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Location Decision of Heterogeneous Multinational Firms*

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Abstract

In this paper we examine how multinational firms with varied levels of total factor productivity (TFP) self-select into different host countries. Using a dataset that records the subsidiaries of French manufacturing multinationals, we find that firm-level TFP plays an important role in explaining the sorting of French firms across host countries. Both the aggregate- and firm-level estimates suggest that more productive French firms are consistently more likely than their less efficient domestic competitors to invest in relatively tough host countries. In particular, countries with a smaller market potential, higher fixed costs of investment or lower import tariffs tend to have higher cutoff productivities and attract a greater proportion of productive multinationals. This self-selection mechanism remains largely robust when we control for unobserved firm and country heterogeneity and address the potential endogeneity of TFP.

Key words: foreign direct investment, multinational firms, location decision, firm heterogeneity, total factor productivity

JEL codes: F23, D24

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1 Introduction

Foreign direct investment (FDI) is at the forefront of policy debates and economic research on globalization. In the past few decades, not only has the volume of investments by multinational corporations (MNCs) grown exponentially, the rate at which it increased has also outpaced traditional international trade flows. As a result, governments in many developed countries are increasingly pressed by public anxiety over the possibility of job losses as more capital moves across borders. Developing country policy makers are keen to determine whether the inflow of foreign direct investment improves or undercuts domestic economic performance. A large economics literature has also developed, in parallel with the tremendous political attention, to address different aspects of FDI, including both the causes and consequences of MNC activities.

However, in the voluminous literature that seeks to explain multinationals' activities abroad, primary emphasis has been placed on the asymmetry of host countries. The role of firm heterogeneity in explaining multinational firms' distinct location choices has been underemphasized.[1] Our paper addresses the latter issue by examining how firms with varied levels of total factor productivity (TFP) self-select into different host countries. Instead of assuming that host-country characteristics exert a homogeneous effect across individual firms as in the majority of the current literature, we explore how the effect of market size, production costs, and trade costs on firms' location decision varies with firm-level TFP. In our analysis, host country attributes not only determine the size of total foreign investments but also the productivity distribution of multinationals that decide to produce in the markets.

We first build on the seminal work of Helpman *et al.* (2004) and model firms' decision to invest and produce in foreign countries. Based on this framework, we derive a number of testable predictions at both country- and firm-level. First, we predict that the pool of multinationals attracted to each host country varies in productivity. Multinationals that self-select into tougher markets should exceed a higher cutoff productivity. This leads to a greater proportion of productive multinational firms in countries with less attractive characteristics. At the disaggregate level, we predict that firms with different TFP levels will differ in their selection of foreign production locations. More efficient firms are more likely than their less productive counterparts to invest in difficult markets as the effect of TFP in raising firms' ability to invest abroad is more pronounced in tougher markets.

We use a rich dataset of French manufacturing multinational firms and their worldwide subsidiaries to examine the self-selection mechanism predicted in the model. The French experience is particularly interesting for two reasons. First, French firms play an increasingly important role in international FDI outflows. According to the World Investment Report (2006), France experienced the world's largest increase in outward FDI in 2005 and became

[1] We discuss the few existing contributions in this area, namely, Helpman *et al.* (2004), Yeaple (2008), Mayer *et al.* (2007) and Nefussi (2006) in greater details below.

the second largest source country with an annual total flow of $115 billion. Second, as a large number of French firms turn to foreign nations as sites of production facilities, the public's concern with the displacement of manufacturing jobs has grown substantially and played a prominent role in the 2007 presidential elections.

In our empirical investigation, we proceed by first examining the cross-country productivity distribution of French MNCs. We find that countries with less attractive FDI host attributes, including a smaller market potential, greater production costs, and a lower import tariff, have both higher cutoff productivities and greater average TFPs. In fact, the productivity distribution of firms that decide to invest in these markets first-order stochastically dominate those investing in more attractive host countries.

These findings are also consistent with the firm-level evidence. We find that heterogeneous firms vary significantly in their choice of foreign production locations. In particular, while French multinational firms on average tend to invest in countries with a larger market potential, more productive firms are consistently more likely than their less efficient counterparts to produce in small-market-potential countries. Similarly, firms with greater productivities are more likely to invest in countries that exhibit high entry costs or high fixed costs of investment than their less efficient French competitors. Host-country tariffs also have an asymmetric effect: A lower tariff rate discourages less productive firms from investing in the markets and leads to a larger proportion of efficient multinational firms.

To establish the causal effect of TFP, we address in the analysis the potential endogeneity of firm productivity resulting from either unobserved firm attributes or reverse causality between productivity and the investment decision. The existing studies that relate productivity to firms' MNC status and location choice have mainly focused on the productivity differential between multinational and non-multinational firms. The possibility that TFP can be both a cause and an effect of the investment decision has not been taken into account. This paper takes several steps to disentangle the causal effect of TFP on MNCs' location choice. First, we estimate multinational firms' productivity based on their past production performance at home. The use of a time and a spatial lag between the measure of TFP and the location decision reduces the likelihood that productivity is affected by the latter variable.

We also employ a two-step control function approach that is developed by Petrin and Train (2005, 2006) and subsequently used by studies such as Liu, Lovely and Ondrich (forthcoming). Specifically, we pair each French multinational firm with respective reference groups—formed by other French national or multinational firms in the same industry and same region—and use the average productivity of these reference groups as instrumental variables for individual MNCs' productivity. The choice of these instruments is motivated by the large literature on technology spillover and social interaction that has suggested the existence of both industry and regional spillovers across firms. As expected, our results show a positive and significant correlation between a firm's productivity and that of its reference groups, especially for firms

that are not only in the same industry but also in the same narrowly defined geographic region. We then, based on the first-stage estimates, recover unobserved firm heterogeneities that may also lead to MNCs' differences in location decisions. We find that controlling for these unobserved factors does not change the main findings of this paper: firms with varied productivity are systematically sorted into different types of host countries.

We are not alone in the effort to explain heterogeneous firms' distinct location choices. Three recent work, Yeaple (2008), Mayer *et al.* (2007) and Nefussi (2006), also seek to examine individual firms' investment decisions overseas. Yeaple (2008) uses U.S. MNC data and examines the role of firm heterogeneity in explaining the structure of U.S. FDI activity in 1994. He decomposes U.S. aggregate outward FDI to several components and shows that host-country characteristics affect both the scale and scope of foreign investment. He also finds that more productive U.S. firms own affiliates in a larger number of countries and have more sales. Similar to this paper, Mayer *et al.* (2007) and Nefussi (2006) are interested in French firms' investment activities. Mayer *et al.* (2007) contribute to the literature by jointly addressing the decision to invest abroad as well as the location choice. They also take the important step to examine the role of financial network and supply access in firms' investment decisions. They find, using a nested logit model, that more productive French firms are more likely to invest abroad. Nefussi (2006) modifies the theoretical framework of Helpman *et al.* (2003) by allowing for variable price demand elasticity. In doing so, the paper reaches different predictions than those obtained in Helpman *et al.* (2003) and finds that firms with intermediate productivities are more likely to engage in FDI.

Our analysis differs from these contributions in a number of ways. First, we investigate how firms' difference in productivity may lead to differential effects of host-country attributes and consequently distinct choices of foreign production locations. This contrasts with Yeaple (2008) who focuses on the role of firm productivity in the scale and scope of aggregate FDI and assumes the effect of productivity is uniform across countries and the effect of host-country characteristics is homogeneous across firms. Our work does complement Mayer *et al.* (2007), who consider the interaction of TFP and home country dummy and find TFP raises firms' incentive to invest abroad instead of at home. We note in this study that the positive effect of TFP on firms' incentive to invest abroad is more pronounced in less attractive markets.

Second, we take into account the ambiguous causality between firm productivity and FDI activity. This is important for our goal to examine the self-selection mechanism of heterogeneous firms. The issue of causal effect between productivity and participation in foreign markets has been long noted in the export literature, where a large number of studies have been devoted to disentangling the causal effect of productivity and export decision. The results there show that the productivity difference between exporters and non-exporters can be both ex ante (i.e., more productive firms self-select into export markets; see, for example, Bernard and Jensen, 1999, 2004; Clerides *et al.*, 1998) and ex post (i.e., exporting raises firm productiv-

ity; see, for example, Baldwin and Gu, 2003; Girma *et al.*, 2005b). The similar concern arises in the case of multinationals. While productive firms are likely to self-select into foreign direct investment, it is also plausible that firms' foreign investment activities exert a significant effect on their productivity. In this paper we use several measures to establish the self-selection linkage between firm productivity and location choice.

Finally, we adopt various procedures to control for unobserved country and firm heterogeneities. For example, we construct an industry-specific measure of host-country attractiveness to control for unobserved country characteristics. Specifically, we use a two-step procedure and estimate in the first step each host country's ability to attract foreign multinationals. This approach allows us to directly examine how heterogeneous firms sort across markets with varied levels of attractiveness. It also enables us to expand the analysis to a larger sample of host countries.

The rest of the paper is organized in the following way. We first discuss the broader literature in Section 2, including studies of FDI determinants and recent work on firm heterogeneity. We then lay out a model in Section 3 to motivate our empirical analysis and derive a number of testable hypotheses. After providing a detailed description of the data in Section 4, we investigate, in Section 5, the productivity distribution of French MNCs across countries. We then report the firm-level empirical results in Section 6 and sensitivity analyses in Section 7. Last, we conclude the paper in Section 8.

2 A broad overview of the literature

In this section, we discuss two broader literature the paper is closely related to: the studies on the determinants of FDI and the notable development in the area of firm heterogeneity.

Determinants of FDI

Two main motives have been identified in the theoretical FDI literature that help explain firm's decision to invest abroad. First, firms may choose to produce overseas to avoid trade costs. This strategy is referred to as the market access (or tariff jumping) motive, and leads firms to duplicate their production process in foreign countries and expand horizontally. Markusen and Venables (2000) offer a representative model of "horizontal FDI". Second, when the production process consists of various separable stages that require different factor intensities, firms may choose to locate each stage in a country where the factor used intensively in that stage is abundant and engage in a vertical type of FDI. This strategy is referred to as the comparative advantage motive and considered to lead to "vertical FDI". Helpman (1984) builds a classic model in this area.

The above two motives have been synthesized in the knowledge-capital model developed by Markusen and Venables (1998) and tested in a number of empirical studies, including, for

example, Brainard (1997), Carr, Markusen, and Maskus (2001), and Yeaple (2003). While Brainard (1997) finds evidence in favor of horizontal FDI, the analysis by Carr, *et. al* (2001) and Yeaple (2003) indicates the existence of both types of investments. Past empirical work has also examined the role of various other factors, most of which are host-country attributes including quality of institutions (e.g., Wei, 2000), taxes (e.g., Hartman, 1984, 1985), anti-dumping duties (e.g., Blonigen, 2002), and market potential (e.g., Head and Mayer, 2004).[2]

Similar to these studies, this paper examines the determinants of foreign direct investment. However, instead of estimating the average effect of host-country attributes across MNCs, we explore how they can affect MNCs' location decision differentially. Our results indicate that the effect of FDI determinants is hardly uniform.

Firm heterogeneity and participation in international markets

This paper is also closely related to the rapidly growing literature on the relationship between firm heterogeneity and participation in international markets. This literature is marked by a series of important firm-level empirical studies led by Bernard and Jensen (1995, 1999, 2004), Clerides *et al.* (1998), Roberts and Tybout (1997), Das *et al.* (2007), Mayer *et al.* (2007), Eaton *et al.* (2008), Crozet, Head and Mayer (2008), and Yeaple (2008) and major theoretical breakthroughs represented by Melitz (2003), Helpman *et al.* (2004), and Bernard *et al.* (2003), among others.

Melitz (2003) analyzes a firm's decision to produce and export in a model with heterogeneous firm-level productivity and fixed costs of production and exporting. The model shows that given the exposure to international trade only more productive firms enter the export market while less productive firms produce only for the domestic market. This theoretical prediction is consistent with the empirical evidence reported in, for example, Bernard and Jensen (1999, 2004) and Clerides *et al.* (1998). These studies find systematically higher productivity levels for exporting firms compared to non-exporting firms in the same industry.

The pioneering work of Melitz (2003) has been extended in various directions. One significant development particularly relevant to this research is led by Helpman *et al.* (2004) and focuses on the relationship between firm heterogeneity and FDI. Helpman *et al.* (2004) analyze the decision to set up a foreign affiliate when firms have a range of possible productivity. By investigating heterogeneous firms' choice between exporting and FDI, they show that (1) only the most productive firms can overcome the plant-level fixed cost of investment and become multinationals; (2) firms with an intermediate level of productivity export, and (3) the least productive only sell domestically. This hypothesis has been tested in several empirical studies including Girma *et al.* (2005a), Girma *et al.* (2004), and Arnold and Hussinger (2005), all of which find a significant productivity differential between multinational and non-multinational

[2] Blonigen (2005) provides an excellent survey of this literature.

firms. One notable exception of this literature is Head and Ries (2003), who build a model that allows heterogeneity between countries in terms of factor price and market size and show that when the foreign country is small and offers cost advantage, for a certain range of parameters, the least productive firms locate abroad whereas more productive ones produce at home.

Our paper extends the above studies by examining the relationship between firm productivity and the choice of specific FDI location. As discussed in Section 1, three recent studies, Yeaple (2008), Mayer et al. (2007), and Nefussi (2006), also examine individual firms' investment decisions, with various emphases. Yeaple (2008) uses 1994 U.S. MNC data and shows that host-country attributes affect both the scale and scope of foreign investment. Mayer *et al.* (2007) focus on French firms' investment activities and find that more productive French firms are more likely to invest abroad and their location choices are dependent on both country-specific variables such as market access and firm-country specific variables such as firms' financial network. Nefussi (2006) also examines French firms and shows in a modified Helpman *et al.* (2004) framework that firms with intermediate productivities are more likely to invest abroad. We complement these contributions by examining the interactive role of firm heterogeneity and country asymmetry in explaining the pattern of host country location decisions. Our results indicate that while multinational firms are in general more productive than exporters, because of self-selection the productivity of multinational firms that invest in different markets can be sharply different.

3 Theoretical framework

3.1 Basic setup

We build on Helpman *et al.* (2004) and Yeaple (2008) to illustrate multinational firms' decision to invest in a country. Suppose the world consists of 2 sectors and $N+1$ countries. One sector produces a homogeneous product while the other sector produces differentiated products. The homogeneous good is the numeraire good and produced in all countries. The $N+1$ countries consist of a home country, denoted as country 0, and N foreign countries denoted as $j = 1, ..., N$.

There is a continuum of firms in each country. Each firm produces a different brand of the differentiated product and exhibits a distinct productivity level θ whose distribution is given by $G(\theta)$. Given a CES utility function, the demand function for the brand of an individual firm, say i, in country j is $x_{ij} = A_j {p_{ij}}^{-\varepsilon}$, where x_{ij} is the quantity, A_j is a measure of the demand level for the differentiated product in country j, p_{ij} is the price, $\varepsilon \equiv 1/(1-\alpha)$ is the demand elasticity, and $j = 0, 1, ..., N$. Because we assume a constant elasticity of substitution with $0 < \alpha < 1$, we have $\varepsilon > 1$. We also note that $A_j \equiv E_j / \int_{i \in I_j} p_{ij}^{1-\varepsilon} di$, where E_j measures the total spending on the differentiated product in country j and I_j represents the set of all

available brands in j.[3]

Without loss of generality, we focus on firms in country 0. If firm i in country 0 chooses to produce and sell at home, it must incur a variable cost of production c_0/θ_i, and a fixed cost of production f_0^D. Its profit-maximizing strategy is to set $p_0 = c_0/(\alpha\theta_i)$, which means that the profit is given by

$$\pi_{i0}^D = B_0 \left(\frac{c_0}{\theta_i}\right)^{1-\varepsilon} - f_0^D, \tag{1}$$

where $B_0 \equiv (1-\alpha)\alpha^{\varepsilon-1}A_0$.

Firm i may also sell to a foreign country $j = 1, ..., N$. It may either export from home or produce in the foreign country.[4] If firm i chooses to export the product to country j, it must incur a per-unit iceberg trade cost τ_{ij} ($\geqslant 1$), which reflects both the transport cost and the tariff country j imposes on the goods imported from i. The firm must also pay an additional fixed cost f_j^X, which includes the costs of forming a distribution and servicing network in country j. Its profit-maximizing strategy is hence to set $p_{ij} = \tau_{ij}c_0/(\alpha\theta_i)$, $j = 1, ..., N$, which yields the export profit as

$$\pi_{ij}^X = B_j \left(\frac{c_0\tau_{ij}}{\theta_i}\right)^{1-\varepsilon} - f_j^X, \tag{2}$$

where $B_j \equiv (1-\alpha)\alpha^{\varepsilon-1}A_j$.

If firm i chooses instead to serve the foreign market through local production, it must pay a fixed cost f_j^I for each foreign market j in which it invests. This includes the costs of operating a subsidiary as well as the distribution and servicing network costs embodied in f_j^X, which means that $f_j^I > f_j^X$ and there exist plant-level economies of scale. In this case, the profit firm i receives from investing and producing in foreign country j is

$$\pi_{ij}^I = B_j \left(\frac{c_j}{\theta_i}\right)^{1-\varepsilon} - f_j^I. \tag{3}$$

Following Helpman *et al.* (2004), we assume that

$$f_0^D < (\tau_{ij})^{\varepsilon-1} f_j^X < \left(\frac{c_j}{c_0}\right)^{\varepsilon-1} f_j^I \tag{4}$$

for all j.

It is clear that firms will serve a foreign country via FDI only if $\pi_{ij}^I > \pi_{ij}^X$. Given equations

[3] As in Yeaple (2008), the model here is not closed via free entry condition.

[4] Note we assume in the model that firms would only consider exporting to a foreign country from home, and thus leave out the possibility of exporting from its foreign subsidiaries. In a similar fashion, we assume that firms would always supply their home country through local production and do not consider the case in which firms export their products from foreign subsidiaries to home. For theoretical contributions in this area, see, for example, Motta and Norman (1996), Head and Ries (2003), and Ekholm, Forslid, and Markusen (2007). We do however take into account these possibilities in the empirical analysis by, for example, including a measure of market potential for each host country to capture the demand in their potential export markets.

(2) and (3), this condition implies that firm productivity must satisfy

$$\theta_i > \underline{\theta}_j^I \equiv \left[\frac{f_j^I - f_j^X}{B_j \left({c_j}^{1-\varepsilon} - (c_0 \tau_{ij})^{1-\varepsilon} \right)} \right]^{\frac{1}{\varepsilon - 1}}. \tag{5}$$

Conversely, firms would prefer exporting to FDI if $\pi_{ij}^X > \pi_{ij}^I$ and $\pi_{ij}^X > 0$, which implies

$$\left[\frac{f_j^X \left(c_0 \tau_{ij} \right)^{\varepsilon - 1}}{B_j} \right]^{\frac{1}{\varepsilon - 1}} \equiv \underline{\theta}_j^X < \theta_i < \underline{\theta}_j^I. \tag{6}$$

Because of the inequality conditions specified in (4), a clear correlation between firm productivity and their participation in domestic and foreign markets is established. The least productive group of firms, i.e., those with $\theta_i < \theta_0^D \equiv (f_0^D {c_0}^{\varepsilon - 1} / B_0)^{1/(\varepsilon - 1)}$, would not produce at all. Firms for which $\underline{\theta}_0^D < \theta_i < \underline{\theta}_j^X \ (\forall j)$, will produce and supply only the domestic market. Relatively more productive firms sell to both the domestic and foreign countries in which $\underline{\theta}_j^X < \theta_i$. The supply strategy of this latter group varies with the level of productivity, however. In a given market j, firms with an intermediate level of productivity, i.e., $\underline{\theta}_j^X < \theta_i < \underline{\theta}_j^I$, will choose to export, whereas the most productive firms with $\theta_i > \underline{\theta}_j^I$ would prefer to produce locally.

In the rest of Section 3, we derive a number of testable predictions based on the outlined model. First, we examine in Section 3.2 the productivity composition of multinationals across host countries.[5] Then, we investigate different aspects of firm-level decision, in particular, the extensive and intensive margins of firm investment activities.

3.2 Cross-country differences in the productivity distribution

First, we obtain a linear equation of the cutoff productivity by taking natural logs of the right hand side of (5):[6]

$$\ln \underline{\theta}_j = \frac{1}{\varepsilon - 1} \left[- \ln B_j - \ln \left({c_j}^{1-\varepsilon} - (c_0 \tau_{ij})^{1-\varepsilon} \right) + \ln \left(f_j^I - f_j^X \right) \right]. \tag{7}$$

This equation shows that the entry threshold productivity is a decreasing function of market "attractiveness". Countries with a greater demand for the differentiated good (B_j) have a lower cutoff productivity. Countries with a larger variable cost of production (c_j) or a larger fixed cost of investment (f_j^I) have higher entry thresholds. A greater trade cost (τ_{ij}) raises firms' incentive to choose FDI instead of exporting. This reduces the minimum productivity

[5] Similar to Yeaple (2008), we also examine the intensive and extensive margins of aggregate FDI. We present the related theoretical and empirical analysis in Appendix B.

[6] In the rest of Section 3, we focus on the cutoff productivity to engage in FDI and hence supress the superscript of $\underline{\theta}_j$.

required for firms to invest in the market.

Now consider the conditional expected productivity of multinationals that choose to enter each country. This will be given by

$$\widetilde{\theta}_j \equiv E\left[\theta|\pi_{ij}^I > \pi_{ij}^X\right] = \frac{\int_{\underline{\theta}_j}^{\infty} \theta dG(\theta)}{\Pr\left(\pi_{ij}^I > \pi_{ij}^X\right)}, \tag{8}$$

where $\Pr(\pi_{ij}^I > \pi_{ij}^X) = \Pr(\theta_i > \underline{\theta}_j)$ represents firm i's probability of investing in country j. We follow the literature and assume that firm productivity follows a pareto distribution, i.e., $G(\theta) = 1 - (b/\theta)^k$, where b is the minimum productivity of the industry in country 0 and k is the shape parameter. Given (5), this assumption implies that

$$\widetilde{\theta}_j = \underline{\theta}_j \frac{k}{k-1} = \left[\frac{f_j^I - f_j^X}{B_j\left({c_j}^{1-\varepsilon} - (c_0\tau_{ij})^{1-\varepsilon}\right)}\right]^{\frac{1}{\varepsilon-1}} \frac{k}{k-1}, \tag{9}$$

which can be transformed to

$$\ln\widetilde{\theta}_j = \frac{1}{\varepsilon-1}\left[-\ln B_j - \ln\left({c_j}^{1-\varepsilon} - (c_0\tau_{ij})^{1-\varepsilon}\right) + \ln\left(f_j^I - f_j^X\right)\right] + \ln\left(\frac{k}{k-1}\right). \tag{10}$$

Similar to $\underline{\theta}_j$, the conditional expected productivity $\widetilde{\theta}_j$ is higher in less attractive markets. In Section 5, we estimate equations (7) and (10) and examine how our hypotheses hold in the data.

Note these two attributes of productivity distribution, i.e., $\underline{\theta}_j$ and $\widetilde{\theta}_j$, can also be expressed in terms of the number of firms that choose to invest in the country (i.e., N_j). This is because in a sufficiently large sample, N_j/N (where N is the total number of firms in country 0) proxies $\Pr(\pi_{ij}^I > \pi_{ij}^X)$. Given the pareto distribution assumption, this implies

$$\underline{\theta}_j \approx (N_j)^{-1/k}\left(b^k N\right)^{1/k} \tag{11}$$

and

$$\widetilde{\theta}_j \approx (N_j)^{-1/k}\left(b^k N\right)^{1/k}\frac{k}{k-1}. \tag{12}$$

As shown in Section 5, the data broadly confirms the predicted relationship between $\underline{\theta}_j$ and N_j and between $\widetilde{\theta}_j$ and N_j.

Now consider the productivity distribution as a whole. The properties of $\underline{\theta}_j$ and $\widetilde{\theta}_j$ discussed above also lead to testable hypothesis on the cumulative distribution of MNC productivities across host countries. That is, the productivity distribution of firms that invest in tougher markets should first-order stochastically dominate those that invest in easy markets.

To see this, let $\lambda_j(\theta_a)$ denote the fraction of firms investing in country j with productivity

less than or equal to θ_a. Since only firms whose productivity exceeds $\underline{\theta}_j$ will invest in country j, $\lambda_j(\theta_a)$ can be expressed as $\lambda_j(\theta_a) = \Pr(\underline{\theta}_j < \theta_i < \theta_a) = \int_{\underline{\theta}_j}^{\theta_a} dG(\theta)$. Given $G(\theta) = 1-(b/\theta)^k$, we obtain

$$\lambda_j(\theta_a) = \underline{\theta}_j^{-k} b^k - \theta_a^{-k} b^k = \left[\frac{B_j \left({c_j}^{1-\varepsilon} - (c_0 \tau_{ij})^{1-\varepsilon} \right)}{f_j^I - f_j^X} \right]^{\frac{k}{\varepsilon-1}} b^k - \theta_a^{-k} b^k. \tag{13}$$

It is clear from the above equation that holding constant θ_a, the fraction of firms investing in a market, i.e., $\lambda_j(\theta_a)$, always increases in market attractiveness. This suggests that the productivity distribution of multinationals in countries with a larger market demand, smaller production costs or a greater trade cost is first-order stochastically dominated by those that self-select into relatively less attractive destinations.

3.3 Firm-level decisions

Next, we proceed to investigate firm-level decisions. First, we consider each firm's decision to undertake FDI in a foreign country. Let y_{ij} denote an indicator variable that equals to 1 if firm i decides to invest in country j and 0 otherwise. As discussed in Section 3.1,

$$y_{ij} = \begin{cases} 1 & \text{if} \quad \theta_i > \underline{\theta}_j \\ 0 & \text{if} \quad \theta_i \leq \underline{\theta}_j \end{cases} . \tag{14}$$

The probability function of $y_{ij} = 1$ is hence given by

$$\Pr\left(y_{ij} = 1\right) = \Pr\left(\theta_i > \underline{\theta}_j\right) = \Pr\left\{ \theta_i > \left[\frac{f_j^I - f_j^X}{B_j \left({c_j}^{1-\varepsilon} - (c_0 \tau_{ij})^{1-\varepsilon} \right)} \right]^{\frac{1}{\varepsilon-1}} \right\}. \tag{15}$$

Equations (14) and (15) suggest that how a firm's productivity compares to host-country cutoff productivity determines that firm's decision to invest in the market. In a given market, more productive firms are more likely than their less efficient competitors to have subsidiaries. An increase in the cutoff productivity $\underline{\theta}_j$, resulting from either a smaller market size (B_j), higher production costs (c_j and f_j^I) or a lower trade cost (τ_{ij}), reduces firms' probability to produce in the country. This is especially true for those with relatively lower productivities. The more productive firms are less likely to be affected and are thus more likely to invest in relatively tough markets. We test these predictions in Section 6 and examine the extent to which firm productivity and country attributes jointly explain firms' location choice. We find that not only does a higher productivity lead to a greater probability to invest in the foreign country, its effect is more pronounced in countries with less attractive attributes.

Now assume a firm already decides to invest in a given country. The affiliate sales this

firm will receive is given by

$$s_{ij} = p_{ij}x_{ij} = \frac{1}{1-\alpha} B_j c_j^{1-\varepsilon} \theta_i^{\varepsilon-1} \quad \text{where } \theta_i > \underline{\theta}_j. \tag{16}$$

The prediction is straightforward: firms with a greater productivity have more affiliate sales. Furthermore, the level of affiliate sales increases in host countries' market demand but decreases in the variable cost of production.

Finally, we note that the model also derives a testable prediction on the number of foreign countries in which each multinational firm invests. According to equation (14), there is a hierarchy in firms' investment patterns. That is, suppose we can rank countries $j = 1, ..., N$ based on their cutoff productivities such that country 1 is the easiest market of all and country N is the most difficult. Then, it must be the case that every firm that invests in country j also invests in country $k < j$. Now let M_i denote the number of countries invested by firm i. We obtain the following expression:

$$M_i = J \quad \text{where } \underline{\theta}_J < \theta_i < \underline{\theta}_{J+1}. \tag{17}$$

This suggests that firms with a greater productivity invest in a larger number of countries. As to be shown in Section 6, this hypothesis is supported in the data.[7]

4 Data

We employ a dataset of French manufacturing firms to examine the empirical regularities in multinationals' location decision. This dataset records the financial and subsidiary information of French public and private firms. It is drawn from AMADEUS, a comprehensive database that contains companies of 38 European countries. The information is collected by providers including national official public bodies that are in charge of collecting the annual accounts (e.g., Institut National de la Propriete Industrielle (National Institute for Industrial Property) in the case of France).

The financial information in the dataset reports each French firm's balance and income statements. We use revenue, value added, fixed asset, employment, and material cost to estimate each firm's total factor productivity, a primary variable of the paper. Details of the

[7] It is worth noting that the hierarchy predicted above rests on the assumptions of the model. This has also been pointed out by Yeaple (2008). For example, as discussed earlier, the model considered here has abstracted from the possibility of export-platform FDI. If the model allows multinationals to serve other countries from their foreign production locations and assumes a sufficiently large plant-level scale economy, the predicted number of countries in which each firm invests is likely to be smaller. But because of the different levels of productivity and varied country characteristics, firms may still self-select into different markets. This is confirmed in the empirical section where the evidence obtained based on various specifications suggests a systematic self-selection mechanism in French MNCs' location decision.

estimation methodology are described in Appendix A.[8] In particular, we use firms' unconsolidated financial data in the period 1993 and 2001 to derive estimates of production function and productivity. Three strategies are employed to help establish the causal effect of TFP on multinational firms' location choices. First, we use firms' unconsolidated financial data and measure TFP solely based on their production activities *at home*. Second, we use firms' average TFP in the period of 1997-2001 to explain their decision to invest abroad in a later period.[9] Third, we adopt a control-function approach in Section 7.2 and address the potential endogeneity of TFP. Note we also use firms' relative TFP to deal with the cross-industry variation in productivity estimates. Specifically, we regress the TFP estimates (obtained from the production function estimations described in Appendix A) on a group of industry dummies and use the fitted residuals as the measure of within-industry heterogeneity.

The subsidiary section of the dataset lists the location and activities of each French firm's foreign subsidiaries in 2005. As discussed above, the time lag between TFP and choice of subsidiary locations mitigates the possibility of reverse causality between the two variables. Furthermore, given the main focus of this paper is to examine firms' decision of where to invest abroad, we limited our sample to firms that have at least one subsidiary overseas in 2005.[10] This results in a final sample of 1302 individual French multinationals, for which both financial and subsidiary information are available.

In addition to firm heterogeneity, we take into account a number of host-country characteristics that have traditionally been used to explain multinationals' location choices. First, we include host-country market potential. Head and Mayer (2004) and Blonigen *et al.* (2007) point out that both the domestic market size and the size of potential export markets play a significant role in multinational firms' choice of host countries. We follow these papers and construct a measure of market potential. Specifically, we calculate, for each country j, the sum of its GDP and GDP of all other countries, each weighed by their distance to j, i.e., $\sum_l (1/d_{jl}) GDP_l$, where d_{jl} is the great circle distance between j and l's largest cities taking into account each country's internal distance and GDP_l is country l's real GDP in 2001 (measured in 2000 U.S. dollars). The data of GDP and distance are obtained from the World

[8] We considered a number of approaches to obtain estimates of TFP, including instrumental variables estimation and semiparametric estimation. Van Biesebroeck (2008) provides a comprehensive comparison of these methods, and finds that they produce similar productivity estimates. Similar to Van Biesebroeck (2008), we did not find significant differences in the estimates of TFP obtained from either the IV or the semiparametric estimation. We report the results based on the semiparametric estimator introduced in Levinsohn and Petrin (2003).

[9] We also used firms' TFP in 2001 and average TFP in 1999-2001 as alternatives. The results were largely similar.

[10] The dropped firms would be needed if we were to compare the productivity of multinationals with other types of firms. However, since our paper does not focus on this issue but rather on heterogeneous multinational firms' location choice abroad, we only consider existing and new multinational firms. The potential bias in TFP resulted from sample selection will be addressed in Section 7.2 where we deal with the potential endogeneity of TFP.

Development Indicators and the CEPII distance database, respectively.[11]

Second, we control for host countries' marginal cost of production by including real unit labor cost, where each industry is weighed by its output share. We obtain the labor cost and output data from the World Bank Trade and Production Database. In addition to the host-country unit labor cost, we include each firm's labor intensity measured by the percentage of labor cost in value added. In particular, we interact the two variables to examine whether firms with a higher labor intensity have a greater probability to invest in low-labor-cost countries. We also take into account host countries' tax policy using the maximum corporate tax rate, which is available from the U.S. Office of Tax Policy Research.[12]

In the analysis we also consider various measures of fixed cost of investment. First, we use the costs of starting a business, available from the World Development Indicators, as a proxy for entry cost. Second, we include the distance between France and the host country with the expectation that subsidiaries located in distant markets are likely to require a larger monitoring cost. A similar hypothesis applies to countries that are contiguous to France. Third, we include host countries' governance quality as a measure of costs of doing business. According to the existing literature, countries with a poorer governance require a greater fixed cost of investment and are thus less likely to attract multinational firms. The index of governance quality is the average of three indices: control of corruption, regulator quality, and government effectiveness, all of which are obtained from the Polity IV database.

Finally, we control for several aspects of trade costs. Following the gravity-equation literature, we include the distance and contiguity between a potential host and France and tariff rates set by host and home countries.[13] Specifically, we include the tariff rate set by a potential host country on a French firm's primary product with the expectation that the higher this tariff, the more incentive the French firm will have to produce the product inside the host country.[14] Furthermore, we use a dummy variable to distinguish EU members from the rest of the world and capture the other trade cost differences between EU and non-EU destinations.[15] We also include the tariff rate France sets on the host-country exports and expect multinationals that seek to export their products back to France would be adversely affected by this tariff. Both tariff data are applied tariff rates measured at the SIC 3-digit level and obtained from the WITS database. Note that preferential tariffs within the EU and those between the EU and

[11] We also considered using sectoral outputs as a measure of demand at the industry level. However, the data of sectoral outputs have many missing values and would reduce our sample size substantially.

[12] Ideally, we would like to use the applied corporate tax rate in each host country. But this data consists of a large number of missing values for the countries in our sample.

[13] Note distance and contiguity also affect the fixed cost of investment, which adversely affects MNCs' investment decision. Furthermore, for firms that engage in intra-firm trade between home and host countries, transport cost can reduce their incentive to produce abroad. As a result, the net effect of distance and contiguity is ambiguous.

[14] We also used the average tariff rate imposed on the firm's primary and secondary products. The results were qualitatively similar.

[15] All countries that joined the EU before 2005 are treated as EU members.

other countries are reflected in the data. Table 1 describes the source and summary statistics of the above variables.[16]

[Table 1 about here]

5 Cross-country differences in the productivity distribution

Before we explicitly estimate individual multinational firms' location decision, we first take a close look at the cross-country differences in the productivity distribution. In particular, we take equations (7), (10) and (13) to the data and compare them with the empirical evidence.

Recall Section 3.2 predicts that countries with more attractive attributes have lower cutoff productivities and consequently lower average productivities. It also predicts a negative correlation between host-country cutoff (and average) productivity and the number of multinationals. We first examine the latter hypothesis by plotting the minimum productivity of French MNCs in each host country against the number of firms. As shown in Figure 1, the entry threshold productivity is indeed negatively associated with the popularity of the market. There is also a negative, albeit less significant, correlation between average TFP and number of MNCs (Figure 2), which suggests that firms that invest in less popular markets are on average more efficient.

[Figures 1-2 about here]

Now we directly estimate the cutoff and average TFPs as a function of host-country characteristics based on equations (7) and (10). Specifically, we identify $\underline{\theta}_{jk} \approx \min_{i\in\Omega_{jk}} \theta_i$ and $\widetilde{\theta}_{jk} \approx \sum_{i\in\Omega_{jk}} \theta_i/N_{jk}$ for each host country j and industry k, where Ω_{jk} is the set of French firms in industry k and investing in j. As shown in Table 2, both the cutoff and average TFPs are negatively correlated with the host-country market potential.[17] This implies that, as expected from the theory, the entry threshold productivity is greater in countries with a smaller market demand. The cutoff productivity is also positively correlated with host-country unit labor cost, a result that is again consistent with the theoretical prediction. Specifically, a 100-percent increase in unit labor cost raises the entry threshold by 62%. Only the relatively more productive firms will find it profitable to invest in countries with a larger variable cost of production. This is similarly true for countries with a greater fixed cost of investment, indicated by the positive parameters of entry cost and distance. The entry threshold productivity is 7% higher in countries where the distance to France is 100-percent greater. Finally, a lower

[16] We also take two measures to address the possibility of omitted host-country characteristics. First, we use a country fixed effect to control for all host-market attributes. Second, we construct an industry-specific measure of host-country attractiveness in Section 7.3 to capture all the country-industry factors that can affect multinationals' location decision.

[17] Our hypotheses are summarized in the second column of Table 2 (and all the following tables).

import tariff in host countries also results in a higher cutoff productivity for multinational firms as exporting becomes less costly.[18]

[Table 2 about here]

Next, we examine the cross-country differences in the distribution of firm productivities indicated by equation (13). We predict in Section 3.2 that the productivity distribution of firms that enter tougher markets should first-order stochastically dominate those that invest in easy markets.

As seen in Figures 3-6, the predicted sorting of multinational firms is supported in the data. Figure 3 shows that the productivity distribution of firms that invest in countries with above-average market potential appears to be first-order stochastically dominated by firms that have subsidiaries in countries with below-average market potential. Similarly, firms that invest in countries with a below-average unit labor cost (Figure 4) or a below-average fixed cost as measured by either the cost of starting a business (Figure 5) or distance (Figure 6) are less productive than other multinational firms.

[Figures 3-6 about here]

These distribution differences are also statistically significant, as shown in Table 3. In this table, we first perform a two-sided Kolmogorov-Smirnov test to examine the equality of the two distributions, i.e., $\lambda_1(\theta) = \lambda_2(\theta)$. If the equality hypothesis is rejected, we then use a one-sided Kolmogorov-Smirnov test to examine the first-order stochastic dominance, i.e., $\lambda_1(\theta) \leqslant \lambda_2(\theta)$. If we fail to reject this hypothesis and given $\lambda_1(\theta) \neq \lambda_2(\theta)$ (obtained from the first step), we conclude that $\lambda_1(\theta) < \lambda_2(\theta)$, i.e., $\lambda_2(\theta)$ is first-order stochastically dominated by $\lambda_1(\theta)$.[19]

We find that, first, consistent with the literature there is a significant productivity differential among domestic, exporting and multinational firms. Not only are multinationals more productive than the other types of firms, those that invest in multiple host countries also exhibit a productivity premium compared to an average MNC. Moreover, the cross-country productivity differential predicted in Section 3.2 is also largely confirmed. The productivity distribution of firms that invest in tougher markets significantly dominates the productivity distribution of those investing in easier markets.

[Table 3 about here]

[18] Note that both the cutoff and average productivities are only observed for countries and industries that have at least one French multinational firm. In other words, they are not observable in countries with prohibitive cutoff productivities, which can give rise to a sample selection issue. We hence also considered using the Heckman (1979) selection model and proceeding in two stages. First, we estimated the probability of having at least one French MNC in a host country and a given industry. Then, we estimated the cutoff and average productivities, taking into account the selection bias reflected in the inverse mills ratio obtained from the first stage. We found the estimated effect of host-country characteristics remains similar.

[19] This approach has been adopted in the past by Girma et al. (2005), Girma, Gorg and Strobl (2004), Arnold and Hussinger (2005) and Wagner (2005) to compare the productivity of domestic, exporting and multinational firms.

6 Main econometric results

In this section, we directly examine our firm-level hypotheses, i.e., equations (15)-(17), and investigate individual firms' investment decisions. We proceed in two steps. First, we estimate, at individual firm level, the relationship between productivity and the intensive and extensive margins of investment.[20] Then we move to firm-country level and examine the primary question of the paper—how firm and country heterogeneity jointly explain individual French firms' investment decisions.

[Table 4 about here]

We find in Table 4 that TFP is positively correlated with firms' average affiliate sales (i.e., $\widetilde{s}_i = \sum_j s_{ij}/M_i$, where M_i denotes the number of countries in which firm i invests). This is consistent with the expectation in Section 3.3 which predicts that more efficient firms sell more in each country. Table 4 also indicates a positive relationship between TFP and the number of countries in which investment occurs (i.e., M_i) as expected from equation (17). This suggests that, relative to an average MNC, more productive firms enter a larger number of host countries.

Now we turn to the central part of the analysis, which is to investigate how firms with varied levels of productivity differ in their foreign production location choice. Based on Section 3.3, we consider the following baseline equation

$$\Pr\left(y_{ij}=1\right) = \Phi(\alpha + \delta_j + \gamma_j \theta_i + \varepsilon_{ij}) \tag{18}$$

where $\Pr\left(y_{ij}=1\right)$ represents the probability of firm i investing in country j, $\Phi(.)$ is the logistic cumulative distribution function, δ_j represents either βX_j (where X_j is a vector of host-country characteristics) or a vector of host-country dummies, θ_i denotes firm i's relative productivity in a lagged period, and γ_j is the effect of productivity across host countries (which we estimate as either a vector of country dummies or a function of host-country attributes).

We begin with Table 5 where we assume that the effect of TFP is uniform across countries, i.e., $\gamma_j = \gamma$ for all j, (and equivalently the effect of host-country attributes is homogeneous across firms). We find that both TFP and host-country characteristics exert a significant effect on multinationals' location decision. First, there is a positive correlation between TFP and firms' probability to have foreign subsidiaries. More productive firms are more likely than their less efficient counterparts to produce in a foreign country. This result is also robust when we include a country fixed effect in the last column of Table 6 (instead of the vector of country attributes).[21]

[20] Because affiliate sales data is not available for all subsidiaries, we do not examine the intensive margin at subsidiary level. We focus instead on firms' average affiliate sales for which there are fewer missing values.

[21] Two strategies have often been used to estimate a fixed-effect binary choice model. One can either include a vector of dummy variables in the estimation or use a conditional-logit model. The former may give rise to

In terms of the effect of host-country attributes, we find that, as expected from the theory, firms are more likely to have subsidiaries in countries with more attractive attributes. For example, French firms have a greater probability to invest in countries with a larger market potential. They also tend to choose countries with a lower unit labor cost as their production locations, suggesting a significant comparative advantage motive in their investment decision. Countries that require a higher entry cost are less likely to be selected by French multinationals, a result that is similarly true for countries remote from France and with poor-quality governance. Finally, both host- and home-country tariffs exert a significant effect on French firms' location choice. Consistent with the tariff-jumping motive theory, French MNCs are more likely to produce in countries that impose a higher tariff on French exports. They also tend to prefer countries where the tariff of selling back to France is relatively low.

[Table 5 about here]

One result that is not predicted analytically is the positive correlation between the host-country corporate tax rate and multinationals' incentive to invest in a foreign country. This may reflect the possibility that the maximum official tax rate used in the paper is not the rate actually applied to foreign firms. Unfortunately, these applied tax rates are not available on a systematic basis and would substantially reduce the sample size.

Now we explore how the effect of TFP can vary across host countries. To do so, we first interact firm TFP with a vector of host-country dummies as in equation (18) and estimate both δ_j and γ_j. As in Section 3.3, suppose we can rank countries $j = 1, ..., N$ based on their cutoff productivities such that country 1 is the easiest market of all and country N is the most difficult. This would suggest that $\delta_1 > \delta_2 > ... > \delta_{N-1} > \delta_N$. If the effect of TFP diminishes in market attractiveness, we should then have $\gamma_1 < \gamma_2 < ... < \gamma_{N-1} < \gamma_N$. As shown in Figure 7, we observe a clear negative correlation between estimated country attractiveness, i.e., $\widehat{\delta}_j$, and the effect of TFP, i.e., $\widehat{\gamma}_j$. In fact, the negative relationship is significant at 1% level. This suggests that the effect of TFP in raising firms' ability to invest abroad is stronger in less attractive markets, i.e., markets with smaller $\widehat{\delta}_j$. For example, in countries such as Germany, UK, Spain, Belgium, US and China where the estimated attractiveness is relatively high, the effect of TFP is relatively small.

[Figure 7 about here]

The above finding leads us to examine next: How does the effect of TFP vary with specific host-country attributes. Put differently, how does firm productivity lead to differential effect

the incidential parameter problem that exists in Maximum Likelihood Estimators, but the associated bias is relatively small when the number of observations per group is sufficiently large (Greene, 2009) as is the case here. We considered both estimators in the paper and found the results were largely similar. The estimates presented here are obtained from the conditional-logit model. Note because of the nature of conditional-logit model, including a country fixed effect in the analysis drops out all the host countries where no French multinationals are present and reduces the sample size.

of host-country attributes across individual firms? We proceed by interacting TFP with host-country characteristics, i.e., replacing $\gamma_j\theta_i$ in equation (18) with $\gamma\theta_i + \widetilde{\gamma}X_j \cdot \theta_i$ where X_j is the vector of host-country characteristics. As shown in Table 6, we find the impact of country characteristics varies systematically across individual firms.[22] Specifically, while a smaller market potential on average reduces multinationals' incentives to invest in a foreign country, its effect is smaller for firms with greater productivities. According to column (1), for an average-productivity multinational firm the probability of investing in a foreign country is 0.8 percentage point lower when the country's market potential is 100-percent smaller than the average. This effect decreases to 0.3 percentage point for multinationals whose TFP is 100-percent greater than the average and 0.2 for firms in the top 90th percentile of productivity distribution. Firms in the bottom 10th percentile are affected most: a 100-percent decrease in market potential reduces these firms' probability to invest by 1.7 percentage point. This implies that more efficient firms are more likely than their less efficient competitors to enter countries with a small market demand.

[Table 6 about here]

The effect of our various measures of fixed costs is also asymmetric across firms. While firms on average are less likely to invest in a country with high entry costs, its adverse effect is significantly smaller for more productive firms. Similarly, the effect of distance diminishes in productivity. Compared to an average-productivity firm whose probability of investing in a foreign country decreases by 0.3 percentage point when host-country distance increases by 100 percent, MNCs with twice the average TFP will only see a decrease of 0.1 percentage point. The above effect falls below 0.1 for firms in the top 90th percentile of productivity distribution but amounts to 0.5 percentage point for the least productive (i.e., 10th percentile) group.

The role of host-country tariffs in prompting firms to invest in a foreign country also varies with productivity level. More productive firms are more likely than their less efficient rivals to invest in the foreign country with low tariffs. In particular, while the likelihood of an average-productivity MNC investing in a foreign country is 0.1 percentage point lower when tariff falls by 100 percent, it has little impact on MNCs with twice the TFP (and those in the top 90th percentile). For firms whose productivity belongs to the 10th percentile, however, it can decrease the investment probability by 0.2 percentage point. The intuition behind this result is that a lower tariff raises the expected export profit and only firms with a relatively high productivity will still find it more profitable to invest than to export. French sectoral tariffs also exert an asymmetric effect on firms' incentive to invest abroad. More productive French firms are less likely to invest abroad when the cost of exporting products back to France

[22] Note, as pointed out by Ai and Norton (2003), interpreting the parameters of the interaction terms requires additional attention when a nonlinear model is used. We followed the procedure described in Ai and Norton (2003) and computed the marginal effect for firms that belong to different percentiles of the productivity distribution.

is high.[23] The above results remain largely robust when we include a country fixed effect and control for all country specific factors.

7 Sensitivity analysis

In this section we address the potential concern of unobserved heterogeneities and reverse causality. This is important given the main goal of this paper is to establish the causal effect of TFP on firms' location choice.

7.1 New entries of multinational firms

We previously used firms' lagged productivity — estimated based on their home production activities — to explain current subsidiary locations. However, some subsidiaries may have existed before or when the TFP was observed and therefore have a spillover effect on firms' performance at home. We modify our dataset in this subsection to mitigate the possibility of reverse causality between TFP and firms' location choice. Specifically, we modify the dataset such that the set of countries available for each individual firm to set up subsidiaries includes only those where this firm has not invested before 2001 (the latest year the TFP was observed). Thus, the analysis here is focused on MNCs' decision to enter a host country market between 2001 and 2005.[24]

[Table 7 about here]

As shown in Table 7, the estimation results are largely similar to Table 6. The effect of TFP in stimulating MNC entry is stronger in countries with less attractive attributes. More productive firms are significantly more likely than their rivals to set up new subsidiaries in countries with a small market potential. They are also more likely to enter countries that require a large entry cost, are geographically distant from France, and have a poor governance, all of which are factors that may lead to a large fixed cost of investment. Furthermore, countries that set relatively low tariffs also attract the entry of firms with higher TFP.

7.2 Endogeneity of TFP

The concern noted above about a possible correlation between TFP and firms' past investment activities can be generalized to a broader econometric issue, that is, the endogeneity of firm

[23] This result is not part of our hypotheses as we did not endogenize the mode of supplying home country. But this empirical finding suggests a possible extension of the analysis that is worth exploring.

[24] We also considered an alternative modification in which we constrain the sample to include only new MNCs, i.e., firms that started investing abroad after 2001. This modification, while significantly reducing the sample size, further mitigates the possibility of reverse causality as the included firms did not have any investment activities until after 2001. The results were largely similar to what is reported here.

productivity. TFP is endogenous when it is correlated with the residuals of the equation, which may include either past investment activities or other unobserved firm attributes such as credit constraint or political assets. We use two approaches to address this potential concern.

First, we control for all firm characteristics with a firm fixed effect. As shown in Table 8, this does not lead to significant changes in the results. More productive firms are still significantly more likely than their less efficient competitors to invest in relatively tough host countries—countries with a relatively small market potential, a great fixed cost of investment and a low tariff.

[Table 8 about here]

While the above approach controls for all firm-specific characteristics, it does not rule out the potential endogeneity of the interaction terms formed by TFP and country characteristics. For example, our results in Table 6 show that more productive firms are less adversely affected by host countries' distance. But this might be capturing the role of firms' previous investment experience. We hence employ a control function approach to further address the potential endogeneity of TFP. This control function method is developed by Petrin and Train (2005, 2006) to control for unobserved factors in differentiated products models and correct for the endogeneity of prices. They exploit the information contained in the endogenous variable (e.g., prices) to recover unobserved variables, which are then used to form controls in the main estimation equation to condition out the dependence of the endogenous variable on the error term.[25] This approach has recently been adopted by Liu, Lovely and Ondrich (forthcoming) to examine the effect of wage rate on MNCs' location choice in China. They use the average wage rate of state-owned enterprises as an instrumental variable to address the potential endogeneity of regional wage.

Formally, our objective is to deal with the bias that exists in the following equation:

$$\Pr\left(y_{ij}=1\right)=\Phi\left(\alpha+\delta_j+\gamma_j\theta_i+\sigma_j\vartheta_i+\varepsilon_{ij}\right), \tag{19}$$

where ϑ_i represents an unobserved firm variable that is correlated with firm productivity (θ_i) and, similar to productivity, can affect firms' location decision. We proceed in two stages. First, we derive an estimate of ϑ_i based on

$$\widehat{\vartheta}_i=\theta_i-E(\theta_i|Z_i), \tag{20}$$

where Z_i is the instrument vector we use to estimate firm productivity.

Plausible instruments in this case include the average productivity of French firms in the same industry, same region or both. The choice of these instruments is motivated by the large

[25] Note that the control function approach leads to the usual IV estimator in standard linear models, but offers distinct advantages relative to the IV estimator in nonlinear models.

economics literature on technology spillover, including the recent studies by Jovorcik (2004), Haskel *et al.* (2007), and Keller and Yeaple (2007).[26] It is also related to studies on social interaction, such as the recent work by Guiso and Schivardi (2007), which finds strong evidence of social interaction in firms' structural adjustment especially for firms in the same industry and geographic district. In light of these findings, we construct two reference groups for each French firm in the sample: (i) firms located in the same region (département) of France;[27] (ii) firms from the same SIC 4-digit industry and same region. Note our TFP measure has already been deflated by the (SIC 4-digit) industry average. We construct the two reference groups using all French manufacturing firms available from the AMADEUS database (excluding the firm of interest), which include both multinational and national firms.[28] If there exists (positive) regional spillover, the productivity of an individual firm should be (positively) correlated with the productivity of its reference group (i). When there is also an intra-industry spillover (due to, for example, technology transfer), the productivity correlation should be strongest for firms that are in not only the same region but also the same industry (group (ii)).[29]

Based on the first stage, we obtain an estimate of ϑ_i, i.e., $\widehat{\vartheta}_i$. This estimate is then included in the second stage to proxy for unobserved firm heterogeneities that are correlated with TFP. In doing so, we mitigate the potential correlation between ε_{ij} and $\gamma_j\theta_i$. Formally, we estimate the following equation:

$$\Pr\left(y_{ij}=1\right)=\Phi\left(\alpha+\delta_j+\gamma_j\theta_i+\sigma_j\widehat{\vartheta}_i+\varepsilon_{ij}\right), \tag{21}$$

where $\widehat{\vartheta}_i$ is interacted with either a vector of host-country dummies or host-country attributes, i.e., X_j.

[Tables 9 and 10 about here]

The first-stage estimates are reported in Table 9. As shown, firm productivity is significantly and positively correlated with the average productivity of its peers in the same region. This correlation is particularly strong for peers in the same industry, even when we control for region fixed effect. We further notice that, in the second stage, correcting for the endogeneity

[26] The majority of the above studies focus on the technology spillovers from foreign MNCs to domestic firms. For our purpose here, we consider all the firms producing in France as a potential source of spillover without distinguishing the structure of their ownership.

[27] We consider firms from the same département as one geographic group. Départements, analogous to English counties, are administrative units of France and many former French colonies. Our sample consists of firms from totally 92 départements.

[28] In the construction of the instrumental variables, firms that are the only observation in their industry and region were dropped because of the lack of reference group (ii). This reduces the number of firms included in the sample. We also considered excluding multinational firms in the formation of reference groups. The results remain largely similar.

[29] We also considered including firm age as an additional instrumental variable and found the results remain largely similar.

does not change our estimates significantly. When we interact TFP (and $\widehat{\vartheta}_i$) with a vector of host-country dummies and estimate equation (21), we find again a negative correlation between the effect of TFP, i.e., $\widehat{\gamma}_j$, and the estimated attractiveness of the market, i.e., $\widehat{\delta}_j$, as in Section 6. In fact, the correlation becomes stronger after we control for the effect of unobserved firm heterogeneities.

The above result is also supported in Table 10 where we interact TFP (and $\widehat{\vartheta}_i$) with host-country characteristics.[30] Our previous findings that more productive firms are more likely to invest in countries with a small market potential, a high fixed cost of investment, and a low tariff remain largely robust.

7.3 Unobserved host-country attributes

So far we have used country dummies in some of our estimations to control for host-country attributes. The issue of unobserved host-country attributes can still arise, however. For example, host countries' sectoral market structure is likely to exert a significant effect on multinationals' location decision and this effect is likely to vary across firms. But the data of sectoral market structure is often missing and difficult to obtain for all host countries. To account for this issue, we adopt a two-step procedure to construct an industry specific measure of host-market attractiveness. This approach is inspired by Head and Mayer (2004) and Head and Ries (2008), who respectively estimate a trade and FDI equation with origin and destination fixed effects and construct a measure of destination-market attractiveness to control for unobserved country characteristics.

The procedure proceeds in two steps. First, we estimate an FDI equation where the dependent variable is an indicator variable that equals to 1 if there is at least one multinational firm from country h and industry k investing in country j.[31] Specifically, we consider the following equation:

$$Y_{hjk} = \mu_{hk} + \delta_{jk} + \lambda\tau_{hjk} + \varepsilon_{hjk}, \tag{22}$$

where $\lambda\tau_{hjk} \equiv \lambda_1 \ln d_{hj} + \lambda_2 B_{hj}$. In the above equation, μ_{hk} represents the home country-industry fixed effect, δ_{jk} represents a vector of host country-industry dummies, and τ_{hjk} is a vector of bilateral market access variables including distance (d_{hj}) and contiguity (B_{hj}). The dataset we use to estimate equation (22) is obtained from AMADEUS and includes the original EU 15 members as home countries and 127 EU and non-EU countries as host countries. One of the motives to consider EU members as the home countries is the uniform trade policy they set on foreign countries and the uniform treatment they receive. This means that δ_{jk} will

[30] Because the estimation consists of fitted values obtained from an earlier stage, we use bootstrapping to correct the standard errors.

[31] We also considered the number of multinationals and the total volume of affiliate sales (from country h, industry k and investing in country j) as alternative dependent variables and found the results qualitatively similar.

capture not only host-country specific attributes, such as market size, production cost and market structure, but also bilateral trade policy variables that do not vary across EU, such as host-country tariffs on EU members and EU's external tariffs on a foreign country.

[Table 11 about here]

In the second step, we use the estimates of δ_{jk}, i.e., $\widehat{\delta}_{jk}$, (obtained from the first step), as an industry specific measure of host-market attractiveness, to estimate individual French MNCs' location decisions. As shown in Table 11, both $\widehat{\delta}_{jk}$ and $\widehat{\delta}_{jk} \cdot \theta_i$ are significant. French firms are more likely to invest in countries with a greater (estimated) attractiveness. But this effect is significantly smaller for more productive firms, as indicated by the negative parameter of $\widehat{\delta}_{jk} \cdot \theta_i$. This again implies that firms with a higher productivity have a greater probability to enter tough markets.

8 Conclusion

Foreign direct investment and firm heterogeneity are two prominent research areas that have attracted a substantial amount of attention from both economists and policy makers. We contribute to these strands of literature by examining the interplay of country asymmetry and firm heterogeneity in determining multinationals' location decisions—how firms' differences in productivity can lead to distinct choices of foreign production locations.

We find, at both aggregate- and firm-level, that there is a systematic relationship between firm productivity and selection of foreign production location. The aggregate-level evidence indicates that the productivity of French MNCs varies significantly across host countries. Markets with less attractive attributes, including a relatively small market potential, a high unit labor cost, a large fixed cost of investment and a low import tariff, tend to have higher cutoff productivities and attract a greater proportion of productive multinationals. Furthermore, the productivity distribution of firms that invest in these countries first-order stochastically dominates those that invest in easy markets.

These findings are also supported by the firm-level evidence. We find that firms' choice of host countries varies significantly with their total factor productivity. More productive firms are significantly more likely to invest in countries with a small market potential, high entry barriers and large fixed costs of investment. The probability of investing in countries that set relatively low tariffs is also higher for these firms.

To establish the causal effect of TFP, we perform a number of sensitivity analyses. First, we seek to mitigate the concern of reverse causality by limiting the analysis to new entries of multinationals. Second, we address the potential endogeneity of firm productivity using a control function approach. In this approach, we pair each French multinational firm with respective reference groups, formed by other French national and multinational firms in the

same region and the same industry, and use the average productivity of the reference groups as instruments. The results suggest that the causal effect of productivity on multinationals' location decision remains largely robust—firms with varied productivity are systematically sorted into different types of host markets. Finally, we construct an industry-specific measure of host-country attractiveness to control for unobserved country attributes. We find the results are qualitatively similar.

These findings convey an important message to host-country policy makers: Changes in investment or trade policies will affect not only the volume of foreign direct investment but also the productivity distribution of multinational firms that decide to enter the host country. For example, an increase in tariffs may in fact stimulate FDI but does so by increasing the entry of less productive firms. To the extent that there might be domestic productivity spillovers from foreign MNCs, it is crucial to be aware that the productivity composition of multinationals is not homogeneous and there can be decreasing returns to using trade policy as means of attracting multinational firms.

While this paper focuses on exploring the role of firm heterogeneity in multinationals' location decision, it can be extended in two main directions. First, like the majority of the literature, this paper has assumed that a firm's decision to invest in one location is independent of their locations in third countries. This assumption is increasingly challenged by real world observations as more multinational firms adopt complex integration strategies. For example, many firms today engage in export-platform FDI, in which case the decision to invest in a foreign country does not only depend on the costs of exporting to that country from multinationals' home but also the costs of exporting from subsidiaries abroad. Blonigen *et al.* (2007) and Baltagi *et al.* (2007), who investigate third-country effects in the pattern of U.S. outward FDI, are two leading studies in this area. However, firm-level evidence obtained with detailed information on individual MNCs' subsidiary network is still largely missing.

Second, most analyses in this area have treated multinationals' location decision as static, despite the fact that firms often adjust their location choices by expanding in new markets and contracting in less attractive locations. While this paper has examined the entry of multinational firms into new host countries (in Section 7.1) as an attempt to disentangle the causality between productivity and location choice, the relationship between firm productivity and location adjustments is a question that can be further explored with the facilitation of additional time series data.

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Appendix A Estimates of Productivity

In the large literature of production function estimations, a long recognized concern is a simultaneity problem generated by the potential correlation between input demand and unobserved productivity shocks. The economics underlying this concern is intuitive. Firms that experience a positive productivity shock may respond by using more inputs. This simultaneity, if true, would bias the ordinary least squares (OLS) estimates of production functions and, consequently, the estimates of productivity.

Many strategies have been proposed. For example, within estimators that use within-firm variation to control for the potential correlation between unobserved firm-specific factors (such as managerial quality) and input choices. However, sometimes the between-firm variation is important for obtaining estimates of output elasticities (for example, when firms do not significantly adjust their capital level in a short time period). Researchers have also considered using an instrumental variable (IV) estimator to achieve consistency. The instruments that have been used include firm-level input prices and lagged values of input use. However, firm-level input prices are rarely observed. Lagged values of inputs are valid instruments if the lag time is long enough to break the dependence between the input choices and the serially correlated shocks.

A novel approach has been suggested by Olley and Pakes (1996). They adopt firm-level investment, which is considered as a strictly increasing function of unobserved productivity shocks, as a proxy to control for the correlation between input levels and the productivity term. A similar strategy is developed by Levinsohn and Petrin (2003), who suggest the use of intermediate inputs (e.g., raw materials and energy) as the proxy variables. Levinsohn and Petrin (2003) also point out that the procedure introduced in Olley and Pakes (1996) must satisfy the monotonicity condition between investments and productivity shocks and thus would truncate all the observations with zero investment. This could create problems when firms only make intermittent investments.

In this analysis, we considered both the IV estimator using lagged values of inputs as the instrumental variable and Levinsohn and Petrin's (2003) semiparametric estimator. The results reported in the paper are based on the TFP estimates obtained from the latter approach. The details of this approach are described next. Formally, we estimate the following production function,

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + \theta_{it} + \varepsilon_{it}, \tag{a.1}$$

where the log of value added y_{it}, i.e., gross output net of material costs, is a function of the logs of employment l_{it}, capital k_{it} and productivity shocks θ_{it}. The demand for material is considered a function of θ_{it} and k_{it}, i.e.,

$$m_{it} = m_{it}(\theta_{it}, k_{it}), \tag{a.2}$$

and assumed to be monotonic in θ_{it} for all k_{it}. Value added, material costs, and capital are all deflated by their respective deflators, taken from the French National Institute for Statistics and Economics Studies (INSEE). Given the monotonicity, one can invert the material demand function to obtain $\theta_{it} = \theta_{it}(m_{it}, k_{it})$ and rewrite the production function as

$$y_{it} = \beta_l l_{it} + \phi_{it}(m_{it}, k_{it}) + \varepsilon_{it}, \tag{a.3}$$

where

$$\phi_{it}(m_{it}, k_{it}) = \alpha + \beta_k k_{it} + \theta_{it}(m_{it}, k_{it}). \tag{a.4}$$

We now proceed in two stages. In the first stage, consider the expectation of equation (b.3) conditional on m_{it} and k_{it},

$$E[y_{it}|m_{it}, k_{it}] = \beta_l E[l_{it}|m_{it}, k_{it}] + \phi_{it}(m_{it}, k_{it}). \tag{a.5}$$

Subtracting the above equation from (b.3) yields

$$y_{it} - E[y_{it}|m_{it}, k_{it}] = \beta_l(l_{it} - E[l_{it}|m_{it}, k_{it}]) + \varepsilon_{it}. \tag{a.6}$$

By assumption ε_{it} is mean independent of l_{it}, no-intercept OLS can be used to obtain consistent estimates of β_l. To be specific, we estimate equation (b.6) by substituting a third-order polynomial approximation in m_{it} and k_{it} in place of $\phi_{it}(m_{it}, k_{it})$.

Since capital enters $\phi_{it}(.)$ twice, a more complete model is used in the second stage to identify β_k. Assuming θ_{it} follows a first-order Markov process and capital does not immediately respond to the innovations in productivity over last period's expectation, defined as $\eta_{it} = \theta_{it} - E[\theta_{it}|\theta_{i(t-1)}]$, we obtain $\hat{\beta}_k$ as the solution to

$$\min_{\beta_k} \sum_t \left(\hat{\theta}_{it} - E[\theta_{it}|\theta_{i(t-1)}]\right)^2 \tag{a.7}$$

where

$$\hat{\theta}_{it} = \hat{\phi}_{it} - \beta_k k_{it} = y_{it} - \hat{\beta}_l l_{it} - \beta_k k_{it}. \tag{a.8}$$

Then, based on the consistent estimates of β_l and β_k, we obtain the estimated levels of productivity

$$\hat{\theta}_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it}. \tag{a.9}$$

Because industries are different in their labor and capital intensities, we estimate the production function for each SIC 3-digit industry and obtain the productivity for each firm based on the industry-specific production-function estimates.

Appendix B Intensive and extensive margins of aggregate FDI

The theoretical framework adopted in this paper also generates testable hypotheses on the structure of aggregate FDI. Yeaple (2008) shows that given firm heterogeneity, host-country characteristics affect both the scale and the scope of FDI (i.e., affiliate sales, the number and the average productivity of multinationals). He tests his hypotheses using U.S. multinational data and finds supporting evidence. Here we follow Yeaple (2008) and examine the intensive and extensive margins of French outward FDI. Specifically, we use multinationals' average affiliate sales in a given market as a measure of the intensive margin and the number of multinationals a measure of the extensive margin.[32] Note the intensive margin considered here differs from Yeaple (2008) who uses the ratio of total affiliate sales to home-country revenue. The reason we focus on cross-country difference in average affiliate sales is to examine a prediction that has been overlooked in the existing literature. That is, because more productive firms are more likely than their less efficient competitors to self-select into tough markets, the conditional average affiliate sales in these markets should be greater than countries with more attractive attributes.

This prediction is derived as follows. Based on Section 3.3, the average affiliate sales, conditional on firms' probability to invest in a foreign country, is given by

$$\widetilde{s}_j \equiv E\left[px|\pi_{ij}^I > \pi_{ij}^X\right] = \frac{\int_{\underline{\theta}_j}^{\infty} A_j {p_{ij}}^{1-\varepsilon} dG(\theta)}{\Pr(\pi_{ij}^I > \pi_{ij}^X)}. \tag{b.1}$$

Given $p_{ij} = c_j/(\alpha\theta_i)$, the numerator of the above equation can be transformed to

$$\int_{\underline{\theta}_j}^{\infty} A_j {p_{ij}}^{1-\varepsilon} dG(\theta) = \frac{kb^k}{(1-\alpha)(k-\varepsilon+1)} B_j {c_j}^{1-\varepsilon} \left(\underline{\theta}_j\right)^{\varepsilon-k-1}. \tag{b.2}$$

For the integral to be finite, we assume $k > \varepsilon - 1$. Since we assume a pareto distribution function for productivity, we can rewrite the denominator of equation (b.1) as

$$\Pr(\pi_{ij}^I > \pi_{ij}^X) = \left(\underline{\theta}_j\right)^{-k} b^k, \tag{b.3}$$

which, combined with equation (b.2), leads to

$$\widetilde{s}_j \equiv E\left[px|\pi_{ij}^I > \pi_{ij}^X\right] = \frac{k}{(1-\alpha)(k-\varepsilon+1)} \cdot \frac{{c_j}^{1-\varepsilon}(f_j^I - f_j^X)}{{c_j}^{1-\varepsilon} - (c_0\tau_{ij})^{1-\varepsilon}}. \tag{b.4}$$

The above equation suggests that the conditional average affiliate sales in a given country increases in the variable and fixed costs of production of that market. This is driven by the selection effect, i.e., the effect of the two variables in raising the average productivity of firms

[32] We have already examined the average productivity of multinationals in Sections 3.2 and 5.

that self-select into the market.

Now look at the number of firms in each host country. As discussed in Section 3.2, this can be expressed as:

$$N_j \approx N \cdot \Pr(\pi_{ij}^I > \pi_{ij}^X), \tag{b.5}$$

which, given equations (b.3) and (5), is equivalent to

$$N_j \approx N \cdot \left[\frac{B_j \left({c_j}^{1-\varepsilon} - (c_0 \tau_{ij})^{1-\varepsilon} \right)}{f_j^I - f_j^X} \right]^{\frac{k}{\varepsilon - 1}} b^k. \tag{b.6}$$

It is clear that the number of firms investing in a foreign country should be greater in more attractive markets. Countries with a greater market demand (B_j), lower production costs (c_j and f_j^I) and a higher trade cost (τ_{ij}) are predicted to receive investments from a larger number of firms.

The above predictions are confirmed in the data. In Table B.1, we estimate the observed average affiliate sales (by firms that enter the host country) and the number of French MNCs in each country and industry, i.e., $\widetilde{s}_{jk}$ and N_{jk}, as a function of host-country attributes.[33]

[Table B.1 about here]

We find that, as expected from equation (b.4), average affiliate sales tends to be greater in markets with higher unit labor costs and greater entry costs. This finding suggests the importance of the self-selection mechanism in determining the magnitude of FDI. For the same reason, we find that the number of multinationals is smaller in less attractive countries. Specifically, there is a smaller number of French MNCs investing in countries with a smaller market potential, a higher unit labor cost and a greater fixed cost of investment.

[33] Similar to the cutoff and average productivities, we estimate the intensive and extensive margins here based on countries that have at least one French MNC.

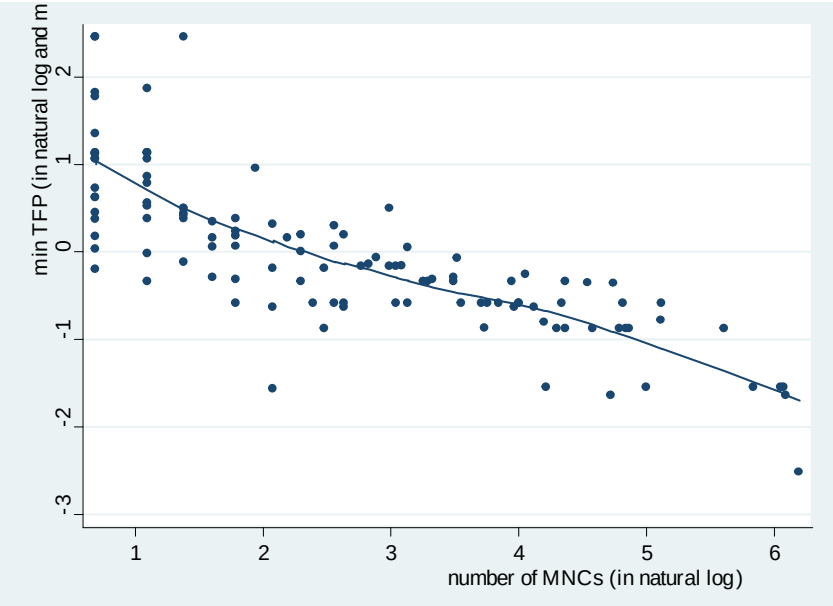

Figure 1: The relationship between minimum TFP and popularity of host countries (with lowess smoother)

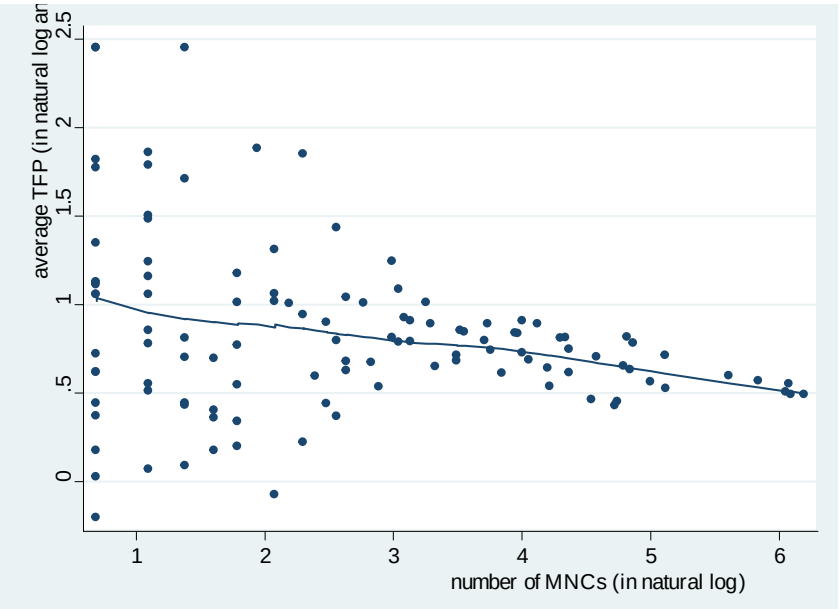

Figure 2: The relationship between average TFP and popularity of host countries (with lowess smoother)

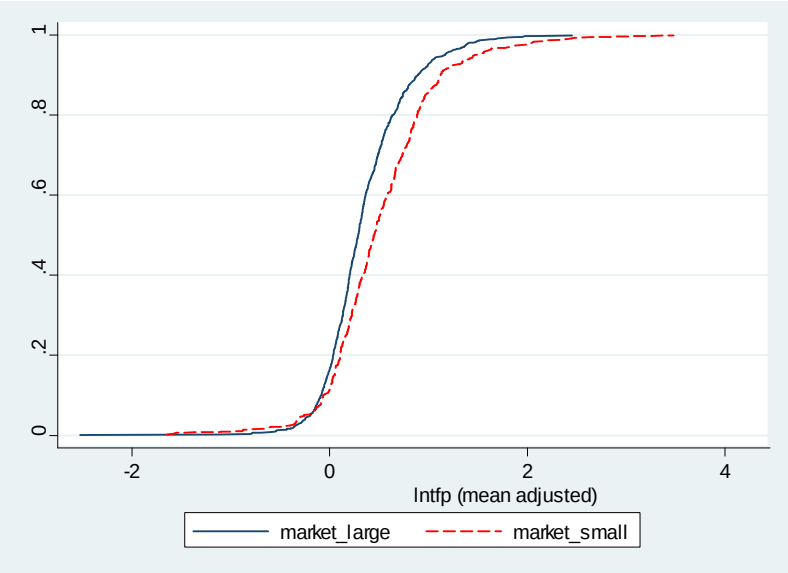

Figure 3: Cross-country difference in MNCs' productivity distribution: countries with above-average market potential versus those below average

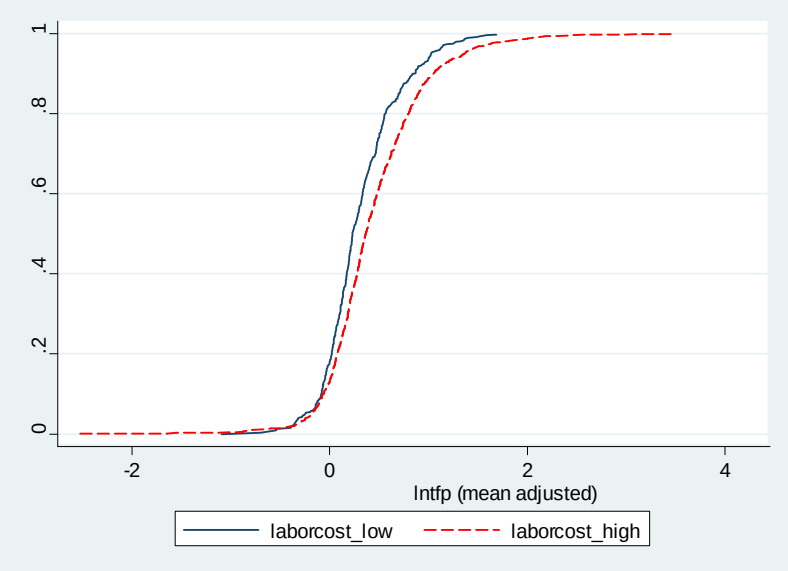

Figure 4: Cross-country difference in MNCs' productivity distribution: countries with below-average labor cost versus those above average

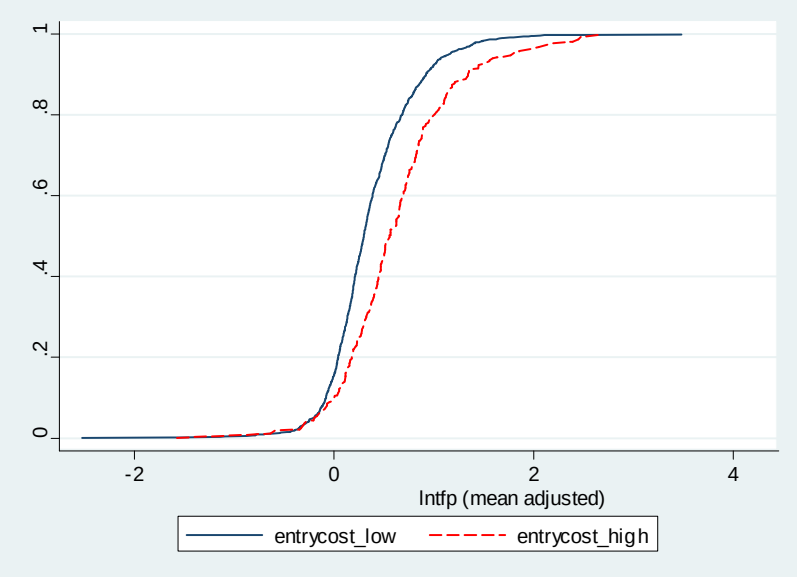

Figure 5: Cross-country difference in MNCs' productivity distribution: countries with below-average entry cost versus those above average

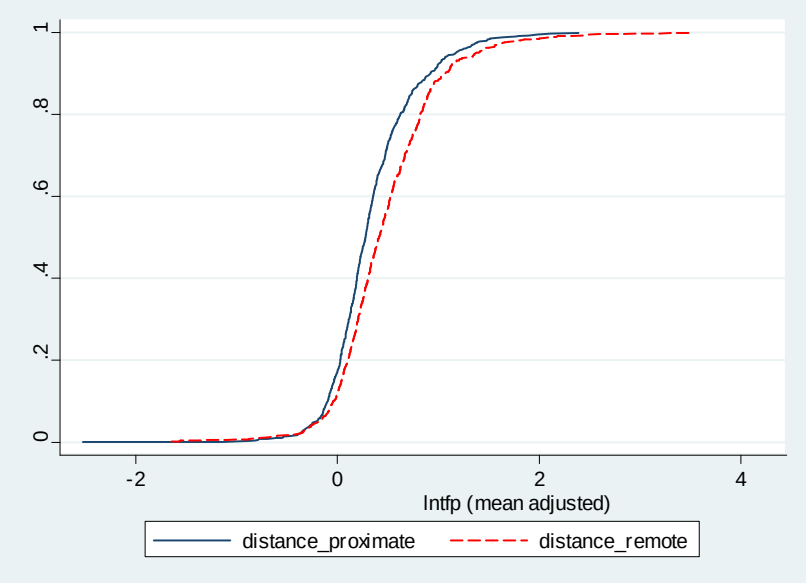

Figure 6: Cross-country difference in MNCs' productivity distribution: proximate versus remote countries

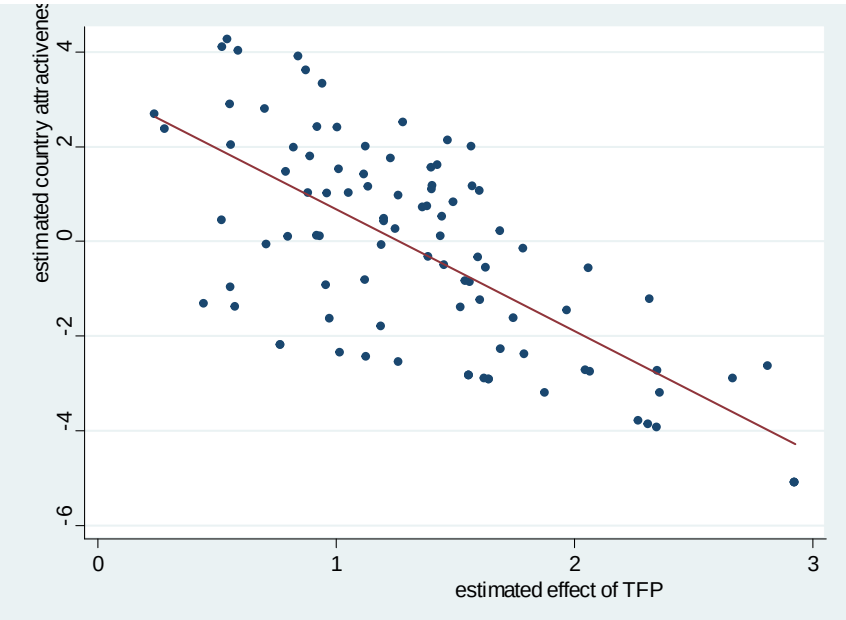

Figure 7: The relationship between the estimated effect of TFP and country attractiveness

Table 1: Summary Statistics

Variables	Source	Mean	Std. dev.	Min	Max
location	AMADEUS	0.02	0.14	0	1
market potential	WDI, CEPII	22.6	0.56	21.7	24.2
unit labor cost	World Bank	0.15	0.07	0.002	0.52
labor intensity	AMADEUS	0.66	0.19	0	0.99
max corporate tax	Office of Tax Policy Research	-1.21	0.27	-2.41	-0.61
entry cost	WDI	3.35	1.52	0	7.16
distance b/w host and home	CEPII	8.29	0.93	5.57	9.85
contiguity	—	0.04	0.20	0	1
EU	—	0.17	0.37	0	1
governance	POLITY	0.13	0.99	-2.16	2.28
host-country tariff	COMTRADE	1.77	1.26	0	5.56
home-country tariff	COMTRADE	0.50	0.78	0	3.71

Note: All variables except location, contiguity, and EU are in natural logs.

Table 2: Minimum and average TFP

Dependent variable	H_0	min TFP		ave TFP	
		coef.	s.e.	coef.	s.e.
market potential	–	-0.06***	(0.02)	-0.03*	(0.02)
unit labor cost	+	0.62**	(0.33)	0.25	(0.27)
corporate tax	+	0.01	(0.04)	0.01	(0.03)
entry cost	+	0.05***	(0.01)	0.02**	(0.01)
distance b/w host and home	+/–	0.07***	(0.02)	0.04***	(0.01)
contiguity	+/–	-0.36***	(0.04)	-0.12***	(0.02)
EU	+/–	0.13***	(0.04)	0.03	(0.04)
governance	–	-0.02	(0.02)	0.01	(0.02)
host-country tariff	–	-0.02*	(0.01)	-0.01	(0.01)
home-country tariff	+	-0.002	(0.02)	-0.02	(0.02)
industry fixed effect		yes		yes	
No. of observations		1,724		1,724	
R square		0.10		0.03	
Prob>F		0.00		0.00	

Notes: (i) robust standard errors are reported in the parentheses; (ii) ***, **, and * respectively represent significance at 1%, 5%, and 10%; (iii) OLS estimates are reported.

Table 3: Kolmogorov-Smirnov test of first-order stochastic dominance

Host-country characteristics	Group A	Group B	Two-sided K-S test H_0: $\Omega_A(\theta) = \Omega_B(\theta)$	One-sided K-S test H_0: $\Omega(A) \leqslant \Omega(B)$
MNC	MNC	exporter	0.00	0.84
Exporter	exporter	domestic	0.00	0.99
number of subsidiaries	large	small	0.00	0.89
market potential	small	large	0.00	0.92
unit labor cost	high	low	0.01	0.96
corporate tax	high	low	0.00	0.94
entry cost	large	small	0.00	0.97
distance	remote	proximate	0.00	0.97
EU	EU	ROW	0.00	0.98
governance	low quality	high quality	0.00	0.84
host-country tariff	low	high	0.07	0.84

Note: (i) p-values of the K-S tests are reported; (ii) the groups except the first two are defined relative to the mean of the corresponding variables.

Table 4: Firm-level decisions

Dependent variable	H_0	ave affiliate sales		num of countries	
		coef.	s.e.	coef.	s.e.
TFP	+	2.62***	(0.19)	3.26***	(0.57)
No. of observations		1,302		1,302	
R square		0.18		0.10	
Prob>F		0.00		0.00	

Notes: (i) robust standard errors are reported in the parentheses; (ii) ***, **, and * respectively represent significance at 1%, 5%, and 10%; (iii) OLS estimates are reported.

Table 5: Effect of TFP and host-country attributes on subsidiary locations

Dep. variable: location	H_0	(1)		(2)	
		coef.	s.e.	coef.	s.e.
TFP	+	1.07***	(0.14)	1.15***	(0.08)
market potential	+	0.46***	(0.04)		
unit labor cost	–	-6.09***	(1.24)		
labor intensity	+	0.52	(0.41)	0.61*	(0.37)
unit labor cost × labor intensity	–	-2.01	(1.90)	-2.53	(2.63)
corporate tax	–	0.25***	(0.09)		
entry cost	–	-0.43***	(0.02)		
distance to home	+/–	-0.42***	(0.04)		
contiguity	+/–	2.06***	(0.06)		
EU	+/–	-0.85***	(0.09)		
governance	+	0.47***	(0.03)		
host-country tariff	+	0.08***	(0.02)	-0.13	(0.10)
home-country tariff	–	-0.15**	(0.06)	-0.07	(0.07)
country fixed effect		no		yes	
No. of observations		85,328		79,236	
Log pseudo-likelihood		-11,576.4		-10,423.3	
Pseudo R square		0.17		0.22	

Notes: (i) standard errors are clustered at firm level and reported in the parentheses; (ii) ***, **, and * respectively represent significance at 1%, 5%, and 10%; (iii) Logit estimates are reported.

Table 6: Asymmetric effect of TFP and host-country attributes on locations

Dep. variable: location	H_0	(1)		(2)	
		coef.	s.e.	coef.	s.e.
TFP	+	1.06	(2.18)	2.61	(2.66)
market potential	+	0.54***	(0.07)		
unit labor cost	–	-5.50***	(1.85)		
labor intensity	+	0.85**	(0.46)	0.90**	(0.48)
unit labor cost × labor intensity	–	-3.98**	(2.21)	-4.18*	(2.37)
corporate tax	–	0.35***	(0.15)		
entry cost	–	-0.52***	(0.03)		
distance to home	–	-0.63***	(0.06)		
contiguity	+	2.30***	(0.11)		
EU	+/–	-0.81***	(0.13)		
governance	+	0.47***	(0.05)		
host-country tariff	+	0.19***	(0.04)	-0.02	(0.06)
home-country tariff	–	0.04	(0.08)	0.14	(0.09)
TFP×					
market potential	–	-0.12*	(0.07)	-0.15*	(0.09)
unit labor cost	+	0.74	(0.83)	0.26	(0.93)
corporate tax	+	-0.15	(0.15)	-0.05	(0.14)
entry cost	+	0.13***	(0.03)	0.11***	(0.04)
distance to home	+	0.33***	(0.06)	0.27***	(0.07)
contiguity	–	-0.40***	(0.15)	-0.48***	(0.16)
EU	+/–	-0.05	(0.15)	-0.21	(0.18)
governance	–	0.00	(0.05)	0.06	(0.08)
host-country tariff	–	-0.16***	(0.04)	-0.16***	(0.04)
home-country tariff		-0.28***	(0.12)	-0.35***	(0.14)
country fixed effect		no		yes	
No. of observations		85,328		79,236	
Log pseudo-likelihood		-11,511.8		-10,513.5	
Pseudo R square		0.17		0.23	

Notes: (i) standard errors are clustered at firm level and reported in the parentheses; (ii) ***, **, and * respectively represent significance at 1%, 5%, and 10%; (iii) Logit estimates are reported.

Table 7: Asymmetric effect of TFP and host-country attributes on entry decision

Dep. variable: entry	H_0	(1)		(2)	
		coef.	s.e.	coef.	s.e.
TFP	+	-0.19	(2.31)	1.40	(2.79)
market potential	+	0.53***	(0.07)		
unit labor cost	–	-4.62***	(2.14)		
labor intensity	+	0.91*	(0.53)	0.94*	(0.54)
unit labor cost × labor intensity	–	-4.64*	(2.57)	-4.74*	(2.73)
corporate tax	–	0.37***	(0.16)		
entry cost	–	-0.48***	(0.03)		
distance to home	–	-0.63***	(0.06)		
contiguity	+	2.34***	(0.11)		
EU	+/–	-0.72***	(0.14)		
governance	+	0.49***	(0.05)		
host-country tariff	+	0.24***	(0.04)	0.01	(0.06)
home-country tariff	–	0.07	(0.07)	0.13	(0.09)
TFP×					
market potential	–	-0.07*	(0.04)	-0.11*	(0.06)
unit labor cost	+	0.68	(1.05)	0.22	(1.14)
corporate tax	+	-0.06	(0.19)	0.02	(0.08)
entry cost	+	0.12***	(0.04)	0.11***	(0.05)
distance to home	+	0.35***	(0.08)	0.30***	(0.09)
contiguity	–	-0.47***	(0.15)	-0.54***	(0.4)
EU	+/–	-0.09	(0.18)	-0.25	(0.23)
governance	–	-0.05	(0.07)	0.02	(0.11)
host-country tariff	–	-0.19***	(0.05)	-0.19***	(0.05)
home-country tariff		-0.31***	(0.10)	-0.35***	(0.12)
country fixed effect		no		yes	
No. of observations		82,218		74,956	
Log pseudo-likelihood		-10,073.8		-9,202.4	
Pseudo R square		0.15		0.20	

Notes: (i) standard errors are clustered at firm level and reported in the parentheses; (ii) ***, **, and * respectively represent significance at 1%, 5% and 10%; (iii) Logit estimates are reported.

Table 8: Controlling firm characteristics

Dep. variable:	H_0	location		entry	
		coef.	s.e.	coef.	s.e.
TFP×					
market potential	–	-0.16*	(0.10)	-0.11*	(0.06)
unit labor cost	+	0.09	(0.87)	0.57	(0.95)
corporate tax	+	-0.05	(0.16)	-0.03	(0.19)
entry cost	+	0.10*	(0.05)	0.06*	(0.03)
distance to home	+	0.14***	(0.07)	0.18***	(0.08)
contiguity	–	-0.21*	(0.11)	-0.38***	(0.13)
EU	+/–	0.22	(0.17)	0.23	(0.19)
governance	–	0.14	(0.08)	0.06	(0.09)
host-country tariff	–	-0.07**	(0.03)	-0.08***	(0.03)
home-country tariff		-0.09*	(0.05)	-0.14***	(0.06)
firm fixed effect		yes		yes	
country fixed effect		yes		yes	
No. of observations		79,236		74,956	
Log pseudo-likelihood		-7,545.1		-6,753,1	
Pseudo R square		0.33		0.30	

Notes: (i) standard errors are clustered at firm level and reported in the parentheses; (ii) ***, **, and * respectively represent significance at 1%, 5% and 10%; (iii) Logit estimates are reported.

Table 9: Endogeneity of TFP: control function approach (stage 1)

stage 1: TFP (industry deflated)	H_0	(1)		(2)	
		coef.	s.e.	coef.	s.e.
ave. firm TFP (same ind. and region)	+	0.38***	(0.08)	0.21***	(0.06)
ave. firm TFP (same region)	+	0.91***	(0.33)		
region fixed effect		no		yes	
No. of observations		1,218		1,218	
R square		0.05		0.05	

Notes: (i) robust standard errors are reported in the parentheses; (ii) ***, **, and * respectively represent significance at 1%, 5%, and 10%.

Table 10: Endogeneity of TFP: control function approach (stage 2)

stage 2: location	H_0	(1)		(2)	
		coef.	s.e.	coef.	s.e.
TFP×					
market potential	–	-0.06*	(0.03)	-0.28**	(0.15)
unit labor cost	+	3.26	(3.64)	1.05	(1.06)
corporate tax	+	0.32	(0.69)	-0.05	(0.28)
entry cost	+	0.48***	(0.19)	0.10	(0.08)
distance to home	+	0.54**	(0.27)	0.39***	(0.11)
contiguity	–	-1.07***	(0.45)	-0.19	(0.18)
EU	+/–	0.52	(0.67)	0.26	(0.27)
governance	–	-0.21	(0.30)	0.11	(0.13)
host-country tariff	–	-0.49***	(0.17)	-0.23***	(0.06)
home-country tariff		-0.53*	(0.30)	-0.37***	(0.12)
$\hat{\xi}_i X_{ij}$		yes		yes	
firm fixed effect		yes		yes	
No. of observations		79,933		79,933	
Log pseudo-likelihood		-7,487.3		-7,486.3	
Pseudo R square		0.22		0.22	

Notes: (i) standard errors are clustered at firm level and reported in the parentheses; (ii) ***, **, and * respectively represent significance at 1%, 5% and 10%; (iii) Logit estimates are reported.

Table 11: Unobserved country sectoral characteristics

Dep. variable:	H_0	location		entry	
		coef.	s.e.	coef.	s.e.
TFP		1.18***	(0.09)	1.05***	(0.09)
estimated attractiveness		0.14***	(0.03)	0.14***	(0.02)
distance to home		—			
contiguity		—			
TFP×					
estimated attractiveness	–	-0.08***	(0.03)	-0.14***	(0.04)
distance to home	+	0.002**	(0.001)	0.006***	(0.001)
contiguity	–	-0.04***	(0.01)	-0.13***	(0.04)
country fixed effect		yes		yes	
No. of observations		114,600		109,153	
Log pseudo-likelihood		-11,273.5		-9,825.3	
Pseudo R square		0.05		0.05	

Notes: (i) standard errors are clustered at firm level and reported in the parentheses; (ii) ***, **, and * respectively represent significance at 1%, 5% and 10%; (iii) Logit estimates are reported.

Table B.1: Intensive and extensive margins of FDI

Dependent variable	H_0	ave affiliate sales		H_0	num of MNCs	
		coef.	s.e.		coef.	s.e.
market potential	–	-0.11	(0.26)	+	0.18**	(0.10)
unit labor cost	+	2.97*	(1.76)	–	-1.73***	(0.75)
corporate tax	+	-0.11	(0.31)	–	0.13	(0.12)
entry cost	+	0.44***	(0.12)	–	-0.36***	(0.05)
distance b/w host and home	+	-0.05	(0.12)	–	-0.38***	(0.07)
contiguity	–	0.02	(0.16)	+	2.37***	(0.28)
EU	+/–	-0.73*	(0.40)	+/–	-0.72***	(0.19)
governance	–	0.41**	(0.18)	+	0.25***	(0.06)
host-country tariff	–	-0.12	(0.10)	+	0.04	(0.05)
home-country tariff	+	-0.14	(0.17)	–	0.03	(0.09)
industry fixed effect		yes			yes	
No. of observations		1,724			1,724	
R square		0.03			0.12	
Prob>F		0.00			0.00	

Notes: (i) robust standard errors are reported in the parentheses; (ii) ***, **, and * respectively represent significance at 1%, 5%, and 10%; (iii) OLS estimates are reported.