Outsourcing versus integration at home and abroad

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Abstract

Using data on a sample of Italian manufacturing companies, this paper analyzes the location (at home or abroad) and the mode of organization (outsourcing versus integration) of intermediate inputs production. We find evidence of a productivity ordering (largely consistent with the assumptions in Antràs and Helpman 2004) where foreign integration is chosen by the most productive firms while domestic outsourcing is chosen by the least productive firms; firms with medium-high productivity choose domestic integration, firms with medium-low productivity foreign outsourcing. We also find that the preference for integration over outsourcing is positively related to several indicators of headquarter intensity, notably capital intensity, as predicted by Antràs (2003) and Antràs and Helpman (2004). *Keywords*: international outsourcing; foreign direct investment; intra-firm trade; productivity. *JEL Classification*: F12; F23; L22.

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Contents

1 Introduction

In the last decades the strong growth of trade in intermediate inputs and the rise in FDI have been major features of international trade. A useful conceptual framework to address these issues is the assumption that a firm which needs an intermediate input has to make a two-dimensional choice: it has to decide *where* to produce the good (at home or abroad) and *how* to produce it (in-house or outsourced to another firm). The combination of these two choices yields four possibilities: an input can be produced in the home country, either in-house (domestic integration) or in outsourcing (domestic outsourcing), or it can be produced in a foreign country, again either in-house (foreign integration or FDI) or in outsourcing (foreign outsourcing). As argued by Helpman (2006a), "an understanding of what drives these choices is essential for an understanding of the recent trends in the world economy".

Several theoretical models, at the crossroads of industrial organization and international trade, have been developed (Antràs 2003, Antràs and Helpman 2004, Grossman and Helpman 2004, Antràs and Helpman 2008; for surveys see Spencer 2005, Helpman 2006b and Antràs and Rossi-Hansberg 2008). Despite the rich set of predictions, the empirical evidence is far from abundant: some studies use industry and country data for the United States (Antràs 2003, Yeaple 2006, Nunn and Trefler 2008, Bernard et al. 2008), while a few others use firm-level data (Kurz 2006, Tomiura 2007, Defever and Toubal 2007, Lin and Thomas 2008). The small number of empirical studies stands in contrast with the large literature on other forms of international activities, such as exporting. As emphasized in a number of recent surveys (Bernard et al. 2007, Greenaway and Kneller 2007, Helpman 2006b), there is a strong need for empirical research, which evidently requires detailed firm-level data on intermediate inputs trade.

This paper contributes to the empirical literature on the choice between outsourcing and integration at home and abroad, using detailed information on the sourcing strategies adopted by a sample of Italian manufacturing firms. We are able to observe the four organizational forms mentioned above

(domestic integration, domestic outsourcing, foreign integration and foreign outsourcing). This is an improvement with respect to previous literature: studies based on trade data usually do not observe input purchases from domestic suppliers; most of previous firm-level studies do not have information on input purchases from foreign affiliates, thus using ownership of any foreign affiliate (even if not providing any intermediate input) as a proxy for foreign-integration sourcing.

Furthermore, our data on intermediate inputs only include inputs produced within a "subcontracting" relationship, i.e. according to the specifications of the buying company. In contrast to studies using trade data, our data therefore exclude raw materials and standardized or "generic" inputs bought on a spot market. This is fully consistent with theory, which usually assumes that the supplier has to undertake relationship-specific investments in order to produce the goods needed by the firm.

The rest of the paper is structured as follows. Section 2 provides a review of related literature and Section 3 describes the data. Section 4 reports empirical results, while Section 5 concludes.

2 Related literature

Theories on the choice between integration and outsourcing are mainly based on the property rights approach. Production of a final good requires two intermediate inputs, which are assumed to be specific for a particular production and cannot be used outside that production. One of the two inputs can only be provided by the final-good producer at home; as regards the other input, the producer decides where to locate its production (at home or abroad) and whether to make it in-house or buy it from an independent supplier. The supplier has to undertake a relationship-specific investment in order to specialize production to the buyer's needs. However, the level of investment cannot be specified in the contract between the supplier and the buyer. The assumption of incomplete contracting leads to a situation in which the provision of both inputs is below the level which would be attained if contracts were complete, because the threat of contractual breach reduces

each party's incentives to invest (hold-up problem). An efficient solution would generally imply that the party which contributes most to the value of the relationship through its investment should own the residual rights of control. Integration arises when production is very intensive in the input provided by the final-good producer. By contrast, when the contribution of the other input is very relevant to the output, it will be optimal to outsource the production of the input to the supplier.

On this basis, it is possible to make predictions about the way the relative prevalence of organizational forms varies according to industry characteristics. Antràs (2003) assumes that production employs capital and labour and that final-good producers can contribute to capital expenses incurred by suppliers. At low levels of capital intensity, it will be optimal to assign the residual rights of control to the supplier (outsourcing); when capital intensity is high, the producer will prefer integration. Antràs and Helpman (2004) suppose that the production function requires the following inputs: headquarter services (whose supply is controlled by the final-good producer) and manufactured components. Outsourcing is preferred to integration in sectors with low intensity of headquarter services, while the opposite happens in sectors with high headquarter intensity.

Antràs (2003) presents evidence that the share of intra-firm U.S. imports on total U.S. imports is positively related to the capital intensity (and R&D intensity) of the industry. The share of intra-firm imports also tends to rise with the capital-labor ratio of the exporting country. Yeaple (2006) finds that intra-firm U.S. imports from the least developed or emerging countries are positively correlated with capital intensity, while imports from advanced countries are positively correlated with R&D intensity. Using data on U.S. imports at a more disaggregated level, Nunn and Trefler (2008) and Bernard et al. (2008) provide further evidence of the positive relationship between intra-firm trade and two measures of headquarter intensity, namely capital intensity and skill intensity.

By introducing heterogeneous firms in this setting further predictions about the choice of organizational forms can be made. In the work of Melitz

(2003), the assumption that exports require fixed costs determines a selection mechanism by which exporting will be profitable only for the most productive firms. A similar reasoning leads to assume that participation in international activities (foreign integration or outsourcing) entails high fixed costs, invoilving as a consequence only the most productive firms. Starting from this assumption, and also supposing that fixed costs of integration are higher than those of outsourcing, Antràs and Helpman (2004) show that the productivity ranking influences firms' choices: specifically, in sectors with high headquarter intensity, foreign integration is chosen by the most productive firms, while firms with medium-high productivity prefer foreign outsourcing, firms with medium-low productivity prefer domestic integration, and the least productive firms prefer domestic outsourcing. In sectors with low headquarter intensity, where the advantage of producing the component abroad is larger, only two organizational forms remain: foreign outsourcing (for less productive firms) and foreign integration (for more productive firms)

However, these findings crucially depend on specific assumptions about fixed costs. For instance, Antràs and Helpman (2004) show that if the ordering of organizational fixed costs were inverted and outsourcing became more costly than integration, then the most productive firms would choose to outsource abroad, while less productive firms would choose foreign integration; lower-productivity firms would outsource at home and domestic integration would be chosen by the least productive firms (Table 1). In the case of economies of scope in management assuming lower fixed costs of integration is more appropriate, because a joint supervision of the production of the input and the other activities is more convenient; conversely, when there are significant costs related to managerial overload the assumption of lower fixed costs of outsourcing is more correct.

In a different setting, the relationship between organizational form and firms' productivity is even more complex. Grossman and Helpman (2004) put forth a "managerial incentives" model of the international organization of production. The production of a differentiated good by a principal requires a component or a service which can only be provided by a skilled agent. The agent may act as an independent supplier or as a "division" of the principal.

There is a trade-off between the stronger incentives if the supplier is independent and the greater monitoring allowed by vertical integration. The authors find that foreign outsourcing will be chosen by the most productive and the least productive firms, while intermediate-productivity firms will choose to integrate (see Table 1). The intuition is that at the two ends of the productivity's spectrum there is a greater need to induce a high level of effort in the agent, whose incentives are stronger if he acts independently; in the middle range the ability to monitor the agent's efforts weighs more heavily in raising potential revenues.

Given the extent to which the various assumptions and models influence the predictions, empirical evidence is definitely needed to discriminate between them. Using industry-level data, Yeaple (2006) and Bernard et al. (2008) show that intra-firm trade is higher in industries with greater productivity dispersion. Nunn and Trefler (2008) confirm this finding, adding that the positive relationship between intra-firm and productivity is stronger for high values of headquarter intensity, as predicted by Antràs and Helpman (2004). Among firm-level studies, Tomiura (2005) analyzes a wide database on Japanese manufacturing firms, highlighting large heterogeneity: less than 3% of firms is involved in foreign outsourcing. He finds a positive correlation between the ratio of foreign outsourcing to sales, on the one hand, and productivity or size on the other. In a follow-up paper (Tomiura 2007), the analysis is extended to the choice between international outsourcing and FDI. The results show that organizational forms follow a productivity ordering which is consistent with the predictions of Antràs and Helpman (2004): the most productive firms engage in FDI, less productive firms choose international outsourcing and domestic firms are the least productive. This productivity ordering holds even when firm size, capital intensity and industry are controlled for.[1]

[1] A reverse ranking, where more productive firms are less likely to source from affiliate suppliers, is found instead by Defever and Toubal (2007). Their sample (which includes only firms that are already multinational firms, i.e. that control at least 50% of the equity capital of a foreign affiliate) might take some role in explaining their finding.

3 Data

3.1 Sample

Our firm-level data come from the "Survey on Manufacturing Firms", conducted every three years by Mediocredito Capitalia (MCC). We use the 7th wave of the survey, carried out in 1998, in which information about firms' sourcing strategies - the core of our analysis - was collected.[2] The survey covers the three years immediately prior (1995-1997), although some parts of the questionnaire only refer to 1997. Balance sheet data are available for the years 1989-1997. The sampling design included all firms with a minimum of 500 employees. Firms whose employees range from 10 to 500 were selected according to three stratification criteria: geographical area, sector and firm size. In the 1998 survey the total number of firms is equal to 4,497. After dropping the firms for which balance sheet data or other important variables were not available, we end up having 3,819 observations (around 4% of the universe according to the 2001 census data).[3]

Table 2 shows that the sample is distributed between the various geographical areas and sectors consistently with the distribution of the reference population. Firms located in the North-West and firms operating in the "chemicals, rubber and plastic" sector are slightly over-represented in the sample, the inverse being true for firms located in the South and Islands and for firms operating in the "textile, clothing and shoes" sector. In terms of firm size, the sample is somewhat unbalanced in favour of medium and large firms.

[2]Unfortunately, the following waves of MCC surveys did not include questions on firms' sourcing strategies. Such information was generally missing in other firm-level databases too. The results reported in this paper cannot therefore be taken as evidence on the most recent trends of the Italian economy.

[3]The coverage ratio rises to 11.9% for firms with a minimum of 50 employees and 23.8% for firms with a minimum of 200 employees.

3.2 Subcontracting

The MCC database provides information on the incidence of subcontracting on total purchases of goods and services, as well as on the type of suppliers. In the Italian legal system, subcontracting is referred to as "a contract through which an entrepreneur engages itself on behalf of the buying company to carry out workings on semifinished products or raw materials, or to supply products or services to be incorporated or used in the buying company's economic activity or in the production of a complex good, *in conformity with the buying company's projects, techniques, technologies, models or prototypes*" (Law 192/1998, italics added). Our definition of subcontracting therefore excludes the purchase of standardized goods or raw materials, in line with the notion used in the theoretical literature.

The theoretical models assume indeed that the supplier must undertake relationship-specific investments in order to produce the goods needed by the firm. A quotation from Grossman and Helpman (2005, p. 136) is illustrative of the point: "To us, outsourcing means more than just the purchase of raw materials and standardized goods. It means finding a partner with which a firm can establish a bilateral relationship and having the partner undertake relationship-specific investments so that it becomes able to produce goods or services that fit the firm's particular needs". In fact, with the exception of Tomiura (2005, 2007), empirical literature has been forced by data limitations to use a wider definition of outsourcing, ranging from imports of all - intermediate and final - goods (Antràs 2003, Yeaple 2006, Nunn and Trefler 2008) to raw materials and components (Kurz 2006) or processing exports (Feenstra and Spencer 2005).

Using our firm-level data we are able to identify four types of suppliers (and, correspondingly, four organizational forms, indicated in brackets): affiliates located in Italy (domestic integration); affiliates located abroad (foreign integration); non-affiliates located in Italy (domestic outsourcing); non-affiliates located abroad (foreign outsourcing). These organizational forms very closely match those usually assumed in the theoretical literature, allowing for a rigorous test of its predictions. A fifth organizational form actually

emerges from our data, namely when the incidence of subcontracting is zero. Although this could be interpreted as a case of domestic integration, in which all transactions occur within the same firm, we think it preferable to consider it as a specific organizational form (no sourcing). There are two reasons: first, their number is quite high (about two thirds of the total amount of firms); second, no-sourcing firms are markedly different from domestic-integration firms, in terms of industry-level or firm-level characteristics.

Table 3 shows that about 1.2% of firms in the sample purchased at least some input from foreign affiliates, while 7.0% of firms purchased at least some input from foreign non-affiliates. As a comparison, Tomiura (2007) finds that the number of foreign-outsourcing firms was equal to 2.7%. The difference is likely due to the bias in favour of medium-large firms of our sample. The usage of foreign inputs varies considerably across industries. Foreign integration is more widespread in the "chemicals, rubber and plastic" industry and in the "metals and mechanical" industry; the latter ranks high also for foreign and domestic outsourcing, followed by the "textile, clothing, shoes" industry.

In terms of firm size, there is a positive monotonic relationship with foreign integration and domestic integration, while both foreign outsourcing and domestic outsourcing there appears to be a peak in the 200-499 employees category. The recourse to mixed sourcing strategies (for instance, simultaneously buying inputs from affiliates and non-affiliates, or from domestic and foreign suppliers) is not infrequent. In particular, there is a strong correlation at the industry level between domestic outsourcing and foreign outsourcing: sectors with a high share of domestic outsourcing also tend to have a high share of foreign outsourcing. Grossman et al. (2005) maintain that this is consistent with industries where the fixed cost of outsourcing is very low.

3.3 Productivity

We compute several measures of firm-level productivity. This variable plays a crucial role in the study of within-industry heterogeneity and the fixed costs of the various organizational forms. Looking at several measures of

productivity, we are able to check the robustness of our results to alternative methods and assumptions. We start with the simplest measure: the log of value added per worker (VA_i/L_i). We then turn to measures based on the estimation of the production function. $TFP_{i,OLS}$ is computed as the residuals from an OLS estimation of a standard Cobb-Douglas, with labour and capital as factors. As an alternative measure, we run a fixed-effects estimation and get the (constant over time) residuals for each firm ($TFP_{i,FE}$). Our fourth and final measure ($TFP_{i,LP}$) tackles the simultaneity bias in OLS estimations of the production function estimation. The reason of simultaneity bias is the correlation between input levels and the (unobservable) productivity shock. A positive productivity shock leads the firm to increase output, thereby increasing input levels. As suggested by Levinsohn and Petrin (2003), we employ an observable proxy variable (intermediate inputs) that reacts to variations in the productivity level. The Appendix provides a more detailed explanation of the methods used. A description of all variables is shown in Table 4.

Table 5 displays the correlation matrix of the four productivity variables, together with two different size indicators (logs of value added and employment). Size indicators were added since their use as a proxy for productivity has not been infrequent in the literature (Helpman et al. 2004, Yeaple 2006). Despite the different methods used, productivity estimates are quite similar to each other. The correlation across observations of the four measures goes from a minimum of 0.56 to a maximum of 0.86. Size indicators are instead less strongly correlated with productivity measures, in line with the evidence reported by Head and Ries (2003).

3.4 Headquarter intensity

We complement firm-level data with industry-level data on headquarter intensity, in order to test the predictions of Antràs (2003) and Antràs and Helpman (2004). Clearly, the importance of headquarter services in the various industries is not easy to measure. Therefore, we use a wide set of indicators, instead of relying on a particular one (see the list in the bottom

part of table 4). Generally speaking, the indicators proxy either capital, skill or R&D intensity. The inclusion of R&D could be rationalized in the Antràs and Helpman (2004) model, but it is also consistent with classic information-based theories of internalization (Ethier 1986), where firms in possession of some unique knowledge choose integration to avoid the risk of technology appropriation.

Capital stock data are not available for Italy at a fine level of disaggregation, therefore we take fixed capital investment per worker and compute the average of a four-year period (K_j/L_j). Skill intensity is measured as the share of non-production employment on total employment (H_j/L_j). R&D intensity is measured as the share of R&D expenditure on value added ($R\&D_j$). We also compute two further indicators: $SCALE_j$ (average workers per establishment), which is expected to be correlated with capital intensity, and average wages per worker (W_j/L_j), which should be correlated with skill intensity if more skilled workers receive higher wages.

The source is Istat, Italy's national statistical institute (Structural Business Statistics and, for $SCALE_j$ only, Census data). All indicators are at the 4-digit level of NACE classification (which corresponds to 224 manufacturing sectors) and are merged to our firms' sample on the basis of each company's sector of economic activity. At this level of industrial disaggregation there is, unfortunately, no measure of advertising intensity. Table 6 reports the correlation matrix among the headquarter intensity indicators. In line with our expectations, scale is highly correlated with capital intensity and wages per worker are highly correlated with skill intensity.

4 Empirical analysis

4.1 Productivity ordering

The aim of the first part of our econometric analysis is to see whether there are systematic productivity differences among firms, depending on their sourcing strategy. We adapt the methodology used for the comparison between exporters and non-exporters in Bernard and Jensen (1999) and in

many subsequent papers. We run OLS estimates of the following equation:

$$Y_i = \beta_0 + \beta_1 Sourcing_i + \beta_2 Area_i + \beta_3 Industry_i + \beta_4 Export_i + e_i \qquad (1)$$

where Y_i is a given characteristic of firm i (generally in log, unless it is a ratio going from zero to one) and $Sourcing_i$ is a dummy for the sourcing strategy. In addition, the regression includes a set of 2-digit industry dummies, area dummies and an export status dummy. The coefficient of interest is β_1, which gives the average difference in firms' characteristics between two groups of firms with different sourcing strategy, conditional on the other regressors.

In columns (1) and (2) of Table 7 we compare groups of firms with the same organizational form, but with different sourcing location, i.e. foreign-integration firms versus domestic-integration firms and foreign-outsourcing firms versus domestic-outsourcing firms. In columns (3) and (4) we look instead at groups of firms with the same sourcing location, but different organizational form, i.e. foreign-integration firms versus foreign-outsourcing firms and domestic-integration firms versus domestic-outsourcing firms.

The results show that foreign-integration firms are much larger and, although not all the TFP indicators are significant, also more productive than domestic-integration firms. Similar results hold for foreign-outsourcing firms relative to domestic-outsourcing firms, although the magnitude of the coefficient tends to be smaller. Notice that these results do not depend on industry composition, nor on firms' export status, as we are already controlling for such variables. If they were not controlled for, the size and productivity differences would be even higher. These findings imply that the fixed costs of foreign sourcing are larger than the fixed costs of domestic sourcing, although the difference is smaller in the case of outsourcing.

Columns (3) and (4) of Table 7 compare firms with the same location of sourcing but different organizational form. Firms with integration strategies are larger and more productive than firms with outsourcing strategies. This implies that the fixed costs of integration are larger than the fixed costs of outsourcing. This difference is quantitatively so relevant, that it overcomes the difference in fixed costs of foreign sourcing: domestic-integration firms

turn out indeed to be larger and more productive than foreign-outsourcing firms.

Finally, beyond size and productivity we also look at other firm characteristics, which could allow a better understanding of firm hetereogeneity. The evidence points to statistically significant differentials in terms of capital intensity and skill intensity in favour of firms with foreign sourcing strategies. This is consistent with models of "vertical" FDI and outsourcing where firms locate abroad labor-intensive production activities and specialize in more capital or skill-intensive activities. Capital intensity (but not skill intensity) is also higher in firms with integration strategies compared to firms with outsourcing strategies. In terms of R&D there are no significant differences among the various groups of firms, with one exception: domestic-integration are more R&D-intensive than domestic-outsourcing firms.

Overall, our results are, to a large extent, consistent with the productivity ordering assumed by Antràs and Helpman (2004): foreign-integration firms are at the top of the productivity distribution, while at the bottom we find domestic-outsourcing firms. In contrast to their assumption, we find that foreign-outsourcing firms are less productive than domestic-integration firms.

4.2 Headquarter intensity

In the second part of our empirical analysis, we adapt the model used by Yeaple (2006) and Nunn and Trefler (2008) to our firm-level data. We estimate the following equation:

$$FORINT_i = \beta_0 + \beta_1 TFP_{i,FE} + \beta_2 HQINT_j + e_i \qquad (2)$$

where $TFP_{i,FE}$ is the TFP level of firm i, estimated by fixed effects, $HQINT_j$ is an indicator of headquarter intensity for industry j and $FORINT_i$ is the share of subcontracted inputs purchased from firm i's own foreign affiliates on total subcontracted inputs purchased from abroad. This equation allows us to estimate the predictions of Antràs (2003) and Antràs and Helpman (2004): foreign integration should be preferred to foreing outsourcing by more productive firms and in industries with high headquarter intensity. Our

data allows us to estimate a similar equation also for domestic inputs, where $DOMINT_i$ is the share of subcontracted inputs purchased from firm i's own domestic affiliates on total subcontracted inputs purchased from domestic firms.

$$DOMINT_i = \beta_0 + \beta_1 TFP_{i,FE} + \beta_2 HQINT_j + e_i \quad (3)$$

Several econometric concerns need to be addressed in the analysis. First, headquarter intensity are, to some extent, correlated with each other. Including the indicators one by one in separate regressions is, however, potentially likely to create an omitted variable bias. Therefore, we choose to include the various indicators in the same regression, even if this implies a non-negligible risk of collinearity. Second, the inclusion of industry-level variables within regressions performed on firm-level data may lead to a downward bias in the estimated standard errors (Moulton 1990). To address this issue, we correct the standard errors for clustering, i.e. we allow for correlation between observations belonging to the same industry. Third, the dependent variable can only take values between zero and one. This would suggest the adoption of limited dependent variable models (Greene 1993). However, we prefer to keep our estimation strategy as close as possible to Nunn and Trefler (2008), where OLS is used. The sensitivity of our main findings to alternative estimation methods will be discussed later in this section.

Tables 8 and 9 report the results of OLS regressions for foreign and domestic integration, respectively. Column (1) of both tables include capital, skill and R&D intensity measures based on industry-level data. In column (2) headquarter intensity is proxied by scale and wages per worker. Column (3) replaces industry-level with firm-level indicators of headquarter intensity.

Starting from table 8, we see that firm's TFP level has a positive and highly significant effect on foreign integration in every specification. Integration turns out to be positively correlated also with some headquarter intensity indicators, namely scale and firm-level capital intensity. In addition, capital intensity in column (1) would also be significant, if it were included in the regression without skill intensity.[4]

[4]Overall, the explanatory power of the model is not large, with R-squared around

The effects of TFP and headquarter intensity are economically significant. We have calculated standardized or "beta" coefficients, as the product of the estimated coefficient and the standard deviation of a given explanatory variable, divided by the standard deviation of the dependent variable. A one standard deviation increase in TFP results in a .21 to .25 standard deviation increase in the share of foreign integration. Beta coefficients are smaller, but still not negligible, for the headquarter intensity indicators (.11-.12 for the two statistically significant indicators). They are comparable, alhtough mainly on the low side, to those reported by Nunn and Trefler (2008) (between .17 and .30 for capital intensity and between .10 and .22 for skill intensity).[5]

The results for domestic integration are reported in Table 9. Here again TFP is always positive and significant, although its magnitude is smaller than in the case of foreign integration. The beta coefficient implied by the estimates is now almost halved, between .12 and .14. The evidence on headquarter intensity is even stronger, as all measures of capital intensity are significantly correlated with integration. This may reflect, among other things, lower standard errors, possibly as a consequence of the larger number of observations.

Our results are robust to alternative estimation methods. First, we correct for the potential bias coming from applying OLS to a limited dependent variable setting, opting for a tobit model instead (tables 10 and 11, columns 1-3). Second, we transform our dependent variable into a discrete variable and apply probit model (tables 10 and 11, columns 4-6). Third, for the subset of firms using domestic and foreign inputs at the same time, we estimate a SURE which takes account of correlated error terms (table 12). The results

.08, although comparable in magnitude with values reported by Nunn and Trefler (2008) (between .05 and .17 depending on the sample with data by industry and .12 with data by country and industry with country fixed effects).

[5]Comparing beta coefficients for TFP is trickier, as Nunn and Trefler (2008) consider an industry-level measure of productivity dispersion, while, using our firm-level data, we directly include firms' productivity level. They report that "a one standard deviation increase in the dispersion measure increases the proportion of within-firm imports by 2.9 percentage points". A similar calculation on our results shows that a one standard deviation increase in the TFP level increases the share of foreign integration by 6.7-8.0 percentage points, depending on the specification.

on our variables of interest are only slightly affected.

Our results are also robust to the adoption of alternative TFP or size indicators and to the inclusion of other explanatory variables, suggested by the relevant literature (for instance, Holl 2008): firm's wage costs; firm age; demand cyclicality and seasonality (Abraham and Taylor 1996); value added on total industry sales, which proxies for the importance of suppliers' production in the overall value chain (Yeaple 2006); area dummies. Unreported estimates show that these variables are generally not significant, with the exception, of age (older firms are more likely to choose outsourcing, as in Ono 2003) and area dummies, in some specifications. Our results are anyway qualitatively unchanged.

Finally, we use alternative industry-level indicators of headquarter intensity, drawn from the NBER productivity database (Bartelsman and Gray 1996). After using the correspondence tables from U.S. SIC 1987 to ISIC rev.3 and from ISIC rev.3 to NACE rev.1, we build the two following U.S.-based indicators, as in Nunn and Trefler (2008): capital per worker and the ratio of non-production workers. They turn out to be quite correlated with analogous measures based on Italy's industry-level data (.57 and .79, respectively). Unreported estimates show that capital intensity has a positive and significant impact on domestic integration, while no significant estimate is obtained for skill intensity.

5 Concluding remarks

Using data on a sample of Italian manufacturing companies, this paper provides evidence on the choice between outsourcing and integration at home and abroad. The main findings can be summarized as follows. First, we find evidence of statistically significant productivity differentials among firms with different sourcing strategies, controlling for industry, area and export status. Specifically, there seems to be a productivity ordering where foreign-integration firms are the most productive ones, and domestic-outsourcing firms are the least productive ones, as assumed by Antràs and Helpman (2004). However, in contrast to their assumptions, we also find that foreign-

outsourcing firms are *less*, and not more, productive than domestic-integration firms.

This suggests what follows: integration is more costly than outsourcing; foreign sourcing is more costly than domestic sourcing; the former is likely to have a more relevant effect than the latter in shaping firms' sourcing strategies, leading to a widespread use of domestic outsourcing and, to a smaller extent, foreign outsourcing. While we find evidence of significant productivity differentials, we are not able to say whether they reflect ex-ante selection or ex-post learning effects. They might also result from imperfectly-specified production functions, which do not allow for differences in the labor force skills, nor for firm-level price deflators, although it is fair to say that these issues are common to much of the empirical literature on firm heterogeneity.

The second result of the paper is that integration is preferred to outsourcing in headquarter-intensive industries, notably in capital-intensive industries. This finding is consistent with previous empirical evidence and with theoretical predictions by Antràs (2003) and Antràs and Helpman (2004), according to which an efficient solution to the hold-up problem, in a context of incomplete contracting and relationship-specific investments, is to give control rights to the party which contributes the most to the value of the relationship: firms in headquarter-intensive industries will therefore be more likely to choose integration over outsourcing.

Appendix

Four productivity measures are computed and used throughout the study. The output proxy is always value added. Sales are influenced by differences in intermediate input usage: a firm with the same "true" productivity of another firm and larger purchases of intermediate inputs would wrongly appear as more productive using sales-based indicators (Kurz 2006).

VA_i/L_i: log of value added (gross output net of intermediate inputs), divided by the number of workers.

$TFP_{i,OLS}$: residuals from OLS estimate of the following production function:

$$y_{i,t} = \alpha + \beta l_{i,t} + \gamma k_{i,t} + \eta_{i,t} \tag{4}$$

where $y_{i,t}$ is the log of value added, $l_{i,t}$ is the log of the number of workers, $k_{i,t}$ is the log of the capital stock (tangible and intangible assets, excluding financial assets) and $\eta_{i,t}$ is the error term.

$TFP_{i,FE}$: fixed-error component from fixed-effects estimate of equation 4.

$TFP_{i,LP}$: productivity component from GMM estimation of the following production function, using the Levinsohn and Petrin (2003) method:

$$y_{i,t} = \alpha + \beta l_{i,t} + \gamma k_{i,t} + \theta m_{i,t} + \omega_{i,t} + \eta_{i,t} \tag{5}$$

where $y_{i,t}$, $l_{i,t}$ and $k_{i,t}$ are defined as above, $m_{i,t}$ is the log of intermediate goods and materials, $\omega_{i,t}$ is the transmitted productivity component and $\eta_{i,t}$ is an error term uncorrelated with input choices.

OLS, FE and GMM estimates are run on a panel of about 3,800 firms between 1989 and 1997, separately for each (NACE classification) 2-digit industry (four industries with a small number of firms are grouped to proximate industries (16 to 15, 23 to 24, 30 to 29, 37 to 36)). Value added, capital stock and intermediate goods and services are deflated using 2-digit industry-level deflators provided by the National Statistical Institute (Istat).

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Table 1: **Productivity rankings in various models**

	AH(04) $f_i > f_o$	AH(04) $f_i < f_o$	GH(04)
Foreign integration	1	2	3
Foreign outsourcing	2	1	1,4
Domestic integration	3	4	2
Domestic outsourcing	4	3	

Source: adapted from Spencer (2005). The table reports the productivity ranking for firms following alternative strategies according to various models. AH(04): Antràs and Helpman (2004). GH(04): Grossman and Helpman (2004). f_i: fixed cost of integration. f_o: fixed cost of outsourcing.

Table 2: **Sample composition**

	Sample		Population	
	N. firms	%	N. firms	%
Geographical area				
North West	1,549	40.6	34,246	36.0
North East	1,143	29.9	29,032	30.6
Centre	646	16.9	17,799	18.7
South and Islands	481	12.6	13,940	14.7
Sector				
Textile, clothing, shoes	617	16.2	20,123	21.2
Chemicals, rubber, plastic	447	11.7	7,144	7.5
Metals and mechanical ind.	1,594	41.7	39,852	41.9
Other manufacturing ind.	1,161	30.4	27,898	29.4
Employment level				
10-49	2,350	61.5	82,628	87.0
50-199	981	25.7	10,335	10.9
200-499	312	8.2	1,475	1.6
+500	176	4.6	579	0.6
Total manufacturing	3,819	100.0	95,017	100.0

Source: author's elaborations on MCC and Istat data. Population data refer to 2001.

Table 3: **Sourcing strategies by industry and firm size**

	FI	FO	DI	DO	NO
Sector					
Textile, clothing, shoes	1.0	7.6	5.8	30.3	64.8
Chemicals, rubber, plastic	1.6	5.8	4.5	24.2	72.0
Metals and mechanical ind.	1.6	9.3	6.0	39.6	56.6
Other manufacturing ind.	0.6	4.0	2.4	22.0	76.1
Employment level					
10-49	0.2	5.3	2.0	29.8	68.5
50-199	1.3	7.3	6.6	30.6	64.2
200-499	4.8	14.7	11.9	39.7	52.6
+500	7.4	14.2	17.0	32.4	59.7
Total	1.2	7.0	4.7	30.9	65.7

Source: author's elaborations on MCC data. The table reports the percentage share of firms on the total number of firms, by sector and employment level, separately for the various forms of sourcing strategies. FI: foreign integration. FO: foreign outsourcing. DI: domestic integration. DO: domestic outsourcing. NO: no sourcing. The sourcing strategies reported in this table are not mutually exclusive.

Table 4: **List of variables**

Variable	Description	Period	Source
	Firm-level variables		
$DOMINT_i$	Inputs from domestic affiliates on domestic inputs	1996	MCC
$FORINT_i$	Inputs from foreign affiliates on foreign inputs	1996	MCC
VA_i	Log value added	1996	MCC
L_i	Log employment	1996	MCC
VA_i/L_i	Log value added on employment	1996	MCC
$TFP_{i,OLS}$	Log TFP estimated by OLS	1996	MCC
$TFP_{i,FE}$	Log TFP estimated by fixed effects	1996	MCC
$TFP_{i,LP}$	Log TFP estimated by Levinsohn and Petrin (2003) method	1996	MCC
K_i/L_i	Log capital stock on employment	1996	MCC
H_i/L_i	Non-production employment on total employment	1996	MCC
$R\&D_i$	R&D expenditure on sales	1996	MCC
	Industry-level variables		
K_j/L_j	Log average investment on employment	1998-2001	Istat
H_j/L_j	Share of non-production employment	1998	Istat
$R\&D_j$	R&D expenditure on value added	1997	Istat
$SCALE_j$	Log workers per establishment	2001	Istat
W_j/L_j	Log wages per worker	1998	Istat

Table 5: **Correlation matrix among productivity and size indicators**

	VA_i/L_i	$TFP_{i,OLS}$	$TFP_{i,FE}$	$TFP_{i,LP}$	VA_i	L_i
VA_i/L_i	1					
$TFP_{i,OLS}$	.862	1				
$TFP_{i,FE}$	.657	.715	1			
$TFP_{i,LP}$	.649	.569	.558	1		
VA_i	.449	.347	.590	.587	1	
L_i	.094	.030	.384	.395	.931	1

Source: author's elaborations on MCC data. The table reports correlation coefficients among productivity and size indicators.

Table 6: **Correlation matrix among headquarter intensity indicators**

	K_j/L_j	H_j/L_j	$R\&D_j$	$SCALE_j$	W_j/L_j
K_j/L_j	1				
H_j/L_j	.133	1			
$R\&D_j$	.228	.444	1		
$SCALE_j$	.477	.166	.270	1	
W_j/L_j	.444	.809	.357	.550	1

Source: author's elaborations on Istat data. The table reports correlation coefficients among indicators of headquarter intensity.

Table 7: **Conditional differences in firms' characteristics, by sourcing strategy**

	FI vs DI	FO vs DO	FI vs FO	DI vs DO
	(1)	(2)	(3)	(4)
VA_i	.935	.398	1.727	.969
L_i	.873	.326	1.515	.811
VA_i/L_i	(.045)	.084	.203	.176
$TFP_{i,OLS}$	(.024)	.059	(.099)	.107
$TFP_{i,FE}$	(.089)	.105	.315	.219
$TFP_{i,LP}$	.230	.133	.558	.364
K_i/L_i	(.227)	.128	.583	.406
H_i/L_i	(.028)	.029	(.028)	(-.007)
$R\&D_i$	(.096)	(.129)	(.255)	.349
Obs.	172	1,153	301	1,023

Source: author's elaborations on MCC data. The table reports conditional differences in firms' characteristics, by sourcing strategies. All differences are significant at the 10% level, except those in brackets. They are obtained through the following OLS regression:

$$Y_i = \beta_0 + \beta_1 Sourcing_i + \beta_2 Area_i + \beta_3 Industry_i + \beta_4 Export_i + e_i$$

where Y_i is a given characteristic of firm i, $Sourcing_i$ is a dummy for the sourcing strategy. For instance, in column (1) ("FI vs DI"), $Sourcing_i$ is one for FI and 0 for DI, in column (2) ("FO vs DO") is one for FO and 0 for DO, and so on. The regression includes 2-digit industry and area dummies and a dummy for the export status. FI: foreign integration. FO: foreign outsourcing (but no foreign integration). DI: Domestic integration (but no foreign integration nor foreign outsourcing). DO: Domestic outsourcing (but no foreign integration nor foreign outsourcing nor domestic integration).

Table 8: **Determinants of foreign integration**

	(1)	(2)	(3)
$TFP_{i,FE}$	.174***	.165***	.147***
	(.052)	(.052)	(.050)
K_j/L_j	.058		
	(.038)		
H_j/L_j	.213		
	(.179)		
$R\&D_j$	-.178		
	(.417)		
$SCALE_j$		.044**	
		(.023)	
W_j/L_j		.066	
		(.091)	
K_i/L_i			.038*
			(.020)
H_i/L_i			.024
			(.103)
$R\&D_i$			-.466
			(1.216)
R-sq.	.083	.085	.075
Obs.	298	298	298

Source: author's elaborations on MCC and Istat data. The table reports OLS estimates of the following equation:

$$FORINT_i = \beta_0 + \beta_1 TFP_{i,FE} + \beta_2 HQINT_j + e_i$$

where $FORINT_i$ is firm i's subcontracting inputs from its own foreign affiliates on total subcontracting inputs from foreign companies, $TFP_{i,FE}$ is the TFP level, estimated by fixed effects, and $HQINT_j$ is a set of headquarter intensity indicators for industry j. For the definition of subcontracting inputs see section 3.2. Standard errors (clustered at 4-digit industry level) are in brackets. ***, ** and * denote significance at the 1, 5 and 10 % level.

Table 9: **Determinants of domestic integration**

	(1)	(2)	(3)
$TFP_{i,FE}$	.084***	.083***	.076***
	(.019)	(.020)	(.019)
K_j/L_j	.040**		
	(.018)		
H_j/L_j	.060		
	(.069)		
$R\&D_j$	-.084		
	(.266)		
$SCALE_j$		.027**	
		(.013)	
W_j/L_j		.034	
		(.046)	
K_i/L_i			.036***
			(.009)
H_i/L_i			-.065
			(.056)
$R\&D_i$			.873
			(.572)
R-sq.	.025	.027	.037
Obs.	1,283	1,283	1,283

Source: author's elaborations on MCC and Istat data. The table reports OLS estimates of the following equation:

$$DOMINT_i = \beta_0 + \beta_1 TFP_{i,FE} + \beta_2 HQINT_j + e_i$$

where $DOMINT_i$ is firm i's subcontracting inputs from its own domestic affiliates on total subcontracting inputs from foreign companies, $TFP_{i,FE}$ is the TFP level, estimated by fixed effects, and $HQINT_j$ is a set of headquarter intensity indicators for industry j. For the definition of subcontracting inputs see section 3.2. Standard errors (clustered at 4-digit industry level) are in brackets. ***, ** and * denote significance at the 1, 5 and 10 % level.

Table 10: **Determinants of foreign integration: tobit and probit**

	Tobit			Probit		
	(1)	(2)	(3)	(4)	(5)	(6)
$TFP_{i,FE}$	2.543***	2.455***	2.183***	.731***	.715***	.580***
	(.828)	(.810)	(.804)	(.216)	(.221)	(.216)
K_j/L_j	.579			.067		
	(.585)			(.171)		
H_j/L_j	3.575			1.418**		
	(2.462)			(.714)		
$R\&D_j$	-3.443			-.974		
	(10.236)			(2.384)		
$SCALE_j$		.591			.148	
		(.467)			(.093)	
W_j/L_j		1.351			.586	
		(.1.684)			(.490)	
K_i/L_i			.715**			.240**
			(.371)			(.112)
H_i/L_i			-.072			.150
			(1.605)			(.455)
$R\&D_i$			-4.820			-.409
			(19.543)			(5.329)
Pseudo R-sq.	.068	.073	.070	.083	.087	.075
Obs.	298	298	298	298	298	298

Source: author's elaborations on MCC and Istat data. Columns 1-3 report tobit estimates of the following equation:

$$FORINT_i = \beta_0 + \beta_1 TFP_{i,FE} + \beta_2 HQINT_j + e_i$$

where $FORINT_i$ is firm i's subcontracting inputs from its own foreign affiliates on total subcontracting inputs from foreign companies, $TFP_{i,FE}$ is the TFP level, estimated by fixed effects, and $HQINT_j$ is a set of headquarter intensity indicators for industry j. For the definition of subcontracting inputs see section 3.2. Columns 4-6 report probit estimates of a similar equation, where the dependent variable is a discrete variable (one if $FORINT_i$ larger than zero, zero otherwise). Standard errors (clustered at 4-digit industry level) are in brackets. ***, ** and * denote significance at the 1, 5 and 10 % level.

Table 11: **Determinants of domestic integration: tobit and probit**

	Tobit			Probit		
	(1)	(2)	(3)	(4)	(5)	(6)
$TFP_{i,FE}$	1.498***	1.471***	1.311***	.563***	.555***	.507***
	(.316)	(.312)	(.313)	(.109)	(.110)	(.222)
K_j/L_j	.484*			.116		
	(.249)			(.096)		
H_j/L_j	.900			.333		
	(.959)			(.345)		
$R\&D_j$	.489			.477		
	(3.144)			(1.615)		
$SCALE_j$		.495***			.186***	
		(.190)			(.069)	
W_j/L_j		.672			.224	
		(.716)			(.249)	
K_i/L_i			.597***			.222***
			(.145)			(.055)
H_i/L_i			-1.148			-.409
			(.700)			(.327)
$R\&D_i$			14.784**			6.047**
			(7.168)			(2.498)
Pseudo R-sq.	.030	.037	.047	.039	.049	.063
Obs.	1,283	1,283	1,283	1,283	1,283	1,283

Source: author's elaborations on MCC and Istat data. Columns 1-3 report tobit estimates of the following equation:

$$DOMINT_i = \beta_0 + \beta_1 TFP_{i,FE} + \beta_2 HQINT_j + e_i$$

where $DOMINT_i$ is firm i's subcontracting inputs from its own domestic affiliates on total subcontracting inputs from domestic companies, $TFP_{i,FE}$ is the TFP level, estimated by fixed effects, and $HQINT_j$ is a set of headquarter intensity indicators for industry j. For the definition of subcontracting inputs see section 3.2. Columns 4-6 report probit estimates of a similar equation, where the dependent variable is a discrete variable (one if $DOMINT_i$ larger than zero, zero otherwise). Standard errors (clustered at 4-digit industry level) are in brackets. ***, ** and * denote significance at the 1, 5 and 10 % level.

Table 12: **Determinants of foreign and domestic integration: SURE**

	(1)		(2)		(3)	
	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic
$TFP_{i,FE}$	.142***	.126***	.135***	.115***	.110**	.105**
	(.041)	(.039)	(.041)	(.038)	(.043)	(.041)
K_j/L_j	.051	.077**				
	(.036)	(.034)				
H_j/L_j	.192	.186				
	(.149)	(.140)				
$R\&D_j$	-.243	-.140				
	(.562)	(.526)				
$SCALE_j$			.034	.046*		
			(.028)	(.026)		
W_j/L_j			.060	.083		
			(.101)	(.094)		
K_i/L_i					.055***	.037*
					(.021)	(.020)
H_i/L_i					.019	-.090
					(.097)	(.092)
$R\&D_i$					-1.474	-.547
					(1.266)	(1.200)
R-sq.	.057	.064	.056	.064	.067	.051
Obs.	267		267		267	

Source: author's elaborations on MCC and Istat data. The table reports seemingly unrelated regression (SURE) estimates of the following system of equations:

$$FORINT_i = \beta_0 + \beta_1 TFP_{i,FE} + \beta_2 HQINT_j + e_i$$

$$DOMINT_i = \beta_3 + \beta_4 TFP_{i,FE} + \beta_5 HQINT_j + e_i$$

where $FORINT_i$ is firm i's subcontracting inputs from its own foreign affiliates on total subcontracting inputs from foreign companies, $DOMINT_i$ is firm i's subcontracting inputs from its own domestic affiliates on total subcontracting inputs from domestic companies, $TFP_{i,FE}$ is the TFP level, estimated by fixed effects, and $HQINT_j$ is a set of headquarter intensity indicators for industry j. For the definition of subcontracting inputs see section 3.2. Standard errors (clustered at 4-digit industry level) are in brackets. ***, ** and * denote significance at the 1, 5 and 10 % level.