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Foreign Ownership and Productivity: Is the Direction of Causality So Obvious?

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Foreign Ownership and Productivity: Is the Direction of Causality so Obvious?*

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Abstract

The purpose of this paper is to estimate the effect of foreign ownership on productivity under reasonable identification assumptions. In particular we estimate dynamic Cobb-Douglas production functions augmented with a set of variables capturing complementary characteristics of foreign ownership. We apply the GMM-System estimator developed by Blundell and Bond (1998) to a large sample of firms located in Italy. Our aggregate findings suggest that after controlling for unobserved heterogeneity, simultaneity and measurement errors, foreign ownership has no effect on productivity. Therefore we do not find widespread empirical support to the standard internalization theory of foreign direct investment. However, we also find that nationality matters since firms under US ownership tend to be more productive than firms under national ownership. In turn this additional result suggests that the transfer of knowledge implied by the internalization theory occurs only if the difference between the recipient and the investment country is sufficiently pronounced.

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1 Introduction

The existence of Multinational Enterprises (MNEs) and the characteristics of their foreign affiliates have been extensively examined by the economic literature. The most widely accepted theory on MNEs, the so-called "internalization theory" (see Caves, 1996), provides some insights to both issues. In fact, it suggests that MNEs exist as they can exploit in foreign markets superior knowledge (managerial expertise, superior technological skills, etc.) which compensates for the higher costs induced by operating in a foreign environment. In turn, MNEs' foreign affiliates will benefit from the transfer of this knowledge and might therefore display higher productivity and profitability levels with respect to domestic-owned firms. The alleged superior performance of MNEs' subsidiaries compared with domestic-owned firms has been widely documented in early empirical works, mostly using cross sectional data, and has become a "stylised fact" in the literature on MNEs (Conyon et al., 2002).

It is however unclear whether this "stylised fact" can be interpreted as a causal or structural relationship between being owned by a MNE and being more productive or profitable. In fact, simple cross section evidence can be criticised on the ground of composition effects, firms' heterogeneity and estimation issues. Firstly, MNEs tend to concentrate in high R&D and advertising spending sectors so that they might be more productive simply because they operate in higher productivity sectors. Secondly, firms are heterogeneous (in terms of age, size, capital intensity, input and managerial quality, and the like) and these characteristics might affect firms' productivity. In so far as firms' characteristics are observable, they can be used as control variables to assess the effect of foreign ownership on productivity. However, if some of the characteristics are unobservable (e.g. managerial quality) then non-trivial estimation issues arise. In particular, if unobservables are correlated with regressors, then simple ordinary least squares are biased and inconsistent. Thirdly, estimation problems might also arise because of simultaneity and measurement errors which are both very likely to occur in the context of production function.

This paper contributes to the recent literature on MNEs' affiliates performance by applying appropriate micro econometric techniques to a specially constructed panel of firms located in Italy and sampled in the 1992-99 period. In particular, we estimate dynamic gross output production functions by using the GMM-system technique recently developed by Blundell and Bond (1998). In doing so, we are able to recover consistent estimates of the impact of foreign ownership on productivity, controlling for unobserved heterogeneity, simultaneity and measurement error.

Our aggregate findings suggest that once potential endogeneity problems are controlled for, any systematic difference between foreign affiliates and domestic firms disappears. This result contrasts with the view that, everything else equal, foreign ownership induces higher productivity levels. However, we also find that the country of origin matters as firms under US ownership outperform domestic-owned firms. This finding gives empirical support to the hypothesis that the transfer of knowledge occurs only if the gap between host (Italy) and home (US) countries is sufficiently pronounced.

The paper unfolds as follows. The next section motivates this paper by reviewing the theoretical literature and the empirical evidence on MNEs' productivity differentials with respect to domestic firms. Section 3 presents our empirical model while Section 4 describes our sample and presents some descriptive statistics. Section 5 comments upon the results whereas Section 6 concludes. An appendix describing the sample used in this paper is also included.

2 Previous Literature

The internalisation - or transaction cost - theory of Foreign Direct Investment (FDI) explains the existence of MNEs in terms of some, possibly intangible, assets owned by these firms which compensate them for the higher costs implied by operating abroad (Caves, 1996). In fact, in order to compete in foreign markets, where local firms have better knowledge of local markets, consumer preferences and business practices, MNEs must enjoy some other specific advantages, such as superior managerial expertise or technological capabilities. These assets (so-called "proprietary assets") are mostly intangible and are more likely to be transferred efficiently through internalisation and expansion abroad than through markets mechanisms. In turn, the internalisation theory suggests that MNEs' foreign subsidiaries will benefit from the transfer of proprietary assets and therefore might display higher productivity or profitability levels compared to local firms.

The empirical literature has tried to shed light on this issue. Early empirical work, mostly based on cross section data, has reached the consensus that foreign affiliates have higher productivity levels (measured as gross output or value added per employee) and pay higher wages than domestic firms. As pointed out by Caves (1996, pp. 185-6), this is hardly surprising since "companies do not become multinationals unless they are(were) good at something". He also points out that the crucial question to be answered is therefore whether productivity advantages "are endogenous to the market-structure environments in which they emerge" or whether they have a "pure residual component".

On the one hand, the superior performance of MNEs' affiliates might in fact be due to the so-called "composition effect". As suggested by the internalization theory of FDI, MNEs tend to be concentrated in high R&D and advertising spending sectors where multinationals are more likely to possess proprietary assets that can be transferred to local subsidiaries. As foreign affiliates might be more productive simply because they operate in higher productivity sectors, their relative performance must be assessed controlling for industry differences. For instance, Davies and Lyons (1991) report that half of the 40% superior productivity of MNEs located in the UK compared with local firms is simply due to this composition effect, MNEs being concentrated in high value added per employee industries.

On the other hand, recent theoretical models developed in the Industrial Organization literature have shown how heterogeneity (in terms of age, size, capital intensity, input and managerial quality, and the like) affects firms' productivity.[1] Therefore, the higher productivity of MNEs' subsidiaries might be simply due to their different characteristics. Following this argument some authors have assessed the relative performance of foreign affiliates controlling for observable characteristics. Globerman et al. (1994), analyse a cross section of Canadian establishments and find that those owned by MNEs show a higher value per employee than domestic ones even controlling for industry effects. However, once the authors control for capital intensity, size and workforce composition MNEs' superior performance disappears. A different result is found by Doms and Jensen (1998). By analysing a large cross section of US establishments they show that MNEs' subsidiaries have 2.3 to 3.7% higher total factor productivity than domestically owned establishments, even after controlling for observable characteristics such as industry, size, age and state. Quite interestingly, they also find that foreign-owned establishments are less - and not more - productive than the subset of domestic-owned establishments owned by US firms with overseas assets.

Finally, a more recent stream of literature has questioned the superior performance of MNE's affiliates on methodological grounds. In fact, some individual characteristics are clearly unobservable (e.g. managerial quality) and hence they cannot be controlled for in cross section data. Furthermore, performance measures

[1] For a recent review see for instance De Backer, 2001.

such as total factor productivity (TFP) are obtained through estimation of production functions where problems of simultaneity and measurements errors usually occur. In fact, productivity shocks might be known by managers (but not by the econometrician) so that inputs are adjusted accordingly. In addition to this, input factors, especially capital, are prone to measurement error. As it is well known, these features make ordinary least squares estimates biased and inconsistent.

To deal with some of the aforementioned methodological issues, recent work has estimated augmented production functions by using appropriate panel data techniques. The results of this scarce literature are mixed. Griffith (1999a, 1999b) applies the same econometric estimation technique used in this paper and tests whether foreign-owned UK plants in the car industry have higher levels of TFP than domestic-owned plants. She finds that - despite the fact that foreign-owned establishments have higher output and value-added per worker - these differences are largely explained by different levels of factor usage and labor quality, so that differences in TFP between foreign and domestic-owned plants are very low and statistically insignificant. A rather different conclusion is reached by Girma et al. (2001) who apply random effect techniques to a cross-industry panel of UK firms. They report that foreign affiliates display higher TFP levels, and significantly so, than domestic firms. Quite interestingly, after splitting by country of origin, US firms are found to be the most productive firms in the sample, whereas Japanese companies are not statistically different from domestic-owned firms.

Mixed results are also provided by those studies focussing directly on the impact of foreign acquisitions. Conyon et al. (2002) collect data on UK firms acquired by foreign companies before and after the acquisition occurs. Results from fixed-effect estimates show that firms acquired by foreign companies experience a 14% significant increase in labor productivity in the period following the acquisition. However, their result can be criticised as the performance comparison is based on a partial productivity measure, even if the authors control for capital intensity. A very different result is found by Harris and Robinson (2002) who analyse a large cross-industry sample of UK plants observed in the 80s and the 90s. Not only foreign companies are found to acquire the most productive plants but, after the acquisition, the performance of these plants is also found to deteriorate.

Summing up, there is overwhelming empirical evidence suggesting a positive statistical association between foreign ownership and productivity. However, more recent work, where endogeneity problems are controlled for, casts more than a passing doubt on whether this association can be given a causal or structural interpretation. In this paper we contribute to this strand of research by providing novel empirical evidence based on a large panel of manufacturing firms located in Italy. The way we control for endogeneity issues is described in the next section.

3 The Model

We consider the following Cobb-Douglas production function:

$$Y_{it} = A_{it} M_{it}^{\beta_m} L_{it}^{\beta_l} K_{it}^{\beta_k} \; i = 1, 2, ..., N; \; t = 1, 2, ...T \tag{1}$$

where Y_{it}, M_{it}, L_{it}, K_{it} denote respectively production, consumption of materials and services, employment and capital stock of firm i at time t. The productivity term A_{it} is modelled as follows:

$$\begin{aligned} A_{it} &= e^{\gamma O_{it} + \delta_t + \eta_i + u_{it}} & (2) \\ u_{it} &= v_{it} + s_{it} & (3) \\ v_{it} &= \rho v_{it-1} + e_{it} \quad |\rho| < 1 & (4) \\ e_{it}, s_{it} &\sim MA(0) \end{aligned}$$

where O_{it} is a neutral shift variable capturing the type of ownership (domestic or foreign) which potentially can vary both over time and across firms, δ_t is a time specific intercept, η_i is the individual effect which in the present context can be thought of as unobserved firm characteristics - such as managerial quality and structure - that can be viewed as constant over the sample period, and u_{it} is the idiosyncratic error. In turn u_{it} is made by a first order autoregressive productivity shock, v_{it} and by a serially uncorrelated measurement error, s_{it}. By using equations (2), (3) and (4) and by taking logs, equation (1) can be rewritten in the following dynamic representation:

$$\begin{aligned} y_{it} &= \rho y_{it-1} + \beta_m m_{it} - \rho\beta_m m_{it-1} + \beta_l l_{it} - \rho\beta_l l_{it-1} + \\ &\quad \beta_k k_{it} - \rho\beta_k k_{it-1} + \gamma O_{it} - \rho\gamma O_{it-1} + \delta_t^* + \eta_i^* + w_{it} \\ \delta_t^* &= \delta_t - \rho\delta_{t-1} \\ \eta_i^* &= \eta_i(1-\rho) \\ w_{it} &= e_{it} + s_{it} - \rho s_{it-1} \end{aligned} \tag{5}$$

where y_{it}, m_{it}, l_{it}, and k_{it} are the logarithms of Y_{it}, M_{it}, L_{it}, K_{it} respectively. Finally, equation (5) is equivalent to:

$$\begin{aligned} y_{it} &= \pi_1 y_{it-1} + \pi_2 m_{it} + \pi_3 m_{it-1} + \pi_4 l_{it} + \pi_5 l_{it-1} + \\ &\quad \pi_6 k_{it} + \pi_7 k_{it-1} + \pi_8 O_{it} + \pi_9 O_{it-1} + \delta_t^* + \eta_i^* + w_{it} \end{aligned} \tag{6}$$

subject to four non-linear restrictions $\pi_1\pi_2 = -\pi_3$, $\pi_1\pi_4 = -\pi_5$, $\pi_1\pi_6 = -\pi_7$, and $\pi_1\pi_8 = -\pi_9$.

As stated in the previous section the main purpose of this paper is to recover consistent estimates of the expected effect on productivity of a change in the type of ownership, holding all other variables fixed. To achieve this goal, reasonable identification assumptions have to be made. In particular, it seems sensible to assume that both input factors (m_{it}, l_{it}, k_{it}) and type of ownership (O_{it}) are correlated with the individual effect (η_i^*) as well as with past and present idiosyncratic error terms (w_{it}). In particular, this allows for the possibility that firm heterogeneity and idiosyncratic productivity shocks - if observable to potential investors even if not to the econometrician - matter in attracting foreign investors.

As shown in Arellano and Bond (1991), the following assumptions on the initial conditions:

$$\begin{aligned} E(x_{i1}e_{it}) &= E(x_{i1}s_{it}) = 0 \quad \text{for } t = 2, ..., T \\ \text{where } x_{it} &= (m_{it}, l_{it}, k_{it}, y_{it}, O_{it}) \end{aligned}$$

yield $5 \times 0.5(T-2)(T-3)$ moment conditions:

$$E(x_{it-s}\Delta w_{it}) = 0 \text{ for } t = 4, ..., T \text{ and } 3 \leq s \leq t-1 \tag{7}$$

In turn this allows the exploitation of $t-3$ and earlier levels of the variables as instruments once equation (6) has been first-differenced to eliminate the individual effect, η_i^*.[2] Unfortunately the resulting first-differenced GMM estimator has been shown to have poor finite sample properties when the lagged levels of the series are only weekly correlated with subsequent first differences (Blundell and Bond, 1998). Furthermore, this has been found to be the case in the context of Cobb-Douglas production functions where the marginal processes for input factors are typically highly persistent.[3] Blundell and Bond (1998) suggest that in this case dramatic

[2] Note that if variables are measured without error, the number of moment conditions increases to $5 \times 0.5(T-1)(T-2)$ and variables lagged $t-2$ are valid instruments.

[3] On this issue see Blundell and Bond (2000) and Blundell, Bond, and Windmeijer (2000).

reductions in finite sample biases can be gained if one is willing to assume that:

$$\begin{aligned} E(\Delta n_{it}\eta_i^*) &= 0 \quad \text{for } n = m, l, k, O \text{ and } t = 2, ..., T \\ \text{and } E(\Delta y_{i2}\eta_i^*) &= 0 \end{aligned}$$

Under these restrictions $5 \times (T-3)$ additional moment conditions are available:

$$E[\Delta x_{it-2}(\eta_i^* + w_{it})] = 0 \quad \text{for } t = 4, ..., T \tag{8}$$

This allows the use of twice lagged first differences of the variables as instruments for the equation in level. Blundell and Bond (1998) suggest to exploit both sets of moment conditions in (7) and in (8) as a linear GMM estimator labelled as the system GMM estimator. The result is a system of $5 \times 0.5(T-2)(T-3)$ first differenced equations and $5 \times (T-3)$ level equations.

4 Data and Descriptive Statistics

Our empirical work exploits the "Centro Studi Luca d'Agliano-Reprint database" (CLA-Reprint database henceforth) which provides information on foreign ownership as well as balance sheet data for a large sample of firms located in Italy.[4]

In particular, the CLA-Reprint database reports information on foreign ownership and - when available - balance sheet data for all manufacturing firms located in Italy and owned by a foreign company for at least one year in the 1992-99 period. As some of the firms are not foreign-owned for the whole period they are observed, foreign ownership is identified through a firm-year dummy variable which is equal to one if the firm is foreign-owned at the end of the year and zero otherwise. The

[4] Additional information on the database can be found in the enclosed data appendix.

database also includes balance sheet data for a random sample of domestic-owned manufacturing firms observed in the same period.

For the purpose of the present paper, additional cleaning procedures have been followed. Firstly, we removed from the original sample firms with unknown industry activity, as defined by the Nace three digit classification. Secondly, we excluded observations with either missing or non-positive values for output, materials, and capital stock. We required a more stringent condition for employment and chose to keep only observations with more than 10 employees. The rationale here is that accounting information for very small firms are unlikely to be very reliable. Thirdly, we applied a standard trimming procedure to the logarithmic first differences of all the variables used in estimation and we excluded observations with values above 1 or below -0.5. Finally, given the requirements of the adopted econometric methodology we selected only firms with at least four contiguous observations. Our final sample is made of 2,026 firms with a number of contiguous observations ranging from 4 to 6 for a total of 10,324 observations (see Table 1).

Table 2 and 3 present some features of foreign ownership in our sample. Firstly, foreign ownership accounts for approximately 39% of observations (see Table 2). Notice that the same proportion does not apply to firms as some of them change ownership either from domestic to foreign or viceversa over the sample period. Secondly, the CLA-Reprint database also reports foreign owners' country of origin and the starting date of foreign ownership. These are two important pieces of information which can be exploited to shed additional light on the topic studied in this paper. On the one hand, it can be assumed that MNEs' country of origin may matter for their ability to possess or transfer proprietary assets to their affiliates. For instance, Japanese firms are commonly viewed as having markedly different work practices and logistical systems (such as "just-in-time" inventory planning). For this reason, we identified the countries with larger shares of foreign ownership (in decreasing order, USA, Germany, France, and United Kingdom, see Table 2) and allocated the remaining countries into two groups: other EU countries and other non-EU countries (including Japan). The result is a set of six dummy variables, one for each of these (groups of) countries. On the other hand, it is reasonable to assume that the transfer of proprietary assets is not an instantaneous and once-for-all phenomenon. Hence, a progressive performance improvement should be recorded as long as the number of years under foreign ownership increases. Therefore, we constructed an additional firm-year dummy variable which takes the value of one if foreign ownership starts no more than five years before the observation year and zero otherwise. We label the observations for which this variable is strictly positive as "new" foreign firms and the remaining observations as "old" foreign firms. As shown in Table 2, 24% of foreign observations are "new". If the transfer of the proprietary assets occurs and affects firms' performance, then "new" foreign firms should display a lower productivity level than "old" ones. On the contrary, the lack of any systematic difference between the two sets of observations provides indirect support to the hypothesis that foreign ownership "per se" does not affect firms' productivity.

Inspection of Table 3, which shows the distribution of our sample among the 23 Nace two-digit sectors, reveals - in accordance with the internalisation theory of FDI - that foreign ownership is concentrated in "high tech" industries. In fact, the share of observations in high tech industries is much higher for foreign than for domestic ownership (56.54% vs. 27.08%). Compared with domestic ownership, foreign ownership is especially concentrated in chemicals (21.54% vs. 4.94%), medical equipment and measurement instruments (4.70% vs. 1.26%) and - to a lesser extent - in electrical machinery (7.48% vs. 3.87%) and motor vehicles (4.03% vs. 2.11%).

Finally, Table 4 presents the descriptive statistics for the variables used in the econometric analysis, separately for domestic and foreign ownership. As unanimously found in the literature, foreign firms appear to be much larger (from four to five times) than domestic ones in terms of both output and inputs. As for labor productivity (measured as real output per worker), foreign firms do outperform domestic ones both if one considers the mean (0.528 vs. 0.454) and the median (0.395 vs. 0.317). However, MNEs' subsidiaries appear to compensate, at least partially, the more productive use of labor with a more intensive use of other inputs. Both capital and material intensities are in fact higher for foreign firms.

Summing up, our summary statistics confirm some "stylised facts" on MNEs' foreign affiliates. They are larger than domestic firms, they are concentrated in "high-tech" sectors and they display a higher labor productivity than domestic firms. However, MNEs' subsidiaries are more capital intensive than local firms. The latter consideration suggests that the use of a partial productivity measure could be misleading and supports the use of a total productivity measure. This is performed in our analysis based on production function estimates, whose results are presented in the next section.

5 Results

Results from the estimation of the unrestricted version of the dynamic Cobb-Douglas production function in equation (6) are shown in Tables 5 to 10. In each table four sets of estimates are reported. With the exception of Table 7, columns differ either for the choice of instruments (columns 1 and 2 versus columns 3 and 4) or for the inclusion/exclusion of the ownership variable lagged once as regressor (columns 1 and 3 versus columns 2 and 4).[5] In Table 7 instead, columns differ for the exclusion/inclusion of industry dummies (columns 1 and 2 versus columns 3 and 4) or for the inclusion/exclusion of the once lagged ownership variable (columns 1

[5] See the legend to Tables 5 to 10 for more detailed information on the set of intruments for each equation.

and 3 versus columns 2 and 4).[6] For each equation estimated coefficients are reported together with their corresponding p-values testing the hypothesis that each coefficient is equal to zero. In addition to estimated coefficients, implied factor ($\varepsilon_{my}, \varepsilon_{ly}, \varepsilon_{ky}$) and scale elasticities are also shown. We also report the results of first and second-order residual serial correlation tests (m_1 and m_2 denote the p-values of the relevant test statistic) and, whenever appropriate, the Sargan tests of over-identifying restrictions. Finally, the long run partial effects of the type of ownership (domestic versus foreign) on productivity are reported, together with the corresponding p-values testing the non-linear restrictions (via the delta method) that the computed coefficient is equal to zero.

Table 5 shows the results for the basic model using earlier instruments dated $t-3$ for the equations in first differences and instruments dated $t-2$ for the equations in level. This choice of instruments is consistent with the orthogonality conditions stated in (7) and (8) respectively. In all columns the test statistics indicate that there is evidence of first but not of second order serial correlation. However, as can be seen by looking at columns 1 and 2, the Sargan statistics reject the validity of the complete set of instruments at the 5 per cent significance level (but not at the one per cent). Once $O(3,5)$ and ΔO_{t-2} are removed from the set of instruments the situation improves and the validity of this reduced set of instruments cannot be rejected even at the 5 per cent significance level (see column 3). In all columns, punctual estimates of factor elasticities look reasonable, perhaps with the exception of the output to capital elasticity which is a little bit on the low side.[7] Furthermore, punctual estimates of scale elasticity point out to the presence of modest increasing returns to scale. More importantly for the purpose of the present paper, the long

[6] Given the very high persistency of the ownership variable, the comparison between the results with and without the lagged ownership dummy provides a consistency check that our findings are not badly affected by near multicollinearity problems.

[7] We also experimented with alternative definitions of the capital stock, including the original accounting variable. All our crucial results are insensitive to the use of these alternative measures.

run (LR) ownership effect is not significantly different from zero in all specifications. In turn this implies that once controlled for unobserved heterogeneity, simultaneity and measurement errors, we do not observe in the aggregate any "structural" effect of foreign ownership on productivity.

As a mean of comparison, Tables 6 and 7 report the results we obtain when applying alternative estimation methods. In particular, Table 6 shows the results using earlier instruments dated $t-2$ for the equations in first differences and instruments dated $t-1$ for the equations in level. This choice of instruments is valid if $w_{it} \sim MA(0)$. This obviously contradicts the assumptions made on the composite idiosyncratic error term in (5) unless the presence of measurement errors is ruled out. In all columns of Table 6 the validity of the choice of instruments is strongly rejected by the Sargan test of overidentyfing restrictions. In turn, this result clearly points out to the presence of measurement errors. In Table 7, OLS estimates are reported. As it is well known, the validity of this estimation method relies on the assumption that each component of the error term - including the time invariant individual effect - is uncorrelated with all regressors in (5), clearly a very unlikely event in the present context. However, these estimates can still be informative to the extent they allow us to measure the statistical associations (as opposed to "structural" or "causal" relations) - unconditional to the unobservables - among our variables of interest. With this purpose in mind, in columns 1 and 2 the model is estimated without industry dummies which are instead included in columns 3 and 4. All equations show a positive and in most cases significant relation between the type of ownership dummy and productivity. Furthermore, this statistical association turns out to be larger (3.9-4.6% versus 1.6-2.6%) and more significant when industry dummies are not included, that is when the so-called composition effect is not controlled for (see Davies and Lyons, 1991).

Tables 8 to 10 present additional evidence by allowing the coefficients on the ownership variable to differ according to economically meaningful criteria.[8] According to received theory it is in high-tech industries that multinationals are more likely to possess proprietary assets that can be transferred to local subsidiaries. This prediction is tested in Table 8 where the effect of ownership on productivity is estimated separately for foreign firms located in high-tech (HT) as opposed to low-tech (LT) industries. Also, as already mentioned in the previous section, it might be argued that it takes some years for MNEs' proprietary assets to be transferred to foreign subsidiaries and, possibly more importantly, to be used efficiently. For this reason Table 9 allows the relevant coefficients to vary according to whether firms are under foreign ownership by more (OLD) or less-equal than five years (NEW). Finally, it has also to be taken into account that countries differ with respect to many economic aspects, including their distance from the technological frontier. To test whether this makes any difference on the observed structural relation between ownership and productivity, Table 10 presents the results of our estimates which compare subsidiaries of US companies (US) with subsidiaries of companies located in other foreign countries (OT).

These additional empirical results can be summarized as follow. Firstly, punctual estimates suggest that foreign ownership has a positive effect on productivity in high-tech industries and a negative effect in low-tech-industries. However, as can be seen by looking at all columns in Table 8, coefficients are imprecisely estimated. Not only they are not significantly different from zero at any conventional statistical level, but their difference is also not statistically significant. Similar conclusions can be drawn by looking at Table 9. In all specifications the coefficients on both "old" and "new" foreign firms are negative but insignificant. Finally, and rather interestingly, in three out of four equations, we find that US foreign firms tend to be significantly more productive than domestic firms. Moreover, the difference be-

[8] In all equations earlier instruments are dated t-3 for the equations in first differences and t-2 for the equations in level.

tween US firms and OT firms is significant in all models at the 10 per cent and in three out of four model at the 5 per cent significance level.[9]

6 Conclusions

Both received theory on multinational firms and common wisdom point out that subsidiaries of foreign firms should operate more efficiently than local firms. However, this may occur for different reasons. Indeed, it may be explained by the fact the MNEs possess superior managerial and/or technological skills that can be transferred to their foreign affiliates. However, it might also be the outcome of a preference for MNEs to acquire the best locals or to operate in the most productive industries. Finally, as pointed out by Griffith (1999a, 1999b) it may simply be that both groups of firms are drawn from the same distribution but only the best foreign owned firms have chosen to locate in a given country.

To shed some light on this issue we have tried to recover the "structural" or "causal" effect of foreign ownership on productivity by imposing only relatively mild restrictions on the initial conditions for the variables in our dynamic model. In particular we have applied the GMM-System estimator developed by Blundell and Bond (1998) which has allowed us to control for unobserved heterogeneity, simultaneity and measurement errors.

The descriptive evidence presented in this paper suggests that the average foreign firm is larger and more (labor) productive than the average domestic counterpart. Furthermore, it is more likely to operate in high-tech industries. Obviously, these statistical associations do not necessarily imply a "causal" relation. Indeed our econometric results suggest that in the aggregate there is no "structural" relation

[9] We run additional equations by splitting the OT firms according the following list of countries: Germany, France, UK, Other EU Countries, Other non-EU Countries. We find zero effects for all countries but "Other non-EU Countries" where a negative and significant effect is detected. These additional results are available from the authors upon request.

at all. In plain words, this implies that the expected effect on total factor productivity of a change from domestic to foreign ownership (regardless of nationality) is zero. This finding holds even after allowing the "structural" effect to differ between high-tech and low-tech industries or between "old" and "new" foreign firms. However our results are not completely negative since we also find that nationality matters. Rather interestingly, a positive and significant effect is found for firms under US ownership but not for firms under EU ownership. This in turn opens a policy relevant question on whether our results have to be interpreted as evidence of American multinationals being more skilled or better equipped to transfer their skills efficiently than their European counterparts.

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8 Data Appendix

8.1 The Sample

The data used in this paper come from the CLA-Reprint database. It has been constructed by Centro Studi Luca d'Agliano in collaboration with R&P consulting company and the Department of Economics and Production of the Politechnic of Milan. The database provides two kinds of information: i) information on foreign ownership for all manufacturing firms located in Italy and owned by a foreign company for at least one year in the 1992-99 period; ii) balance sheet data covering the same period for a large sample of (both foreign and domestic-owned) firms located in Italy.

The following information on foreign-owned manufacturing firms is available in the database: identification number ("Partita IVA"), name, localisation and main industry of activity (NACE-Rev.1, five digit classification) of the foreign owned company; name and country of origin of the foreign owner; starting date (and ending date, if any) of foreign participation; type of foreign participation (majority, joint, minority).

The CLA-Reprint database also contains balance sheet data for 1,600 foreign-owned firms as well as for a random sample of domestic-owned firms. Balance sheet data have been retrieved from the on-line version of the Aida data-bank produced by Bureau Van Dijk. The on-line version includes data for the 6 most recent fiscal years and provides information for more than 50,000 Italian manufacturing firms. The sample of domestic-owned firms (4,846 firms) has been selected by drawing a random sample of 5,000 firms and by excluding foreign firms from the random sample.

For the purpose of the present paper, additional cleaning procedures have been followed. Firstly, we removed from the original sample firms with unknown industry activity, as defined by the Nace three digit classification. This has been done in order to allow the use of three-digit price deflators for output. Secondly, we excluded observations with either missing or non-positive values for output, materials, and capital stock. We required a more stringent condition for employment and chose to keep only observations with more than 10 employees. The rationale here is that accounting information for very small firms are unlikely to be very reliable. Indeed, observations for the micro-firms in the original sample show puzzling summary statistics for some of the variables (and especially for the capital stock). Thirdly, we applied a standard trimming procedure to the logarithmic first differences of all the variables used in estimation and we excluded observations with values above 1 or below -0.5. In this case the purpose is to exclude form the sample firms with anomalously high growth rates in absolute values. Finally, given the requirements of the adopted econometric methodology we selected only firms with at least four contiguous observations. Our final sample is made of 2,026 firms with a number of contiguous observations ranging from 4 to 6 for a total of 10,324 observations (see Table 1).

8.2 The Variables

The variables used in the estimation of the production function are output, materials, capital stock and labor.

Output is computed as the sum of sales, capitalised costs and the change of work-in-progress and in finished goods inventories. All variables are deflated with the appropriate three digit production price index provided by the National Statistical Bureau (ISTAT).

Materials are computed as a Tornquist index of deflated materials and services. Materials equal purchases of materials net of the increase in raw material inventories. Materials are deflated with an aggregate price index for raw materials and services are deflated with the GDP price index.

The capital stock is the real fixed capital stock (at the end of period) computed by a Perpetual Inventory Method with a constant rate of depreciation (6%). The benchmark at the first year is the accounting value as reported in the balance sheet; fixed investment is the difference between the capital stock as reported in two contiguous balance sheets and the deflator is the production price index for investment goods.

Labor is measured as the total number of workers at the end of the fiscal year.

Table 1: Number of Consecutive Observations

Cons. Obs.	Firms	Observations
4	670	2680
5	492	2460
6	864	5184
Total	2026	10324

Table 2: Share of Observations by Type of Ownership (%)

Sector	Observations
Domestic Ownership (DO)	60.62
Foreign Ownership (FO)	39.38
Germany	7.05
France	6.65
United Kingdom	3.75
Other EU Countries	6.31
United States	9.00
Other non-EU Countries	6.62
New FO Firms	9.33
Old FO Firms	30.05

Note: New (Old) FO firms refer to firm-year observations fallen under foreign ownership no more (more) than 5 years before.

Table 3: Share of Observations by Industry (%)

Industry	Dom. Owner.	For Owner.
Food and Beverage	9.12	7.60
Tobacco	0.00	0.10
Textile	10.08	2.36
Clothing	3.24	0.71
Leather and Leather Goods	5.13	0.42
Wood Products	2.56	0.12
Paper and Paper Products	2.27	3.32
Printing and Publishing	2.32	2.43
Coke and Petroleum Products	0.75	1.03
Chemical Products(*)	4.94	21.54
Rubber and Plastics	6.73	8.04
Non-Ferrous Production	7.94	5.63
Ferrous Production	2.84	2.61
Ferrous Products (exc. Machinery)	12.08	6.76
Machinery Products(*)	12.62	15.54
Office Machinery and Computers(*)	0.27	0.15
Electrical Machinery(*)	3.87	7.48
Radio, TV and TLC Equipments(*)	1.05	2.14
Medical Equipment, Meas. Instrum.(*)	1.26	4.70
Motor Vehicles(*)	2.11	4.03
Other Transportation Equipments(*)	0.96	0.96
Other Manufacturing Industries	7.85	2.19
Recycling	0.00	0.12
Total	100.00	100.00
High-Tech Industries (HT)	27.08	56.54

Note: * denotes high-tech industries.

Table 4: Descriptive Statistics

Variables	**Mean**	**St. Dv.**	**1st Q.**	**Median**	**3rd Q.**
Dom. Owners.					
Output (Y)	34.20	143.96	8.16	13.66	27.72
Materials (M)	17.29	102.35	3.24	5.93	12.59
Labor (L)	86.50	348.13	25.00	40.00	79.00
Capital (K)	5.96	18.72	0.91	2.21	5.03
Output/Labor (Y/L)	0.454	0.684	0.219	0.317	0.517
Capital/Labor (K/L)	0.073	0.088	0.026	0.050	0.090
Materials/Labor (M/L)	0.239	0.548	0.080	0.137	0.256
For. Owners.					
Output (Y)	174.72	656.25	26.30	57.27	134.44
Materials (M)	80.74	290.89	11.33	25.62	60.15
Labor (L)	373.68	956.28	63.00	141.00	325.00
Capital (K)	29.76	89.16	3.23	8.86	22.26
Output/Labor (Y/L)	0.528	0.600	0.269	0.395	0.596
Capital/Labor (K/L)	0.087	0.123	0.033	0.058	0.103
Materials/Labor (M/L)	0.272	0.410	0.105	0.171	0.300

Note: all variables except Labor are in billions lira at 1995 prices. Labor is measured as number of employees at the end of fiscal year.

Table 5: Equation Results - Basic Model

Estimation method	Gmm-Sys	Gmm-Sys	Gmm-Sys	Gmm-Sys
Earlier Instruments	$t-3, \Delta t-2$	$t-3, \Delta t-2$	$t-3, \Delta t-2$	$t-3, \Delta t-2$
y_{t-1}	0.577(0.00)	0.576(0.00)	0.597(0.00)	0.599(0.00)
m_t	0.516(0.00)	0.513(0.00)	0.494(0.00)	0.489(0.00)
m_{t-1}	−0.231(0.00)	−0.227(0.00)	−0.222(0.00)	−0.219(0.00)
l_t	0.481(0.00)	0.488(0.00)	0.430(0.00)	0.438(0.00)
l_{t-1}	−0.343(0.00)	−0.348(0.00)	−0.280(0.00)	−0.287(0.00)
k_t	0.089(0.08)	0.085(0.09)	0.102(0.09)	0.093(0.10)
k_{t-1}	−0.075(0.14)	−0.072(0.15)	−0.099(0.09)	−0.092(0.11)
O_t	−0.054(0.55)	−0.002(0.93)	−0.106(0.45)	−0.024(0.51)
O_{t-1}	0.050(0.57)		0.082(0.54)	
ϵ_{my}	0.675	0.673	0.676	0.672
ϵ_{ly}	0.326	0.329	0.372	0.377
ϵ_{ky}	0.032	0.029	0.007	0.002
Scale elasticity	1.033	1.031	1.055	1.052
m_1	(0.00)	(0.00)	(0.00)	(0.00)
m_2	(0.14)	(0.12)	(0.18)	(0.14)
Sargan	(0.04)	(0.04)	(0.06)	(0.06)
LR ownership effect	−0.008(0.90)	−0.005(0.93)	−0.062(0.51)	−0.061(0.52)

Note: All regressions are estimated in DPD98 (see Arellano and Bond, 1998). All estimates include a full set of time and two-digit industry dummies as regressors and instruments. In all columns instruments used are l(3,5), m(3,5), k(3,5), y(3,5) for the equations in differences and Δl(t-2), Δm(t-2), Δk(t-2), Δy(t-2) for the equations in level. Additional instruments in columns (i) and (ii) are O(3,5) and ΔO(t-2). P-values in round brackets. The null hypothesis that each coefficient is equal to zero is tested using one-step robust standard errors. $m_1(m_2)$ is a test of the null hypothesis of no first (second) order serial correlation. Sargan is a test of the validity of the overidentyfing restrictions based on the efficient two-step GMM estimator.

Table 6: Equation Results - Alternative Estimation Method (Gmm-Sys 2)

Estimation method	Gmm-Sys	Gmm-Sys	Gmm-Sys	Gmm-Sys
Earlier Instruments	$t-2, \Delta t-1$	$t-2, \Delta t-1$	$t-2, \Delta t-1$	$t-2, \Delta t-1$
y_{t-1}	0.401(0.00)	0.402(0.00)	0.423(0.00)	0.421(0.00)
m_t	0.481(0.00)	0.480(0.00)	0.444(0.00)	0.446(0.00)
m_{t-1}	$-0.011(0.70)$	$-0.011(0.69)$	0.007(0.80)	0.008(0.80)
l_t	0.255(0.00)	0.254(0.00)	0.219(0.00)	0.220(0.00)
l_{t-1}	$-0.136(0.03)$	$-0.135(0.03)$	$-0.110(0.12)$	$-0.111(0.12)$
k_t	0.072(0.04)	0.071(0.04)	0.109(0.01)	0.109(0.01)
k_{t-1}	$-0.065(0.07)$	$-0.065(0.07)$	$-0.108(0.01)$	$-0.109(0.01)$
O_t	0.021(0.78)	0.001(0.97)	-0.013(0.91)	0.031(0.37)
O_{t-1}	$-0.020(0.78)$		0.045(0.70)	
ϵ_{my}	0.786	0.786	0.782	0.783
ϵ_{ly}	0.198	0.198	0.190	0.189
ϵ_{ky}	0.011	0.011	0.000	0.000
Scale elasticity	0.994	0.995	0.973	0.972
m_1	(0.00)	(0.00)	(0.00)	(0.00)
m_2	(0.25)	(0.25)	(0.55)	(0.53)
Sargan	(0.00)	(0.00)	(0.00)	(0.00)
LR ownership effect	0.002(0.97)	0.001(0.97)	0.055(0.37)	0.054(0.38)

Note: All regressions are estimated in DPD98 (see Arellano and Bond, 1998). All estimates include a full set of time and two-digit industry dummies as regressors and instruments. In all columns instruments used are l(2,5), m(2,5), k(2,5), y(2,5) for the equations in differences and Δl(t-1), Δm(t-1), Δk(t-1), Δy(t-1) for the equations in level. Additional instruments in columns (i) and (ii) are O(2,5) and ΔO(t-1). P-values in round brackets. The null hypothesis that each coefficient is equal to zero is tested using one-step robust standard errors. $m_1(m_2)$ is a test of the null hypothesis of no first (second) order serial correlation. Sargan is a test of the validity of the overidentyfing restrictions based on the efficient two-step GMM estimator.

Table 7: Equation Results - Alternative Estimation Method (Ols)

Estimation method	Ols	Ols	Ols	Ols
y_{t-1}	0.848(0.00)	0.848(0.00)	0.836(0.00)	0.836(0.00)
m_t	0.509(0.00)	0.509(0.00)	0.510(0.00)	0.510(0.00)
m_{t-1}	−0.398(0.00)	−0.398(0.00)	−0.390(0.00)	−0.390(0.00)
l_t	0.266(0.00)	0.266(0.00)	0.265(0.00)	0.265(0.00)
l_{t-1}	−0.227(0.00)	−0.227(0.00)	−0.223(0.00)	−0.223(0.00)
k_t	0.019(0.00)	0.019(0.00)	0.019(0.00)	0.019(0.00)
k_{t-1}	−0.014(0.01)	−0.014(0.01)	−0.015(0.00)	−0.015(0.00)
O_t	−0.021(0.09)	0.006(0.02)	−0.023(0.07)	0.003(0.22)
O_{t-1}	0.028(0.02)		0.027(0.03)	
ϵ_{my}	0.733	0.734	0.731	0.731
ϵ_{ly}	0.253	0.254	0.258	0.260
ϵ_{ky}	0.030	0.029	0.023	0.023
Scale elasticity	1.016	1.017	1.013	1.014
m_1	(0.00)	(0.00)	(0.00)	(0.00)
m_2	(0.00)	(0.00)	(0.00)	(0.01)
Sargan				
LR ownership effect	0.046(0.00)	0.039(0.01)	0.026(0.09)	0.019(0.21)

Note: All regressions are estimated in DPD98 (see Arellano and Bond, 1998). All estimates include a full set of time dummies. The last two columns also include a full set of two-digit industry dummies as regressors. The null hypothesis that each coefficient is equal to zero is tested using one-step robust standard errors. $m_1(m_2)$ is a test of the null hypothesis of no first (second) order serial correlation.

Table 8: Equation Results - "High-Tech" versus "Low Tech" FO Firms

Estimation method	Gmm-Sys	Gmm-Sys	Gmm-Sys	Gmm-Sys
Number of Observations	$t-3, \Delta t-2$	$t-3, \Delta t-2$	$t-3, \Delta t-2$	$t-3, \Delta t-2$
y_{t-1}	0.570(0.00)	0.575(0.00)	0.580(0.00)	0.596(0.00)
m_t	0.516(0.00)	0.511(0.00)	0.490(0.00)	0.467(0.00)
m_{t-1}	−0.233(0.00)	−0.225(0.00)	−0.218(0.00)	−0.200(0.00)
l_t	0.483(0.00)	0.490(0.00)	0.442(0.00)	0.456(0.00)
l_{t-1}	−0.336(0.00)	−0.351(0.00)	−0.275(0.01)	−0.302(0.00)
k_t	0.099(0.07)	0.085(0.09)	0.112(0.08)	0.096(0.10)
k_{t-1}	−0.088(0.10)	−0.072(0.16)	−0.108(0.08)	−0.092(0.11)
$O_t * HT_t$	−0.396(0.09)	0.006(0.93)	−0.568(0.07)	0.037(0.66)
$O_{t-1} * HT_{t-1}$	0.438(0.07)		0.646(0.04)	
$O_t * LT_t$	0.109(0.46)	-0.006(0.88)	0.047(0.82)	−0.076(0.28)
$O_{t-1} * LT_{t-1}$	−0.124(0.43)		−0.133(0.50)	
ϵ_{my}	0.658	0.672	0.647	0.663
ϵ_{ly}	0.343	0.328	0.397	0.382
ϵ_{ky}	0.025	0.030	0.008	0.009
Scale elasticity	1.026	1.030	1.052	1.054
m_1	(0.00)	(0.00)	(0.00)	(0.00)
m_2	(0.28)	(0.12)	(0.47)	(0.14)
Sargan	(0.14)	(0.04)	(0.29)	(0.07)
LR ownership effect				
High-Tech (HT)	0.098(0.61)	0.015(0.93)	0.186(0.42)	0.092(0.66)
Low-Tech (LT)	−0.036(0.73)	−0.015(0.88)	−0.204(0.29)	−0.187(0.30)
High-Low ($HT-LT$)	0.134(0.61)	0.030(0.90)	0.390(0.29)	0.279(0.41)

Note: as in Table 5.

Table 9: Equation Results - "Old" versus "New" FO Firms

Estimation method	Gmm-Sys	Gmm-Sys	Gmm-Sys	Gmm-Sys
Number of Observations	$t-3, \Delta t-2$	$t-3, \Delta t-2$	$t-3, \Delta t-2$	$t-3, \Delta t-2$
y_{t-1}	0.568(0.00)	0.578(0.00)	0.576(0.00)	0.592(0.00)
m_t	0.512(0.00)	0.509(0.00)	0.504(0.00)	0.502(0.00)
m_{t-1}	−0.218(0.00)	−0.225(0.00)	−0.220(0.00)	−0.231(0.00)
l_t	0.475(0.00)	0.487(0.00)	0.419(0.00)	0.432(0.00)
l_{t-1}	−0.330(0.00)	−0.345(0.00)	−0.259(0.01)	−0.281(0.00)
k_t	0.086(0.09)	0.083(0.10)	0.084(0.17)	0.096(0.10)
k_{t-1}	−0.074(0.15)	−0.072(0.16)	−0.075(0.22)	−0.087(0.13)
$O_t * OLD_t$	−0.153(0.20)	−0.011(0.77)	−0.108(0.50)	−0.006(0.88)
$O_{t-1} * OLD_{t-1}$	0.143(0.19)		0.104(0.48)	
$O_t * NEW_t$	−0.055(0.54)	−0.003(0.90)	−0.055(0.73)	−0.093(0.15)
$O_{t-1} * NEW_{t-1}$	0.050(0.56)		−0.059(0.71)	
ϵ_{my}	0.679	0.674	0.671	0.665
ϵ_{ly}	0.335	0.337	0.378	0.372
ϵ_{ky}	0.029	0.027	0.021	0.020
Scale elasticity	1.044	1.037	1.069	1.057
m_1	(0.00)	(0.00)	(0.00)	(0.00)
m_2	(0.09)	(0.11)	(0.10)	(0.23)
Sargan	(0.06)	(0.04)	(0.21)	(0.23)
LR ownership effect				
OLD	−0.024(0.79)	−0.027(0.77)	−0.009(0.93)	−0.015(0.88)
NEW	−0.011(0.85)	−0.008(0.90)	−0.268(0.10)	−0.227(0.16)
OLD-NEW	−0.013(0.84)	−0.019(0.78)	0.259(0.13)	0.212(0.19)

Note: as in Table 5.

Table 10: Equation Results "US" versus "Other" FO Firms

Estimation method	Gmm-Sys	Gmm-Sys	Gmm-Sys	Gmm-Sys
Number of Observations	$t-3, \Delta t-2$	$t-3, \Delta t-2$	$t-3, \Delta t-2$	$t-3, \Delta t-2$
y_{t-1}	0.531(0.00)	0.522(0.00)	0.563(0.00)	0.551(0.00)
m_t	0.506(0.00)	0.495(0.00)	0.483(0.00)	0.467(0.00)
m_{t-1}	−0.189(0.01)	−0.172(0.01)	−0.187(0.01)	−0.166(0.02)
l_t	0.448(0.00)	0.465(0.00)	0.384(0.00)	0.418(0.00)
l_{t-1}	−0.289(0.00)	−0.304(0.00)	−0.217(0.03)	−0.254(0.01)
k_t	0.055(0.31)	0.059(0.26)	0.072(0.24)	0.075(0.20)
k_{t-1}	−0.041(0.44)	−0.046(0.38)	−0.068(0.26)	−0.073(0.22)
$O_t * US_t$	0.290(0.11)	0.158(0.03)	0.366(0.11)	0.144(0.06)
$O_{t-1} * US_{t-1}$	−0.155(0.42)		−0.273(0.27)	
$O_t * OT_t$	−0.181(0.12)	-0.052(0.12)	−0.261(0.13)	−0.056(0.20)
$O_{t-1} * OT_{t-1}$	0.129(0.25)		0.197(0.22)	
ϵ_{my}	0.676	0.674	0.676	0.672
ϵ_{ly}	0.339	0.336	0.381	0.366
ϵ_{ky}	0.030	0.027	0.008	0.005
Scale elasticity	1.045	1.037	1.065	1.042
m_1	(0.00)	(0.00)	(0.00)	(0.00)
m_2	(0.12)	(0.11)	(0.17)	(0.14)
Sargan	(0.09)	(0.04)	(0.23)	(0.07)
LR ownership effect				
US	0.288(0.07)	0.331(0.02)	0.215(0.25)	0.321(0.06)
Other (OT)	−0.110(0.12)	−0.109(0.11)	−0.146(0.16)	−0.125(0.21)
$US - OT$	0.398(0.03)	0.440(0.01)	0.361(0.07)	0.446(0.02)

Note: as in Table 5.