CORE DISCUSSION PAPER
2004/11

Foreign Direct Investment, Competition and Industrial Development in the Host Country

Salvador BARRIOS[1], Holger GOERG[2], and Eric STROBL[3]

March 2004

Abstract

This paper analyses the impact of foreign direct investment (FDI) on the development of local firms. We focus on two likely effects of FDI: a competition effect which deters entry of domestic firms and positive market externalities which foster the development of local industry. Using a simple theoretical model to illustrate how these forces work we show that the number of domestic firms follows a u-shaped curve, where the competition effect first dominates but is gradually outweighed by positive externalities. Evidence for Ireland tends to support this result. Specifically, applying semi-parametric regression techniques on plant level panel data for the manufacturing sector we find that while the competition effect may have initially deterred local firms' entry, this initial effect has been outpaced by positive externalities making the overall impact of FDI largely positive for the domestic industry.

Keywords: Foreign direct investment, spillovers, industrial development, firm entry, semi-parametric estimations

JEL classification: F2, L6, O1

[1]CORE, Université Catholique de Louvain, Belgium. E-mail: barrios@core.ucl.ac.be
[2]Department of Economics, University of Nottingham, United Kingdom. E-mail: holger.gorg@nottingham.ac.uk
[3]CORE, Université Catholique de Louvain, Belgium. E-mail: strobl@core.ucl.ac.be

We are grateful to Forfás for the provision of the data. We would also like to thank the participants at a research seminar organized by FEDEA (Madrid) and to the VI Jornadas de Economía Internacional at the University of Valencia for useful comments. We are especially grateful to Omar Licandro and Juan José de Lucio for very helpful suggestions. We also wish to thank Oscar Bajo, Lionel Fontagné, Jacques Mélitz, Patrick Messerlin and two anonymous referees for very useful comments on earlier versions of this work. Holger Görg gratefully acknowledges financial support from the Leverhulme Trust under Programme Grant F114/BF and the European Commission under Grant No. SERD-2002-00077. Eric Strobl is grateful for a Marie Curie Research Fellowship. This paper presents research results of the Belgian Program on Interuniversity Poles of Attraction initiated by the Belgian State, Prime Minister's Office, Science Policy Porgramming. The scientific responsibility is assumed by the authors.

I Introduction

It is a well-known fact that foreign direct investment (FDI) flows have increased dramatically over the last three decades or so. It is also undoubted that governments across the world, in developing and developed countries alike, are trying to attract multinational enterprises (MNEs) to locate in their country, using generous financial and fiscal incentives (see, for example, Hanson 2001). The rationale for such enthusiasm displayed at attracting MNEs has been debated in the academic literature as well as in policy making circles. One argument is that multinationals bring with them some sort of superior technology and that this will "spill over" to domestic firms, thus assisting them in improving their efficiency and, hence, productivity. However, the vast evidence that has thus far been accumulated is less than conclusive on whether such spillovers do take place. In fact, there are a substantial number of studies arguing that there are actually negative spillover effects, i.e., the presence of multinationals harms productivity in domestic firms due to increased competition.[1]

Even disregarding the issue of knowledge spillovers, there are other ways in which the entry or presence of MNEs may assist the development of host country firms. In particular, multinationals' demand for intermediate inputs, some of which will be sourced on the domestic market, can induce changes in the domestic industrial structure and can kick-start the development of local industry. This is the issue with which we concern ourselves in this paper, analysing the impact of FDI on the development of local firms.

In order to illustrate these arguments and motivate our subsequent empirical analysis we begin by presenting a simple theoretical framework in order to analyze the main mechanisms at hand. We build on the existing theoretical literature concerning the potential

1 See, for example, Aitken and Harrison (1999) and Konings (2001) for arguments to that extent. Recent studies finding positive spillover effects are, for example, Keller and Yeaple (2003) and Haskel et al. (2002). See Görg and Strobl (2001) and Lipsey (2002) for surveys of the literature.

impact of FDI, in particular, Markusen and Venables (1999), Rodriguez-Clare (1996) and Rivera-Batiz and Rivera-Batiz (1991). The interaction between MNEs and domestic firms takes place through several channels. The first one is the factor market, as FDI represents a capital inflow and modifies the host country capital endowment. In addition, foreign affiliates use differentiated intermediate product which indirectly affects the production conditions for domestic firms. The second channel is a competition effect, where MNEs are competing with local producers on their product market as well as on the factor market. We show that the evolution of the number of local firms as a function of the presence of foreign firms can be depicted as a u-shaped relationship where the competition effect first dominates but is gradually outweighed by positive externality effects.

We then analyze empirically the impact of FDI on domestic start-ups using plant level panel data for the manufacturing sector in the Republic of Ireland over the period 1972 to 2000. The Irish economy provides arguably a model example for such an analysis given that it is heavily dependent on multinational companies, which accounted for roughly one half of manufacturing employment in 2000.[2] More importantly, the presence of multinationals has had profound effects on sectoral adjustment in the Irish manufacturing sector. While indigenous manufacturing industry tended to initially be concentrated in traditional and food-sector activities, MNEs have invested primarily in modern high-tech sectors, leading to an increase in the significance of the high-tech sectors for the Irish economy (Barry and Bradley, 1997).

Using the plant level data and applying semi-parametric regression techniques we find that the impact of FDI on domestic firms' entry follows a u-shaped curve. In other words, an increasing presence of multinationals may initially harm the development of domestic firms

[2] This is evident from our datasource, see also Table 1 below.

due to increasing competitive pressure. However, after reaching a certain threshold value, the positive benefits of FDI outweigh the negative factors, hence fostering the development of domestic firms.[3]

The rest of the paper is structured as follows. In the next section we describe our theoretical framework. Section III outlines our empirical specification in order to test these predications and contains a description of our data. Our empirical results are presented in Section IV. Concluding remarks are provided in the last section.

II Theoretical framework

In order to motivate our empirical analysis of the effects of FDI on local development this section builds a simple model to illustrate the main forces at hand. In order to do so we draw on the literature on imperfect competition and intermediate linkages between industries. One of the main analytical tools used here is a transformation of the Dixit-Stiglitz (1977) utility function into a production function. As pointed out by Romer (1987), this allows capturing a preference for variety in intermediate inputs and, as a consequence, to consider increasing returns due to specialization. In particular, Ethier (1982) used this tool in a model of international trade with external increasing returns to scale. This idea has also been applied by Rivera-Batiz and Rivera-Batiz (1991) to analyze the impact of FDI on host economies. Using a simple general equilibrium model, they show how foreign capital entry may induce more specialization in services, which in turn has a positive effect on efficiency in related industries.

---

[3] There are a number of related empirical papers examining the effect of multinationals on the Irish economy. Ruane and Ugur (2002) find evidence for positive spillovers emanating from multinationals. Görg and Strobl (2003) show that the presence of multinationals enhances the survival probabilities of domestic firms in the same industry. The paper most closely related to ours is an earlier study by Görg and Strobl (2002) on the effect of multinationals on domestic firms. While they find a positive effect, their study is limited in that it is not directly based on a theoretical model and that they do not allow for a potential non-linear relationship.

The idea is fairly straightforward. Consider an economy with two sectors of activity, services and manufacturing, both of which employ capital as primary input. In addition, the manufacturing industry uses differentiated services as inputs. Since there are increasing returns in services and competition is of the monopolistic type, an external entry of foreign capital makes available capital cheaper and average costs lower in the service sector. If the number of firms in equilibrium (and the variety of differentiated services) is determined by a zero profit condition in the service sector, then lowering the average cost through foreign capital entry causes an increase in services variety. This has, in turn, an indirect impact on the manufacturing sector as the number of services available in the economy increases the productive efficiency of manufacturing firms.

However, this model has some limitations. First, FDI is modeled only through foreign capital entry. Second, competition in the manufacturing sector within which FDI occurs is supposed to be perfect while the general theory of FDI postulates that multinationals are more likely to exist in imperfectly competitive markets, see Hymer (1976), and, more recently Markusen (1995, 2002). According to these latter contributions, multinationals own some advantages internalized through FDI against other possible strategies like exporting or licensing. Recent studies, in particular Rodriguez-Clare (1996) and Markusen and Venables (1999) considered these elements in an explicit way to analyze the effects of FDI on host economies.

In Rodriguez-Clare (1986) the impact of FDI on host economy industry depends on the input-output linkages multinationals generate compared to the linkages domestic firms would themselves generate. When a multinational has a higher linkage coefficient than domestic firms this leads to a higher equilibrium variety of specialized inputs and this is thus beneficial to the domestic economy as whole. However, in Rodriguez-Clare (1996) the relative strength of the competition and spillovers effects is left unclear. In fact, one can consider that the competition effect may condition the way FDI affect the local industry. Such a competition effect is explicitly analysed in the model by Markusen and Venables (1999).[4] Their results show that FDI may have two main effects on host economies: the linkage effect through intermediate demands as described above and the product competition effect through which multinationals may force domestic firms to exit the market. However, their model suggests that, while multinationals can act as a catalyst to stimulate local industry, local industry and multinationals do not coexist.[5] One can, however, consider this result as particular case. As noted by Markusen and Venables themselves, *"this result comes from the relatively high degree of similarity between local and multinational firms, and it is easy to imagine circumstances which would permit coexistence"* (1999, p.351).

In what follows we build a simple model in which coexistence of domestic firms and foreign multinationals is possible. Such a scenario may arguably be more general than the specific case considered by Markusen and Venables (1999). In particular, this allows us to study the way competition and spillovers effects act successively through the entry of FDI. We do not consider the conditions under which the coexistence between domestic and foreign firms is possible, as in Markusen and Venables (1999). Instead, we assume that FDI is determined exogenously and takes place both through the entry of new firms into the product market and of foreign capital entry as described by Rivera-Batiz and Rivera-Batiz (1991). This is made possible by considering that FDI occurs through foreign capital entry as long as the return to capital in the host economy is higher than in the origin country. In doing so, we

---

[4] Haaland and Wooton (1999) have a similar theoretical setting, though they focus on the rationale for financial incentives.

[5] The authors argue that this case corresponds to the experience of some countries in East Asia where multinationals have served as catalyst for industrial development and, after a certain period of time, have been wiped out because of the strong competition they ended-up facing on their own product market.

introduce a simple law of motion where FDI ceases when the returns to capital are equalized in both countries. This allows us to describe the way competition and positive externalities act successively and how they can possibly influence the development of a local industry in which both domestic and multinational firms coexist.

II.1 Structure of the model

We consider an economy with three sectors: agriculture, which produces a homogeneous good *y*, manufacturing and services which produce differentiated goods *x* and *s*, respectively. All sectors use a composite factor *K* which includes both labor and capital. Services are intermediate inputs in the production of the manufacturing good. Consumers own *K* and purchase *x* and *y* and have identical preferences described by a utility function defined on *y* and on a sub-utility function defined on *x*. The utility function of the representative consumer takes the form:

$$U = X^{\delta} Y^{1-\delta} \qquad (1)$$

where $0 < \delta < 1$ and *X* is a sub-utility function of CES-type defined by:

$$X = \left\{ \sum_{j} x_j^{\Gamma} \right\}^{\frac{1}{\Gamma}} \qquad (2)$$

where $0 < \Gamma < 1$ and $j = 1..n_x$, with n_x being the number of varieties of the manufactured good.

We assume monopolistic competition in manufacturing so that each variety of the manufacturing good is produced by only one firm. Additionally, there are increasing returns to scale represented by decreasing average costs and manufacturers use *K* as a primary production factor and services as intermediate inputs. Given *r*, the unit price of *K*, q_s, the price index of services, and x_j, the production level of each producer taken individually the cost function of each manufacturing firm is defined by:[6]

$$C_j(x_j) = q^{\mu}\ r^{1-\mu}\ \left(\alpha + \beta\ x_j\right) \qquad (3)$$

with $0 < \mu < 1$.

The terms α and β are positive parameters and average costs are decreasing with production so that there are increasing returns to scale, specifically *internal returns to scale*. The price index of services is defined as follows:

$$q_s = \left\{ \sum_i p_i^{\ 1-\sigma} \right\}^{\frac{1}{1-\sigma}} \qquad (4)$$

where i=$1 \ldots n_s$, and n_s is the number of available varieties of differentiated services and σ is the constant elasticity of substitution between each pair of variety of differentiated services with $\sigma > 1$. Assuming that all varieties of the differentiated services enter symmetrically in the production function, expression (4) can be simplified to

$$q_s = n_s^{\ \frac{1}{1-\sigma}}\ p_i \qquad (4´)$$

Equation (4´) depicts the relationship between q_s and n_s . Since the expression $1/1-\sigma$ is negative, an increase in n_s provokes a decrease in q_s. The direct consequence is that the cost function of manufacturing firms defined by (3) decreases with n_s for a given production level. This implies a potential external effect or *external returns to scale* of service sector activity on manufacturing because service variety, represented by n_s, plays a positive role for manufacturing firm efficiency *per se*. Given the specification of the utility function in (1) and

[6] This is the cost function used by Venables (1996) and it can be easily derived from a Cobb-Douglas production function with a fixed component in term of services and the composite factor.

(2), constant elasticity of substitution between each pair of differentiated manufactured products is equal to

$$\theta = \frac{1}{1-\Gamma} > 1 \quad (5)$$

It can be shown that, for a sufficiently large number of firms, θ is also the price elasticity of demand. We can then write the price index for manufactured products:

$$q_x = \left\{ \sum_j p_j^{\ 1-\theta} \right\}^{\frac{1}{1-\theta}} \quad (6)$$

Given θ, individual prices are determined by the equalization of marginal income to marginal costs. Prices are set above marginal cost and using (3) and (5) we can find the expression for the price of the manufactured good:

$$P_j = \frac{\theta}{\theta - 1} \beta \, q_s^{\ \mu} \ r^{1-\mu} \quad (7)$$

There is free entry and exit in manufacturing implying zero profits. Using (3) and (7) one can find the expression for the quantity produced by each manufacturing firm as a constant term equal to:

$$x_j = \frac{\alpha \, (\theta - 1)}{\beta} \quad (8)$$

This represents the break-even level of production or, in other words, the production level to be reached by each manufacturing firms to cover fixed costs.

There is monopolistic competition also in the services sector so prices and quantities can be derived using the same assumptions as above. In addition, as in Markusen and Venables (1999), we assume that services are non-tradable. The cost function is the same for each service producer and is equal to:

$$C_i(s_i) = r \, (\gamma + \rho \, s_i) \quad (9)$$

where s_i is the production level of each service firm i and γ and ρ are positive constant terms. Average costs decrease with s_i so that there are increasing returns in the service sector. Hence, firm behaviour is similar in the service and manufacturing sectors. Given σ, the constant demand elasticity between each pair of services, individual prices are set above marginal costs. Services are only used by manufacturing firms but not by consumers. With a sufficiently large number of service varieties, σ can be taken as the price elasticity of demand, so that using equation (9), the expression for service price is equal to:

$$p_i = \frac{\sigma}{\sigma - 1} \rho\, r \tag{10}$$

As in manufacturing, there is free entry and exit in the service market so that profits equal zero in equilibrium. Using equations (9) and (10) we can derive the break-even level of output in services as:

$$s_i = \frac{\gamma\, (\sigma - 1)}{\rho} \tag{11}$$

Finally, equilibrium in the agricultural sector is quite simple. We assume that y is the production level of the agricultural good, which is also the numeraire. There is perfect competition in this sector, the production function for agriculture can then be represented by an aggregated function as:

$$y = K_y \tag{12}$$

where K_y is the total quantity of composite factor employed in agriculture. The price of the agricultural good is equal to marginal cost:

$$p_y = r \tag{13}$$

The description of the model is completed with equilibrium in the composite factor market. Using Shephard's lemma to derive demand for capital by manufacturing and service firms from equations (3) and (9) respectively and from equation (12) for agriculture, it is possible to derive the equilibrium condition in the composite factor market as:

$$n_x \frac{\partial C_j}{\partial r} + n_s \frac{\partial C_i}{\partial r} + K_y = K \qquad (14)$$

K is the total endowment in the composite factor of the economy and the second partial derivative of the left hand side is defined taking p_i as given and K_y is the total factor employed in agriculture.

One can now use the model to analyze the relationships between the service sector and the manufacturing industry. To simplify the analysis, we examine first the closed economy case and show afterwards how FDI may modify the picture and play an active role for the development of local firms.

II.2 The closed economy case

The interactions between service and manufacturing firms work through two channels, namely, the factor market and the upstream-downstream production structure. To consider interactions in the factor market, one has to bear in mind that all sectors use the same factor. The equilibrium number of firms in services and manufacturing is determined by the size of the market, i.e., the total endowment of K in the economy. Hence one can use equation (14) to derive the first relationship between the equilibrium number of firms of both sectors as follows.

Since the utility function depicted in equation (1) has a Cobb-Douglas form, the expenditure on the agriculture good equals:

$$p_y\ y = (1-\delta)\ rK \qquad (15)$$

With full employment, the term rK is equal to the available income destined for consumption of agricultural and manufactured goods. Then $(1-\delta)\ rK$ is the value of income available for consumption of the agricultural good. Using equation (13) one can show that the demand for the composite factor in agriculture is equal to

$$K_y = (1-\delta)\ K \tag{16}$$

The term δK represents the total quantity of the composite factor employed in the service and manufacturing sectors. We can then use equation (14) together with equations (3) and (9) for the cost function, and equations (4´), (8), (10), and (11), which give the equilibrium values for prices and quantities, to determine the equilibrium number of manufacturing firms as a function of the parameters of the model, the number of services firms and the total capital endowment of the economy. This yields the following expression:

$$n_x = \frac{\delta\ K - n_s\ (\gamma\,\sigma)}{(\frac{\sigma}{\sigma-1}\rho)^{\mu}\ (\alpha\,\theta)\ n_s^{\frac{\mu}{1-\sigma}}} \tag{17}$$

Equation (17) shows that n_x is greater, the larger is K. Here the equilibrium number of firms in the service sector n_s, acts on n_x through two opposite effects. The first one is positive and plays through the externality effect since a larger number of varieties in the service sector implies a lower price index for such services as described in equation (4´) and increases manufacturing firms' efficiency. This is because the exponent $\mu/(1-\sigma)$ of n_s in the denominator is negative, a rise n_s provokes a rise of n_x. The second one is negative since a higher number of service firms implies also a higher demand for K which increases the price of capital *ceteris paribus*, playing against manufacturing firms efficiency. There is then competition on the factor market which limits the equilibrium number of firms in the two different industries as these firms use both K factor. The general relationship between n_x and n_s is thus ambiguous although one should note that both are affected positively by a larger endowment in K.

Finally one can derive the number of service firms by using the equilibrium condition on the service market. We assume that each service enters the production function symmetrically. One can then use the cost function for manufacturing firms given by equation (3) to determine the total demand for intermediate services multiplying individual demands by the equilibrium number of manufacturing firms. We can use Shephard's lemma to derive individual demand for each service variety. Since the individual supply of each service is fixed at the break-even level of production given by equation (11), the demand for each service variety is equal to its supply which gives the following expression:

$$n_x \frac{\partial C_j}{\partial p_i} = s_i \tag{18}$$

III.3 Multinationals in the model

In order to introduce MNEs into the model we need to make two important assumptions. First, we assume that there is a continuous entry of new firms in the market. Second, we assume that FDI is the only way to penetrate the local market. FDI occurs through firms located outside the host country ignoring the production and competition conditions in their home market. The entry of foreign firms is then determined by the differential in the price of r between the host market and the home market (r^*), namely, $\Delta n_m > 0$ if $r > r^*$ and $\Delta n_m = 0$ if $r \leq r^*$. That is, with $r > r^*$, foreign firms enter the market until $r = r^*$. The number of local firms is then endogenous in the model while the number of MNEs is directly determined by the relative value of r and r^*.[7]

It then follows that the entry of foreign firms in the local market is accompanied by an exogenous entry of the foreign composite factor K. The amount of K transferred by each

[7] Note that in order to make the analysis more tractable we still assume that for MNEs, like domestic firms, output level is set in order to get zero profit. In addition, we assume that all services consumed by MNEs are produced locally by firms from the service sectors.

multinational is represented by a constant term Φ. This entry of the additional factor exerts indirectly a positive effect on domestic firms since it increases K. As such, the potential negative impact of an increase in demand for production factors represented by a larger number of firms is lowered through a larger endowment in capital which increases the variety of services available in the economy. This also captures the positive macroeconomic effect of a larger capital endowment in the host economy, as in Rivera-Batiz and Rivera-Batiz (1991).

In addition we assume that MNEs have the same cost function compared to their local counterparts and we can use equations (7) and (8) to determine the equilibrium level of prices and quantities as before.[8] The number of multinationals is represented by n_m and the number of local firms n_l, which are our two main variables of interest. Given that all firms within each type are identical, each variety of manufactured good enters the price index symmetrically and we can rewrite equation (6) as the price index for the manufacturing product including multinationals:

$$q_x = \left\{ n_l p_l^{1-\theta} + n_m p_m^{1-\theta} \right\}^{\frac{1}{1-\theta}} \tag{19}$$

This equation shows, as in Markusen and Venables (1999), that multinationals will exert a competitive pressure on domestic firms by lowering the price index of the final product. As a consequence, the entry of multinationals reduces domestic firms' sales and drives some to exit the market in order to fulfill the zero-profit condition.

Conditions remain equal in the service sector and conditions for equilibrium depicted in the previous section remain unchanged. We can then rewrite equations (14) and (18) by considering the entry of MNEs and the modification of K to represent the magnitude of FDI in order to determine the equilibrium number of local firms in manufacturing and service

[8] Note that one could perfectly imagine cases where production cost differ between each firm-type, as in Markusen and Venables (1999), without changing the main results.

sectors. This leaves us with two expressions to determine: the equilibrium condition for full employment in the capital market and the equality between demand and supply of individual services. Both equations are derived taking as given the equilibrium values for prices and quantities as before. After some calculation, the equilibrium in the capital market is given by:

$$\alpha\,\theta\left(\frac{\sigma}{\sigma-1}\rho\right)^{\mu} n_s^{\frac{\mu}{1-\sigma}}\left(n_l+n_m\right)+n_s\gamma\sigma \;=\delta K+\Phi n_m \qquad (20)$$

where $\Phi\, n_m$ represents the proportional change in the capital endowment of the host economy due to FDI. The term Φ represents the variation rate at which *K* changes. Given that we assume that domestic firms and multinationals have the same cost functions, the equilibrium conditions in the service market is given by the following expression:

$$\left(n_l+n_m\right)\frac{\partial C_j}{\partial p_i}=s_i \qquad (21)$$

Using the expression of the cost function and the equilibrium level of each service production, the preceding expression can be rewritten as:

$$\mu\theta\alpha\left(\frac{\sigma}{\sigma-1}\rho\right)^{\mu-1} n_s^{\frac{\mu}{1-\sigma}}\left(n_l+n_m\right)=\frac{\gamma(\sigma-1)}{\rho} \qquad (22)$$

Equations (20) and (22) have no straightforward interpretation, however, and one has to rely on numerical simulation in order to analyze the mechanisms at hand. Before doing this, let recall the main economic forces at work. The first mechanism is represented by the positive externality arising from the increase of *K* by an amount that we have supposed to be proportional to the number of MNEs. The second element is that an increase in the number of active firms in the market increases the demand for intermediates and provokes externality effects through the relationship between the equilibrium number of manufacturing and services firms. However, the last element can also play against the equilibrium number of local firms. An entry of MNEs increases competition and, *ceteris paribus*, provokes the exit of a determined number of local firms to restore zero-profit given the break-even level of output. There are thus several elements working simultaneously making the analysis quite difficult.

The numerical simulations of (20) and (22) is represented in Figure 1. The *u-curve* represented in this figure depicts the potential effect of FDI on the number of local firms in the host economy. This effect is first negative meaning that first the competition effect of FDI dominates. Entry of new foreign firms, although they have higher fixed costs than local firms, provokes the exit of a determined number of local firms. This is in part due to our hypothesis concerning the way in which FDI occurs. The entry of multinationals then forces some domestic firms out of the market through competitive pressure. However, for further increases of n_m , the equilibrium number of local firms starts to increase as a result of the dominance of the positive externalities effect. Moreover, since we have considered successive changes in the capital endowment of the economy, the competition effect begins to be less important relative to the larger market reflected by a larger factor market and, as a consequence, a larger market for intermediate products and final consumption.

[Figure 1 here]

It is important to mention the particularity of our hypothesis. Taking FDI as both an entry of new firms in the market and as a capital inflow it causes n_s to increase monotonously. Consequently, FDI always has a positive effect on intermediate services variety. The potential benefit for domestic firm then lies in the relative strength of this positive externality and of the competition effect as described earlier in the model. Perhaps more interestingly, Figure 1 shows that the potential positive effect of FDI is more important than the negative one.

When positive externalities from FDI dominate, the number of local firms ends up being higher than initially, in the equilibrium without FDI.[9]

Note finally that, in the model presented here, we make the hypothesis that FDI is the only way to penetrate the local market and that multinationals do not re-export their production to third markets. The literature on MNEs suggests however that FDI and international trade may well be complementary rather than substitute see, for instance, Markusen (1995, 2002). This, in turn, means that the potential effect of MNEs entry could be large if FDI is export-oriented. One could imagine for instance that, in addition to the different effects of FDI considered in our model, another effect could be represented by the fact that FDI allows domestic firms in the intermediate product sector to expand their production via the exports of multinationals. While the data set used for our empirical analysis does not contain information on exports, studies by Ruane and Sutherland (2002) and Barry and Bradley (1997) find that foreign multinationals, in particular from non-EU countries, export over 90 percent of their total output in the 1990s. This picture was similar at the beginning of our sample period, with McAleese (1977) showing that US multinationals exported 95 percent of sales, while British and German owned affiliates had export ratios of 82 percent in 1974.[10] Hence, changes in the impact of FDI on the local industry are not likely to be due to changes in the propensity of foreign affiliates to export in our Irish case study.

[9] Other numerical examples could have been considered here. For example, if local firms are relatively less efficient than MNEs (i.e. for a α sufficiently lower for multinationals than for domestic firms), FDI may provoke the exit of all the local firms. Efficiency is then a key determinant making local firms able to capture potential spillovers arising from FDI. A more complete model would also include the balance of payments equilibrium to determine the potential effect of FDI on local wages and welfare; however, this is not the focus of our analysis here and is therefore not pursued.

[10] The current high export ratios are frequently attributed, at least in part, to Ireland's being an EU member. In the earlier years, multinationals locating in Ireland could benefit from an export tax holiday, explaining the high export ratios. See Ruane (1991) for a detailed discussion of Irish industrial policy.

III Empirical Specification and Data

III.1 Empirical Specification

We take the prediction of a u-shaped relationship between FDI and domestic firms as a guide for our empirical work. However, in order to provide empirical evidence we need to slightly depart from the theory in two main ways. Firstly, the theory considers the number of MNEs as the crucial variable. However, that does not take account of the empirical fact that multinationals are generally much larger than domestic firms (e.g., Barry and Bradley, 1997 for Ireland). Hence, in order to measure the importance of multinationals in an industry we measure the presence of multinational enterprises by the share of employment in MNEs, as is commonly done in the related recent literature (see, e.g., Keller and Yeaple, 2003; Görg and Strobl, 2003). Nevertheless, we also experiment in our empirical analysis with using the share of total plant numbers as a proxy for foreign presence.

Secondly, the theory predicts a relationship between the number of MNEs and the number of domestic firms. However, rather than examining the absolute number our empirical approach is to look at the rate of entry of new domestic firms. This allows us to focus on the effect of fostering or discouraging new entry while at the same time scaling entry relative to the total number of firms in the industry. Furthermore, it places our paper firmly into the tradition of entry models in empirical industrial organisation (e.g., Acs and Audretsch, 1989; Mata, 1993).

Hence, our empirical implementation of the theoretical relationship amounts to estimating the following relationship

$$E_{jt} = \alpha + g(FS_{jt}) + \gamma \mathbf{Z_{jt}} + u_j + v_t + \varepsilon_{jt} \qquad (23)$$

where the dependent variable is the net entry rate defined as the number of indigenous plant entries minus exits over the period *t* to *t+1* divided by the total number of plants at time *t* in industry j, u_j is a sector (three digit NACE Rev 1) specific term, v_t is a year specific effect, and ε_{jt} is the remaining error term, assumed to be independent across sectors and over time. **Z** is a vector of time and industry varying covariates, namely the sectoral growth rate (SEGR), industry size (ISIZE), minimum efficient scale (MES - measured as average size), and average age of plants in the industry (AGE). The inclusion of these is motivated by empirical studies of firm entry (e.g., Mata, 1993; Mata and Machado, 1996; Görg and Strobl, 2002); detailed descriptions and definitions are included in the appendix.

FS is our proxy intended to capture the effect of foreign multinational companies on the entry of new firms. As discussed above, it is calculated as the share of employment in foreign-owned plants, i.e., employment in foreign plants divided by total employment in industry j at time t. One should note, that we do not restrict it to be linear, but to be of some function g(.). Our theoretical model suggests that it should be u-shaped.

III.2 Data

Our plant level data source is the annual Employment Survey collected since 1972 by Forfás, the policy and advisory board for industrial development in Ireland, and we have access to this data up until and including the year 2000. The response rate to this survey is estimated by Forfás to be generally well over 99 percent, i.e., our data can be seen as including virtually the whole population of manufacturing firms in Ireland. Information at the plant level include the nationality of ownership, level of employment, and the sector of production of each plant. Forfás defines foreign firms as firms which are majority-owned by foreign shareholders, i.e., where 50 percent or more of the shares are owned by foreign shareholders. While arguably, firms with lower foreign ownership should possibly still be considered foreign owned, this is not necessarily a problem for the case of Ireland since almost all foreign direct investment in Ireland has been greenfield investment rather than acquisition of local firms; see Barry and Bradley (1997).

Table 1 and 2 provide some aggregate data averaged over several years pertaining to the net entry rate of indigenous plants and the share of employment in foreign multinationals as a percentage of total employment in the two digit (NACE Rev 1) industry, respectively. As can be seen, the net entry rate of indigenous plants has fluctuated considerably over the years. In aggregate, it reached a high of a little over 9 percent in the late 1970s, but has been steadily decreasing since the late 1980s. Examining individual sectors reveals considerable variability across these, where the high entry rates in the more high-tech sectors are particularly notable. The aggregate series concerning foreign presence in Table 2 reveals that multinationals have been steadily increasing their importance in the Irish manufacturing sector. More precisely, foreign multinationals accounted for some 33 percent of manufacturing employment in the early 1970s, and this share has risen to around 47 percent by the end of our sample period. Again, however, the data in the table show that there are considerable sectoral differences, where foreign presence has been generally lower in the traditional sectors.

[Tables 1 and 2 here]

Section IV: Econometric Results

IV.1 OLS Estimator

In order to estimate the impact of foreign presence on entry of domestic firms we first proceed using simple OLS and including foreign presence and its higher order values. Results of this using foreign presence defined in terms of share of employment are depicted in Table 3. Restricting FS to a linear impact we find it has a positive and statistically significant effect on the net indigenous entry rate, in line with the findings by Görg and Strobl (2002). However, estimating (23) without FS, regressing the subsequent residual on FS, and then employing a Ramsey test suggests that a simple linear effect may not be correctly capturing the required functional form. We thus proceed and include a quadratic term, but this renders the linear term insignificant and a Ramsey test still suggests that the specification is unsatisfactory. While including a third order term does result in all FS variables being significant, a Ramsey test still suggests misspecification. Moreover, the inclusion of fourth and fifth order terms, as shown in the last two columns, suggests that the relationship between the net indigenous entry rate and foreign presence is not easily modelled by the shape restrictions that come with using higher order terms. We also conduct a similar exercise using the share of foreign plants in total plant population within a sector as a foreign presence proxy, as shown in Table 4. Here, similarly, it is difficult to judge from the higher order terms and the Ramsey tests what proper functional form FS should take.

[Tables 3 and 4 here]

IV.2 Semi-Parametric Kernel Regression Estimator

A more flexible and perhaps more attractive approach to further investigate the possible non-linearity of the relationship between E and FS in (23), while also allowing for the (linear) effect of other conditioning variables Z, follows the semi-parametric methodology proposed by Robinson (1988) using the Kernel regression estimator.[11] Specifically, this estimator does not, in contrast to including higher order terms, impose any restrictions on the relationship of interest. Accordingly, one can consider the following equation to be estimated:

$$Y = \alpha + g(X) + \delta Z + u \qquad (24)$$

[11] See Blundell and Duncan (1998) for details and a helpful discussion of the implementation of this method.

where Z are a set of explanatory variables that are assumed to have a linear effect on $\tilde{y}$ (= $\Delta \log y$), *g()* is a smooth and continuous, possibly non-linear, unknown function of *X*, and *u* is a random error term. A commonly used non-parametric estimator of an unknown function like *g(X)* without allowing for the effect of other conditioning variables is the Nadaraya-Watson estimator (see Nadaraya, 1964 and Watson, 1964):

$$\hat{m}_h(X) = \quad n^{-1} \frac{\sum_{i=1}^{n} K_h(X - X_i)\tilde{y}_i}{n^{-1}\sum_{i=1}^{n} K_h(X - X_i)} \tag{25}$$

such that *i=1…n* are the *n* number of observations, $K_h()$ is the shape function, commonly referred to as the Kernel, that is a continuous, bounded and real function that integrates to one and acts as a weighting function of observations around *X* and depends on the choice of bandwith *h*.

The appeal of this estimator lies in its very flexible approach to non-linearity by allowing the relationship of $\tilde{y}$ with respect to *X* to vary over all values of *X*. Specifically, this technique corresponds to estimating the regression function at a particular point by locally fitting constants to the data via weighted least squares, where those observations closer to the chosen point have more influence on the regression estimate than those further away, as determined by the choice of *h* and *K*. An additional appeal of this sort of technique is that it avoids any parametric assumptions regarding the conditional mean function *m(X)*, and thus about its functional form or error structure.

Allowing for the linear effect of other explanatory variables only slightly complicates the estimation of *g(X)*. Specifically, Robinson (1988) showed that in controlling for other conditioning variables the (semi-parametric) Kernel regression estimator for *g(X)* simply becomes:[12]

$$\hat{g}(X) = \hat{m}_{\tilde{y}}(X) - \hat{\delta}\hat{m}_X(X) \qquad (26)$$

where $\hat{m}_{\tilde{y}}(X)$ and $\hat{m}_X(X)$ are the (non-parametric) Kernel regression estimates of $E(\tilde{y}/X)$ and $E(Z/X)$, and $\hat{\delta}$ is the OLS estimator of:

$$\tilde{y} - \hat{m}_{\tilde{y}}(X) = \delta(Z - \hat{m}_X(X)) + \varepsilon \qquad (27)$$

where ε is a random error term. Intuitively, $\hat{g}(X)$ is the estimate of *g(X)* after the independent effect(s) of *Z* on *Y* has been removed.

Given that the estimate of $\hat{g}(X)$ is at least in part based on non-parametric estimation techniques, one cannot subject it to the standard statistical type tests (e.g. *t*-test) that economists have grown so accustomed to using in parametric regressions. One can, however, relatively easily calculate upper and lower pointwise confidence bands as:[13]

CI = g^(X) +/- $(c_\alpha c_K)^{1/2}$ η^(x) / [h $CI = \hat{g}(X) \pm (c_\alpha c_K)^{\frac{1}{2}}\hat{\eta}(X) \Big/ \left[\sum_{i=1}^{n} K_h(X - X_i)\right]^{\frac{1}{2}}$ (28)

where $c_\alpha c_K$ is a kernel specific constant corresponding to the α quantile of the distribution and $\hat{\eta}^2(X)$ is defined as:

$$\hat{\eta}^2(X) = n^{-1}\frac{\sum_{i=1}^{n} K_h(X - X_i)\tilde{y}_i}{n^{-1}\sum_{i=1}^{n} K_h(X - X_i)} \qquad (29)$$

One should note that (29) ignores the possible approximation error bias of $\hat{g}(X)$. Including this in (29) would complicate the expression considerably since the bias is a

[12] The fact that δ is in part estimated using OLS makes this a semi- rather than non-parametric estimator.
[13] See Haerdle (1990) for details.

complicated function of the first and second derivatives of *g(X)*. This bias tends to be highest at sudden peaks of $\hat{g}(X)$ and at the necessarily truncated left and right boundaries of the data. However, if *h* is chosen proportional to $1/n^{(1/5)}$ times a sequence that tends slowly to zero then the bias vanishes asymptotically for the interior points.[14] For all our estimations we use a Gaussian kernel for K_h and an optimal bandwidth *h* such that:

$$h = \frac{0.9m}{n^{1/5}} \tag{30}$$

where $m = (\hat{\sigma}^2(X) \times$ (interquantile range)$_X$ / 1.349)

One should also note that the size of $\hat{\sigma}^2(X)$ at any point of X will depend proportionally on the marginal distribution of X. In other words the accuracy of the estimate of *g(X)* at X is positively related to the density of other observations around that point. In order to visualize this effect we, as suggested by Haerdle (1990), calculate the pointwise confidence bands at points chosen according to the distribution of X. Specifically, we chose points so that five per cent of the observations lie between them.[15]

Our semi-parametric kernel regression estimates of g(x) along with pointwise confidence bands using the net entry rate as the dependent variable and foreign share of employment as the measure of FDI presence are given in Figure 2.[16] One should also note that we do not report the actual estimates of *g(FS)* on the vertical axes, just graph the relationship between *FS* and the dependent variable. Our primary reason for not reporting these is that our estimates of *g(FS)* are predicted values from which the influence of the other control variables have been purged, and hence, cannot be directly linked to the actual range of

[14]See Haerdle (1990) and Wand and Jones (1995) for a discussion of these aspects.
[15] From the endpoints we chose the 1 and 99 percentiles of the distribution.
[16] Given that values on the vertical axis for the net entry rate are based on predicted values and thus do not correspond necessarily to the actual observed entry rates, we have omitted labeling the axis rather than shifting the value by some constant to fall within the range of actual values.

observed the net indigenous entry rate. Instead, as is standard, one should use the figures to gauge the estimated slope of the relationship in question. Of course, it is this relationship that the is paper is concerned with in any case.

As can be seen, we find a u-shaped relation ship between the net entry rate and foreign presence within a sector, although this is not continuously smooth.[17] Nevertheless, the size of the confidence bands shows that the curve is estimated with considerable confidence, except for higher values of FDI presence where also the distribution of observations is relatively small, as indicated by the horizontal width between each confidence band. If our estimate of *g(FS)* is taken at face value, then the minimum of the curve is found where FDI presence takes the value of 29 per cent. Thus the competition effect of FDI outweighs any positive spillover effects on net indigenous plant entry up until this point, but once this threshold level of reached positive spillover effects dominate. This evidence, thus, is in line with the patterns suggested in the theoretical analysis in Section II.

We also estimated the model using the share of multinationals in total plant population as a proxy for FDI presence and present the results in Figure 3. First of all one should note that the observations near the maximum value of FDI in our data (0.8) are very sparsely distributed, so that estimates are likely to be poor. This is at least in part probably part of the reason for the curve's wide fluctuations near the right boundary. The rest of the curve is similar to that for foreign employment share, although the turning point is somewhat earlier, namely around 23 per cent.

[Figures 2 and 3 here]

One should note that the semi-parametric Kernel regression estimator can be extremely sensitive to outliers given that it is roughly speaking simply a local weighted average

[17] Using a larger value of h could ensure greater smoothness, but the trade-off is a greater approximation bias.

of the response variable. This is already apparent from the greater width of the confidence bands around peaks and near the right hand side end points where there are fewer observations. In order to check for the robustness of the shapes implied by the overall sample we re-estimated our regressions excluding what may be ‘outliers’. Specifically, we excluded all observations where the net entry rate was one standard deviation above or below the sample mean. For the foreign share of plant population regression we also excluded all observations where the share was above 0.6, since Figure 3 seems to suggest a number of poorly estimated peaks to the right of this value. The kernel regression estimates for these sub-samples for foreign presence measured in terms of employment and in terms of plant population are given in Figures 4 and 5, respectively.

[Figures 4 and 5 here]

Accordingly, in terms of employment share there still exists a general u-shaped relationship, although, given that a large part of the right hand side has been truncated, this is not as pronounced as for the unrestricted sample. Clearly, however, the depicted curve suggests that at low values of foreign presence there is a competition effect, while the overall trend beyond a value of 0.2 is upward sloping, indicating positive spillovers. For the plant population curve, as shown in Figure 5, the u-shaped link between net indigenous entry and foreign presence similarly remains, although perhaps not as pronounced as for the full sample.

V Conclusion

This paper examines the effect of foreign direct investment (FDI) on the entry of local firms in host economies. In our theoretical framework we show that the impact of FDI on local development depends on two countervailing forces: first, a competition effect which provokes the exit of local firms; second, positive market externalities related with foreign presence which foster domestic firms' start-up. With a continuous flow of FDI, the evolution of the number of local firms can be depicted as a u-curve where the competition effect first dominates but is gradually outweighed by positive externalities effects. Taking this as a motivating framework for our empirical analysis and applying semi-parametric regression techniques on plant level panel data for the manufacturing sector in the Republic of Ireland, we find support for such a u-shape.

Our results have important implications for economic policies pursued in host countries. This concerns questions such as incentives for resources transfer with FDI. Our model shows how FDI can be positive for local firms expansion and that positive externalities are more likely to occur the larger is the amount of capital transferred through FDI and the greater is the efficiency of local firms. We also show that local firms need to adapt to new competitors since FDI represents a greater competition factor than imports due to the factor market size limitation. FDI may provoke the exit of a given number of local firms while the remaining firms will be able to capture the positive spillovers effects related to FDI. This implies a transition period in which the competition effect dominates. In this case policy may be aimed at shortening this period and smoothing the transition process by assisting domestic firms to improve their capacities in order to be able to compete with multinationals. Thus, policy could be aimed at increasing R&D and innovative activity, as well as training of workers.

References

Acs, Z.J. and D.B. Audretsch (1989), Small-firm Entry in US Manufacturing, *Economica* 56, 255-265.

Aitken, B.J. and A.E. Harrison (1999), Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela, *American Economic Review*, 89, 605-618.

Barry, F. and J. Bradley (1997), FDI and Trade: The Irish Host-Country Experience, *Economic Journal*, 107, 1798-1811.

Blundell, R. and A. Duncan (1998), Kernel Regression in Empirical Microeconomics, *Journal of Human Resources*, 33(1), pp.62-87

Dixit, A.K. and Stiglitz, J. (1977), Monopolistic Competition and Optimum Product Diversity, *American Economic Review*, 67, 297-308.

Ethier, W.J., (1982), National and International Returns to Scale in the Modern Theory of International Trade, *American Economic Review* 72, 389-405.

Görg, Holger and Eric Strobl (2001), Multinational Companies and Productivity Spillovers: A Meta-analysis, *Economic Journal*, 111, F723-F739.

Görg, H. and E. Strobl (2002), Multinational Companies and Indigenous Development: An Empirical Analysis, *European Economic Review*, 46, 1305-1322.

Görg, H. and E. Strobl (2003), Multinational Companies, Technology Spillovers and Plant Survival, *Scandinavian Journal of Economics*, 105, 581-595.

Haaland, J.I. and I. Wooton (1999), International Competition for Multinational Investment, *Scandinavian Journal of Economics*, 101, 631-649.

Haerdle, W. (1990), *Applied Nonparametric Regression*, Cambridge University Press.

Hanson, Gordon H. (2001), Should Countries Promote Foreign Direct Investment, G-24 Discussion Paper No. 9, UNCTAD, Geneva.

Haskel, J.E., S.C. Pereira and M.J. Slaughter (2002), Does Inward Foreign Direct Investment boost the Productivity of Domestic Firms?, NBER Working Paper 8724.

Hymer, S.H. (1976), *The international Operations of Multinationals firms: A study of Direct Foreign Investment*. MIT Press, Cambridge, Mass.

Keller, W. and S. Yeaple (2003), Multinational Enterprises, International Trade, and Productivity Growth: Firm-Level Evidence from the United States, NBER Working Paper 9504

Konings, J. (2001), The Effects of Foreign Direct Investment on Domestic Firms: Evidence from Firm Level Panel Data in Emerging Economies, *Economics of Transition*, 9, 619-633.

Lipsey, R.E. (2002), Home and host country effects of FDI, NBER Working Paper 9293.

Markusen, J.R., (1995). The boundaries of multinational enterprises and the theory of International Trade. *Journal of Economic Perspectives* 9(2), 169-189.

Markusen, J.R. (2002). *Multinational Firms and the Theory of International Trade*. MIT Press.

Markusen, J.R. and Venables, A. (1999), Foreign Direct Investment as a Catalyst for Industrial Development, *European Economic Review*, 43, 335-356.

Mata, J. (1993), Entry and Type of Entrant: Evidence from Portugal, *International Journal of Industrial Organization*, 11, 101-122.

Mata, J. and J.A.E. Machado (1996), Firm start-up size: A conditional quantile approach, *European Economic Review*, 40, 1305-1323.

McAleese, D. (1977), *A Profile of Grant-Aided Industry in Ireland*. IDA Publication Series No. 5, Dublin: The Industrial Development Authority.

Nadarya, E. (1964), On estimating regression, *Theory of Probability and its Applications*, 9, 141-142.

Rivera-Batiz, F.L; and L.A. Rivera-Batiz (1991), The Effects of Direct Foreign Investment in the Presence of Increasing Returns due to specialization, *Journal of Development Economics*, 34, 87-307.

Robinson, P. (1988), Root-N-Consistent Semiparametric Regression, *Econometrica* 56, 931-54.

Rodríguez-Clare, A. (1996), Multinationals, Linkages, and Economic Development, *American Economic Review*, 86, 852-873.

Ruane, F. and J. Sutherland (2002), Globalization, Europeanization and Trade in the 1990s: Export Responses of Foreign and Indigenous Manufacturing Companies, in: H. Kierzkowski, ed., *Europe and Globalization* (London, Palgrave Macmillan), 207-228.

Ruane, F. and A. Ugur (2002), Foreign Direct Investment and Productivity Spillovers in Irish Manufacturing Industry: Evidence from Firm Level Panel Data, Trinity Economic Papers 02/06, Trinity College Dublin.

Venables, A. (1996), Equilibrium Location of Vertically Linked Industries, *International Economic Review*, 37, 341-59.

Wand, M.P. and M.C. Jones (1995), *Kernel Smoothing*, Chapman & Hall.

Watson, G.S. (1964), Smooth regression analysis, *Sankhya*, Series A, 26, 359-372.

Table 1: Domestic Entry Rate Five Year Averages

NACE	NAME	1972-1977	1977-1982	1982-1987	1987-1992	1992-1997	1997-2000
15	**Food**	5.3	3.8	6.8	5.9	5.3	4.5
16	**Drink & Tobacco**	3.3	0.0	0.0	5.0	0.0	19.4
17	**Textiles**	5.6	8.8	15.4	9.1	5.5	2.6
18	**Wood and Wood Products**	5.2	6.6	10.3	11.7	5.3	3.1
19	**Clothing**	6.4	5.9	9.1	6.5	4.6	4.1
20	**Leather Products**	8.1	9.1	6.4	4.2	3.8	2.6
21	**Paper and Paper Products**	6.4	9.8	7.4	7.2	5.1	3.3
22	**Printing and Publishing**	7.1	5.7	3.9	3.6	3.4	3.2
23	**Coke and Petr. Pr. & Nuclear F.**	0.0	6.7	17.6	4.7	0.0	0.0
24	**Chemicals and Chemical Prod.**	7.2	7.7	12.2	7.9	5.3	6.5
25	**Rubber and Plastic Products**	7.2	12.2	10.1	7.6	5.9	3.3
26	**Other Non-Metallic Minerals**	7.0	7.9	9.2	5.2	3.6	2.8
27	**Basic Metals**	8.5	13.4	11.2	8.5	10.8	4.6
28	**Fabricated Metal Products**	8.7	13.0	8.5	4.8	3.0	2.9
29	**Machinery and Equipment NEC**	10.5	13.5	6.0	9.8	5.7	5.3
30	**Office Machiner and Computers**	18.3	28.4	23.2	13.3	13.0	10.1
31	**Electrical Machinery**	9.1	15.4	12.6	7.3	5.7	5.7
32	**Electronic Equipment**	6.1	21.6	8.1	9.5	12.5	9.3
33	**Medical and Precision Instr.**	14.7	13.2	12.9	9.4	9.0	9.6
34	**Automobile Products**	5.9	8.5	5.1	4.1	2.7	2.1
35	**Other Transport Products NEC**	7.3	6.8	10.0	5.6	5.3	5.1
36	**Furniture**	8.2	13.0	11.2	7.3	7.9	5.3
37	**Other Manufacturing NEC**	---	---	---	50.0	0.0	---
ALL		7.0	9.1	8.9	6.7	5.3	4.3

Table 2: Foreign Presence Five Year Averages

NACE	NAME	1972-1977	1977-1982	1982-1987	1987-1992	1992-1997	1997-2000
15	Food	28.7	28.6	29.1	29.1	26.5	24.7
16	Drink & Tobacco	64.1	57.7	59.4	61.0	75.5	75.5
17	Textiles	41.2	53.7	57.1	59.6	59.3	52.0
18	Wood and Wood Products	21.2	23.9	33.2	35.6	31.7	28.6
19	Clothing	27.1	31.0	25.5	7.9	13.1	13.8
20	Leather Products	10.0	7.4	7.7	9.4	9.0	13.5
21	Paper and Paper Products	29.0	28.9	31.9	32.1	27.8	21.9
22	Printing and Publishing	8.4	7.7	6.8	7.0	8.8	8.8
23	Coke and Petr. Pr. & Nuclear F.	28.3	27.6	21.9	19.7	17.6	19.3
24	Chemicals and Chemical Prod.	58.0	70.5	75.7	79.0	81.5	82.4
25	Rubber and Plastic Products	42.2	47.4	45.7	44.9	42.5	40.8
26	Other Non-Metallic Minerals	22.3	23.1	23.6	23.0	20.3	15.8
27	Basic Metals	75.6	68.3	69.5	65.0	55.4	46.2
28	Fabricated Metal Products	33.4	27.2	23.8	26.9	26.6	25.5
29	Machinery and Equipment NEC	51.0	55.6	57.7	55.7	50.1	48.5
30	Office Machiner and Computers	86.9	97.0	94.4	90.1	90.6	92.7
31	Electrical Machinery	33.0	50.4	62.2	67.4	69.4	66.9
32	Electronic Equipment	44.5	56.1	72.7	77.9	82.5	82.4
33	Medical and Precision Instr.	81.4	86.3	86.9	86.4	86.2	85.1
34	Automobile Products	70.9	69.5	69.2	78.1	77.0	71.0
35	Other Transport Products NEC	49.7	43.5	26.7	32.4	45.2	50.9
36	Furniture	13.9	16.9	15.5	16.8	19.6	16.5
37	Other Manufacturing NEC	---	---	---	58.3	62.5	---
ALL		33.8	37.6	40.8	43.8	45.7	47.1

Table 3: OLS Estimation Using Foreign Share of Employment

	(1)	(2)	(3)	(4)	(5)
FS	0.190***	-0.015	0.505***	-0.162	0.471
	(0.035)	(0.091)	(0.184)	(0.325)	(0.476)
FS2		0.233**	-1.326***	2.226	-3.375
		(0.095)	(0.489)	(1.510)	(3.420)
FS3			1.132***	-4.840**	11.874
			(0.349)	(2.426)	(9.473)
FS4				3.148**	-17.027
				(1.266)	(11.127)
FS5					8.495*
					(4.655)
MES	0.000*	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AGE	0.004**	0.004**	0.004**	0.004**	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
SEGR	0.150***	0.149***	0.150***	0.149***	0.149***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
ISIZE	-0.000***	-0.000***	-0.000***	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.119	0.124	0.120	0.123	0.126
	(0.198)	(0.197)	(0.197)	(0.197)	(0.197)
Observations	2530	2530	2530	2530	2530
F-test	5.19***	5.21***	5.27***	5.29***	5.28***
Ramsey Test	3.76***	5.00***	7.27***	7.22***	7.76***
R-squared	0.22	0.22	0.22	0.23	0.23

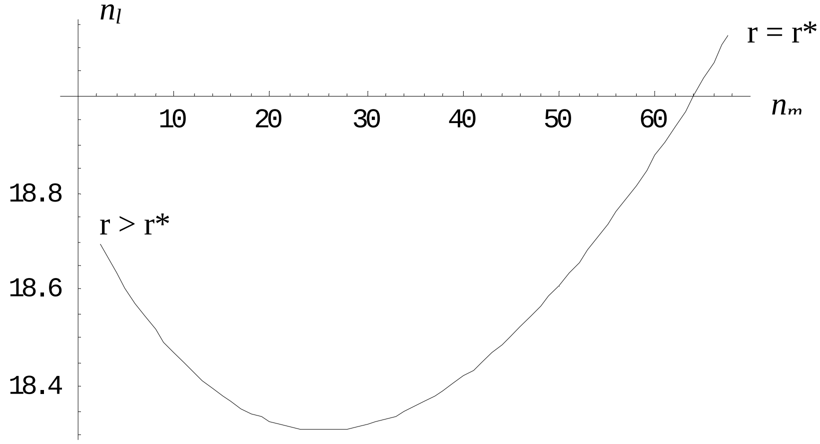
Notes: (1) Time and Industry Dummies included. (2) Standard errors in parentheses. (3) ***, **, and * are 1, 5, and 10 per cent significance levels.

Table 4: OLS Estimation Using Foreign Share of Plant Numbers

	(1)	(2)	(3)	(4)	(5)
FS	0.565***	-0.213	0.577**	0.016	-0.514
	(0.057)	(0.136)	(0.236)	(0.417)	(0.650)
FS2		1.280***	-2.054**	2.076	7.831
		(0.203)	(0.843)	(2.661)	(6.040)
FS3			3.398***	-5.985	-27.931
			(0.833)	(5.795)	(21.475)
FS4				6.561	40.867
				(4.010)	(32.571)
FS5					-18.723
					(17.641)
MES	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AGE	0.001	0.002	0.003*	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
SEGR	0.152***	0.149***	0.149***	0.149***	0.149***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
ISIZE	-0.000***	-0.000**	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.067	0.090	0.094	0.090	0.089
	(0.195)	(0.193)	(0.193)	(0.193)	(0.193)
Observations	2530	2530	2530	2530	2530
F-test	5.86***	6.21***	6.33***	6.31***	6.27***
Ramsey Test	8.41***	2.15**	1.96*	0.99	1.84*
R-squared	0.24	0.25	0.26	0.26	0.26

Notes: (1) Time and Industry Dummies included. (2) Standard errors in parentheses. (3) ***, **, and * are 1, 5, and 10 per cent significance levels.

Figure 1



Parameter values: K=50, δ *=0.5 ,* α *=0.4 ,* β *=1 ,*λ *=0.8 ,*μ *=0.4 ,*θ *=6 ,*ρ *=1 ,*σ *=1.38,* γ *=0.5,* Φ *=1.*

Figure 2: Net Domestic Entry Rate – Share of Total Employment by Foreign Plants

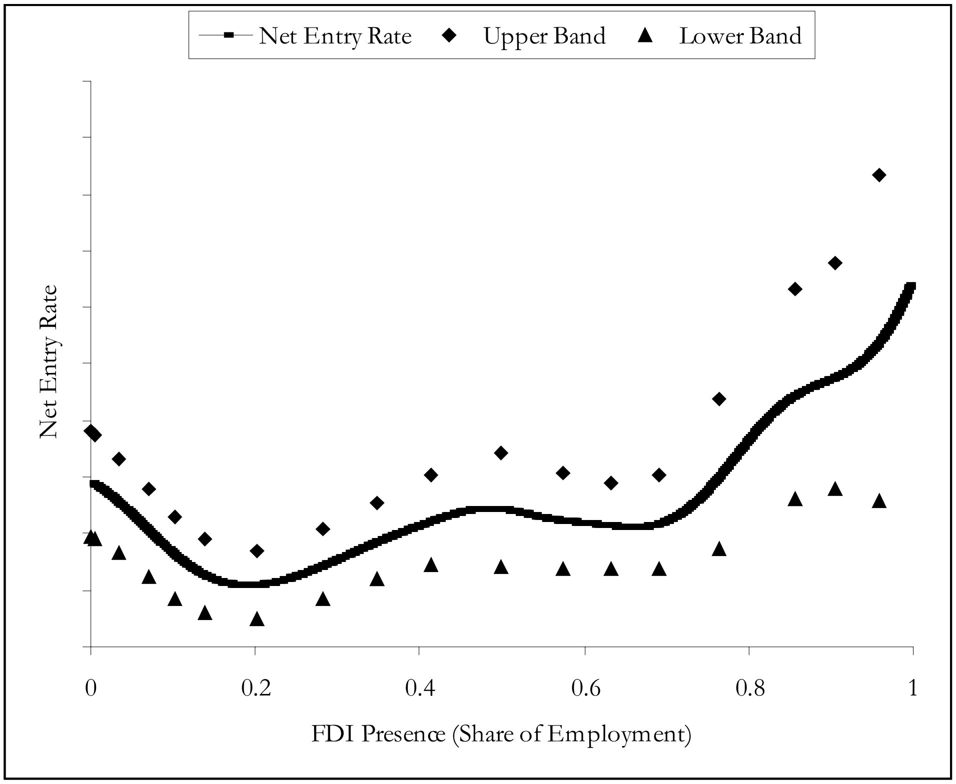


Figure 3: Net Domestic Entry Rate – Share of Total Plant Population by Foreign Plants

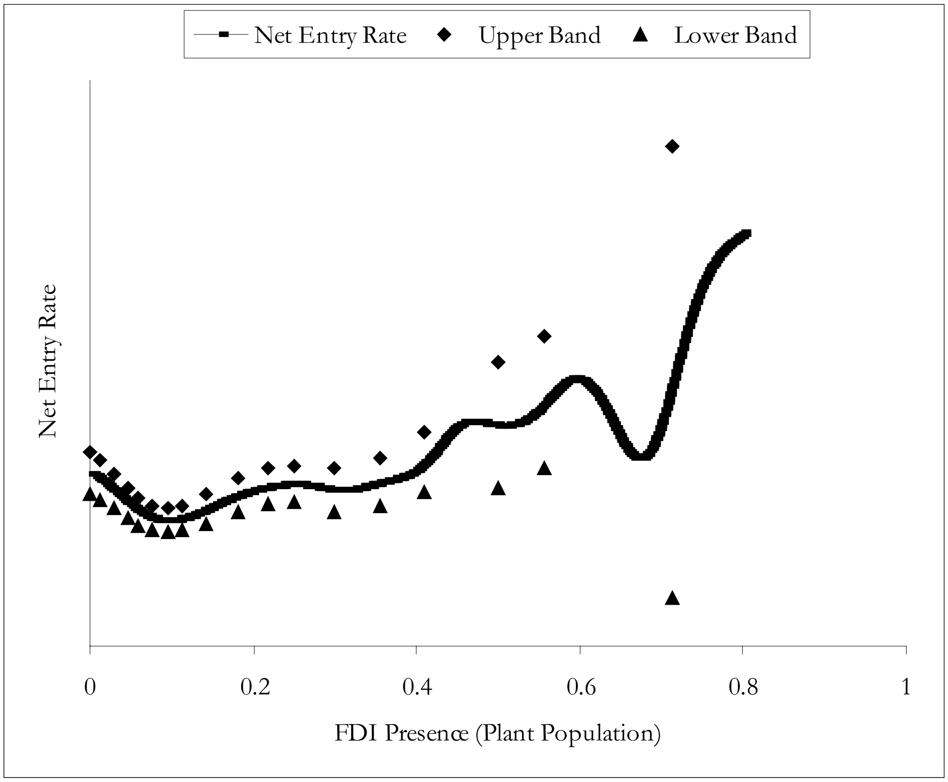


Figure 4: Net Domestic Entry Rate – Share of Total Employment by Foreign Plants – Without Outliers

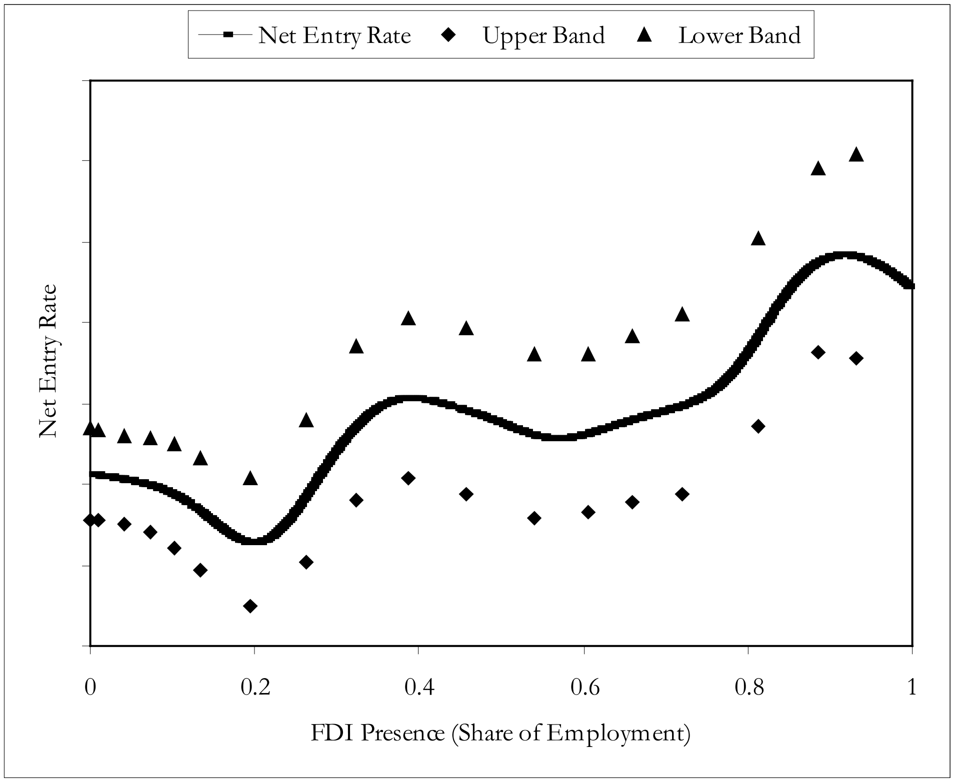


Figure 5: Net Domestic Entry Rate – Share of Total Plant Population by Foreign Plants