For our purposes, the affiliates' total receipts should suffice for assessing the impact of local IPRs on the ability of affiliates to become sources of technology transfer; that is, to become less dependent on technology borrowing and to contribute intangible assets for others to use.[10] Data on firm-level R&D, net capital stock, domestic sales, and employment were also collected and used in the estimation of the endogenous measure of firm productivity.[11] All the data have been converted into constant 2000 PPP US dollars.

From this larger subsample of foreign affiliates, we select the foreign affiliates that demonstrate autonomy from their parent firm when making decisions. More details about the data-set are provided in Appendix 2, while an enhanced discussion of the selection of autonomous affiliates follows below.

4.1. Selecting an autonomous foreign affiliate sample

Foreign affiliates of US multinational firms vary in terms of the degree of autonomy they have to make export and licensing decisions. Some affiliates may make these decisions independently, while other affiliates coordinate with or simply implement strategies decided upon by the US parent firm. Distinguishing between these types of decision-making strategies for foreign affiliates is useful in assessing whether the outward orientation of such firms can be attributable to the local patent system. If, for example, the exports and licensing of affiliates are fully determined by the parent firm, even if the affiliate is located in a strong patent regime, we cannot fully attribute the affiliate's outward orientation to local patent policies. Thus, ideally, we should focus on those affiliates that are capable of making independent choices given local conditions.[12]

We therefore select affiliate firms that exhibit decentralized decision-making. Here, we follow the methodology of Robinson and Stocken (2011) of using a foreign affiliate's choice of currency for keeping financial records to ascertain whether an affiliate's decision-making is decentralized. The general idea is that foreign affiliates have a choice of using the US dollar (the currency of their parent company), their own country's currency, or the currency of another country in making its operational, financial, and investment decisions. Affiliates whose activities are an extension of their US parent firm's operations tend to use the US dollar, while those whose activities are more independent tend to use their own country's currency for record keeping. We therefore use this 'functional currency' as a proxy for autonomy; that is, we selected a sample of US foreign affiliates that use their own country's currency. As Robinson and Stocken (2011) note, this measure of affiliate autonomy cannot capture the full complexity of decision-making within a multinational organization, but it has a number of advantages, including its parsimony, large coverage, and support from international financial statements and accounting reports which correlate the location of decision rights and the designation of the local currency as the functional currency.

Through this procedure of selecting foreign affiliates, we arrived at a sample of benchmark year data on 4765 firms operating in 91 countries.[13] As described in Appendix 2, about 70% of the affiliates are located in developed countries and about 30% in developing countries.

4.2. Patent rights data

The index of patent rights is from Park (2008). The index is based on both statutory and case laws (which interpret and apply the statutes) that govern the rights and restrictions of patent holders. The index ranges from zero (no patent system) to five (strongest) and is obtained by aggregating the following five components: extent of coverage, membership in international treaties, duration of protection, absence of restrictions on rights, and enforcement provisions.[14] Patent statutes and case laws benefit rights holders by expressly codifying their rights, and form

the basis for legal disputes. An advantage of this index is that it covers a large number of countries and is longitudinal. This index has also been used in several previous studies and thus provides some comparability with the existing literature. A disadvantage of the index is that it does not account for the execution of laws (for example, the time it takes to seek injunctions, court costs, or patent pendency). The index also does not consider other types of industrial property rights that are relevant to trade, such as trademarks and trade secrecy. As a check, we therefore use other indexes of IPRs, as developed by the *Economist Intelligence Unit* and the *World Economic Forum*. These indices are based on surveying business executives on their views of the strength of IPRs and enforcement (say, on a scale from one to five, or other range). Their opinions can help fill in some gaps, such as how well laws have been executed and what the strength of IPRs are in general, including the state of trademarks, copyrights, and others.

Since the BEA benchmark survey periods differ from the periods in the patent rights data-set, the 2005 patent rights index is matched to 2009 BEA data, the 2000 patent rights index to 2004 BEA data, the 1995 patent rights index to 1999 BEA data, 1990 patent rights index to 1994 BEA data, the 1985 patent rights index to 1989 BEA data, and the 1980 patent rights index to 1982 BEA data.

4.3. Sample statistics

Table 1 presents the sample statistics of the main variables used in our empirical analysis, for all foreign affiliates as well as for subgroups of these affiliates in developed and developing countries. Affiliates produce much for the local market, with foreign sales accounting for about 35% of the total sales (or gross output). Of their foreign sales, about 27% are to the US market. This share is higher for affiliates located in developing countries. Overall, the volume of exporting significantly exceeds that of licensing (i.e., receipts of licensing fees and royalties). In developing countries, the ratio of licensing to exports is especially small. Affiliates in developed countries have considerably more licensing receipts than those in developing countries. Capital stock and R&D expenditures (in levels or as a percentage of sales) are also significantly larger for affiliates in developed countries compared to those in developing countries, while productivity and employment are only slightly higher in developed country affiliates. Firm productivity, on the other hand, is notably similar across developed and developing countries. Last, Table 1 demonstrates that affiliates in developed countries operate under stronger domestic patent regimes and larger markets (as measured by GDP).

Table 2 shows the composition of firms by mode of sales, and highlights some trends in the outward orientation of foreign affiliates. Among affiliate firms in developed countries, the shares of those who sell locally only, export, and license, are fairly stable over time. However, among affiliates in developing countries, this composition has significantly shifted, particularly when we compare the extreme years (1982 and 2009). For example, the share of firms in developing countries that engage in licensing has more than doubled between 1982 and 2009. Note that the

Table 1. Descriptive statistics.

		Foreign affiliates of US parents	. . . in developed countries	. . . in developing countries
Exports	Mean	74.2	85.4	43.1
	(Std dev)	(532.4)	(597.4)	(278.7)
Exports (as a percentage of sales)	*Mean*	*34.6%*	*35.4%*	*30.7%*
Exports (percentage to US destination)	*Mean*	*27.3%*	*24.0%*	*40.1%*
Licensing	Mean	0.66	0.86	0.12
	(Std dev)	(16.8)	(19.6)	(2.4)
R&D performed	Mean	2.59	3.33	0.53
	(Std dev)	(27.3)	(31.7)	(5.7)
R&D performed (as a percentage of sales)	*Mean*	*1.2%*	*1.4%*	*0.5%*
Productivity	Mean	8.12	8.18	7.94
	(Std dev)	(1.76)	(1.81)	(1.60)
Capital stock	Mean	42.9	48.3	27.7
	(Std dev)	(251.4)	(283.8)	(121.0)
Employment	Mean	720	732	685
	(Std dev)	(3050)	(3383)	(1828)
Tax rate	Mean	0.31	0.28	0.39
	(Std dev)	(7.39)	(8.31)	(3.69)
Patent rights index	Mean	2.72	3.82	2.31
	(Std dev)	(1.18)	(0.81)	(1.04)
Economist Intelligence Unit Index (IPR)	Mean	3.26	4.48	2.48
	(Std dev)	(1.27)	(0.72)	(0.90)
World Economic Forum Index (IPR)	Mean	3.94	5.46	3.33
	(Std dev)	(1.29)	(0.84)	(0.88)
GDP	Mean	218	544	99.1
	(Std dev)	(547)	(914)	(227)

Notes: Exports refer to the foreign sales of firms and licensing to the receipts of royalties and licensing fees of firms in millions of constant 2000 PPP US dollars. R&D performed is expenditures on research and development conducted by a firm in millions of constant 2000 PPP US dollars. Productivity is defined as the amount of output that is explained by factors other than the inputs to production: capital, labor, and materials. In addition, productivity is allowed to differ between firms with different levels of R&D expenditures. Discussion of the role of firm productivity on export and licensing decisions is most accurately discussed in relation to a comparison group, as magnitudes of the coefficient on productivity can be compared, but do not constitute a unit of measure. Capital stock is real property, plant, and equipment (net of depreciation) in millions of constant 2000 PPP US dollars. Employment is in thousands of employees. Tax rate is the ratio of taxes paid to net income. Gross domestic product (GDP) is in billions of constant 2000 PPP (US) dollars. The index of patent rights is the strength of patent protection, which varies from zero (weakest) to five (strongest). The Economist Intelligence Unit Index of Intellectual Property Rights (IPR) ranges from one to five, and is based on surveys of executives and managers on their perceptions of the strength of IPR in their country. The World Economic Forum's Index is also based on a survey of the perceptions of the strength of intellectual property rights, and ranges from one to seven. The sample statistics are calculated for the benchmark survey years: 1982, 1989, 1994, 1999, 2004, and 2009. The classification of developed and developing countries is based on United Nations classification (see UNCTAD *Handbook of Statistics* 2006–7).

Table 2. Composition of mode: exports and licensing.

Mode	1982	1989	1994	1999	2004	2009
US foreign affiliate firms in developed countries						
No exports or licensing	36.5%	32.6%	38.5%	37.0%	35.3%	35.7%
Export only	56.4%	59.8%	54.1%	53.8%	55.9%	56.4%
Licensing (with or without exports)	7.1%	7.6%	7.3%	9.2%	8.8%	7.9%
US foreign affiliate firms in developing countries						
No exports or licensing	41.8%	42.0%	39.0%	38.2%	30.4%	30.9%
Export only	56.0%	53.7%	56.7%	56.1%	64.2%	64.3%
Licensing (with or without exports)	2.2%	4.3%	4.3%	5.7%	5.4%	4.8%

Notes: The table indicates the percentage of foreign affiliates during a given year that had (1) no exports or licensing fee income; (2) exports only (with no licensing); or (3) at least had licensing fee income. The classification of developed and developing countries is based on that of the United Nations Conference on Trade and Development *Handbook of Statistics 2006–7*. Maximum number of firms = 4765 (in both developed and developing countries).

share of affiliates in developing countries that participate in licensing is still below that of affiliates in developed countries, suggesting that there is more technological catching up to do on the part of affiliate firms in developing economies.

Figure 1 corroborates the shift in the licensing activities of affiliates. The figure shows the ratio of licensing payments made by affiliates to the licensing receipts earned by affiliates. This ratio has been trending downward. For example, in the late 1980s, for every dollar of licensing income, affiliates in developed countries paid ten times more to use the technology or other intangible assets of other companies. By the late 2000s, affiliates paid just about four times more. Likewise, for affiliates in developing countries, their technological balance of payments has improved.[15] These trends indicate that affiliate firms have reduced their relative

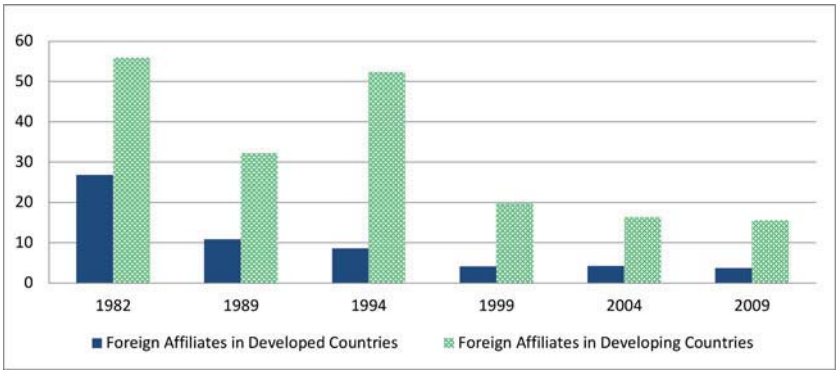

Figure 1. Ratio of licensing payments to licensing receipts.

dependence on other firms' technologies and have become sources of technology transfer to others.

5. Empirical results

Our primary objective is to test whether the strength of patent protection promotes the outward orientation of firms, controlling for other factors. We have two approaches for examining this issue. First, our Bivariate Tobit model relates the volume of an affiliate's exports and licensing to the strength of patent rights and other factors (i.e. intensive margin). Second, our ordered probit model studies the mode of sales (i.e. extensive margin).

Before proceeding, we address another potential selection bias, namely that patent reform occurs in those countries where foreign affiliates actively engage in exporting and licensing. Countries that engage in relatively high levels of technological innovation and exchange may have stronger incentives to enhance their patent systems, and vice versa. We therefore test for endogeneity between patent rights and firm exports and licensing, but conclude that we cannot reject our assumption that patent rights are exogenous. These results are summarized in Table 3. As instrumental variables for patent rights, we used indicators of legal origins, political rights, and governance, since patent systems are built on existing legal and institutional foundations.[16]

An F-test of the excluded regressors (in a regression of the natural log of the patent rights index on the included and excluded regressors) indicates that the instruments are jointly significant (p-value = 0.000). Next, Sargan–Hansen overidentification tests failed to reject the null hypothesis of instrument validity; that is, the residuals from each instrumental variable (IV) regression (of exports and licensing) were regressed on the included and excluded regressors, and we could not reject the null hypothesis that the coefficient estimates of the excluded regressors are jointly zero (suggesting no correlation between the IV residuals and the instruments). Last, Durbin—Wu–Hausman tests failed to reject the null hypothesis of no simultaneity between patent rights and exports (or licensing); that is, we could not reject the null hypothesis that the coefficient estimate of the IV residuals in the Bivariate Tobit equations is zero. One reason for the lack of simultaneity between patent rights and exports (or licensing) is that individual firm decisions have a small influence on the national setting of patent rights. Another reason is that the patent rights variable precedes the dependent variables by a few years (e.g. the 2009 data on exports and licensing are matched to the 2005 year level of patent rights, and so on, as indicated earlier).

5.1. Bivariate regression results

The first set of results is contained in Table 4. The first column shows estimates of the export equation and the second shows those of the licensing equation. The results support the view that outward orientation is driven by the environment

Table 3. Tests of endogeneity between patent rights and the dependent variables.

Included regressors	Coefficient	Std. error
First stage dependent variable: patent rights		
ln R&D	0.0005**	(0.0002)
ln capital	−0.0009**	(0.0004)
ln productivity	0.0076**	(0.0039)
ln GDP	0.0361***	(0.0012)
Past export only	0.0003	(0.0021)
Past license only	0.0022	(0.0039)
Past export & license	−0.0010	(0.0042)
Constant	0.0954***	(0.0333)
Industry dummies	Yes	
Year dummies	Yes	
Country dummies	Yes	
Number of observations:	10,469	
Instrumental variables		
Governance indicators index	0.0628***	(0.0026)
Political rights index	0.2558***	(0.0141)
Legal origin (French)	0.0335***	(0.0034)
Legal origin (German)	−0.0226***	(0.0028)
Legal origin (UK)	−0.0155***	(0.0041)
F-test of instruments: Prob > F	0.0000	
	Export equation	Licensing equation
Second stage overidentification tests of instrumental variables		
Hansen J Statistic: Chi-sq(4) *p*-value	0.6208	0.1455
Durban–Wu–Hausman: Chi-sq(1) *p*-value	0.2241	0.3779

Notes: Robust standard errors (clustered by country and year) are in parentheses. ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively. Scandinavia is the comparison for the legal origin dummies. The index of governance is the aggregation of the governance indicators (i.e., for regulatory quality, government effectiveness, rule of law, control of corruption, voice and accountability, and political stability). Data sources are described in Appendix 2. The test was conducted on the full sample of firms.

for innovation. Patent rights are positively and significantly associated with the exports and licensing of affiliate firms (at the 1% level of significance), controlling for other factors. The coefficient estimates show that licensing is more sensitive to patent rights than exports. This is reasonable since licensing is more explicitly connected to IPRs in an integral way. Indeed, what is often being licensed is intellectual property or an intangible asset, such as an industrial process, a patented technology, musical work, film, books, trademark, franchise, or software. Thus, the very core of a licensing contract involves a knowledge good. Exports are much more wide-ranging, from non-high tech goods (such as footwear and apparel) to very high-tech goods (such as office equipment and aircraft parts).[17]

These results are qualitatively similar if we use alternative measures of IPRs derived from the *Economist Intelligence Unit* (EIU) survey (see columns III and IV)

Table 4. Bivariate Tobit – full sample of affiliate firms in all countries.

	I ln exports	II ln licensing	III ln exports	IV ln licensing	V ln exports	VI ln licensing
ln patent rights	0.96***	3.10***				
	(0.31)	(1.01)				
ln EIU IPR Survey			0.99***	2.46**		
			(0.26)	(0.94)		
ln WEF IPR Survey					1.22***	2.92**
					(0.46)	(1.39)
ln R&D	0.17***	0.48***	0.18***	0.51***	0.21***	0.51***
	(0.02)	(0.06)	(0.02)	(0.06)	(0.04)	(0.08)
ln capital	0.57***	0.57***	0.56***	0.60***	0.61***	0.68***
	(0.03)	(0.09)	(0.04)	(0.10)	(0.05)	(0.12)
ln productivity	5.89***	6.62***	5.86***	6.94***	7.06***	7.42***
	(0.53)	(0.95)	(0.55)	(1.01)	(0.82)	(1.25)
ln GDP	−0.24**	−0.47	−0.21	−0.48	−0.25*	−0.18
	(0.10)	(0.31)	(0.15)	(0.42)	(0.15)	(0.41)
Past export only	6.22***	0.16	6.23***	0.23	5.55***	0.53
	(0.22)	(0.40)	(0.23)	(0.43)	(0.28)	(0.51)
Past license only	−0.47	10.96***	−0.38	10.99***	−0.38	9.42***
	(0.48)	(0.85)	(0.50)	(0.94)	(0.63)	(1.01)
Past export & license	0.17	−0.99	−0.16	−1.38	0.03	−1.78
	(0.52)	(0.96)	(0.54)	(1.04)	(0.68)	(1.33)
ln tax rate	−1.40***	0.30	−1.13**	0.31	0.15	0.86*
	(0.65)	(0.43)	(0.57)	(0.46)	(0.45)	(0.51)
Constant	−16.19***	−27.54***	−24.99***	−31.49***	−32.09***	−35.92***
	(2.72)	(8.15)	(4.88)	(12.14)	(4.04)	(10.11)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Trade agreement dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,843	13,843	12,991	12,991	8121	8121
rho	0.024		0.023		0.01	
	(0.018)		(0.019)		(0.020)	

Notes: Robust standard errors, clustered by country and year, are in parentheses. ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively. Industry dummies: NAICS. Trade/economic agreement dummies: Andean, Apec, Asean, Caricom, Comesa, EU, NAFTA, Mercosur. *rho* is the correlation coefficient between the residuals of the export and licensing equations. IPR Survey refers to the index of intellectual property rights conducted by an Economist Intelligence Unit survey. The sample period is 1982–2009.

Correlation: patent rights and WEF survey = 0.70; patent rights and EIU survey = 0.70; EIU and WEF surveys = 0.90.

See Appendix 2 for data sources.

and the *World Economic Forum* (WEF) survey (see columns V and VI). The similarity of results is not too surprising since the EIU and WEF survey measures and our patent rights index are highly correlated (see the bottom of Table 4). Our patent rights index, however, exhibits more data variability. Its coefficient of variation is 0.44 compared to 0.39 for the EIU IPR survey measure and 0.33 for the WEF IPR survey measure.

Table 4 also shows that the effect of productivity on exports and licensing is consistently positive and strongly significant. This supports the findings of Melitz (2003), Helpman, Melitz, and Yeaple (2004), and others, which conclude that it is the most productive firms that participate in trade, but extends the importance of firm productivity to outward licensing as well. The effect of the capital stock and R&D expenditures on exports and licensing is also consistently positive and significant. The impact of capital is relatively stable across the export and licensing decisions, while the impact of R&D on licensing is larger than its impact on exports (i.e., comparing a coefficient of about 0.48 versus about 0.17), due likely to the greater role of knowledge capital in licensing contracts. Local market size, as proxied by the GDP, has a negative influence, suggesting that in smaller local markets, firms are more likely to pursue foreign markets (all else held constant); however, the coefficient estimates of GDP are only weakly significant, if at all.[18]

Other control variables in Table 4 also provide insight into the outward orientation of firms. For example, past exporting is a significant determinant of exports and past licensing is a significant determinant of licensing. As discussed earlier, if sunk costs are substantial, we should expect current export status to depend on past participation in exporting, and the same for licensing. Sunk costs of entry create persistence in the decisions to export or license. Interestingly, the coefficient estimate of past licensing in the licensing equation is larger than the coefficient estimate of past exporting in the export equation. Thus, licensing status exhibits more persistence, which is consistent with our assumption that the sunk and fixed costs associated with licensing tend to be larger than those associated with exporting. But note that past participation in exporting is not a significant determinant of a firm's licensing, nor is past participation in licensing a significant influence on a firm's exporting. This suggests that 'experience' in technology transfer is activity-specific; that is, knowledge gained from exporting and knowledge gained from licensing are imperfect substitutes.[19]

In Table 5, we estimate the bivariate model for different sub-samples of the data: foreign affiliates in developed countries and those in developing countries. A list of countries by level of development is shown in Appendix 2. By splitting the sample this way, we do find some differences in results by the level of economic development. As with the sample as a whole (i.e., countries all pooled), patent protection, R&D, capital, and productivity are all strong, positive influences on the exports and licensing of firms in developed countries. In developing countries, though, patent protection has a positive influence on the exporting and licensing of affiliates, but this effect is statistically significant at lower levels than for affiliates in developed countries, and only at conventional levels for the licensing of developing

Table 5. Bivariate Tobit – subsamples of affiliate firms in developed and developing countries.

	Developed countries		Developing countries	
	I ln exports	II ln licensing	III ln exports	IV ln licensing
ln patent rights	0.90**	2.54**	0.64	3.74**
	(0.36)	(1.17)	(0.54)	(1.68)
ln R&D	0.18***	0.49***	0.08**	0.30*
	(0.02)	(0.06)	(0.04)	(0.16)
ln capital	0.56***	0.57***	0.60***	0.30
	(0.03)	(0.09)	(0.07)	(0.33)
ln productivity	5.85***	6.53***	7.08***	11.55**
	(0.54)	(0.95)	(0.89)	(3.58)
ln GDP	−0.21*	−0.44	−0.31***	−1.20**
	(0.12)	(0.34)	(0.11)	(0.52)
Past export only	6.23***	0.15	5.47***	0.04
	(0.22)	(0.40)	(0.29)	(1.20)
Past license only	−0.54	10.88***	−0.57	8.08***
	(0.49)	(0.87)	(0.96)	(2.23)
Past export & license	0.25	−0.99	0.75	4.02
	(0.53)	(0.97)	(1.11)	(2.64)
ln tax rate	−2.00**	0.40	−1.54	−0.42
	(0.89)	(0.38)	(2.12)	(7.86)
Constant	−16.61***	−25.54***	−17.80***	−17.71
	(3.15)	(8.35)	(2.99)	(12.17)
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Trade agreement dummies	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes
Country-specific time trend	Yes	Yes	Yes	Yes
Observations	10,200	10,200	3643	3643
rho	0.030*		−0.033	
	(0.018)		(0.039)	

Notes: Robust standard errors, clustered by country and year, are in parentheses. ***, **, and * indicate significance levels of 1%, 5%, and 10% respectively. Industry dummies: NAICS. Trade/Economic Agreement dummies: Andean, Apec, Asean, Caricom, Comesa, EU, NAFTA, Mercosur. *rho* is the correlation coefficient between the residuals of the export and licensing equations. The sample period is 1982–2009.

country affiliates. The result that IPRs have greater statistical significance for developed countries than for developing countries is quite consistent with existing work.[20] As Kim et al. (2012) argue, IPRs in developing economies work best when some adequate technological capabilities are present, so as to enable firms to utilize an IP system. Firms in developing economies are largely reliant on technological imitation and learning. Affiliates in developing countries do not, in general, possess the technological capabilities of their counterparts in developed countries. Thus, while IPRs may foster the growth of an innovative sector, they

may also inhibit technological adaptation and imitation, and therefore not produce the same strong effect on local production.

The finding that IPRs in developing countries have a greater statistically significant effect on affiliate licensing than on affiliate exporting occurs for the reasons previously mentioned in our discussion of Table 4, as well as because the exports of developing country affiliates traditionally contain relatively lower technological content than developed country exports (for example, they may be labor-intensive goods or primary commodities, and the like), and thus are not as sensitive to intellectual property protection as the intangible assets that affiliate firms license.

Table 6 further considers the robustness of our results by employing an alternate estimation methodology; namely, a standard panel data estimation with affiliate fixed effects and country-specific time trends to account for exogenous changes in economic development that may spur exporting and licensing. This analysis is included to ensure that the previous results are not being driven by cross-sectional differences across firms, and allows us to capture these effects within firms over time. As shown in Table 6, under this alternate estimation methodology, the strength of the domestic patent rights remains a strong and statistically significant determinant of a firm's volume of exports and licensing, except in the case of exports by affiliate firms in developing countries – which is a finding consistent with that of Table 5. In addition, R&D expenditures and firm productivity continue to exhibit a strong, positive influence on the outward orientation of firms.

5.2. Ordered probit results

In Table 7, we study how a strengthening of patent protection and other innovation factors generate an ordered response by affiliate firms to export and license. We anticipate a sequential pattern whereby the firms sell locally, then export, and then license, as patent rights and innovative capacity expand.[21] The reason is that there are fixed and sunk costs of participating in foreign markets, and that these costs associated with licensing, such as contractual costs and rent dissipation risks, tend to be greater than those associated with exporting. This is important for policy in that it shows how the outward orientation of firms evolves. Firms do not become licensors of technologies right away. Rather, as patent reforms occur and R&D and productivity are enhanced, affiliate firms in initially weak patent regimes become exporters, and then build upon that experience to become licensors as patent rights and innovative capacities strengthen further, controlling for other factors. As the results in Table 7 show, this sequential pattern is quite significantly exhibited in the data. Expansions in firm-level R&D, capital stock, and productivity, and a strengthening of patent protection, all increase the likelihood that firms will transition from local sales to exporting, and then to licensing.

In Table 8, we compute the marginal effects of patent protection, R&D, and firm productivity on the probabilities of exporting and/or licensing, using the estimates in Table 7. The table shows the effects by country group. We are particularly

Table 6. Standard panel regression with firm fixed effects.

	Affiliate firms in all countries		Affiliate firms in developed countries		Affiliate firms in developing countries	
	I ln exports	II ln licensing	III ln exports	IV ln licensing	V ln exports	VI ln licensing
ln patent rights	0.95***	0.30***	0.99***	0.32***	0.41	0.20***
	(0.21)	(0.07)	(0.26)	(0.08)	(0.36)	(0.08)
ln R&D	0.17***	0.07***	0.17***	0.07***	0.09***	0.02**
	(0.02)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)
ln capital	0.44***	0.06***	0.44***	0.06***	0.46***	−0.01
	(0.02)	(0.01)	(0.02)	(0.01)	(0.05)	(0.02)
ln productivity	4.43***	0.63***	4.43***	0.63***	5.14***	0.59***
	(0.32)	(0.07)	(10.33)	(0.07)	(0.60)	(0.15)
ln GDP	−0.17**	−0.05***	−0.15*	−0.06***	−0.22***	−0.06***
	(0.07)	(0.02)	(0.08)	(0.02)	(0.07)	(0.02)
Past export only	3.03***	−0.07***	3.03***	−0.07***	2.88***	0.01
	(0.13)	(0.03)	(0.14)	(0.03)	(0.20)	(0.05)
Past license only	−0.41*	1.49***	−0.43*	1.52***	−0.27	0.41*
	(0.24)	(0.20)	(0.24)	(0.21)	(0.49)	(0.22)
Past export & license	0.36	0.42*	−0.39	0.39*	0.52	1.07***
	(0.28)	(0.23)	(0.28)	(0.23)	(0.65)	(0.37)
ln tax rate	−0.02	0.05*	−0.05	0.05*	0.48	0.11
	(0.13)	(0.03)	(0.14)	(0.03)	(1.36)	(0.25)
Constant	−8.52***	−0.83*	−9.03***	−0.73	−8.34***	−0.05
	(1.83)	(0.49)	(2.11)	(0.56)	(2.04)	(0.56)
Firm dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Trade agreement dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,843	13,843	10,200	10,200	3643	3643

Notes: Robust standard errors, clustered by country and year, are in parentheses. ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively. Industry dummies: NAICS. Trade/economic agreement dummies: Andean, Apec, Asean, Caricom, Comesa, EU, NAFTA, Mercosur.

interested in examining the marginal effects on the second mode of entry (i.e., $\Pi = 2$, or the 'exports and no licensing' mode) since the net effect of increased patent strength on this mode is ambiguous. While more local sellers could become exporters, more exporters could switch out of exporting only and into licensing (or into jointly exporting and licensing). The results in Table 8 indicate that the increase in exporting and licensing comes at the expense of firms just selling locally, as the negative marginal effects suggest for mode $\Pi = 1$. In other words, as patent protection rises, there are more affiliate firms doing both licensing and exporting,

Table 7. Ordered Probit analysis: choice between exporting and licensing.

	I Affiliate firms in in all countries	II Affiliate firms in developed countries	III Affiliate firms in developing countries
ln patent rights	0.277***	0.254***	0.228***
	(0.06)	(0.07)	(0.10)
ln R&D	0.057***	0.058***	0.034***
	(0.00)	(0.00)	(0.01)
ln capital	0.0962***	0.095***	0.094***
	(0.01)	(0.01)	(0.01)
ln productivity	0.804***	0.784***	1.162***
	(0.08)	(0.08)	(0.18)
ln GDP	−0.047**	−0.040*	−0.076***
	(0.02)	(0.02)	(0.03)
ln tax rate	−0.172*	−0.200*	−0.358
	(0.10)	(0.12)	(0.38)
Threshold 1	1.71***	1.82***	1.38***
	(0.52)	(0.60)	(0.66)
Threshold 2	3.73***	3.83***	3.65***
	(0.51)	(0.59)	(0.65)
Industry dummies	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes
Trade agreement dummies	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes
Country-specific time trend	Yes	Yes	Yes
Observations	13,843	10,200	3643

Notes: Robust standard errors, clustered by country and year, are in parentheses. ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively. Industry dummies: NAICS. Trade/economic agreement dummies: Andean, Apec, Asean, Caricom, Comesa, EU, NAFTA, Mercosur. The Pseudo R^2 equals one minus the ratio of the log-likelihood of the full model to the log-likelihood of the intercept only model. Firms have the following ordered choices: (1) no exports or licensing; (2) exports (with no licensing); and (3) licensing (with or without exporting). Large firms refer to affiliates with above median value added in the host country, while small firms refer to firms with below (or equal to) median value added in the host country. The sample period is 1982–2009.

as well as more affiliate firms just doing exports. Throughout, these firms that export or license, or do both, are also selling locally, but not exclusively as when patent rights are too low. Similarly, an increase in firm R&D or firm productivity has the effect of diverting affiliate firm activity away from exclusively producing for the local market to exporting and licensing.

Table 8 also compares the predicted frequencies of each mode to the actual frequencies. The predicted frequencies are quite close to the actual. If anything, our model overpredicts exporting and underpredicts licensing. Both the actual and predicted frequencies indicate that firms engage in more exporting than licensing. Affiliate firms in developed countries are more likely to engage in licensing than affiliate firms in developing countries.

Table 8. Marginal effects from Ordered Probit estimates.

Variable	Outcome #1: no exports or licensing	Outcome #2: exports (no licensing)	Outcome #3: licensing (with or without exports)
Affiliate firms in developed countries			
ln patent rights	−0.093***	0.066***	0.028***
ln R&D	−0.021***	0.015***	0.006***
ln productivity	−0.289***	0.204***	0.085***
Predicted probabilities	34.5%	60.2%	5.3%
Actual frequencies	38.0%	53.8%	8.2%
Affiliate firms in developing countries			
ln patent rights	−0.084**	0.068**	0.016**
ln R&D	−0.013***	0.010***	0.002***
ln productivity	−0.428***	0.348***	0.080***
Predicted probabilities	34.5%	62.4%	3.1%
Actual frequencies	38.9%	56.6%	4.5%

Notes: The sample period is 1982–2009. ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively. The calculations are based on columns (2)–(3) of Table 7.

5.3. Industry subgroups

As our last area of exploration, we consider how our findings may differ across industries. Detailed analysis by sector is difficult to conduct, as there are not enough observations by country and industry to provide sufficient spatial variation in IPR levels. We therefore focus more on meta-groups of industries, such as total manufacturing and total non-manufacturing. Within the group of manufacturing firms, we present results for two subsectors: *chemicals* and *machinery and equipment*. Table 9 reports the Bivariate Tobit results for the sectoral analysis.

A comparison between the manufacturing and non-manufacturing sectors shows that patent rights and innovation-related factors are more important to the exporting and licensing of affiliate firms in manufacturing (see columns I – IV of Table 9). The results for the manufacturing sector reflect the results of the pooled sample (from Table 4). In the non-manufacturing sector, patent protection significantly influences licensing but not exports. One reason is that *services* are in the non-manufacturing sector. Intellectual property rights are quite important in licensing activities related to technical, professional services, and consulting. A US Patent and Trademark Office and Economics and Statistics Administration (2012) study identified scientific research and development, management and technical consulting, and business support services to be among the intellectual property-intensive service industries.

As expected, affiliate firms in the chemical sector are large drivers in the results for patent rights among manufacturing firms, especially in the export decision (see columns V and VI in Table 9). Chemical products are well known to be relatively easy to imitate or reverse engineer, and therefore sensitive to

Table 9. Bivariate Tobit – industry sub-samples of all affiliate firms.

	Manufacturing		Non-manufacturing		Chemicals		Industrial machinery	
	I ln exports	II ln licensing	III ln exports	IV ln licensing	V ln exports	VI ln licensing	VII ln exports	VIII ln licensing
ln patent rights	0.91***	2.42**	0.60	4.49**	1.31***	3.55**	−0.10	−2.34
	(0.33)	(1.11)	(0.73)	(2.19)	(0.50)	(1.50)	(0.71)	(3.22)
ln R&D	0.14***	0.40***	0.32***	0.72***	0.08***	0.49***	0.25***	0.49***
	(0.02)	(0.05)	(0.04)	(0.13)	(0.02)	(0.09)	(0.03)	(0.14)
ln capital	0.74***	0.55***	0.38***	0.50***	0.75***	0.42**	0.80***	0.70**
	(0.05)	(0.14)	(0.05)	(0.12)	(0.06)	(0.19)	(0.07)	(0.34)
ln productivity	4.44***	4.90***	7.88***	10.14***	6.01***	5.43**	2.55***	2.75
	(0.57)	(1.49)	(0.75)	(1.45)	(0.74)	(2.29)	(0.77)	(3.27)
ln GDP	−0.29***	−0.50	−0.35*	−0.53	−0.15	−0.59	−0.38	−1.49
	(0.10)	(0.36)	(0.21)	(0.59)	(0.14)	(0.53)	(0.24)	(1.24)
Past export only	4.69***	0.58	8.89***	−0.71	4.79***	−0.71	3.24***	−1.07
	(0.22)	(0.63)	(0.29)	(0.69)	(0.29)	(0.87)	(0.44)	(1.19)
Past license only	−0.93	10.52***	−0.38	11.68***	−1.32	8.18***	−3.18	13.21***
	(0.73)	(1.02)	(0.79)	(1.14)	(1.00)	(1.42)	(2.05)	(2.58)
Past export & license	0.80	−1.45	−0.23	0.31	0.93	0.56	3.00	−5.39*
	(0.77)	(1.15)	(0.86)	(1.58)	(1.03)	(1.57)	(2.09)	(2.79)

(*continued*)

Table 9. (*Continued*).

	Manufacturing		Non-manufacturing		Chemicals		Industrial machinery	
	I ln exports	II ln licensing	III ln exports	IV ln licensing	V ln exports	VI ln licensing	VII ln exports	VIII ln licensing
ln tax rate	−3.52***	1.09	0.07	0.14	−3.79**	2.61	−3.30*	6.19
	(1.17)	(0.86)	(0.33)	(0.97)	(1.89)	(6.06)	(1.87)	(3.84)
Constant	−9.06***	−17.53**	−15.15***	−27.64*	−15.01***	−16.65	0.88	11.62
	(2.74)	(8.76)	(5.35)	(14.57)	(3.71)	(12.34)	(5.99)	(30.75)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trade agreement dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7194	7194	6649	6649	2981	2981	1824	1824
rho	0.023		0.021		0.071**		0.049	
	(0.024)		(0.028)		(0.035)		(0.052)	

Notes: Robust standard errors, clustered by country and year, are in parentheses. ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively. Trade/economic agreement dummies: Andean, Apec, Asean, Caricom, Comesa, EU, NAFTA, Mercosur. *rho* is the correlation coefficient between the residuals of the export and licensing equations. The sample period is 1982–2009.

patent protection. The chemical industry has been a key beneficiary of global patent reforms, given the fact that many countries prior to joining the World Trade Organization and agreeing to the patenting guidelines outlined by the *Trade Related Aspects of Intellectual Property Rights* (TRIPS) agreement did not allow for the patenting of certain chemicals and/or pharmaceuticals; thus, from the perspective of the chemical industry, drastic improvements have occurred in their intellectual property rights, which should have enhanced their incentives for innovation and commercialization.

Unlike in the chemical industry, patent rights are found to play no statistically significant role in the outward orientation of firms in the machinery and equipment sector (see columns VII and VIII of Table 9). This sector is relatively capital-intensive, particularly in specialized capital equipment. For purposes of appropriating the returns to commercialization, the high setup costs in this industry may be a natural barrier against imitation (see Nicholson (2007)) and reduce the need for patent protection. Nonetheless, patent rights may indirectly matter to the extent that they stimulate R&D and productivity, both of which are strong determinants of exporting and licensing in this industry. In all, Table 9 provides precursory insight into the varying role of patent rights and innovation in the outward orientation of affiliate firms across different industries. These points are worthy of continued examination in future research.

6. Conclusion

In previous research, the beneficial effects of patent rights have been evaluated from the perspective of how patent protection can encourage inward technology transfer. This paper adds another dimension to the debate. It shows that patent policies and innovation activities influence the ability of firms to become sources of technology transfer, via exports or licensing. Stronger patent rights affect outward technology transfers, not only indirectly through increased R&D and increased productivity, but also directly by encouraging firms to commercialize their innovations and make their products (or technologies) available for exporting and licensing. R&D and firm-level productivity are consistently important determinants of the exporting and licensing of firms. Patent rights contribute to outward flows where the technological content of products or knowledge assets is high enough to require protection against misappropriation. Thus, patent protection has a positive, but statistically weak, effect on the firm-level exports of developing countries but a positive and statistically significant effect on the firm-level licensing of those economies. The paper also finds that the outward orientation of firms contributes to their future productivity. Specifically, past participation in exporting and licensing is a source of learning and augments firm productivity, and increased firm productivity in turn enhances a firm's capacity to export and license.

In addition, we find the outflows of technology to occur sequentially, with firms typically selling locally before exporting, and then eventually licensing

(domestically and/or abroad) as patent protection levels rise, controlling for other factors. The reason behind this sequential pattern is the presence of fixed and sunk costs of exporting and licensing, in which the costs associated with licensing, such as contractual costs and rent dissipation risks, tend to be greater than those associated with exporting. Thus, the threshold level of profitability that induces licensing is typically higher than that for exporting. The significance of increased outward technology transfer activities is several, but we will highlight two things. First, it reflects the growth in the innovative capacities of local affiliate firms, particularly where patent regimes are strong. Second, outward oriented firms can be a source of technology spillovers to domestic firms and provide linkages to global markets.[22] This is an important channel of influence for patent and innovation policies that has not been thoroughly analyzed.

We conclude with a few suggestions for further research. This paper focused on an affiliate's trade with the rest of the world. Future research could focus on the issues from a bilateral or regional trade framework in order to study the effects of IPR provisions in bilateral or regional agreements. Future research could also continue to investigate the industry differences that influence the role of patent rights on the outward orientation of firms, including case studies of particular products or technologies. Last, it would be useful to study other mechanisms for technology transfer, namely foreign direct investment (FDI). Using data, for example, on inward FDI into the US market, future work could examine how innovation policies abroad affect the ability of foreign parent firms to invest in the US.

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Notes

1. For example, Maskus and Penubarti (1995), Smith (1999), Co (2004), Awokuse and Yin (2010), Ivus (2010), Foster (2012), and Briggs (2013) study the effect of patent reform on imports, while Smith (2001), Yang and Maskus (2001), Javorcik (2004), Nunnenkamp and Spatz (2004), Park and Lippoldt (2005), Nicholson (2007), and Branstetter et al. (2011) study the effects on inward foreign direct investment (FDI) and/or licensing.
2. For example, see Chen and Puttitanun (2005) and Kanwar and Evenson (2003).
3. For example, see Aw, Roberts, and Xu (2011), Caldera (2010), Grossman and Helpman (1989), Helpman, Melitz, and Yeaple (2004), Lileeva and Trefler (2010), and Melitz (2003).

4. See Eaton and Kortum (1996), Lai and Qiu (2003), and Mondal and Gupta (2006) for similar formulations in which stronger patent protection affects a firm's ability to appropriate its profits.
5. Other research work supports the view that source factors matter to exporting. Anderson and van Wincoop (2003) and Helpman, Melitz, and Rubinstein (2008) argue that domestic factors can shape the home environment that influences the export decision. Krugman (1980) showed under monopolistic competition and international transportation costs that larger markets attract the entry of new product varieties and ultimately result in increased exports. Our study is consistent with this 'home market effect' in that stronger IPRs are equivalent to an expansion of markets (as well as an increase in market power), and new varieties are often the result of increased innovation.
6. Due to the *Trade-Related Aspects on Intellectual Property Rights* (TRIPS) agreement, IPR levels across the world have generally risen. This creates a positive correlation among the increases in IPR levels of trading partners. Thus, to better isolate the effects of host country IPRs, we control for time fixed effects and host country involvement in popular trade agreements, which often contain sections related to IPRs.
7. Dischinger and Riedel (2011) and Karkinsky and Riedel (2012) suggest that the lack of transparency in the transfer pricing of intangible assets within corporations, coupled with incentives to increase corporate profits, creates an incentive for corporations to locate their intellectual property at affiliate firms with low corporate tax rates. This might imply that affiliates with low tax rates have a greater relative stock of intangible assets, and thus experience inherently greater outflows of exports and licensing as a result. We control for this possibility by including the tax rate as a regressor in our estimations. Overall, even when controlling for the tax rate, IPRs and other innovation factors remain important determinants of affiliate exports and licensing.
8. Eight such dummies are included as regressors: the Andean Community of Nations (Andean), Association of Southeast Asian Nations (ASEAN), Caribbean Community and Common Market (Caricom), Common Market for Eastern and Southern Africa (COMESA), European Union (EU), North American Free Trade Agreement (NAFTA), Southern Cone Common Market (Mercosur), and Asia-Pacific Economic Cooperation (APEC). Each dummy equals one if a country is a member.
9. Net income is defined as gross income minus total costs and expenses. The reason the tax base used is net income, rather than gross income, is to obtain a measure of taxable income. Countries vary in terms of their statutory tax rates and regulations on tax deductions, so that gross income would not consistently measure what is taxable.
10. A number of affiliates in the sample sequentially switch from exporting to licensing, which may suggest that licensing displaced exporting as the means of foreign sale. If so, technology is being licensed outside the host country.
11. The nominal data are deflated by the BEA's private GDP deflator. Purchasing power parity dollars are obtained by applying the World Bank's PPP conversion factors to market exchange rates. We convert measures to PPP dollars because market exchange rates do not take into account differences in the costs of goods across countries.
12. Growing evidence suggests that the decision-making of affiliates is often decentralized (Garnier 1982; Beechler et al. 1995) and that decentralization is a growing trend (Malone 2004). Indeed, Robinson and Stocken (2011) find that a majority of foreign affiliates of US multinationals exhibit autonomy. Gupta and Govindarajan (1994), in particular, find that it is the innovative activity of foreign affiliates that tends to be independent from that of the parent firm. Damijan and Kostevc (2010) concur but find that access to parent R&D does appear to complement innovative ventures by affiliate firms. A common element among these studies seems to be that where managers of

affiliates require a great deal of local information and contacts to perform efficiently, parent firms tend to delegate decision-making to their affiliates (Dunning and Lundan 2008).

13. In an earlier version, we used a larger sample of foreign affiliates where we did not distinguish between decentralized and centralized decision-making. The results were strikingly similar to those in this paper. However, we chose to focus on the decentralized sample in order to avoid including any affiliates whose sales decisions might have come from the parent firm. The results are available upon request.
14. Coverage refers to the subject matter that can be patented, duration to the length of protection, and restrictions to conditions imposed on rights holders. Membership in international treaties indicates participation in international agreements. The enforcement component consists of mechanisms that aid in enforcing one's patent rights (such as preliminary injunctions against infringers). Each of these components is scored on a scale from 0 to 1 (reflecting the fraction of legal features that are available). The overall value of the patent rights index is the sum of the component scores.
15. Note the temporary spike in the ratio of licensing payments to receipts in 1994 for affiliates in developing countries. This may be the result of increased inward technology transfers owing to TRIPS, or in anticipation of the IPR reforms and related policy shifts of the late 1990s. We leave this for future research.
16. Legal (or colonial) origins have also been used as instruments for patent rights in Maskus and Penubarti (1995), Hu and Png (2009), and Ivus (2010).
17. Indirectly, though, some non-high tech exports could be sensitive to IPRs, due to the trade name or trademark of the product, or to the underlying patented method of production or patented ingredient used to make them.
18. Coefficient estimates of the trade agreement control variables are suppressed in the tables in order to conserve space. ASEAN, COMESA, and EU membership dummies were statistically significant; the rest were insignificant.
19. Maskus, Saggi, and Puttitanun (2005) point out that certain firm and country characteristics may be more conducive to different avenues of technology transfer, which may not be easily substitutable.
20. For a survey, see Maskus (2012), Chapter 2.
21. We have experimented with alternative ordered choices, and found the present sequence to fit the data best. The ordered response is dictated by the coefficient signs. The results are available upon request.
22. See Aitken, Hanson, and Harrison (1997), Greenaway, Sousa, and Wakelin (2004), and Pradhan, Das, and Paul (2011).

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Appendix 1. Endogenous firm-level productivity

The purpose of this appendix is to explain how we derived a measure of endogenous firm-level productivity. Implicit equations are used. Readers interested in detailed, explicit steps are referred to Aw, Roberts, and Xu (2011). Recall equation (2A) for the evolution of productivity in the text:

$$\omega_{it} = g\left(\omega_{it-1}, r_{it-1}, x_{it-1}, l_{it-1}\right) + \xi_{it}$$

where ξ_{it} is an independent identically distributed (iid) error term with mean zero and variance σ_{ξ}^{2}. Although including past productivity, R&D, and exports is consistent with the evolution of productivity detailed in Aw, Roberts, and Xu (2011), including the effect of past licensing on firm productivity is unique to our paper. Our view is that licensing can generate learning-by-doing and affect a firm's productivity in a way similar to that of exporting. First, licensors need to know their market – the technological needs and capacities of their customers, which they can better acquire through repeated interaction; that is, by engaging in licensing transactions. The feedback from the market better enables licensors to improve or adapt their technologies. The improved firm's technologies and knowledge base helps augment future firm-level productivity. Following Aw, Roberts, and Winston (2007), licensing activities can also help firms 'absorb, assimilate, and manage technical change.'

(1) First, firm revenue R is a positive function of firm productivity and the capital stock:

$$R_{it} = R(k_{it}, \omega_{it}) + u_{it} = R^1(k_{it}) + R^2(\omega_{it}) + u_{it}$$

where R is assumed to be a log-linear function of the variables and u represents an iid error term, due say to revenue or optimization errors. While ω_{it} is observable to the firm, both u_{it} and ω_{it} are unobservable to the econometrician, and hence the need for a way to separate them.

(2) Following Levinsohn and Petrin (2003), Doraszelski and Jaumandreu (2008), and Aw, Roberts, and Xu (2011), we use observed firm-level choices in variable inputs to control for unobserved productivity. A firm's choices of inputs should be a function of the firm's productivity realization, ω, and thus contain information about it. Hence, let unobserved productivity be a function of a vector of observed variables, z, conditional on the amount of capital available:

$$\omega_{it} = \omega(z_{it}|k_{it})$$

(3) Substituting the equation in step 2 into the revenue function in step 1 yields:

$$R_{it} = R(k_{it}, \omega(z_{it}|k_{it})) + u_{it} = h(k_{it}, z_{it}) + u_{it}$$

(4) Assume that the h in step 3 above is a cubic function of its arguments. Run an ordinary least squares (OLS) regression of revenue on them, and call the resulting fitted values, $\widehat{h}_{it}$.

(5) Comparing steps 1 and 3, we can make the following match:

$$\widehat{h}_{it} = R(k_{it}, \omega_{it})$$

(6) We next invert the above equation to get $\omega_{it} = \varpi(k_{it}, \hat{h}_{it})$ and as long as R is log-linear, ϖ is a linear function as well:

$$\omega_{it} = \varpi(k_{it}, \hat{h}_{it}) = \rho_k k_{it} + \rho_h \hat{h}_{it}$$

In order to derive a measure of firm-level productivity from this equation, estimates of ρ_k and ρ_h must first be obtained.

(7) As Aw, Roberts, and Xu (2011) show, ρ_h depends on demand elasticities. An estimate, $\hat{\rho}_h$, can thereby be obtained by running an OLS regression of revenues on total variable costs.

(8) Obtaining an estimate of ρ_k is somewhat more involved. This requires a functional form for g in the equation for the evolution of firm-level productivity; namely

$$g(\omega_{it-1}, r_{it-1}, x_{it-1}, l_{it-1}) = \zeta_0 + \zeta_1 \omega_{it-1} + \zeta_2 (\omega_{it-1})^2 + \zeta_3 (\omega_{it-1})^3 + \zeta_4 r_{it-1} + \zeta_5 x_{it-1} + \zeta_6 l_{it-1} + \zeta_7 r_{it-1} x_{it-1} + \zeta_8 r_{it-1} l_{it-1} + \zeta_9 x_{it-1} l_{it-1}$$

Substitute the function for unobserved productivity in step 6 – i.e., $\omega_{it} = \varpi(k_{it}, \hat{h}_{it}) = \rho_k k_{it} + \rho_h \hat{h}_{it}$– into the equation for the evolution of firm-level productivity. This yields the following implicit equation:

$$\hat{h}_{it} = \eta(\hat{h}_{it-1}, k_{it}, k_{it-1}, r_{it-1}, x_{it-1}, l_{it-1}) + \xi^*_{it}$$

A nonlinear least squares regression of h_{it} provides a coefficient estimate for k_{it} from which $\hat{\rho}_k$ can be isolated.

(9) With estimates of $\hat{\rho}_h$ and $\hat{\rho}_k$ from steps 7 and 8 in hand, we can now derive the measure of endogenous productivity, using the equation in step 6, as follows:

$$\hat{\omega}_{it} = \hat{\rho}_k k_{it} + \hat{\rho}_h \hat{h}_{it}$$

It is this productivity estimate that we use in our system of equations (5) and (6).

Appendix 2. Data sources and composition of data-set

Table A.2.1. Data sources.

Variable	Description	Source
Exports	Foreign sales (firm level)	BEA USDIA Survey
Licensing	Royalties and licensing receipts (firm level)	BEA USDIA Survey
R&D	Research and development performed (firm level)	BEA USDIA Survey
Capital	Net property, plant, and equipment (i.e. net of accumulated depreciation) (firm level)	BEA USDIA Survey
Tax rate	Taxes per net income (firm level)	BEA USDIA Survey
Productivity	Endogenous productivity estimated using the method described in Appendix 1 (firm level)	Estimated by authors
Labor	Total number of employees (firm level)	BEA USDIA Survey
Materials	Total sales (local plus foreign) minus value added; i.e. value of production net of intermediate inputs (firm level)	BEA USDIA Survey
Material	Total sales (local plus foreign) minus value added; i.e. value of production net of intermediate inputs (firm level)	BEA USDIA Survey
Domestic revenues	Local sales (firm level)	BEA USDIA Survey
Past exporting, past licensing	Dummy variables of whether the firm has exported, licensed in the previous period (firm level)	Estimated by authors
Patent rights	Index of the strength of patent protection (country level)	Park (2008)
EIU IPR Survey	Survey ratings of the enforcement of intellectual property rights (country level)	Economist Intelligence Unit (EIU) http://www.eiu.com
WEF IPR Survey	Survey ratings of level of intellectual property right protection (country level).	World Economic Forum, www.weforum.org

(*continued*)

Table A.2.1. (*Continued*).

Variable	Description	Source
Governance indicators	An aggregate index of regulatory quality, control of corruption, government effectiveness, rule of law, political stability, and voice and accountability (country level)	Kaufman, Kraay, and Mastruzzi (2009) and http://www.govindicators.org
Political rights	An index of political rights and civil liberties (country level)	Freedom House http://www.freedomhouse.org
Legal origin	Dummy variables for whether a country's legal origins are British, French, German, or Scandinavian (country level)	La Porta, Lopez-de-Silanes, and Shleifer (2008)
GDP, PPP conversion factor	Gross domestic product in constant 2000 dollars and purchasing power parity conversion factor (GDP) to market exchange rate ratio (country level)	World Bank *World Development Indicators*
Economic and trade agreements	Dummy variables of whether a country is a member of a trade or economic agreement: Andean, Apec, Asean, Caricom, Comesa, European Union, Mercosur, Nafta (country level)	Websites of agreements

Table A.2.2. Distribution of foreign affiliates by country.

Region	% Share of firms
Developed: Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Luxembourg, Malta, The Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom	71.1%
Developing countries: Algeria, Angola, Argentina, Bangladesh, Bolivia, Brazil, Bulgaria, Cameroon, Chile, China, Colombia, Congo (Dem. Rep.), Costa Rica, Czech Rep., Dominican Rep., Ecuador, Egypt, El Salvador, Ethiopia, Fiji, Gabon, Ghana, Guatemala, Guyana, Haiti, Honduras, Hong Kong, Hungary, India, Indonesia, Jamaica, Jordan, Kenya, Liberia, Lithuania, Malawi, Malaysia, Mauritius, Mexico, Morocco, Nicaragua, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Senegal, Singapore, Slovak Rep., South Africa, South Korea, Sri Lanka, Swaziland, Taiwan, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uruguay, Venezuela, Zimbabwe	28.9%
	100%