Sourcing strategies and productivity: evidence for Spanish manufacturing firms

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Abstract:
This paper explores the relationship between productivity and offshoring/domestic outsourcing using a sample of Spanish manufacturing firms. Our results indicate that productivity and other firm characteristics differ systematically across groups of firms with a different domestic/international outsourcing status. The ranking of productivities we observe is consistent with the predictions of Antràs and Helpman (2004) model.

JEL codes: D24, F10, M20
Keywords: Total factor productivity, offshoring, domestic outsourcing.

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1. Introduction

Besides international trade and foreign direct investment, offshoring has grown in prominence in recent decades as a major international firm activity. Underlying this phenomenon is the growing fragmentation of production processes across firms and countries. To explain this kind of trade, Grossman and Rossi-Hansberg (2006, 2008) refer to what they call "trade in tasks," which is different from trade in complete goods. A slightly different approach is offered by Antràs and Helpman (2004), which combines elements of the intra-industry heterogeneity setting of Melitz (2003) and the incomplete contract approach of Grossman and Hart (1986). In this setting, companies make two endogenous organizational choices, an integration decision and a location decision, and the model shows how a firm's decisions to integrate or to outsource are a consequence of the level of firm technology. The prevalence of one way over the other to organize the production (integrate vs. outsource; outsource in the domestic market vs. outsource abroad) depends on the distribution of productivity across firms within an industry. Feenstra (2010) and Helpman (2011) offer a systematic account of the explanations and the empirical evidence available for offshoring.

There is an empirical literature using firm-level data to investigate the causes and consequences of offshoring. In this literature, the most frequent use of the term offshoring refers to the outsourcing of a good or service in a foreign country, either from outside suppliers (out-of-house offshoring) or from affiliated suppliers (in-house offshoring). Recent contributions include Girma and Görg (2004) for the UK; Tomiura (2007) provides evidence on the relationship between foreign outsourcing and the productivity of Japanese firms; Defever and Toubal (2007) examines the association between foreign sourcing and productivity for French firms; Jabbour (2010) also for France; Morrison and Yasar (2009) for Turkey; Amiti and Wei (2009) use sectorial data for the US; Federico (2010) estimates sourcing premia for Italian firms; Kohler and Smolka (2011) considers both domestic and foreign sourcing strategies for Spanish manufacturing firms. A summary of the empirical literature is offered by Görg, Greenaway and Kneller (2008).

This paper explores the relationship between the firm's decision to outsource either at home or abroad and firm productivity. This issue is addressed empirically using a sample of Spanish manufacturing firms taken from the Encuesta sobre Estrategias Empresariales (ESEE).

We take as reference Grossman and Helpman (2004) and Antràs and Helpman (2004) to identify general conditions for stabilising a complete relationship between the level of firms' productivity and the organizational form and location of its input sourcing. The paper contributes to the literature by, first, identifying a number of stylized facts about the relationship between firm heterogeneity and sourcing strategies and, second, by estimating productivity premia for groups of firms with different sourcing strategies. The estimation of productivity premia permit testing if the ranking of productivities is consistent or not with the predictions of Grossman and Helpman (2004) and Antràs and Helpman (2004).

Our results indicate that firm characteristics differ systematically across groups of firms with different outsourcing/offshoring statuses. The productivity of firms engaged in offshoring outperforms the productivity of firms either integrating at home or outsourcing in the domestic market. These differences are robust to the control of various firm characteristics. Furthermore, firms that offshore with an affiliated company outperform firms which send the production process abroad outside the boundaries of the firms. The group of firms with the lowest level of productivity corresponds to domestic outsourcing firms.

The paper is organized as follows. Section 2 provides a review of the related literature. Section 3 describes the main characteristics of the data set used in the analysis and presents some basic descriptive evidence on the magnitude and evolution of offshoring and outsourcing. Section 4 presents the ranking of productivities across groups of firms with different patterns in their outsourcing/offshoring activity. Section 5 takes as reference firms with different transition patterns in their sourcing strategies to test for two alternative hypothesis of the superior performance of foreign outsourcing firms: selection and/or relocation. Finally, Section 6 provides the main conclusions.

2. Theoretical framework and related literature

This section briefly summarizes the predictions of theories on the choice between integration and outsourcing which are mainly based on the property rights approach.

Antràs and Helpman (2004) model is the first model that we take as reference to organize our empirical work. The characteristics of the model are quite specific: a world of two countries, with a factor of production and monopolistic competition. Each final-good producer of a given variety draws a productivity level λ from a known distribution M(λ). Firm heterogeneity, as in Melitz (2003), is the first element that the model integrates. The second element comes from the incomplete contract approach literature (Grossman and Helpman, 2002) which allows for addressing the choice between outsourcing and integration. By the term outsourcing, the model means the acquisition of an intermediate input or service from an unaffiliated supplier. Integration means the production of the intermediate input or service within the boundaries of the firm.

Two agents are engaged in production: final-good producers, who provide headquarter services, and firms producing components that can be located either at home (D) or in a foreign market (F). Therefore, in this setting, firms make two endogenous organizational choices. The first one concerns the ownership structure of the firm, which can decide to integrate the activity within the boundaries of the firm –vertical integration (V)– or, alternatively, to engage in some kind of outsourcing (O). The second refers to the location decision: firms producing components can be located at home or in the foreign market.

The production combines two specialized inputs: intermediate inputs and headquarter services. Sectors differ in relative input intensity and firms differ in their productivity level. Fixed organizational costs of search, monitoring and communication are ranked as follows:

$$f_V^F > f_O^F > f_V^D > f_O^D,$$

which says that regardless of the ownership structure of the firms, fixed costs are higher in the foreign country. The fixed costs of integrating or outsourcing abroad, f_V^F, f_O^F respectively, are higher than the costs of integrating or outsourcing at home, f_V^D, f_O^D

respectively. Furthermore, for a given location, fixed costs of a V-firm are higher than the fixed costs of an O-firm. With respect to this latter assumption, on one hand the integration of the production of components implies additional supervision costs, and on the other hand economies of scope may reduce the costs of integration relative to outsourcing. Antràs and Helpman assume that the first component is higher than the second and overall the ranking of fixed costs is as in the expression above.

The industry equilibrium predictions coming out of the model indicate that the location and integration decisions will depend on both the level of firm productivity (λ) and the relative input intensity of the industry. The pattern of results can be summarized as follows. First, for component-intensive industries, firms get theirs according to the following criteria:

$$\lambda_O^D < \lambda_O^F$$

As a general strategy, in this type of industry, firms do not integrate. Those firms with higher productivity outsource abroad and the rest outsource in the domestic market. The ranking of firm productivities reproduces the assumptions of the ranking of organizational costs. Firms with productivity higher than λ_O^F outsource abroad, and firms with productivity higher than λ_O^D but lower than λ_O^F outsource at home.

In the case of headquarter-intensive industries, the pattern of decisions is richer. Firms decide to integrate or not and to locate abroad or not according to the following criteria:

$$\lambda_O^D < \lambda_V^D < \lambda_O^F < \lambda_V^F$$

Firms with productivity higher than λ_V^F integrate the production of components in the foreign country (intra-firm trade). Firms with productivity levels between λ_V^F and λ_O^F outsource abroad (arm's length trade). Firms with productivity lower than λ_O^F either integrate or outsource at home, the former when the productivity level is higher than λ_V^D and lower than λ_O^F, the latter when the productivity level is between λ_V^D and λ_O^D.

In a different setting Grossman and Helpman (2004) suggest a different and more complex relationship between organizational form and productivity. The approach in this model is slightly different to the property rights approach of Antràs and Helpman (2004). Grosmman and Helpman (2004) put forth a managerial incentives model of international organization of production. The model finds that foreign outsourcing is chosen by the most productive and the least productive firms, while intermediate productivity firms chose to integrate (…)

Given the extent to which the various assumptions and models put forth by the theory of international organization of production differ in their predictions, empirical evidence is a good strategy to discriminate between them. The rest of the paper is devoted to this objective.

3. Data and descriptive evidence

This section describes the main characteristics of the data set used in the analysis and presents some basic descriptive evidence on the magnitude and evolution of offshoring and domestic outsourcing. This information is completed in the next section with a more in-depth analysis of the differences in performance between firms that are classified according to the choice of outsourcing/offshoring they make.

We employ a longitudinal set of Spanish manufacturing firms taken from the Encuesta sobre Estrategias Empresariales (ESEE). The data base contains a longitudinal sample of firms from 1990 to 2005. The sample of firms used in this section is a panel of firms that contains 20,113 observations corresponding to an average number of 1,359 firms per year[1]. The final sample is an unbalanced panel of firms that is representative of the population of Spanish manufacturing firms (see Fariñas and Jaumandreu (1999) for more details on the characteristics of this data set; Delgado, Fariñas and Ruano (2002), Fariñas and Martín-Marcos (2007, 2010), Merino and Rodríguez (2007) are examples of applications using the ESEE).

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[1]Two conditions are imposed on the information that is required for a firm in the panel to be included in the sample that is used in this section: 1) it has to have all the information that is required for the estimation of the equation presented in Section 4; 2) it has to have information available for a sequence of three or more consecutive years over the period 1990-2005.

The measures of domestic outsourcing and offshoring are based on information reported directly by the firm in the survey. This information indicates whether or not the firm subcontracts some parts of its production process to external suppliers. In particular, firms report the value of their purchases of products and customized components subcontracted to external suppliers. To avoid ambiguity, we list the question to which firms were responding in the questionnaire: "Value of purchased products and components subcontracted to external suppliers and tailored to the needs of the firm (the firm can indicate whether it provides also some materials)".

Furthermore, we split the total amount of subcontracted purchases of products and components between the value that corresponds to purchases from suppliers located in the domestic market and the value that comes from purchases from suppliers located abroad. For the latter group, the survey provides information on the value of offshored inputs that come from both unaffiliated and affiliated suppliers.

The information available describes decisions of firms to relocate some stages of their production process outside of their boundaries, either in the domestic market or abroad. Although there is not a commonly accepted terminology (see Crinò, 2009), we use the term domestic outsourcing to refer to the activity of firms which subcontract some stages of their production process to external suppliers which are located in the domestic market, and the term offshoring for a firm doing a similar operation in international markets. Offshoring can be performed with either an affiliated or unaffiliated company. As in Antràs and Helpman (2004) and Helpman (2006) we use the term intra-firm trade to refer to the first type of offshoring and the term arm's-length trade to refer to offshoring performed with a non-affiliated company. A similar use of the terms domestic outsourcing and offshoring can be found in Olsen (2006) and Feenstra (2010). As foreign outsourcing is already included in the term offshoring, in the rest of the paper we use the term outsourcing to refer to domestic outsourcing.

According to previous information, we are able to classify firms into the following groups from the point of view of their outsourcing activities:

[1] Firms that integrate in the domestic market (neither outsource at home nor offshore abroad) (DI)

[2] Firms that outsource at home (DO)

[3] Offshoring firms:

      [3.1] Outsourcing abroad from unaffiliated suppliers (FO)

      [3.2] Outsourcing abroad from affiliated suppliers (FI)

We classify firms distinguishing between domestic vs. foreign and between integration vs. external sourcing. As firms pursue combined strategies that involve two or more combinations of the four possible organizational modes, we proceed as follows. Group [1] of firms integrating at home corresponds to those firms that neither outsource at home nor offshore abroad. For the rest of firms that pursue an external sourcing strategy, when observing multiple sourcing, i.e. a firm that simultaneously performs domestic outsourcing and offshoring, we assign it in the following mutually exclusive way. Any firm pursuing offshoring from affiliated suppliers is included in group [3.1] regardless of whether it relies on this strategy alone or it also performs domestic outsourcing. A similar criterion is applied to group [3.2] of offshoring firms from unaffiliated suppliers if they also perform domestic outsourcing. Therefore, group [2] includes firms that outsource in the domestic market and do not offshore abroad.

After the definition of groups of firms to be considered, we begin by presenting some basic empirical regularities concerning both the level and the evolution of domestic outsourcing/offshoring over the period 1990-2005. According to Figures 1 and 2, there is no clear and explicit tendency over the period for both the extensive and the intensive margins of domestic outsourcing. The extensive margin, i.e., the proportion of firms performing this activity, fluctuates around 40 percent. The intensive margin, conditional on the group of firms performing this activity, shows the magnitude of domestic outsourcing relative to the value of intermediate inputs. It fluctuates around 14 percent over the period with a slight reduction at the end of the period.

Figures 1 and 2 show a slight increase in the proportion of firms that perform offshoring over the period 1990-2005. Although there is a reduction in years 2003 and 2004, the extensive margin increases from 25.2 percent in 1990 to 31.4 percent in 2005. A similar pattern can be found for the intensity of offshoring: at the beginning of the period,

intermediate inputs subcontracted from abroad represented 2.9 percent of the total purchase of intermediate inputs, and at the end of the period, the magnitude reached the level of 5.9. Therefore, foreign outsourcing has expanded through two channels: the participation rate has increased and so has the intensity of this activity within the group of firms that outsource abroad.

Distinguishing between the group of firms that perform offshoring with a subsidiary/parent company and the group of firms that uses other channels external to the firm, we observe a large difference in the magnitude of the extensive margin between both groups of firms. At the end of the period, only 6 percent of the firms perform offshoring via intra-firm trade, while 28.9 percent of the firms in the sample perform offshoring via transactions with non-related parties. In addition, the extensive margin of offshoring via intra-firm trade diminishes slightly over the period, whereas offshoring with non-affiliated suppliers to the firm has increased significantly over the period. The intensive margins of offshoring performed with either non-affiliated or affiliated suppliers show a continuous and systematic increase throughout the period.

According to Table 1, there is a positive relationship between outsourcing either at home or abroad and the size of the firm. In general terms, there is a positive and strong relationship between size and the probability of performing domestic/foreign outsourcing. This suggests that performing this activity involves significant fixed costs for the firm and, consequently, the larger ones are in better conditions to offshore. Furthermore, after conditioning on offshoring, there is no significant relationship between the intensity of this activity and the size of the firm.

Across industries there is a positive relationship between the intensive and the extensive margins (see Figure 3). However, more interesting than this is the fact that there is a high degree of heterogeneity across industries. The extensive margin for domestic outsourcing ranges from 18.7 percent (meat and meat products) to around 63 percent (machinery and equipment and other transport equipment) and the intensive margin from 6 percent (meat and meat products) to 22 percent (machinery and equipment).

The group of industries where the intensive and the extensive margins are higher for foreign outsourcing include: other transport equipment; office machinery, computers

and precision instruments; motor vehicles; machinery and equipment; textile and clothing; and electrical machinery and communication equipment.

4. Sourcing strategies and the pattern of firm productivities.

This section compares the characteristics of the four groups of firms defined in the previous section. Models of outsourcing/offshoring, in particular Antràs and Helpman (2004), predict that the least productive firms perform domestic outsourcing, that relatively more productive firms integrate at home, and that the most productive firms engage in offshoring strategies. We provide some evidence supporting this sorting pattern. This section also provides a measure of productivity premium for offshoring and other groups of firms. Appendix 1 offers the definition of firm characteristics examined in this section.

Table 2 reports the means for the four groups of firms and performs three comparisons. The first one (column 5) corresponds to domestic outsourcing firms vs. firms integrating at home. The latter are larger, older, more capital intensive, more productive and pay higher wages than firms outsourcing in the domestic market. Two characteristics –R&D effort and the proportion of qualified workers- do not exhibit significant differences among both groups.

The second comparison (column 6) corresponds to offshoring firms vs. non-offshoring firms. The former are larger and older than the latter. Furthermore, offshoring firms are more productive in terms of both labor productivity and TFP. They use more qualified workers and pay higher wages. Concerning R&D activities, offshoring firms have a higher R&D effort, measured in terms of the ratio of R&D expenditure to sales, and obtain more product/process innovations than non-offshoring firms. Test statistics confirm that these differences are statistically significant at one percent level, with the only exception of labour productivity which is rejected at the 8.2 percent level.

Table 2 reports a third comparison for the set of offshoring firms, between the group of firms that offshore from unaffiliated suppliers (arm's-length trade) and the group offshoring from affiliated suppliers (intra-firm trade). Firms engaging in intra-firm trade abroad are more productive; they use more qualified workers and pay higher wages than

firms performing offshoring via arm's-length trade. Besides these differences, the percentage of firms with majority foreign capital participation is 71.6 percent in the group of firms that perform intra-firm trade, while in the group of firms that perform offshoring via conventional trade with unaffiliated suppliers, it is only 16 percent of the firms. This association between direct investment and offshoring performed via intra-firm trade suggests that inward foreign direct investment stimulates in-house offshoring.

Overall, the ranking of productivities between firms is consistent with the predictions of Antràs and Helpman (2004) model. The least productive group is the group of firms outsourcing in the domestic market. The second group with a higher productivity level corresponds to firms integrating in the domestic market. The group occupying the third position corresponds to firms which offshore from non-affiliated suppliers. At the top of the ranking, the group of firms with the highest productivity, corresponds to those companies offshoring from affiliated suppliers. Reported test statistics are to a large extent consistent with the prediction of Antràs and Helpman's (2004) model.

To make the analysis more complete, we check for robustness of productivity differences between the groups of firms. In particular, to estimate productivity differences across groups of firms with a different outsourcing/offshoring status, we calculate the average difference between groups of firms after controlling for other firm characteristics. The objective is to check whether productivity differentials are robust to other firm characteristics.

Using a similar specification like ISGEP (2008), the outsourcing/offshoring productivity premium is estimated from a regression of log productivity on the current outsourcing/offshoring status of the firm (defined by a dummy variable) and a set of control variables:

$$\ln Productivity_{it} = \beta_0 + \beta_1 \, Outsourcing \, / \, Offshoring \; status_{it} + \beta_2 \, Control_{it} + \varepsilon_{it} \quad (1)$$

where i is the index of the firm, t is the index of the year, *Productivity* can represent both labor productivity and TFP, *Offshoring status* is a set of dummy variables for current subcontracting status (1 if the firm is included in any of the groups of firms that are considered, 0 otherwise), *Control* is a vector of control variables including year

dummies, industry dummies, variables capturing the log size of the firm, the log of the firm's age and exporting status. The outsourcing/offshoring productivity premium, computed from the coefficient β_1 estimated as $100((\exp(\beta))-1)$, shows the average percentage difference in productivity between two group of firms after controlling for industry, year, size and export status of the firm. A variant of this premium equation is estimated including fixed firm effects (FE).

With respect to the measurement of productivity we consider three alternative definitions.

Our first measure is labor productivity, which is defined as the ratio of value of gross production of goods and services expressed in real terms to the number of yearly effective hours of work.

The second measure refers to TFP and follows the framework developed by Aw, Chen and Roberts (2001). It particular, it is an extension of the multilateral total factor productivity index proposed by Caves, Christensen and Diewert (1982), and has been used previously by Delgado, Fariñas and Ruano (2002). The expression used to estimate total factor productivity for firm i, at time t, in a given industry is:

$$\lambda_{it} = y_{it} - \overline{y_\tau} - \frac{1}{2}\sum_{r=1}^{R}(\varpi_{it}^r + \overline{\varpi_\tau^r})(x_{it}^r - \overline{x_\tau^r}) + \overline{y_\tau} - \overline{y} - \frac{1}{2}\sum_{r=1}^{R}(\overline{\varpi_\tau^r} + \overline{\varpi^r})(\overline{x_\tau^r} - \overline{x^r})$$

where y_{it} is the log of output, x_{it}^r is the log of input r, and ϖ_{it}^r is the cost share of input r. Firms are classified in two size groups of small and large firms. A bar over a variable indicates the arithmetic mean of the variable. The average value of variables with index τ, refers to a given size group of firms; otherwise, the average refers to the entire sample of small and large firms. The estimation of this index considers three inputs: labor, intermediate inputs and capital input. Input cost shares, ω_{it}^r, are defined as the fraction of the cost of each input in total input costs. Total input costs are defined by the sum of labor costs, intermediate input costs and the cost of capital. The cost of labor is measured by the sum of wages, social security contributions, and other labor costs paid by the firm. The cost of intermediate inputs is measured by the sum of costs of raw materials purchases, energy and fuel costs and other services paid for by the firm. The user cost of capital is measured for each firm by the cost of the long-term external debt

of each firm as reported by the ESEE plus the depreciation rate, d_{it}, minus the variation of the aggregate price index for capital goods. Details of the definition of output and inputs can be found in the Appendix.

The index takes a hypothetical firm as a reference and measures productivity in each year relative to this reference firm. In particular, the index uses the average firm of the industry and the size group the firm belongs to as the reference point, and then chain-links the average firm for both size groups to preserve transitiveness between firms of different size groups within the same industry. Reference firms are defined in terms of industry and size in order to take advantage of the characteristics of the data set.

As a third alternative measure, we use a measure of TFP applying the Olley and Pakes (1996) three step algorithm in order to control for the estimation biases originating in endogenous selection into markets (and simultaneous choice of input factors.

The main results are presented in Tables 3 to 7. We apply a unified econometric framework as defined by equation (1).

Sourcing dummies are computed in three alternative ways:
1) Mutually exclusive with a hierarchy. When a firm is active in more than one sourcing mode, we classify it in one exclusive category according to the following hierarchy FI > FO > DI > DC.
2) Firms are classified according to the intensity of their sourcing activity. The category with the highest proportion of subcontracting relative to the value of intermediate inputs defines the criteria used for classification.
3) An alternative way to construct sourcing dummies is what we call *non-mutually exclusive coding*: (see Kholer and Smolka (2011) for a similar procedure). With non-mutually exclusive coding each firm is classified in more than one dummy variable if pursuing a multiple sourcing strategy.

Results presented in Tables 3-7 indicate a general pattern of productivity differentials according to which foreign-integration firms perform best and domestic-integration perform worst. This result is independent of the sourcing code used and independent of

the productivity measure. The pattern of productivity premia is not robust to the inclusion of fixed effects.

5. Offshoring and firm productivity: selection vs. relocation

6. Conclusions

This paper explores the relationship between firm decisions to outsource either at home or abroad and firm productivity. This issue is addressed empirically using a sample of Spanish manufacturing firms taken from the Encuesta sobre Estrategias Empresariales (ESEE).

Sections 3 present descriptive evidence on the magnitude and evolution of offshoring and domestic outsourcing, and Section 4 provides a test of whether or not the ranking of productivities between groups of firms with different outsourcing/offshoring strategies is consistent with the predictions of models by Grossman and Helpman (2004) and Antràs and Helpman (2004). Our results confirm that firms outsourcing in the domestic market define the group of firms with the lowest productivity and firms offshoring from affiliated companies are the group with the highest productivity. These differences are robust to the control of various firm characteristics.

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Data Appendix

The data set is a longitudinal survey of Spanish manufacturing firms that comes from the Encuesta sobre Estrategias Empresariales (ESEE), collected by the Fundación Empresa Pública and sponsored by the Spanish Ministry of Industry. This data set contains a longitudinal sample of firms from 1990 to 2005.

The panel of firms contains 24,272 observations that correspond to an average number of 1,517 manufacturing firms. From this set of firms, 16,495 observations that correspond to 1,339 firms were available for estimation. The units included for estimation were required to contain information on the whole set of the variables that were used in the analysis for at least three consecutive years. Furthermore, we only use information of non-outsourcing firms and of firms active in domestic and international outsourcing. The definition of the variables used in the analysis is as follows:

- *Age*: computed as the difference between the calendar year at t and the birth-year reported by the firm.
- *Capital input* (K): net capital stock at current replacement value calculated from an initial estimate of the capital stock according to the perpetual inventory formula for each firm:

$$K_{it} = I_{it} + K_{it-1}(1 - d_{it})\frac{P_t}{P_{t-1}}$$

where I_{it} corresponds to the value of investment in equipment of firm i at time t, d_{it} stands for depreciation rates, and P_t is an aggregate price index for equipment investment published by the Spanish Institute of Statistics. The initial value of capital stock is estimated considering the book value of the capital stock and the average age of the equipment. Replacement values of the capital equipment are expressed in real terms.
- *Capital per hour:* is defined as the ratio between the net capital stock at current replacement value and the number of effective hours of work per year.
- *Employment*: is the average number of workers during the year.
- *Foreign ownership:* dummy variable indicating that foreign ownership is 50 per cent or more of total equity.

- *Intermediate inputs* (*I*): measured by the cost of intermediate inputs, which includes raw materials purchases, energy and fuel costs and other services paid for by the firm. Intermediate inputs are expressed in real terms using individual price indexes of intermediate inputs reported by the firm.

- *Intermediate inputs non-subcontracted*(*M*): intermediate inputs excluding subcontracted purchases.

- *Labor input* (*L*): measured by the number of effective hours of work per year, which is equal to normal hours plus overtime hours minus non-working hours.

- *Labor productivity*: defined as the ratio of value of gross production of goods and services expressed in real terms to the number of yearly effective hours of work.

- *Output* (*Y*): measured by the annual value of gross production of goods and services expressed in real terms using price indexes for each firm reported by the ESEE.

- *Price index of purchased external services:* Paasche-type price index computed from the variations in the price of external services reported by the firm.

- *Product and/or process innovation:* dummy variable with value equal to 1 if during the year the firm obtained product innovations (completely new products or with such modifications that they are different from those produced earlier) and/or introduced a process innovation (some important modification in the process).

- *Proportion of temporary workers: percentage ratio between temporary workers and total workers on December 31st.*

- *Qualified worker/Total employment:* ratio defined by the quotient between the number of highly qualified workers (engineers and graduates) and the average number of workers during the year.

- *R&D effort*: defined by the ratio between total R&D expenditures and gross production. Total R&D expenditures reflect the cost of R&D activities plus expenditures on imported technology (patent licenses and technical assistance).

- *Size:* log of employment defined by the average number of workers.

- *Subcontracted purchases of intermediate inputs:* value of purchases of elaborated products and customized components from external suppliers. These purchases in current prices are deflated by a firm's specific price index of intermediate inputs.

The distinction between subcontracted purchases in the domestic market and in foreign markets is not reported directly by firms. We approximate both concepts with additional information from the ESEE. In particular, we assume that the distribution of subcontracted purchases between domestic and foreign markets is equal to the

distribution of total purchases of intermediate inputs between domestic and foreign markets.

Firms provide information about the value of total imports, including imports of intermediate inputs (materials and services) and imports of capital equipment goods. Firms also report the percentage of capital goods that have been manufactured abroad and used by the firm, as well as the annual investment in capital goods. We use this information to approximate the value of imports of capital goods. Therefore, the value of imported intermediate inputs is equal to total imports minus the value of imported capital goods. Furthermore, firms provide information that permits to distribute the total value of imported intermediate inputs in two components: the value of imports from affiliated suppliers (intra-firm trade) and the value from unaffiliated suppliers (arm's length trade).

- *Total factor productivity*: Details of the definition can be found in the main text.

- *Wage per hour*: ratio of labor cost to the number of yearly effective hours of work. The labor cost is measured by the sum of wages, social security contributions, and other labor costs paid for by the firm.

Figure 1
Participation rate for domestic outsourcing and offshoring firms (%)
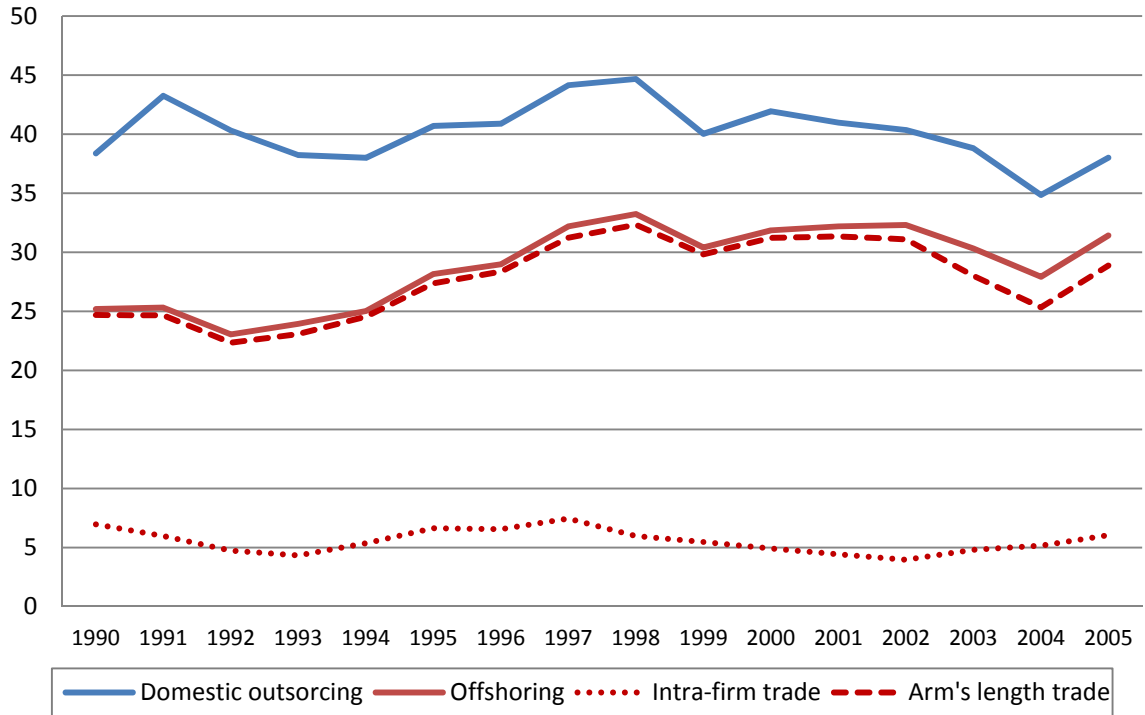
Figure 2
Offshoring and domestic outsourcing intensities (conditional on performing these activities, %)
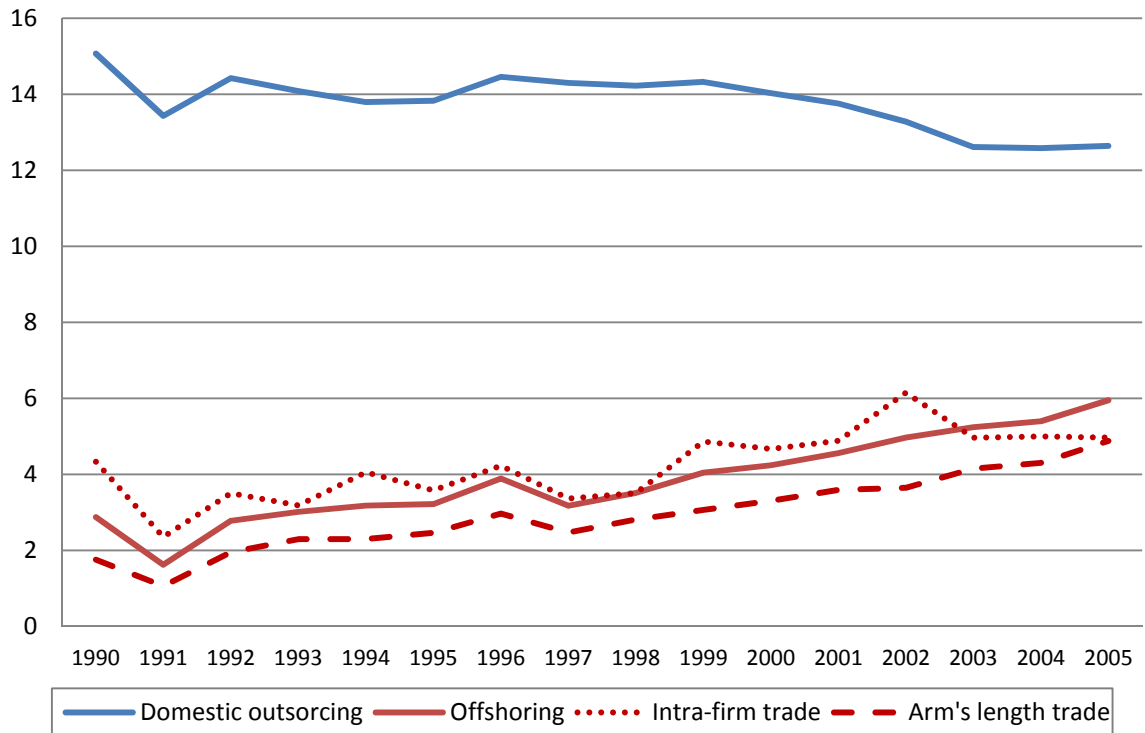
Figure 3
Domestic outsourcing and offshoring across industries: intensive and extensive margins
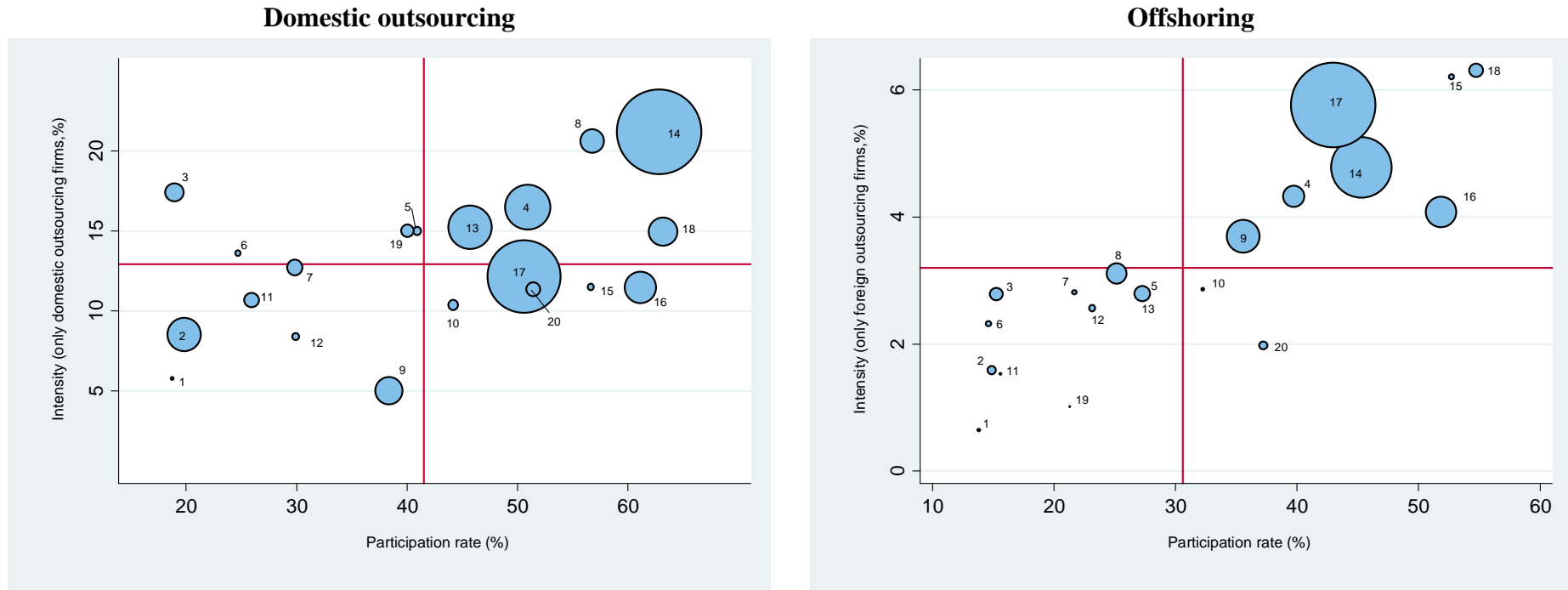
Notes:
- The size of the markers of the first figure is proportional to the weight of each industry in total subcontracted purchases from the domestic market in 1990. The size of the markers of the second figure is proportional to the weight of each industry in total subcontracted purchases from foreign markets in 1990
- The list of industries is: (1) Meat and meat products, (2) Food industry, (3) Beverages, (4) Textiles and clothing, (5) Leather and footwear, (6) Products of wood, except furniture, (7) Paper products, (8) Publishing and printing, (9) Chemicals and chemical products, (10) Rubber and plastic products, (11) .Non-metallic mineral products, (12) Basic metals, (13) Metal products, (14) Machinery and equipment, (15) Office machinery, computers and precision instruments, (16) Machinery and electrical goods, (17) Motor vehicles, (18) Other transport equipment, (19) Furniture, (20) Manufacturing n.e.c. and recycling.

Table 1
Domestic outsourcing and offshoring vs. firm size

	Firms with ≤ 200 employees		Firms with > 200 employees	
	Participation rate (%)	Intensity (%) (Only outsourcing/offshoring firms)	Participation rate (%)	Intensity (%) (Only outsourcing/offshoring firms)
Domestic outsourcing	37.2	16.0	51.6	10.7
Offshoring	20.9	2.9	49.7	4.2
With affiliated suppliers (intra-firm trade)	2.6	4.2	14.7	3.4
With unaffiliated suppliers (arm's length trade)	20.3	2.5	47.8	3.3

Table 2
Mean characteristics by groups of firms

	Groups of firms				Differences test statistic[b]		
	Integrate at home (neither outsource at home nor offshore) (1)[a]	Outsourcing at home (2)[a]	Offshoring from unaffiliated suppliers (3.1)[a]	Offshoring from affiliated suppliers (3.2)[a]	(1) vs. (2)	(1)+(2) vs. (3)	(3.1) vs. (3.2)
Production (000€)	35,898	4,592	55,494	124,261	0.029	0.009	0.136
Employment (number)	159	48	273	439	0.006	0.000	0.124
Capital per hour (€ per hour)	15.3	6.9	15.6	17.0	0.000	0.082	0.531
Labour productivity (€ per hour)	68.3	39.4	72.6	111.9	0.000	0.001	0.000
Total factor productivity	-0.040	-0.088	-0.023	0.068	0.031	0.004	0.002
Wage per hour (€ per hour)	11.3	9.8	13.0	18.0	0.001	0.000	0.000
Qualified workers / Total employment . (%)	8.2	6.9	11.9	19.2	0.165	0.000	0.000
Product and/or Process innovation (% of firms)	36.5	44.3	63.4	67.9	0.058	0.000	0.437
R&D effort (%)	3.9	4.0	14.1	13.8	0.955	0.000	0.962
Age (years)	23	17	28	33	0.001	0.000	0.035
Foreign ownership (% of firms)	13.3	1.8	16.0	71.6	0.000	0.000	0.000
Number of firms	835	167	368	81			

Notes:

[a] The number in parentheses identifies the group of firms defined in section 2.

[b] P-Value of the two-group comparison test. The null hypothesis is $H_0 : mean(\#)- mean(\#) = 0$.

Table 3 Sourcing premia with dummy variables based on the hierarchy FI > FO > DI > DO

	Baseline estimates			Including other controls			Including fixed effects		
	Labor productivity	TFP (Index)	TFP (Olley-Pakes)	Labor productivity	TFP (Index)	TFP (Olley-Pakes)	Labor productivity	TFP (Index)	TFP (Olley-Pakes)
Sourcing dummies:									
DO	-12.51***	-3.38***	-1.78***	-1.74	-1.79***	-1.27**	0.22	-0.32	-0.35
	(1.32)	(0.54)	(0.62)	(1.43)	(0.55)	(0.63)	(1.09)	(0.58)	(0.69)
FO	41.12***	3.23***	-1.24***	14.07***	0.07	-2.02***	2.62***	-0.05	-0.55
	(1.66)	(0.43)	(0.49)	(1.34)	(0.43)	(0.49)	(1.03)	(0.54)	(0.55)
FI	61.63***	7.54***	3.17***	23.48***	3.40***	1.95**	1.73	0.37	-0.34
	(2.95)	(0.69)	(0.79)	(2.27)	(0.69)	(0.82)	(1.70)	(1.05)	(1.07)
Other variables:									
Size				0.033	0.032***	0.007	-0.371***	-0.087***	-0.049
				(0.023)	(0.008)	(0.009)	(0.070)	(0.030)	(0.034)
$(Size)^2$				0.009***	-0.002***	-0.000	0.018**	0.009**	0.008**
				(0.002)	(0.001)	(0.000)	(0.008)	(0.004)	(0.004)
Age				0.030***	0.028***	0.007**	0.007	0.024*	-0.002
				(0.006)	(0.002)	(0.002)	(0.024)	(0.014)	(0.016)
Export				0.358***	0.040***	0.002	0.055***	0.014	0.013
				(0.012)	(0.004)	(0.005)	(0.015)	(0.009)	(0.009)
Equality tests (p-values):									
DO vs. FO	0.000	0.000	0.423	0.000	0.003	0.282	0.065	0.712	0.801
DO vs. FI	0.000	0.000	0.000	0.000	0.000	0.001	0.438	0.554	0.992
FO vs. FI	0.000	0.000	0.000	0.000	0.000	0.000	0.595	0.681	0.842
Oservations	20,136	20,031	20,136	20,135	20,030	20,135	20,135	20,030	20,135
R^2	0.257	0.113	0.525	0.361	0.138	0.526	0.221	0.141	0.069

Table 4 Sourcing premia with dummy variables which classify firms according to their level of sourcing intensity

	Baseline estimates			Including other controls			Including fixed effects		
	Labor productivity	TFP (Index)	TFP (Olley-Pakes)	Labor productivity	TFP (Index)	TFP (Olley-Pakes)	Labor productivity	TFP (Index)	TFP (Olley-Pakes)
Sourcing dummies:									
DO	19.98***	1.10***	-1.38***	6.79***	-0.61*	-1.76***	1.24	-0.22	-0.60
	(1.26)	(0.37)	(0.42)	(1.04)	(0.36)	(0.42)	(0.82)	(0.43)	(0.47)
FO	75.38***	7.91***	3.62***	35.84***	4.19***	2.69**	4.92***	1.31	1.08
	(4.9)	(1.20)	(1.33)	(3.82)	(1.15)	(1.33)	(2.14)	(1.23)	(1.17)
FI	101.10***	9.81***	8.66***	54.62***	5.90***	7.64***	5.23	0.39	1.23
	(7.86)	(1.41)	(1.75)	(5.93)	(1.37)	(1.76)	(3.30)	(1.43)	(1.35)
Other variables:									
Size				0.042*	0.033***	0.006	-0.370***	-0.087***	-0.049
				(0.023)	(0.008)	(0.009)	(0.070)	(0.030)	(0.034)
$(Size)^2$				0.008***	-0.002***	0.000	0.018**	0.009**	0.008**
				(0.002)	(0.001)	(0.001)	(0.008)	(0.004)	(0.004)
Age				0.032***	0.028***	0.006**	0.008	0.024*	-0.002
				(0.006)	(0.002)	(0.003)	(0.024)	(0.014)	(0.016)
Export				0.372***	0.042***	0.001	0.055***	0.015	0.013
				(0.012)	(0.004)	(0.005)	(0.015)	(0.010)	(0.009)
Equality tests (p-values):									
DO vs. FO	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.198	0.136
DO vs. FI	0.000	0.000	0.000	0.000	0.000	0.000	0.215	0.662	0.166
FO vs. FI	0.003	0.287	0.018	0.005	0.321	0.019	0.927	0.564	0.923
Oservations	20,136	20,031	20,136	20,135	20,030	20,135	20,135	20,030	20,135
R^2	0.235	0.108	0.5251	0.362	0.138	0.526	0.221	0.140	0.070

Table 5 Sourcing premia with not mutually exclusive sourcing dummies

	Baseline estimates			Including other controls			Including fixed effects		
	Labor productivity	TFP (Index)	TFP (Olley-Pakes)	Labor productivity	TFP (Index)	TFP (Olley-Pakes)	Labor productivity	TFP (Index)	TFP (Olley-Pakes)
Sourcing dummies:									
DO	-9.43***	-2.85***	-1.44**	0.34	-1.44***	-0.97***	0.43	-0.26	-0.36
	(1.35)	(0.53)	(0.60)	(1.42)	(0.54)	(0.61)	(1.07)	(0.57)	(0.67)
FO	53.39***	6.01***	0.08	12.47***	1.36**	-1.20*	2.27*	0.23	-0.15
	(2.41)	(0.61)	(0.65)	(1.81)	(0.61)	(0.67)	(1.24)	(0.71)	(0.76)
FI	26.43***	5.25***	4.61***	10.91***	3.65***	3.98***	-0.55	0.45	0.17
	(2.41)	(0.70)	(0.61)	(2.05)	(0.70)	(0.84)	(1.62)	(1.03)	(1.06)
Other variables:									
Size				0.036	0.032***	0.007	-0.371***	-0.087***	-0.049
				(0.023)	(0.008)	(0.009)	(0.070)	(0.030)	(0.034)
$(Size)^2$				0.009***	-0.002***	-0.000	0.018**	0.009**	0.008**
				(0.002)	(0.001)	(0.001)	(0.008)	(0.004)	(0.004)
Age				0.030***	0.028***	0.007**	0.007	0.024*	-0.002
				(0.006)	(0.002)	(0.003)	(0.024)	(0.014)	(0.015)
Export				0.362***	0.040***	0.002	0.055***	0.015	0.013
				(0.012)	(0.004)	(0.005)	(0.015)	(0.010)	(0.009)
Equality tests (p-values):									
DO vs. FO	0.000	0.000	0.188	0.000	0.008	0.846	0.376	0.676	0.876
DO vs. FI	0.000	0.000	0.000	0.000	0.000	0.000	0.645	0.554	0.682
FO vs. FI	0.000	0.442	0.000	0.5868	0.012	0.000	0.162	0.870	0.814
Oservations	20,136	20,031	20,136	20,135	20,030	20,135	20,135	20,030	20,135
R^2	0.254	0.112	0.525	0.360	0.138	0.526	0.221	0.140	0.070

Table 6. Sourcing premia with dummy variables based on the hierarchy FI > FO > DI > DO, excluding firms that integrate at home

	Baseline estimates			Including other controls			Including fixed effects		
	Labor productivity	TFP (Index)	TFP (Olley-Pakes)	Labor productivity	TFP (Index)	TFP (Olley-Pakes)	Labor productivity	TFP (Index)	TFP (Olley-Pakes)
Sourcing dummies:									
DO	63.14***	6.80***	0.71	38.76***	3.81***	0.96	3.10*	0.41	-0.39
	(2.64)	(0.65)	(0.70)	(2.67)	(0.74)	(0.80)	(1.79)	(1.02)	(1.07)
FO	104.59***	11.73***	5.28***	64.37***	7.98***	5.63***	3.39	1.35	0.47
	(4.33)	(0.89)	(0.99)	(4.20)	(1.04)	(1.19)	(2.71)	(1.56)	(1.64)
Other variables:									
Size				-0.186***	0.009	-0.035***	-0.632***	-0.157***	-0.014***
				(0.034)	(0.011)	(0.013)	(0.116)	(0.046)	(0.052)
$(Size)^2$				0.026***	-0.001	0.003**	0.044***	0.016***	0.017***
				(0.004)	(0.001)	(0.001)	(0.013)	(0.005)	(0.006)
Age				-0.011	0.015***	-0.002	0.028	0.032	-0.017
				(0.009)	(0.003)	(0.004)	(0.040)	(0.021)	(0.023)
Export				0.231***	0.033***	0.020	0.019	0.010	0.012
				(0.018)	(0.007)	(0.008)	(0.019)	(0.012)	(0.013)
Equality tests (p-values):									
FO vs. FI	0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.426	0.489
Oservations	8,273	8,241	8,273	8,273	8,241	8,273	8,273	8,421	8,273
R^2	0.313	0.129	0.507	0.580	0.137	0.580	0.270	0.136	0.062

Table 7. Sourcing premia with dummy variables based on the hierarchy FI > FO > DI > DO; excluding local affiliates majority owned by a foreign firm.

	Baseline estimates			Including other controls			Including fixed effects		
	Labor productivity	TFP (Index)	TFP (Olley-Pakes)	Labor productivity	TFP (Index)	TFP (Olley-Pakes)	Labor productivity	TFP (Index)	TFP (Olley-Pakes)
Sourcing dummies:									
DO	-5.08***	-2.27***	-1.79***	1.24	-1.41**	-1.54**	0.086	-0.36	-0.47
	(1.42)	(0.56)	(0.64)	(1.46)	(0.57)	(0.65)	(1.10)	(0.59)	(0.70)
FO	52.55***	4.13***	-1.57***	23.29***	1.01**	-2.20***	3.43***	0.24	-0.29
	(1.92)	(0.48)	(0.54)	(1.59)	(0.49)	(0.55)	(1.18)	(0.62)	(0.63)
FI	64.35***	9.13***	3.50***	27.36***	5.18***	2.62*	5.63**	2.61	1.77
	(4.41)	(1.29)	(1.34)	(3.46)	(1.26)	(1.35)	(2.49)	(1.87)	(1.89)
Other variables:									
Size				0.058**	0.013	0.002	-0.360***	-0.087***	-0.053
				(0.027)	(0.009)	(0.011)	(0.077)	(0.033)	(0.038)
$(Size)^2$				0.003	-0.001	0.000	0.016*	0.008*	0.009*
				(0.003)	(0.001)	(0.001)	(0.010)	(0.004)	(0.005)
Age				0.053***	0.030***	0.008***	0.025	0.029*	0.002
				(0.007)	(0.003)	(0.003)	(0.025)	(0.016)	(0.018)
Export				0.332***	0.033***	-0.001	0.063***	0.014	0.013
				(0.012)	(0.004)	(0.005)	(0.016)	(0.010)	(0.010)
Equality tests (p-values):									
DO vs. FO	0.000	0.000	0.734	0.000	0.000	0.370	0.016	0.430	0.830
DO vs. FI	0.000	0.000	0.000	0.000	0.000	0.004	0.033	0.118	0.254
FO vs. FI	0.007	0.000	0.000	0.235	0.001	0.000	0.351	0.190	0.259
Oservations	16,980	16,886	16,980	16,979	16,885	16,979	16,979	16,885	16,979
R^2	0.243	0.106	0,522	0.327	0.125	0.523	0.188	0.129	0.059