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Published version:

DOI:10.1007/s11187-014-9625-x

SUPPLY CHAINS AND THE INTERNATIONALIZATION OF SMALL FIRMS*

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Abstract *This paper explores the relation between supply chain participation and the internationalization of firms. We show that even small and less productive firms, if involved in production chains, can take advantage of reduced costs of entry and economies of scale that enhance their probability of exporting. The empirical analysis is carried out on an original database, obtained by merging and matching balance-sheet data with data from a survey on over 25,000 Italian firms, which include direct information on the involvement in supply chains. We find a positive and significant relation between being part of a supply chain and the probability of exporting, as well as the intensive margin of trade. The number of foreign markets served (the extensive margin), on the other hand, does not seem to be affected. We also investigate whether being in different positions along the chain,* i.e., *upstream or downstream, matters, and we find that downstream producers tend to benefit more. Our results are robust to different specifications, estimation methods, and to the inclusion of the control variables typically used in heterogeneous firms models.*

Keywords Supply Chains, Global Value Chains, Internationalization, Small and medium enterprises, Heterogeneous firms

JEL Classification F12, F14, F21

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* We would like to thank two anonymous referees, Tadashi Ito and the participants to the Royal Economics Society Conference (Manchester, April 7-9, 2014); the Italian Trade Study Group Conference (November 2013); the 15, European Trade Study Group Conference (September 2013); the 10th c.Met05 Workshop (July 2013) and seminars at University of Florence, and IDE-JETRO for their comments on previous drafts of the paper. Financial support from the *Regione Sardegna* for the project CIREM "Analysis of competitiveness of Sardinia's production system" is gratefully acknowledged. The remaining errors are ours.

1 INTRODUCTION

International trade models have recently highlighted that the heterogeneity of firms often results in self-selection in foreign markets. The presence of entry costs and imperfect competition allows more productive firms to enter (stay in) foreign markets and to upgrade, while (initially) lower productivity firms, given the costs of internationalization, are likely to be confined to the domestic market. Hence, successful exporting firms tend to be relatively few, but they are larger, more productive, and generally better performers according to a number of indicators (Melitz, 2003; Bernard et al., 2007; Melitz and Redding, 2013). The empirical support for these predictions is nowadays robust (see Wagner, 2012, for a recent review).

A related strand of the literature has emphasized the importance of the international fragmentation of production and specialization in trading "tasks" rather than goods (Grossman and Rossi-Hansberg, 2008). The related evidence suggests that firms find different ways of internationalizing, by exploiting their specialization, by being involved in importing activities, and by joining global supply chains (Castellani et al., 2010; Baldwin and Lopez-Gonzales, 2013). An active involvement in supply chains is likely to enhance efficiency, by allowing firms to specialize in functions which suit their capacities better and to upgrade in a number of different ways, including through exports and innovation (Humphrey and Schimtz, 2002; Gereffi, 1999; Agostino et al., 2014; OECD, 2006; Giunta et al., 2012). Furthermore, involvement in supply chains can be seen as a rational choice since it potentially reduces agency and transaction costs, and, through formal and informal relations with other firms, allows a more efficient transfer of resources (Wynarczy and Watson, 2005; Atalay et al., 2014).

These two strands of the literature, however, have some limitations. On the one hand, the literature on heterogeneous firms has highlighted the mechanisms of the internationalization process, especially for large firms; on the other hand, the literature on the supply chain has mainly focused on firms that are already operating at global level. Moreover, the empirical evidence rarely focuses directly on Small Enterprises (SEs).[1] The evidence of the participation of SEs in the global market, as well as that of the effects of supply-chain participation on the internationalization of firms, is therefore still limited. It is often restricted to factors which hamper internationalization, such as the role of family ownership or the lack of human capital and poor access to credit, rather than to the factors which enhance the capacity of firms to internationalize, including, for instance, innovation, networking, and inter-firm contractual arrangements (Higón Añón and Driffield, 2011; OECD, 2012; Cerrato and Piva, 2012; Bricongne et al., 2012).

SEs, which represent the vast majority of firms, jobs, sales and value-added in many economies (WTO, 2013), play an important role in supply chains, and are becoming increasingly internationalized. Empirical research highlighting the interaction of heterogeneity benefits with advantages of belonging to a supply chain is therefore not only relevant, but also of immediate policy interest.

Participation in a supply chain may enhance the internationalization of firms through complex and highly-interrelated mechanisms. A major example of these mechanisms concerns incomplete contract theory and specialization (Grossman and Helpman, 2002; Grossman and Hart, 1986; Antràs, 2003). In line with Antràs and Helpman (2004), heterogeneous firms deciding whether, and, if so, how to fragment their production (domestically and/or internationally) are likely to

[1] In accordance to the official EU definition, in the rest of the paper Small Enterprises are denoted as those with less than 50 employees.

undertake a relationship-specific investment[2] in an incomplete contracts environment. An example of such a situation can be found in the decision regarding where to position themselves along the supply chain, according to their specialization. Since inputs are often customized to the buyers' needs, trust between agents becomes key.[3] Recognizing the importance of trust has been used to justify the fact that firms could internationalize through vertical foreign direct investment (FDI). However, the fixed costs faced by the firms along the supply chain are likely to be lower *vis-à-vis* vertical integration, except in cases in which the intra-firm trade along the chain involves valuable intangible resources (Atalay et al., 2014). Hence, being part of a supply chain (domestic or international) is a strategy that could be chosen also by relatively less productive firms, such as small firms and suppliers, which, otherwise, might not be able to afford the costs of vertical integration. As a consequence, supply chains can enhance the engagement of SEs in international markets, by opening new niches, also for service suppliers, and allowing firms to overcome information costs, incompleteness of contracts and other structural barriers to internationalization.

This paper exploits an original dataset based upon a survey conducted by MET (*Monitoraggio Economia e Territorio*) on over twenty-five thousands Italian firms. The survey includes direct information on the involvement of firms in supply chains. Most existing studies use the status of the supplier as a proxy for participation in supply chains; we, however, rely upon a direct measure of the involvement of firms: the answer to an *ad hoc* question in the survey. Thanks to

[2] By "relationship-specific", we mean that the value of the assets or investments is higher inside a particular relationship than outside of it.

[3] An interesting example can be found in the value chain certification of the famous Italian brand "*Gucci*", which has certified its suppliers and sub-contractors. The certification involves over 600 firms from Tuscany. As a consequence, these firms, improving their reputation, have also increased their access to credit (Il Sole 24 ore online, "*Intesa San Paolo e Gucci alleate per favorire l'accesso al credito delle PMI*", January 17, 2013).

this unique information, this paper is able to investigate the link between supply chains and internationalization, from a different perspective and with a focus on small firms.

Italy provides an ideal setting to our analysis for at least two reasons. On the one hand, substantially more than in other European countries, Small and Medium Enterprises (SMEs) represent the bulk of the productive structure, employment and the contribution to the overall export performance (Barba Navaretti et al., 2011). On the other hand, Italy's sectorial specialization and industrial structure has triggered a high division of labor among firms, many of which often work as specialized suppliers. Some recent work has highlighted how traditional small suppliers can take advantage from the international fragmentation of production to engage in more complementary activities with the final firms and improve their performance (Giunta et al., 2012; Agostino et al., 2014). Furthermore, Italian SMEs often engage in formal and informal networking at local level (Giovannetti et al., 2013), involving co-operation among specialized firms, in order to achieve collective efficiency and better performance compared to firms outside industrial districts (Becattini, 1990; Brusco and Paba, 1997; Di Giacinto et al. 2014). External economies at district level also affect the international projection of small firms, and, therefore, their traditional sources of competitiveness (Crouch et al., 2001; Becchetti and Rossi, 2000).

Our results show that belonging to a supply chain helps to offset some of the competitive disadvantages of SEs (e.g., lower levels of productivity), as it is positively correlated to (i) their probability of exporting, and (ii) the intensive margin of export (measured as a share of the total exports on turnover). On the other hand, supply-chain participation does not seem to affect the extensive margin, measured as the number of foreign markets served, in line with the view that structural limits linked to the size matter for the international expansion of SEs. Coherently with recent advancements in the literature (Antràs et al., 2013), we show that firms involved in downstream activities benefit more from being part of a supply chain.

Our results suggest some important implications, especially for countries like Italy, characterized by a high number of small firms and a fragmented production system. In a rapidly changing international context, new opportunities emerge for firms, including the smaller ones, which specialize in the different phases of the supply chains. Without entering the debate on the factors which affect a firm's involvement in supply chains, our findings seem to support the view that high specialization of domestic firms in well-defined processes and tasks has a potential to enhance their integration in global production. However, our results also suggest that only a small fraction of domestic firms is able to integrate in supply chains autonomously, thus calling for specific policies which support the inclusion in more organised, domestic and global, production processes.

The remainder of the paper is organized as follows: Section 2 describes the data and definitions, while the estimates of the relations between supply chain participation and the internationalization of firms using different methodologies are presented in Section 3. Section 4 concludes.

2 DATA AND DESCRIPTIVE STATISTICS

Our main source of information is the MET 2011 survey, covering 25,090 Italian firms belonging to manufacturing and service sectors. The survey includes detailed information on employment, input, sales, investments, internationalization modes, innovation, as well as participation and the role of firms within networks and supply chains over the period 2009-2011. In order to estimate total factor productivity (TFP), we merged the MET survey data with the balance-sheet information from AIDA, a database published by the Bureau van Dijk. This merged dataset contains 7,590 firms[4] and its characteristics are in line with those of the most recent census for Italy (ISTAT, 2013). A detailed description of the dataset is provided in the appendix.

In the existing literature, supply chains are defined in a number of different ways, all built around the existence of an Input/Output (I/O) structure, which includes a range of value-added activities (WTO, 2013; Baldwin and Lopez-Gonzales, 2013; Gereffi et al., 2001). The most recent attempts to measure a country's involvement in (global) production chains use finely disaggregated I/O tables to determine their distance to the final consumption of the goods produced (Antràs et al., 2013).

In this paper, we take advantage of a direct measure of the involvement of firms in supply chains, defined in the survey as a "*participation in a specific supply chain, implying a continuative contribution of the firm to specific productions, provided that this activity constitutes the majority of the firm's turnover*".

The definition which we use in this paper has several advantages with regard to the existing studies at firm level, which, to date, rely on the simple status of subcontractor or supplier of intermediate goods as a proxy for participation in global supply chains (Wynarczy and Watson, 2005; Accetturo et al., 2011; Agostino et al., 2014). First, it is based upon a direct answer from a firm's representative. Second, it captures the specialization of the firm in specific tasks within a

[4] The sample reduction is mainly due to micro and small firms for which balance sheet data is unavailable or inconsistent across the two data sources (*2-digit* sector and/or region do not match). After the merge, the share of firms below 50 employee decreases to 75.3 per cent from 86.2 per cent. Moreover, we lose a large number of firms in services: the share of manufacturing increases to almost two-thirds after the merge from about one-half before the merge.

well-defined production process.[5] Finally, thanks to specific information on the firm's upstream and downstream activities, it also allows us to control for the role of each firm within the production process.

However, this definition of supply chain participation has some disadvantages, too: it does not clearly allow the type of interactions arising among the firms within the supply chain (*i.e.*, arm's length *vs* collaborative) to be established, and does not explicitly address the deepness of the input/output structure of the production of the firm. For this reason, as a robustness check, we built a proxy of supply-chain participation based upon the input/output relationships of each firm, in line with the variable used in the existing literature (Agostino et al., 2014). The variable includes firms that buy and/or sell intermediate inputs, and, at the same time, have some degree of participation in the design of the final product.[6] As expected, this variable is positively correlated with the "self-reported" assessment on supply-chain participation (*i.e.*, the answer to the specific question in the survey). For about 78.7 per cent of the firms, the two variables provide the same information.[7]

According to our definition, firms belonging to a supply chain represent 15.7 per cent of the sample, the majority (82.3 per cent) being manufacturers. The share of exporters (40.3 per cent) rises to 58.3 per cent for firms in a supply chain. TABLE 1 reports the share of exporters by employment class, highlighting those in supply chains. The comparison of the two columns suggests that belonging to a supply chain increases the share of exporters for all the employment classes, but particularly for smaller firms.

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[5] The involvement in a specific production process is identified in the survey with a firm's identification with a specific supply chain, which is different from the sector they belong to.

[6] The aspect of participation in the final product has been added for consistency with our definition, given that it is likely to signal the "contribution of the firm to specific forms of production".

[7] The use of the alternative proxy for supply chain participation is also discussed when we introduce the robustness checks in Section 3.4, and detailed results are provided in the Appendix B, and TABLES B3 and B4.

TABLE 1 HERE

The survey also provides direct information on the involvement of firms in network activities. Networks are defined as "*relevant and continuative relationships with other firms and institutions*". It is worth noting that such network relationships consist of a range of many different activities that are independent from the type of production relationships within the supply chain. While relationships within supply chains are prevalently related to the production process and are based upon firm-to-firm agreements, network relations are more varied, including for instance R&D or commercial activities, and involve different partners, such as institutions, research centers and universities.

Some firms in supply chains are outside the "network", as defined in the survey (54.8 per cent of supply chain firms), while others belong to a network, but do not operate within a supply chain (78.1 per cent of network firms). Thus, we have firms involved in supply chains, which are not involved in any other form of continuative collaboration (for instance, commercial or of research) with the firms outside the value chain or institutions, and firms that, instead, have relationships with other firms or institutions, but not of the specific type arising within a supply chain. The survey allows us to distinguish local, domestic (national) and foreign networks. TABLE 2 reports the share of firms involved in the various activities (buying, selling, design, marketing, *etc*.) by the type of network and/or supply chain.

TABLE 2 HERE

The empirical literature on heterogeneous firms has shown the existence of a hierarchy of firms in terms of productivity and other performance indicators, by mode of internationalization

(Helpman et al. 2004). Exploiting the information on the FDI activities of Italian firms from the ICE-Reprint database after merging it with MET and Aida data, we compute total factor productivity for Italian firms.[8] About 9.5 per cent of firms are both exporting and involved in FDIs; this corresponds to 24 per cent of the FDI firms among the exporters, and to 73.8 per cent of the exporters among FDI firms. Our TFP estimates are in line with the findings of the literature, and show that productivity *premia* are different for the different internationalization modes (FIGURE 1). On average, the productivity *premium* tends to increase with the exported value, and large exporters are generally involved in more complex internationalization forms, such as FDIs. Interestingly, some evidence of heterogeneity emerges if we consider the role of the supply chain. Firms integrated into a supply chain show a level of productivity in-between that of non-exporters and exporters (FIGURE 1.a), suggesting that participation in a supply chain should definitely be further analyzed. This is in line with Antràs and Yeaple (2013), who, concentrating on Spanish firms, find an organizational sorting in which outsourcing, be it domestic or global, is performed by the least productive firms, while the most productive firms are more likely to choose integration at home or abroad.[9]

FIGURE 1 HERE

3 EMPIRICAL ANALYSIS

[8] The TFP estimation is based upon the Solow residuals from an econometric specification derived from a Cobb-Douglas production function. We estimated the TFP at the sectoral level, using the Levinshon and Petrin (2003) methodology, with intermediate inputs as proxies for unobservable productivity shocks. Further details on the estimation methods are provided in the appendix.

[9] Pieri and Zaninotto (2013), in a study on the Italian machinery tool industry, find that: “the most efficient builders of MTs choose integrated structures, while less efficient firms choose to outsource part of their production process by buying intermediate inputs from other firms.” (p. 413).

In what follows, we formally explore the relation between participation in a supply chain and the probability of exporting, taking the features of the firm into account and disaggregating our sample in order to check whether the relation is consistent with different specifications.

Our baseline specification is a standard Probit model:

$$(1) \qquad Pr(Y_i = 1) = \Phi(\alpha + \beta_1 SC_i + \beta_2 X_i + \gamma_i + \delta_i)$$

where $Y_i=\{0,1\}$ is the export dummy for firm i,[10] $\Phi(\bullet)$ is the c.d.f. of the standard normal distribution, α is the constant term, and γ_i and δ_i are regional and sector effects, respectively.

Our variable of interest is the dummy measuring the participation of the firm in supply chains (SC_i). In line with the literature, we control for size, age, group, and innovation, and the firm's involvement in FDIs (see, for instance, Barba Navaretti et al., 2011; Giovannetti et al., 2013; Bartoli et al., 2014). We also explicitly control for the firm's network participation at local, domestic or global level.[11] TABLE 3 reports the descriptive statistics.[12]

TABLE 3 HERE

Results from the regressions, reported in TABLE 4, are consistent across the different samples, highlighting an overall stability of the relations observed.[13] In line with the existing evidence, we

[10] The construction of this variable is based upon the answer to a specific question of the survey, in which a firm is asked whether it has been involved in international activities over the past three years. Direct and indirect exports have been considered for the purpose of this analysis. This choice is consistent with the consideration that firms along the supply chain, upstream or downstream, have different degrees of proximity to the final market.

[11] For consistency, the network variables that we include in the regressions are mutually exclusive. Hence, while some firms are involved in different types of networks simultaneously (e.g., local and domestic, domestic and global or local and global), our definitions are such that each firm is univocally attributed to the wider type of network.

[12] The matrix of correlations is available in the Appendix B, TABLE B1, showing no concerns of collinearity between our variables.

[13] Results are robust to the inclusion of each regressor separately and consistent also/even when the model is estimated on the whole sample of 25,090 firms (*i.e.*, not merged with balance sheet data). As a robustness check, all the estimations presented in the paper have been performed also on the whole sample of 25,090 firms (without checking for the TFP and FDIs). For space reasons, results are available in the Appendix B, TABLES B6-B8.

find that the probability of exporting increases with the age of the firm and with the participation in a group, and that innovation is a key driver of internationalization (Grossman and Helpman, 1991). Not surprisingly, we also find that the firms involved in FDI operations are more likely to be exporters. The introduction of a dummy variable to identify small-sized enterprises (less than 50 employees) confirms that larger companies are more likely to internationalize (Melitz, 2003; Mayer and Ottaviano, 2007).[14]

Firms belonging exclusively to local networks are less likely to export, while networking with foreign firms fosters internationalization, thereby reducing the transaction costs of exploring far-away markets. The negative and significant sign of a "local network" seems to suggest that firms able to exploit the positive impact of local networks on their productivity have fewer incentives to internationalize. This is in line with the literature stating that benefits from clustering are very localized (Duranton and Overman, 2008), and that geographical proximity, organizational proximity and social interactions are the channels through which the externalities have an impact on firm's decisions.

Last, but not least, belonging to a supply chain is positively correlated with the probability of exporting, and this result is robust to the introduction of regional and sector fixed effects (Column 2). Hence, we find preliminary evidence that exporting can be considered to be a positive spillover of being part of a supply chain.

TABLE 4 HERE

[14] Replacing the SEs dummy with the logarithm of the number of employees produces similar results, with the coefficient of the latter being positive. Regressions with the SEs dummy, however, are more consistent with the following analysis, in which we split the sample between SEs and MLEs.

In line with the literature on heterogeneous firms, we introduce the lagged level of TFP and its percentage change over the period 2007-2011 as additional controls (Columns 3 and 4 of TABLE 4).[15] Controlling for changes in productivity allows us to analyze the possibly asymmetric effects of the recent crisis on the different types of firms in the sample. This, in turn, allows us to say that the results for the supply chain are not driven by post-crisis specific circumstances. Both the initial levels of productivity and its growth are positively correlated with the probability of exporting. This result meets both our expectations and that of the literature on heterogeneous firms. First, in line with Melitz (2003), firms with higher initial productivity are more likely to be exporters. Second, given the initial level of productivity, firms that experienced a higher increase in the TFP are more likely to be exporters. This seems to suggest that they are likely to be relatively less affected by the crisis. Finally, and more importantly for our purposes, controlling for productivity does not change our findings: being integrated into a supply chain is positively correlated with the probability of exporting. More precisely, considering the marginal effect of our preferred model (Column 4 of TABLE 3), we can say that belonging to a supply chain can increase the probability of exporting by between 6.1 and 8.0 percentage points on average,[16] and correctly predicts 72.5 per cent of the observations.[17]

3.1 Supply chain and internationalization of SEs

To check whether size matters, we estimate the previous model separately for small (less than 50 employees) and medium-large firms (MLEs, with more than 50 employees). Columns 5 and 6 of

[15] Note that using the initial productivity level and the change in productivity helps also to avoid concerns over a possible simultaneity bias with the dependent variables. Moreover, there is general consensus among trade economists that the direction of causality mainly goes from productivity to export, via self-selection effects *à la* Melitz (2003).

[16] Average marginal effect and marginal effect at the mean, respectively.

[17] The prediction is considered to be correct if the predicted probability is greater than 50 percent and the firm is indeed exporting or if the predicted probability is below 50 percent and the firm is not exporting (Hosmer and Lemeshow, 2000).

TABLE 4 suggest that the aggregation masks important differences. Participation in a group is not significantly correlated with the probability to export of SEs. On the other hand, the introduction of new products seems to matter. This is not surprising, especially if seen in relation to the participation in supply chains, where product innovation is a core strategy to upgrading (Agostino et al., 2014; WTO, 2013). As far as their networking strategy is concerned, in line with previous results, domestic and global networks are positively related to the internationalization of SEs, while local networks are not. In line with our expectations, more productive SEs are more likely to export. However, for larger firms, the TFP coefficients, though positive, are not significant. This asymmetry is possibly due to non-linearities for larger firms, for which further increasing size and productivity is likely to have a small correlation with an already relatively high export probability.

More relevant for our research question, belonging to a supply chain has a clear positive relation with the internationalization of small firms, and is not significant (albeit still positive) for larger firms. This result comes as no surprise if we go back to the mechanisms linking supply chain participation and internationalization described in the introduction. As noted above, involvement in a supply chain relation may entail lower entry costs, due to well-defined contractual arrangements with other companies along the chain, and may facilitate access to cheaper and/or higher quality intermediate inputs. In addition, being part of a supply chain may be the preferred strategy when capital and R&D intensity are relatively low, since such inputs are more likely to be controlled by downstream firms. Larger firms, on the other hand, might be relatively unaffected by supply chain participation, since their structural characteristics are more likely to project them internationally, independently of whether they belong to the chain or not. The marginal effects computed by running different regressions for small and larger firms suggest that belonging to a supply chain can increase the probability of exporting by 6.2 to 7.7 percentage points for SEs. As a robustness check, and to have a more detailed picture of how the size affects these results, we run two separate sets of regressions for different size thresholds. In the first set, we consider smaller firms only (up to 5 employees) and progressively increase the upper bound; in the second set, we do the opposite, *i.e.*, start from the larger firms (at least 300 employee) and progressively reduce the lower bound.[18] Clearly, once the upper bound is sufficiently high or the lower bound sufficiently low, the regression results converge to the aggregate results. FIGURE 2 depicts the marginal effects of belonging to a supply chain on the probability of exporting, together with their confidence interval, and confirms that they are higher for smaller firms, while no significant effect emerges for larger firms.[19]

FIGURE 2 HERE

The above results seem to suggest that belonging to a supply chain may, to some extent, foster the internationalization of smaller and less efficient firms. If this is the case, one will expect a lower correlation between the probability of exporting and productivity, for firms participating in a supply chain. To test this hypothesis, we introduce in our model an interaction term, defined as the product of the supply-chain dummy and the initial total factor productivity. The coefficient of the interaction term is negative and significant only for small firms, and positive and non-

[18] The full set of results for 6 different regressions for small firms (up to 50 employees) and 6 for larger firms (from 50 employees) are reported in TABLES A3 and A4 in the appendix. For simplicity, we report regressions up to 50 employees for SEs and over 50 employees for large firms. Above 50 employees the two sets of regressions produce very similar results. Regressions for all the different thresholds are available from the authors.

[19] The negative and significant effect found for firms with at least 300 employees (Column 6, Table A4) should be taken with caution, since in this sub-group most firms are already exporting (62 per cent), the number of observations is rather small, and the confidence interval is quite large.

significant for larger firms.[20] Note, however, that the interpretation of the interaction effect in non-linear models (such as probit) requires some caution, since it cannot be directly interpreted as in linear models (Ai and Norton, 2003). For this reason, we also compute corrected interaction effects for the case of a dummy-continuous variable interaction, following the procedures suggested by Norton et al. (2004). The corrected z-statistics for small and medium-large firms are reported in FIGURE 3. The interaction effect is found to be negative and statistically significant for small firms with a predicted probability of export between 40 and 80 per cent, while it is negative but non-significant otherwise (FIGURE 3.a); in contrast, no significant effect is found for medium-large firms (FIGURE 3.b). The interaction term seems to suggest that even the less productive among the small firms can internationalize, conditional to their participation to a supply chain. Overall, thus, our evidence supports our underlying assumption that supply-chain participation provides smaller and less productive firms with additional advantages to be exploited in their internationalization process.

3.2 Intensive and the extensive margins

In order to check whether the positive relationship between participation in supply chains and export performance can be confirmed for alternative measures of internationalization, we compute the intensive and extensive margins of trade at firm level. The intensive margin is calculated as the share of exports over total turnover, while the extensive margin has been constructed as an index which includes the number of different geographic destinations served

[20] Detailed results from the regressions with the interaction term, not reported here for reasons of space, are available in Appendix B, TABLE B2. In addition, we also run separate regressions for firms in a supply chain. For this sub-sample, the initial level of TFP is expected to show a low correlation with the probability of exporting, and, indeed, the coefficients from the regressions are found to be non-significant. However, the number of observations is rather small, making the introduction of an interaction term more appropriate.

by the firm.[21] On average, firms in our sample export 14.2 per cent of their turnover, whereas firms in supply chains export 21.7 per cent. With regard to the number of destination markets, the average is 2.1 for all exporting firm (0.83 for all firms), while firms in supply chain reach 2.3 markets.

To measure the relation between supply chain participation and the intensive margin, we estimate a Tobit model with left censoring at 0. The results, displayed in Columns 1-3 of TABLE 5, are in line with the previous ones: the same variables that affect the probability of exporting also contribute to the intensity of exports. Again, a significant difference emerges between firms of different sizes. We find that not only does participation in supply chains foster the internationalization of small firms, but also that their high levels of specialization and the likely deepening of linkages along the chain make SEs more dependent on foreign network relationships.

Conversely, we do not find any evidence that being part of supply chains has positive spillovers on geographic diversification. The results reported in Columns 4-6 of TABLE 5 and obtained by means of a negative binomial estimator, show that the geographic scope of SEs does not improve when they are in supply chains. Interestingly, larger firms in supply chains seem to take advantage of it, with a significant probability of operating in different markets, independently of their distance. Our findings for the extensive margin of trade suggest that size still needs to be considered a structural barrier to the international expansion of SEs, and that being part of a supply chain cannot be a substitute for the lack of other structural resources.

The above results could be due to the existence of different entry costs. SEs may, therefore, benefit more from supply-chain participation through reduced entry costs in foreign markets.

[21] The extensive margin index goes from 0 (non-exporters) to 8. The different destinations for which we have data are: EU, EXTRA-EU, North America, China, India, rest of Asia, South America, other.

Hence, firms in supply chains are more likely to internationalize and to export a larger share of their turnover. However, increasing the number of destination markets and reaching distant markets may involve additional costs, and size once again becomes a stringent requirement.

TABLE 5 HERE

3.3 The role of firms within the supply chain

We showed that small firms, less likely to internationalize, might partly overcome their intrinsic weaknesses through an active involvement in a supply chain. However, they are themselves heterogeneous, and different firms involved in the production of the same final product may have different roles, degrees of monopoly power, and proximity to the final market. More precisely, the position along the chain is likely to determine the benefits that can be obtained, and the activities offering greater revenues are often intangible (Antràs et al., 2013). Ignoring these differences may bias the results, even when firms are of a similar size and share other common characteristics. In a pioneer model, Antràs and Chor (2013) consider a set-up in which the existence of a number of many (sequential) suppliers gives rise to differential incentives to integrate along the supply chain. The position, *i.e.*, being upstream or downstream, determines whether a given task or a given input is better produced by an independent supplier or an integrated firm.

In Italy, firms tend to outsource part of their production more than other countries while being less prone to international integration (Federico, 2012). This could be linked to the diffuse presence and historical relevance of industrial districts, characterized by a tight division of labor and a large diffusion of sub-contracting practices (Accetturo et al., 2011). These stylized facts are in line with theoretical models which show that smaller, less productive firms are more likely to outsource and, hence, to be part of production networks (Antràs and Helpman, 2004). However, while this could explain, together with other factors, why Italian SEs may find it convenient to be involved in supply chains in order to outsource, little has been said on their role as sub-contractors. The existing evidence highlights a consistent *sub-contracting discount*, and a marginal role of sub-contractors in terms of performance, when compared to final producers (Razzolini and Vannoni, 2011). More recent studies, however, find a large degree of heterogeneity within the group of sub-contractors, showing that the opportunities offered by involvement in supply chains might allow them to escape "captive" contractual arrangements, and provides an incentive to upgrade, including through innovation and export (Giunta et al., 2012; Agostino et al., 2014).

In order to take such heterogeneity into account, we re-estimate our baseline model by introducing a new set of variables. From our database, we know the share of total sales for each respondent by type of product (final vs. intermediate) and to what extent each firm produces for other firms or on their own. We, therefore, distinguish three types of firms: 1) a *final-good producer*: a firm whose sales are entirely constituted by final consumption and final industrial goods; 2) a *sub-contractor:* a firm which works only on a contractual basis for other firms; and 3) a "*own-branded*" *firm*: a firm that sells own-designed proprietary products (*i.e.*, a firm that designs its own products, final or not, and retains the industrial property, either with or without patents).[22]

TABLE 6 HERE

[22] In our case, the definition of binary variables is preferable to the use of the actual shares of total sales. In fact, the latter is likely to contain measurement errors, *i.e.*, the observed shares are only indicative and extreme values are indeed prevalent in the sample.

To account for these considerations, we introduce other controls into our baseline model (TABLE 6). The resulting regressions are robust: all coefficients have the same sign and their numerical value is similar to previous results. While belonging to the supply chain keeps its explanatory power, final-good producers strongly emerge as those with the highest probability of exporting; furthermore, in line with the above-mentioned existing empirical evidence, we find confirmation of a sub-contracting discount.

Columns 2-4 present the results for the sub-samples of sub-contractors, own-branded firms and final-good producers, respectively. We find that belonging to a supply chain is highly correlated with the probability of exporting for both final-good producers and own-branded firms. The supply chain coefficient is positive also for sub-contractors, but is not statistically significant.

Our results suggest that participation in supply chains is particularly beneficial to downstream producers, such as “final” firms, possibly due to a more effective organization of the upstream production process. Moreover, supply chain participation is likely to enhance the specialization of firms with their own-designed proprietary products, increasing their probability of exporting. All in all, these findings seem to suggest that downstream firms, which have some decisional power and are able to benefit more from the division of labor, are the most likely to increase their probability of exporting due to their supply chain participation. This hypothesis is consistent with the results reported in Column 5, where we restrict the analysis to the sub-group of own-branded and final firms. While all the other coefficients are in line with previous estimates, the numerical value of the supply chain coefficient increases, thus supporting our priors. In Columns 6 and 7, we confine out attention exclusively to small firms, which represent the vast majority of the own-branded/final group (69 per cent). Results hold even when we exclude larger firms.

3.4 Robustness checks

The econometric analysis suggests that belonging to a supply chain is positively correlated with the probability of exporting. We performed different robustness checks.[23] First, as already mentioned, the results are confirmed when the regressions are run on the whole survey sample.[24] Second, our baseline model yields similar results when run on manufacturing and services separately.[25] Third, results are consistent even if we replace our supply chain variable with an alternative variable constructed by taking the I/O relations of firms into account, as discussed in Section 2.

In this section, we report, as an additional robustness check, the results obtained with a different, non-parametric, methodology, *i.e.*, the Propensity Score Matching (PSM). Note that, even though PSM is often used to address causality issues, in our case not much can be said on the direction of causality, at least from a statistical point of view, particularly due to the cross-sectional limitation of the data. This has to do with the issue of self-selection: for instance, if firms with an *ex-ante* higher probability of exporting also choose to produce within a supply chain, then the observed correlation might over-estimate the causal effect of the supply chain. Such a problem is difficult to overcome, without panel data and/or valid instruments. However, matching procedures may be employed to validate regression results. Despite being subject to a number of criticisms, mainly related to the difficulty of selecting the control group, PSM has two main advantages: first, matching, under the common support condition, focuses on comparable

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[23] The results of these robustness checks, not included here for reasons of space, are available in Appendix B, TABLES B3-B8.

[24] To run regressions on the whole sample, however, we cannot control for TFP.

[25] Though service firms are likely to take advantage from supply chain participation, in our sample they are less represented both in absolute terms (they are one third of the merged sample) and especially as far as supply chain involvement is concerned (only less than 17.7 per cent of firms in a supply chain operate in services, and less than 7.3 per cent of firms in services report to be part of a supply chain). Finally, most of the services firms in our sample are localized (*i.e.*, not easily exportable) services, including business services and transportation.

subjects only; second, it is a non-parametric technique, and this avoids the potential mis-specification of the conditional mean.

We match firms with similar observable characteristics, with the exception of their participation in supply chains, by performing a PSM estimator. Since the two matched groups are comparable (and, in particular, they have the same predicted probability of participating in a supply chain), the second group acts as a counterfactual, allowing us to obtain reasonable estimates on the relation between supply chain participation and the probability of exporting.

Formally, our parameter of interest is the "average treatment effect on the treated" (ATT), which represents an estimate of the difference in the average probability of exporting for firms belonging to a supply chain, had they not been part of the supply chain (the counterfactual). The ATT is defined as:

(2) $\tau_{ATT} = E(\tau|D=1) = E[Y(1)|D=1] - E[Y(0)|D=1]$

where D={0,1} is the treatment (the supply chain), and Y(D) is the potential outcome (the probability of exporting). Since the counterfactual E[Y(0)|D=1] cannot be observed, a control group is selected through the matching procedure so that it can reasonably mimic treated units had they not be treated. In particular, the propensity score matching estimator can be written as:

(3) $\tau_{PSM} = E_{P(X)|D=1}\{E[Y(1)|D=1,P(X)] - E[Y(0)|D=0,P(X)]\}$

where P(X) is the propensity score, which is the probability of receiving the treatment.[26]

Heckman-Ichimura-Todd (1998) show that, in observational studies, it is desirable (i) that the same questionnaire is submitted to the treated and the control group, and (ii) that the two groups

[26] For a detailed discussion of the methodology, see Caliendo and Kopeinig (2008); Becker and Ichino (2002); Dehejia and Wahba (1999); Heckman et al. (1998); Rosenbaum and Rubin (1983).

can be extracted from the same local market. Our dataset allows us to satisfy both these requirements.

It should be noted that the matching procedure may not guarantee, nor allow testing, that the so-called unconfoundedness assumption holds, which is the requirement that the treatment is/be exogenous or independent from the potential outcomes (Imbens and Wooldridge, 2009; Becker and Caliendo, 2007). This is typically a problem with non-experimental data, where unconfoundedness might not hold precisely for the same reason that regression results might not capture the true causal effect. In our case, the choice of participating in a supply chain may be endogenous. Indeed, two otherwise identical firms may take different decisions about integration into a supply chain, if the decision depends on some unobserved factors. Importantly, however, it can be shown that, if such unobserved factors are unrelated to the probability of exporting, or, more generally, to access the foreign market, then the unconfoundedness assumption may not be violated (Imbens and Wooldridge, 2009; Becker and Caliendo, 2007).

Confining attention to small firms, we report estimates of the average treatment effects for different propensity score matching specifications. We start from a basic specification including only sectoral and regional dummies, and then turn to more complete specifications, including different sets of covariates. We estimate five different models. For all the models, the matching procedures use the common support condition, and the balancing property of the propensity scores is satisfied both according to the stratification t-test procedure and the standardized percentage bias.[27] The ATT are estimated with the nearest neighbor matching both according to the Becker and Ichino (2002) and the Leuven and Sianesi (2003) algorithms, with the same

[27] Aggregate tests are reported in the Appendix, TABLE A5.

results.[28] The estimated ATT indicates that small firms belonging to a supply chain are at least 7 percentage points more likely to export on average (TABLE 7). These numbers are largely consistent with the marginal effects from the previous regression analysis (where the range was between 6.2 to 7.7 percentage points, Model 5 in TABLE 4). Thus, the propensity score matching analysis seems to reinforce our results.

TABLE 7 HERE

4 CONCLUSION

The recent literature on supply chains has emphasized the importance of international fragmentation of production and specialization in functions better fitting the specific capacities of firms, focusing on firms already operating at a global level (Grossman and Rossi-Hansberg, 2008; Humphrey and Schimtz, 2002; Gereffi, 1999). The existing literature on heterogeneous firms has highlighted different self-selection mechanisms in international markets (Melitz, 2003; Bernard et al., 2007; Melitz and Redding, 2013). Larger and more productive firms are more likely to access the foreign market. Smaller and less productive firms are more likely to choose disintegrated production structures, either domestically or globally. In this paper, we build on these strands of the literature and study the relation between the participation of firms to supply chains and their internationalization, with a specific focus on Italian small enterprises. The main findings can be summarized as follows: (i) in line with the existing literature on heterogeneous firms, small firms are less likely to export than larger ones; (ii) small firms participating in a supply chain are more likely to export than small firms outside the supply chain; (iii) they also

[28] The propensity score matching models and the ATTs estimations have been performed also on the whole survey as a robustness check. Estimated ATTs are similar (slightly higher) to those reported in the paper, but the matching procedure was more problematic. Details are available in appendix B, TABLES B9 and B10.

tend to export a higher share of their turnover, while there is no evidence that they also reach a higher number of markets; (iv) the position of the firm along the supply chain matters, and so does the scope for specialization; in particular, downstream firms, such as final-good producers, and firms with own-designed proprietary products are likely to gain more from participating in supply chains than upstream firms or sub-contractors.

Our results are robust to different specifications and estimation methods, including non-parametric techniques, suggesting that firms in supply chains, especially smaller ones, are, on average, more likely to export, *ceteris paribus* (with a range that varies between 6.2 to 7.7 percentage points for small firms). While the size and productivity of a firm are the key determinants of its internationalization, supply chain participation may help smaller and less productive firms to offset their structural weaknesses and to internationalize. This paper contributes to a better understanding of the mechanisms through which this occurs, at the same time justifying the co-existence of firms which are internationalized or domestic and/or with different productivity levels and organizational forms in the Italian economy.

Our results have some relevant implications. In our framework, supply chains facilitate trade and international integration of smaller firms. This, in turn, enhances the possibilities for countries characterized by a large share of small firms, such as Italy, to access new types of production and to specialize further in the specific "tasks" in line with their (firm level) comparative advantage. In other words, supply chains play an increasingly important role in fostering competitiveness and determining how countries can gain from specialization and international trade. Hence, policies designed to support firms, especially smaller ones, in actively participating in and upgrading supply chains represent an important tool to increase the gains of globalization.

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TABLES AND FIGURES

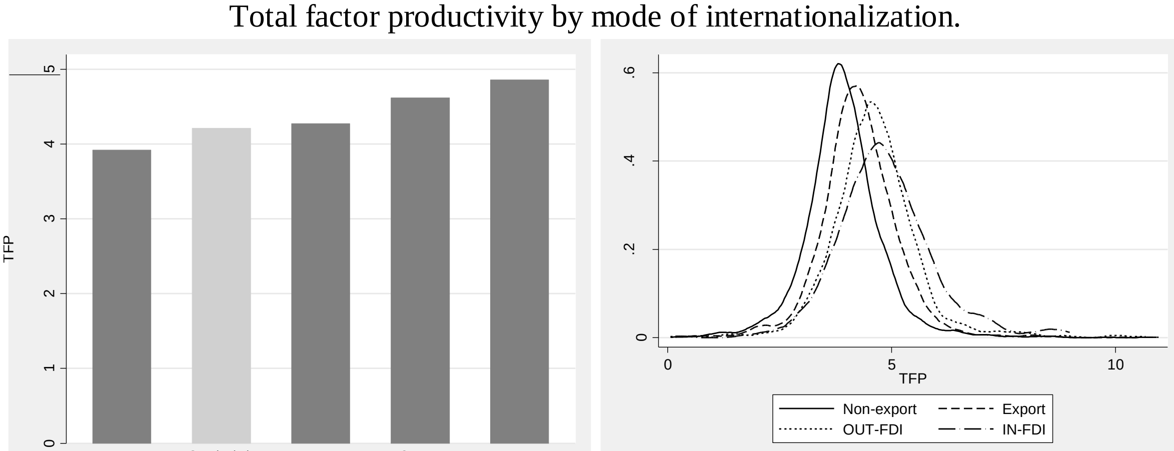
TABLE 1
Probability of exporting by class of employment.

	Share of exporters		
Class of employment	Supply chain	Others	Odds
1-9	0.36	0.18	1.98
10-49	0.57	0.42	1.34
50-249	0.73	0.54	1.34
≥250	0.75	0.60	1.25
Total	0.58	0.37	1.58

TABLE 2
Share of firms by type of activity within networks.

	Local network		Domestic network		Foreign network	
Type of relationship	total	supply chain	total	supply chain	total	supply chain
Buy	51,2	57,9	54,1	59,0	51,4	58,4
Sell	60,3	62,4	64,9	69,4	67,4	68,8
Design	12,6	12,6	14,1	11,9	12,2	9,6
Services	15,3	11,8	12,2	8,3	6,9	6,4
Marketing	13,7	18,7	12,8	17,3	15,1	14,4
Activities abroad	1,6	2,4	3,0	3,2	15,4	16,0
R&D	2,7	5,0	3,7	4,7	3,2	3,2
Other	4,9	2,9	4,0	2,9	2,8	2,4
Any kind	100	100	100	100	100	100
N	1835	380	1124	278	436	125

FIGURE 1
Total factor productivity by mode of internationalization.



(a) Average TFP by mode of internationalization.

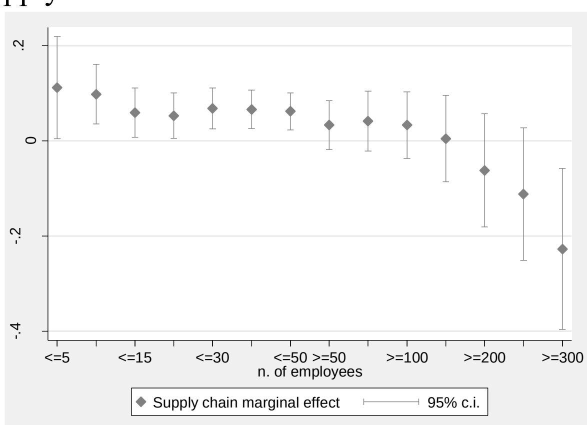
(b) TFP distribution by mode of internationalization.

TABLE 3
Summary statistics.

Variable	Mean	Std. Dev.	Min	Max
Export	0.40	0.49	dummy	
Export share	14.2	23.99	0	100
N. foreign markets	0.83	1.49	0	8
Supply chain	0.16	0.36	dummy	
SEs	0.75	0.43	dummy	
Age (ln)	3.07	0.59	0.69	5.20
Group	0.17	0.38	dummy	
Local network	0.16	0.37	dummy	
Domestic network	0.11	0.31	dummy	
Foreign network	0.06	0.23	dummy	
FDI	0.13	0.33	dummy	
Product innovation	0.11	0.32	dummy	
Process innovation	0.09	0.29	dummy	
TFP (ln)	4.06	0.94	-2.60	10.96
TFP change (Δln)*	-0.13	0.54	-5.97	4.16
Subcontractor	0.29	0.45	dummy	
Own-branded firm	0.55	0.50	dummy	
Final-good producer	0.44	0.50	dummy	

* Number of observations reduced to 5396 from 7590.

FIGURE 2
Supply chain coefficients for different firm's sizes.



Note: the bars represent the confidence intervals at 95% of the supply chain coefficients in the probability to export regressions by firm size.

TABLE 4
Probability of exporting.

	Final dataset		Controlling for TFP		SEs	MLEs
Dep. export dummy	(1)	(2)	(3)	(4)	(5)	(6)
Supply chain	0.392***	0.214***	0.347***	0.201***	0.200**	0.124
	(9.00)	(4.61)	(7.05)	(3.81)	(3.13)	(1.26)
SE	-0.324***	-0.406***	-0.278***	-0.364***		
	(-8.06)	(-9.22)	(-6.14)	(-7.10)		
Age	0.168***	0.0447	0.141***	0.0353	0.0468	0.0204
	(6.20)	(1.49)	(4.34)	(0.98)	(1.09)	(0.29)
Group	0.158***	0.186***	0.0890+	0.118*	0.0521	0.227**
	(3.50)	(3.90)	(1.78)	(2.22)	(0.71)	(2.73)
Local network	-0.447***	-0.399***	-0.472***	-0.429***	-0.430***	-0.376***
	(-9.87)	(-8.31)	(-8.71)	(-7.46)	(-6.11)	(-3.53)
Domestic network	0.0823	0.0988+	0.0968+	0.126*	0.182*	-0.0278
	(1.64)	(1.88)	(1.67)	(2.07)	(2.52)	(-0.23)
Foreign network	1.297***	1.338***	1.281***	1.313***	1.288***	1.458***
	(15.52)	(14.84)	(13.37)	(12.65)	(11.23)	(5.01)
FDI	0.669***	0.456***	0.555***	0.354***	0.541***	0.267**
	(12.58)	(8.03)	(9.71)	(5.74)	(5.83)	(2.91)
Product innovation	0.755***	0.667***	0.738***	0.647***	0.647***	0.648***
	(13.35)	(11.18)	(11.45)	(9.51)	(7.53)	(5.49)
Process innovation	0.147*	0.213**	0.145*	0.194**	0.115	0.290*
	(2.35)	(3.25)	(2.04)	(2.60)	(1.16)	(2.38)
Initial TFP			0.0907***	0.171***	0.212***	0.0712
			(3.98)	(4.46)	(4.50)	(0.88)
TFP change			0.0566	0.113**	0.137**	0.0459
			(1.63)	(2.92)	(3.03)	(0.55)
Constant	-0.799***	0.0249	-0.987***	-0.609*	-1.217***	0.184
	(-8.45)	(0.17)	(-6.85)	(-2.41)	(-4.32)	(0.33)
Sector and Region f.e.	no	yes	no	yes	yes	yes
Observations	7560	7549	5383	5357	3755	1561
Pseudo R-squared	0.156	0.234	0.148	0.226	0.188	0.274

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

TABLE 5
Intensive and extensive margins.

	Intensive margin			Extensive margin		
	all	SEs	MLEs	all	SEs	MLEs
	(1)	(2)	(3)	(4)	(5)	(6)
Supply chain	4.647**	5.643**	0.964	0.125**	0.0808	0.148*
	(2.96)	(2.65)	(0.42)	(2.69)	(1.26)	(2.19)
SE	-9.160***			-0.411***		
	(-5.84)			(-8.69)		
Age	0.324	0.605	0.0442	0.0385	0.0456	0.0452
	(0.29)	(0.40)	(0.03)	(1.11)	(0.97)	(0.87)
Group	4.449**	3.654	5.268**	0.100*	0.0911	0.120+
	(2.78)	(1.48)	(2.62)	(2.10)	(1.23)	(1.95)
Local network	-15.99***	-17.38***	-12.95***	-0.504***	-0.635***	-0.338***
	(-8.31)	(-6.71)	(-4.51)	(-7.97)	(-7.22)	(-3.65)
Domestic network	1.480	2.966	-0.860	0.0892	0.0889	0.0666
	(0.77)	(1.18)	(-0.29)	(1.52)	(1.14)	(0.75)
Foreign network	26.29***	30.59***	16.56***	0.780***	0.858***	0.552***
	(11.82)	(10.54)	(4.80)	(12.79)	(10.91)	(5.79)
FDI	13.73***	19.61***	10.33***	0.301***	0.395***	0.268***
	(7.76)	(6.82)	(4.74)	(5.90)	(4.78)	(4.11)
Product innovation	15.84***	20.44***	9.896***	0.420***	0.492***	0.315***
	(8.40)	(7.61)	(3.90)	(7.68)	(6.35)	(4.18)
Process innovation	2.440	2.027	3.040	0.0136	0.0536	-0.0300
	(1.15)	(0.63)	(1.13)	(0.22)	(0.56)	(-0.37)
Initial TFP	6.459***	7.376***	5.359**	0.221***	0.208***	0.242***
	(5.23)	(4.40)	(2.66)	(5.65)	(3.91)	(3.81)
TFP change	4.184***	5.540***	1.661	0.109**	0.136**	0.0724
	(3.34)	(3.43)	(0.80)	(2.73)	(2.63)	(1.09)
Constant	-23.79**	-39.47***	-13.23	-0.935***	-1.267***	-1.060*
	(-2.95)	(-3.93)	(-1.00)	(-3.67)	(-4.00)	(-2.56)
sigma / ln_alpha	37.99***	40.24***	33.36***	-0.521***	-0.446***	-0.780***
	(64.84)	(49.65)	(42.02)	(-8.81)	(-5.52)	(-8.47)
Sector and Region f.e.	yes	yes	yes	yes	yes	yes
Observations	5383	3786	1597	5383	3786	1597
Pseudo R-squared	0.057	0.052	0.058	0.109	0.102	0.105

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Note: Estimates for the intensive margin regressions are done by means of a Tobit model censored at zero. Estimates for the extensive margin are done by a Negative binomial regression.

TABLE 6

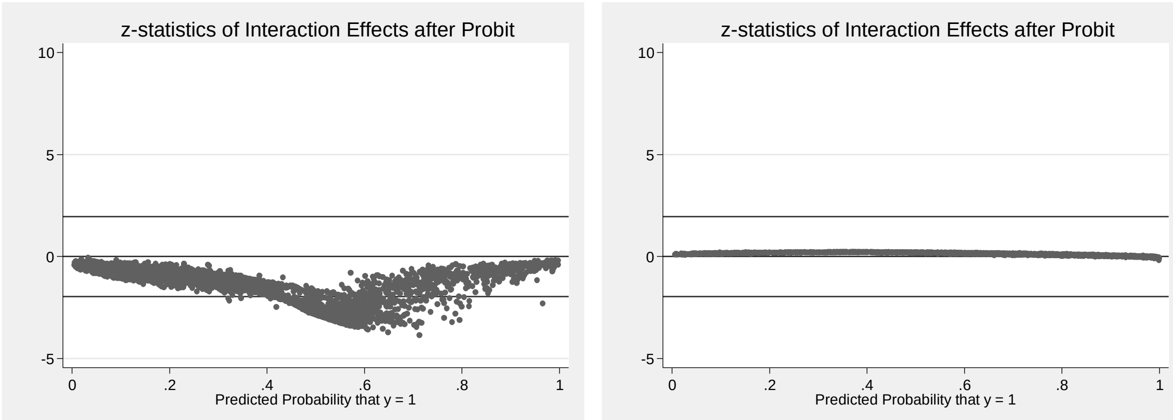
Firms' role within the supply chain.

					own-branded and final		
	all	subcon.	own-branded	final	all	SEs	SEs
Dep. export dummy	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Supply chain	0.239***	0.132	0.237**	0.364***	0.413***	0.312*	0.330*
	(4.50)	(1.31)	(3.17)	(4.36)	(3.69)	(2.39)	(2.54)
SE	-0.358***	-0.445***	-0.414***	-0.386***	-0.399***		
	(-6.95)	(-4.52)	(-5.85)	(-4.83)	(-3.81)		
Subcontractor	-0.133*						
	(-2.19)						
Own-branded firm	0.00230						
	(0.04)						
Final-good producer	0.303***						
	(7.28)						
Age	0.0281	0.00317	0.00904	0.00946	0.0501	0.00136	
	(0.78)	(0.05)	(0.18)	(0.18)	(0.70)	(0.02)	
Group	0.122*	0.0724	0.130+	0.0952	-0.00892	0.0976	
	(2.29)	(0.71)	(1.76)	(1.14)	(-0.08)	(0.63)	
Local network	-0.409***	-0.546***	-0.406***	-0.377***	-0.354**	-0.358*	-0.371*
	(-7.07)	(-5.01)	(-4.93)	(-4.15)	(-2.85)	(-2.35)	(-2.46)
Domestic network	0.141*	0.202+	0.0446	-0.0101	0.0388	0.156	
	(2.31)	(1.78)	(0.50)	(-0.11)	(0.29)	(0.97)	
Foreign network	1.305***	1.259***	1.243***	1.418***	1.303***	1.239***	1.229***
	(12.50)	(6.02)	(9.32)	(8.33)	(6.58)	(5.86)	(5.85)
FDI	0.354***	0.247+	0.461***	0.399***	0.526***	0.573**	0.600**
	(5.70)	(1.92)	(5.51)	(4.10)	(4.08)	(3.04)	(3.24)
Product innovation	0.617***	0.585***	0.720***	0.670***	0.657***	0.560***	0.559***
	(9.02)	(3.70)	(7.77)	(6.85)	(5.17)	(3.57)	(3.89)
Process innovation	0.180*	0.301+	0.0885	0.0680	-0.0796	-0.00349	
	(2.40)	(1.92)	(0.88)	(0.62)	(-0.57)	(-0.02)	
Initial TFP	0.179***	0.195*	0.176***	0.241***	0.245***	0.350***	0.344***
	(4.63)	(2.43)	(3.44)	(4.18)	(3.29)	(3.75)	(3.93)
TFP change	0.119**	0.156*	0.0502	0.0399	0.0123	0.0242	
	(3.05)	(2.14)	(0.95)	(0.70)	(0.17)	(0.28)	
Constant	-0.868***	-0.708	-0.510	-0.770*	-0.996*	-1.736**	-1.696***
	(-3.34)	(-1.34)	(-1.52)	(-2.08)	(-2.08)	(-3.28)	(-3.80)
Sector and Region f.e.	yes	yes	yes	yes	yes	yes	yes
Observations	5357	1498	2948	2450	1474	1018	1019
Pseudo R-squared	0.234	0.197	0.258	0.224	0.236	0.204	0.204

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

FIGURE 3
Supply chain and productivity interaction effect (z-statistics).



(a) Small firms. (b) Medium-large firms.

TABLE 7
Supply chain and probability of exporting: average treatment effects on the treated (SEs).

model	ATT	std. err.	t	n. treated	n. controls	common support	balancing property
(1)	0.130	0.020	6.674	786	4916	[.021, .278]	yes/yes
(2)	0.129	0.020	6.540	786	4377	[.017, .326]	yes/yes
(3)	0.093	0.026	3.572	785	1013	[.010, .618]	yes/yes
(4)	0.090	0.020	4.416	786	4634	[.013, .546]	yes/yes
(5)	0.070	0.022	3.211	786	3800	[.010, .538]	yes/yes

Note: ATT estimated using the nearest neighbor matching according to the Becker and Ichino (2002) algorithm. Indistinguishable results are obtained with the Leuven and Sianesi (2003) algorithm. The balancing property is tested using both the propensity score stratification t-test procedure and the standardized percentage bias.
Listed models use the following variables: (1) 1-digit sector and macro-region f.e.; (2) 1-digit sector and region f.e.; (3) variable that affect the treatment, i.e. age, group dummy, size class, final producer, network dummies, FDI and product innovation; (4) variables with the stronger effect on the treatment, i.e. network dummies, FDI and product innovation; (5) variables that affect both the treatment and the outcome, i.e. size class, final producer, network dummies, FDI and product innovation. Models 3-5 also use 1-digit sector and macro-region f.e.

APPENDIX A

Data and variables description

The main source of information is a survey conducted by the MET (Monitoraggio Economia e Territorio s.r.l.). The survey contains information on 25,090 Italian firms for the year 2011, with some information also referring to the period 2009-2011. This sample of firms has been built using a stratification procedure by size, sector and region of the firms, to ensure representativeness at a national level. Firms in the dataset belong to different sectors of manufacturing and services and are located in all Italian regions. The information contained in the survey is mostly qualitative and ranges from employment to investments, innovation and internationalization. To also have quantitative information (particularly for the TFP estimation), we match and merge the MET survey and the balance sheet information from AIDA (Bureau Van Dijk) and the ICE-Reprint data (confining to the foreign direct investments information). After matching the information for each firm from the survey with the balance sheet data and checking the consistency of a number of firm identifiers (mainly the 2-digit sector and the region) we are left with 10,459 firms for which the matching procedure has been successful. Further controls, and the necessity to estimate the TFP reduce the sample size to 7,590 firms, which represent our final dataset. The main variables we employ are described in TABLE A1.

TABLE A1

Main variables description.

Variable	Source	Description
Export dummy	MET	1 if direct or indirect export in the last three years
Export share	MET	Export as a share of total turnover
N. foreign markets	MET	Number of export markets served
Supply chain	MET	1 if firm is steadily involved in the production process of a specific good and this activity constitutes its major source of revenue.
SEs	MET	1 if firms has up to 50 employees
Age (ln)	MET	Number of years of the firm
Group dummy	MET	1 if firm belongs to a group
Local network	MET	1 if firm has relevant and continuative relationships with local firms
Domestic network	MET	1 if firm has relevant and continuative relationships with domestic firms
Foreign network	MET	1 if firm has relevant and continuative relationships with foreign firms
FDI	ICE-Reprint	1 if firm was involved in inward or outward FDI in the last 10 years
Product innovation dummy	MET	1 if product innovation in the last three years
Process innovation dummy	MET	1 if process innovation in the last three years
TFP (ln)	calculations on AIDA data	Productivity of the firm in 2007
TFP change	calculations on AIDA data	Change in productivity 2007-2011 (%)
Subcontractor	MET	1 if firm sales come 100% from subcontracts
Own-branded firm	MET	1 if firm sales come 100% from own designed products, final or not, and the firm retains the industrial property
Final-good producer	MET	1 if firm output is 100% final products

Total factor productivity estimation

The TFP estimation is based on the Solow residuals from an econometric specification derived from a Cobb-Douglas production function. This measure of the TFP, strictly related to the economic theory and rooted on clear assumptions, triggers a number of empirical issues, mainly due to the endogeneity of the observed data (del Gatto et al., 2011; van Beveren, 2012). As a robustness check, we estimate the TFP in three different ways using a fixed effects estimation (FE), the general method of moments (GMM) and the Levinsohn-Petrin (2003) approach (LP). Exploiting information from our merged database, we build a panel of indicators to estimate TFP on data covering the period 2007-2011. Overall, the three TFP estimates are robust and show a good degree of overlap (TABLE A2). In the paper, however, we only present the results based on the LP estimates, more appropriate for our analysis, since they explicitly take into account firms' intermediate inputs.

TABLE A2
Estimates of the total factor productivity.

	Summary statistics				Correlations		
	Mean	Std. Dev.	Min	Max	FE	GMM	LP
	ln(TFP) in 2011						
FE	5.16	1.19	-1.73	13.59	1		
GMM	3.93	1.08	-2.77	9.10	0.55	1	
LP	4.06	0.94	-2.60	10.96	0.73	0.53	1
	Δln(TFP) 2007-2011						
FE	-0.11	0.52	-6.01	4.18	1		
GMM	-0.13	0.54	-5.96	3.94	0.92	1	
LP	-0.13	0.54	-5.97	4.16	0.91	0.93	1

TABLE A3

The effect of the supply chain for small firms.

	(1) ≤5 empl.	(2) ≤10 empl.	(3) ≤15 empl.	(4) ≤20 empl.	(5) ≤30 empl.	(6) ≤40 empl.
Supply chain	0.506*	0.389**	0.209*	0.176*	0.222**	0.213**
	(2.02)	(3.03)	(2.22)	(2.16)	(3.09)	(3.20)
Age	-0.0384	-0.121	-0.0612	-0.0553	-0.0224	0.0587
	(-0.24)	(-1.48)	(-0.98)	(-1.02)	(-0.46)	(1.30)
Group	0.611*	0.256+	0.0822	0.0689	0.0555	0.0630
	(2.19)	(1.66)	(0.71)	(0.69)	(0.64)	(0.79)
Local network	0.00797	-0.231+	-0.320**	-0.297***	-0.362***	-0.418***
	(0.04)	(-1.87)	(-3.23)	(-3.49)	(-4.69)	(-5.74)
Domestic network	0.240	0.245+	0.190+	0.234*	0.215**	0.186*
	(0.85)	(1.65)	(1.75)	(2.47)	(2.62)	(2.43)
Foreign network	1.101**	1.269***	1.308***	1.314***	1.343***	1.275***
	(3.16)	(6.19)	(8.29)	(9.11)	(10.35)	(10.59)
FDI	0.400	0.310	0.399*	0.329*	0.479***	0.530***
	(0.98)	(1.32)	(2.54)	(2.44)	(4.09)	(5.32)
Product innovation	1.025**	0.773***	0.512***	0.523***	0.607***	0.632***
	(3.16)	(4.07)	(3.71)	(4.48)	(6.19)	(6.90)
Process innovation	0.179	0.225	0.0252	0.0731	0.0933	0.100
	(0.42)	(0.95)	(0.15)	(0.53)	(0.81)	(0.95)
Initial TFP	-0.0844	-0.00661	0.0787	0.138*	0.133*	0.164***
	(-0.67)	(-0.09)	(1.25)	(2.43)	(2.52)	(3.34)
TFP change	-0.199+	-0.0556	0.0233	0.0706	0.0875+	0.111*
	(-1.69)	(-0.83)	(0.42)	(1.38)	(1.80)	(2.39)
Constant	-0.980	-0.315	-0.577	-0.823*	-0.824**	-1.133***
	(-1.15)	(-0.66)	(-1.52)	(-2.41)	(-2.63)	(-3.87)
Sector and Region f.e.	yes	yes	yes	yes	yes	yes
Observations	494	1325	2041	2510	3048	3468
Pseudo R-squared	0.188	0.179	0.161	0.156	0.170	0.180

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

TABLE A4

The effect of the supply chain for medium-large firms.

	(1) ≥75 empl.	(2) ≥100 empl.	(3) ≥150 empl.	(4) ≥200 empl.	(5) ≥250 empl.	(6) ≥300 empl.
Supply chain	0.163	0.142	0.0200	-0.245	-0.460	-0.970*
	(1.29)	(0.93)	(0.10)	(-1.02)	(-1.56)	(-2.53)
Age	-0.0146	0.0248	-0.119	0.0342	-0.0577	0.00682
	(-0.17)	(0.25)	(-0.93)	(0.22)	(-0.30)	(0.03)
Group	0.230*	0.127	0.0536	-0.0353	0.146	-0.182
	(2.26)	(1.05)	(0.34)	(-0.18)	(0.64)	(-0.64)
Local network	-0.401**	-0.542***	-0.723***	-0.522*	-0.557+	-0.480
	(-3.10)	(-3.48)	(-3.48)	(-2.18)	(-1.93)	(-1.34)
Domestic network	0.0641	0.0650	0.195	-0.0336	-0.152	0.0260
	(0.42)	(0.35)	(0.78)	(-0.12)	(-0.47)	(0.07)
Foreign network	1.419***	1.473***	1.231*	.	.	.
	(4.05)	(3.66)	(2.42)			
FDI	0.390***	0.516***	0.384*	0.0957	0.148	0.107
	(3.37)	(3.68)	(1.99)	(0.40)	(0.51)	(0.30)
Product innovation	0.570***	0.608***	0.528*	0.870**	0.933**	1.004*
	(3.93)	(3.37)	(2.36)	(3.18)	(3.02)	(2.45)
Process innovation	0.472**	0.623***	0.617**	0.343	0.467	0.282
	(3.18)	(3.63)	(2.78)	(1.30)	(1.59)	(0.74)
Initial TFP	0.0931	0.188	0.0886	0.120	0.115	0.206
	(0.91)	(1.58)	(0.62)	(0.69)	(0.52)	(0.77)
TFP change	0.118	0.109	0.105	-0.0604	-0.361	-0.385
	(1.04)	(0.84)	(0.69)	(-0.36)	(-1.46)	(-1.39)
Constant	0.0655	-0.572	0.966	0.393	0.842	0.162
	(0.09)	(-0.69)	(0.93)	(0.32)	(0.54)	(0.08)
Sector and Region f.e.	yes	yes	yes	yes	yes	yes
Observations	1069	826	534	345	264	202
Pseudo R-squared	0.306	0.363	0.380	0.338	0.356	0.387

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

TABLE A5

Aggregate tests for the balancing property (SEs).

model	sample	pseudo R2	LR chi2	p-val	mean bias	med bias
(1)	Raw	0.063	287.160	0.000	15.000	9.400
	Matched	0.000	0.000	1.000	0.000	0.000
(2)	Raw	0.069	313.770	0.000	7.900	5.100
	Matched	0.000	0.000	1.000	0.000	0.000
(3)	Raw	0.101	463.340	0.000	17.100	17.500
	Matched	0.005	10.57	0.912	3.100	2.400
(4)	Raw	0.088	401.480	0.000	15.800	15.500
	Matched	0.000	0.310	1.000	0.700	0.500
(5)	Raw	0.096	439.050	0.000	16.200	15.500
	Matched	0.001	2.230	1.000	1.400	1.00

Listed models use the following variables: (1) 1-digit sector and macro-region f.e.; (2) 1-digit sector and region f.e.; (3) variable that affect the treatment, i.e. age, group dummy, size class, final producer, network dummies, FDI and product innovation; (4) variables with the stronger effect on the treatment, i.e. network dummies, FDI and product innovation; (5) variables that affect both the treatment and the outcome, i.e. size class, final producer, network dummies, FDI and product innovation. Models 3-5 also use 1-digit sector and macro-region f.e.

APPENDIX B (NOT FOR PUBLICATION)

Total factor productivity estimation (detailed)

Our TFP estimation procedure follows a vast literature on the topic. The theoretical basis for the estimation lies in the assumption of a Cobb-Douglas production function for the firm:

(A1) $Y_{it} = A_{it} L_{it}^{\beta_l} K_{it}^{\beta_k} \qquad \beta_l, \beta_k > 0$

where *i* and *t* are firms and year subscripts respectively; Y is output (value added); L is labor; K is capital and A is a Hicksian neutral technology multiplier (unobservable). One of the advantages of the econometric approach is that the production function is not required to exhibit constant returns to scale (i.e. $\beta_l + \beta_k = 1$), as it is often necessary under non-econometric approaches. However, in order to perform the estimation, we must assume that firms share the same technology, except than for the neutral parameter A, that is β_l and β_k are the same for all firms, otherwise we may get biased estimates. Taking the logarithm (denoted by small case letters), the baseline econometric specification takes the following form:

(A2) $y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \varepsilon_{it}$

In the above equation, the sum of the constant and the error term gives the Hicksian technology:

(A3) $a_{it} = \beta_0 + \varepsilon_{it}$

Theoretically, we can further model the unobservable firm-level error term so to decompose it into a predictable and an unpredictable component such that $\varepsilon_{it} = v_{it} + u_{it}$. Since both terms are unobservable, additional assumptions need to be made on the v_{it} terms; while the u_{it} terms are usually assumed to be i.i.d. and uncorrelated with inputs choices, being due to measurement errors and other unpredictable factors. After the estimation of the production function parameters, the estimated productivity can be calculated as:

(A4) $\hat{a}_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it}$

The above equation (A4) represents the objective of the TFP estimation. We now discuss the empirical approaches that we employ. First, note that applying the above model directly or performing an OLS estimation gives biased estimates for several reasons, mainly due to the endogeneity of labor and capital and to the fact that we cannot disentangle the predictable and unpredictable component of the error term without additional data and/or assumptions (Arnold, 2005; del Gatto et al., 2009; van Beveren, 2010). For this reasons, we perform three different non-OLS estimations of the TFP: fixed effects (FE), general method of moments (GMM) and Levinsohn-Petrin (2003, LP). In the empirical specification, the GDP deflator is used for output and capital, while for intermediate inputs we use the producer price index at the 2-digit sectoral level; moreover, we perform all the estimations at the sectoral level. The FE estimation assumes that the predictable component of the error term is time-invariant so that it can be estimated by adding firm-level fixed effects. In the GMM, lagged first-differences of the variables are used as instruments (Blundell and Bond, 2000; Benfratello and Sembenelli, 2006). The LP estimation uses intermediate inputs as an instrument for unobservable productivity shocks. In particular, the LP estimation assumes that the firm demand for intermediate inputs depends on firms state variables, namely capital and the predictable component of the error term, $m_{it} = m(k_{it}, v_{it})$. Under the assumption of monotonicity, the latter function can be inverted and we can write $v_{it} = v(k_{it}, m_{it})$, so that the unobservable productivity is a function of two observable variables. However, the functional form is unknown. Following Olley-Pakes (1996), LP take a semiparametric approach by approximating the function $\varphi(k_{it}, m_{it}) = \beta_0 + \beta_k k_{it} + v(k_{it}, m_{it})$ with a third-order polynomial. The production function to be estimated can now be written as:

(A5) $y_{it} = \beta_l l_{it} + \varphi(k_{it}, m_{it}) + u_{it}$

The first stage of the LP estimation involves estimating the above equation (A5) so to get $\hat{\beta}_l$, while $\hat{\beta}_k$ is obtained in the second stage under some additional assumptions about the v_{it} terms, e.g. that they follow a first order Markov process. For further details we refer to LP (2003).

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TABLE B1

Correlation matrix.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	Export	1.000								
(2)	Export share	0.707	1.000							
(3)	N. foreign markets	0.661	0.597	1.000						
(4)	Supply chain	0.144	0.112	0.120	1.000					
(5)	SEs	-0.205	-0.190	-0.216	-0.078	1.000				
(6)	Age	0.102	0.072	0.099	0.075	-0.120	1.000			
(7)	Group	0.151	0.160	0.163	0.062	-0.344	0.023	1.000		
(8)	Local network	-0.139	-0.124	-0.117	0.034	-0.017	-0.001	-0.011	1.000	
(9)	Domestic network	0.047	0.004	0.018	0.070	-0.015	0.032	0.050	-0.148	1.000
(10)	Foreign network	0.228	0.208	0.248	0.082	-0.015	0.041	0.065	-0.111	-0.095
(11)	FDI	0.244	0.285	0.260	0.070	-0.367	0.080	0.320	-0.026	0.006
(12)	Product innovation	0.234	0.201	0.201	0.098	-0.151	0.023	0.098	-0.005	0.066
(13)	Process innovation	0.150	0.114	0.110	0.053	-0.161	0.013	0.127	-0.007	0.055
(14)	TFP (ln)	0.152	0.153	0.153	0.067	-0.254	0.141	0.194	-0.037	0.008
(15)	TFP change (Δln)	0.024	0.027	0.021	-0.019	-0.059	-0.020	0.034	0.006	0.008
(16)	Subcontractor	-0.102	-0.081	-0.101	-0.018	0.076	-0.051	-0.041	0.030	0.005
(17)	Own-branded firm	0.056	0.065	0.057	-0.021	-0.038	0.038	0.017	-0.032	-0.035
(18)	Final-good producer	0.173	0.143	0.149	-0.021	0.014	0.073	-0.015	-0.078	-0.020

		(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(10)	Foreign network	1.000								
(11)	FDI	0.079	1.000							
(12)	Product innovation	0.055	0.150	1.000						
(13)	Process innovation	0.049	0.128	0.438	1.000					
(14)	TFP (ln)	0.028	0.239	0.080	0.061	1.000				
(15)	TFP change (Δln)	-0.004	0.036	0.025	0.023	-0.154	1.000			
(16)	Subcontractor	-0.037	-0.086	-0.111	-0.070	-0.052	-0.027	1.000		
(17)	Own-branded firm	0.034	0.058	0.043	0.044	0.042	0.027	-0.704	1.000	
(18)	Final-good producer	0.039	0.019	0.078	0.043	0.049	-0.022	-0.096	0.100	1.000

TABLE B2

Interaction between the supply chain and productivity (see TABLE 4).

	Controlling for TFP		SEs	MLEs
Dep. export dummy	(1)	(2)	(3)	(4)
Supply chain	0.539*	0.677*	1.070**	0.0435
	(2.01)	(2.35)	(2.70)	(0.09)
SE	-0.278***	-0.364***		
	(-6.15)	(-7.10)		
Age	0.141***	0.0346	0.0473	0.0206
	(4.33)	(0.96)	(1.10)	(0.29)
Group	0.0887+	0.116*	0.0540	0.227**
	(1.78)	(2.20)	(0.74)	(2.73)
Local network	-0.471***	-0.427***	-0.429***	-0.376***
	(-8.69)	(-7.43)	(-6.09)	(-3.53)
Domestic network	0.0970+	0.126*	0.184*	-0.0276
	(1.67)	(2.08)	(2.54)	(-0.23)
Foreign network	1.280***	1.314***	1.288***	1.457***
	(13.36)	(12.64)	(11.22)	(5.01)
FDI	0.555***	0.354***	0.542***	0.267**
	(9.71)	(5.73)	(5.84)	(2.91)
Product innovation	0.738***	0.648***	0.650***	0.648***
	(11.46)	(9.53)	(7.56)	(5.49)
Process innovation	0.145*	0.196**	0.119	0.290*
	(2.05)	(2.62)	(1.20)	(2.38)
Initial TFP	0.0972***	0.192***	0.245***	0.0669
	(3.96)	(4.75)	(4.94)	(0.79)
TFP change	0.0564	0.114**	0.136**	0.0456
	(1.63)	(2.95)	(3.01)	(0.54)
Supply Chain X Initial TFP	-0.0436	-0.109+	-0.204*	0.0171
	(-0.73)	(-1.68)	(-2.23)	(0.17)
Constant	-1.014***	-0.691**	-1.349***	0.200
	(-6.81)	(-2.69)	(-4.67)	(0.36)
Sector and Region f.e.	no	yes	yes	yes
Observations	5383	5357	3755	1561
Pseudo R-squared	0.148	0.226	0.189	0.274

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

TABLE B3

Probability of exporting for manufacturing only (see TABLE 4).

	Final dataset		Controlling for TFP		SEs	MLEs
Dep. export dummy	(1)	(2)	(3)	(4)	(5)	(6)
Supply chain	0.232***	0.201***	0.228***	0.207***	0.203**	0.185+
	(4.64)	(3.82)	(4.04)	(3.50)	(2.83)	(1.67)
SE	-0.608***	-0.613***	-0.515***	-0.514***		
	(-11.20)	(-10.84)	(-8.65)	(-8.08)		
Age	0.0991**	0.0334	0.0702+	0.0234	0.0527	-0.0234
	(2.94)	(0.91)	(1.76)	(0.55)	(1.05)	(-0.27)
Group	0.133*	0.124*	0.0518	0.0384	-0.000421	0.111
	(2.28)	(2.05)	(0.82)	(0.59)	(-0.00)	(1.11)
Local network	-0.364***	-0.355***	-0.365***	-0.352***	-0.441***	-0.0854
	(-6.25)	(-5.92)	(-5.40)	(-5.07)	(-5.28)	(-0.62)
Domestic network	0.0584	0.0678	0.0777	0.0860	0.105	0.0149
	(0.93)	(1.06)	(1.09)	(1.18)	(1.22)	(0.10)
Foreign network	1.338***	1.332***	1.365***	1.376***	1.313***	1.734***
	(12.06)	(11.48)	(10.93)	(10.47)	(9.14)	(4.04)
FDI	0.383***	0.298***	0.288***	0.207**	0.388***	0.207+
	(5.90)	(4.39)	(4.19)	(2.86)	(3.50)	(1.94)
Product innovation	0.739***	0.720***	0.740***	0.742***	0.783***	0.633***
	(10.98)	(10.35)	(9.81)	(9.52)	(8.08)	(4.60)
Process innovation	0.0815	0.127	0.0789	0.0912	0.0346	0.149
	(1.06)	(1.60)	(0.91)	(1.03)	(0.30)	(1.03)
Initial TFP			0.119***	0.193***	0.271***	-0.0293
			(3.47)	(3.98)	(4.61)	(-0.29)
TFP change			0.120**	0.126**	0.144**	0.128
			(2.78)	(2.74)	(2.64)	(1.34)
Constant	-0.0700	0.349*	-0.439*	-0.463	-1.461***	1.016
	(-0.57)	(2.01)	(-2.23)	(-1.50)	(-4.29)	(1.53)
Sector and Region f.e.	no	yes	no	yes	yes	yes
Observations	4680	4680	3646	3646	2556	1090
Pseudo R-squared	0.150	0.192	0.145	0.184	0.162	0.141

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

TABLE B4
Probability of exporting for services only (see TABLE 4).

	Final dataset		Controlling for TFP		SEs	MLEs
Dep. export dummy	(1)	(2)	(3)	(4)	(5)	(6)
Supply chain	0.334***	0.234*	0.220+	0.107	0.163	0.00393
	(3.38)	(2.24)	(1.91)	(0.86)	(1.09)	(0.02)
SE	-0.0552	-0.115	-0.0390	-0.100		
	(-0.80)	(-1.53)	(-0.48)	(-1.08)		
Age	0.0875+	0.0493	0.0912	0.0605	0.0528	0.0831
	(1.78)	(0.92)	(1.47)	(0.87)	(0.61)	(0.62)
Group	0.257***	0.259**	0.272**	0.261**	0.174	0.466**
	(3.38)	(3.23)	(3.14)	(2.78)	(1.36)	(2.87)
Local network	-0.429***	-0.445***	-0.513***	-0.567***	-0.413**	-0.851***
	(-5.47)	(-5.38)	(-5.07)	(-5.20)	(-3.06)	(-4.06)
Domestic network	0.180*	0.159+	0.240*	0.228*	0.393**	-0.0961
	(2.05)	(1.71)	(2.28)	(2.03)	(2.92)	(-0.40)
Foreign network	1.299***	1.337***	1.225***	1.246***	1.383***	0.966+
	(9.51)	(9.18)	(7.32)	(6.89)	(6.75)	(1.86)
FDI	0.911***	0.787***	0.895***	0.750***	0.851***	0.650**
	(9.12)	(7.31)	(8.05)	(6.08)	(4.93)	(3.12)
Product innovation	0.472***	0.537***	0.366*	0.382*	0.0339	0.774**
	(4.04)	(4.43)	(2.55)	(2.53)	(0.16)	(3.05)
Process innovation	0.337**	0.424***	0.391**	0.463**	0.269	0.572*
	(2.99)	(3.61)	(2.96)	(3.29)	(1.35)	(2.43)
Initial TFP			0.00725	0.0840	0.0764	0.0472
			(0.22)	(1.26)	(0.92)	(0.29)
TFP change			-0.0105	0.0437	0.0744	-0.108
			(-0.17)	(0.59)	(0.88)	(-0.52)
Constant	-1.210***	-1.251**	-1.176***	-1.334*	-1.569*	-0.687
	(-7.33)	(-2.75)	(-4.79)	(-2.21)	(-2.13)	(-0.51)
Sector and Region f.e.	no	yes	no	yes	yes	yes
Observations	2880	2869	1737	1711	1199	469
Pseudo R-squared	0.131	0.187	0.137	0.206	0.181	0.313

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

TABLE B5

Alternative proxy for the supply chain participation (see TABLE 4).

	Final dataset		Controlling for TFP		SEs	MLEs
Dep. export dummy	(1)	(2)	(3)	(4)	(5)	(6)
I/O Supply chain	0.541***	0.326***	0.479***	0.288***	0.211***	0.569***
	(12.02)	(6.78)	(9.33)	(5.27)	(3.37)	(4.48)
SE	-0.354***	-0.423***	-0.301***	-0.377***		
	(-8.77)	(-9.60)	(-6.63)	(-7.36)		
Age	0.162***	0.0425	0.131***	0.0324	0.0467	0.0118
	(5.97)	(1.41)	(4.02)	(0.90)	(1.09)	(0.17)
Group	0.174***	0.197***	0.107*	0.129*	0.0669	0.235**
	(3.84)	(4.11)	(2.15)	(2.44)	(0.91)	(2.81)
Local network	-0.425***	-0.389***	-0.452***	-0.418***	-0.418***	-0.377***
	(-9.41)	(-8.13)	(-8.35)	(-7.29)	(-5.96)	(-3.53)
Domestic network	0.0901+	0.101+	0.0979+	0.126*	0.187**	-0.0638
	(1.79)	(1.92)	(1.68)	(2.08)	(2.59)	(-0.53)
Foreign network	1.329***	1.360***	1.309***	1.335***	1.313***	1.425***
	(15.68)	(14.98)	(13.46)	(12.77)	(11.42)	(4.80)
FDI	0.669***	0.463***	0.557***	0.361***	0.544***	0.278**
	(12.52)	(8.14)	(9.72)	(5.83)	(5.86)	(2.99)
Product innovation	0.739***	0.661***	0.723***	0.641***	0.650***	0.604***
	(12.98)	(11.05)	(11.16)	(9.40)	(7.57)	(5.07)
Process innovation	0.137*	0.209**	0.141*	0.194**	0.107	0.313*
	(2.18)	(3.18)	(1.98)	(2.59)	(1.08)	(2.55)
Initial TFP			0.0938***	0.172***	0.211***	0.0787
			(4.09)	(4.46)	(4.47)	(0.97)
TFP change			0.0453	0.103**	0.129**	0.0401
			(1.30)	(2.67)	(2.86)	(0.47)
Constant	-0.780***	0.0640	-0.976***	-0.581*	-1.182***	0.0973
	(-8.23)	(0.45)	(-6.75)	(-2.31)	(-4.20)	(0.18)
Sector and Region f.e.	no	yes	no	yes	yes	yes
Observations	7560	7549	5383	5357	3755	1561
Pseudo R-squared	0.162	0.236	0.153	0.227	0.188	0.284

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Robustness checks on the whole survey

TABLE B6

Probability of exporting and the supply chain (whole survey; see TABLE 4).

	whole survey		SEs	MLEs
Dep. export dummy	(1)	(2)	(3)	(4)
Supply chain	0.405***	0.281***	0.289***	0.174*
	(14.26)	(8.92)	(8.07)	(2.49)
SE	-0.689***	-0.613***		
	(-25.10)	(-20.03)		
Age	0.213***	0.153***	0.157***	0.0410
	(17.18)	(10.24)	(9.72)	(0.93)
Group	0.402***	0.352***	0.359***	0.320***
	(13.44)	(10.77)	(8.47)	(5.90)
Local network	-0.278***	-0.275***	-0.270***	-0.259***
	(-9.90)	(-8.98)	(-7.86)	(-3.62)
Domestic network	0.206***	0.178***	0.225***	-0.0379
	(6.33)	(5.07)	(5.74)	(-0.46)
Foreign network	1.354***	1.317***	1.362***	1.068***
	(26.45)	(23.07)	(21.69)	(7.67)
Product innovation	0.768***	0.694***	0.695***	0.677***
	(21.23)	(17.49)	(15.02)	(8.32)
Process innovation	0.205***	0.228***	0.173**	0.398***
	(5.10)	(5.19)	(3.24)	(4.80)
Constant	-0.901***	3.349	2.542	-0.663
	(-19.13)	(0.03)	(0.02)	(-1.28)
Sector and Region f.e.	no	yes	yes	yes
Observations	23797	20414	17189	3186
Pseudo R-squared	0.173	0.225	0.165	0.270

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

TABLE B7

Intensive and extensive margins and the supply chain (whole survey; see TABLE 5).

	Intensive margin			Extensive margin		
	all	SEs	MLEs	all	SEs	MLEs
	(1)	(2)	(3)	(4)	(5)	(6)
Supply chain	9.081***	11.31***	2.535	0.284***	0.315***	0.156**
	(8.03)	(7.77)	(1.46)	(7.83)	(6.53)	(3.07)
SE	-21.91***			-0.708***		
	(-20.00)			(-20.68)		
Age	5.683***	6.513***	0.342	0.230***	0.252***	0.103**
	(9.88)	(9.45)	(0.29)	(11.56)	(10.43)	(2.89)
Group	13.86***	15.79***	10.94***	0.340***	0.428***	0.253***
	(11.98)	(9.28)	(7.70)	(9.23)	(7.56)	(5.83)
Local network	-11.72***	-12.80***	-9.099***	-0.360***	-0.392***	-0.271***
	(-9.83)	(-8.62)	(-4.47)	(-8.74)	(-7.51)	(-4.15)
Domestic network	4.393***	6.229***	-1.456	0.262***	0.329***	0.0837
	(3.33)	(3.79)	(-0.66)	(6.12)	(6.05)	(1.28)
Foreign network	36.45***	45.06***	18.31***	1.058***	1.257***	0.593***
	(22.37)	(21.35)	(7.54)	(21.33)	(18.88)	(8.88)
Product innovation	21.00***	25.09***	13.20***	0.574***	0.693***	0.354***
	(15.45)	(13.77)	(7.00)	(13.34)	(11.53)	(6.41)
Process innovation	5.508***	5.534**	6.431**	0.120*	0.164*	0.0774
	(3.61)	(2.59)	(3.24)	(2.42)	(2.27)	(1.29)
Constant	-21.16	-55.94	-8.010	-1.075	-2.113	-0.586
	(-0.50)	(-1.22)	(-0.50)	(-0.74)	(-1.34)	(-1.09)
sigma / ln_alpha	42.51***	45.55***	34.87***	0.0823*	0.389***	-0.662***
	(95.66)	(77.33)	(57.18)	(2.40)	(9.53)	(-10.14)
Sector and Region f.e.	yes	yes	yes	yes	yes	yes
Observations	20452	17236	3216	20452	17236	3216
Pseudo R-squared	0.073	0.058	0.059	0.119	0.093	0.103

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

TABLE B8

Firms' role within the supply chain and export (whole survey; see TABLE 6).

					own-branded and final		
	all	subcon.	own-branded	final	all	SEs	SEs
Dep. export dummy	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Supply chain	0.300***	0.167**	0.384***	0.314***	0.455***	0.437***	0.521***
	(9.48)	(2.86)	(8.49)	(6.47)	(6.91)	(5.96)	(7.27)
SE	-0.607***	-0.601***	-0.652***	-0.702***	-0.750***		
	(-19.77)	(-10.48)	(-15.56)	(-14.38)	(-11.47)		
Subcontractor	-0.229***						
	(-7.01)						
Own-branded firm	-0.0854**						
	(-2.85)						
Final-good producer	0.233***						
	(10.47)						
Age	0.148***	0.144***	0.161***	0.163***	0.196***	0.205***	
	(9.85)	(5.51)	(7.61)	(7.37)	(6.57)	(6.41)	
Group	0.348***	0.363***	0.355***	0.325***	0.281***	0.383***	
	(10.64)	(6.00)	(7.90)	(6.28)	(4.10)	(4.37)	
Local network	-0.269***	-0.395***	-0.213***	-0.267***	-0.247***	-0.248***	-0.262***
	(-8.74)	(-7.10)	(-4.91)	(-5.62)	(-3.81)	(-3.43)	(-3.72)
Domestic network	0.175***	0.193**	0.158**	0.145**	0.120	0.185*	
	(4.96)	(3.01)	(3.15)	(2.70)	(1.64)	(2.27)	
Foreign network	1.299***	1.298***	1.295***	1.311***	1.299***	1.334***	1.370***
	(22.71)	(12.30)	(16.91)	(15.51)	(12.06)	(11.38)	(11.92)
Product innovation	0.656***	0.726***	0.627***	0.668***	0.547***	0.492***	0.550***
	(16.43)	(8.27)	(11.73)	(11.78)	(7.39)	(5.80)	(7.23)
Process innovation	0.224***	0.230*	0.216***	0.151*	0.126	0.111	
	(5.09)	(2.55)	(3.63)	(2.29)	(1.49)	(1.11)	
Constant	3.447	-1.580***	3.341	-1.212***	-1.212**	-2.212***	-1.604**
	(0.03)	(-3.98)	(0.02)	(-3.43)	(-2.74)	(-4.35)	(-3.20)
Sector and Region f.e.	yes	yes	yes	yes	yes	yes	yes
Observations	20413	6579	10708	8247	4756	3955	4196
Pseudo R-squared	0.232	0.192	0.244	0.238	0.257	0.199	0.189

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

TABLE B9

Average treatment effects on the treated (SEs from the whole survey; see TABLE 7).

model	ATT	std. err.	t	n. treated	n. controls	common support	balancing property
(1)	0.142	0.011	12.894	2094	19527	[.022, .207]	yes/yes
(2)	0.138	0.011	12.509	2094	18633	[.014, .242]	no/yes
(3)	0.082	0.014	6.072	2061	5236	[.011, .591]	no/yes
(4)	0.103	0.011	9.254	2094	19307	[.015, .474]	no/yes
(5)	0.081	0.012	7.067	2094	17910	[.010, .500]	no/yes

Note: ATT estimated using the nearest neighbor matching according to the Becker and Ichino (2002) algorithm. Indistinguishable results are obtained with the Leuven and Sianesi (2003) algorithm. The balancing property is tested using both the propensity score stratification t-test procedure and the standardized percentage bias.

Listed models use the following variables: (1) 1-digit sector and macro-region f.e.; (2) 1-digit sector and region f.e.; (3) variable that affect the treatment, i.e. age, group dummy, size class, final producer, network dummies and product innovation; (4) variables with the stronger effect on the treatment, i.e. network dummies and product innovation; (5) variables that affect both the treatment and the outcome, i.e. size class, final producer, network dummies and product innovation. Models 3-5 also use 1-digit sector and macro-region f.e.

TABLE B10

Aggregate tests for the balancing property (SEs from the whole survey; see TABLE A5).

model	sample	pseudo R2	LR chi2	p-val	mean bias	med bias
(1)	Raw	0.053	728.380	0.000	16.800	17.800
	Matched	0.000	0.000	1.000	0.000	0.000
(2)	Raw	0.059	807.710	0.000	9.700	6.000
	Matched	0.000	0.000	1.000	0.000	0.000
(3)	Raw	0.089	1183.150	0.000	18.900	20.100
	Matched	0.003	18.430	0.427	2.000	1.000
(4)	Raw	0.078	1079.700	0.000	17.900	20.100
	Matched	0.000	0.000	1.000	0.000	0.000
(5)	Raw	0.088	1215.230	0.000	19.000	20.100
	Matched	0.000	0.590	1.000	0.300	0.200

Listed models use the following variables: (1) 1-digit sector and macro-region f.e.; (2) 1-digit sector and region f.e.; (3) variable that affect the treatment, i.e. age, group dummy, size class, final producer, network dummies and product innovation; (4) variables with the stronger effect on the treatment, i.e. network dummies and product innovation; (5) variables that affect both the treatment and the outcome, i.e. size class, final producer, network dummies and product innovation. Models 3-5 also use 1-digit sector and macro-region f.e.