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FOREIGN DIRECT INVESTMENT AND FIRM PERFORMANCE: AN EMPIRICAL ANALYSIS OF ITALIAN FIRMS

by Alessandro Borin* and Michele Mancini**

Abstract

Both empirical and theoretical literature show that multinational firms exhibit a competitive advantage before investing abroad. However, there are no clear empirical results regarding the ex-post effects of foreign direct investment (FDI) on firm performance, partially due to the inadequacy of available firm-level data. We build a brand new firm-level dataset able both to represent the extent of Italian firms' foreign activity and to provide reliable measures of key performance indicators, especially total factor productivity (TFP) and employment. We then use a propensity score matching procedure to analyze the causal relationship between FDI and firm performance. Firms investing abroad for the very first time, especially in advanced economies, show higher productivity and employment dynamics in the years following the investment: the average positive effect on TFP is driven by new multinationals operating in specialized and high-tech sectors, while the positive employment gains are explained by an increase of the white collar component. On average there are no negative effects on the parent firm's blue collar component.

JEL Classification: F23, C25, D24.
Keywords: multinational firms, FDI, productivity, propensity score matching.

Contents

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1 Introduction[1]

Multinational enterprises (MNEs) play a key role in the global economy; their domestic and foreign activity generate one third of world value added and exports. Foreign affiliates employ approximately 69 million workers.[2] Despite some delays, internationalization through foreign direct investment (FDI) is also increasing in Italy, as a growing number of firms, including small-sized ones, start to invest abroad (Borin and Cristadoro, 2014). The foreign turnover of Italian MNEs account for about 40% of Italy's exports, roughly one million workers are employed in foreign affiliates of Italian firms, and 40% of Italian employees work for an Italian MNE (Cristadoro and D'Aurizio, 2015).

In the last decade a burgeoning literature has shown that the ability of a firm to export and produce goods and services abroad is enhanced by high productivity and efficiency (Bernard and Jensen, 1999; Melitz, 2003; Helpman et al., 2004). Focusing on the competitive advantage of each firm, this literature explains why such a large proportion of an economy's output, employment and exports depend on the activity of a small number of big firms, usually MNEs. Thus microeconomic data analysis is crucial to evaluating the policy implications of firm heterogeneity.

Internationalization strategies may have an uneven impact on firm performance, depending on the purpose of the investment (e.g. efficiency-seeking or market-seeking FDI) and its destination (advanced or emerging economies); firms may or may not modify their productive or financial structure through FDI, with potentially strong effects on productivity and employment. In a context of increasing foreign competition, stagnating productivity and internal recession, such as the one in Italy, FDI may represent a way to strengthen a firm's competitive position or to ensure its survival; on the other hand, off-shoring activities have always generated concern in public opinion regarding the potential negative effects on employment.

Thus in order to understand whether and how public policies should promote firms' internationalization, gains in performance that may arise from investing abroad should be considered in conjunction with potential employment losses back home. The best case scenario is clearly represented by the implementation of policy measures to promote internationalization strategies capable of enhancing both

[1]This paper has been prepared within the Bank of Italy working group on the internationalization of Italian firms. We wish to thank Andrew Bernard, Matteo Bugamelli, Riccardo Cristadoro, Giuseppe De Arcangelis, Luca De Benedictis, Jan De Loecker, Massimo Del Gatto, Stefano Federico, Alfonso Rosolia, Marco Sideri, Jeffrey Wooldridge and the participants at the Italian Trade Study Group conference in Cagliari for the insightful comments.

[2]UNCTAD (2010, 2011).

firm performance and employment. The adoption of policies able to promote the strategies that boost performance, while leaving unaltered firm-level employment, are clearly also advantageous. On the other hand, it might be difficult to justify public actions promoting foreign direct investments if they reduce employment in the local economy.

To evaluate the ex-post effects of FDI accurately, we need to take into account self-selection. In fact, the ex-ante causal relationship (from performance to internationalization) introduces a severe form of endogeneity; ex-post performance might reflect not only foreign investment, but also pre-existent advantages in terms of managerial ability, know-how and technology. Thus, tackling this issue requires an appropriate estimation procedure.

Up to now the results of the empirical literature have proved unclear, mainly due to the lack of reliable and detailed firm-level data, especially for Italy. The aim of this paper is three-fold: 1) to build a brand new firm-level dataset to represent both the extent of Italian firms' foreign activity and to provide reliable measures of key performance indicators (especially TFP); 2) to analyze the causal relationship between firm performance and foreign direct investment, looking in particular at the potential gains in terms of productivity and potential losses in terms of employment in the parent firm due to the acquisition of multinational status; 3) to evaluate whether these effects are evenly spread across new MNEs or concentrated among certain groups of investors.

2 Related literature

2.1 From performance to FDI: ex ante premia

A large body of theoretical and empirical trade literature has investigated both the determinants of firm internationalization and the key features of multinational firms (Hymer, 1960; Dunning, 1981; Helpman, 1984; Horstmann and Markusen, 1987; Markusen, 2004). Thanks to the new availability of firm-level data, descriptive statistics and econometric analyses[3] have highlighted the presence of a performance premium in favor of internationalized firms (exporters and especially multinationals), compared to firms operating in the domestic market only, both in terms of size and efficiency. The representative firm hypothesis, i.e. considering all firms identical, does not appear to be supported by the data.

[3]See Greenaway and Kneller (2007) for a comprehensive survey.

From a theoretical standpoint, the first research to succeed in reconciling this new empirical evidence with the trade theory is Helpman et al. (2004), which followed the scheme of firm heterogeneity in productivity by Melitz (2003). Helpman et al. (2004) show that ex-ante productivity advantages are the real trigger of the internationalization.[4] Only the most productive firms become multinationals as they manage to bear the fixed cost of producing abroad. This cost is too high for mid-productivity firms, which prefer to serve foreign markets through exports. Low-productivity firms either produce for the domestic market only or exit the market to avoid losses. Older theories had already stressed that the ex-ante competitive advantage is a precondition for not making losses when producing directly in foreign countries (Hymer, 1960; Dunning, 1981; Horstmann and Markusen, 1987). In particular, the OLI framework developed by Dunning (1981) considers that multinationals have some specific knowledge (ownership), a competitive advantage compared to non-multinational firms.

The model by Helpman et al. (2004) deals with horizontal FDI, motivated by the potential gains from producing directly in the foreign destination market. Nevertheless, firms invest abroad also to exploit factor cost differentials, driven by differences in relative factor endowments (vertical FDI). Head and Ries (2003) extend the model to consider both horizontal and vertical FDI. Their results predict that multinationals operating in emerging markets in order to reduce labor costs exhibit low productivity, whereas more productive firms prefer to serve advanced markets with high levels of demand directly. Also, multinationals often follow mixed strategies,[5] as suggested by Grossman et al. (2006). For example, firms may offshore single stages of production to multiple countries, depending on demand and factor cost. Which strategy the firm chooses depends on multiple factors,[6] therefore the relationship between productivity and internationalization strategy can vary a lot.[7]

Broad empirical evidence supports the existence of a positive correlation between productivity and international involvement[8] (Table 1). On the other hand,

[4]The model prediction stems from the presence of a tradeoff between the fixed cost of setting up a new plant abroad and the variable cost of exporting goods to the foreign countries.

[5]Feinberg and Keane (2006) show that only 12% of Canadian affiliates controlled by US multinationals resemble purely horizontal FDI and only 19% purely vertical FDI; the remaining 69% is the result of some complex integration strategy.

[6]Among others: foreign market dimension, transportation costs of intermediate and final goods, fixed cost of producing and assembling.

[7]For a more general overview of offshoring see also (Feenstra and Hanson, 1996; Grossman and Rossi-Hansberg, 2008), who consider the possibility for firms to outsource some stages of the value chain to foreign enterprises.

[8]Helpman et al. (2004) for a sample of US firms, show the presence of an advantage in terms of labor productivity in favor of multinationals compared to exporters (+15%) and in favor of

empirical evidence on the presence of an ex-ante premium is scarce,[9] since firm-level data are not particularly suited to shedding light on this phenomenon,[10] but generally confirm the presence of a self-selection process (Table 2).

2.2 From FDI to performance: ex post effects of FDI

The opposite causal direction, which goes from acquiring the multinational status to obtaining some advantage for firm performance (ex-post gains), has less profound theoretical foundations. The Helpman et al. (2004) model does not provide any prediction in this sense. Some insights come from offshoring literature. Grossman and Rossi-Hansberg (2008) describe the production process as a continuum of different tasks; each task requires either low-skill or high-skill work and the firm must choose which to offshore (trading tasks), paying a specific cost.[11] In this way global supply chain fragmentation emerges as a result of an optimal strategy at the micro level. Thus, offshoring a task frees up resources that can be useful for other activities, in particular those for which the firm has a competitive advantage, increasing overall efficiency. Furthermore, an exogenous reduction in the cost of offshoring may encourage this process, resulting in even larger efficiency gains. It is fairly easy to imagine that in recent decades offshoring costs have fallen thanks to innovation in the ICT sector, making international coordination simpler. In this way the evolution of productivity for multinational firms may exhibit better dynamics compared to firms located only in the domestic market.

Foreign investment may boost a firm's performance also through other channels. The ownership advantage of the OLI paradigm may be viewed not only as a precondition for investing abroad (standard OLI framework; Dunning, 1981), as we already pointed out in section 2.1, but also as a driver to filter and absorb new knowledge (modern OLI framework; Cantwell and Narula, 2001). According to this

exporters compared to non-internationalized firms (+40%). Girma et al. (2005) find the same productivity sorting for a sample of firms in the United Kingdom. Kimura and Kiyota (2006) show that Japanese exporters with some form of foreign production are more productive than domestic firms (+6.4%). In Italy, Castellani and Zanfei (2007) confirm only the advantage for multinational firms over exporters; Castellani and Giovannetti (2010) add that these productivity premia are explained by a higher productivity of capital as well as managerial and clerical employment. The same results are confirmed for Germany (Wagner, 2006; Arnold and Hussinger, 2010) and France (Engel and Procher, 2012).

[9] By contrast, the self-selection of exporting firms has been widely investigated. See Wagner (2007).

[10] Multinationals are a small fraction of active firms and usually acquire this status once; therefore it is not easy to obtain appropriate micro-data to evaluate this theoretical prediction.

[11] Some tasks are more difficult to offshore than others (i.e. post-sales support is easier to offshore than assembly of the final product), so the offshoring costs may vary.

approach, foreign investment may be followed by internal restructuring, best practice acquisition and new research and development activities. All of these factors together can contribute to higher productivity growth.[12]

Existing empirical studies have found mixed results on the FDI effects on firm performance (Table 3). Barba Navaretti and Castellani (2004) analyze the performance of a sample of Italian firms which invest abroad for the first time between 1994 and 1997, showing a positive gap in turnover and productivity growth rates (+8.8% and 4.9%, respectively) and a difference in the labor growth rate with respect to non-multinational firms that is not statistically different from zero. Productivity gains seem to be associated especially with investment in advanced countries (Barba Navaretti et al., 2010). Different results emerge from a similar analysis (Hijzen et al., 2007) of multinational firms in Japan; gains are observed regarding employment but are negligible with respect to productivity.[13] The impact on firm performance also depends on the type of investment. Horizontal investments guarantee positive gains in the labor growth rate, whereas vertical ones do not reduce employment, but do increase the capital to labor ratio, thanks to the reorganization of the production process[14] (Hijzen et al., 2011). Dealing with a sample of Italian firms, Bronzini (2010) confirms the hypothesis of a better division of labor, in particular for those firms choosing complex strategies of internationalization. Furthermore, as employment in the affiliate firm increases, the white collar component in the parent firm also widens, while the blue collar component remains unchanged; the sales and sales-to-employment ratio are not affected by the acquisition of multinational status.

Another strand of literature analyzes the relationship (substitutability or complementarity) between domestic and foreign employment by multinational firms. In a study of a sample of Swedish firms, Braconier and Ekholm (2000) find that employment in the parent company and in the affiliates located in other high-income countries are substitutes, but they do not find evidence of employment substitution stemming from investments in low-income locations. This result is in line with what Konings and Murphy (2006) find for a sample of European MNEs investing in Europe. Muendler and Becker (2010) use an integrated econometric model that embeds location selection into labor-demand estimation. Labor demand depends on wage differentials across locations both at the extensive margin, when

[12]See Amiti and Wei (2009) for a description of some of these channels.

[13]Furthermore, productivity gains for Japanese firms are observed in the service sector, but not in manufacturing (Ito, 2007).

[14]High-skill activities are located in the parent firm while low-skill ones are off-shored. Interestingly, this process does not lead to a decrease in overall employment.

an MNE expands into foreign locations, and at the intensive margin, when an MNE reallocates jobs across existing affiliates. They find that home and foreign employment are substitutes within MNEs not only at the intensive but also at the extensive margin.[15]

In short, the presence of a positive effect of investing abroad on firm performance is controversial. Nevertheless, previous works come with a number of caveats: 1) they do not take into account simultaneously some aspects of firm heterogeneity (sector, labor composition) and the destination of investments since the analyses are usually conducted on a small number of observations; 2) they do not address important issues in measuring firm performance; 3) they do not consider simultaneously the multivariate nature of firm performance. We attempt to address these issues in the following sections.

3 Data

Data on multinational firms are obtained by combining different sources. The starting point is the Bank of Italy's annual Survey of Industrial and Service Firms (the Invind survey). These firm-level data are merged with Bureau Van Dijk-Orbis and other national datasets providing information about the foreign activity of Italian firms (Reprint, FATS, Direct Reporting). Balance sheet data are obtained from the Company Accounts Data Service (henceforth CADS). The sample resulting from this matching comprises 9263 firms, observed from 1988 to 2011, of which 1673 are multinationals. The total number of foreign direct investments is 5601 (for 3439 of them we also know the date). We observe the year of the very first FDI for 1214 firms; however only 900 invest for the first time in the period we consider (1988-2011). We focus our attention on manufacturing firms only, ending with 700 new MNEs.

In order to estimate total factor productivity we need a reliable measure of capital stock. In previous studies capital is approximated by tangible assets as they appear in the balance sheet (e.g. Castellani and Giovannetti, 2010 with a sample of Italian firms). However, this may reflect accounting artifices, giving a wrong picture of the real value of capital stock available to the firm at each point in time. We follow the perpetual inventory method to tackle this issue: tangible

[15]Unfortunately, the methodology developed by Muendler and Becker (2010) cannot be employed here since we do not observe employment in the foreign affiliates. See Crinò (2009) for an extensive survey of the effects on employment of multinational firms.

assets from balance sheet data are considered as a starting point; capital stock for the following years is calculated through the perpetual inventory method using gross investment flows directly reported in the Invind survey or looking to financial flows and notes to the accounts in CADS, when investment is missing in Invind. Capital usage and divestment are controlled using depreciation rates taken from national statistics (ISTAT). We consider two different types of capital investment separately: machines, vehicles, other investments and buildings.[16] Since we focus our attention on manufacturing firms only, the sample is reduced to 6721 firms, 1481 of which are multinationals, obtaining a panel of 118440 observations.

Total factor productivity ($\omega_{it} + \eta_{it}$) is obtained as a residual of the (log) Cobb-Douglas production function in capital (k_{it}) and labor (l_{it})

$$y_{it} = \alpha k_{it} + \beta l_{it} + \omega_{it} + \eta_{it}, \tag{1}$$

where y_{it} is value added, ω_{it} is the productivity observed by the firm but not by the econometrician and η_{it} is a random iid term. We estimate production function coefficients α and β with different methodologies: 1) Levinsohn and Petrin (2003), henceforth LP; 2) Ackerberg et al. (2006), ACF; 3) Gandhi et al. (2012), GNR; 4) Wooldridge (2009) corrected for unobserved firm-level prices following the work of Smeets and Warzynski (2013), WLP; 5) Wooldridge (2009) corrected for unobserved firm-level prices with a modified version of De Loecker (2011), WLP-M. We go through these methodologies in the appendix A. These different estimation methods provide us with a broad set of TFP measures, a key variable to evaluate the relationship between internationalization strategies and firm performance. Thus we may obtain more robust results in addressing our main research question: does going multinational improve firm productivity?

4 FDI and firm performance: empirical results

In the following sections we first estimate the correlation between several measures of firm performance and international involvement both on average and on the entire distribution (4.1); we then focus on ex-ante differentials between future multinationals and other firms (4.2); finally, we evaluate the effects of investing abroad for the first time on several measures of firm performance (4.3).

[16] The procedure follows that of Bontempi et al. (2010).

4.1 FDI premia

As already mentioned, both empirical and theoretical analyses show that MNEs perform better than exporters and pure domestic firms (Table 1). Cristadoro and D'Aurizio (2015) support this evidence by conducting a detailed descriptive analysis on the same dataset employed in the present study; the basic findings of the literature also appear to hold for our sample of Italian manufacturing firms. However, before investigating the causal link between foreign investment and firm performance, we want to examine in more detail the differences between MNEs and non-MNEs in our data. In particular, it might be useful to test the presence of premia for MNEs along several dimensions of firm performance, also controlling for a number of other characteristics of the firm (e.g. industry, regional location, firm dimension etc).

Since the seminal contributions in this field (Bernard and Jensen, 1999, 2004) a standard methodology has been frequently applied to test the differences in performance between groups of firms with different internationalization strategies. This methodology basically consists in estimating the parameters of an equation of the following form:[17]

$$Z_{it} = \alpha + \gamma MNE_{it} + \beta control_{it} + \varepsilon_{it}, \tag{2}$$

where Z_{it} is the variable of performance (productivity, value added, turnover, profits etc.) of firm i at time t, MNE_{it} is a dummy variable that takes value 1 if the firm has at least one foreign subsidiary at time t. Thus the associated parameter (γ) should summarize the difference between MNEs and non-MNEs in terms of variable Z. Also, $control_{it}$ is a vector of control variables such as class size, geographical (regional) location of the firm and a number of sector-year dummies that take into account the unobservable factors common to all firms in a particular industry at time t (e.g. supply and demand conditions).

The results of these simple linear regressions (Table 4) suggest that multinationals are about two and half times bigger in terms of employees compared to domestic firms (including both exporters and non-exporters); this ratio rises to over three times when considering turnover and is slightly lower for value added, suggesting that multinational enterprises are characterized by higher intensity in the use of intermediate goods. Controlling for differences in firm size, the premium with

[17] See Wagner (2007) for a detailed analysis of the standard methodologies employed in the literature.

respect to non-MNEs is around 16% in terms of labor productivity and capital per worker. In relation to TFP (Table 5), firms with foreign affiliates show a premium in the range of 8%-14%, depending on the method used to estimate the production function parameters. In particular, the advantage turns out to be larger with the productivity estimates which take into account the pricing power of the firms, and lower when considering the TFP estimates based on gross output, instead of value added. This last result is in line with the evidence in the study by Gandhi et al. (2012) that analyzes the productivity gap between exporters and non-exporters. The differences are even more pronounced when ignoring the different sectoral composition, size and regional location of MNEs. Cristadoro and D'Aurizio (2015), on the same sample, find an average labor productivity premium of 28% over exporters and of about 40% over firms serving only the domestic market.

The results reported in Table 5 essentially confirm that on average there are positive and statistically significant productivity differentials in favor of MNEs. However, the sample means could be heavily influenced by tail values. For instance, a small number of extremely productive multinationals may drive the results, while the groups of firms might be very similar in the other part of the distribution. It could be worth checking whether the differences characterize the whole productivity distribution or whether they are limited to certain intervals of the support.

Figure 1, which shows the Kernel-density estimates for multinational companies, domestic-exporters and domestic non-exporters, provides graphical evidence of the presence of a productivity premium along the entire distribution. This result is confirmed by the non-parametric test by Kolmogorov-Smirnov, which indicates that the TFP distribution of multinationals stochastically dominates that of exporters, which in turn dominates the productivity distribution of pure domestic firms.[18] The presence of a productivity premium in favor of MNEs over the entire TFP distribution is confirmed even after controlling for differences in firm size, region and sector-year, using a quantile regression.[19]

The total factor productivity premium of multinational companies shows a downward trend over the period included in the sample (Table 7). The difference was around 20% at the beginning of the 1990s, falling to 10% in most recent years. Since the mid-90s firm size differentials have also followed a decreasing pattern. This evolution is in line with the evidence that emerges from aggregate figures about the internationalization dynamics of Italian manufacturing firms: Reprint

[18]Kolmogorov-Smirnov test results are available upon request.

[19]See Table 6 in the appendix.

data (Mariotti and Mutinelli, 2012; Borin and Cristadoro, 2014) show that over the past two decades an increasing number of smaller companies have opened or acquired at least one subsidiary abroad. In keeping with the theory of firm heterogeneity, the reduction of internationalization costs in recent years (Baldwin and Lopez-Gonzalez, 2013) may have opened access of foreign markets to marginal firms, which are relatively less productive than the incumbent multinationals.

4.2 Ex-ante evaluation of firm characteristics and firms' selection

Both recent firm heterogeneity theories and the classic OLI approach explain the observed premia in favor of multinationals, assuming some kind of pre-existent competitive advantage that makes it convenient for these firms to invest abroad. In order to test the presence of this ex-ante advantage empirically it is necessary to look at the characteristics of future MNEs before investing abroad and compare them with those of other firms that will never become multinationals.[20] It is possible to evaluate these differences through the estimation of the parameter γ in equation 3,

$$Z_{i(t^*-s)} = \alpha + \gamma MNEstart_{it^*} + \beta control_{i(t^*-s)} + \varepsilon_{i(t^*-s)}, \tag{3}$$

where $Z_{i(t^*-s)}$ represents the variable of performance of company i, measured s periods before the year of the first investment abroad (t^*); the dummy variable $MNEstart_{it^*}$ takes value 1 if the firm becomes multinational in the period t^*, and 0 if it goes on operating only in the domestic market (in this exercise observations of incumbent multinationals are excluded from the sample).

The results (Table 8) confirm the existence of a clear ex-ante advantage; five years before becoming a multinational companies that are going to acquire this status are significantly larger (with over 50% more employees and roughly double the sales) than firms that remain domestic . Future multinationals also show clear advantages in terms of productivity long before investing abroad, confirming the existence of a self-selection process whereby only the best firms choose (or are able) to establish a subsidiary abroad. It also seems that on average these companies decide to invest abroad when they are in an expansionary phase, as the differential in size and total factor productivity increases approaching the year of the first

[20] An alternative approach employed in the literature is to test whether a rise in productivity may increase the propensity of firms to invest abroad.

investment t^*.

Some theoretical contributions (Head and Ries, 2003; Yeaple, 2009) show that even among those companies that choose to invest abroad there may be differences in productivity, which, according to the predictions of these models, result in different investment strategies (e.g. vertical rather than horizontal FDI) and destination (e.g. investing in countries with higher or lower levels of income and labor costs). Figure 2 reports the cumulative productivity distributions in the year preceding the first investment abroad; future multinationals are grouped by FDI destination distinguishing those that establish their first affiliate abroad in an advanced country from those that locate it in an emerging country. These two groups do not show substantial differences in productivity. Nevertheless, those that invest in advanced countries appear slightly more productive (in the range of 3-4%), the most evident differentials being concentrated in the middle-upper range of the TFP distribution. Focusing only on firms that establish the first foreign affiliate in an emerging country (Figure 3), we see that companies which invest in neighboring regions of Eastern Europe and Middle East-North Africa (MENA) have a clear productivity gap with respect to those that choose more remote countries. In the 2011 Bank of Italy Invind survey, companies were asked to answer some questions about what lay behind their internationalization strategies; those that invested in Eastern Europe and MENA most frequently motivated their choice with reference to a reduction of production costs ("efficiency seeking"). Furthermore, we know that between the mid-90s and early 2000s investments in these areas led to the internationalization boom of small and medium enterprises, mostly operating in traditional manufacturing industries (Borin and Cristadoro, 2014). Ex-ante these firms showed average productivity levels that were only marginally higher than firms confined to the domestic market. Conversely there was a clear advantage for those able to invest in emerging and developing regions further away (especially in emerging Asia and Latin America). Reaching these destinations probably required facing higher fixed costs and implementing more complex business strategies. Thus only the most productive firms had the financial and organizational resources required to establish a stable presence in those markets.

4.3 The effects of foreign direct investment on firm performance

As already mentioned, one important question is whether investing abroad might (or might not) significantly affect the dynamics of employment, productivity and other key variables. However, the identification of the causal relationship that goes from investment in a foreign affiliate to a firm's later development raises specific empirical issues.

Before examining this problem more rigorously, it would be opportune to provide some descriptive evidence on the dynamics of some characteristic variables of the firm in the years after the first investment abroad. Using a methodology similar to that applied in the analysis of the ex-ante selection, we can estimate the growth differentials for different time horizons between firms that invest abroad and those that stay in Italy (Table 9). The companies that become multinational in t^* seem to grow at a faster rate than the others during the following five years, with a growth differential in the order of 4 to 6 percentage points per year in terms of turnover, value added and employment. The average growth rate in labor productivity is statistically different between the two groups only in the period immediately after the investment, while for the 5-year horizon a positive TFP differential of about 1 percentage point emerges in favor of the multinationals.

As previously shown, the decision to invest abroad originates from some specific pre-existing competitive advantage, and in some ways this complicates the analysis of the effects of foreign direct investment on firm performance. The ex-ante selection with respect to the strategies of internationalization, in fact, implies that multinationals differ in several respects to companies that do not operate abroad. In other words, the group of new MNEs is not randomly selected and the impact of investing abroad on these firms may be assessed only by taking into account this sample selection problem. In the following sections we briefly discuss the empirical methodology adopted to address this issue, while the technical details are provided in Appendix B. We then present our results.

4.3.1 Empirical methodology

Among the several econometric techniques proposed in the literature to overcome this kind of sample selection issue, we employ a propensity score matching procedure. This follows the procedure adopted by Barba Navaretti and Castellani (2004), one of the first studies to propose an evaluation of the effects of foreign investments

on firm performance. The rationale of this methodology can be summarized as follows: ideally the identification of the effects of FDI would require comparing the evolution of new MNEs with the performance of the exact same company with no investment; since it is not possible to observe the same company in these two different scenarios, another company, ex-ante very similar to the first one, but that does not choose to invest abroad, acts as a proxy of the unobservable counterfactual.[21]

To implement this procedure, it is first necessary to identify a set of observable variables on which the relationship of ex-ante similarity is based, including all the characteristics that may influence the decision to invest abroad. This multidimensional representation of firm characteristics can then be resembled in a single composite measure by estimating the propensity score,[22] i.e. the probability that a firm will start to invest abroad (at time t^*) conditional on a set of variables being measured before the time of the first investment ($t^* - 1$). Depending upon the similarity of this predicted probability each investing firm is matched with one (or more) firms that will not invest abroad: the control group.[23] Finally, it is possible to evaluate the effect of the treatment (the acquisition of the MNE status) by comparing the performance of the two groups of firms in the years following the investment (from t^* to $t^* + s$). We provide formal details on this methodology in Appendix B.

To obtain a valid identification of the causal effects using this methodology, the so-called conditional independence assumption (CIA) must be verified; conditional on the observable variables, the performance of the non-investing company must be equal to that of the MNE had it not invested abroad in time t^*. Thus, it is necessary for unobservable variables that may affect the future performance of the firm to not influence the choice of internationalization; the self-selection in the treatment depends only on the observable variables included in the estimation of the propensity score (selection on observables). This is clearly a demanding assumption, which could undermine the robustness of the empirical analysis. However, by exploiting the panel nature of our dataset it is possible to relax this assumption. In particular, it is possible to allow for self-selection owing to some unobservable

[21]Matching may not correctly identify the idiosyncratic effect of foreign investment if the endogeneity depends both on self-selection and simultaneity between performance and FDI. An instrumental variable analysis is better suited to solving these forms of endogeneity. Unfortunately, finding an instrument that is exogenous with respect to performance and correlated with the choice of investing abroad is not an easy task and to the best of our knowledge the literature has not yet found a variable with these features.

[22]See Rosenbaum and Rubin (1983) for a formal proof.

[23]For an extensive discussion on the methodologies of matching and the concept of similarity see Blundell and Costa Dias (2000).

characteristics, under the assumption that these held constant over time. This can be obtained by combining a difference-in-differences estimations by Heckman et al. (1997), which eliminate the fixed unobserved variables, with propensity score matching (PSM-DiD), meaning we compare the growth rates calculated between $t^* - 1$ and $t^* + s$ (with $s = 1, 3, 5$) between new MNEs and the matched domestic firms, computing the so called average treatment effect on the treated (ATT) in the evaluation literature. Therefore the ATT is simply the difference between the average performance of new multinational companies and the weighted-average performance of matched domestic firms.

In our analysis we choose the following set of variables to estimate the propensity score: levels and changes in TFP, employees and stock of capital, to control for the ex-ante dimension and performance of the firm (in line with Helpman et al. (2004)); firm age and financial leverage, since young and highly leveraged firms often suffer from credit constraints (in line with Minetti and Zhu (2011)), which pose a potential obstacle to internationalization; a series of dummy variables that control for sector and region of the parent company; interaction terms between macro-sector dummies and levels and changes in TFP and employment, to further control for sectoral heterogeneity. Finally, we include the rate of growth of the main outcome variables (TFP, labor and capital) in the vector of explanatory variables to control for the possibility of an increasing trend for new MNEs before starting to invest abroad, a potential violation of the parallel trend assumption required by the diff-in-diff strategy.

Thus, the probit is estimated within a rolling window of nine years in the baseline exercise. Once the common support condition[24] has been verified, the observations of almost-multinational firms are matched with those of domestic firms by employing an algorithm that selects the closest observations in terms of propensity score. The selection procedure is set to limit the choice of the control observations within the same industry and year of the corresponding treated one.[25] Finally, for the main variables of interest, we check that the selected control sample does not

[24]The propensity score matching requires that, for each firm, there is a positive probability of being treated and a positive probability of not being treated. This condition must hold both for the treated and the control groups, which should be drawn from the same ex-ante distribution. Then the propensity score matching is usually conducted only among firms that belong to the same support as regards the distribution of vector X (known as the common support condition).

[25]The estimates presented are based on the methodology of *radius matching*, especially useful for preventing errors in associating observations of the treated and untreated firms within the same industry-year. The caliper, as suggested by the literature, was set at one-fifth of the standard deviation of the propensity score. We also tested the robustness of our results employing the *nearest neighbor matching procedure*, obtaining similar estimates. For an overview of the different algorithms used in the literature see Caliendo and Kopeinig (2008).

present significant differences in mean with respect to the group of treated companies before starting to invest abroad (Table 10).

4.3.2 Results

The results[26] based on the propensity score matching procedure (Table 11) indicate that, compared to analogous domestic firms, companies that invest abroad show higher growth rates both in terms of output (employment, turnover and value added) and input (employees and fixed capital) after the investment. Employment, in particular, shows an average differential growth of about 2 percentage points per year over the longer horizon. The point estimates of differential growth of turnover and value added are even more remarkable. In addition, there is a positive and significant effect on total factor productivity (4 percentage points in the first year after the investment and around 2 percentage points over longer horizons); it is also higher compared to the difference in value added per employee. Capital growth rate differentials are positive but lower than employment rates, so capital per worker shows a lower dynamic for new internationalized firms, even if it is significant only at 10% confidence level.[27] As expected, from the matching procedure we do not find any statistically significant difference in $t^* - 1$ between multinationals and domestic firms. As a further robustness check we control for differences also in $t^* - 3$, keeping track of the same firms up to $t^* + 5$ (Table 12). Results about ex-post gains are in line with the previous analysis and moreover there are no statistically significant differences between the two groups both in $t^* - 3$ and $t^* - 1$.

In Table 13 we test the robustness of these results by employing several estimation methodologies for the TFP. All of the measures produce similar estimated effects for the differences in productivity dynamics, as regards both the significance and the magnitude of the ATT. The only exception are the effects generated through the TFP measure adopted by Gandhi et al. (2012). Indeed, this method

[26] All the ATT estimates are obtained considering only firms that are observed over a broad interval of time before and after the key year t^*, i.e. in the range $t^* - 2$, $t^* + 5$. Since we have verified that counterfactual (domestic) firms are subject to higher attrition than MNEs we consider it to be a conservative choice to analyze the effects of FDI conditional upon the survival of both groups of firms. Moreover, in this way the results at different time horizons are easier to compare since we always use the same treated and control firms. Unfortunately following this procedure entails a loss of about 160 of new MNEs evaluated in $t^* + 1$ and 120 in $t^* + 3$. Nevertheless, our results are robust to relaxing the constraint of being always observed in the range $t^* - 2$, $t^* + 5$.

[27] These estimates may be biased as new multinationals may start transferring prices to tax-advantaged jurisdictions, over-invoicing input and under-invoicing output: this may lead to downward bias estimates of ex-post gains in total factor productivity and output and an upward bias of ex-post gains in capital (labor is unaffected since it is measured as the number of workers).

probably provides a lower bound for the productivity differential, as it produces a measure of productivity dispersion across firms that turns out to be narrower than the others (see Gandhi et al., 2012; Rivers, 2013). However, also after adopting this particular TFP measure, the annual productivity growth rate is about 0.5 percentage points higher for new-MNEs with respect to non-MNEs; the difference is statistically significant at a 5 year horizon and only marginally at a 3 year horizon.

The positive effect on productivity growth appears to be consistent over the entire time period considered for firms that invest in advanced countries, which probably aim to obtain stable and effective access to the markets of destination (Table 14). By contrast, investing in emerging countries does not seem to yield significant efficiency gains, especially in the short term (Table 15), while the gains in terms of turnover, value added, and employment for companies that invest in advanced countries are sizeable and significant over the entire horizon. The ratio of capital per worker of new multinationals that locate subsidiaries in advanced regions also tends to grow at a slower pace compared with domestic firms. This suggests that these firms are pursuing specific investment and organizational strategies, also modifying the mix of production factors at home. However it is worth stressing that this does not mean that these companies show lower investment rates in the domestic market with respect to non-MNEs. Instead, the result originates from the fact that employment dynamics tend to be proportionally stronger than capital stock dynamics, compared to what happens in other companies. Employing a different approach, Castellani and Giovannetti (2010) show that multinational firms are able to exploit the capital factor more efficiently, and this may lead to a reduction in the intensity of capital per worker in the headquarters. Investing in the emerging countries does not generate this result, since capital differentials with respect to domestic firms are positive while employment ones are not statistically different from zero. Later on, when discussing the results of the effect of FDI on different categories of workers, we will provide further explanations for this evidence.

It may appear rather puzzling that new MNEs experience significantly stronger employment growth in the parent company compared to non-MNEs. Conversely, public opinion has often shown concern about the possible negative impact of FDI on domestic employment. Table 16 shows that the aggregate positive effect we found is probably driven by the increase of white collar occupation in new-MNEs investing in advanced countries.[28] Instead there are no significant differences be-

[28]In this part of the analysis we do not constrain firms to be observed over the entire time span $[t^* - 2, t^* + 5]$ since we have information about the labor force composition only for a small subset of our sample.

tween new-MNEs and domestic firms in the employment dynamics of blue collar workers, irrespective of the region of destination. This evidence suggests that the parent company tends to intensify its human capital resources in order to manage the greater complexity of the activity of a multinational firm and to provide head quarter services to the subsidiaries. Moreover, since it seems reasonable to assume that the capital intensity per worker is lower for white collar compared to blue collar workers, this evidence may also justify the variation of capital per worker observed in firms investing in advanced regions.

Finally, it is worth emphasizing that on average, starting to invest abroad does not negatively affect employment. According to our estimates, this evidence also applies to blue collar workers and to firms investing in emerging markets, at least in the short to medium term. Even if these results are in line with the findings of previous studies on the internationalization of Italian firms (Bronzini, 2010), their implications should be interpreted cautiously, given that there are many aspects that are not fully considered in this kind of analysis. For instance, we do not take into account the potential negative spillovers on domestic suppliers, which might be replaced by other firms located in the country of destination of the affiliates. Another potential risk for domestic employment may arise only over longer time horizons than those considered in our analysis; for example, if the foreign-based activity turns out to be more profitable than the domestic one, in the long run the MNE may decide to close some plants or even to cease doing business at home completely. Finally, our analysis does not take into account both the labor force dynamic in the foreign affiliate (intensive margin) and the effects of further investments abroad (extensive margin), as in Muendler and Becker (2010).

In order to identify which group of new MNEs are responsible of the positive performance differentials, we estimate ATT separately for three broad economic sectors: i.e. traditional, scale intensive and specialized-high tech.[29] It turns out that the positive productivity growth differentials are driven by new MNEs in specialized and high-tech sectors investing in advanced countries (Table 17, 18 and 19) while gains in scale (value added, turnover) are widespread among all firms establishing their first subsidiary in developed regions. Growth in employment is stronger for new MNEs investing in advanced economies, as already pointed out, but we find that

[29]Traditional sectors: food, beverages and tobacco; textiles and apparel; leather and related products; wood and wood products; other manufacturing. Scale intensive sectors: paper products and printing; coke and refined petroleum products; chemical and pharmaceutical products; rubber and plastic products; non-metallic mineral products; metals and metal products. Specialized and high-tech sectors: machinery and equipment; electrical, electronic and optical products; transport equipment.

it is strongest for firms in traditional sectors. Italian firms operating in these sectors may suffer more than others from increasing foreign competition and stagnating internal demand and without a proper strategy to reach foreign markets they may be forced to reduce the number of their employees. In line with the previous analyses, firms investing for the first time in developing countries do not exhibit higher growth rates on average (Table 20, 21 and 22); the employment dynamic is actually lower for firms operating in traditional sectors, but not statistically different.

As already mentioned, using the propensity score matching technique to identify a causal relationship requires demanding assumptions on the similarity between the control and the treatment groups. Even if ex-ante the two subsamples are not statistically different in their observable characteristics, one could claim that there might be some unobservable aspects (other than investing abroad) that may influence productivity growth patterns. Therefore, we implement a falsification test in order to verify the robustness of our results and to provide further evidence that the productivity gains observed in new MNEs do originate from investing abroad. We reassigned to the multinational companies in our sample a "new" year of internationalization ($t^{'}$) randomly drawn over a time interval that, for each firm, starts from the first observation in the sample and ends ten years before the first investment.[30] We then repeated the propensity score matching procedure considering the "new" year of investment artificially constructed as the treatment event. The resulting ATT estimates on total factor productivity variations are not statistically different from zero.[31] It follows that we can rely on this additional evidence to claim that the results obtained using the actual year of investment do identify a causal effect of FDI on productivity.

[30]Both the theoretical and the empirical findings on firm heterogeneity suggest considering a period not too close to the time of the true investment (t^*). In fact, we know that firms investing abroad must have an ex-ante competitive advantage in line with the findings of Helpman et al. (2004); in a dynamic framework, this advantage may arise from a series of positive productivity shocks in the years preceding the investment (Ghironi and Melitz, 2007). In our falsification exercise we randomly choose $t^{'}$ at least 10 years before the actual investment, so even the evaluation at the longest time horizon considered ($t^{'} + 5$) shall not be too close to true investment year t^*.

[31]The falsification exercise implies a reduction of the sample period of the analysis (1988-2002) compared to the original one (1988-2011). To verify that the estimates of the falsification test were not driven only by the sample modification, we re-estimated the baseline ATT effects using the actual investment year t^* and the falsification test sub-period (1988-2002). The estimates obtained are significant and in line with those found for the whole sample. The results are available on request.

5 Conclusions

Over the last two decades an increasing number of Italian firms have started producing abroad, establishing new plants or through mergers and acquisitions. Understanding how going multinational affects the firm's ability to compete and how it influences the business of the parent company in Italy may have relevant policy implications. In particular, it is interesting to assess whether and how these internationalization strategies affect firms' productivity. This is a key factor, in particular for the Italian productive system, which has been suffering from a chronic loss of competitiveness since the mid-nineties. Another critical point concerns the impact of FDI on employment. This, more than any other aspect, has attracted the attention of public opinion and policy makers. To date the literature has not provided unequivocal results on these issues, also because of the lack of adequate information at firm level to analyze the phenomenon.

In order to shed new light on the topic, it was first necessary to build a sufficiently broad and informative database. We tried to pursue this aim by identifying a representative sample of Italian firms for which we could combine information on foreign affiliates from different sources with the data necessary to obtain a satisfactory measure of performance variables. For a large number of firms it was possible to precisely date the investments and to define a complete geographical picture of their presence abroad. In addition, by combining detailed balance sheet data with those from the Invind surveys, it was possible to obtain a reliable estimate of total factor productivity (TFP), the key variable to providing an overall assessment of firm efficiency.

The recent literature on firm heterogeneity has provided exhaustive evidence that companies which go multinational have a competitive advantage over companies that do not. This result is also clearly confirmed for our sample of manufacturing firms. Before becoming multinationals they are already much larger than average (about twice in terms of turnover) and more productive; we estimated a TFP premium of around 14%, even controlling for firm size.

It is evident that the selection of firms that become multinationals is anything but random. This self-selection process significantly complicates the empirical analysis of the effects of internationalization on firm performance. In line with some contributions that have recently addressed this issue, we attempted to identify the causal relationship through a propensity score matching technique. Using this method of estimation we found that new MNEs have a higher dynamic than

other similar domestic firms both in terms of total employment and total factor productivity.

The effect on performance variables is very heterogeneous, depending on the country of destination of the investment and the sector in which the firm operates. We find positive gains for new MNEs investing in advanced economies in all the size variables considered (turnover, value added, employment and capital). This group of firms also shows a negative differential in the growth rate of capital per worker, even if growth in the number of workers and capital is stronger. This could signal a reorganization of production factors in the parent company in favor of the labor input. In particular, the positive effects on employment are essentially explained by developments in the white collar component. However, on average, and regardless of the country of location, we do not find negative effects even on the employment of blue collar workers. The aggregate gains in total factor productivity are mainly driven by new multinationals operating in specialized and high-tech sectors.

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Tables and figures

Table 1: Correlation between productivity and internationalization strategy

	Sample	Estimation	Results
Head and Ries, 2003	Japan, 1989	OLS	MNE=EXP=DOM
Helpman et al., 2004	US, 1996	OLS	MNE>EXP>DOM
Girma et al., 2004	Ireland, 2000	SD	MNE>EXP=DOM
Girma et al., 2005	UK, 1990-1995	SD	MNE>EXP>DOM
Kimura and Kiyota, 2006	Japan, 1994-2000	OLS	MNE>EXP>DOM
Wagner, 2006	Germany, 1995	SD	MNE>EXP>DOM
Castellani and Zanfei, 2007	Italy, 1994-1996	OLS	MNE>EXP=DOM
Arnold and Hussinger, 2010	Germany, 1996-2002	SD	MNE>EXP>DOM
Castellani and Giovannetti, 2010	Italy, 1998-2003	OLS	MNE>EXP>DOM
Engel and Procher, 2012	France, 2004	SD	MNE>EXP>DOM

MNE: multinational firms; EXP: exporters; DOM: domestic only firms. Estimation methods are linear regression (OLS) and stochastic dominance (SD).

Table 2: Ex-ante advantage: self-selection test

	Country	Estimation	Self-selection
Barba Navaretti and Castellani (2004)	Italy	Probit	Yes
Barba Navaretti et al., 2010	Italy, France	Logit	Yes
Kimura and Kiyota, 2006	Japan	Dynamic Probit	Yes
Damijan et al., 2007	Slovenia	Probit	Yes
Hijzen et al., 2007	Japan	Probit	Yes
Hijzen et al., 2011	France	Logit	Yes
Raff et al., 2012	Japan	Logit	Yes

Null hypothesis: presence of a positive difference in productivity between multinationals and non-multinationals before the first foreign investment.

Table 3: Ex-post effects of investing abroad

	Country	Starters[1]	Estimation	Ex-post effects on TFP
Barba Navaretti and Castellani, 2004	Italy	∼110	PS-M	Yes
Barba Navaretti et al., 2010	Italy	∼80	PS-M	Yes
	France	∼80		No
Hijzen et al., 2007	Japan	<350[2]	PS-M	No
Hijzen et al., 2011	France	<240[2]	PS-M	No
Ito, 2007	Japan	<550[2]	PS-M	No
Bronzini, 2010	Italy	∼85	M	No[3]

[1] FDI starters are domestic firms switching to multinationals.
[2] Due to the difficulty in obtaining the actual number of observations, sample size of the descriptive analysis is reported.
[3] Bronzini (2010) uses the sales-employment ratio instead of TFP. PS-M: propensity score matching; M: matching.

Table 4: Multinational firms premia in performance and size variables

	Turnover	Value Added	Employment	VA per worker	Capital per worker	Avg wage
MNE	3.448***	3.157***	2.490***	1.162***	1.171***	1.040***
	(0.04)	(0.036)	(0.025)	(0.006)	(0.01)	(0.003)
controls						
sector-year	y	y	y	y	y	y
regional	y	y	y	y	y	y
dimension (L)	n	n	n	y	y	y
N	98452	96333	96054	92639	95064	93916
R^2	0.306	0.308	0.248	0.198	0.210	0.370

Dependent variables are in logs. Percentage premia are computed by the exponential transformation of the estimated MNE coefficients. Standard errors clustered at the firm level in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 5: Multinational firms premia in total factor productivity

	WLP	WLP-M	ACF	LP	GNR
MNE	1.118***	1.137***	1.117***	1.112***	1.082***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.003)
controls					
sector-year	y	y	y	y	y
regional	y	y	y	y	y
dimension (L)	y	y	y	y	y
N	88127	88143	88102	88147	89127
R^2	0.583	0.907	0.439	0.618	0.924

Dependent variables are in logs. Percentage premia are computed by the exponential transformation of the estimated MNE coefficients. WLP: Wooldridge (2009); WLP-M: Wooldridge (2009) with omitted price bias correction; LP: Levinsohn and Petrin (2003); ACF: Ackerberg et al. (2006); GNR: Gandhi et al. (2012). Standard errors clustered at the firm level in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 6: TFP premium for MNEs: quantile regression

	Quantile regression					OLS
	10%	**25%**	**50%**	**75%**	**90%**	
MNE	1.141***	1.109***	1.103***	1.101***	1.133***	1.118***
	(0.005)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)
sector-year ctrls	y	y	y	y	y	y
regional ctrls	y	y	y	y	y	y
dimension (L) ctrls	y	y	y	y	y	y
Obs	88127	88127	88127	88127	88127	88127
R2	0.35	0.40	0.4	0.37	0.34	0.58

Percentage premia are computed by the exponential transformation of the estimated MNE coefficients. TFP is estimated using the Wooldridge (2009) methodology. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 7: Premia evolution over time

	Employment				TFP			
	1988-1995	**1996-2000**	**2001-2005**	**2006-2011**	**1988-1995**	**1996-2000**	**2001-2005**	**2006-2011**
MNE	2.794***	2.939***	2.872***	2.744***	1.212***	1.165***	1.170***	1.100***
	(0.084)	(0.08)	(0.061)	(0.047)	(0.016)	(0.013)	(0.013)	(0.012)
controls								
sector-year	y	y	y	y	y	y	y	y
regional	y	y	y	y	y	y	y	y
dimension (L)	n	n	n	n	y	y	y	y
N	24137	22777	24678	26141	22671	21465	22766	23042
R^2	0.237	0.242	0.253	0.266	0.461	0.522	0.496	0.474

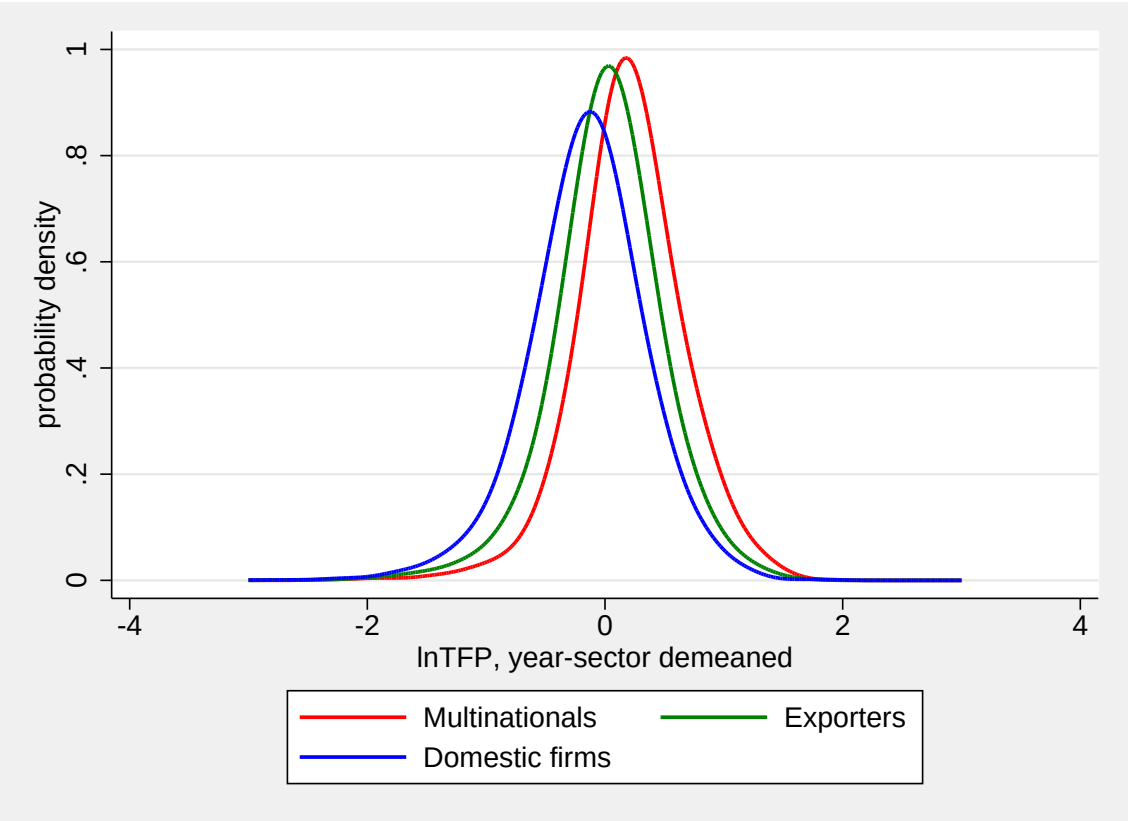
Dependent variables are in logs. Percentage premia are computed by the exponential transformation of the estimated MNE coefficients. TFP is estimated using the Wooldridge (2009) methodology. Standard errors clustered at the firm level in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 8: Self-selection: premia before starting to invest abroad

dependent var	**Turnover**	**Value Added**	**Employment**	**VA per worker**	**TFP**	**Capital per worker**	**Avg wage**
start (t*-1)	**2.385***** (0.122)	**2.186***** (0.107)	**1.751***** (0.0797)	**1.186***** (0.0269)	**1.143***** (0.0246)	**1.191***** (0.0390)	**1.021*** (0.0122)
N	78214	76767	76460	74276	70973	75813	75212
R^2	0.207	0.206	0.154	0.148	0.477	0.176	0.268
start (t*-3)	**2.161***** (0.114)	**2.012***** (0.104)	**1.632***** (0.0736)	**1.176***** (0.0238)	**1.135***** (0.0222)	**1.176***** (0.0399)	**1.015** (0.0116)
N	66516	65667	65599	64139	61541	65098	64740
R^2	0.208	0.205	0.156	0.157	0.497	0.181	0.274
start (t*-5)	**2.004***** (0.110)	**1.881***** (0.104)	**1.565***** (0.0753)	**1.184***** (0.0242)	**1.133***** (0.0218)	**1.194***** (0.0439)	**1.019*** (0.0115)
N	55803	55262	55370	54271	52280	54949	54704
R^2	0.209	0.206	0.159	0.162	0.509	0.187	0.284

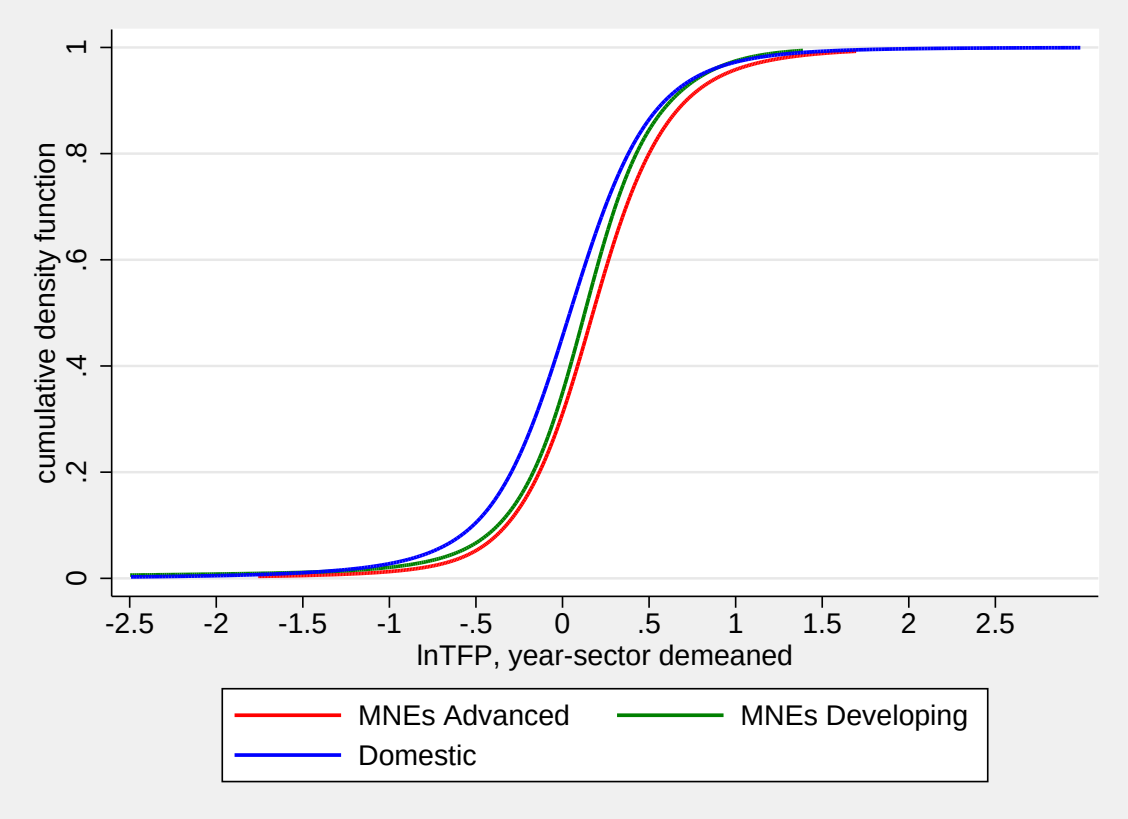
Dependent variables are in logs. Standard errors clustered at the firm level in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Figure 1: TFP (log of) distribution in manufacturing



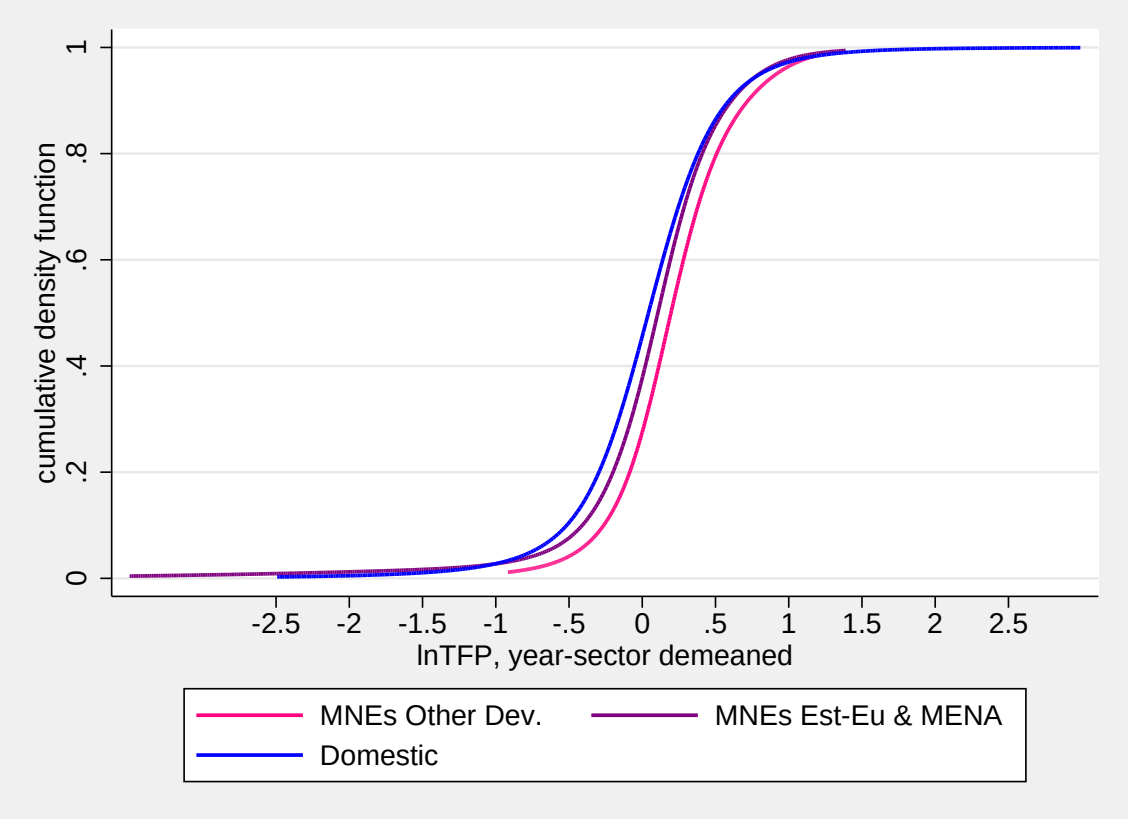
TFP is estimated using the Wooldridge (2009) methodology. We control for sector heterogeneity and business cycles subtracting from the actual firm level TFP the sector-year average.

Figure 2: Cumulative TFP (log of) distribution in manufacturing by destination



TFP is estimated using the Wooldridge (2009) methodology. We control for sector heterogeneity and business cycles subtracting the sector-year average from the actual firm level TFP. Distributions refer to one year before starting to invest abroad.

Figure 3: Cumulative TFP (log of) distribution in manufacturing by destination (only developing countries)



TFP is estimated using the Wooldridge (2009) methodology. We control for sector heterogeneity and business cycles subtracting the sector-year average from the actual firm level TFP. Distributions refer to one year before starting to invest abroad.

Table 9: Ex-post effects of investing abroad without controlling for endogeneity

dependent var	Turnover	Value Added	Employment	VA per worker	TFP	Capital per worker
MNE (t*+1)	**0.058*** **	**0.062*** **	**0.052*** **	**0.021***	**0.020***	**-0.028*** **
	(0.00932)	(0.0120)	(0.00683)	(0.0109)	(0.0115)	(0.0103)
N	76186	73981	74201	70449	64614	72926
R^2	0.060	0.037	0.042	0.024	0.027	0.024
MNE (t*+3)	**0.050*** **	**0.040*** **	**0.042*** **	**0.000**	**0.006**	**-0.018*** **
	(0.00614)	(0.00746)	(0.00421)	(0.00558)	(0.00563)	(0.00657)
N	64370	62435	62305	59159	54161	61237
R^2	0.090	0.072	0.092	0.039	0.039	0.056
MNE (t*+5)	**0.044*** **	**0.042*** **	**0.033*** **	**0.002**	**0.099*** **	**-0.018*** **
	(0.00538)	(0.00538)	(0.00344)	(0.00389)	(0.00378)	(0.00488)
N	53784	52104	51703	49098	44899	50836
R^2	0.099	0.089	0.123	0.047	0.043	0.082

Dependent variables are average yearly growth rates. Standard errors clustered at the firm level in parenthesis.
*: p<0.1; **: p<0.05; ***: p<0.01.

Table 10: Balancing test: pre and post-matching t-test differences

$t^* - 1$	**Pre**	**Post**
Labor		
level	0.637***	0.060
	(0.054)	(0.081)
growth rate	0.006	0.007
	(0.008)	(0.012)
TFP		
level	0.185***	0.018
	(0.018)	(0.028)
growth rate	-0.003	-0.006
	(0.011)	(0.017)
Capital		
growth rate	0.016	0.006
	(0.012)	(0.018)
Capital per worker		
level	0.185***	-0.022
	(0.036)	(0.056)
Leverage		
level	-272.088	2.616
	(257.386)	(64.665)
Age		
level	0.032	0.014
	(0.034)	(0.052)
treated	353	330
untreated	33010	7399

Differences in mean with respect to the group of control companies (t-test). Variables, in logs (with the exception of financial leverage) are year-sector demeaned. TFP is estimated using the Wooldridge (2009) methodology. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 11: Ex-post effects of investing abroad: PSM-DiD

	Turnover	**Value added**	**Employment**	**Capital**	**VA per worker**	**Capital per worker**	**TFP**
t*-1	**-0.004**	**0**	**0.007**	**0.006**	**-0.007**	**-0.001**	**-0.006**
	(0.009)	(0.013)	(0.009)	(0.015)	(0.013)	(0.016)	(0.012)
treated	330	330	330	330	330	330	330
control	7399	7399	7399	7399	7399	7399	7399
t*+1	**0.054*** **	**0.064*** **	**0.03*** **	**0.016**	**0.034*** **	**-0.013**	**0.039*** **
	(0.011)	(0.013)	(0.007)	(0.011)	(0.011)	(0.012)	(0.011)
treated	330	330	330	330	330	330	330
control	7399	7399	7399	7399	7399	7399	7399
t*+3	**0.028*** **	**0.039*** **	**0.022*** **	**0.014** **	**0.017*** **	**-0.008**	**0.021*** **
	(0.005)	(0.007)	(0.004)	(0.007)	(0.005)	(0.006)	(0.005)
treated	330	330	330	330	330	330	330
control	7399	7399	7399	7399	7399	7399	7399
t*+5	**0.025*** **	**0.033*** **	**0.021*** **	**0.013** **	**0.012** **	**-0.008***	**0.016*** **
	(0.005)	(0.006)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
treated	330	330	330	330	330	330	330
control	7399	7399	7399	7399	7399	7399	7399

Dependent variables are average yearly growth rates. Bootstrapped standard errors in parentheses. *: $p<0.1$; **: $p<0.05$; ***: $p<0.01$.

Table 12: Ex-post effects of investing abroad: PSM-DiD, robustness check

	Turnover	**Value added**	**Employment**	**Capital**	**VA per worker**	**Capital per worker**	**TFP**
t*-3	**0.004**	**0.003**	**0.005**	**0.003**	**-0.003**	**-0.002**	**-0.001**
	(0.008)	(0.01)	(0.007)	(0.009)	(0.006)	(0.011)	(0.006)
treated	257	257	257	257	257	257	257
control	5766	5766	5766	5766	5766	5766	5766
t*-1	**0.007**	**0.011**	**0.013**	**0.005**	**-0.003**	**-0.008**	**0.002**
	(0.011)	(0.015)	(0.01)	(0.015)	(0.013)	(0.016)	(0.014)
treated	257	257	257	257	257	257	257
control	5766	5766	5766	5766	5766	5766	5766
t*+1	**0.044*** **	**0.056*** **	**0.024*** **	**0.025** **	**0.033** **	**0.002**	**0.034** **
	(0.014)	(0.017)	(0.008)	(0.012)	(0.014)	(0.013)	(0.015)
treated	257	257	257	257	257	257	257
control	5766	5766	5766	5766	5766	5766	5766
t*+3	**0.03*** **	**0.045*** **	**0.022*** **	**0.015** **	**0.022*** **	**-0.007**	**0.025*** **
	(0.007)	(0.01)	(0.005)	(0.007)	(0.007)	(0.008)	(0.008)
treated	257	257	257	257	257	257	257
control	5766	5766	5766	5766	5766	5766	5766
t*+5	**0.025*** **	**0.036*** **	**0.02*** **	**0.014** **	**0.016*** **	**-0.007**	**0.019*** **
	(0.006)	(0.006)	(0.004)	(0.005)	(0.005)	(0.006)	(0.005)
treated	257	257	257	257	257	257	257
control	5766	5766	5766	5766	5766	5766	5766

Dependent variables are average yearly growth rates. Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 13: Ex-post effects on TFP of investing abroad: PSM-DiD

	WLP	WLP-M	LP	ACF	GNR
t*-1	**-0.006**	**0**	**0.002**	**0.004**	**-0.003**
	(0.012)	(0.014)	(0.016)	(0.017)	(0.008)
treated	330	332	330	326	330
control	7399	7159	7136	6885	7130
t*+1	**0.039*** **	**0.033** **	**0.039*** **	**0.031*** **	**0.012**
	(0.011)	(0.014)	(0.011)	(0.012)	(0.008)
treated	330	332	330	326	330
control	7399	7159	7136	6885	7130
t*+3	**0.021*** **	**0.025*** **	**0.023*** **	**0.018** **	**0.006***
	(0.005)	(0.008)	(0.006)	(0.008)	(0.004)
treated	330	332	330	326	330
control	7399	7159	7136	6885	7130
t*+5	**0.016*** **	**0.019*** **	**0.016*** **	**0.014*** **	**0.005** **
	(0.005)	(0.006)	(0.004)	(0.005)	(0.002)
treated	330	332	330	326	330
control	7399	7159	7136	6885	7130

Dependent variables are average yearly growth rates. WLP: Wooldridge (2009); WLP-M: Wooldridge (2009) with omitted price bias correction; LP: Levinsohn and Petrin (2003); ACF: Ackerberg et al. (2006); GNR: Gandhi et al. (2012). Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 14: Ex-post effects of investing abroad, advanced countries only

	Turnover	Value Added	Employment	Capital	VA per worker	Capital per worker	TFP
t*-1	**0.004**	**0.013**	**0.007**	**0.015**	**0.006**	**0.009**	**0.005**
	(0.016)	(0.025)	(0.013)	(0.021)	(0.022)	(0.021)	(0.021)
treated	205	205	205	205	205	205	205
control	5150	5150	5150	5150	5150	5150	5150
t*+1	**0.064*** **	**0.072*** **	**0.044*** **	**0.005**	**0.027**	**-0.039** **	**0.037** **
	(0.018)	(0.02)	(0.012)	(0.014)	(0.019)	(0.018)	(0.018)
treated	205	205	205	205	205	205	205
control	5150	5150	5150	5150	5150	5150	5150
t*+3	**0.042*** **	**0.049*** **	**0.032*** **	**0.008**	**0.017** **	**-0.024** **	**0.023*** **
	(0.008)	(0.01)	(0.009)	(0.009)	(0.008)	(0.011)	(0.008)
treated	205	205	205	205	205	205	205
control	5150	5150	5150	5150	5150	5150	5150
t*+5	**0.031*** **	**0.037*** **	**0.026*** **	**0.011***	**0.01***	**-0.016** **	**0.015** **
	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)
treated	205	205	205	205	205	205	205
control	5150	5150	5150	5150	5150	5150	5150

Dependent variables are average yearly growth rates. TFP is estimated using the Wooldridge (2009) methodology. Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 15: Ex-post effects of investing abroad, developing countries only

	Turnover	Value Added	Employment	Capital	VA per worker	Capital per worker	TFP
t*-1	**0.008**	**-0.013**	**-0.003**	**0.023**	**-0.011**	**0.026**	**-0.016**
	(0.025)	(0.034)	(0.018)	(0.02)	(0.03)	(0.026)	(0.031)
treated	89	89	89	89	89	89	89
control	2946	2946	2946	2946	2946	2946	2946
t*+1	**0.003**	**0.003**	**-0.001**	**0.044**	**0.004**	**0.045***	**-0.002**
	(0.019)	(0.022)	(0.013)	(0.027)	(0.021)	(0.025)	(0.02)
treated	89	89	89	89	89	89	89
control	2946	2946	2946	2946	2946	2946	2946
t*+3	**-0.006**	**0.012**	**0.005**	**0.028****	**0.007**	**0.023***	**0.004**
	(0.011)	(0.015)	(0.008)	(0.014)	(0.013)	(0.013)	(0.013)
treated	89	89	89	89	89	89	89
control	2946	2946	2946	2946	2946	2946	2946
t*+5	**0.005**	**0.02***	**0.012***	**0.018***	**0.008**	**0.006**	**0.009**
	(0.008)	(0.012)	(0.007)	(0.01)	(0.011)	(0.009)	(0.011)
treated	89	89	89	89	89	89	89
control	2946	2946	2946	2946	2946	2946	2946

Dependent variables are average yearly growth rates. TFP is estimated using the Wooldridge (2009) methodology. Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 16: Ex-post effects on white and blue collars of investing abroad

	White collar		Blue collar	
	Advanced	Emerging	Advanced	Emerging
t*-1	**0.032**	**-0.009**	**-0.019**	**0.012**
	(0.027)	(0.029)	(0.022)	(0.03)
treated	143	79	143	79
	2009	1444	2009	1444
t*+1	**0.074**	**0.004**	**-0.014**	**-0.012**
	(0.052)	(0.052)	(0.059)	(0.021)
treated	120	67	120	67
	1594	976	1594	976
t*+3	**0.055*****	**-0.009**	**0.01**	**0.001**
	(0.018)	(0.028)	(0.03)	(0.041)
treated	81	51	81	51
	957	538	957	538
t*+5	**0.037****	**-0.019**	**-0.002**	**0.026**
	(0.016)	(0.019)	(0.022)	(0.025)
treated	56	32	56	32
	461	317	461	317

Dependent variables are average yearly growth rates. Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 17: Ex-post effects of investing abroad, advanced countries only, traditional sectors

	Turnover	Value Added	Employment	Capital	VA per worker	Capital per worker	TFP
t*-1	**-0.004**	**0.019**	**-0.003**	**0.06****	**0.021**	**0.062***	**0.01**
	(0.028)	(0.035)	(0.023)	(0.025)	(0.024)	(0.035)	(0.025)
treated	89	89	89	89	89	89	89
control	1787	1787	1787	1787	1787	1787	1787
t*+1	**0.05*****	**0.041***	**0.054*****	**0.013**	**-0.013**	**-0.041****	**-0.003**
	(0.016)	(0.022)	(0.019)	(0.02)	(0.024)	(0.019)	(0.022)
treated	89	89	89	89	89	89	89
control	1787	1787	1787	1787	1787	1787	1787
t*+3	**0.038*****	**0.041****	**0.042*****	**0.007**	**-0.001**	**-0.035*****	**0.008**
	(0.012)	(0.02)	(0.013)	(0.011)	(0.015)	(0.011)	(0.015)
treated	89	89	89	89	89	89	89
control	1787	1787	1787	1787	1787	1787	1787
t*+5	**0.036*****	**0.043*****	**0.035*****	**0.009**	**0.007**	**-0.026*****	**0.014**
	(0.011)	(0.013)	(0.01)	(0.008)	(0.009)	(0.008)	(0.009)
treated	89	89	89	89	89	89	89
control	1787	1787	1787	1787	1787	1787	1787

Dependent variables are average yearly growth rates. TFP is estimated using the Wooldridge (2009) methodology. Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 18: Ex-post effects of investing abroad, advanced countries only, scale intensive sectors

	Turnover	Value Added	Employment	Capital	VA per worker	Capital per worker	TFP
t*-1	**0.032**	**0.045**	**0.019**	**0.01**	**0.026**	**-0.008**	**0.03**
	(0.023)	(0.042)	(0.024)	(0.029)	(0.043)	(0.033)	(0.041)
treated	48	48	48	48	48	48	48
control	1797	1797	1797	1797	1797	1797	1797
t*+1	**0.058****	**0.073****	**0.034**	**0.03***	**0.04**	**-0.003**	**0.044**
	(0.028)	(0.033)	(0.021)	(0.017)	(0.034)	(0.03)	(0.032)
treated	48	48	48	48	48	48	48
control	1797	1797	1797	1797	1797	1797	1797
t*+3	**0.037****	**0.037*****	**0.024**	**0.05****	**0.014**	**0.026**	**0.01**
	(0.016)	(0.014)	(0.015)	(0.02)	(0.016)	(0.018)	(0.015)
treated	48	48	48	48	48	48	48
control	1797	1797	1797	1797	1797	1797	1797
t*+5	**0.039*****	**0.041*****	**0.031*****	**0.039*****	**0.01**	**0.008**	**0.011**
	(0.013)	(0.014)	(0.01)	(0.014)	(0.013)	(0.015)	(0.012)
treated	48	48	48	48	48	48	48
control	1797	1797	1797	1797	1797	1797	1797

Dependent variables are average yearly growth rates. TFP is estimated using the Wooldridge (2009) methodology. Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 19: Ex-post effects of investing abroad, advanced countries only, specialized and high tech sectors

	Turnover	Value Added	Employment	Capital	VA per worker	Capital per worker	TFP
t*-1	**-0.004**	**-0.011**	**0.018**	**-0.025**	**-0.029**	**-0.043**	**-0.021**
	(0.027)	(0.03)	(0.018)	(0.032)	(0.029)	(0.033)	(0.029)
treated	70	70	70	70	70	70	70
control	1435	1435	1435	1435	1435	1435	1435
t*+1	**0.086*** **	**0.104*** **	**0.034***	**-0.013**	**0.07*** **	**-0.046***	**0.081*** **
	(0.029)	(0.031)	(0.018)	(0.026)	(0.025)	(0.028)	(0.026)
treated	70	70	70	70	70	70	70
control	1435	1435	1435	1435	1435	1435	1435
t*+3	**0.052*** **	**0.065*** **	**0.025** **	**-0.016**	**0.04*** **	**-0.041** **	**0.049*** **
	(0.013)	(0.019)	(0.012)	(0.017)	(0.013)	(0.017)	(0.015)
treated	70	70	70	70	70	70	70
control	1435	1435	1435	1435	1435	1435	1435
t*+5	**0.025** **	**0.031** **	**0.013**	**-0.007**	**0.018** **	**-0.02***	**0.022*** **
	(0.012)	(0.013)	(0.011)	(0.013)	(0.008)	(0.011)	(0.008)
treated	70	70	70	70	70	70	70
control	1435	1435	1435	1435	1435	1435	1435

Dependent variables are average yearly growth rates. TFP is estimated using the Wooldridge (2009) methodology. Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 20: Ex-post effects of investing abroad, developing countries only, traditional sectors

	Turnover	Value Added	Employment	Capital	VA per worker	Capital per worker	TFP
t*-1	**-0.045**	**-0.009**	**-0.014**	**-0.044**	**0.005**	**-0.031**	**0.01**
	(0.039)	(0.048)	(0.027)	(0.033)	(0.051)	(0.038)	(0.048)
treated	29	29	29	29	29	29	29
untreated	1122	1122	1122	1122	1122	1122	1122
t*+1	**-0.021**	**-0.033**	**-0.029**	**-0.009**	**-0.004**	**0.02**	**-0.01**
	(0.025)	(0.04)	(0.025)	(0.033)	(0.041)	(0.034)	(0.039)
treated	29	29	29	29	29	29	29
untreated	1122	1122	1122	1122	1122	1122	1122
t*+3	**-0.035***	**-0.001**	**-0.013**	**0.014**	**0.012**	**0.028**	**0.003**
	(0.019)	(0.025)	(0.016)	(0.024)	(0.019)	(0.025)	(0.018)
treated	29	29	29	29	29	29	29
untreated	1122	1122	1122	1122	1122	1122	1122
t*+5	**-0.001**	**0.019**	**-0.003**	**0.017**	**0.022**	**0.02**	**0.016**
	(0.015)	(0.021)	(0.015)	(0.018)	(0.015)	(0.016)	(0.014)
treated	29	29	29	29	29	29	29
untreated	1122	1122	1122	1122	1122	1122	1122

Dependent variables are average yearly growth rates. TFP is estimated using the Wooldridge (2009) methodology. Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 21: Ex-post effects of investing abroad, developing countries only, scale intensive sectors

	Turnover	Value Added	Employment	Capital	VA per worker	Capital per worker	TFP
t*-1	**0.012**	**-0.03**	**-0.018**	**0.053**	**-0.012**	**0.071**	**-0.027**
	(0.028)	(0.036)	(0.027)	(0.041)	(0.047)	(0.048)	(0.043)
treated	33	33	33	33	33	33	33
control	1025	1025	1025	1025	1025	1025	1025
t*+1	**-0.01**	**-0.007**	**-0.002**	**0.076**	**-0.005**	**0.078**	**-0.014**
	(0.025)	(0.035)	(0.014)	(0.056)	(0.028)	(0.05)	(0.026)
treated	33	33	33	33	33	33	33
control	1025	1025	1025	1025	1025	1025	1025
t*+3	**-0.011**	**0.01**	**0.015**	**0.025**	**-0.004**	**0.011**	**-0.003**
	(0.017)	(0.019)	(0.012)	(0.033)	(0.017)	(0.028)	(0.018)
treated	33	33	33	33	33	33	33
control	1025	1025	1025	1025	1025	1025	1025
t*+5	**-0.013**	**0.002**	**0.018****	**0.018**	**-0.016**	**0**	**-0.013**
	(0.014)	(0.016)	(0.009)	(0.025)	(0.017)	(0.021)	(0.018)
treated	33	33	33	33	33	33	33
control	1025	1025	1025	1025	1025	1025	1025

Dependent variables are average yearly growth rates. TFP is estimated using the Wooldridge (2009) methodology. Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

Table 22: Ex-post effects of investing abroad, developing countries only, specialized and high tech sectors

	Turnover	Value Added	Employment	Capital	VA per worker	Capital per worker	TFP
t*-1	**0.079***	**0.031**	**0.033**	**0.032**	**-0.001**	**0**	**0.003**
	(0.044)	(0.057)	(0.024)	(0.037)	(0.059)	(0.043)	(0.056)
treated	26	26	26	26	26	26	26
control	663	663	663	663	663	663	663
t*+1	**0.029**	**0.042**	**0.03**	**0.07**	**0.013**	**0.041**	**0.01**
	(0.042)	(0.047)	(0.018)	(0.049)	(0.049)	(0.053)	(0.049)
treated	26	26	26	26	26	26	26
control	663	663	663	663	663	663	663
t*+3	**0.031**	**0.027**	**0.011**	**0.042***	**0.016**	**0.031**	**0.013**
	(0.02)	(0.031)	(0.014)	(0.023)	(0.026)	(0.023)	(0.026)
treated	26	26	26	26	26	26	26
control	663	663	663	663	663	663	663
t*+5	**0.033***	**0.044***	**0.021***	**0.023**	**0.023**	**0.002**	**0.026**
	(0.017)	(0.025)	(0.012)	(0.02)	(0.019)	(0.022)	(0.02)
treated	26	26	26	26	26	26	26
control	663	663	663	663	663	663	663

Dependent variables are average yearly growth rates. TFP is estimated using the Wooldridge (2009) methodology. Bootstrapped standard errors in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01.

A TFP estimation

We start from a (log) Cobb-Douglas production function in capital (k_{it}) and labor (l_{it})

$$y_{it} = \alpha k_{it} + \beta l_{it} + \omega_{it} + \eta_{it}, \tag{A.1}$$

where y_{it} is value added, ω_{it} is observed by the firm but not by the econometrician and η_{it} is a random iid term, and adopt different estimation methodologies to obtain the total factor productivity $\omega_{it} + \eta_{it}$.[32]

The first is that of Levinsohn and Petrin (2003), henceforth LP, in order to deal with the simultaneity bias. This bias arises as the level of inputs chosen by the firm are correlated with the unobserved productivity shocks (a positive shock will induce firms to use a higher amount of variable inputs). Thus, endogeneity between variable inputs and ω_{it} will lead to an upward bias in the labor coefficient and a downward bias in the capital one, under the plausible assumption of a positive correlation between labor and capital. In order to tackle this bias, Levinsohn and Petrin (2003) use materials, function of capital and productivity, to control for unobserved productivity and obtain an estimate of the variable input coefficient, labor; then, in a second stage, they obtain an unbiased estimate of the capital coefficient.

The second methodology was developed by Ackerberg et al. (2006), henceforth ACF, in order to overcome the collinearity problem in the input choices of the Levinsohn and Petrin (2003) method. As both variable inputs, i.e. labor and materials, are chosen simultaneously and depend on the same state variables (capital and ω_{it}), it is impossible to identify in the first stage both the capital coefficient and the labor one. Therefore, Ackerberg et al. (2006) estimate both coefficients in the second stage, after netting out from value added the random iid term η_{it}. Morover, we assume that the labor market is characterized by some frictions - i.e. firms cannot freely modify labor, for example for hiring and/or firing costs.

The third methodology is the Wooldridge (2009) method, henceforth WLP, similar to Ackerberg et al. (2006) but more efficient. In this case we also assume there are no frictions in the labor market, so firms can modify labor without any cost.

Finally, Gandhi et al. (2012), henceforth GNR, provide the fourth method, where the dependent variable is gross output instead of value added. In this way, the

[32] For a comprehensive survey of different estimation methodologies see Van Beveren (2011) and Ackerberg et al. (2007).

elasticity of materials is no longer constrained to unity and the production function is a translog.

The estimation procedure is carried out on 14 manufacturing sectors, following the 1991 ATECO classification.

Furthermore, we try to take into account another potential source of bias, i.e. using a sectoral-level deflator instead of the real firm price in the estimation of TFP, as pointed up in several studies.[33] We follow two different strategies.

First, we build a quasi-firm level price index. Using firm-level production volumes and values in the TFP estimation, Smeets and Warzynski (2013) find that new exporters obtain a positive premium on productivity with respect to non-exporting firms. Nevertheless, the premium disappears when estimating TFP with a sectoral price index, so unobservable firm prices introduce a severe form of bias. We do not have access to values and volumes firm data. However, in Invind we observe firm level annual price variations; exploiting this information permits the construction of a highly disaggregated price index, taking into account sector, dimension and region of the firm. This index has been considered as the initial price level of each firm in the panel. Annual variations from Invind are then applied to these levels, when available. We end up with a quasi-firm price index, computed with both firm level information and sector/dimension/location data.

Second, we indirectly correct for omitted price bias following the De Loecker (2011) procedure, based on Klette and Griliches (1996) approach of modeling explicitly the demand side. The Wooldridge (2009) methodology is modified assuming monopolistic competition in each sector, i.e. horizontally differentiated goods; we add sub-sector value added in the production function as a proxy of demand reaching each firm and sub-sector dummies to control for specific shocks. Thus, we are able to estimate a mark-up for each of the 14 sectors, exploiting longitudinal demand variation at the sub-sector level. In this way, input elasticities in the production function are not biased since they are estimated explicitly taking into account firms' price-making behavior, under the assumption of monopolistic competition.

Production function estimation with the WLP method, quasi-firm price index and net tangible assets from balance sheets leads to very low and often not statistically different from zero capital coefficient estimates (Table A1). These val-

[33]Klette and Griliches (1996) show that input coefficients are downward biased if firm price is not equal to the sector price index. In order to obtain an unbiased estimate of TFP Levinsohn and Melitz (2002) suggest embedding in the model, following Klette and Griliches (1996), a demand side characterized by horizontally differentiated goods so that the difference between sector and firm price can be estimated.

ues do not appear very realistic, according both to macroeconomic factor shares and previous micro-level empirical evidence (Griliches and Mairesse, 1995; Blundell and Bond, 2000; Levinsohn and Petrin, 2003). The test for constant returns to scale often fails, indicating that the majority of sectors are characterized by decreasing returns, another unrealistic result. Other works employing similar estimation methodologies and capital measures (tangible assets) encounter the same issues of low capital elasticity and decreasing returns to scale (e.g. Van Biesebroeck, 2008; Castellani and Giovannetti, 2010; Mancini, 2011). This evidence is in line with the results of Lizal and Galuscak (2012): inaccuracy in measuring tangible assets might lead to a downward bias in the capital coefficient in the production function.

Switching to a more reliable capital measure - the one obtained from the perpetual inventory method - brings higher estimates of capital elasticities in every sector,[34] much more in line with previous evidence (Table A2). Moreover, constant returns to scale are present in the vast majority of sectors.

Lastly, we use the WLP method with the correction for omitted prices, henceforth WLPM, mentioned above. Not surprisingly we obtain much higher coefficient estimates and returns to scale, in some cases increasing (Table A3).

[34]These results are not very different from those obtained using the sectoral price index instead of the quasi-firm price. Estimates are available upon request.

Table A1: Production function estimate results: quasi-firm price index and net tangible assets

	Food, beverages and tobacco	**Textiles and apparel**	**Leather and related prod.**	**Wood and wood prod.**	**Paper products and printing**	**Coke and refined petroleum prod.**	**Chemical and pharma. prod.**
labor	**0.635*** **	**0.664*** **	**0.682*** **	**0.727*** **	**0.926*** **	**0.639*** **	**0.806*** **
	(0.0235)	(0.0209)	(0.0370)	(0.0446)	(0.0308)	(0.0828)	(0.0269)
capital	**0.0707*** **	**0.147*** **	**0.0909*** **	**0.0561**	**0.0461** **	**0.0608**	**0.0695***
	(0.0205)	(0.0224)	(0.0289)	(0.0880)	(0.0223)	(0.0394)	(0.0396)
RTS ($H_0 : RTS = 1$)	0.71***	0.81***	0.77***	0.78***	0.97	0.70***	0.88***
N	12879	10157	3922	2126	4874	664	5814

	Rubber and plastic prod.	**Non-metallic mineral products**	**Metals and metal products**	**Machinery and equipment**	**Eletrical, electronic and optical prod.**	**Transport equipment**	**Other manufact.**
labor	**0.752*** **	**0.711*** **	**0.797*** **	**0.788*** **	**0.755*** **	**0.728*** **	**0.788*** **
	(0.0426)	(0.0309)	(0.0165)	(0.0200)	(0.0211)	(0.0404)	(0.0376)
capital	**0.0361**	**0.0493** **	**0.0285***	**0.0638*** **	**0.0751*** **	**0.0890** **	**0.0831*** **
	(0.0272)	(0.0197)	(0.0147)	(0.0220)	(0.0235)	(0.0447)	(0.0230)
RTS ($H_0 : RTS = 1$)	0.79***	0.76***	0.83***	0.85***	0.83***	0.82***	0.87***
N	5228	7126	14273	12808	7494	4431	5440

Production function estimates are obtained through Wooldridge (2009) methodology; standard errors in parentheses; *: p<0.1; **: p<0.05; ***: p<0.01.

Table A2: Production function estimate results: quasi-firm price index and PIM

	Food, beverages and tobacco	**Textiles and apparel**	**Leather and related prod.**	**Wood and wood prod.**	**Paper products and printing**	**Coke and refined petroleum prod.**	**Chemical and pharma. prod.**
labor	**0.622*** **	**0.649*** **	**0.699*** **	**0.688*** **	**0.876*** **	**0.653*** **	**0.772*** **
	(0.0239)	(0.0217)	(0.0404)	(0.0483)	(0.0322)	(0.0894)	(0.0271)
capital	**0.224*** **	**0.271*** **	**0.210*** **	**0.300***	**0.145*** **	**0.225**	**0.125** **
	(0.0336)	(0.0319)	(0.0493)	(0.180)	(0.0427)	(0.142)	(0.0580)
RTS ($H_0 : RTS = 1$)	0.85***	0.92**	0.91	0.99	1.02	0.88	0.90
N	11896	8781	3153	1949	4255	616	5271

	Rubber and plastic prod.	**Non-metallic mineral products**	**Metals and metal products**	**Machinery and equipment**	**Eletrical, electronic and optical prod.**	**Transport equipment**	**Other manufact.**
labor	**0.720*** **	**0.698*** **	**0.764*** **	**0.752*** **	**0.749*** **	**0.670*** **	**0.762*** **
	(0.0463)	(0.0251)	(0.0211)	(0.0199)	(0.0218)	(0.0454)	(0.0406)
capital	**0.265*** **	**0.316*** **	**0.137*** **	**0.155*** **	**0.167*** **	**0.173** **	**0.226*** **
	(0.0503)	(0.0397)	(0.0305)	(0.0258)	(0.0418)	(0.0806)	(0.0385)
RTS ($H_0 : RTS = 1$)	0.99	1.01	0.90***	0.91***	0.92**	0.84	0.99
N	4696	6517	12857	11089	6386	3895	4763

Production function estimates are obtained through Wooldridge (2009) methodology; standard errors in parentheses; *: p<0.1; **: p<0.05; ***: p<0.01.

Table A3: Production function estimate results: demand side assumption and PIM

	Food, beverages and tobacco	**Textiles and apparel**	**Leather and related prod.**	**Wood and wood prod.**	**Paper products and printing**	**Coke and refined petroleum prod.**	**Chemical and pharma. prod.**
labor	**0.662*** **	**0.786*** **	**0.740*** **	**0.812*** **	**0.859*** **	**1.395*** **	**0.874*** **
	(0.0348)	(0.0461)	(0.0822)	(0.0716)	(0.0493)	(0.198)	(0.0608)
capital	**0.221*** **	**0.302*** **	**0.209*** **	**0.351**	**0.220*** **	**0.375**	**0.187*** **
	(0.0342)	(0.0396)	(0.0499)	(0.219)	(0.0488)	(0.261)	(0.0675)
RTS ($H_0 : RTS = 1$)	0.88**	1.09	0.95	1.16	1.08	1.77**	1.06
mark-up	1.086	1.193	1.045	1.152	1.148	1.965	1.175
N	11897	8781	3153	1949	4257	628	5271

	Rubber and plastic prod.	**Non-metallic mineral products**	**Metals and metal products**	**Machinery and equipment**	**Eletrical, electronic and optical prod.**	**Transport equipment**	**Other manufact.**
labor	**0.800*** **	**1.077*** **	**0.823*** **	**0.999*** **	**0.911*** **	**0.695*** **	**0.769*** **
	(0.0862)	(0.0752)	(0.0323)	(0.0572)	(0.0432)	(0.0644)	(0.0639)
capital	**0.283*** **	**0.434*** **	**0.178*** **	**0.213*** **	**0.182*** **	**0.173****	**0.224*** **
	(0.0525)	(0.0649)	(0.0326)	(0.0337)	(0.0556)	(0.0801)	(0.0425)
RTS ($H_0 : RTS = 1$)	1.08	1.51***	1.00	1.21	1.09	0.87***	0.99
mark-up	1.126	1.488	1.073	1.304	1.274	1.067	1.028
N	4696	6517	12857	11089	6390	3895	4763

Production function estimates are obtained through Wooldridge (2009) methodology corrected for monopolistic competition, following De Loecker (2011); standard errors in parentheses; *: p<0.1; **: p<0.05; ***: p<0.01.

B Propensity score matching with diff-in-diff

Defining Y^{FDI} and Y^{DOM} as the potential outcome of an investing or domestic firm, respectively, and d as the treatment indicator (investment=1), the effect of investing abroad can be computed as the Average Treatment effect on the Treated:

$$ATT = E(Y^{FDI} - Y^{DOM}|d = 1) = E(Y^{FDI}|d = 1) - E(Y^{DOM}|d = 1), \quad \text{(B.1)}$$

that is the effect of investing abroad for the first time on the multinational firms.

In principle, the identification of the effects of FDI would require comparing the evolution of new MNEs, $E(Y^{FDI}|d = 1)$, with the performance of the exact same company in the event that it had not made the investment $E(Y^{DOM}|d = 1)$. In practice, this option is not viable since we can only observe the outcome of those firms that are not investing abroad, $E(Y^{DOM}|d = 0)$. Using the latter as a counterfactual could potentially generates a bias:

$$B(ATT) = E(Y^{DOM}|d = 1) - E(Y^{DOM}|d = 0). \quad \text{(B.2)}$$

Thus, in order to obtain a valid identification of the causal effect through matching the conditional mean independence assumption must be verified: conditional on a set of observable characteristics X, the average performance of the non-investing company must be equal to that of the MNE had it not invested abroad in time t^*:

$$E(Y^{DOM}|X, d = 1) = E(Y^{DOM}|X, d = 0) = E(Y^{DOM}|X), \quad \text{(B.3)}$$

in other words, there are a set of observed characteristics X such that outcomes of domestic firms are (mean) independent with respect to the treatment indicator.

Unfortunately, it is likely that some unobservable variables (excluded from X) could also affect both the future performance of the firm and the choice of internationalization; the self-selection in the treatment (the acquisition of the MNE status) does not only depend on the observable variables included in X (selection on observables) but also on some unobserved characteristics (selection on unobservables). Following a standard propensity score matching procedure requires assuming no selection on unobservables at all. However, it is possible to combine a difference-in-differences approach (Heckman et al., 1997), which eliminate the fixed

unobserved variables, with propensity score matching (PSM-DiD). Therefore we evaluate the change in outcome up to $t^* + s$ where t^* is the year of the first foreign investment and s are different horizons $(1, 3, 5)$:

$$ATT_{t^*+s} = E(\Delta Y^{FDI}_{t^*+s} - \Delta Y^{DOM}_{t^*+s} | X, d = 1). \tag{B.4}$$

Matching estimators are difficult to implement when the set of conditioning variables X is large and some variables are continuous. Rosenbaum and Rubin (1983) demonstrate that if (B.3) is valid, then it is possible to avoid the curse of dimensionality by simply focusing on $P(d = 1|X)$ instead of the vector X, i.e. the predicted probability of investing abroad for the very first time. In this way it is possible to match treated and untreated units on the basis of their similarity on the estimated propensity score.

Thus the conditional mean independence assumption (B.3) becomes

$$E(Y^{DOM}|P(d = 1|X), d = 1) = E(Y^{DOM}|P(d = 1|X), d = 0), \tag{B.5}$$

and in terms of the growth rate, following the diff-in-diff procedure:

$$E(\Delta Y^{DOM}_{t^*+s}|P(d = 1|X), d = 0) = E(\Delta Y^{DOM}_{t^*+s}|P(d = 1|X), d = 1), \tag{B.6}$$

where we include the rate of growth of the main outcome variables (TFP, labor and capital) ΔY_{t^*-1} in the X vector to control for the possibility of an increasing trend for new MNEs before starting to invest abroad, a potential violation of the parallel trend assumption required by the diff-in-diff strategy.

Thus once matching has been performed we compute:

$$\begin{aligned} ATT_{DID} = \frac{1}{N_{FDI}} \sum_{i \in FDI} \left[\Delta Y^{FDI}_i - \sum_{j \in DOM} w_{ij} \Delta Y^{DOM}_j \right] = \\ = \Delta \bar{Y}^{FDI} - \frac{1}{N_{FDI}} \sum_{j \in DOM} w_j \Delta Y^{DOM}_j, \end{aligned} \tag{B.7}$$

where N_{FDI} is the number of companies that start to invest abroad, ΔY^{FDI}_i is the variation in the performance variable between t^* and $t^* + s$ for firm i starting to invest abroad, ΔY^{DOM}_i is the same for firm j that operates only in the domestic market, w_{ij} is the weight of the $j - th$ control firm associated with the treated firm i through the matching procedure and w_j is the sum of w_{ij} across i.

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