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Abstract

Which firms find it optimal to integrate their input suppliers into the firm boundaries of control (vertical integration)? Which firms choose to expand their sourcing activities across the national border (offshoring)? This letter provides novel evidence on these questions based on a Spanish firm-level data set. We find that firms selecting into strategies of vertical integration and of offshoring tend to have been more productive ex ante than firms choosing not to do so. This finding is in line with the recent heterogeneous-firm literature on input sourcing under incomplete contracts.

JEL-Classification: F14, F23, L22, L23

Keywords: vertical integration, offshoring, firm selection, firm productivity.

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1 Introduction

The sourcing of inputs is of key importance for a firm’s success. Firms face a two-dimensional choice problem: they decide about the location of sourcing (foreign *vs.* domestic) as well as the ownership structure of sourcing (vertical integration *vs.* outsourcing). Which firms select which sourcing strategy has been the subject of intensive research, but remains an open question. This letter aims to provide novel empirical evidence on this interesting question by exploring the relationship between *pre-existing* productivity differentials across manufacturing firms in Spain and *subsequent choice (or selection)* of different sourcing strategies.

Identification of productivity-based firm selection is important, because it points to aggregate productivity effects. Changes in the costs of operating a strategy of vertical integration or of outsourcing, domestically or abroad, have the potential to change the aggregate productivity of an industry, by analogy to the selection effects of trade and foreign direct investment discussed in Melitz (2003) and Helpman et al. (2004).

We use data from the Spanish “Encuesta Sobre Estrategias Empresariales” (ESEE) from 2006-2011 to investigate how firms’ selection of sourcing strategies in year t is related to their productivity in years *prior to* t . Overall, we find evidence that firms that select strategies of vertical integration and of offshoring ex post tend to have been more productive ex ante. We call this an “*ex ante sourcing premium*” of vertical integration and offshoring, respectively. It points to causation running from productivity to sourcing modes, as required for the above mentioned aggregate productivity effects.

This finding is in line with the recent literature on global sourcing by heterogeneous firms. This literature studies the boundaries of the firm—a classical question in economics dating back to Coase (1937)—against the backdrop of a global economy that allows for firms to move the source of their inputs abroad; see Helpman (2006) and Antràs (2013) for surveys. In an application of the property-rights theory of the firm (Grossman & Hart, 1986; Hart & Moore, 1990), Antràs & Helpman (2004) introduce a monopolistic competition model in which vertical integration and offshoring can be advantageous in terms of variable production costs, but disadvantageous in terms of fixed costs. Hence

there is a trade-off, and the optimal sourcing strategy depends on the firm's productivity.

Existing empirical literature focuses on the *contemporaneous* relationship between a firm's productivity and its sourcing behaviour, and it has produced mixed evidence. Defever & Toubal (2012) find that French firms relying on an outsourced (rather than an integrated) foreign supplier tend to be more productive. Corcos et al. (2013) document the opposite pattern in an extended sample of the same French data source. Federico (2010, 2012) provides evidence that firms choosing strategies of vertical integration and of offshoring tend to be more productive than firms that source their inputs domestically and from independent suppliers. Tomiura (2007) and Kohler & Smolka (2011, 2012) find similar patterns in Japanese data and ESEE data, respectively. A common feature of these studies is that time-series information is not available or, where available, has not been exploited to address firm selection. Hence causality remains an open issue. Fariñas et al. (2010) and Wagner (2011) find evidence for productivity-based firm selection into offshoring. However, they do not study (or condition on) the ownership structure of sourcing due to lack of data. We contribute to the literature by addressing firm selection in both dimensions of sourcing, location and ownership structure, and by exploiting panel data towards estimating the corresponding "ex ante sourcing premia".

2 Data and identification

ESEE is a longitudinal dataset of Spanish manufacturing firms with 10 or more employees. There are at least three advantages of using ESEE data for this work. The first is that it is based on a truly representative sample. The initial selection of firms in 1990 was carried out through a two-way sampling scheme, distinguishing between large firms (more than 200 employees; exhaustive sampling) and small firms (10-200 employees; stratified, proportional, and systematic sampling with a random seed). Subsequent sampling was carried out in a way that preserves representativeness of the sample with respect to the Spanish manufacturing sector with 10 or more employees.¹

¹More information on ESEE data and its sampling properties are available at <http://www.fundacionsepi.es/esee/en/epresentacion.asp> (accessed on 25/10/2013).

The second advantage of this data set is the level of detail. The ESEE survey collects data on a large set of firm characteristics, including firms' main activities, their accounting statements, as well as information on their customers and suppliers. Importantly, information on output and the use of labor as well as capital allow for firms' productivity levels to be estimated using standard estimation routines. Of special importance for the present purpose, the survey obtains answers to the following questions:

- *Of the total amount of purchases of goods and services that you incorporate (transform) in the production process, indicate – according to the type of supplier – the percentage that these represent in the total amount of purchases of your firm in [year].*
 - (a) *Spanish suppliers that belong to your group of companies or that participate in your firm's joint capital. [yes/no] / [if yes, then percentage rate]*
 - (b) *Other suppliers located in Spain. [yes/no]/[if yes, then percentage rate]*
- *For the year [year], indicate whether you imported goods and services that you incorporate (transform) in the production process, and the percentage that these imports – according to the type of supplier – represent in the total value of your imports. [yes/no]*
 - (a) *From suppliers that belong to your group of companies and/or from foreign firms that participate in your firm's joint capital. [yes/no]/[if yes, then percentage rate]*
 - (b) *From other foreign firms. [yes/no]/[if yes, then percentage rate]*

We are thus able to identify foreign integration (*FI*), foreign outsourcing (*FO*), domestic integration (*DI*) and domestic outsourcing (*DO*) as distinct sourcing strategies. In 2011, 5.0% of small firms and 34.1% of large firms have relied on *FI*. The corresponding numbers are 40.2% and 70.1% for *FO*, 10.9% and 33.6% for *DI*, and 93.6% and 93.5% for *DO*. Thus, the sourcing strategies are not mutually exclusive, but appear complementary to one another (Kohler & Smolka, 2011).

The third advantage of our data is given by its panel structure and time horizon. Firms rarely change their sourcing from one year to another. This means that a relatively long time horizon is essential in order to have sufficient variation in the data that can be exploited for identification purposes. ESEE data on both dimensions of sourcing (location and ownership structure) has been collected for six consecutive years from 2006 to 2011. The average number of sourcing strategies used in 2006 was 1.37 for small firms and 2.11 for large firms. In 2011, the same numbers were 1.50 and 2.31, respectively. This trend towards a stronger fragmentation of the production process was largely driven by firms adding either *FI* or *FO* to their existing sourcing portfolios, which indicates growing importance of offshoring.

We use regression analysis in order to compare the ex ante productivity across firms that select the same sourcing strategy in year $t - 1$ (the pre-selection period), but select different sourcing strategies in year t (the selection period). Key to our approach are suitable sample restrictions imposed to identify productivity-based firm selection into both vertical integration (conditional on the location of sourcing) and foreign sourcing (conditional on the ownership structure of sourcing). Figure 1 illustrates the identification of firm selection into vertical integration, conditional on the firm sourcing abroad: we first restrict the sample to firms that select *FO*, *DI*, and *DO* at both $t - 1$ and t , and to firms that do not select *FI* at $t - x$, with $x = 1, \dots, t - 1$. This sample restriction leaves us with a sufficient number of firms that differ in their *FI* status (the strategy of interest) in the selection period, but that behave identical otherwise, both in the pre-selection period as well as in the selection period.² We then estimate the pre-selection productivity differences (in both levels and first differences) between firms choosing to select *FI* in the selection period and firms choosing not to change their sourcing strategy, controlling for a host of other firm characteristics. We do so in a linear regression framework where selection into *FI* is captured through a $(0, 1)$ indicator variable (the selection variable).³

²We include firms that—in addition to sourcing abroad—choose to source domestically as well, since we would otherwise be left with an almost empty set of firms.

³Notice that for a given firm the selection variable can be equal to zero in one period and equal to one in another (subsequent) period. In principle, the model could therefore be identified even in case we observed just a single firm through time.

We apply the Olley & Pakes (1996) estimation algorithm, henceforth called OPA, in order to estimate total factor productivity (TFP) as a firm-specific, time-variant variable. The OPA avoids estimation biases due to endogenous selection into markets and simultaneous choice of input factors. We feed the OPA with ESEE data from 2000-2011, using annual information on each firm’s real output, real investment, real capital stock, real purchases, labor employment, and exit decisions. *Real output* is the total production value plus other operating income (income from rent and leasing, industrial property, commissions, and certain services), expressed in terms of prices of the year 2000. We deflate production values and other types of operating revenue by using firm-level ESEE data on goods price variations along with an industry-level price index from the Spanish Instituto Nacional de Estadística (INE) for years with missing data. This avoids estimation biases due to firm-specific mark-up pricing, firm-specific demand shocks, or firm-specific market access (Klette & Griliches, 1996; De Loecker, 2007). *Real investment* is the total investment value in real estate, construction, and equipment, deflated with an industry-level INE price index. The *real capital stock* is the reported value of real estate, construction, and equipment, deflated with an industry-level INE price index. We use a firm-level price index along with industry-level INE data to compute *real purchases*, defined as the total expenditure on intermediate inputs and external services. *Labor employment* is measured by effectively worked hours. *Exit decisions* of firms documented in ESEE data allows us to distinguish firms shutting down production from firms staying in the market, but exiting the sample.

3 Results

Table 1 reports the main results from the analysis of firm selection into vertical integration. There is strong evidence that the more productive firms self-select into strategies of vertical integration, whether in the foreign or in the domestic economy. We obtain an estimated coefficient of the selection variable which is above 0.2 and significantly different from zero, when estimating TFP differences in *levels* and not including any firm-level con-

trols. If we control for a firm’s age, skill intensity, capital intensity, technological effort, export status, and foreign ownership, the estimated coefficient of the selection variable is slightly below 0.2, but with a strictly positive lower confidence limit. This means that in the pre-selection period the firms self-selecting into vertical integration are on average somewhat less than twenty percent more productive than their competitors in the same industry with otherwise identical characteristics. These are quite strong and interesting results, also because the two samples employed in Table 1 are entirely disjunct. There is, however, no evidence that pre-selection TFP *growth* is larger for firms selecting vertical integration—the estimated coefficient of the respective selection variable has a negative sign throughout and is not significantly different from zero. This is in line with existing theory, where sourcing is driven by productivity levels, not productivity growth.

Table 2 looks at firm selection into foreign sourcing. While there is again little evidence for differences in TFP *growth* in the pre-selection period, we find clear evidence for differences in TFP *levels* prior to selecting into strategies of foreign sourcing. The estimated coefficient of the corresponding selection variable is between +0.074 and +0.139 when we condition on firms relying exclusively on an outsourced production structure, and between +0.219 and +0.279 when we condition on firms operating an integrated production structure.⁴ With a single exception, the estimated coefficients are statistically significant at least at the 5% level. These results strongly suggest that the more productive firms self-select into strategies of foreign sourcing, whether they operate an integrated or an outsourced production structure.

4 Conclusions

We present novel evidence on sourcing behavior, based on direct observation of firms’ self-selection. Using panel data information on Spanish firms, we find that among the firms that abstain from vertical integration to start with, it will be the more productive ones that subsequently self-select into strategies of vertical integration (at home or abroad).

⁴In this latter case, we include firms that—in addition to domestic integration—rely on domestic outsourcing as well, in order to have a sufficiently large number of firms in the sample. The two samples employed in Table 2 are nevertheless entirely disjunct.

The same pattern is found for self-selection of firms into foreign sourcing (integrated or outsourced).

Two comments on these findings are in order. First, our results only hold *on average* across industries. Hence, it is possible that in some industries it is the less productive firms (rather than the highly productive ones) that select into vertical integration. This could explain the seemingly contradictory results found in Defever & Toubal (2012) and Corcos et al. (2013). Second, and relatedly, while the productivity-based firm selection evidenced by our data supports a central tenet of the recent heterogeneous-firm literature on global sourcing, it should not be interpreted as lending support to any specific model of sourcing. To see whether the selection patterns found in this paper are in line with the predictions of a certain theoretical model of sourcing, we need an empirical strategy that goes beyond establishing the mere presence and direction of self-selection. In particular, we must establish a connection between the detailed pattern of self-selection and certain industry- and firm-specific variables that theoretical models propose, over and above a firm's productivity level, as key explanatory variable for the ownership structure and the location of sourcing.

Figures and tables

Figure 1: Identification of productivity-based firm selection into vertical integration (conditional on foreign sourcing)

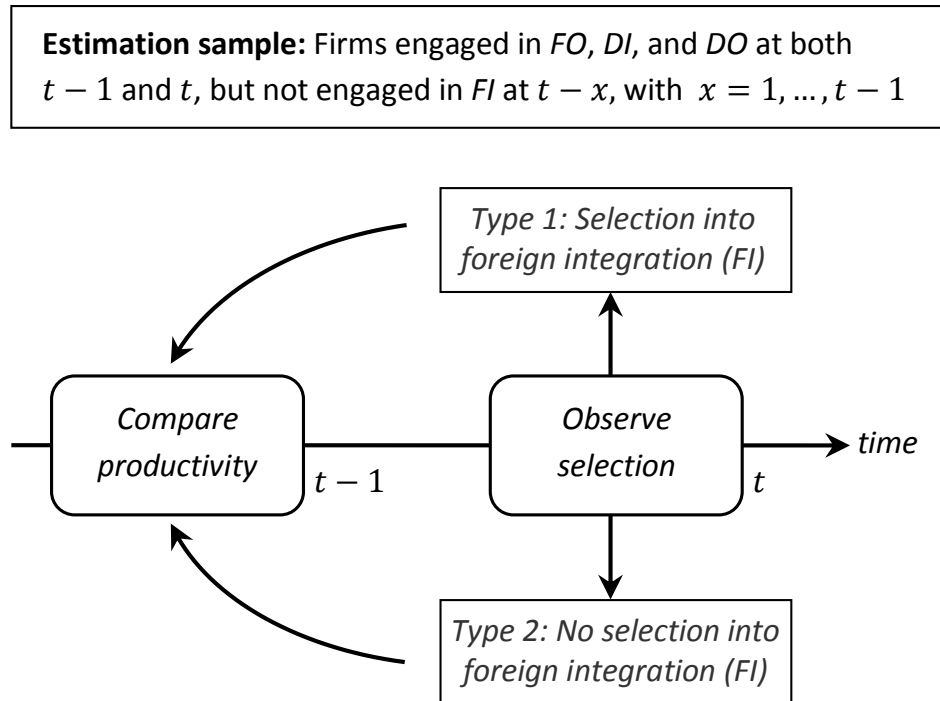


Table 1: Productivity-based firm selection into vertical integration

Selection variable	<i>Offshore production</i>				<i>Domestic production</i>			
	Sample restrictions:							
	at t-x: <i>FI status</i> =0, with x=1,...,t-1 at t-1 and t: <i>FO status</i> =1 & <i>DI status</i> =1 & <i>DO status</i> =1				at t-x: <i>DI status</i> =0, with x=1,...,t-1 at t-1 and t: <i>FI status</i> =0 & <i>FO status</i> =0 & <i>DO status</i> =1			
	TFP level		TFP growth		TFP level		TFP growth	
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
<i>FI status</i> at t (left panel) OR	0.216**	0.182**	-0.023	-0.031	0.242**	0.169*	-0.043	-0.047
<i>DI status</i> at t (right panel)	(0.101)	(0.092)	(0.025)	(0.030)	(0.097)	(0.093)	(0.041)	(0.041)
<i>Firm-level controls</i>	No	Yes	No	Yes	No	Yes	No	Yes
<i>No. of observations</i>	379	359	379	359	3,359	3,331	3,351	3,323
<i>% of switching firms</i>	>5%	>5%	>5%	>5%	>1%	>1%	>1%	>1%
<i>R-squared</i>	0.532	0.649	0.429	0.468	0.047	0.124	0.059	0.061

The table reports estimated coefficients of the selection variable for vertical integration, as explained in Section 2. The left panel (*offshore production*) looks at vertical integration conditional on the firm sourcing abroad; the right panel (*domestic production*) looks at vertical integration conditional on the firm sourcing domestically only. The variables *FI status*, *FO status*, *DI status*, and *DO status* are dummy variables for the respective sourcing strategies. Industry-year constants are always included. Firm-level controls are a firm's age, skill intensity (graduate workers over total workers, in logs), capital intensity (capital assets over average number of workers, in logs), technological effort (R&D costs plus technology imports over total sales, in logs), export status, and an ordered variable for the ratio of foreign capital in the firm's joint capital (zero;one:0-25;two:25-50;three:>50). Robust standards errors (clustered by firm) are given in parenthesis. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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Table 2: Productivity-based firm selection into foreign sourcing

Selection variable	<i>Outsourced production</i>				<i>Integrated production</i>			
	Sample restrictions:							
	at t-x: <i>FO status</i> =0; with x=1,...,t-1 at t-1 and t: <i>DI status</i> =0 & <i>FI status</i> =0 & <i>DO status</i> =1				at t-x: <i>FI status</i> =0; with x=1,...,t-1 at t-1 and t: <i>FO status</i> =0 & <i>DI status</i> =1 & <i>DO status</i> =1			
	TFP level		TFP growth		TFP level		TFP growth	
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
<i>FO status</i> at t (left panel) OR	0.139***	0.074***	0.003	0.001	0.279**	0.219	0.112	0.112
<i>FI status</i> at t (right panel)	(0.026)	(0.026)	(0.015)	(0.015)	(0.137)	(0.142)	(0.157)	(0.151)
<i>Firm-level controls</i>	No	Yes	No	Yes	No	Yes	No	Yes
<i>No. of observations</i>	3,287	3,260	3,281	3,254	289	280	286	277
<i>% of switching firms</i>	>8%	>8%	>8%	>8%	>1%	>1%	>1%	>1%
<i>R-squared</i>	0.054	0.129	0.058	0.060	0.437	0.507	0.555	0.573

The table reports estimated coefficients of the selection variable for foreign sourcing, as explained in Section 2. The left panel (*outsourced production*) looks at foreign sourcing conditional on the firm operating an outsourced production structure only; the right panel (*integrated production*) looks at foreign sourcing conditional on the firm operating an integrated production structure. The variables *FI status*, *FO status*, *DI status*, and *DO status* are dummy variables for the respective sourcing strategies. Industry-year constants are always included. Firm-level controls are a firm's age, skill intensity (graduate workers over total workers, in logs), capital intensity (capital assets over average number of workers, in logs), technological effort (R&D costs plus technology imports over total sales, in logs), export status, and an ordered variable for the ratio of foreign capital in the firm's joint capital (zero;one:0-25;two:25-50;three:>50). Robust standards errors (clustered by firm) are given in parenthesis. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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