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OUTSOURCING VERSUS INTEGRATION AT HOME OR 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 and domestic outsourcing by the least productive firms; firms with medium-high productivity choose domestic integration, those with medium-low productivity foreign outsourcing. We also find that the preference for integration over outsourcing is positively related to some indicators of headquarter intensity, notably capital intensity, as predicted by Antràs (2003) and Antràs and Helpman (2004).

JEL Classification: F12, F23, L22.
Keywords: international outsourcing, foreign direct investment, intra-firm trade, productivity.

Contents

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1 Introduction[1]

In recent decades the strong growth of trade in intermediate inputs and the increase in foreign direct investment (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). Combining these two choices yields four possibilities: an input can be produced in the home country, either in-house (domestic integration) or not (domestic outsourcing), or it can be produced in a foreign country, again either in-house (foreign integration or FDI) or not (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, 2005, Antràs and Helpman 2004, Grossman and Helpman 2004, Antràs and Helpman 2008). Despite a rich set of predictions, the empirical literature is far from abundant and provides only partial and incomplete pictures of sourcing strategies. Using trade data, some studies look at intra-firm imports as a proxy of

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the preference for FDI over foreign outsourcing (Antràs 2003, Yeaple 2006, Nunn and Trefler 2008, Bernard et al. 2008), but this literature does not take into account domestic production (either by integration or outsourcing). Very few studies use firm-level data (Tomiura 2007, Defever and Toubal 2007), but they suffer from the same limitation, that is they do not provide any information on inputs purchased from domestic suppliers. Two related strands of literature look at the effects of imported intermediate inputs on productivity (Amiti and Konings 2007, Kasahara and Rodrigue 2008, Görg et al. 2008) or at importers' productivity premia (Bernard et al. 2007, Castellani et al. 2008, Muuls and Pisu 2009), respectively. These studies, however, only consider the location of production, and not the organization of production: no distinction is made between intra-firm and arm's-length imports.

This paper contributes to the literature by simultaneously taking into account both the location and the organization of production of intermediate inputs. 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). The structure of our data closely matches the Antràs and Helpman (2004) model, allowing for a rigorous test of its predictions. Furthermore, our data on intermediate inputs only include inputs produced within a "subcontracting" relationship, i.e. according to the specifications of the buying company. Therefore, in contrast to the large majority of previous studies, our data 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 is required to undertake relationship-specific investments in order to produce the goods needed by the firm.

To our knowledge, this is the first paper which reports firm-level evidence for the four organizational forms at the same time. This goes exactly in the direction suggested, among others, by Bernard et al. (2007, p. 128): "Further progress [...] will require explicit consideration of the boundaries of the firm, including the decisions about whether to insource or outsource stages of production, and whether such insourcing or outsourcing takes place within or across national boundaries" (see also Greenaway and Kneller 2007, Helpman 2006b).

A further contribution of this paper is that it provides much-needed evidence on Italian firms' sourcing strategies abroad. Unlike those of other countries, Italy's trade statistics do not collect information on whether goods are imported from an affiliate company or from an independent supplier. This has made it impossible until now to evaluate the relative importance of FDI versus foreign outsourcing for Italian firms, and this paper aims to fill this gap.

The rest of the paper is structured as follows. Section 2 reviews related literature and Section 3 describes the data. Sections 4 and 5 report empirical results on productivity ordering and headquarter intensity, respectively. Section 6 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; for 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 incentive to invest (hold-up problem). An efficient solution would generally imply that the party which contributes the 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 significant, outsourcing its production will be optimal.

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-labour 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.

Introducing heterogeneous firms in this setting allows further predictions about the choice of organizational form to be made. In the work of Melitz (2003), the assumption that exports require fixed costs determines a selection mechanism by which exporting is profitable only for the most productive firms. A similar line of reasoning leads to the assumption that participation in international activities (foreign integration or outsourcing) entails high fixed costs, and is thus viable only for the most productive firms. Starting from this assumption, and also supposing that fixed integration costs are higher than outsourcing costs, Antràs and Helpman (2004) show that productivity ranking influences the firm's choice; 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, those with medium-low productivity prefer domestic integration, and the least productive firms prefer domestic outsourcing. In sectors with low headquarter intensity, where producing abroad yields a lower advantage, only two organizational forms remain: foreign outsourcing (for less productive firms) and foreign integration (for more productive firms).

However, these findings depend crucially 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 opt for foreign integration; lower-productivity firms would outsource at home and the least productive firms would elect domestic integration (Table 1). In the case of economies of scope in management, assuming lower fixed costs of integration is more appropriate, because joint supervision of input production and other activities is advantageous; conversely, when there are significant costs related to managerial overload the assumption of lower fixed costs of outsourcing seems more correct.

In a different setting, the relationship between organizational form and firm productivity is even more complex. Grossman and Helpman (2004) propose a "managerial incentives" model of 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 (in the case of an independent supplier) and the greater monitoring allowed by vertical integration. The authors find that foreign outsourcing is chosen by the most productive and the least productive firms, while intermediate-productivity firms choose to integrate (see Table 1). The intuition is that at the two ends of the productivity spectrum there is a greater need to induce a high level of effort in the agent, whose incentives will be stronger if he acts independently; in the middle range the ability to monitor the agent's efforts counts more in raising potential revenues.

Given the extent to which the various assumptions and models influence the predictions, empirical evidence is essential in order 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 trade and productivity is stronger for high values of headquarter intensity, as predicted by Antràs and Helpman (2004). Among firm-level studies, Tomiura (2005), analyzing a wide database on Japanese manufacturing firms, highlights a significant heterogeneity: fewer than 3% of firms are 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) extends the analysis 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. A reverse ranking, where more productive firms are less likely to source from affiliate suppliers, is found instead by Defever and Toubal (2007). The composition of their sample (which only includes firms that are already multinational , i.e. firms that control at least 50% of the equity capital of a foreign affiliate) may help explain their finding.[2]

3 Data

3.1 Sample

Our firm-level data come from the "Survey on Italian 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.[3] The

[2]Using firm-level data for Spain, Kohler and Smolka (2009) show that firm labour productivity, capital intensity and skill intensity are positively correlated with the probability of sourcing intermediate inputs from an integrated supplier.

[3]Unfortunately, the subsequent waves of MCC surveys did not include questions on firms' sourcing strategies. Such information was also generally missing in other firm-level databases. The results reported in this paper therefore cannot be taken as evidence on

survey covers the three immediately preceding years (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 includes all firms with a minimum of 500 employees. Firms with between 10 and 499 employees were selected according to three stratification criteria: geographical area, sector and firm size. In the 1998 survey the total number of firms is 4,497. After dropping the firms for which balance sheet data or other important variables were not available, we eventually had 3,976 observations (around 4% of the universe of Italian manufacturing firms with 10 or more employees according to the 2001 census data). The coverage ratio, however, rises to 12.4% for firms with 50 or more employees and 24.8% for those with 200 or more employees.

Table 2 shows that the sample is distributed in 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; firms located in the South and Islands and firms operating in the "textiles, clothing and footwear" sector are slightly under-represented. In terms of firm size, the sample is somewhat unbalanced in favour of medium-sized and large firms.

3.2 Subcontracting

The MCC database provides information on the incidence of subcontracting in relation to total purchases of goods and services, as well as on the type of supplier. In the Italian legal system, subcontracting is referred to as "a

the most recent trends of the Italian economy.

contract by which a firm engages to carry out processing of semifinished products or raw materials on behalf of the buying company, 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, emphasis 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 indeed assume 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) illustrates 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 match very closely those usually accounted for in the literature, allowing for a rigorous test of theoretical predictions. Actually, a fifth organizational form emerges from our data, namely when the incidence of subcontracting is zero. Although this could be interpreted as a form 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 for this: first, the number of no-sourcing firms is quite high (about two thirds of all firms); second, no-sourcing firms are markedly different from domestic-integration firms in terms of industry-level and firm-level characteristics.

Table 3 shows that about 1.2% of firms in the sample purchased at least some inputs from foreign affiliates, while 6.8% of firms purchased at least some inputs from foreign non-affiliates. By comparison, Tomiura (2007) finds that the number of foreign-outsourcing firms was equal to 2.7%. The difference is likely due to our sample's bias in favour of medium-sized and large firms. The use 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 also ranks high for foreign and domestic outsourcing, followed by the "textiles, clothing, footwear" sector. In terms of firm size, there seems to be a positive monotonic relationship, except for domestic outsourcing, which reaches its peak in firms with 200-499 employees.

Recourse to mixed sourcing strategies (for instance, buying inputs simultaneously 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 those 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 consider those measures which are 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. The source 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 given 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 appear quite similar. The correlation across observations of the four measures goes from a minimum of 0.56 to a maximum of 0.86. Size indicators are less strongly correlated with productivity measures, in line with the evidence reported by Head and Ries (2003).

3.4 Headquarter intensity

We supplement 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, so 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 capital, skill or R&D intensity.[4] 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.

[4]The literature on transaction costs, asset specificity and contractual incompleteness points to other potential determinants of the choice between integration and outsourcing. Testing the implications of this literature would go beyond the scope of this paper.

Capital stock data are not available for Italy at a fine level of disaggregation, so 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 in total employment (H_j/L_j). R&D intensity is measured as the ratio of R&D expenditure to 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 highly 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 with 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 Productivity ordering

4.1 Main results

The aim of the first part of our econometric analysis is to determine 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:

$$Y_i = \beta_0 + \beta_1 FI_i + \beta_2 FO_i + \beta_3 DI_i + \beta_4 Area_i + \beta_5 Industry_i + \beta_6 Export_i + \epsilon_i \quad (1)$$

where Y_i is an indicator of productivity for firm i, and FI_i, FO_i and DI_i are dummies for each sourcing strategy (relative to the group of domestic-outsourcing firms, which is the baseline category). The regression includes a set of 2-digit industry dummies, area dummies and an export status dummy. An alternative regression also includes firm size (measured by the log of employment) as a further control variable. The coefficients of interest are β_1, β_2 and β_3, which give the average difference in firms' characteristics between firms with a given sourcing strategy compared with domestic-outsourcing firms, conditional on the other regressors. Using such a methodology allows an easy comparison of our findings with the huge literature on exporting and importing premia. Moreover, it allows us easily to take into account the four sourcing strategies at the same time and carry out tests of equality among the coefficients on the sourcing dummies.

As in Bernard and Jensen (1999), the regression should not be thought of as a structural model, in which productivity is actually caused by explanatory variables. Rather, it should be interpreted as a way to get conditional means, i.e. the average productivity premia (or discounts) for firms following a given organizational form relative to other firms and conditional on a set of factors. A discussion of causality issues is provided in Section 4.3.

As mentioned in the previous section, in our sample firms typically follow mixed strategies, for instance buying inputs from domestic and foreign suppliers at the same time. This behaviour can be easily explained if we assume that firms usually need several inputs and choose the optimal organizational form for each input. Issues concerning the most appropriate way to deal with mixed strategies arise in our regression framework. We start by assigning firms to a given organizational form on the basis of the following scheme: firms buying domestic outsourcing inputs but no domestic-integration or foreign outsourcing/integration inputs (DO, the baseline category); firms buying at least some domestic-integration inputs but no foreign outsourcing/integration inputs (DI); firms buying at least some foreign-outsourcing inputs but no foreign-integration inputs (FO); firms buying at least some foreign-integration inputs (FI). The advantage of this classification is that it allows a more clear-cut identification of each organizational form, including FI (for which the number of active firms is relatively small and the incidence of mixed strategies is high). However, our results are also robust to an alternative classification method, as we will show later in the next section.

Table 7, which reports the results controlling for area, industry and export status, shows that all the coefficients on the three dummies (FI, FO and DI) are positive and significant at the 10% level. Foreign-integration, foreign-outsourcing and domestic-integration firms are larger and more productive than the baseline group of domestic-outsourcing firms. Size premia are larger than productivity premia, as would be expected if larger firms tended to be more productive. The magnitude of the coefficients is highest for FI, lowest for FO, and it is at an intermediate level for DI. It should be noted that these results do not depend on either industry composition or on firms' export status, as these variables are already controlled for; otherwise, size and productivity differences would be even higher. The next three rows show p-values of tests of equality between couples of coefficients on sourcing dummies. We always reject the hypothesis that foreign-outsourcing firms are as productive as foreign-integration firms and (with only one exception) the hypothesis that they are as productive as domestic-integration firms. In most cases we also reject the hypothesis that domestic-integration firms are as productive as foreign-integration firms. The goodness of fit of our model shows a wide variability depending on the measure of size or productivity (see Görg et al. 2008 for similar evidence); for the most structural indicator (TFP à la Levinsohn and Petrin 2003), the R-squared is as high as .62.[5]

Overall, these results are largely consistent with the productivity ordering assumed by Antràs and Helpman (2004), where foreign-integration firms are at the top of the productivity distribution and domestic-outsourcing firms are at the bottom. In contrast to their assumptions, however, we

[5]Weighting observations using a post-stratification weight (16 strata, defined according to sector and firm size) does not affect our findings.

find that foreign-outsourcing firms are less, not more, productive than domestic-integration firms. These findings suggest that, for firms in our sample, fixed costs of foreign sourcing are higher than fixed costs of domestic sourcing and fixed costs of integration are higher than fixed costs of outsourcing. The latter difference is quantitatively so important in our data that it overcomes the difference in fixed costs of foreign sourcing.

In order to interpret this finding, one should bear in mind that foreign outsourcing includes inputs purchased from other EU countries: the EU Single Market Programme, which implies no barriers to intra-EU trade, might therefore explain the low fixed costs of foreign outsourcing in our data. It would be interesting to make a distinction between EU outsourcing and non-EU outsurcing, but, unfortunately, our data do not include such information. Low fixed costs of outsourcing might also be explained by Italian manufacturing industry's specialization in traditional goods and industrial machinery. Both sectors are typically characterized by a plentiful use of independent suppliers, and both show the highest percentages of domestic and foreign outsourcing (as we have seen in Table 3).

4.2 Robustness analysis

This section analyzes the robustness of our findings. As a first step, we control for several firm-level indicators of skills and innovation that could have a positive impact on productivity. Our data allow us to build the following five variables: the share of non-production workers ($White\ collars$), the ratio of R&D investments to sales ($R\&D$) and three dummies for investments in ICT hardware or software (*ICT investments*), introduction of new products (*Product innovation*) or new processes (*Process innovation*) over the previous three years. In Table 8 we include them among the explanatory variables.[6] As expected, the coefficients on these variables are almost always positive and often statistically significant. The goodness of fit also increases noticeably. After introducing these variables, the coefficients on sourcing dummies become only slightly smaller, but are still significantly different from zero in each specification (except for the foreign-outsourcing dummy in two out of six specifications).

Table 9 reports the results when firm size is included among the control variables, together with three dummy variables, corresponding to being part of a group as an affiliate (*Affiliate*), being part of a business consortium (*Business Consortium*) and being exposed to competition mainly from large firms (*Large Competitors*). The variability of sourcing premia among TFP is now greatly reduced, but the productivity differentials remain statistically significant and quantitatively large. Foreign-integration firms tend to be 18-27% more productive than domestic-outsourcing firms; the differential is 11-17% for domestic-integration firms and 5-8% for foreign-outsourcing firms, always relative to domestic-outsourcing firms. The results on equality tests are similar to the previous ones, except for the equality between FI and DI, which is not rejected.

In Table 10 we test the robustness of our results to two alternative assumptions. First, we include the set of no-sourcing firms, which now

[6] Data on skills and innovation were not available for 9.0% of firms in our sample (119 out 1,316 firms).

becomes the baseline category relative to which the productivity premia are computed. Second, we modify our sourcing dummies in order to allow for mixed strategies. Each sourcing dummy now equals one if firms buy at least a positive amount of inputs according to that sourcing strategy. Two or more sourcing dummies may then be simultaneously positive for the same firm. Controlling for area, industry and export status, the results are confirmed, as the coefficients on FI, DI and FO are significantly positive, with decreasing magnitude. There is, instead, no statistically significant difference in terms of size or productivity between domestic-outsourcing firms and no-sourcing firms. P-values on equality tests also provide further support to the previous findings.

Our evidence on productivity differentials is obtained as an average across all manufacturing sectors. It would be interesting to see whether different sectors exhibit different productivity rankings. This would be the case if the relative importance of forces leading to integration (e.g. economies of scope in management) and forces leading to outsourcing (e.g. managerial overload, suppliers' incentives) varies across industries. We split the sample into four groups according to the Pavitt classification (traditional, scale-intensive, specialized and science-based sectors, which to some extent captures differences in terms of industry structure and technology.[7] Using finer classifications is unfortunately not feasible, given the size of the sample. Unreported estimates show that the productivity ranking is similar in the various groups, while there are differences in the magnitude of productivity

[7]For science-based sectors we do not have enough observations, we therefore focus on the first three sectors only.

differentials. The coefficient on FI is indeed larger in traditional sectors than in the other sectors; this would suggest a higher fixed cost of integration abroad for firms in these sectors. The productivity premia for FO are only significant for specialized industries (e.g. industrial machinery), which might suggest higher costs in finding specialized suppliers in the foreign country. No substantial difference across sectors arises in terms of DI. Further evidence, possibly based on larger samples, is needed, however, in order to draw more robust conclusions on this issue.

4.3 Endogeneity

Our results show that there are systematic patterns between firm productivity and sourcing strategies, but, being based on a cross-section, do not say anything about the direction of causality. This section discusses the potential channels of causation and presents further empirical evidence on the issue.

On one hand, causality may run from firm productivity to sourcing strategies, as long as the latter imply different fixed costs and firms differ in their productivity levels. Firms would then self-select in a given organizational form, depending on their productivity level. If, for instance, fixed costs of foreign integration are very high, only the most productive firms will be able to bear them and will choose to produce through foreign integration, while less productive firms will opt for less expensive organizational forms. This is analogous to the self-selection hypothesis in the literature on exporting and productivity.

On the other hand, causality may run in the opposite direction, from sourcing strategies to firm productivity. In particular, foreign sourcing may lead to increased productivity in various ways. First, there could be a learning mechanism by which contacts with foreign suppliers allow firms to improve their products. Second, operating with foreign suppliers could give access to higher-quality inputs or to inputs which are simply not available from domestic suppliers. A third channel is suggested by Glass and Saggi (2001). In their model, foreign sourcing lowers marginal costs of production and increases profits, thus providing greater incentives for innovation. This in turn may lead to higher productivity for firms with foreign suppliers. These potential explanations are, however, only partially consistent with our findings, in which domestic-integration firms turn out to be more (not less) productive than foreign-outsourcing firms.

There is an other channel by which sourcing strategy may have an impact on firm productivity. Firms might choose to outsource the production of non-core activities, in order to focus on those activities in which they have a competitive advantage. In this case outsourcing would determine an increase in productivity. This explanation too is not consistent with our evidence, which suggests that outsourcing firms are less productive than integration firms.

If causality runs from sourcing strategies to firm productivity, then we would expect a productivity ranking that is only partially consistent with what we actually observe in our data. On this basis the alternative interpretation, namely the self-selection hypothesis, would seem more likely.

For further insights on the causality issue it is necessary to turn to the empirical evidence. Unfortunately, data on sourcing strategies are only available on a cross-section basis. This prevents us from running the usual tests of endogeneity based on time-series information on entry to or exit from a given organizational form. For almost two thirds of firms in our sample, however, we have time-series information on productivity. We are able to compute the growth rate of productivity between 1992 and 1997 and regress it on the sourcing dummies in 1997. We also regress the productivity level in 1992 on the sourcing dummies in 1997 (similarly to Baldwin and Gu 2003 for export premia). The idea behind this test is that if firms differ ex ante, then we should already see differences in productivity levels a few years before sourcing is observed. The learning channel implies instead that firms, starting with similar levels of productivity, experience different growth rates of productivity.[8]

The upper panel of Table 11 shows that firms with different sourcing strategies in 1997 do not exhibit any difference in terms of the productivity growth rate over the previous five years. If we look instead at the level of productivity in 1992, sourcing dummies in 1997 become once again statistically significant in most specifications, showing a productivity ranking similar to our previous results.[9] These findings do not provide much support to the learning hypothesis, while they are somewhat more consistent with the self-selection hypothesis, showing persistent differences in productivity levels. This is also in line with the insights arising from the conceptual discussion. However, much caution is warranted, given the data limitations

[8]Unfortunately there is no information on productivity after 1997 in our data.

[9]The results are robust to changes in the period over which the growth rate of productivity and its lagged level are measured.

which prevent us from carrying out a richer empirical analysis of the causality issue.

5 Headquarter intensity

5.1 Main results

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:

$$FORINT_i = \beta_0 + \beta_1 TFP_{i,LP} + \beta_2 HQINT_j + \epsilon_i \quad (2)$$

where $TFP_{i,LP}$ is the TFP level of firm i, estimated by Levinsohn-Petrin method, $HQINT_j$ 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 in relation to 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 foreign outsourcing by more productive firms and in industries with high headquarter intensity.

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

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

Several econometric concerns need to be addressed in the analysis. First, measures of headquarter intensity are, to some extent, correlated with each other. However, including the indicators one by one in separate regressions is 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). Nevertheless, 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 in Section 5.2.

Before starting with the econometric analysis, it is interesting to look at the distribution of the dependent variables $FORINT_i$ and $DOMINT_i$ in Tables 12 and 13, respectively. In both cases, there is evidence of a bimodal distribution, with peaks at the two extreme values (zero and one). $FORINT_i$ is zero (i.e. all foreign inputs are foreign-outsourcing inputs) in 84% of observations and one (i.e. all foreign inputs are foreign-integration inputs) in 10% of observations. $DOMINT_i$ is zero in 86% of observations and one in 8% of observations. The second and third columns of Table 12 split the sample according to whether foreign inputs are less than or equal to 50% of total inputs (low foreign inputs) or more than 50% (high foreign inputs). It turns out that about 70% of observations fall among the former. The distribution of $FORINT_i$ still looks similar in the two cases. The second and third columns of Table 13 replicate the same exercise for $DOMINT_i$: the large majority of observations reflects firms with high domestic inputs.

Tables 14 and 15 report the results of OLS regressions for $FORINT_i$ and $DOMINT_i$, respectively. Column (1) of both tables includes 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 14, we see that firm's TFP level has a positive and highly significant effect on foreign integration in every specification. Integration also turns out to be positively correlated 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.[10]

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

[10] Overall, the explanatory power of the model is not great, with R-squared around .10, although comparable in magnitude with values reported by Nunn and Trefler (2008).

one-standard-deviation increase in TFP results in a .26 to .29 standard deviation increase in the share of foreign integration. Beta coefficients are smaller, but not negligible, for the headquarter intensity indicators (.11-.16 for the two statistically significant indicators). They are comparable, although 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).

The results for domestic integration are reported in Table 15. 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 more than halved, around .12. The evidence on headquarter intensity is even stronger, as all measures of capital intensity are significantly correlated with integration.[11] [12]

5.2 Robustness analysis

Our results are robust to the adoption of alternative TFP or size indicators and to the inclusion of other explanatory variables, suggested by the relevant

[11]Regressions with firm-level covariates do not include sector fixed effects, the aim being to see to what extent firm-level covariates proxy for industry-level characteristics. Unreported regressions including either Pavitt classification dummies or 2-digit sector fixed effects show that the results for capital intensity are mainly unchanged (with the exception of regressions using foreign integration as dependent variable). Sector fixed effects generally turn out to be statistically significant and to have signs in line with the overall results (traditional sectors such as textiles, clothing etc. are negatively correlated with domestic or foreign integration).

[12]We have also checked the prediction of the Antràs and Helpman (2004) model, according to which the impact of productivity on integration is higher for sectors with a higher headquarter intensity. Unreported estimates show that the interaction between TFP and various headquarter-intensity variables is indeed positive, as expected, but is not significant in most specifications. This may be due to collinearity among the regressors or to sample size.

literature (for instance, Holl 2008): firm's wage costs; firm age; demand cyclicality and seasonality (Abraham and Taylor 1996); value added over 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 in any case qualitatively unchanged. We have also included the log level of total expenditure in intermediate inputs or of expenditure in subcontracting inputs in order to control for differences in the amount of input sourcing. There is some evidence that integration is more likely for higher input purchases, but the results for the other variables do not substantially change.[13]

We also 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.

Our results are robust to alternative estimation methods. First, we

[13] Weighting observations using a post-stratification weight (16 strata, defined according to sector and firm size) does not affect our findings.

correct for the potential bias coming from applying OLS to a limited dependent variable setting, opting for a tobit model instead (Tables 16 and 17, columns 1-3). Second, we transform our dependent variable into a discrete variable and apply probit model (Tables 16 and 17, 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 18). The results for our variables of interest are only slightly affected.

Finally, we check whether our results are affected by a sample selection bias, related to the exclusion of no-sourcing firms (see Tomiura 2005). We estimate a Heckman probit model of foreign integration. The variable included in the selection equation but not in the outcome equation is the export dummy, as a proxy of firm's experience in foreign business. The idea is that export activity might help explain foreign sourcing but should not be related to whether foreign sourcing takes place through integration or outsourcing. Clearly, we estimate the model only for foreign integration, since the selection variable would not work as well for domestic integration. Table 19 reports the results for the selection and outcome equations. In the selection equation, the export dummy does a very good job in explaining the probability of foreign sourcing. In the outcome equation, TFP is still positive and significant for all specifications, and capital intensity is positive and significant in the last specification. It is also important to notice that LR tests never reject the null hypothesis that equations are independent. This suggests that there is no sample selection bias in foreign integration estimates.

6 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 as well as for other variables. Specifically, there seems to be a productivity ordering by which foreign-integration firms are the most productive, and domestic-outsourcing firms are the least productive, as assumed by Antràs and Helpman (2004). However, in contrast to their assumptions, we also find that foreign-outsourcing firms are *less* productive than domestic-integration firms. This suggests a relatively high fixed cost of integration, which more than offsets the fixed cost of operating with foreign suppliers.

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 that contributes the most to the value of the relationship.

Two main caveats apply. First, we are not able to draw strong conclusions on whether productivity differentials reflect ex-ante selection or ex-post learning, although it is fair to say that this issue is common to much of the empirical literature on firm heterogeneity. Second, our findings should not be taken as evidence that one organizational form is optimal while another organizational form is less preferable.

We believe nonetheless that our results provide valuable insights for the understanding of aggregate phenomena. First of all, they imply that Italian manufacturing industry will show a greater preference for outsourcing over FDI than other EU countries' industries, given its smaller average firm size and its specialization in sectors with a lower capital intensity.

Furthermore, our findings suggest that models based on incomplete contracting and relationship-specific investments are indeed very relevant to firms' global sourcing strategies. Theory has only just begun to investigate their policy implications (Antràs and Staiger 2008, Ornelas and Turner 2008). One of the main results is that if contracts are incomplete in the foreign country (as might be expected in the case of developing countries with weak property rights and institutions), the hold-up problem leads to an inefficiently low volume of input trade, and this creates a new and stronger rationale for trade policy intervention. A more general point is that if the hold-up problem is quite pervasive, "international trade agreements should extend their focus beyond the traditional market access concerns of establishing and maintaining conditions of competition to cover as well the conditions of bargaining" (Antràs and Staiger 2008, p. 2).

Finally, as argued by Antràs and Rossi-Hansberg (2008), firms' organizational decisions often interact with technology or institutional factors, such as the quality of the legal environment, which lead to different economic outcomes. Although less investigated, their dynamic implications may also be potentially significant in terms of the evolution of economic activity, skills and knowledge.

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 3,976 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 ranking 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 or 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	
	No. firms	%	No. firms	%
Geographical area				
North West	1,615	40.6	34,246	36.0
North East	1,183	29.8	29,032	30.6
Centre	685	17.2	17,799	18.7
South and Islands	493	12.4	13,940	14.7
Sector				
Textiles, clothing, footwear	654	16.5	20,123	21.2
Chemicals, rubber, plastic	459	11.5	7,144	7.5
Metals and mechanical ind.	1,658	41.7	39,852	41.9
Other manufacturing ind.	1,205	30.3	27,898	29.4
Employment level				
10-49	2,443	61.4	82,628	87.0
50-199	1,023	25.7	10,335	10.9
200-499	330	8.3	1,475	1.6
+500	180	4.5	579	0.6
Total manufacturing	3,976	100.0	95,017	100.0

Source: Author's calculations 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					
Textiles, clothing, footwear	0.9	7.0	5.5	28.6	66.8
Chemicals, rubber, plastic	1.5	5.9	4.4	23.8	72.3
Metals and mechanical ind.	1.6	8.9	5.7	38.1	58.1
Other manufacturing ind.	0.6	4.1	2.3	21.2	76.9
Employment level					
10-49	0.2	5.2	1.9	28.7	69.6
50-199	1.3	6.9	6.3	29.5	65.6
200-499	4.9	13.6	11.5	37.0	55.2
+500	7.2	14.4	16.7	32.2	60.0
Total	1.2	6.8	4.5	29.8	66.9

Source: Author's calculations on MCC data. The table reports the percentage shares of firms in 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 over domestic inputs	1996	MCC
$FORINT_i$	Inputs from foreign affiliates over foreign inputs	1996	MCC
VA_i	Log value added	1996	MCC
L_i	Log employment	1996	MCC
VA_i/L_i	Log value added over 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 over employment	1996	MCC
H_i/L_i	Non-production employment over total employment	1996	MCC
$R\&D_i$	R&D expenditure over sales	1996	MCC
	Industry-level variables		
K_j/L_j	Log average investment over employment	1998-2001	Istat
H_j/L_j	Share of non-production employment	1998	Istat
$R\&D_j$	R&D expenditure over 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 calculations 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 calculations on Istat data. The table reports correlation coefficients among indicators of headquarter intensity.

Table 7: **Productivity premia**

	VA_i	L_i	VA_i/L_i	$TFP_{i,OLS}$	$TFP_{i,FE}$	$TFP_{i,LP}$
				Premia		
FI	2.02	1.73	.29	.17	.42	.76
FO	.39	.31	.08	.06	.10	.12
DI	.99	.81	.18	.11	.22	.38
Export	.61	.55	(.06)	(.02)	.11	.20
			Equality tests (p-values)			
$FI = FO$	.00	.00	.00	.00	.00	.00
$FI = DI$	.00	.00	.21	.49	.04	.00
$FO = DI$	.00	.00	.08	.24	.02	.00
Obs.	1,316	1,316	1,316	1,316	1,316	1,316
R-sq.	.23	.21	.12	.03	.08	.62

Source: Author's calculations on MCC data. The table reports coefficients on sourcing dummies and p-values for equality tests between coefficients. All coefficients are significant at the 10% level, unless in brackets. The coefficients are obtained from the following OLS regression:

$$Y_i = \beta_0 + \beta_1 FI_i + \beta_2 FO_i + \beta_3 DI_i + \beta_4 Area_i + \beta_5 Industry_i + \beta_6 Export_i + \epsilon_i$$

where Y_i is a given characteristic of firm i, FI_i, FO_i and DI_i are dummies corresponding to the sourcing strategies (relatively to domestic-outsourcing firms). The regression includes 2-digit industry dummies, area dummies (unreported coefficients) and a dummy for the export status. FI_i: one if firm i buys at least some foreign-integration inputs, zero otherwise. FO_i: one if firm i buys at least some foreign-outsourcing inputs but no foreign-integration input, zero otherwise. DI_i: one if firm i buys at least some domestic-integration inputs but no foreign-outsourcing/integration input, zero otherwise.

Table 8: **Productivity premia (controlling for indicators of skills and innovation)**

	VA_i	L_i	VA_i/L_i	$TFP_{i,OLS}$	$TFP_{i,FE}$	$TFP_{i,LP}$
				Premia		
FI	1.84	1.60	.24	.14	.38	.69
FO	.32	.28	(.05)	(.02)	.07	.09
DI	.89	.74	.15	.09	.19	.34
Export	.51	.48	(.03)	(.02)	.10	.16
White collars	(-.36)	-1.03	.66	.56	.40	.35
R&D	.09	.10	(.00)	(-.01)	(.01)	(.01)
ICT investments	.34	.33	(.01)	(.01)	.06	.11
Product innovation	.32	.31	(.01)	(-.02)	(.02)	.08
Process innovation	.18	.15	(.03)	(.00)	(.02)	(.04)
				Equality tests (p-values)		
$FI = FO$	.00	.00	.00	.06	.00	.00
$FI = DI$	.00	.00	.21	.53	.04	.00
$FO = DI$	.00	.00	.05	.15	.02	.00
Obs.	1,197	1,197	1,197	1,197	1,197	1,197
R-sq.	.28	.29	.18	.09	.13	.63

Source: Author's calculations on MCC data. The table reports coefficients on sourcing dummies and p-values for equality tests between coefficients. All coefficients are significant at the 10% level, unless in brackets. The coefficients are obtained from the following OLS regression:

$$Y_i = \beta_0 + \beta_1 FI_i + \beta_2 FO_i + \beta_3 DI_i + \beta_4 Area_i + \beta_5 Industry_i + \beta_6 Export_i + \sum \beta_z Z_i + \epsilon_i$$

where Y_i is a given characteristic of firm i, FI_i, FO_i and DI_i are dummies corresponding to the sourcing strategies (compared with domestic-outsourcing firms). Z_i includes five firm-level indicators of skills and innovation. The regression includes 2-digit industry dummies, area dummies (unreported coefficients) and a dummy for the export status. Sourcing dummies are defined as in Table 7.

Table 9: **Productivity premia (controlling for firm size and other variables)**

	VA_i/L_i	$TFP_{i,OLS}$	$TFP_{i,FE}$	$TFP_{i,LP}$
		Premia		
FI	.25	.17	.19	.26
FO	.07	.06	.06	(.03)
DI	.17	.12	.13	.14
$Export$	(.04)	(.03)	(.03)	(.04)
$Size$	(.00)	(-.02)	.13	.28
$Large\ Competitors$	.10	.05	(.03)	.06
$Business\ Consortium$	(.00)	(-.01)	(.01)	(-.01)
$Affiliate$	(.03)	(.02)	(-.04)	(.03)
		Equality tests (p-values)		
$FI = FO$	.01	.08	.10	.00
$FI = DI$	.32	.46	.49	.14
$FO = DI$	.08	.22	.14	.04
Obs.	1,315	1,315	1,315	1,315
R-sq.	.13	.04	.18	.74

Source: Author's calculations on MCC data. The table reports coefficients on sourcing dummies and p-values for equality tests between coefficients. All coefficients are significant at the 10% level, unless in brackets. The coefficients in the upper part of the table are obtained from the following OLS regression:

$$Y_i = \beta_0 + \beta_1 FI_i + \beta_2 FO_i + \beta_3 DI_i + \beta_4 Area_i + \beta_5 Industry_i + \beta_6 Export_i + + \sum \beta_z Z_i + \epsilon_i$$

where Y_i is a given characteristic of firm i, FI_i, FO_i and DI_i are dummies corresponding to the sourcing strategies (compared with domestic-outsourcing firms). The regression includes 2-digit industry dummies, area dummies (unreported coefficients), a dummy for the export status and the log of employment. Sourcing dummies are defined as in Table 7.

Table 10: **Productivity premia (relatively to no-sourcing firms)**

	VA_i	L_i	VA_i/L_i	$TFP_{i,OLS}$	$TFP_{i,FE}$	$TFP_{i,LP}$
				Premia		
FI	1.26	1.12	.14	(.08)	.25	.49
FO	.30	.26	(.04)	(.02)	.06	.08
DI	.85	.72	.13	.08	.17	.29
DO	(-.04)	(-.02)	(-.02)	(-.01)	(-.02)	(-.02)
				Equality tests (p-values)		
$FI = FO$	.00	.00	.23	.48	.05	.00
$FI = DI$	.11	.09	.93	.99	.45	.09
$FI = DO$	.00	.00	.03	.23	.00	.00
$FO = DI$	.00	.00	.12	.25	.04	.00
$FO = DO$	.00	.00	.13	.43	.06	.04
$DI = DO$	.00	.00	.00	.00	.00	.00
Obs.	3,976	3,976	3,976	3,976	3,976	3,976
R-sq.	.16	.15	.12	.05	.08	.61

Source: Author's calculations on MCC data. The table reports coefficients on sourcing dummies and p-values for equality tests between coefficients. All coefficients are significant at the 10% level, unless in brackets. The coefficients are obtained from the following OLS regression:

$$Y_i = \beta_0 + \beta_1 FI_i + \beta_2 FO_i + \beta_3 DI_i + \beta_4 DO_i + \beta_5 Area_i + \beta_6 Industry_i + \beta_7 Export_i + \epsilon_i$$

where Y_i is a given characteristic of firm i, FI_i, FO_i, DI_i and DO_i are dummies corresponding to the sourcing strategies (compared with no-sourcing firms). The regression includes 2-digit industry dummies, area dummies and a dummy for the export status (unreported coefficients). FI_i: one if firm i buys at least some foreign-integration inputs, zero otherwise. FO_i: one if firm i buys at least some foreign-outsourcing inputs, zero otherwise. DI_i: one if firm i buys at least some domestic-integration inputs, zero otherwise. DO_i: one if firm i buys at least some domestic-outsourcing inputs, zero otherwise. In contrast with the previous tables, the sourcing dummies in this table are not mutually exclusive.

Table 11: **Productivity premia (5-year growth rate and lagged level)**

	VA_i	L_i	VA_i/L_i	$TFP_{i,OLS}$	$TFP_{i,FE}$	$TFP_{i,LP}$
	1992-97 growth rate regressed on 1997 sourcing dummies					
FI	(.02)	(-.04)	(.06)	(.05)	-	(.05)
FO	-.07	(-.02)	(-.06)	(-.05)	-	-.08
DI	(.03)	(-.02)	(.07)	(.07)	-	(.04)
Obs.	841	841	841	841	-	742
R-sq.	.05	.04	.07	.06	-	.07
	1992 level regressed on 1997 sourcing dummies					
FI	1.76	1.61	.15	(.05)	.35	.55
FO	.30	(.16)	.14	.11	(.06)	.17
DI	.68	.61	(.07)	(.02)	.17	.19
Obs.	841	841	841	841	841	742
R-sq.	.24	.24	.12	.06	.10	.67

Source: Author's calculations on MCC data. The table reports coefficients on sourcing dummies. All coefficients are significant at the 10% level, unless in brackets. The coefficients are obtained from the following OLS regression:

$$Y_i = \beta_0 + \beta_1 FI_i + \beta_2 FO_i + \beta_3 DI_i + \beta_4 Area_i + \beta_5 Industry_i + \beta_6 Export_i + \epsilon_i$$

where Y_i is a given characteristic of firm i, FI_i, FO_i and DI_i are dummies corresponding to the sourcing strategies (compared with domestic-outsourcing firms). The dependent variable is the growth rate of size or productivity between 1992 and 1997, the level of size or productivity in 1992 in the lower panel. Sourcing dummies refer to 1997. The regression includes 2-digit industry dummies, area dummies and a dummy for the export status (unreported coefficients). Sourcing dummies are defined as in Table 7.

Table 12: **Foreign integration: descriptive statistics**

	Total	Low foreign inputs	High foreign inputs
0	84.2	60.1	24.2
.01-.25	1.0	0.7	0.3
.26-.50	2.0	1.7	0.3
.51-.75	1.7	1.7	0.0
.76-.99	1.0	0.3	0.7
1	10.1	6.0	4.0
Total	100.0	70.5	29.5

Source: Author's calculations on MCC data. The first column reports the distribution of $FORINT_i$ (firm i's subcontracting inputs from its own foreign affiliates over total subcontracting inputs from foreign companies) for 298 firms with foreign sourcing. The second and third columns split the sample according to whether foreign inputs are less than or equal to 50% of total inputs (low foreign inputs) or are more than 50% (high foreign inputs), respectively.

Table 13: **Domestic integration: descriptive statistics**

	Total	Low domestic inputs	High domestic inputs
0	86.1	3.8	82.2
.01-.25	2.2	0.0	2.2
.26-.50	2.6	0.2	2.4
.51-.75	0.5	0.0	0.5
.76-.99	0.7	0.0	0.7
1	7.9	0.5	7.5
Total	100.0	4.4	95.6

Source: Author's calculations on MCC data. The first column reports the distribution of $DOMINT_i$ (firm i's subcontracting inputs from its own domestic affiliates over total subcontracting inputs from domestic companies) for 1,284 firms with domestic sourcing. The second and third columns split the sample according to whether domestic inputs are less than or equal to 50% of total inputs (low domestic inputs) or are more than 50% (high domestic inputs), respectively.

Table 14: **Determinants of foreign integration**

	(1)	(2)	(3)
$TFP_{i,LP}$	.101***	.107***	.096***
	(.028)	(.027)	(.027)
K_j/L_j	.020		
	(.037)		
H_j/L_j	.142		
	(.176)		
$R\&D_j$	-.119		
	(.570)		
$SCALE_j$		.064***	
		(.024)	
W_j/L_j		-.023	
		(.084)	
K_i/L_i			.036*
			(.021)
H_i/L_i			.002
			(.093)
$R\&D_i$			.105
			(1.135)
R-sq.	.089	.108	.095
Obs.	298	298	298

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

$$FORINT_i = \beta_0 + \beta_1 TFP_{i,LP} + \beta_2 HQINT_j + \epsilon_i$$

where $FORINT_i$ is firm i's subcontracting inputs from its own foreign affiliates over total subcontracting inputs from foreign companies, $TFP_{i,LP}$ is the TFP level, estimated by Levinsohn-Petrin method, 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 15: **Determinants of domestic integration**

	(1)	(2)	(3)
$TFP_{i,LP}$	.038***	.041***	.036***
	(.012)	(.011)	(.011)
K_j/L_j	.026		
	(.020)		
H_j/L_j	.025		
	(.075)		
$R\&D_j$	.015		
	(.304)		
$SCALE_j$		.032**	
		(.014)	
W_j/L_j		-.001	
		(.048)	
K_i/L_i			.035***
			(.011)
H_i/L_i			-.059
			(.056)
$R\&D_i$			.988*
			(.579)
R-sq.	.019	.024	.035
Obs.	1,284	1,284	1,284

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

$$DOMINT_i = \beta_0 + \beta_1 TFP_{i,LP} + \beta_2 HQINT_j + \epsilon_i$$

where $DOMINT_i$ is firm i's subcontracting inputs from its own domestic affiliates over total subcontracting inputs from foreign companies, $TFP_{i,LP}$ is the TFP level, estimated by Levinsohn-Petrin method, 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 16: **Determinants of foreign integration: tobit and probit**

	Tobit			Probit		
	(1)	(2)	(3)	(4)	(5)	(6)
$TFP_{i,LP}$	1.684***	1.692***	1.587***	.510***	.525***	.462***
	(.523)	(.510)	(.516)	(.153)	(.144)	(.143)
K_j/L_j	.172			-.060		
	(.559)			(.167)		
H_j/L_j	2.096			1.013		
	(2.405)			(.724)		
$R\&D_j$	-5.356			-1.463		
	(10.425)			(2.968)		
$SCALE_j$		.925*			.259**	
		(.494)			(.105)	
W_j/L_j		-.149			.146	
		(1.619)			(.463)	
K_i/L_i			.628*			.217*
			(.358)			(.119)
H_i/L_i			-.952			-.102
			(1.658)			(.440)
$R\&D_i$			3.852			2.219
			(19.556)			(5.223)
Pseudo R-sq.	.082	.098	.070	.105	.120	.117
Obs.	298	298	298	298	298	298

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

$$FORINT_i = \beta_0 + \beta_1 TFP_{i,LP} + \beta_2 HQINT_j + \epsilon_i$$

where $FORINT_i$ is firm i's subcontracting inputs from its own foreign affiliates over total subcontracting inputs from foreign companies, $TFP_{i,LP}$ is the TFP level, estimated by Levinsohn-Petrin method, 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 $FORINT_i$ is 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 17: **Determinants of domestic integration: tobit and probit**

	Tobit			Probit		
	(1)	(2)	(3)	(4)	(5)	(6)
$TFP_{i,LP}$	.631***	.681***	.561***	.231***	.243***	.203**
	(.165)	(.162)	(.158)	(.081)	(.073)	(.079)
K_j/L_j	.274			.040		
	(.250)			(.105)		
H_j/L_j	.354			.128		
	(.970)			(.390)		
$R\&D_j$	2.416			1.125		
	(3.167)			(1.980)		
$SCALE_j$		.628***			.229***	
		(.195)			(.074)	
W_j/L_j		.111			.022	
		(.720)			(.264)	
K_i/L_i			.619***			.228***
			(.148)			(.059)
H_i/L_i			-.1.079			-.368
			(.698)			(.331)
$R\&D_i$			17.939**			7.121***
			(7.177)			(2.521)
Pseudo R-sq.	.020	.031	.042	.025	.039	.054
Obs.	1,284	1,284	1,284	1,284	1,284	1,284

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

$$DOMINT_i = \beta_0 + \beta_1 TFP_{i,LP} + \beta_2 HQINT_j + \epsilon_i$$

where $DOMINT_i$ is firm i's subcontracting inputs from its own domestic affiliates over total subcontracting inputs from domestic companies, $TFP_{i,LP}$ is the TFP level, estimated by Levinsohn-Petrin method, 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 $DOMINT_i$ is 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 18: **Determinants of foreign and domestic integration: SURE**

	(1)		(2)		(3)	
	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic
$TFP_{i,LP}$	.085***	.050***	.094***	.062***	.110**	.052**
	(.022)	(.021)	(.021)	(.020)	(.043)	(.021)
K_j/L_j	.018	.052				
	(.036)	(.034)				
H_j/L_j	.142	.172				
	(.149)	(.142)				
$R\&D_j$	-.172	-.161				
	(.560)	(.532)				
$SCALE_j$			.054*	.060**		
			(.028)	(.026)		
W_j/L_j			-.012	.034		
			(.101)	(.096)		
K_i/L_i					.055***	.038**
					(.021)	(.020)
H_i/L_i					.019	-.095
					(.097)	(.093)
$R\&D_i$					-1.474	-.089
					(1.266)	(1.201)
R-sq.	.068	.047	.083	.064	.086	.049
Obs.	267		267		267	

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

$$FORINT_i = \beta_0 + \beta_1 TFP_{i,LP} + \beta_2 HQINT_j + \epsilon_i$$

$$DOMINT_i = \beta_3 + \beta_4 TFP_{i,LP} + \beta_5 HQINT_j + \epsilon_i$$

where $FORINT_i$ is firm i's subcontracting inputs from its own foreign affiliates over total subcontracting inputs from foreign companies, $DOMINT_i$ is firm i's subcontracting inputs from its own domestic affiliates over total subcontracting inputs from domestic companies, $TFP_{i,LP}$ is the TFP level, estimated by Levinsohn-Petrin method, 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 19: **Determinants of foreign integration: selection model**

	(1)		(2)		(3)	
	Selection	Outcome	Selection	Outcome	Selection	Outcome
$TFP_{i,LP}$	.159***	.527***	.149***	.525***	.131***	.470***
	(.037)	(.113)	(.036)	(.136)	(.037)	(.116)
K_j/L_j	-.128**	-.137				
	(.058)	(.189)				
H_j/L_j	.302	1.163				
	(.252)	(.732)				
$R\&D_j$	.586	-1.419				
	(.917)	(3.183)				
$SCALE_j$			.129***	.236		
			(.045)	(.157)		
W_j/L_j			-.037	.212		
			(.178)	(.530)		
K_i/L_i					-.008	.230**
					(.032)	(.107)
H_i/L_i					.662***	.090
					(.169)	(.588)
$R\&D_i$					.996	2.221
					(1.647)	(5.759)
$Export_i$	.513***		.530***		.521***	
	(.086)		(.086)		(.086)	
ρ	.297		.038		.315	
χ^2	.21		.00		.27	
Obs.	3,861		3,861		3,861	
Censored obs.	3,569		3,569		3,569	

Source: Author's calculations on MCC and Istat data. The table reports a Heckman probit model with selection. The selection equation estimates the probability of foreign sourcing and includes the same explanatory variables as the outcome model, together with an export dummy (excluded variable). The outcome model is:

$$DUMMYFORINT_i = \beta_0 + \beta_1 TFP_{i,LP} + \beta_2 HQINT_j + \epsilon_i$$

where $DUMMYFORINT_i$ is one if $FORINT_i$ is greater than zero, zero otherwise, $TFP_{i,LP}$ is the TFP level, estimated by Levinsohn-Petrin method, and $HQINT_j$ is a set of headquarter intensity indicators for industry j. The outcome model is defined for all firms with non-missing values for $FORINT_i$. 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.

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