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ABSTRACT

Firms that engage in international transactions have been shown to outperform domestic firms in several dimensions. This paper studies the advantages of affiliates of multinationals to grow through an expansion in their range of products. I first develop a monopolistic competition model with multiproduct firms in which firms are heterogeneous in two dimensions: the fixed cost of developing new varieties and the variable cost of production. Multinationals have cost advantages because of economies of scale and learning by doing across countries. Using firm-level data for the Chinese manufacturing sector during 1998-2000, I compare the performance of foreign and domestic firms in terms of the new varieties that they introduce, and, as described in the model, I estimate whether the number of new varieties can be explained by differences in the cost of development and variable productivity. Controlling for size, I find that firms with more than 50 percent of foreign ownership introduce on average more than twice as many more new varieties of goods as private domestic firms. Advantages in productivity account for 33 to 45 percent of the difference in the number and sales of new varieties, while advantages in the cost of development account for 5 to 17 percent of these differences.

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1 Introduction

Firms that engage in international transactions have been found to outperform firms that only operate domestically in several dimensions. There is evidence that exporters are more productive, more capital and skill intensive, and pay higher wages than non-exporters (Clerides, Lach and Tybout, 1998, Bernard and Jensen, 1999, and 2004). Similarly, affiliates of multinational corporations have also been shown to outperform domestic firms in recipient countries in terms of wages (Feenstra and Hanson, 1997), while headquarters are thought to spend more in R&D and to have better rates of innovation and patenting than firms that do not operate abroad (Caves, 1996, and Markusen, 2002, describe traditional stylized facts; Criscuolo, Haskel and Slaughter, 2005, provide more recent evidence on innovation by multinational and exporting firms). Firms that get involved in international commerce are also thought to enjoy higher growth rates.

This paper focuses on a different dimension of heterogeneity among firms and explores the propensity of affiliates of multinational corporations to grow through an expansion in their range of products. In a world with differentiated products and economies of scope, it is natural for firms to attempt to capture larger market shares through diversification of varieties.[1] Among domestic and multinational firms, there could be systematic differences that predict different behaviors in terms of introduction of new varieties of goods.

Horizontal multinationals have a cost advantage in the expansion of their product range because of the fact that they introduce the same products in several countries. When a domestic firm is looking to introduce a new variety, it is faced with the full cost of development. An affiliate of a multinational, on the other hand, can introduce a variety that the same corporate group is already producing elsewhere. In the extreme, a firm that is producing a good abroad, can introduce that same good into the local market at zero marginal cost. In a less extreme case, local affiliates need to incur some development expenditures to adapt the good to the local market, advertise, and setup production. The initial cost of development, however, is diffused across countries and firms with production

[1] Bernard, Redding and Schott (2005) find that multiproduct firms account for 91 percent of output in the U.S. manufacturing sector.

in several countries can more cheaply introduce a new variety than firms that only operate in one place. Learning by doing in production setup can also help reduce the local costs.[2]

Similar arguments apply to technology to introduce new products that is obtained from outside sources; for example, by purchasing a license. If a license is valid to produce in many countries, then the license cost faced by a local affiliate is only a fraction of the total cost. In the case that a license is needed for each affiliate, it can be expected that by acquiring licenses for several affiliates multinationals will have more bargaining power than local firms and will be able to obtain the licenses at better prices.

When making a decision to expand their product range firms consider variable profits in addition to the costs of development discussed above. Multinational firms tend to enjoy technological advantages in the variable cost side that will make introduction of new varieties more profitable and thus worth paying the cost of development. One source of such advantage is learning by doing across countries. When a firm is producing a variety worldwide the different affiliates may benefit from improvements in production processes and organization abroad, which reduce variable costs. Firms that operate abroad may also be more productive because of selection. Melitz (2003) and Helpman, Melitz and Yeaple (2004) describe how transport costs and fixed costs of entry to foreign markets can only be incurred by the most productive firms. Eaton and Kortum (2002) and Bernard, Eaton, Jensen, and Kortum (2003) develop Ricardian models where the most productive firms, net of transport costs, are the only suppliers in a given market.

I formalize these ideas in a static partial equilibrium model of horizontal differentiation and monopolistic competition with firms that can choose to produce more than one variety. Firms are heterogeneous in two dimensions: they face different fixed costs of development and production setup of each variety, and they bear different marginal costs of production. Domestic firms and affiliates of multinationals are different in the distribution of these costs.

Firms enter the market and gather information about the cost of development and production of a given number of potential varieties, which depend on their average technical

[2] A similar idea is explored in Criscuolo, Haskel and Slaughter (2005), where firms that export or invest abroad have access to a larger stock of knowledge through contact with clients and suppliers and between affiliates.

efficiency in these two dimensions. They later decide which of these varieties to introduce based on deterministic potential profits and they incur the cost of development. Finally, they compete in prices facing independent residual demands for each variety and the associated variable costs of production. Foreign firms are on average more efficient than domestic firms.

A firm finds that introducing a particular variety is profitable when the cost of development is lower than variable profits. This is more likely to happen when a firm faces lower average costs of development and of production. On average more efficient firms introduce a larger number of goods than their less advantaged counterparts. The expected number of varieties introduced by one particular firm can be approximated by a Poisson distribution.

The model builds on Melitz's (2003) extension of Dixit and Stiglitz (1997) model of monopolistic competition where firms are heterogeneous in the cost of production. In this paper firms also differ in the cost of development, which explains why they choose to produce a different number of goods. The prediction of the model is that systematic differences in development and production efficiencies among foreign and domestic firms lead to differences in their expansion strategies through the number of varieties that they produce. Foreign affiliates will research more varieties and find that a larger fraction of those varieties is worth developing and introducing into the market.

I then apply the arguments described in the model to the study of the number of new varieties introduced by foreign and domestic manufacturing firms in China during the period 1998-2000. There are several reasons why China makes a good case study. The notion that multinational firms have a technical advantage due to repetition of production and introduction of varieties across countries applies best to countries that are recipients of FDI and where domestic firms do not generally invest abroad, not to countries where headquarters are located. China has received a considerable amount of FDI in the last decade accounting for about one third of FDI in all emerging markets and 60 percent of FDI in Asian emerging markets according to Prasad and Wei (2005). In 2003 China became the largest overall recipient of FDI in the world, a position that was previously occupied by the U.S. Additionally, a large fraction of FDI in China has taken place in the form of greenfield investment, as opposed to the acquisition of domestic plants by foreign firms. When a new production plant is set up from scratch there is more room for heterogeneity between foreign and domestic firms.

In this context new varieties are not innovation, but rather a horizontal expansion or renovation of the product portfolio of firms. The objective of the empirical section is to link product range expansion to technological differences. There are other reasons that can explain differences in product range expansion, mostly demand side explanations such as production for exporting and vertical differences across goods. The focus of this paper is to describe and quantify the contribution of technological factors.

Labor productivity and average expenditure in R&D and purchases of technology from outside sources are used as proxies for efficiency in production and development. Foreign firms do prove to be more efficient in both dimensions. Controlling for size I also find that firms with more than 50 percent of foreign ownership introduce on average more than twice as many new goods as private domestic firms. This advantage is enjoyed only by firms with foreign ownership that are indeed partially owned by a foreign firm, as opposed to firms that are merely owned by a foreign investor, indicating that the interaction among parents and affiliates creates a production efficiency. Advantages in productivity account for 33 to 45 percent of the difference in the number and sales of new varieties; while advantages in the cost of development account for 5 to 17 percent of these differences.

The hypothesis of economies of scale and learning by doing enjoyed by multinational firms cannot be formally tested. The data, however, provide some support to the idea that technical advantages of foreign firms go beyond selection: average productivity is higher for foreign firms even after restricting the distribution of domestic firms to have the same truncation point as foreign firms.

The remaining of the paper is organized as follows: Section 2 presents the model; Section 3 discusses the data and compares the performance of foreign and domestic firms in terms of number and sales of new varieties; Section 4 explores the differences in productivity and development costs and their link to the expansion of the product portfolio; Section 5 concludes.

2 A model of multiproduct firms

Consumers are identical and their preferences are represented by a CES utility function over a continuum of differentiated goods in $[0, n^*]$. Let q_i be the demanded quantity of variety i, and $\sigma > 1$ the elasticity of substitution across the different varieties; the utility function is

$$U = \left[\int_0^{n^*} q(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}. \tag{1}$$

Given the exogenous income y and prices p_i, the resulting demand function for each variety is

$$q_i = p_i^{-\sigma} P^{\sigma-1} y, \tag{2}$$

where P is the Dixit and Stiglitz price index defined by

$$P = \left[\int_0^{n^*} p(i)^{1-\sigma} di \right]^{\frac{1}{1-\sigma}}. \tag{3}$$

On the production side there is a continuum of firms indexed by j over the interval $[0, J]$. Each firm produces a measure $n(j)$ of differentiated varieties. The aggregate measure of different varieties n^* satisfies

$$n^* = \int_0^J n(j)\, dj. \tag{4}$$

Hereafter, I will refer to J, $n(j)$ and n^* as the number of firms and varieties; it should be understood that each is a continuum.

The production technology is represented by a cost function for each variety i produced by firm j that takes the form

$$C^{ij}(q_{ij}) = F_{ij} + c_{ij} q_{ij}. \tag{5}$$

F_{ij} is the fixed cost of developing and setting up production of variety i by firm j, while c_{ij} is the marginal cost of production.[3] For simplicity F_{ij} includes both the cost of R&D and the fixed cost of production. Note that the fixed and variable costs are not necessarily the

[3] In Dixit and Stiglitz (1977) firms are homogeneous, while in Melitz (2003) firms differ in their variable costs.

same for different varieties produced by a same firm.

The decision of how many varieties to develop and produce involves two steps. First, firms need to gather information on the characteristics of potential varieties (i.e. the cost function in equation (5)). Firms cannot gather information on an infinite number of varieties since this activity involves time and effort.[4] Learning the cost function of a number N_j of potential varieties has a cost $\gamma(N_j)$, where γ is a strictly increasing and convex function that satisfies $\gamma(0) = 0$. For simplicity the cost of information γ is the same for all firms. Once firms are aware of the costs of R&D and production of a number N_j of varieties they decide which of these varieties to introduce into the market. This decision is based on the profit opportunities that each variety presents.

The number of varieties introduced by each firm is small enough relative to the total number of varieties in the market. The effect of one firm in the aggregate price index is negligible and the index is taken as given in the profit maximization problem. Strategic effects across varieties produced by the same firm are disregarded as well, for the same reason. Under this assumption firms act as monopolists over a residual demand with constant elasticity σ for each of their varieties.[5]

The firms' decision-making process is described by the following sequence: (1) firms decide to enter the market; (2) they gather information about potential varieties; (3) they decide which of these varieties to develop and introduce into the market; (4) they choose a price for each variety. There is a cost associated to each stage.

Firms are homogeneous before entry. To enter the market they need to pay a sunk fee S, which represents legal, organizational and basic setup costs. The sunk fee is independent of the number of varieties that each firm later chooses to produce and therefore creates economies of scope in the number of varieties.

Upon entry firms learn their firm type, that is, how efficient they are in R&D and

[4] The idea that gathering information about varieties is costly is similar to the idea from the incomplete contract literature that including provisions for each contingency is not free. See Battigalli and Maggi (2002) for a model of endogeneity of the degree of completeness of a contract.

[5] Ottaviano and Thisse (1999), Baldwin and Ottaviano (2001), and Eckel and Neary (2005) model the behavior of multiproduct firms in an oligopolistic setting in which firms take cannibalization of own products into account when making a decision on the number of varieties. Nocke and Yeaple (2005) assume independent demands for different products produced by a same firm.

production. The firm type is represented by a pair $\left(\bar{F}^j, \bar{c}^j\right)$, which are the expected fixed and variable costs of R&D and production in cost function (5). The pair is drawn from a distribution $G_1(.)$, common to all firms. The actual costs of R&D and production of each variety, F_{ij} and c_{ij}, are stochastic functions of (5).

Expected profits are decreasing in the number of firms in the market. Firms enter until ex-ante expected profits (before learning their firm type) are equal to the sunk fee, so that net expected profits are zero. This determines the equilibrium number of firms, J.

After entry and before engaging in the development of products, firms obtain information on the development and production costs of different varieties by taking draws of (F_{ij}, c_{ij}) from distributions $G_2\left(F_{ij}|\bar{F}^j\right)$ and $G_3\left(c_{ij}|\bar{c}^j\right)$, where $\bar{F}^j$ and $\bar{c}^j$ are the mean of F_{ij} and c_{ij}. The functions G_2 and G_3 are the same for all firms, however, the innovation and production efficiency parameters $\left(\bar{F}^j, \bar{c}^j\right)$ differ across firms and thus so does the distribution of (F_{ij}, c_{ij}).

The activity of collecting information is costly and firms need to choose how many varieties to explore. Firms compute the expected profits of gathering information about N_j varieties, which has an associated cost of $\gamma(N_j)$, and choose this number optimally depending on their efficiency parameters. More efficient firms are more likely to find that introducing a particular variety is profitable and thereby have incentives to gather information on a larger number of varieties than less efficient firms. A firm may choose to explore zero varieties, which is equivalent to exiting the market immediately after entry.

Once firms have the information on the cost of innovation and production cost of N_j varieties, all uncertainty is resolved. Firms decide which of the potential varieties to introduce into the market based on the fixed and variable costs learnt in the previous stage and represented by the cost function (5). Given the assumptions on market structure and production technology, firms make a separate decision about each variety that depends solely on whether variable profits from sales net of fixed innovation and production costs are larger than zero. The total number of varieties introduced by firm j is given by n_j. After the firms have decided which varieties to introduce they make price decisions subject to the residual demand faced for each variety.

The firm decision process is solved backwards. In the last stage, taking the varieties that are introduced as given, firms choose the prices that maximize variable profits given by $(p_{ij} - c_{ij})\, q\,(p_{ij})$. Under the CES utility assumption prices are determined by a constant mark-up over the production cost that depends on the elasticity of substitution, $p_{ij} = \frac{\sigma}{\sigma-1} c_{ij}$. Indirect profits are

$$\pi_{ij} = k {c_{ij}}^{1-\sigma} P^{\sigma-1} y - F_{ij}, \tag{6}$$

with $k = \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}$.

Firms decide which varieties to introduce based on their information on c_{ij} and F_{ij} and the profit maximizing prices. A variety is introduced if $\pi_{ij} \geq 0$; with n_j denoting the number of varieties for which $\pi_{ij} \geq 0$.

Next, firms decide how many varieties to investigate based on the information that they have on their firm type, $\left(\bar{F}^j, \bar{c}^j\right)$, and prior to the realizations of (F_{ij}, c_{ij}). With the information on firm type they compute the probability of introducing a variety, $\Pr\left(\pi_{ij} \geq 0 | \bar{F}^j, \bar{c}^j\right)$, and the expected profit of a successful variety, $E\left[\pi_{ij} | \pi_{ij} \geq 0; \bar{F}^j, \bar{c}^j\right]$. Note that the probability of successfully introducing a variety and the expected profit from each successful variety are identical across varieties for a same firm and do not depend on N_j. Firms maximize total expected profits net of the cost of information $\gamma(.)$,

$$\max_{N_j} \Pr\left(\pi_{ij} \geq 0 | \bar{F}^j, \bar{c}^j\right) * E\left[\pi_{ij} | \pi_{ij} \geq 0; \bar{F}^j, \bar{c}^j\right] * N_j - \gamma\left(N_j\right). \tag{7}$$

Finally, when firms are deciding whether to enter the market or not, they compute the ex-ante expected profits prior to learning their firm type. Mathematically this means integrating the maximized objective function (7) over the distribution of firm types G_1. Firms enter until ex-ante expected profits are equal to the entry fee S.[6]

Under these assumptions all firms are homogeneous prior to entry. Let us now introduce foreign and domestic firms and let them differ systematically. Foreign affiliates are part of larger corporations which are researching, developing and producing goods elsewhere. Some

[6] The condition is

$$\int\limits_{\overline{F}^j, \overline{c}^j} \left[\max_{N_j} \Pr\left(\pi_{ij} \geq 0 | \overline{F}^j, \overline{c}^j\right) * E\left[\pi_{ij} | \pi_{ij} \geq 0; \overline{F}^j, \overline{c}^j\right] * N_j - \gamma\left(N_j\right)\right] dG_1\left(\overline{F}^j, \overline{c}^j\right) = S$$

of the affiliates produce the same goods as the parents (or affiliates located elsewhere) and benefit from the corporation's experience in the production of the good, both in terms of R&D (it is not necessary to develop a good from scratch if it is being produced elsewhere) and it terms of variable productivity (foreign firm have organizational advantages, for example).

The differences between foreign and domestic firms can be expressed as differences in the function G_1. Efficiency of foreign firms is ruled by a cumulative distribution function $G_1^F(.)$, while efficiency of domestic firms depends on $G_1^D(.)$. $G_1^D(.)$ first order stochastically dominates $G_1^F(.)$ in both arguments, which implies that foreign firms are on average more efficient in R&D and in production. Foreign firms face a higher entry fee than domestic firms, represented by S^F and S^D, respectively.[7] Both types of firms face ex-ante zero profits in equilibrium.

The variable of interest is the expected number of products introduced by firms and how it relates to technology and firm's origin. Results can be summarized in the following predictions,

Implication 1: *The number of products introduced by firm j, n_j, is approximated by a Poisson distribution with parameter* $E\left(n_j|\overline{F}^j, \overline{c}^j\right) = \Pr\left(\pi_{ij} \geq 0|\bar{F}^j, \bar{c}^j\right) * N_j$. After having decided to gather information on a number of varieties N_j, firm j takes N_j independent draws of (F_{ij}, c_{ij}) and for each of these draws evaluates whether the profits, given by (6), are greater than zero. Each of these draws and profit evaluations is an independent Bernoulli trial with the same probability of success, given by $\Pr\left(\pi_{ij} \geq 0|\bar{F}^j, \bar{c}^j\right)$. Taking the number of trials N_j as given, the number of varieties introduced n_j follows a Binomial distribution. As the number of trials becomes larger and the probability of success becomes smaller, the distribution of n_j can be approximated by a Poisson with parameter $E\left(n_j|\overline{F}^j, \overline{c}^j\right)$. In the empirical section I adopt a Poisson specification to explain the number of new varieties introduced by each firm.

Implication 2: *The expected number of products introduced by firm j, $E\left(n_j|\overline{F}^j, \overline{c}^j\right)$, is decreasing in the cost parameters $\overline{F}^j$ and $\overline{c}^j$*. Intuitively, relatively more efficient firms - in

[7]Several authors argue that set up costs are higher for firms entering a foreign market (either via exports or FDI) due to differences in consumers' preferences, language, regulations, etc. For the FDI case, see Helpman, Melitz and Yeaple (2004).

product development or in production - find on average that profits from a particular variety are higher than for less efficient firms. As a result both the probability of introducing a given variety and the number of varieties for which they gather information N_j are larger.

Implication 3: *Foreign firms introduce on average more products than domestic firms.* Foreign firms are on average more efficient in R&D and production ($G_1^D\left(\overline{F}^j, \overline{c}^j\right)$ stochastically dominates $G_1^F\left(\overline{F}^j, \overline{c}^j\right)$) and, thus, the expected number of products is higher. The effect of higher entry fees for foreign firms goes in the same direction.

3 Comparing foreign and domestic firms

In the next two sections I study the introduction of new varieties of goods by firms in the Chinese manufacturing sector and assess the roles played by advantages in productivity and R&D costs, as described in the model. I look at the different performances of foreign and domestic firms and examine whether they face systematic differences in productivity and in the cost of developing new varieties.

3.1 Data

I use firm-level data from the World Bank's 2001 Investment Climate Survey. This survey was run in collaboration with the Chinese National Bureau of Statistics and is part of a World Bank's larger project to study the business environment at the firm-level in Africa, Latin America, and South and East Asia. A total of 1,500 firms were interviewed in 2001 in five Chinese cities - Beijing, Tianjin, Shanghai, Guangzhou and Chengdu - by members of the Enterprise Survey Organization of the Chinese National Bureau of Statistics. The surveyed unit is the main production facility of a firm. The data include accounting information on sales, inputs, labor, stock of capital, investment and several other expenditures; and broader information such as ownership structure, characteristics of the labor force, relations with competitors, clients and suppliers, innovation, and market environment and investment climate.

One thousand of these firms correspond to 27 different 3-digit and 4-digit level industries in the Manufacturing sector, while the other 500 correspond to Services. The 27 industries were selected non-randomly with the purpose of focusing on the main sectors in China and on those with high growth and innovation rates. They can be categorized into 5 big groups: Apparel and Textiles, Household Appliances, Vehicles and Vehicle Parts, Electronic Equipment, and Electronic Components. Approximately two hundred firms were surveyed in each of these groups. Within these groups firms were chosen randomly and their composition is therefore representative of the population. A list of the 27 industries grouped in 5 sectors is provided in Table 1.

The data span the period 1998-2000, however, firms were interviewed only once, in 2001. As a result some questions are answered annually; while other answers involve information for the entire 3-year period. The accounting information on sales and input usage is annual. For these particular entries the data are equivalent to a 3-year panel with no entry and exit of firms. The questions on introduction of new varieties of goods are answered for the entire 3-year period. There is information on how many new varieties firms have introduced from the beginning of 1998 to the end of 2000, but not on how many per year.

A new variety does not necessarily constitute a new production line, or an innovation from the point of view of consumers. To be classified as "new" a variety needs to be different from all other varieties produced by the same firm, regardless of whether there is already a similar product in the Chinese market. A new variety includes true innovations, or a new production line for a given firm, or a horizontal increase in the product range, or an improvement in quality. The number of new varieties captures the extent to which a firm expands by increasing and replacing the range of products that they offer. From the point of view of the survey the definition of what constitutes a new variety is to some extent subjective to the firm. To minimize subjectivity, when a new good is similar to an old good that is being replaced, it is considered a new variety only if the price difference with respect to the old good is greater than 10 percent.[8]

Table 2 provides descriptive statistics. After discarding plants that were established after

[8]Given the subjective involved, different firms possibly follow different criteria. As long as the definitions of new varieties are uncorrelated to the ownership structure of the firms, the differences in criteria do not introduce a bias in the estimation.

1998 and some outliers for which the reported number of new varieties is more than one hundred,[9] the sample includes 878 firms - 605 domestic firms and 273 foreign firms. Within domestic firms 47 percent are privately owned, 29 percent are state-owned, and 23 percent are cooperatives or collectively owned by workers. I define a firm as foreign when foreign participation in its capital is at least 10 percent. Of the 273 firms with some degree of foreign ownership, 72 percent are majority-owned foreign firms (16 percent are fully-owned foreign and 56 percent have foreign participation between 50 and 99 percent) while the remaining 28 percent have less than 50 percent of foreign ownership.

Columns 2 to 4 display the median number of workers in 1998, the average value added per worker in 1998, and the average number of new varieties introduced during the period 1998 - 2000, each by ownership type. The overall median number of workers is 274. There are substantial differences across ownership types. State-owned firms are the largest (in terms of workers) and cooperatives, private domestic and fully-owned foreign firms are the smallest. The performance of foreign firms in terms of output per worker is better than the performance of domestic firms. Within foreign firms those with more than 50 percent of foreign ownership outperform firms with less than 50 percent of foreign ownership; within domestic firms private ones do better than state-owned firms and cooperatives. Firms introduce on average 3.5 new varieties of goods; foreign firms are above this average (3.8 new varieties for firms with less than 50 percent of foreign ownership and 5.7 and 4.5 new varieties for firms with 50 percent or more of foreign ownership); while domestic firms are below this average (private firms introduce 2.9 new varieties on average, state-owned firms introduce 3.4 varieties and cooperatives 1.8 varieties).

Figure 1 shows the distribution of foreign firms by country of origin. More than 50 percent of foreign firms are from Japan and Hong Kong, and almost equally distributed among the two; 14 percent of firms are from other Asian countries (mostly Korea, Singapore, Thailand and Malaysia); and 17 percent from Europe, the U.S. and Canada. A large fraction of firms from Hong Kong have less than 50 percent of foreign ownership. Anecdotal evidence

[9] Discarded observations include both foreign and domestic firms and do not follow a particular pattern. More than 97 percent of firms report introducing less than 20 new goods, and only 10 firms report introducing more than a hundred new goods. I do not include the latter to avoid these outliers to drive results.

suggests that Chinese firms seek partners in Hong Kong to enjoy some of the benefits granted to foreign firms by the Chinese government.[10]

3.2 Varieties introduced by foreign and domestic firms

Following the model in section 2 I assume that the number of new varieties introduced by firm i, n_i, follows a Poisson distribution with parameter λ_i.[11] Under this assumption, the conditional probability that firm i introduces n_i new varieties is $P(n_i|\lambda_i) = \frac{\lambda_i^{n_i} e^{-\lambda_i}}{n_i!}$. Both the mean and the variance of the number of new varieties is given by λ_i. The parameter λ_i is specific to each firm and it is a deterministic function of observable firm characteristics x_i and the ownership structure of the firm.

I adopt the log-linear specification[12]

$$\lambda_i = \exp\left(x_i'\beta_0 + \beta_1 FOR_{1i} + \beta_2 FOR_{2i} + \beta_3 NONPRIV_i\right) \tag{8}$$

Observable firm characteristics included in x are size, measured by the logarithm of the number of workers, self-reported market share, the logarithm of the age of the firm and dummy variables for firms that started operating in 1997 and 1998. FOR_1 and FOR_2 are indicator variables for firms with some degree of foreign ownership; firms with less than 50 percent of foreign participation in capital are included in FOR_1 (hereafter, minority-owned foreign firms), while FOR_2 comprises firms with foreign capital ranging from 50 to 100

[10]See Naughton (1996) for a description of tax and import benefits granted to FDI. Branstetter and Feenstra (2002) argue that multinationals have faced restrictions on operations and extralegal surcharges that could have compensated the tax and import benefits.

[11]Different forms of the Poisson distribution are usually adopted when the dependent variable is a non-negative integer. In the innovation literature several authors model the number of patent applications as a Poisson process: Hausman, Hall and Griliches (1984) and Crepon and Duguet (1997) study the effect of expenditure on R&D on patents; Blundell, Griffith and Van Reenen (1995) investigate the relation between patents and market power and stock of knowledge.

[12]The log-linear specification is convenient because it guarantees that the expected number of new varieties is positive. Compared to least squares, the Poisson specification handles count data more naturally. If OLS is used (where the expected number of varieties is linear in the explanatory variables instead of log-linear) the estimated expected number of new varieties is not necessarily non-negative. This problem does not arise when using non-linear least squares with a log-linear specification, however, there is the problem of how to treat the observations in which the number of new varieties is zero. The Poisson distribution, on the other hand, models the probability of observing each non-negative integer, including zero.

percent (majority-owned foreign firms).[13] $NONPRIV$ is equal to one for non-private domestic firms, that is, state-owned firms and collectively-owned firms. Private domestic firms are the baseline category. I include city and industry effects that capture differences in the mean number of new varieties introduced across these two dimensions. The fixed effects also control for potential selection of foreign firms into cities or industries where more varieties are introduced.

The first column of Table 3 displays the results of the Poisson regression (8) of the number of new varieties on firm ownership. Because the regression function is not linear the interpretation of the coefficients is not straightforward. To provide a more intuitive interpretation of the results the table shows the coefficients and the incidence ratios $\exp(\beta_k \Delta x_k)$, which indicate the expected proportional change in the number of varieties.[14] Results show that, other things equal, firms with more than 50 percent of foreign participation introduce more than twice as many new varieties as private domestic firms. Firms with foreign capital between 10 and 50 percent, on the other hand, actually introduce less varieties than private domestic firms, although the difference is not statistically significant. Non-private firms introduce 73 percent of the number of varieties introduced by private domestic firms.

A priori there may be a reverse causality problem with using market share as a control: firms with larger market shares have more incentives to invest in R&D and to introduce more goods; on the other hand, firms that introduce newer varieties gain a larger fraction of the market from its rivals. I use a two-step control function approach as in Blundell and Powell (2003 and 2004) with the self-reported number of competitors as an instrument for market

[13]Firms with exactly 50% of foreign capital are included in the majority group FOR_2. Regression results are not substantially different when the groups are defined taking 40 percent or 60 percent as cutoffs. I have also experimented with a continuous variable indicating the degree of foreign participation in a firm's capital obtaining a positive and significant coefficient (not shown). The dummy specification is preferred given that the relation appears to be non-linear.

[14]For an indicator variable the incidence ratio is the ratio of the expected number of new varieties introduced by firms that belong to that particular category and by firms in the baseline category (private domestic firms). For example, the ratio of the expected number of varieties between majority-owned foreign firms and domestic firms is $\frac{\exp\left(x_i'\beta_0+\beta_2\right)}{\exp\left(x_i'\beta_0\right)} = \exp(\beta_2)$. For continuous regressors the incidence ratio is computed for a 10 percent change. For example, the incidence of 10 percent increase in the number of workers is $\frac{\exp\left(x_i'\beta_0+10*\beta_{workers}\right)}{\exp\left(x_i'\beta_0\right)} = \exp(10*\beta_{workers})$.

share.[15] In the first step (Table 4) I run an OLS regression of the market share on the number of competitors (the instrument) plus the other explanatory variables in regression (8) and compute the residuals.[16,17] In the second step I estimate the Poisson regression including the residual from the first step as a regressor; these residuals control for the endogeneity of the market share. Standard errors need to be corrected to account for the first stage.

Results from the control function regression are displayed in column (2) of Table 3. Majority-owned foreign firms introduce 2.47 as many new goods as private domestic firms, which is very similar to the result from the previous regression. The coefficient on market share is not statistically significant.

In equilibrium the number of workers is determined jointly with the number of varieties. First, firms that introduce more varieties need to hire more workers to increase production. To minimize this reverse causality problem I use the number of workers in 1998, the first year of data. Second, the number of new varieties and the number of workers may depend on unobserved firm characteristics not included in the regression and which affect scale. The number of workers is included as a scale variable and its coefficient should not be interpreted as the change in the number of new varieties predicted by an exogenous change in the number of workers. The coefficient has a reduced form interpretation that relates the number of workers and the number of varieties in equilibrium without predictive value. In column (3) I exclude the number of workers from the regression. The coefficient for majority-owned foreign firms is larger than before since these firms are on average larger than domestic firms.

The last four columns of Table 3 test the sensitivity of the results to different distributional assumptions. Column (4) corresponds to a Poisson-Gamma mixture (Negative Binomial) and column (5) corresponds to a Zero-Inflated Poisson specification.[18] The

[15]The control function approach was originally investigated by Smith and Blundell(1986), Newey (1987), and Rivers and Vuong (1988) for Tobit and Probit models.

[16]More general non-parametric methods can be used instead (Blundell and Powell, 2004).

[17]The identifying assumptions of the first stage regression is not simply that the market share and number of competitors are correlated and that the number of competitors is uncorrelated to the error term - as would be the case in the instrumental variables case - but rather that the first step regression function correctly specifies the econometric model that determines the market share. In addition, the error term in the first step regression is assumed to be uncorrelated to the error term in the second step regression.

[18]In many applications with count data, it is argued that the variance of the dependent variable can be

coefficients and incidence ratios can be directly compared to the previous columns in Table 3. There are no substantial differences in the results.

Columns (6) and (7) display the results of OLS and IV regressions.[19] In these two cases the expectation is a linear function of the regressors and the coefficients can be interpreted directly: majority-owned foreign firms introduce on average 3.8 more new varieties than private domestic firms. To compare these numbers with the Poisson results it is necessary to compute the difference in the expected number of new varieties between majority-owned foreign firms and private domestic firms in the Poisson specification.[20,21] This difference is 3.09 and 3.21 for Poisson and IV Poisson.

The firm survey includes information on whether the foreign owners are foreign firms or foreign investors. The distinction between firms and investors is relevant in this case. The hypothesis is not that foreign capital per se makes a difference in terms of introducing more varieties, but that a firm's experience abroad, both in research and development and in production, is what provides an advantage. From this point of view only firms operating in China that are owned by foreign firms, and not simply foreign investors, should have an advantage. Table 5 explores this hypothesis. Column (1) reproduces the results from the IV Poisson from Table 3. In Column (2) majority-owned foreign firms are split into those that are a joint venture of a foreign and a domestic firm and those who are partially owned by a foreign investor without production activities elsewhere. The evidence supports that it is foreign production activities that provide an advantage, not simply foreign ownership. Firms operating in China that are partially owned by foreign enterprises introduce 3.3 more new varieties than private domestic firms; while firms operating in China that are partially owned by foreign investors do not have an advantage when compared with private domestic

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higher than the mean (in a Poisson distribution the mean and the variance are equal). This phenomenon is referred to as overdispersion and is usually attributed to two factors, unobserved heterogeneity and excess zeros (more zeros than the Poisson distribution can account for). These effects are ameliorated in the Negative Binomial and Zero-Inflated Poisson, respectively, by mixing distributions. For details on the validity of Poisson estimators under overdispersion see Gourieroux, Monfort and Trognon (1984a, 1984b). Cameron and Trivedi (1998) describe general estimation issues.

[19] In the IV case market share is instrumented with the number of competitors.

[20] The Poisson incidence ratios provide a percentage increment in the number of goods; while the linear coefficients represent absolute differences in the number of goods.

[21] Evaluated at the mean, the difference in expected values is given by $\exp\left(\overline{x}'\beta_0+\beta_2\right)-\exp\left(\overline{x}'\beta_0\right).$

firms; as a matter of fact, these firms actually do worse than domestic firms. Column (3) considers fully-owned foreign firms separately. There are few fully-owned foreign firms in the survey and results are not very precise, however, the point estimates suggest that there is no difference between majority-owned foreign firms and fully-owned foreign firms with respect to introducing new varieties.

The number of varieties is a good indicator of introduction of new products but it does not capture consumers' valuation of the new products. Table 6 reports results of regressions explaining the sales of new products. Results from four different specifications show that on average and controlling for firm size sales of new products by majority-owned foreign firms are 1,622 to 2,484 thousands of dollars higher, and account for an additional 5.6 to 8.4 percent of total sales when compared to private domestic firms.

4 Technology determinants

The model in Section 2 describes two dimensions of firm-level heterogeneity that explain why firms choose to introduce a different number of varieties: efficiency in production and efficiency in research and development. In this section I investigate whether there exist systematic differences in these two dimensions of heterogeneity between domestic and foreign firms and assess the impact that both dimensions have on the number of varieties introduced by a firm. I decompose the total difference in the number of varieties introduced by domestic and foreign firms into the fractions explained by differences in productive efficiency and efficiency in R&D. We expect foreign firms to be more efficient in production due to learning from their experience in other countries, and to have lower costs of R&D in China because part of this cost has been incurred to introduced the same new varieties in other markets.

To measure efficiency in production I compute measures of labor productivity. I define labor productivity as value added per worker, and alternatively as value added per production worker. I approximate efficiency in development with expenditure in R&D and purchases of technology from outside sources per new variety. For foreign firms I consider expenditure by Chinese affiliates only, as the intention is to capture the cost of introducing new varieties in

China, not worldwide. I also compare the preferred ways of getting access to new varieties across firms.

4.1 Are foreign firms more productive?

Figure 2 shows the empirical density functions of the logarithm of labor productivity for private domestic firms and majority-owned foreign firms (50 percent to 100 percent) for 12 of the 27 industries included in the survey (the selected industries are those with a larger number of observations). Labor productivity is defined as value added per worker in 1998, the first year of data. The graphs provide a first visual inspection of the distribution of productive efficiency of foreign and domestic firms. The first two graphs correspond to Apparel and Leather Products. There is no evidence that foreign firms have a productivity advantage in these industries. In all remaining sectors the density of labor productivity for majority-owned foreign firms lies to the right of the density of private domestic firms, which implies that foreign firms are on average more productive.

As a more formal test for evidence of the existence of productivity advantages in foreign firms, I regress labor productivity on ownership structure and firm characteristics. The regression function takes the following form,

$$\log PROD_{ij} = x'_{ij}\delta_0 + \delta_1 FOR^1_{ij} + \delta_2 FOR^2_{ij} + \delta_3 NONPRIV_{ij} + \mu_{ij} \tag{9}$$

The ownership structure dummies are the same as in the Poisson regression: FOR^1 and FOR^2 are dummies for minority and majority-owned foreign firms, and $NONPRIV$ indicates that the firm is domestic and state or collectively owned. Other control variables are the book value of the stock of capital, age, and industry and city effects. Since ownership variables are time invariant during the sample there is no advantage from incorporating different time periods and the regression reduces to a cross-section of firms.

Results are displayed in Table 7. Majority-owned foreign firms are on average 36 percent more productive than private domestic firms; minority-owned foreign firms do not have a productive advantage; while state and collectively-owned firms are 60 percent less efficient than private firms.

Column (2) splits majority-owned foreign firms into those owned by a firm that operates abroad and those owned by a foreign investor. It is confirmed that it is only firms that are partially owned by a firm operating abroad that have an advantage, instead of all firms with foreign ownership. Column (3) separates majority-owned foreign firms into four categories: subsidiaries of multinationals, firms fully owned by foreign investors, firms partially owned by a firm operating abroad, firms partially owned by foreign investors. Production advantages are found for subsidiaries of multinationals and firms partially owned by a firm operating abroad. The productive advantages with respect to private domestic firms are 119 percent and 75 percent. This last finding supports the hypothesis of improved technical efficiency through interactions of parents and affiliates: firms owned by multinationals and firms operating abroad can take advantage of the experience that they have developed in other countries, while firms owned by investors cannot.

Results are very similar when labor productivity is defined as value added per production worker instead of value added per worker (columns 5 to 7). I have also experimented with measures of total factor productivity, instead of labor productivity, estimated from a Cobb-Douglas production function with the investment-proxy method developed by Olley and Pakes (1996).[22] Results are qualitatively similar to those in Table 7. The labor productivity measures are preferred in this application because the relatively low number of firms in each sector does not allow for precise estimates of production functions.

Possible selection of foreign firms to most productive industries and cities is controlled for with industry and city effects. There is still a potential selection effect if firms of different origin face systematic differences in the costs of entry, as in Melitz (2003) and Helpman, Melitz and Yeaple (2004).[23] Only firms with variable profits above the fixed cost of entry will be able to enter and stay in the market. If the fixed cost of entry is higher for foreign firms

[22]This method has been used extensively in the trade and productivity literature. Among many examples, Pavcnik (2000) estimates changes in productivity at the firm level due to major trade liberalizations in Chile, and Javorcik (2004) and Keller and Yeaple (2003) focus on whether there are productivity spillovers from foreign firms to domestic firms in Lithuania and the U.S., respectively.

[23]Even another selection problem arises in the case of mergers and acquisitions, since foreign firms may be inclined to choose the most productive domestic firms.

than for domestic firms, the required profit level is also higher for foreign firms. If differences in variable profits depend solely on differences in productivity, the entry condition can be written as a cutoff level for productivity, with the cutoff productivity being higher for foreign firms. In this situation the truncated observed productivity levels are on average higher for foreign firms even in the case that the distributions of productivities are the same for both types of firms (conditional on the costs of R&D).

I address this question by estimating truncations in the distribution of productivity for majority-owned foreign firms. Consider the distribution of productivity levels in one sector, and assume there is a cutoff, so that the productivity levels of observed firms are all above the cutoff (firms below the cutoff exit and are not captured in the data). Asymptotically the lowest realized value of productivity converges to the cutoff. Following this argument I estimate the cutoffs for majority-owned foreign firms in each sector by choosing the firm with the lowest measured productivity.[24]

In Table 7, column (4), I reestimate the regression of productivity on ownership excluding private domestic firms with productivity below the cutoffs for majority-owned foreign firms in each sector. In this case majority-owned foreign firms are 28 percent more productive than their private domestic counterparts. Note that this is not strictly a test for the existence of cutoffs in productivity levels. The regression is a robustness check: majority-owned foreign firms are substantially more productive than domestic firms, even when the less productive domestic firms are not included in the comparison, indicating that the distributions are indeed different according to origin of the firm and that the higher productivity observed among foreign firms is not solely the result of selection.

Table 8 explores differences in productivity by country of origin of the foreign firms. Foreign firms from the European Union, the U.S. and Canada, and Japan are 104 percent, 78 percent, and 36 percent more productive than Chinese private domestic firms. On the other hand, firms from Hong Kong and other Asian countries do not enjoy productivity

[24]Formally, the cutoff in sector j for majority-owned foreign firms is defined by

$$\min_i \{PROD_{ij} \mid i \text{ is a majority-owned foreign firm in industry } j\}.$$

advantages.

4.2 Is the cost of development lower for foreign firms?

To address the question of whether foreign firms have a cost advantage in the introduction of new goods, I look at the expenditure on R&D plus expenditure on purchases of technology from outside sources (mostly licenses) over the period 1998-2000 per dollar sold of new varieties that the firm successfully introduced in China. This is a proxy for the average fixed cost of introducing new goods. For foreign multinationals I consider expenditure on R&D by the Chinese affiliates only, since I am interested in the marginal cost of introducing new varieties in China, not elsewhere.

Table 9 shows the results of a regression of this proxy for development costs on ownership structure categories (same as in the previous sections). The regressions include only firms that introduce a strictly positive number of new varieties, as the development cost is not available for firms that do not introduce new varieties. Since the choice of number of varieties is not modeled in this section, results need to be interpreted as a correlation.

Controlling for self-reported market share, logarithm of age, dummies for firms that started operating in 1997 and 1998, and industry and city effects, majority-owned foreign firms enjoy a 58 percent development cost advantage compared to private domestic firms (column (1)). When instrumenting for market share with the self-reported number of competitors, the advantage for majority-owned foreign firms is 66 percent (column (3)). Columns (2) and (4) split foreign firms into those owned by foreign companies and by foreign investors. As expected, it is firms owned by foreign companies that are more efficient. However, the difference in R&D efficiency between the two types of foreign firms is not nearly as striking as the difference in efficiency in production. Possibly this is because the proxy for development costs includes purchases of licenses and presumably foreign investors could have advantages in getting access to license sources compared to Chinese domestic firms.

As additional evidence on lower fixed cost of development I look at the mode in which firms introduce new products: whether they have transferred at least one new variety from a company in the same corporate group, whether they have purchased at least one license for a new product from a foreign source, and whether they have developed at least one new variety in-house (for multinational firms, this means in the affiliates located in China). The mode of introduction of new varieties is not related to differences in variable productivity but rather it reflects the least expensive fixed cost of development. A propensity of foreign firms to transfer technology from abroad is an indication of scale economies in development.

I run three different probit regressions among firms that did introduce a positive number of new varieties with the three modes of introduction as the dependent variable (the three modes are not mutually exclusive since firms can follow different strategies for different varieties). The explanatory variables are ownership structure, captured by the same categories defined before (majority-owned foreign, minority-owned foreign, private domestic, non-private), the logarithm of the number of workers, the logarithm of age, dummy variables for firms that started production in 1997 and 1998, and industry and city fixed-effects. Results are displayed in Table 10 and can be interpreted straightforwardly: majority-owned foreign firms are 17 percent more likely to transfer new products from a firm in a the same corporate group than are private domestic firms, they are 38 percent more likely to purchase at least one foreign license, and they are 19 percent less likely to develop products in-house. All results are significant. The difference in the probability of occurrence of any of these three events is not significant for minority-owned foreign firms and state and collectively-owned firms (the baseline category is private domestic firms). These findings support the idea that foreign firms can take advantage of the development costs that have been already incurred abroad by the same firm and that they do not need to develop new products in the Chinese affiliate as much as domestic Chinese firms.

4.3 How much does each factor explain?

The previous findings support the idea that foreign firms have a cost advantage over domestic firms, both in terms of variable costs and in the fixed cost of incorporation of new varieties. In this section I estimate the extent to which these differences affect the ability of firms to introduce new varieties of goods.

I reestimate the regressions that explain the number of new varieties including efficiency in production and in development as explanatory variables. I consider two alternative dependent variables: the number of new varieties and the participation of new varieties in sales. In both cases only firms that introduce a positive number of new varieties are included in the regressions and thus the distribution of the dependent variable needs to be adjusted to account for the truncation. This means estimating a Poisson regression conditional on the number of varieties being strictly positive in the case of the number of new varieties; and a truncated normal regression in the case of participation of new varieties in sales.

Results for truncated Poisson, linear, and truncated normal regressions are reported in Table 11. Both efficiency variables are significant and have the expected signs: firms introduce more varieties the higher the variable productivity and the lower the fixed costs of development. Ownership type does not have explanatory power once efficiency has been accounted for, which suggests that the advantage of foreign firm in the introduction of new varieties is largely explained by technological advantages.

The role of efficiency in explaining the difference in performance between foreign and domestic firms is further explored in Table 12 by performing a decomposition. Here I compute the predicted average number of new varieties and participation of new varieties in sales for two different groups: majority-owned foreign firms and private domestic firms; and I calculate what percentage of the difference in the two predicted means is accounted for by the productivity and cost factors. Let $PROD$ and $COST$ denote labor productivity and cost of development, and let F and D index majority-owned foreign and private domestic firms. In the linear case, the percentage contribution of labor productivity is given by

$$\frac{\widehat{\beta}_{PROD}\left(\overline{PROD}_F - \overline{PROD}_D\right)}{\left(\overline{x}_F - \overline{x}_D\right)' \widehat{\beta}_0 + \widehat{\beta}_{PROD}\left(\overline{PROD}_F - \overline{PROD}_D\right) + \widehat{\beta}_{COST}\left(\overline{COST}_F - \overline{COST}_D\right)}, \tag{10}$$

where $\widehat{\beta}$ are the coefficients from Table 11 and $\overline{PROD}$, $\overline{COST}$, and $\overline{x}$ are the means of labor productivity, development cost, and the control variables for the two groups of firms (majority-owned foreign and private domestic). The definition of the contribution of $COST$ is analogous.

In the Poisson and truncated normal cases, the regression is non-linear and there are different alternatives to compute the contribution of each factor. I use the contribution to the index function evaluated at the mean, which yields (10), as in the linear case.

Table 12 shows the decomposition. Differences in labor productivity between foreign and domestic firms explain between 33 and 45 percent of the predicted advantage of foreign firms in the introduction of new varieties. Differences in the cost of R&D and purchases of new technology explain between 5 and 27 percent of this advantage. Together the two technology factors explain from 38 to 72 percent. Industry and geographic location also play an important role in explaining differences in introduction of new varieties across foreign and domestic firms, ranging from 22 to 54 percent in the different specifications. Factors that have not been included in the analysis, such as differences in domestic demand or exporting behavior, are grouped within the "unexplained" category and account for -39 percent to 22 percent of the difference.[25]

5 Conclusion

This paper describes the role of firm technological heterogeneity in expansion strategies through increases and renovations of the product portfolio of multinational and domestic firms. The role of firm heterogeneity has been largely studied in the context of trade and FDI; this paper contributes to this literature by adding differences and diffusion in the cost of development and learning from other affiliates in the cost of production, and by studying the introduction of several varieties of goods.

The data for the Chinese manufacturing sector support the hypotheses that multinational firms have technical advantages and that these play an important role in the introduction of varieties. For firms of equal size, foreign affiliates with more than 50 percent of foreign capital do indeed expand their product portfolio more than twice as much as domestic firms. This result does not hold for foreign firms which are owned by foreign investors, indicating that the fact that the same firm has production facilities elsewhere matters.

Differences in labor productivity and the cost of development are significant across foreign

[25]Negative contributions indicate that, together, the factors that were left out of the analysis explain a relative disadvantage of foreign firms.

and domestic firms, with the former being more efficient in both dimensions. The advantages in variable productivity seem to be caused by differences in productivity distributions and not solely by selection.

Overall, heterogeneity in technology explains between 38 and 72 percent of the advantage in product expansion by foreign firms (differences in labor productivity account from 33 to 45 percent, and differences in cost of development between 5 and 27 percent). Industry and geographic location also play an important role in explaining this difference, ranging from 22 to 54 percent.

References

Baldwin, R. and G. Ottaviano (2001): "Multiproduct Multinationals and Reciprocal Dumping," *Journal of International Economics*, Vol. 54, 429-448.

Battigalli, P. and G. Maggi (2002): "Rigidity, Discretion, and the Costs of Writing Contracts," *The American Economic Review,* Vol. 92, No. 4, 798-817.

Bernard, A. and B. Jensen (1999): "Exceptional Exporter Performance: Cause, Effect, or Both?," *Journal of International Economics*, No. 47, 1-25.

Bernard, A. and B. Jensen (2004): "Exporting and Productivity in the USA," *Oxford Review of Economic Policy*, Vol. 20, No. 3, Autumn, 343-357.

Bernard, A., J. Eaton, B. Jensen, and S. Kortum (2003): "Plants and Productivity in International Trade," *American Economic Review*, Vol. 93, No. 4, September, 1268-1290.

Bernard, A., S. Redding and P. Schott (2005): "Multiproduct Firms and the Dynamics of Product Mix," Yale University, School of Management.

Blundell, R., R. Griffith and J. Van Reenen (1995): "Dynamic Count Data Models of Technological Innovation," *Economic Journal,* Vol. 105, No. 429, March, 333-344.

Blundell, R. and J. Powell (2003): "Endogeneity in Nonparametric and Semiparametric Regression Models," *Advances in Economics and Econometrics: Theory and Applications*, ed. by M. Dewatripont, L. P. Hansen and S. Turnovsky, Vol. 2, Econometric Society Monograph #36, Cambridge University Press, Cambridge.

Blundell, R. and J. Powell (2004): "Endogeneity in Semiparametric Binary Response Models," *Review of Economic Studies*, Vol. 71, No. 3, 655-679.

Branstetter, L. and R. Feenstra (2002): "Trade and Foreign Direct Investment in China: A Political Economy Approach," *Journal of International Economics*, Vol. 58, No. 2, December, pp. 335-358.

Cameron, A.C. and P. Trivedi (1998): *Regression Analysis of Count Data,* Cambridge University Press, Cambridge.

Caves, R. (1996): *Multinational Enterprise and Economic Analysis*. Cambridge University Press, London.

Clerides, S., S. Lach and J. Tybout (1998): "Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco," *The Quarterly Journal of Economics*, Vol. 113, No. 3, August, 903-947.

Crepon, B. and E. Duguet (1997): "Research and Development, Competition and Innovation. Pseudo-Maximum Likelihood and Simulated Maximum Likelihood Methods Applied to Count Data Models with Heterogeneity," *Journal of Econometrics,* Vol. 79, 355-378.

Criscuolo, C., J. E. Haskel and M. J. Slaughter (2005): "Global Engagement and the Innovation Activities of Firms," *NBER* Working Paper Working Paper No. 11479, July.

Dixit, A. and J. Stiglitz (1977): "Monopolistic Competition and Optimum Product Diversity," *The American Economic Review,* Vol. 67, No. 3, June, 297-308.

Eaton, J. and S. Kortum (2002): "Technology, Geography, and Trade," *Econometrica*, Vol. 70, No. 5, 1741-1779.

Eckel, C. and P. Neary (2005): "Multi-Product Firms and Flexible Manufacturing in the Global Economy," University College Dublin, Department of Economics.

Feenstra, R. and G. Hanson (1997): "Foreign Direct Investment and Relative Wages: Evidence from Mexico's Maquiladoras," *Journal of International Economics*, Vol. 42, 371-394.

Gourieroux, C., A. Monfort and A. Trognon (1984a): "Pseudo Maximum Likelihood Methods: Theory," *Econometrica*, Vol. 52, No. 3, May, 681-700.

Gourieroux, C., A. Monfort and A. Trognon (1984b): "Pseudo Maximum Likelihood Methods: Applications to Poisson Models," *Econometrica,* Vol. 52, No. 3, May, 701-720.

Hausman, J., B. Hall, and Z. Griliches (1984): "Econometric Models for Count Data with an Application to the Patents-R&D relationship," *Econometrica,* Vol. 52, No. 4, July, 909-938.

Helpman, E., M. Melitz and S. Yeaple (2004): "Export versus FDI with Heterogeneous Firms," *The American Economic Review,* Vol. 94, No. 1, March, 300-316.

Javorcik, B. (2004): "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages," *The American Economic Review*, Vol. 94, No. 3, June, 605-627.

Keller, W. and S. Yeaple (2003): "Multinational Enterprises, International Trade, and Productivity Growth: Firm Level Evidence from the United States," *NBER*, Working Paper No. 9504.

Melitz, M. (2003): "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, Vol. 71, No. 6, Nov., 1695-1725.

Naughton, B. (1996): "China's Emergence and Prospects as a Trading Nation," *Brookings Papers on Economic Activity*, Vol. 2, 273-343.

Newey, W. (1987): "Efficient Estimation of Limited Dependent Variable Models with Endogenous Explanatory Variables," *Journal of Econometrics,* Vol. 36, 231-250.

Nockey, V. and S. Yeaple (2005): "Endogeneizing Firm Scope: Multiproduct Firms in International Trade," University of Pennsylvania, Department of Economics.

Olley, G.S. and A. Pakes (1996): "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica,* Vol. 64, No. 6, Nov., 1263-1297.

Ottaviano, G. and J-F. Thiesse (1999): "Monopolistic Competition, Multiproduct Firms, and Optimal Product Diversity," *CEPR* Discussion Paper No. 2151.

Pavcnik, N. (2002): "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants," *Review of Economic Studies,* Vol. 69, No. 1, 245-276.

Prasad, E. and S-J. Wei (2005): "The Chinese Approach to Capital Inflows: Patterns and Possible Explanations," *NBER* Working Paper No. 11306.

Rivers, D. and Q. Vuong (1988): "Limited Information Estimators and Exogeneity Tests for Simultaneous Probit Models," *Journal of Econometrics* Vol. 39, 347-366.

Smith, R. and R. Blundell (2005): "Endogeneity in Semiparametric Binary Response Models," *Review of Economic Studies* Vol. 71, No 3, 655-679.

Table 1: Industrial Sectors

	Number of firms
Apparel and Leather Goods	
Apparel	104
Leather processing	14
Leather products	39
Knitted apparel	45
Electronic Equipment	
Computers	74
Communications equip.	55
Audio and video	33
Electronic Components	
Electron tubes	21
Printed circuits	16
Semiconductors	29
Printed circuit assembly	15
Capacitors and resistors	100
Household Appliances	
Cooking appliances	23
Refrigerators and freezers	23
Laundry equip.	8
Small appliances	86
Vehicles and Vehicle Parts	
Motor vehicles	27
MV Body and trailer	6
MV accesories	64
Engines	14
Electrical equip.	12
Steering and suspension	10
Brake systems	10
Transmission	7
Seating	5
Metal stamping	4
Motorcycles and bicycles	34
TOTAL	878

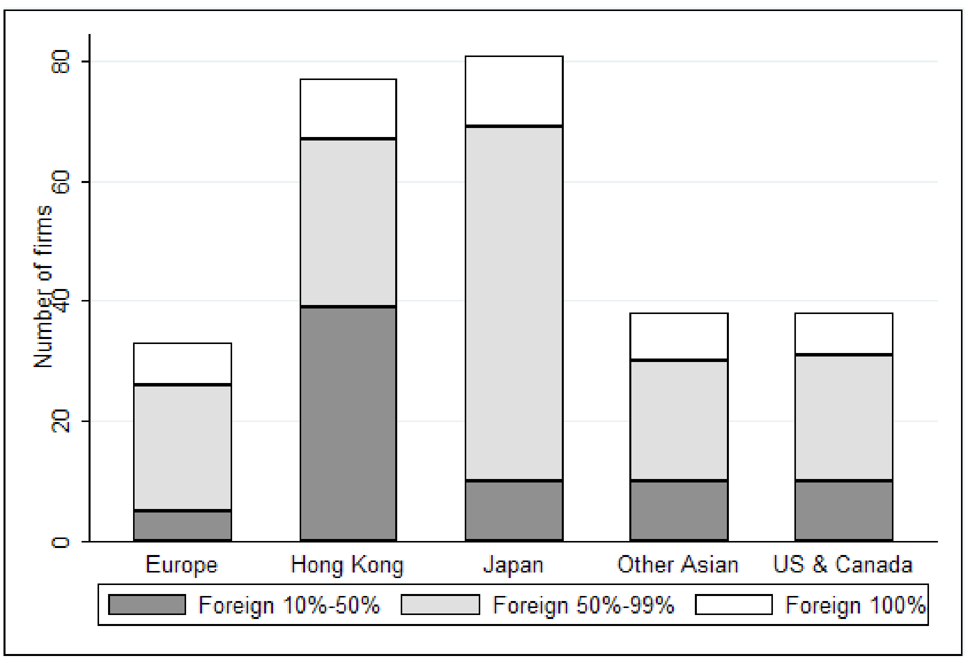
Note: based on The World Bank 2001 Chinese Investment Climate Survey

Table 2: Summary Statistics

Type of firm	Number of firms (1)	Median number of workers (2)	Average value added per worker (3)	Average number of new products (4)
Private domestic	287	180	8.1	2.9
State-owned	176	637	3.1	3.4
Cooperative	142	138	3.6	1.8
Foreign 10%-50%	76	210	10.8	3.8
Foreign 50%-99%	153	312	19.2	5.7
Foreign 100%	44	161	17.1	4.5
Total	878	274	8.9	3.5

Source: own calculations based on The World Bank 2001 Chinese Investment Climate Survey.

Figure 1: Country of Origin of Foreign Firms



Distribution of foreign firms by country of origin based on The World Bank 2001 Chinese Investment Climate Survey.

Table 3: New Varieties and Foreign Ownership

	Poisson	IV Poisson	IV Poisson	Negative Binomial	Zero-Inflated Poisson	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Majority (50-100%)	0.87***	0.91**	1.12***	0.74***	0.48*	3.84**	3.82**
Incidence ratio	2.39	2.47	3.07	2.09	1.62		
	(0.32)	(0.40)	(0.37)	(0.27)	(0.27)	(1.73)	(1.72)
Minority (10-49%)	-0.2	-0.12	0.27	-0.38	-0.68**	-0.46	-0.51
Incidence ratio	0.82	0.88	1.31	0.68	0.51		
	(0.29)	(0.49)	(0.42)	(0.24)	(0.32)	(0.87)	(1.12)
Non-private	-0.31	-0.29	-0.23	-0.63***	-0.96***	-0.87	-0.88
Incidence ratio	0.73	0.75	0.79	0.53	0.38		
	(0.26)	(0.32)	(0.29)	(0.21)	(0.27)	(0.79)	(0.82)
Log workers 1998	0.17**	0.16*	-	0.26***	0.19**	0.63**	0.63*
Incidence ratio	1.19	1.17		1.29	1.20		
	(0.07)	(0.10)		(0.07)	(0.08)	(0.29)	(0.32)
Market share	0.01***	0.02	0.09	0.01***	0.01**	0.06**	0.05
Incidence ratio	1.01	1.02	1.09	1.01	1.01		
	(0.00)	(0.06)	(0.05)	(0.00)	(0.00)	(0.02)	(0.1)
Log age	0.23	0.24	0.38**	0.35**	0.17	0.86	0.85
Incidence ratio	1.26	1.28	1.47	1.41	1.19		
	(0.16)	(0.18)	(0.17)	(0.16)	(0.17)	(0.62)	(0.62)
Setup 1998	0.72	0.75	0.88*	0.5	0.68	3.29	3.27
	(0.53)	(0.67)	(0.61)	(0.37)	(0.42)	(2.93)	(2.97)
Setup 1997	0.22	0.26	0.54	0.18	0.32	0.87	0.83
	(0.37)	(0.48)	(0.44)	(0.32)	(0.43)	(1.21)	(1.28)
Observations	665	665	665	665	665	665	665
R-squared						0.09	0.09

Dependent variable: Number of new varieties of goods introduced by the firm from 1998 to 2000. Robust standard errors in parenthesis (bootstrapped in the case of IV Poisson); SE computed for coefficients, not incidence rations; * significant at 10%; ** significant at 5%; *** significant at 1%. Domestic private firms are the baseline category. Majority and Minority: indicator variables for foreign firms, according to the participation of foreign ownership in capital. Non-private: domestic firms owned by the State or by a cooperative. Setup 1998 and Setup 1997: indicator variables for plants that started operating in those years. Regressions include city and industry effects.

Table 4: First Stage Regression for Market Share

	(1)	(2)
Number of competitors	-0.04***	-0.04***
	(0.01)	(0.01)
Majority (50-100%)	-3.32	-3
	(2.58)	(2.51)
Minority (10-49%)	-6.23*	-6.14*
	(3.23)	(3.17)
Non-private	-1.35	-1.93
	(2.39)	(2.32)
Log workers 1998	1.02	-
	(0.7)	
Log age	-0.9	0.24
	(1.69)	(1.53)
Setup 1998	-2.00	-2.36
	(4.08)	(3.72)
Setup 1997	-4.14	-2.86
	(4.38)	(4.1)
Observations	665	685
R-squared	0.14	0.13

Dependent variable: self-reported market share. Instrument: self-reported number of competitors. Robust standard errors in parenthesis; * significant at 10%; ** significant at 5%; *** significant at 1%. City and industry effects included.

Table 5: Additional Definitions of Ownership

	IV Poisson			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Majority (50-100%)	0.91**	-	-	3.82**	-	-
Incidence ratio	2.47					
	(0.40)			(1.72)		
Majority (50-100%) * JV	-	1.20***	-	-	6.45***	-
Incidence ratio		3.32				
		(0.36)			(2.35)	
Majority (50-100%) * INV	-	-1.13**	-	-	-1.13	-
Incidence ratio		0.32				
		(0.45)			(1.24)	
Fully (100%) * SUB	-	-	1.15*	-	-	7.82
Incidence ratio			3.16			
			(0.63)			(6.18)
Fully (100%) * INV	-	-	-1.33	-	-	-1.82
Incidence ratio			0.26			
			(3.07)			(1.59)
Majority (50-99%) * JV	-	-	1.22***	-	-	6.19***
Incidence ratio			3.38			
			(0.39)			(2.39)
Majority (50-99%) * INV	-	-	-1.03*	-	-	-0.85
Incidence ratio			0.36			
			(0.53)			(1.25)
Minority (10-49%)	-0.12	-0.18	-0.18	-0.51	-0.34	-0.35
Incidence ratio	0.88	0.83	0.84			
	(0.49)	(0.30)	(0.30)	(1.12)	(1.13)	(1.12)
Observations	665	657	657	665	657	657
R-squared				0.09	0.12	0.12

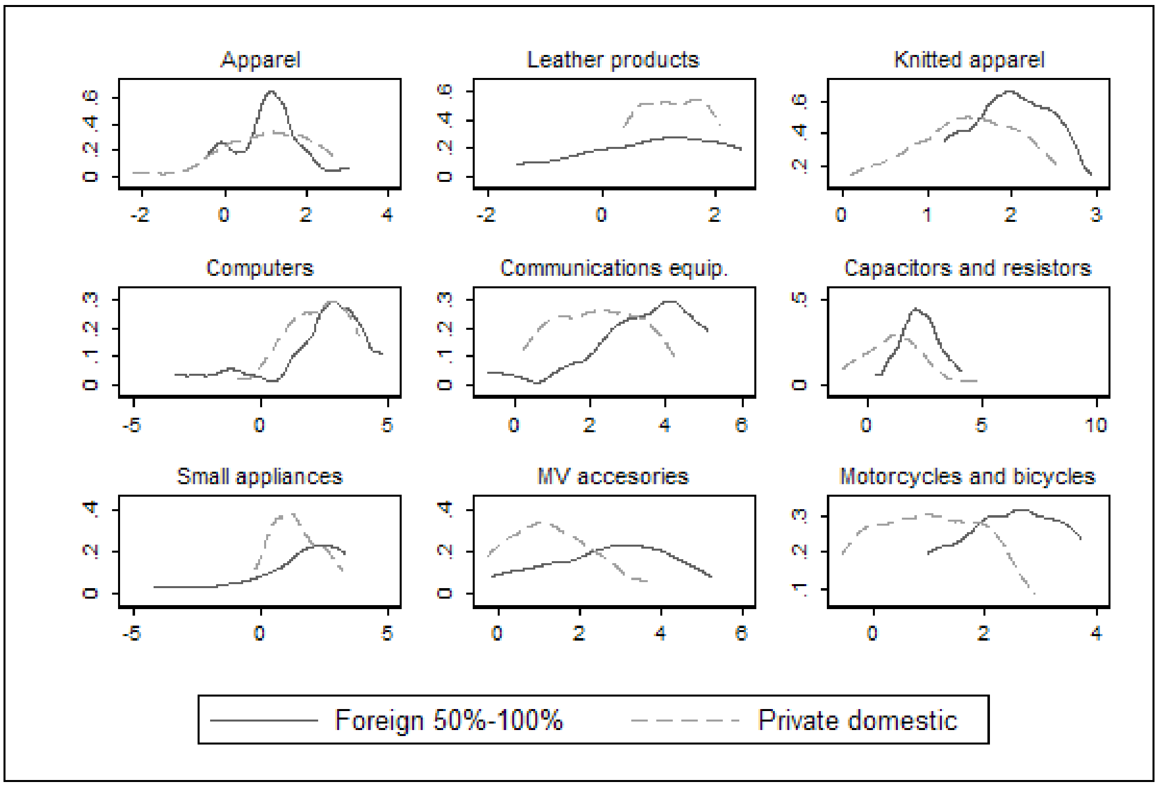
Dependent variable: Number of new varieties of goods introduced by the firm from 1998 to 2000. Robust standard errors in parenthesis (bootstrapped in the case of IV Poisson); * significant at 10%; ** significant at 5%; *** significant at 1%. Domestic private firms are the baseline category. Other controls: Non-private, Log workers, Market share, Log age, Setup 1997, Setup 1998, city and industry effects. Majority JV: foreign joint venture; Majority INV: foreign firms owned by investors; Fully SUB: subsidiary of a foreign multinational; FULLY INV: fully-owned foreign firm, owned by an investor.

Table 6: Sales of New Varieties

	Dependent variable: Sales of newproducts (thousands of US$)			
	Tobit	IV Tobit	OLS	IV
Majority (50-100%)	1,622***	1,997***	2,480**	2,484**
	(433)	(642)	(1,005)	(1,010)
Minority (10-49%)	784	1,516	312	321
	(546)	(933)	(785)	(899)
Non-private	-333	-167	-338	-336
	(422)	(554)	(420)	(437)
Observations	663	663	663	663
R-squared			0.19	0.19
	Dependent variable: Percentage sales of newproducts			
	Tobit	IV Tobit	OLS	IV
Majority (50-100%)	5.65**	8.41**	6.81**	8.43**
	(2.13)	(3.51)	(3.09)	(3.36)
Minority (10-49%)	4.65	10.65**	3.26	6.76*
	(2.66)	(5.41)	(3.18)	(4.00)
Non-private	-2.26	-1.99	-2.68	-1.59
	(2.04)	(7.09)	(2.18)	(2.65)
Observations	662	662	662	662
R-squared			0.18	0.18

Dependent variables: Sales of new products in thousands of US dollars from 1998 to 2000, and sales of new products as a fraction of total sales from 1998 to 2000. Standard errors in parenthesis; * significant at 10%; ** significant at 5%; *** significant at 1%. Domestic private firms are the baseline category. Other controls: Log workers, Market share, Log age, Setup 1997, Setup 1998, city and industry effects. Marginal effects for unconditional expectation reported for Tobit and IV Tobit regressions.

Figure 2: Distribution of Labor Productivity



Density functions of labor productivity in 1998 for majority-owned foreign firms and private domestic firms. Labor productivity is computed as value added per worker.

Table 7: Efficiency in Production

	Log value added per worker				Log value added per production worker		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Majority (50-100%)	0.36***	-	-	0.28**	0.38**	-	-
	(0.14)			(0.13)	(0.16)		
Majority (50-100%) * JV	-	0.82***	-	-	-	0.76***	-
		(0.14)				(0.18)	
Majority (50-100%) * INV	-	-0.23	-	-	-	-0.12	-
		(0.24)				(0.27)	
Fully (100%) * SUB	-	-	1.19***	-	-		1.21***
			(0.24)				(0.3)
Fully (100%) * INV	-	-	-0.53	-	-	-	-0.6
			(0.51)				(0.55)
Majority (50-99%) * JV	-	-	0.75***	-	-	-	0.69***
			(0.15)				(0.19)
Majority (50-99%) * INV	-	-	-0.07	-	-	-	0.11
			(0.21)				(0.28)
Minority (10-49%)	0.22	0.24	0.23	0.15	0.34*	0.36*	0.35*
	(0.16)	(0.16)	(0.16)	(0.15)	(0.19)	(0.19)	(0.19)
Non-private	-0.60***	-0.60***	-0.60***	-0.64***	-0.39***	-0.40***	-0.40***
	(0.13)	(0.13)	(0.13)	(0.12)	(0.15)	(0.15)	(0.15)
Log capital	0.10***	0.09***	0.09***	0.10***	0.13***	0.13***	0.13***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Log age	-0.14	-0.13	-0.13	-0.16*	0.15	0.17*	0.17*
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.1)	(0.1)
Observations	796	783	783	789	750	739	739
R-squared	0.3	0.33	0.34	0.3	0.25	0.26	0.27

Dependent variable: Log value added per worker in 1998; in columns (5)-(7) only production workers are included. Column (4): drops private domestic firms with productivity below minimum for foreign firms. Robust standard errors in parenthesis; * significant at 10%; ** significant at 5%; *** significant at 1%. Domestic private firms are the baseline category. Majority JV: foreign joint venture; Majority INV: foreign firms owned by investors; Fully SUB: subsidiary of a foreign multinational; FULLY INV: fully-owned foreign firm, owned by an investor. City and industry effects included.

Table 8: Efficiency in Production by Country of Origin

	(1)	(2)
Majority (50-100%) * EU	1.04**	1.30***
	(0.42)	(0.3)
Majority (50-100%) * USA & CAN	0.78***	0.59**
	(0.3)	(0.28)
Majority (50-100%) * Japan	0.36**	0.52**
	(0.17)	(0.22)
Majority (50-100%) * Hong Kong	0.13	0.18
	(0.19)	(0.23)
Majority (50-100%) * Other Asian	-0.18	-0.47
	(0.39)	(0.42)
Minority (10-49%)	0.2	0.34*
	(0.16)	(0.19)
Non-private	-0.59***	-0.39***
	(0.13)	(0.15)
Log capital	0.09***	0.12***
	(0.02)	(0.03)
Log age	-0.13	0.16*
	(0.09)	(0.1)
Observations	788	742
R-squared	0.31	0.27

Dependent variable: Log value added per worker in 1998; in column (2) only production workers are included. Robust standard errors in parenthesis; * significant at 10%; ** significant at 5%; *** significant at 1%. Domestic private firms are the baseline category. City and industry effects included.

Table 9: Expenditure in New Varieties

	OLS		IV	
Majority Foreign (50-100%)	-0.58**		-0.66**	
	(0.29)		(0.33)	
Majority Foreign (50-100%)*JV		-0.68**		-0.71**
		(0.3)		(0.34)
Majority Foreign (50-100%)*INV		-0.43		-0.71
		(0.72)		(0.99)
Minority (10-49%)	-0.73*	-0.75**	-0.98**	-1.00**
	(0.39)	(0.38)	(0.43)	(0.43)
Non-private	0.24	0.24	0.13	0.15
	(0.28)	(0.28)	(0.34)	(0.33)
Market Share			-0.02*	-0.02*
			(0.01)	(0.01)
Log Age	-0.31*	-0.37**	-0.26	-0.33*
	(0.17)	(0.17)	(0.19)	(0.19)
Setup 1997	0.2	0.17	0.67*	0.63
	(0.47)	(0.47)	(0.39)	(0.39)
Setup 1998	-0.48	-0.78	0.07	-0.25
	(0.58)	(0.6)	(0.65)	(0.68)
Observations	293	288	263	259
R-squared	0.13	0.14	0.1	0.12

Dependent variable: Ratio of expenditure in R&D and in purchases of technology to sales of new goods during 1998-2000. Robust standard errors in parenthesis;* significant at 10%; ** significant at 5%; *** significant at 1%. Regressions only include firms that introduced new goods. City and industry effects included.

Table 10: Ways in Which Firms Introduce New Varieties

	Transferred		Licensed		In-house	
	(1)	(2)	(3)	(4)	(5)	(6)
Majority (50-100%)	0.20***		0.31***		-0.23***	
	(0.07)		(0.08)		(0.08)	
Majority (50-100%) * JV		0.27***		0.37***		-0.29***
		(0.09)		(0.09)		(0.09)
Majority (50-100%) * INV		(0.15		0.46***		-0.14
		(0.15)		(0.15)		(0.14)
Minority (10-49%)	0.02	0.02	-0.06	-0.06	0.00	0.00
	(0.07)	(0.07)	(0.06)	(0.06)	(0.08)	(0.08)
Non-private	-0.08*	-0.08*	-0.08	-0.09	-0.08	-0.07
	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)
Observations	362	354	380	372	399	391

Probit regressions. Table reports the incremental probability with respect to the baseline category (private domestic firms). Dependent variables: (1)-(2) Transferred at least one new good from company in same corporate group during 1998-2000; (3)-(4) Purchased at least one license from a foreign source during 1998-2000; (5)-(6) Developed a new good in house, in China, during 1998-2000. Robust standard errors in parenthesis; * significant at 10%; ** significant at 5%; *** significant at 1%. Regressions only include firms that introduced new goods. Other controls: Log workers, Log age, Setup 1997, Setup 1998, city and industry effects.

Table 11: New Varieties and Productivity and Cost Advantages

	Number of new varieties		Sales of new varieties in total sales			
	Poisson	IV Poisson	OLS	IV	Trunc.	IV Trunc.
	(1)	(2)	(3)	(4)	(5)	(6)
Log Value added per worker	0.22**	0.21**	2.65**	3.45*	5.38***	7.10**
Incidence ratio/Marginal effect	1.24	1.23			2.66	3.58
	(0.09)	(0.1)	(1.34)	(1.91)	(2.08)	(2.87)
Cost of Development	-0.15***	-0.16***	-5.28***	-5.68***	-11.24***	-12.33***
Incidence ratio/Marginal effect	0.86	0.85			-5.55	-6.22
	(0.05)	(0.06)	(0.66)	(0.76)	(1.62)	(1.77)
Majority Foreign (50-100%)	0.13	0.02	1.27	-1.07	2.36	-5.01
	(0.37)	(0.4)	(4.73)	(6.29)	(6.74)	(8.97)
Minority (10-49%)	-0.17	-0.42	-2.7	-6.28	-5.32	-14.47
	(0.34)	(0.39)	(5.04)	(6.61)	(8.51)	(10.87)
Non-private	-0.16	-0.32	-6.04	-7.38	-12.59*	-15.96**
	(0.33)	(0.38)	(3.7)	(4.58)	(7.25)	(7.91)
Log Workers	0.12	0.18	0.94	1.8	1.5	3.78
	(0.1)	(0.12)	(1.24)	(1.59)	(2.08)	(2.72)
Log Age	-0.03	-0.02	1.84	1.42	4.56	2.87
	(0.2)	(0.2)	(2.19)	(2.62)	(4.44)	(4.5)
Market Share	0.00	-0.01	-0.04	-0.47	-0.09	-1.02
	(0.00)	(0.01)	(0.05)	(0.38)	(0.11)	(0.74)
Setup 1998	1.68***	1.85***	0.06	3.59	-1.75	1.53
	(0.65)	(0.62)	(8.97)	(9.92)	(15.92)	(16.58)
Setup 1997	-0.38	-0.05	3.95	9.27	6.2	19.6
	(0.5)	(0.38)	(11.05)	(12.44)	(13.17)	(13.45)
Observations	238	219	259	239	259	239
R-squared			0.39	0.28		

Robust standard errors in parenthesis;* significant at 10%; ** significant at 5%; *** significant at 1%. Regressions only include firms that introduced new goods. Poisson (1)-(2) and Truncated (5)-(6) regressions are conditional on the dependent variable being greater than zero. Log value added per worker and cost of development: incidence ratios reported for regressions (1)-(2) and marginal effects for regressions (5)-(6). City and industry effects included.

Table 12: Contribution of Each Factor

	Number of new varieties		Sales of new varieties in total sales			
	Poisson (1)	IV Poisson (2)	OLS (3)	IV (4)	Trunc. (5)	IV Trunc. (6)
Technology	**0.39**	**0.38**	**0.62**	**0.66**	**0.59**	**0.72**
Labor productivity	0.33	0.34	0.35	0.42	0.33	0.45
Cost of development	0.06	0.05	0.27	0.24	0.26	0.27
Other factors	**0.29**	**0.53**	**0.16**	**0.51**	**0.22**	**0.67**
Size	0.03	0.05	0.03	0.05	0.02	0.05
Market share	0.01	0.04	0.00	0.13	0.00	0.14
Initial year	0.02	0.01	-0.10	-0.07	-0.12	-0.07
Industry and Location	0.22	0.44	0.24	0.41	0.31	0.54
Unexplained	**0.33**	**0.09**	**0.22**	**-0.17**	**0.19**	**-0.39**

Results show the percentage contribution of each explanatory variable to the difference in the predicted means of the dependent variables (number of new varieties, and sales of new varieties in total sales) between majority-owned foreign firms and private domestic firms. Based on Table 11. Truncated and Poisson regressions show the percentage contribution to the index function.