Innovation activities and learning processes in the crisis.

Evidence from Italian export in manufacturing and services

Raffaele Brancati*, Emanuela Marrocu**, Manuel Romagnoli* and Stefano Usai**,+

*MET Economia, Italy

**Department of Economics & Business and CRENoS, University of Cagliari, Italy

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Abstract: Are there any factors driving firms' internationalization process other than productivity? By means of a firm-level dataset on manufacturing and production services sectors collected by MET, this paper investigates the export performance of enterprises in Italy in the aftermath of the recent economic crisis. Our results suggest that productivity is not the only (and most important) determinant in this matter. Innovation activity and learning processes are indeed pivotal in boosting enterprises to sell their products abroad and, to a certain extent, in backing their success on foreign markets. In particular, by estimating dynamic probability models, as well as Tobit II-Heckman and two-part models, we provide evidence that firm's ability to learn from its past export experiences lowers international trade informal barriers, while its ability to learn thanks to local spillovers is important in terms of both extensive and intensive performances on foreign markets.

Keywords: international trade, inter-regional trade, innovation, regional/industrial spillovers, dynamic binary models, Tobit II models, two-part models.

JEL: F14, O3, D22, C23, C25

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+ Corresponding author, email: stefanousai@unica.it

1. Introduction

International competitiveness is usually seen as an important ingredient for the success of economic systems as well as an essential source for sustained growth dynamics. Such a competitiveness depends on the decision by heterogeneous firms to take part in the international market contest and on the intensity of this participation. The issue of firm, rather than countries or sectors, heterogeneity has received increasing attention in international trade studies since Bernard and Jensen (1995). Thanks to the availability of large micro-databases, a plethora of diverse empirical studies have offered a robust set of explanatory phenomena which justify the differences in firms' participation to exporting activities (see the reviews by Wagner, 2007, 2012, 2014, Greenaway and Kneller, 2007 and Bernard et al. 2012). At the same time, starting from Melitz (2003), theoretical contributions model the selection mechanism into foreign markets resulting from the existence of a large heterogeneity among firms. In particular, they analyse internationalisation processes both in terms of participation (extensive margin) and in terms of firm's quota of sales abroad on total sales (intensive margin). These studies mainly conceive the firm's internationalization process as either a direct outcome of having gained sufficiently high productivity levels or an indirect result of other determinants, whose major role is to contribute to further productivity improvements (Constantini and Melitz, 2008).

Our approach aims at addressing the export-competitiveness relationship from a different perspective. Firstly, we consider firm's extensive and intensive margins as two interconnected, although distinct, phenomena, which may be subject to differing dynamics. Indeed the decision to sell products abroad is only partially related to the extent of its success on these markets, for the final outcome stems both from the competition and the evolution of foreign demand. Secondly, by regarding firms as complex organizations rather than mere profit maximizers (Penrose, 1959; Nelson and Winter, 1982), we conceive innovative activities and 'learning-to-export' abilities as multidimensional key determinants of the internationalization processes, going beyond the productivity channel. In order to include this multidimensional aspect in our analysis, we exploit the richness of the MET database information on Italian manufacturing and production services sectors.

The original contribution of this paper is twofold. Firstly, we assess the effects of innovation and different learning processes – mainly past experiences and local spillovers – on the export behaviour of a representative sample of Italian enterprises, while accounting for productivity and controlling for various features at firm, sector and regional level. To this extent, we model foreign market participation as a dynamic process by thoroughly tackling the often neglected issues related to endogeneity of the lagged dependent variable and to the initial conditions problem, while firm's intensive margin is studied by means of Tobit II-Heckman models or by two-part models (Cameron and Trivedi, 2005). The second novelty of the work is represented by its focus on the export performance in times of financial and economic distress thanks to an extended and updated new database drawn from the 2007-2013 MET sample surveys.

Our empirical analysis builds on the recent literature on the Italian case applied to the pre-crisis period (Sterlacchini, 2000, Becchetti e Rossi, 2000, Basile, 2001, Nassinbeni, 2001, Castellani and Zanfei, 2007, Castellani et al., 2010, Antonietti and Cainelli, 2011) using different econometric methodologies and firm level data, as reported above. At the same time, such data allow us to follow the recent original contribution on the United Kingdom by Harris and Li (2012), who provide the first analysis for the whole tradable economy, including not only manufacturing but also services.

Our results suggest that firm's innovation activities and learning capabilities increase its probability to export. Past trade experiences (especially on foreign markets) grant the firm with a valuable set of skills and

knowledge, needed, if not to overcome, at least to reduce informal barriers. This result remains very significant even when controlling for unobserved firm-level heterogeneities. In terms of space, the degree of local industry internationalisation as well as the effort exerted by firms within the same region, positively affect the enterprise probability to export. Indeed, the larger the number of surrounding exporters, the higher the incentives for the enterprise to imitate its neighbours and to lower export sunk costs. Furthermore, firm's ability to learn from the surrounding environment also helps the enterprise to reach higher performances in terms of intensive margin. Finally, local network affiliation does not appear to hamper firm's probability to export but it is negatively correlated with the export intensive margin. Hence, enterprises undertaking stable and relevant relationships with the territory where they are located do not show any particular difficulty to export: even though being their focus on a local territory, their performance on foreign markets is penalized.

The paper is structured as follows. The second section reviews the rich theoretical and empirical background within which this research is located, in order to highlight its original contents. The third section offers an account of the characteristics of the MET-database and describes the main features of the phenomena under examination. The fourth section presents the methodology, while the main results are discussed in the fifth section. Section six concludes.

2. Theoretical and empirical background on firms' export activities as a by-product of market-selection mechanism

The decision by a firm to export stems from a comparison between costs and benefits of selling products on a particular foreign market. In other words, an enterprise is able to carry out export strategies as long as it has a competitive advantage allowing positive profits in presence of trade costs. Therefore, export activities are strictly bound to the market selection mechanism at work, as well as to the forces underpinning this process.

According to the neoclassical Heckscher-Ohlin model, efficiency derives from the relative comparative advantage following from the distribution of factor endowments across sectors and countries. In so doing, sectors, rather than firms, are the focus of the analysis to study internationalization.

Starting from 'new trade theories' *à la* Krugman (1979), however, the attention is brought back to the microeconomic-level and firm's productivity becomes the key element for export activities in an environment featuring monopolistic competition and increasing returns to scale. Following this perspective 'new-new trade theories' (Melitz, 2003; Yeaple, 2005) reinterpret the exporters-domestic producers differences highlighted by the empirical literature (Bernard and Jensen, 2004, 1999, 1995) in terms of sunk costs (associated to informal barriers[1]) and firms' heterogeneity (in productivity terms). According to these works, internationalized firms are able to act profitably on foreign markets thanks to their high levels of productivity that allow them to overcome trade barriers. Even when technology is endogenised within the framework, its role is just to improve productivity levels in order to allow the enterprise to overcome trade barriers (Costantini and Melitz, 2008; Aw et al., 2008).

Empirically, the existence of sunk costs has been investigated by looking at the degree of persistency of the export status or performance (Clerides et al., 1998; Roberts and Tybout, 1997), by assuming that firms that

[1] These barriers entail several phenomena such as the incomplete information about international markets, the uncertainty about contract enforcements, the unfamiliarity with market characteristics abroad, the difficulties in the establishment of distribution channels and the costs of complying with new or more developed product standards.

have already faced and overcome international entry barriers in the past have already reached a sufficiently high productivity level to operate on foreign markets today. For example, Bugamelli and Infante (2003), by studying the Italian case, find that past experience on foreign markets increases the probability of exporting by about 70%, almost twice the percentage estimated by Bernard and Jensen (2004) for US plants. On top of that, a large number of studies (Aw et al., 2000; Bernard and Jensen, 1999; Greenway and Kneller, 2004 among many others) provide evidence that this persistency follows from a self-selecting mechanism and that productivity plays a crucial role in this process.

The existence of sunk costs has been also investigated in an indirect way by linking firm's size in terms of employees or sales and export propensity (Wakelin, 1998). The main rationale is that larger firms may exploit economies of scale in production-marketing and other advantages related to fixed and sunk costs of exporting that made them more apt at competing in foreign markets. However, Wagner (2007) finds that the relationship between size and export is not always constantly increasing but assumes an inverted U-shape. This means that the impact of size on export performance is positive only for small to medium firms and may become negative or non-significant after a certain threshold.

Whilst there is no doubt efficiency is an important key element for firm's success, many contributions framed within several approaches suggest it is not the only one at work. For example, a recent strand of neo-classical literature points out that demand specificities are as pivotal as productivity in determining corporate entrance, survival and growth (Foster et al., 2016 and 2008).

The evolutionary perspective, on the contrary, emphasizes the degree of complexity of the process generating, improving and diffusing technological knowledge (Nelson and Winter, 1982; Cohen and Levinthal, 1990). In fact, contrary to equilibrium theories *à la* Melitz (2003), this approach conceives technology and innovation as disequilibrium phenomena that act not only on firms' efficiency levels but also on the demand side, thanks to the creation and exploitation of new business opportunities (Malerba, 2006). Thus, technology, rather than production costs, represents the key element for competitive advantages, and innovation activities and learning processes, rather than productivity, are placed at the core of both industrial and firm dynamics (Posner, 1961; Dosi et al., 1990; Dosi and Nelson, 2010). Hence, to study export behaviour and performance, one must consider the multifaceted connection between all these phenomena.

To begin with, innovation may refer to either new products, processes or organisational procedures. All of them may influence sales growth, even though in different ways, which entail diverse potential impacts on export. New products are likely to be associated more often with dynamic demand and technological competition (Guarascio et al, 2016). Enterprises introduce this type of innovation to create new business opportunities and to take advantage of the newly acquired market power. As such, product innovations yield a competitive advantage that is neither immediate nor costless to imitate, leading to temporary quasi-rents (Dosi, 1988; Coad, 2009).

Conversely, the effects of process and organisational innovations on sales growth pass through the improvement of the production techniques and/or through cost reduction strategies (Guarascio et al. 2016). However, even in this case, the competitive advantage obtained by innovative enterprises is not necessarily due to efficiency gains. Especially when new processes entail disruptive technologies, innovation strategies may provide the firm with a market power in the form of temporary quasi-rents (Dosi et al. 1990 and Barletta et al., 2014). As a result, success on markets via process and organizational innovations may follow from a combination of both productivity improvements and market power expansion.

In this respect, the empirical literature has provided robust evidence in favour of a positive effect on trade due to R&D expenditure and to product innovation, whilst process innovation seems to play a more marginal role (Sterlacchini, 2000, Basile, 2001, Roper and Love, 2002, Cassiman et al. 2010; Becker and Egger, 2013).

Another aspect of the innovation-export relationship is its bi-directional nature. The introduction of new products, processes or organisational patterns may be either the key for entering new markets, or the consequence of the knowledge gained through the activities on foreign markets. The former phenomenon postulates a relationship moving from innovation towards export, while the latter, labelled *learning-by-exporting*, focuses on the effects of firms exporting activities on their knowledge base and innovative strategies (see Castellani and Zanfei, 2006 for a thorough review of the literature on these subjects).

Although the evidence supporting the former aspect is more robust, there are also studies that provide some evidence on positive effects of a learning-by-exporting effect (Damijan et al., 2010 and Bratti and Felice, 2012). As a matter of fact, enterprises, among other things, are learning entities that constantly interact with the environments they get in touch with (Boschma and Martin, 2010; Leoncini and Montresor, 2007). This interaction, by increasing the organisational knowledge base, fosters technological improvements and innovation opportunities (Teece and Pisano, 1994; Teece et al., 1997). In this way, innovation and internationalisation strategies may reinforce each other in a co-evolving pattern.

Furthermore, learning activities are important for internationalisation beyond their link with innovation, for they can affect the firm evolution process (Malerba, 2006). The sources of learning opportunities are manifold (sector, technology, firm's and individuals' specific knowledge) and depend on the organisational capacity to absorb knowledge and ideas from other geographically and/or technologically proximate agents (Cohen and Levinthal, 1990). Recent literature has provided a large set of potential determinants of local advantages, among others we refer to Andersson and Weiss (2012) for Sweden, Koenig et al. (2010) for France, Greenaway and Kneller (2004) for UK, López-Bazo and Motellón (2013) for Spain, Rodríguez-Pose et al. (2013) for Indonesia, and Choquette and Meinen (2015) for Denmark.

Whenever the knowledge is absorbed passively, learning processes are labelled 'spillovers'. The literature on 'spillovers' has traditionally placed a lot emphasis on the effects that firm's exposure to superior technologies may have on its productivity (Görg and Greenaway, 2004). Many contributions point to the fact that R&D and innovative activities, by possessing the characteristics of public goods, are eligible of producing effects on the efficiency levels of the 'surrounding' enterprises (Lychagin et al., 2016).

A complementary phenomenon is represented by the so called 'export spillovers', i.e. those situations in which an enterprise embarks on an export activity by building its strategies on the other firms' experiences (Aitken et al., 1997; Koening, 2009). Differently from the 'productivity spillovers', these phenomena provide the organisation with new information dampening sunk costs and helping the internationalisation process by being primarily related to firm's ability in finding new business opportunities. In a recent paper, Choquette and Meinen (2015) summarise and test this literature on a set of Danish firms for the 1995-2006 period by identifying three possible channels through which the enterprise gets in touch with this new information. The first one deals with the knowledge embedded in the newly hired employees who previously worked for internationalised enterprises. The second channel is represented by *intra-industry* linkages which may go horizontally from one leading firm to another firm which, for instance, emulates the leader. The last channel is represented by *inter-industry* externalities that operate thanks to vertical exchanges within the network of buyers and sellers. Their results highlight not only a strong presence of these spillovers, but also a different degree of sensitivity to geographical proximity between intra- and inter- industry effects. In fact, while the

emulation effect is geographically bounded, inter-industry influences may occur even when companies are distant one another.

The existence of local externalities has been investigated also for Italy by Becchetti and Rossi, (2000) and Antonietti and Cainelli, (2011), for the period 1989-91 in the former paper and 1998-2003 in the latter one. Results are not homogenous because of the differences in the empirical settings and, most importantly, in the set of indicators used to measure local advantages. Nonetheless, there is a general agreement that local features may play a significant role in firms' productivity and export performance.

Other studies for the Italian case have focused their attention on more general characteristics of export performance of firms, starting from Bonaccorsi (1992), who mainly analyses the relative importance of firm size with mixed evidence. Successive contributions, such as Sterlacchini (2000), Basile (2001) and Nassinbeni (2001), suggest that innovation capabilities, especially among small and medium enterprises, are essential competitive factors and help to explain part of the heterogeneity in export behavior among Italian firms. More recent studies, such as Castellani and Zanfei (2007) and Castellani et al. (2010) extend the span of variables to capture intra-industry heterogeneity, by focusing on both productivity and innovation. They confirm that Italian firms engaged in international activities are larger, more productive and more innovative. Latest studies include Giovannetti et al. (2014)[2] who show that small and less productive firms, if involved in production chains, can overcome their diseconomies of scale and decide to face international competition.

In conclusion, theories on innovation and learning activities stress the multifaceted nature of these phenomena together with the multifaceted nature of their relationships with exports. Whilst productivity plays an important role in this matter, it may not be the only element determining competitiveness. Demand dynamics, market power, spillover effects, network connections, and learning-by-exporting phenomena directly link innovation and learning with the decision to export as well as to the extent of this activity. Our aim is to investigate all these channels in a single framework in order to provide some evidence of the co-existence of differing factors leading to the internationalization of firms. In the next section, we illustrate the dataset employed to test these hypotheses.

3. Data and descriptive statistics

3.1 The structure of the dataset

The empirical analysis in this paper is carried out by using firm-level data from the MET sample survey on Italian manufacturing (ISIC Rev.4 C sectors) and production services sectors (ISIC Rev.4 H and J sectors). This survey is specifically conceived to study Italian firms' characteristics and strategies, with particular attention to their internationalization process, innovative behaviour and network relationships. The representativeness of results is warranted by a sample design stratified along three dimensions: size class, sector and geographical region.[3] It is worth mentioning that, unlike many other firm-level databases, the MET dataset includes even family and micro-firms with less than 10 employees. On top of that, the survey is currently made up of four waves (2007, 2009, 2011 and 2013), which cover a time span starting before the Lehman collapse (wave 2007) until the most recent sovereign debt crisis (wave 2013). Consequently, the data

[2] This contribution uses the same MET database analyzed in this paper even though related to just one wave: 2011. Another recent paper on the relationship between international openness and firm performance based on MET data, is Brancati et al. (2015) who prove that global value chain participation induces positive effects on Italian firms' innovative activity and performance.

[3] See the Appendix for more details on the MET Survey and on the variables used in this study.

refer to a period characterised by a great stagnation of the Italian internal demand that pushed many companies to look for new opportunities on foreign markets.

Each wave of the survey consists of about 25,000 observations, with a longitudinal data share accounting for roughly 50% of every wave, starting from the 2009 one. Since we explain current performance via past experience, the selected sample includes only firms appearing at least in two consecutive waves (see the middle column in Table 1). Furthermore, we merged MET survey data with CRIBIS D&B balance sheet database in order to collect information on firm's economic performance and financial structure. As a result we obtained an unbalanced panel containing 16,541 observations (see the last column of Table 1). It is worth noting that firms included in the final sample exhibit a higher propensity to export and innovate with respect to those included in the two-period panel sample. We are aware that the sample used to perform the empirical analysis is not representative of the whole Italian firms' population. However, it represents the set of firms that perform most of the export activity in Italy. Furthermore, the use of the larger sample would have led to the exclusion of variables capturing crucial firm's characteristics (e.g. productivity, financial structure) which are likely to be correlated with innovative behaviour and firms' learning processes causing the well-known omitted variable bias.

Moreover, even when considering the final panel, the dataset shows a firm size distribution skewed towards the smallest dimensions. Indeed, the overwhelming majority of observations (76%) refer to small and micro firms (<50 employees), while large enterprises with more than 249 employees account for only 5% of the panel (see Table 2). In terms of geographical distribution, 46.1% of firms are located in the North of Italy, 28.8% in the central regions and 25.1% in-between the southern regions and the two islands (Sicilia and Sardegna). The great majority of observations (63%) belong to the manufacturing sectors, which in turn contain higher shares of small and medium-size enterprises than the production services sectors. Furthermore, manufacturing firms tend to be located more often in the North of Italy (especially in the North-East), while the production services ones are more frequently settled in the central regions.

The variables within the panel cover a wide set of information on firms, such as:

- Structural characteristics: age, size, location, sector and its financial structure (leverage)
- Export performances both on foreign and on inter-regional markets
- Innovation activity and productivity levels
- Local network memberships.

Furthermore, spillover effects are studied by means of selected local industry and regional characteristics.

3.2 Descriptive statistics

The main task of this paper is to study how innovative activity and learning processes have shaped Italian firms export performances during the period 2007-2013, once accounting for the effects of productivity and firm, sector and regional-level features.

Differently from the majority of previous contributions in the field, we emphasize that firm's decision to sell products and services abroad (extensive margin) and the degree of its foreign market penetration (intensive margin) are two distinct, but correlated, phenomena. The former is measured through a dummy indicating whether the enterprise has sold (part of) its products/services outside Italy, while the latter is represented by the quota of export on revenues. Non-exporting firms are considered as obtaining 0% of their revenues

from international markets. Overall, exporters account for 39% of the sample amounting to 6,510 observations, with an average export revenue share equal to 13.7% (see Table 3).

Innovation activity is proxied by both *innovative inputs* and *outputs* variables. In terms of innovative inputs, we consider R&D expenditures normalized by the firm's total turnover.[4] In this way, we try to measure the effort the firm puts in this activity. As shown in Table 3, the enterprises in our sample invest in R&D on average 1.4% of their earnings (2.3% when focusing only on innovators).

However, codified R&D activities are rare among Italian firms and particularly among the smallest ones (see for example Santarelli and Sterlacchini, 1990). Furthermore, R&D is uninformative as to the actual realization and adoption of innovative outcomes. This is the reason why we have decided to employ also innovative output indexes. Such indexes are determined by means of a series of dummies indicating whether the firm has actually introduced some types of innovation. In particular, we consider:

- generic innovative output (i.e. the firm has introduced at least one of the following types of innovation)
- product innovation
- process innovation
- organizational innovation.

As shown in Table 3, 38% of firms in our sample have introduced at least one type of innovation in the previous wave (at time *t-2*). This share increases to 71% when the analysis is restricted to time *t* innovators, i.e. to all those firms that have introduced at least one type of innovation at time t. To this extent, the attitude towards innovative activities is highly persistent through time for organisations innovating today are likely of having been innovators in the preceding wave as well. In terms of types of innovation, enterprises change their organization more often than they introduce new products on markets (23% vs. 17%). We may interpret this as a partial consequence of the crisis: the sharp fall in aggregate demand may have decreased firms' incentives to introduce new products by contemporarily calling them for a structural reorganization. Therefore, while we expect a positive relationship between product innovation and firm's export performance, we have no particular *a priori* as to the sign of the organizational innovation effect. On the one hand, organizational innovation (along with process innovation) may represent a way for the firm to increase its efficiency levels. On the other hand, it may be the signal of a defensive strategy implemented after a fall in demand.

Furthermore, in line with the literature (for a review see Wagner, 2007, 2012, 2014), exporting firms tend to be, on average, larger, more productive and more innovative than non-exporting ones (see Table 4). In particular, by looking at the different types of innovation, the widest and the narrowest gaps between the two subsamples occur in correspondence to product and organizational innovations respectively. This is consistent with our argument that product innovation is strictly correlated with market penetrating strategies while organizational innovation may be due both to defensive and aggressive strategies.

According to what has been highlighted in the literature review, firms' learning ability is accounted by means of three different channels. The first one refers to the ability of enterprises to learn from their own past export experiences or past trade in inter-regional markets; the second one refers to their ability to learn from

[4] R&D investment are included in the empirical models as a log-transformed variable. Therefore, if the firm did not undertake R&D investments in the previous period (i.e. previous wave, at time *t-2*), we impose an R&D expenditure very close to 0 in order to be able to compute the log-transformed value and keep the observation in the sample.

the surrounding environment (*spillover effects*), while the third one is related to their ability to learn from their relationships within networking phenomena.

In line with the previous literature (Bernard and Jensen, 2004), we proxy past export experiences through the past exporter status. However, unlike previous studies, we also test whether firm's current approach to the international environment is facilitated by past experience in national markets beyond regional borders. To this extent, we have computed a dummy variable taking the value of 1 when the firm has sold its products on national markets and used the lagged values of this variable to proxy another potential channel of 'learning-to-export'.

As Table 3 reports, less than 40% of enterprises were exporters in the previous wave, while 60% sold part of their products on national markets. However, this picture polarizes once the dataset is divided in exporters and non-exporters at time *t* (see Table 4). Indeed, data suggest a high degree of persistency in terms of both exporting and non-exporting behaviours: 74% of current exporters used to export in the previous wave, while only 12% of current non-exporters sold their products abroad two years ahead. This evidence is therefore in line with our 'learning-to-export' hypothesis. In terms of the inter-regional trade propensity, past exporters' shares among current exporters and non-exporters are closer, but still strongly in favour of a 'learning-to-export' behaviour (see Table 4).

The second learning channel is related to spillover effects exerted by the firm's surrounding environment. At first sight, regional and sectoral descriptive statistics support this hypothesis by showing a great degree of heterogeneity that could be produced by the influence of the local environment on firms' performances (see Tables A2 and A3). Following the export spillover literature we construct a measure for intra-industry spillovers by computing the share of exporters belonging to the same sector and located within the same region of the enterprise under consideration.

The index takes advantage of MET survey estimates and is computed as follows:

$$Export\ spillover_{itsr} = \begin{cases} \dfrac{\#\ exporters_{tsr}}{\#\ firms_{tsr} - 1}\ if\ i\ is\ not\ an\ exporter\ at\ t \\ \\ \dfrac{\#\ exporters_{tsr} - 1}{\#firms_{tsr} - 1}\ if\ i\ is\ an\ exporter\ at\ t \end{cases}$$

where *i* identifies the firm, *t* the period, *s* the sector and *r* the region.

At the same time we control for the degree of dynamism of the local environment, which may enhance the firm export performances, by also including the private and public regional expenditures in R&D.

In order to account for learning processes via networking phenomena, we introduce a dummy variable taking value 1 whenever the enterprise carries on any stable and persistent set of relations between the enterprise and other firms/institutions located in the same environment (local network). Overall 41% of the sample firms participate in a local network (see Table 3). The local network membership seems to be in contrast with export activities, for the share of firms taking part to such organizations is larger among non-exporters (see Table 4)[5].

[5] In a preliminary analysis we also include a dummy variable accounting for firm's participation in a group of enterprises, but it turned out to be not relevant at conventional significance levels.

Firm productivity is measured in terms of value added per employee. To compute this index we divide the value added information coming from financial statements by the number of employees within the MET survey. However, given possible measurement errors due to the different sources of information, we also decided to implement robustness checks using total factor productivity (TFP) as an alternative measure.[6] As expected, descriptive statistics suggest a positive relationship between this variable and firm's ability to export. As a matter of fact, exporting firms are on average more productive than non-exporting ones, (see Table 4). Furthermore, this relationship should be more important for new exporters. In fact, as pointed out in the literature review section, the existence of entry sunk costs may hinder less productive firms from penetrating foreign markets.

Finally, Table A2 and A3 in the Appendix offer interesting information on the distribution of the phenomena under analysis across regions and sectors. As expected, we note that export propensity and intensity are very diversified across territories, which are characterized by different production systems and across industries, which are more or less internationally oriented.

In the following section, we lay out the econometric strategy we have adopted to estimate our model.

4. Methodological issues and estimation strategy

The empirical models estimated in this study to identify the main determinants of the exporting propensity of Italian firms have their theoretical foundation in the studies reviewed in section 2 and in particular in the one by Roberts and Tybout (1997), who proposed a multi-period model of exporting with entry costs. According to the model, a firm decides to export if its current and expected revenues exceed current costs and any sunk cost that the firm has to face in order to gain access to external markets. Therefore, the decision to export will be undertaken when the expected profits are positive. Expected profits depend crucially on firm-level and location characteristics, such as regional factors and agglomeration economies, insofar these characteristics can increase or decrease revenues or costs. The latent model for exporting is as follows:

$$export^{*}_{it} = \alpha_i + X_{it}\beta + Z_{rt}\gamma + \delta S_t(1 - export_{it-1}) + \varepsilon_{it} \quad \text{with } i = 1, \ldots, N \text{ and } t = 2, \ldots, T \qquad (1)$$

where $export^{*}_{it}$ denotes the firm's i export choice, α_i is the individual effect, X_{it} and Z_{rt} are matrices including firm-level and local-level characteristics, respectively. The variables considered were described in detail in section 3. S_t is the sunk cost that the firm has to face at time t if it was not an exporter in the previous period. Note that, due to the design of the MET survey, in our study we consider as previous period the previous wave, which was carried out two years before with respect to the focal year.

Model (1) above is estimated by means of a non-structural binary model:

$$export_{it} = \begin{cases} 1 & if\ (\alpha_i + X_{it}\beta + Z_{rt}\gamma + \delta S(1 - export_{it-1}) + \varepsilon_{it} > 0 \\ 0 & otherwise \end{cases} \qquad (2)$$

[6] TFP is estimated through the Levinsohn and Petrin (2003) technique by implementing the *levpet* STATA command. Contrary to the value added per employee index, TFP is estimated exclusively by means of financial statements information. Unfortunately, these robustness checks have been run only on a sub-sample of enterprises since not all the balance sheet data provide the necessary components for the TFP estimation.

Before estimating model (2) we have to address two possible sources of endogeneity. The first one is due to simultaneity issues, as also emphasised by the extant empirical literature. Following previous contributions (see among others Bernard and Jensen, 2004; Koenig et al., 2010, and Choquette and Meinen, 2015), in order to guard against simultaneity issues, in all the estimated models all the explanatory variables are included with a two-year lag (previous wave of the MET survey). This approach is expected to yield consistent estimators as far as the explanatory variables are not highly persistent. We checked for persistence by estimating pooled autoregressive models. For innovation, which is the variable most likely to induce simultaneity due to the 'learning-by-exporting' mechanism, the first order autoregressive coefficient is estimated in 0.30, while for productivity the estimate is around 0.35. These results allow us to rule out severe simultaneity problems, although great caution should be applied in interpreting the effects on the propensity to export as proper causal effects.

The second source of endogeneity arises because in model (2) the lagged dependent variable is correlated with the unobserved heterogeneity term. Therefore, we have to address the well-known initial conditions problem. We tackle this problem by combining the approach suggested in Mundlak (1978), Chamberlain (1982) and Wooldridge (2005, 2010). In nonlinear dynamic models, this approach entails modelling the unobserved effect as a function of the within mean of the exogenous variables included in the model and the initial value of the dependent variable:

$$\alpha_i = \alpha_0 + \alpha_1 \bar{x}_i + \alpha_2 export_{i1} + u_i \qquad (3)$$

where u_i is the error term, which is now assumed to be independent of the *X* variables, the initial conditions and the idiosyncratic error term ε_{it}. This approach allows for correlation between the individual effect and the means of the firm-level exogenous variables and has the advantage of enabling the estimation of the effect of time-invariant covariates. In our models, as well as the initial value of the dependent binary value, we include the mean of each firm's age. Among the firm-level variables, we can consider *age* as the less problematic one in terms of endogeneity, it is the least likely to be correlated with the model error term.[7]

It is worth noting that there are other approaches suggested by the econometric literature to account for the initial conditions problem, as the ones suggested by Heckman (1981) and Orme (1997, 2001), which are based on different approximations for the distributions of the individual term. We have chosen to apply the one described above, not only because its application is straightforward, but also because Arulampalam and Stewart (2009) have shown that none of the three alternative methods dominates the other two as far as the small sample performance is concerned.

It is worth emphasising that previous works that have analysed export propensity by means of dynamic binary models have overlooked the initial conditions problem and the endogeneity induced by the lagged dependent variable. Other studies (Bernard and Jensen, 2004), in an attempt to deal with the endogeneity issue have abandoned the nonlinear probability framework in favour of the linear one in order to be able to resort to the GMM methodology suggested by Arellano-Bond (1991).

To model firms' export propensity, we consider both pooled and random effects probability models, complemented by the inclusion of the individual term approximation, as described above (eq n. 3).

[7] In following this approach, we are assuming that firm unobserved heterogeneity depends only on firm-level features and not on local-level ones. The analysis of the combined effect of firm-local level characteristics is left for future research.

In the second part of the paper, we also assess which are the main determinants of export intensity. Following previous studies, such as the recent one by Rodríguez-Pose et al. (2013), we first consider the Tobit II-Heckman specification, which allows for correlation between the selection process and the process for the observed positive values. In estimating the Tobit II-Heckman model, we achieve identification not only by means of the nonlinear functional form, but also by imposing two additional exclusion restrictions. More specifically, we restrict the past trading experience, in both the international and in the inter-regional market, to be included only in the selection process.

As it is well known, the consistency of the Tobit II estimators crucially depends on the assumption of normality and homoscedasticity, which are rarely satisfied for observed firm-level data. For this reason in the next section, we also present results obtained from two-part models (Cameron and Trivedi, 2005). Although the latter do not account for possible correlation between the two processes, they are very flexible alternatives. They allow to specify the selection as a logit or probit process, whereas the process for the positives can be modelled according to a linear specification or on the basis of the Beta distribution, which is supposed to be more appropriate when the dependent variable is a share, as it is the case for the export intensity. However, only results for the linear specification are presented in the next section, because the specification based on the Beta distribution was outperformed by its linear counterpart.

In the next section, we discuss in detail the results obtained from the export propensity and intensity models, by focusing in particular on the role played by innovation activity and learning processes represented by past performance, in both the international and national markets, local externalities and network relationships. Moreover, since the strong decrease in industrial production in recent years can have induced some changes in the relevance of these determinants, our estimation allows us to assess the validity of the model also during the great crisis started in 2008.

5. Results

5.1. Extensive margin model

Table 5 reports the estimates of the extensive margin dynamic models. In column (1) we report the linear probability model, which serves as a benchmark with respect to the non-linear counterparts. Column (2) reports the pooled probit, while the probit conditional correlated random effects model, which controls for unobserved heterogeneity at the firm level, is reported in column (3)[8]. The latter specification is estimated by including as innovative output innovation as a whole, while in the subsequent columns (4-6) we consider product, process or organization innovation in turn. As described in the previous section, we account for the initial conditions and the endogeneity of the *Past export* variable by means of the Mundlak (1978), Chamberlain (1982) and Wooldridge (2005, 2010) approach. All estimated models include time, sector-specific and macro-regional fixed effects. For the main export determinants, in Table 6 we report the average marginal effects, computed on the basis of the estimated models (3) and (4) of Table 5, for the overall sample and by distinguishing between the sub-sample of past exporters and non past exporters.

[8] The nonlinear models presented in Table 5 were also estimated according to the logistic specifications. Results, not reported in order to save space, are very similar to the ones discussed in this section.

Likewise previous contributions, firm's innovative activity positively affects its probability of exporting both via R&D investments and via innovative outputs. By comparing the models by type of innovation it is evident that the effect on export propensity is mainly driven by product innovation. As a matter of fact, despite being always positive, process and organisational innovations' coefficients are never statistically significant. Indeed, the organisational innovation result may be interpreted as an outcome of two contrasting firms' strategies: a pro-active one positively correlated with export activities and a defensive one aiming at preserving shares on domestic markets. Being our variable unable to identify the purpose of the adopted strategy, organisational innovations end up being poorly informative as to the firm export activity. For this reason, the discussion of the results will be mainly focused on the model which includes product innovation (column 4 in Table 5). In particular, an enterprise which introduced a product innovation in the previous period tends to have, on average, a 2.1 percentage points greater probability of exporting in the current period with respect to the one referring to non-innovators (see Table 6)[9]. On the contrary, a past marginal increment in R&D effort, on average, increases firm's probability to export at time *t* by 0.2 percentage points. This effect although significant, indicates a limited contribution of R&D investments to increase firms' propensity to export, which on average is around 39% (see Table 3). Even though the nature of the R&D and innovation effects is different, due to the different types of variables, it is possible to say that the average premium on export probability due to the introduction of an innovation equals about 10 times the one stemming from a marginal increase in R&D effort. An explanation for such an evidence may be that innovative outcomes are more directly related to firm performances and to the market (thus to export decision) than innovative inputs. In a similar vein, Table 6 shows that the gap between past exporters and non-exporters probability premia due to innovation is larger than the gap between past exporters and non-exporters probability premia due to R&D effort. To put it in a different way, the opportunity cost of being an innovator increases with the export status more than the opportunity cost of increasing R&D effort does.

In terms of learning processes, past international and inter-regional trade experiences are crucial in shaping firms' exporting strategy. Indeed, both variables show positive and significant coefficients. Therefore, our estimates suggest that previous export activity reduces information gaps/asymmetries and increases the firm's ability to tackle informal barriers in international trade: firms 'learn-to export'.

In line with Bernard and Jensen (2004) estimates, the difference between the average predicted probability among past exporters and the average predicted probability among past non-exporters amounts to 36.5 percentage points (see Table 6). Our result differs remarkably with respect to the one found by Bugamelli and Infante (2003) for Italian exports during the period 1982-1999; it is worth noting that these authors did not include innovation variables among their set of regressors, and this may have induced an upward bias in their estimate for the past export premium. Moreover, it is also worth highlighting that in the case of models that do not account for firms' heterogeneity, such as the linear and the pooled probit model, the effect of past exports is overestimated, being equal to 56.0 and 47.0 percentage points, respectively.

If we look at inter-regional exchanges instead, the export probability premium lowers considerably (5.6 percentage points) with respect to past international trade. Therefore, the experience provided by international markets enhances firm's capabilities more than the one provided by national markets outside the regional borders. In addition to that, past international exchanges seem to exert a sort of amplification effect over the firm's learning capabilities, for the inter-regional export premium is larger within the 'past international exporters' sub-sample than within the 'past non-international exporters' one (6.6 vs. 5.0). Firms

[9] For comparison purposes in Table 6 we also report the effects computed for the model which includes innovation as a whole.

getting in touch with international environments develop new capabilities helping them to improve their learning processes.

In terms of spillover effects, firm's decision to export appears to be positively correlated with the degree of local industry internationalisation. This suggests that a firm is expected to have a higher probability to sell its products abroad the larger the number of surrounding exporting enterprises. On the contrary, learning processes through network relationships do not turn out to be relevant in enhancing the participation of Italian firms in foreign markets.

The results discussed so far are very relevant because they provide evidence on the role played by other driving factors of the firms' internationalization process, over and above the prominent role, traditionally assigned to firm's productivity by both the theoretical and the empirical literature. Also in our analysis, we find evidence confirming productivity as one of the main determinants of firm's export decision. Its coefficient (see Table 5) is always statistically significant at 1% level irrespective of the model specification considered. Furthermore, the export probability premium stemming from a marginal increase in productivity amounts on average to 5 percentage points. However, in line with sunk costs theories, we observe that the average probability premium stemming from productivity decreases as soon as the firm becomes a stable exporter. Indeed, by comparing the average probability premium among past exporters (4.6 percentage points) with that computed among past non-exporters (5.5), we find that the latter is greater than the former. This implies that, once the firm has penetrated the market, the role of productivity shrinks.

Focusing on the other firm-level features, firm size has a significant and positive impact on the export probability: the larger the firm, the higher its ability in dealing with internationalisation costs. It is worth highlighting that the number of employees enters the models as a log-transformed variable, therefore its effect on the probability, although positive, tends to decline in magnitude as the size of the firm becomes larger. This result confirms previous findings on the inverted U-shape relationship with respect to firm's size (Wagner, 2007), as discussed in section 2.[10] As it was the case for productivity, the marginal effect of the firm's dimension is larger for non-past exporters.

Turning to age, our results suggest that the older the firm the smaller the chances to access international markets. Following Bugamelli and Infante (2003), we also considered including age as both a linear and a squared term, but, as in their case, we find that both terms turn out to be not significant. We interpret this finding as a sign that old enterprises have not been as able as young firms in reacting to the crisis. This different degree of sensitivity may be due to differing learning processes: old firms are probably more rigid on their routines and less capable of rapid changes in their strategies.

Firm's leverage is negatively associated with export activities. As a matter of fact, the larger the amount of debts, the smaller the room for the firm to undertake further costs linked to the internationalisation process due to credit rationing or internal constraints.

Finally, controls at the regional level suggest that only private expenditure in R&D contributes positively to enhance the innovative environment/context in which enterprises operate. On the other hand, it seems that regional public R&D expenditure negatively affects firm's incentive to export. However, the level of

[10] This is confirmed by results obtained by estimating the models reported in Table 7 by including the number of employees linearly and as a squared term, rather than log-transformed. Same qualitative evidence was found by proxing firm's size by means of mutually exclusive dummy variables for large, medium, small and micro firms (with the latter being the reference group). We found somewhat weaker evidence on the effects of previous experience in international markets being an increasing function of firm's size. Although this issue may have important implications, its further investigation is left for future research.

significance of this variable is almost always at 10%, so we cannot conclude there is a strong evidence against these types of public interventions.

5.2 Robustness analysis

In this section we present the main results of the robustness analysis carried out for model (4) of Table 5. The main robustness tests are performed to check whether the results are sensitive when we consider (a) a static specification of the model, (b) different indicators for productivity, or (c) the inclusion of interactive terms with respect to the firm sector, the firm dimension and the export destination markets. The results are in Table 7.

In the first column of Table 7 we present the results for the static counterpart of model (4) of Table 5; in this case we exclude the lagged term of the dependent variable from the set of the explanatory variables and we consider as exporters only the firms which export at least 10% of their total sales.[11] Such definition of exporters has been proposed in studies (Farole and Winkler, 2014; López-Bazo and Motellón, 2013) in which, due to the lack of time series data, it was not possible to account for sunk costs on the basis of past firms' behavior. As a result, the analysis was carried out on the assumption that firms exporting more than 10% of their sales had already paid the sunk entry costs. Comparing the results of model (4) in Table 5 with the ones obtained for the static specification, it is evident that for the latter model the estimated coefficients are higher yielding larger effects for the export determinants. For instance, the effect of product innovation in the static model rises to 5.5 percentage points, the one for R&D intensity is 1.5 percentage points, and inter-regional exchanges exhibit an effect as large as 20.5 percentage points. These results indicate that the static specification suffers from a problem of omitted variable bias; therefore, the inclusion of the past export firm's behaviour seems to be crucial to properly account for sunk costs.

The model in column (2) of Table 7, which, with respect to model (4) in Table 5, excludes the productivity variable, is estimated to check whether innovation exerts a direct effect on firm's export decision or whether such an effect is mediated by productivity. The results indicate that the estimate coefficients are very stable between the compared models, thus confirming the direct effect of innovation. Moreover, this offers further empirical support to the theories presented in section 2 stating that innovation, not only leads to efficiency enhancements, but may also yields competitive advantages and quasi-rents in foreign markets.

The model in which TFP is included in place of labour productivity (column (3) in Table 7) overall supports previously discussed results, the noticeable exceptions are represented by product innovation which is now significant only at the 13% level and that leverage, which is no longer significant. These results may be due to the fact that the number of observations is reduced when the TFP variable is included.

The last three models presented in Table 7 check whether there are significant differences in the effects of innovation and learning processes when we consider specific features of the firm or the destination market.

In the fourth model of Table 7 we include additional variables constructed as the interaction between the dummy for the service sector and each of the variables related to innovation or learning processes. The results indicate that significant differences exist for past trade behaviour in both international and national markets. Therefore, it seems that this kind of learning process is more valuable for firms which export services

[11] It is worth noting that similar results were found when we select as a threshold to define exporter a share of 20% with respect to total sales.

rather than manufacture products. This could be due to the fact that gathering information on services exchanges is very difficult when it is not obtained by direct experience in the markets.

In the fifth model of Table 7 we include the interactive terms with respect to the dimension of the firm by distinguishing between two subgroups of firms, large (with more than 249 employees) and micro-small-medium ones. The model is estimated by dropping the continuous variable "size" and including the additive dummy "large" and the interactive terms with respect to innovation and learning processes. According to the results, the only significant coefficient is found for past exports, signalling that large firms have an additional export probability premium given by their prominent position in the foreign markets. It is worth recalling that this could apply only to less than 1% of Italian firms, given that the great majority of them have a limited dimension.

Finally, we check whether the estimated effects are sensitive to the distance of the export markets. We, therefore, distinguish between intra-EU and extra-EU foreign markets, and construct the interactive terms by multiplying the innovation and learning processes variables with a dummy variable which takes value 1 when the most distant market to which a firm export is in an Extra-EU country. The results (last column of Table 7) indicate evidence of a probability premium in the case of past export and R&D investments, whereas exports spillovers turn out to be negative. This latter result may depend on the fact that only 17% of the firm-time observations refer to extra-EU exports. Thus, it seems plausible to argue that the information conveyed by the export spillover variable pertains most to the integrated EU markets and is much less valuable to support decisions to export to distant countries.

5.3 Extensive and intensive margin models

In Table 8 we report the results on the analysis of the determinants of firms' export intensity. As already discussed in section 4, we perform this analysis by jointly estimating the models for two processes, selection and positives values. For all the models presented in Table 8, the selection process is represented by the pooled dynamic probit model discussed in the previous section. In what follows we focus on the most salient results obtained for the export share part of the models. The latter is modelled according to either a static or a dynamic linear specification[12].

We first consider the Tobit II model, which accounts for possible correlation between the two processes. We report results for the two-step Heckman specification of the Tobit II model, which, differently from the standard Tobit II model, is based on a univariate normality assumption. For this reason, it is expected to be relatively more robust (Cameron and Trivedi, 2005). The linear model for the positive export shares includes the same set of explanatory variables included in the selection model, except for the past firm experience in both the international and the inter-regional market. These exclusion restrictions are based on the argument that past trade experience is included in the selection model in order to proxy the entry sunk costs. Therefore, we do not expect this phenomenon to be a relevant determinant of the export intensity. Although the *lambda* coefficient of the inverse Mill's ratio term is highly significant (see Table 8), indicating that the propensity to export and the export share are significantly correlated, we also consider two-part models because they rely on less restrictive assumption with respect to the Tobit II model.

[12] To estimate the dynamic specification, we adopt the Mundlak-Chamberlain-Wooldridge approach discussed in section 4.

Focusing on the share part of the model, we find that the past export share is highly significant although it does not indicate a very high degree of persistence. It is worth noting that the effect of some variables changes when contrasting the static with the dynamic specification, being in general lower for the latter specification.

Differently from the extensive margins' case, the innovative activity does not seem to play any role in influencing export shares. Although in Table 8 we report results only for the specifications including product innovation, insignificant results were also obtained for the case of process and organization innovation. The result for R&D intensity is not robust with respect to the specification adopted, it turns out to be a significant determinant of export intensity only in the static models. This is also the case for local network indicator, which exhibits a negative coefficient in the static specification; this finding might suggest that firms too much oriented towards the regional markets tend to reduce the intensity of their presence in the international ones. Conversely, export spillovers exert a positive and highly significant effect on the intensive export margin. Turning to firm's characteristics, productivity and size exhibit a positive effect, whereas leverage a negative one; overall, these effects are robust across specifications. Regional R&D expenditure displays the same kind of effects already discussed for the extensive margin models, only private R&D expenditure exhibits a positive and significant effect.

To provide an overall evaluation of the estimated models, we also compute the expected value for the export share, both unconditional and conditional with respect to observing a positive value. By comparing the expected values obtained by the models reported in Table 8 with the actual ones, E(share)=0.137, E(share| share>0)=0.349, we find that the Tobit II-Heckman model outperforms the two-part linear model with respect to the conditional expected share.

Overall, our results are similar to the ones in Rodríguez-Pose et al. (2013), which is the only recent article in which the analysis is performed within the same framework as the one adopted for the current study. Other recent articles for the Italian case are not directly comparable because the export share is modelled by means of either a fractional probit model (Antonietti and Cainelli, 2011), which assumes that the zero and the unity values are generated by the same process that generates the other positives, or a simple Tobit model (Giovannetti et al., 2014). Our results prove that the Tobit II or the two-part models are more consistent with the actual firms export behavior.

Comparing the results for the extensive and intensive models, the evidence provided by our study suggests that, once controlling for firm's characteristics, innovation and learning processes are crucial determinants of the choice to enter a foreign market, but they play a limited role in enhancing export shares. These are mostly driven by past firm's features and the past degree of export intensity.

6. Concluding remarks

Our paper investigates firms' export behaviour during recent years – the great crisis period – by means of a very rich micro-dataset on Italian manufacturing and production services sectors. Once accounting for firm's productivity, the analysis contributes to the literature by seeking to single out the additional role of innovative activities and learning abilities on firm's internationalisation processes. In order to do so we account for several channels ranging from past trade experiences (both on international and on national markets) to location and sector specific spillover effects.

With respect to previous empirical evidence, our results suggest that the probability of exporting is correlated not only with firm's age, size, degree of indebtedness and productivity levels, but also with its innovative activities and learning capabilities. Indeed, past trade experiences (especially on foreign markets), product innovations, R&D expenditures and some specific regional-sectoral features enhance firm's capabilities to reach markets beyond national borders. It is also noteworthy that the effect of productivity on extensive margin decreases once the firm becomes a persistent exporter. Thus, this evidence suggests that the permanence on foreign markets requires the firm to improve its learning capabilities rather than its productivity.

As a matter of fact, the quota of export revenues on total sales turns out to be affected only by structural characteristics (size, age, sector, degree of indebtedness) and by the regional-sectoral features of the firm's location environment. On the contrary, the introduction of new products and productivity levels cease to be significant, and the positive influence of R&D investment is no longer robust.

Moreover, neither organizational nor process innovations appear to exert significant effects on both extensive and intensive margin measures. This is probably due to the inability of our variables to disentangle whether these types of innovations took part to defensive or pro-active strategies during the crisis period.

All in all, our analysis shows that during the latest years, characterised by the harshest crises of the last decades, export behaviour of Italian firms has maintained the main features which have been proved relevant in the past and in other national contexts. Nonetheless, the importance of learning phenomena and especially those related to location and sector specific spillover effects, which are pivotal in terms of both extensive and intensive margins, leaves room for some specific policy considerations. In particular, our findings suggest that the degree of local industry internationalization and private R&D expenditures at the regional level represent two valid objectives to boost export activities. Indeed, policies directly affecting new exporters may trigger a 'domino' effect. First, they stimulate those learning abilities supporting firm's survival in foreign markets. Secondly, they act on enterprises via spillover effects by increasing the number of internationalised firms within local industries. In a similar vein, policies aiming at boosting R&D investments, such as those within the EU2020 strategy, may act on firms' degree of openness, both directly and via spillover effects.

Finally, results clearly show that there might be some role of policy measures devoted to reduce financial and structural constraints, which are partially linked to the small dimensions of Italian manufacturing and production services enterprises. The combination of diseconomies of scale due to size and the negative spillovers coming from the orientation towards local networks still represent an important impediment to export activity which can addressed by specific policy interventions.

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TABLES AND APPENDIX

Table 1: Sample breakdown

Year	MET-firms	Two-period panel	Merge with balance sheet data
2007_8	24,894		
2009	22,340	11,549	6,016
2011	25,090	13,901	5,797
2013	25,000	10,537	4,728
Total	**97,324**	**35,987**	**16,541**

Notes. Number of observations in each wave. The column on the left shows the number of observations per each MET wave. The central column shows the number of longitudinal observations per each MET wave. The column on the right shows the number of longitudinal observations matched with balance sheet data per each MET wave. The source of balance sheets is CRIBIS D&B.

Table 2: Size class and geographical distributions of the final sample

	Total		Manufacturing		Production Services	
	N. of obs.	%	N. of obs.	%	N. of obs.	%
micro	5,622	34.0	3,112	30.0	2,510	40.7
small	6,953	42.0	4,795	46.2	2,158	35.0
medium	3,144	19.0	1,979	19.1	1,165	18.9
large	822	5.0	485	4.7	337	5.5
Total	**16,541**	**100.0**	**10,371**	**100.0**	**6,170**	**100.0**
North West	3,397	20.5	2,219	21.4	1,178	19.1
North East	4,226	25.6	2,943	28.4	1,283	20.8
Centre	4,770	28.8	2,678	25.8	2,092	33.9
South	2,977	18.0	1,841	17.8	1,136	18.4
Islands	1,171	7.1	690	6.7	481	7.8
Total	**16,541**	**100.0**	**10,371**	**100.0**	**6,170**	**100.0**

Notes. Composition of the final sample both in terms of firm size dass and in terms of firm geographical location. Size dasses are identified according to the number of firm's employees: micro-firms (<10 employees), small firms (10-49 employees), medium firms (50-249 employees), large firms (>249 employees). The geographical location corresponds to the NUTS1 macro-area where firm's headquarters are settled. The sample has been also split in two macro-sectors: industry and production services sectors. The former refers to firms belonging to NACE Rev.2 B to E sectors, while the latter refer to firms belonging to NACE Rev.2 H and J sectors.

Table 3: Main statistics for whole sample and innovative firms

	All firms (16,541 obs.)				*Innovators (5,067 obs.)*			
	Mean	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
At time t								
export propensity	39%	49%	0%	100%	54%	50%	0%	100%
export share (%)	13.7	23.97	0	100	19.4	26.94	0	100
At time t-2								
export propensity	37%	48%	0%	100%	47%	50%	0%	100%
inter-regional trade propensity	60%	49%	0%	100%	66%	47%	0%	100%
Innovation - all types	38%	49%	0%	100%	71%	45%	0%	100%
Innovation - main product	17%	37%	0%	100%	32%	47%	0%	100%
Innovation - process	19%	39%	0%	100%	37%	48%	0%	100%
Innovation - organization	23%	42%	0%	100%	44%	50%	0%	100%
Productivity - va per worker	10.61	1.05	2.30	16.99	10.6	1.03	2.69	16.44
Productivity - tfp	5.8	1.30	-2.9	12.1	6.0	1.30	-2.1	12.1
R&D intensity	1.4	5.90	0	100	2.3	7.15	0	100
RD_D	14%	35%	0%	100%	24%	43%	0%	100%
Leverage	12.0	100.07	0	9118.9	11.3	132.08	0	9118.9
Employees	68.1	250.46	1	9000	107.1	342.58	1	9000
Age	19.4	14.79	0	169	19.2	15.04	0	154
Local network	41%	49%	0%	100%	46%	50%	0%	100%

Notes. See Appendix for definitions of variables. Time *t-2* refers to the previous survey wave. The 'innovators' subsample includes all those firms that have introduced at least one type of innovation at time *t*.

Table 4: Exporters and non-exporters characteristics

	All firms		Innovators	
	Exporters	**Non exporters**	**Exporters**	**Non exporters**
At time t				
Number of observations	6,510	10,031	2,715	2,352
export share (%)	34.9	-	36.2	-
At time t-2				
export propensity	74%	12%	79%	10%
inter-regional trade propensity	79%	47%	81%	49%
Innovation - all types	45%	33%	70%	73%
Innovation - main product	22%	13%	36%	27%
Innovation - process	24%	16%	38%	36%
Innovation - organization	26%	21%	42%	47%
Productivity - va per worker	10.64	10.58	10.65	10.59
Productivity - tfp	6.1	5.6	6.2	5.7
R&D intensity	2.2	0.9	3.1	1.4
RD_D	24%	8%	34%	13%
Leverage	10.0	13.3	11.7	10.9
Employees	93.5	51.6	135.2	74.7
Age	20.9	18.4	20.6	17.7
Local network	39%	42%	42%	51%

Note: See Appendix for definitions of variables. Time *t-2* refers to the previous survey wave

Table 5: Export propensity models

	Linear Probability model	Pooled Probit model	Random Effects Probit model	Random Effects Probit model	Random Effects Probit model	Random Effects Probit model
	(1)	(2)	(3)	(4)	(5)	(6)
Innovative efforts						
Innovation	0.013 **	0.063 **	0.072 **			
	(0.007)	*(0.027)*	*(0.031)*			
Product innovation				0.095 **		
				(0.040)		
Process innovation					0.034	
					(0.037)	
Organization innovation						0.034
						(0.034)
R&D intensity	0.001 **	0.005 **	0.006 **	0.006 **	0.007 ***	0.007 ***
	(0.001)	*(0.002)*	*(0.003)*	*(0.003)*	*(0.003)*	*(0.003)*
Learning processes						
Past export	0.559 ***	1.393 ***	1.175 ***	1.175 ***	1.177 ***	1.179 ***
	(0.008)	*(0.044)*	*(0.063)*	*(0.063)*	*(0.063)*	*(0.063)*
Past inter-regional trade	0.055 ***	0.218 ***	0.247 ***	0.249 ***	0.247 ***	0.247 ***
	(0.007)	*(0.027)*	*(0.032)*	*(0.032)*	*(0.032)*	*(0.032)*
Export spillovers	0.001 ***	0.003 **	0.003 **	0.003 **	0.003 **	0.003 **
	(0.0003)	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*
Local network	-0.007	-0.020	-0.029	-0.025	-0.022	-0.023
	(0.006)	*(0.025)*	*(0.029)*	*(0.029)*	*(0.029)*	*(0.029)*
Firm characteristics						
Productivity - va per worker	0.027 ***	0.112 ***	0.132 ***	0.133 ***	0.133 ***	0.133 ***
	(0.003)	*(0.013)*	*(0.015)*	*(0.015)*	*(0.015)*	*(0.015)*
Size	0.026 ***	0.102 ***	0.122 ***	0.124 ***	0.124 ***	0.123 ***
	(0.002)	*(0.010)*	*(0.013)*	*(0.013)*	*(0.013)*	*(0.013)*
Age	-0.004	-0.466 ***	-0.528 ***	-0.522 ***	-0.523 ***	-0.521 ***
	(0.004)	*(0.119)*	*(0.137)*	*(0.137)*	*(0.137)*	*(0.137)*
Leverage	-0.007 ***	-0.024 **	-0.029 **	-0.030 **	-0.029 **	-0.029 **
	(0.003)	*(0.012)*	*(0.014)*	*(0.014)*	*(0.014)*	*(0.014)*
Regional controls						
Regional public R&D	-0.025 **	-0.090 *	-0.109 **	-0.106 *	-0.109 *	-0.108 *
	(0.011)	*(0.047)*	*(0.057)*	*(0.057)*	*(0.057)*	*(0.057)*
Regional private R&D	0.022 ***	0.100 ***	0.120 ***	0.119 ***	0.119 ***	0.119 ***
	(0.006)	*(0.027)*	*(0.033)*	*(0.033)*	*(0.033)*	*(0.033)*
Constant	-0.190 ***	-2.598 ***	-3.011 ***	-3.015 ***	-2.986 ***	-2.983 ***
	(0.039)	*(0.170)*	*(0.219)*	*(0.220)*	*(0.219)*	*(0.219)*
Log-likelihood	-6978.78	-7168.56	-7153.33	-7153.15	-7155.56	-7,155.49

Note: Number of observations: 16,541. All explanatory variables are two-year lagged (previous MET survey wave). R&D intensity, productivity, leverage, size, age and regional R&D variables are log-transformed. All models include fixed effects for macro-sectors (manufacturing, services), macro-regions (North-West, North-East, Centre, Islands) and time. Pooled and Random Effect model contain the terms required to account for initial conditions and for the endogeneity of the lagged dependent variable. Clustered Standard Errors in parenthesis.
Level of significance: *** 1%; ** 5%; * 10%.

Table 6: Selected average marginal effects

	Random Effects Probit model *Innovation*	Random Effects Probit model *Product innovation*
Innovative efforts		
Innovation	0.0157 **	
Innovation - non past exporters	0.0146 **	
Innovation - past exporters	0.0177 ***	
Product innovation		0.0207 **
Product innovation - non past exporters		0.0196 **
Product innovation - past exporters		0.0228 ***
R&D intensity	0.0023 **	0.0022 **
R&D intensity - non past exporters	0.0022 **	0.0021 **
R&D intensity - past exporters	0.0024 **	0.0023 **
Learning processes		
Past export	0.3646 ***	0.3648 ***
Past inter-regio trade	0.0555 **	0.0558 **
Past inter-regio trade - non past expo	0.0499 **	0.0502 **
Past inter-regio trade - past exporters	0.0652 ***	0.0656 ***
Export spillovers	0.0003 **	0.0003 **
Export spillovers - non past exporter	0.0003 **	0.0003 **
Export spillovers - past exporters	0.0004 ***	0.0004 ***
Firm characteristics		
Productivity	0.0511 **	0.0514 **
Productivity - non past exporters	0.0542 ***	0.0546 ***
Productivity - past exporters	0.0456 **	0.0458 **
Size	0.0449 ***	0.0456 ***
Size - non past exporters	0.0482 ***	0.0490 ***
Size - past exporters	0.0392 **	0.0397 **

Note: The effects are computed for models (3) and (4) of Table 5. The effects of continous variables are computed for one standard deviation change with respect to the mean value. Non past exporters: 10476 observations; Exporters: 6065 observations.

Level of significance: *** 1%; ** 5%; * 10%.

Table 7: Robustness analysis for export propensity models

Random Effects Probit models

	Static model export share >=10%	No productivity	TFP	Interactive terms service sector	Interactive terms size	Interactive terms extra-EU exports
Innovative efforts						
Product innovation	0.225 ***	0.093 **	0.065	0.087 **	0.102 ***	0.109 **
	(0.053)	*(0.040)*	*(0.044)*	*(0.046)*	*(0.041)*	*(0.045)*
R&D intensity	0.033 ***	0.007 **	0.006 **	0.009 ***	0.007 **	0.001
	(0.004)	*(0.003)*	*(0.003)*	*(0.003)*	*(0.003)*	*(0.003)*
Learning processes						
Past export		1.167 ***	1.196 ***	1.034 ***	1.143 ***	1.116 ***
		(0.064)	*(0.063)*	*(0.068)*	*(0.064)*	*(0.066)*
Past inter-regional trade	0.851 ***	0.242 ***	0.258 ***	0.205 ***	0.291 ***	0.250 ***
	(0.044)	*(0.032)*	*(0.035)*	*(0.039)*	*(0.032)*	*(0.033)*
Export spillovers	0.012 ***	0.003 **	0.003 *	0.004 ***	0.003 **	0.004 ***
	(0.002)	*(0.001)*	*(0.002)*	*(0.001)*	*(0.001)*	*(0.002)*
Local network	-0.097 **	-0.031	-0.020	-0.001	-0.008	-0.003
	(0.041)	*(0.029)*	*(0.033)*	*(0.035)*	*(0.030)*	*(0.032)*
Firm characteristics						
Productivity - va per worker	0.224 ***			0.132 ***	0.089 ***	0.132 ***
	(0.022)			*(0.015)*	*(0.014)*	*(0.015)*
Productivity -TFP			0.089 ***			
			(0.014)			
Size	0.308 ***	0.087 ***	0.053 ***	0.127 ***		0.118 ***
	(0.020)	*(0.012)*	*(0.014)*	*(0.013)*		*(0.013)*
Large (=1 if size>=250 employees)					-0.057	
					(0.273)	
Age	-0.070 **	-0.513 ***	-0.598 ***	-0.505 ***	-0.547 ***	-0.516 ***
	(0.033)	*(0.136)*	*(0.151)*	*(0.137)*	*(0.137)*	*(0.137)*
Leverage	-0.086 ***	-0.045 ***	-0.010	-0.030 **	-0.039 ***	-0.029 **
	(0.021)	*(0.014)*	*(0.017)*	*(0.014)*	*(0.014)*	*(0.014)*
Regional controls						
Regional public R&D	-0.333 ***	-0.079	-0.162 ***	-0.122 **	-0.122 **	-0.104 *
	(0.085)	*(0.056)*	*(0.063)*	*(0.057)*	*(0.057)*	*(0.057)*
Regional private R&D	0.213 ***	0.107 ***	0.116 ***	0.120 ***	0.128 ***	0.115 ***
	(0.051)	*(0.033)*	*(0.037)*	*(0.034)*	*(0.033)*	*(0.033)*
Interactive terms						
Product innovation * service sector / size / extra-EU exports				0.067	-0.213	-0.087
				(0.089)	*(0.199)*	*(0.097)*
R&D intensity * service sector / size / extra-EU exports				-0.008	0.010	0.014 **
				(0.006)	*(0.013)*	*(0.006)*
Past export * service sector / size / extra-EU exports				0.509 ***	1.026 ***	0.553 ***
				(0.068)	*(0.176)*	*(0.160)*
Past inter-regional trade * service sector / size / extra-EU exports				0.119 *	-0.018	-0.052
				(0.065)	*(0.202)*	*(0.117)*
Export spillovers * service sector / size / extra-EU exports				-0.004	0.003	-0.006 **
				(0.004)	*(0.006)*	*(0.003)*
Local network * service sector / size / extra-EU exports				-0.075	-0.058	-0.120
				(0.062)	*(0.156)*	*(0.078)*
Constant	-4.139 ***	-1.470 ***	-2.067 ***	-2.932 ***	-2.269 ***	-3.070 ***
	(0.308)	*(0.115)*	*(0.157)*	*(0.222)*	*(0.194)*	*(0.222)*
Log-likelihood	-8554.65	-7194.78	-6,038.45	-7114.33	-7163.00	-7,140.91
Number of observations	16,541	16,541	13,781	16,541	16,541	16,541

Note: All explanatory variables are two-year lagged (previous MET survey wave). R&D intensity, productivity, leverage, size, age and regional R&D variables are log-transformed. All models include fixed effects for macro-sectors (manufacturing, services), macro-regions (North-West, North-East, Centre, Islands) and time. Pooled and Random Effect model contain the terms required to account for initial conditions and for the endogeneity of the lagged dependent variable. Clustered Standard Errors in
Level of significance: *** 1%; ** 5%; * 10%.

Table 8: Export intensity

		Tobit II model - two steps		Two-part model	
	Selection	*Share*	*Share*	*Share*	*Share*
Pooled models	**Probit**	**Static**	**Dynamic**	**Static**	**Dynamic**
Innovative efforts					
Product innovation	0.083 **	0.001	0.008	0.004	-0.004
	(0.034)	*(0.009)*	*(0.007)*	*(0.009)*	*(0.007)*
R&D intensity	0.005 **	0.001 *	0.0001	0.001 **	-0.001 *
	(0.002)	*(0.0005)*	*(0.0005)*	*(0.001)*	*(0.0005)*
Learning processes					
Past export	1.394 ***				
	(0.043)				
Past inter-regional trade	0.219 ***				
	(0.027)				
Past export share			0.473 ***		0.492 ***
			(0.018)		*(0.013)*
Export spillovers	0.003 **	0.0015 ***	0.001 ***	0.002 ***	0.001 ***
	(0.001)	*(0.0003)*	*(0.0003)*	*(0.0003)*	*(0.0002)*
Local network	-0.016	-0.022 ***	-0.004	-0.023 ***	-0.005
	(0.025)	*(0.007)*	*(0.006)*	*(0.007)*	*(0.006)*
Firm characteristics					
Productivity - va per worker	0.113 ***	0.005	0.012 ***	0.007 *	0.006 *
	(0.012)	*(0.004)*	*(0.003)*	*(0.004)*	*(0.003)*
Size	0.103 ***	0.023 ***	0.018 ***	0.028 ***	0.006 ***
	(0.010)	*(0.003)*	*(0.002)*	*(0.003)*	*(0.002)*
Age	-0.460 ***	-0.007	-0.019	-0.008	-0.001
	(0.120)	*(0.005)*	*(0.029)*	*(0.006)*	*(0.004)*
Leverage	-0.024 **	-0.010 ***	-0.008 **	-0.011 ***	-0.006 **
	(0.012)	*(0.003)*	*(0.003)*	*(0.004)*	*(0.003)*
Regional controls					
Regional public R&D	-0.088 *	-0.031 **	-0.026 **	-0.036 **	-0.014
	(0.047)	*(0.013)*	*(0.011)*	*(0.015)*	*(0.011)*
Regional private R&D	0.099 ***	0.022 **	0.026 ***	0.025 ***	0.018 ***
	(0.028)	*(0.009)*	*(0.008)*	*(0.009)*	*(0.007)*
Constant	-2.602 ***	0.256 ***	-0.111 **	0.202 ***	0.132
	(0.171)	*(0.050)*	*(0.044)*	*(0.054)*	*(0.045)*
Lambda Mills		-0.039	0.154		
		(0.007)	*(0.007)*		
Implied *rho*		-0.148			
E(share| X, Z)		0.137	0.135	0.137	0.135
E(share| X, Z, share>0)		0.306	0.313	0.321	0.268

Observations: 16,541 full model; 10,031 zero values; 6,510 positive values

Note: All explanatory variables are two-year lagged (previous MET survey wave). R&D intensity, productivity, leverage, size, age and regional R&D variables are log-transformed. Macro-sectors: manufacturing, services; Macro-regions: North-West, North-East, Centre, Islands. Probit and Logit parts contain the terms required to account for initial conditions and for the endogeneity of the lagged dependent variable. Clustered Standard Errors in parenthesis for two-part

Level of significance: *** 1%; ** 5%; * 10%.

APPENDIX

The dataset used in this study merges firm-level data from the MET Survey on Italian manufacturing (ISIC Rev.4 C sectors) and production services sectors (ISIC Rev.4 H and J sectors) with data on firm's economic performance and financial structure obtained from the CRIBIS balance sheet database and data on public and private R&D expenditure obtained from the Italian National Institute of Statistics (ISTAT) website.

The MET Survey, made up of four waves for the years 2007, 2009, 2011 and 2013, provides data on Italian firms' internationalization processes, innovative behaviours and network relationships. Each wave of the survey consists of about 25,000 observations, with a longitudinal data share accounting for roughly 50% of every wave, starting from the 2009 one. The representativeness of results is warranted by a sample design stratified along three dimensions: size class, sector and geographical region.
In terms of firm size, four classes are accounted for: micro-firms (<10 employees), small firms (>= 10 and <50 employees), medium firms (>=50 and <250 employees) and large firms (>= 250 employees).
In terms of sectors, the MET survey is representative for the following ISIC Rev4 sectors: Food products, beverages and tobacco (C10-12), Textiles, textile products, leather and footwear (C13-15), Wood, products of wood, cork and furniture (C16 and 31), Pulp, paper, paper products, printing and publishing (C 17-18), Chemical, rubber, plastics and fuel products (C19-22), Basic metals and fabricated metal products (C 24-25), Transport equipment (C29-30), Machinery and equipment n.e.c. (C28), Electrical and optical equipment (C 26-27), Other manufacturing sectors(C 32-33), Transport and storage (H), Information and communication (J). The former ten sectors (ISIC Rev4 section C sectors) represent the manufacturing sectors, while the latter ones (ISIC Rev4 H and J) represent the production services sectors.
Finally, the dataset is also representative for the 20 NUTS2 Italian regions, which can be clustered in five NUTS1 macro-areas: North-West (Valle d'Aosta, Piemonte, Liguria, Lombardia), North-East (Veneto, Trentino Alto Adige, Friuli Venezia-Giulia, Emilia-Romagna), Centre (Toscana, Umbria, Marche, Lazio), South (Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria) and the Islands (Sicilia and Sardegna). Given the main task of the survey is to study innovative firms' characteristics, the sample design seeks to oversample them by looking for the cells with a greater probability of containing innovative enterprises. This identification procedure is performed according to a Bayesian technique which updates each wave's information with the innovative firms' frequencies observed in the preceding wave. Interviews are performed either via phone call or via web (with phone call assistance). For further information about the sampling technique and the methodology see Brancati et al. (2015).

Table A1 reports the full list of variables used in the empirical analysis along with a short description.

Tables A2 and A3 report the distribution of the main variables across regions and sectors, respectively.
Table A2 shows that Italy is divided into two systems in terms of international competitiveness. Most of the regions in the Centre and in the North have quite a high propensity to export (around 45%) and, consequently, a high export intensity (usually above 15%). On the contrary, regions in the South and in the Islands are much more inclined to regional and national market, as the quota of exporting firms is below 30% for the South and below 25% for the Islands. This gap can be related to differences in firms' characteristics and in the context in which they operate: firms in the North are larger and more innovative and their regional productive system is, on average, more open and technologically advanced.
Table A3 suggests that part of the difference across regions may be due to different production specialization structure. Industries are, as a matter of fact, more or less oriented to international markets. First of all, propensity to export in Manufacturing is almost double the one in Services (47.9% and 25% respectively). Secondly, among manufacturing sectors heterogeneity is quite significant since export propensity goes from around 57% for Machinery and Equipment and Electrical and Optical Equipment to around 32% for Other Manufacturing.

Table A1 - Appendix

Variable name	Definition	Source
International and interregional trade		
export propensity	dummy = 1 if the firm sells at least part of its products/services abroad	MET database
export share	share of revenues stemming from export activities	MET database
inter-regional trade propensity	dummy = 1 if the firm sells part of its products/services outside the region where it is located but within the national boundaries	MET database
Innovation activity		
Innovation - all types	dummy = 1 if the firm has introduced one or more innovations	MET database
Innovation - main product	dummy = 1 if the firm has either introduced a new product on the market or radically changed an old	MET database
Innovation - process	dummy = 1 if the firm has changed its production process	MET database
Innovation - organization	dummy = 1 if the firm has changed the organisation of its activity	MET database
R&D intensity	natural logarithm of the R&D expenditure at time *t*, normalised by total turnover at time *t*	MET database
R&D dummy	dummy = 1 if the firm carries out R&D activity	MET database
Productivity measures		
Productivity - va per worker	natural logarithm of the Value Added per employee at time *t*	MET database, CRIBIS D&B
Productivity - tfp	natural logarithm of the firm's Total Factor Productivity	CRIBIS D&B
Financial and structural chacteristics		
Leverage	natural logarithm of the financial leverage of the firm	CRIBIS D&B
Age	natural logarithm of the age of the firm computed as the difference between time t and the date of its	MET database
Employees	number of employees	MET database
Large	dummy = 1 if the number of firm's employees is > 249	MET database
Service macro-sector	dummy = 1 if the firm operates in a service sector (ISIC Rev.4 H and J sectors)	
Local network	dummy = 1 if the firm belongs to a local network of firms at time *t*	MET database
Sectoral and regional exogenous factors		
Export spillovers	share of exporting firms, at time t, operating in the same sector and located in the same region of the focal firm	MET database
Regional public R&D	natural logarithm of the public expenditure in R&D at the regional level, normalised by the regional GDP at time *t*	ISTAT
Regional private R&D	natural logarithm of the private expenditure in R&D at the regional level, normalised by the regional GDP at time *t*	ISTAT

Table A2: The main variables across Italian regions and macroregions

		At time t		*At time t-2*										
	Obs	**export propensity**	**export share**	**Innovation**	**R&D intensity**	**export propensity**	**inter-regional exchanges**	**Export spillovers**	**Productivity va per worker**	**Productivity tfp**	**Employees**	**Age**	**Regional public R&D**	**Regional private R&D**
North West	***3,397***	***50.5%***	***18.6%***	***40.7%***	***1.8%***	***47.6%***	***68.7%***	***20.2%***	***10.6***	***5.9***	***88.0***	***22.5***	***35.1%***	***110.8%***
Piemonte	1,277	49.8%	17.2%	43.2%	1.8%	47.9%	69.1%	19.8%	10.5	5.9	102.6	20.7	38.3%	144.5%
Valle D'Aosta	143	32.2%	10.5%	35.0%	0.6%	23.1%	39.2%	15.2%	10.8	5.3	23.0	19.8	14.9%	45.2%
Lombardia	1,563	53.7%	20.8%	39.8%	2.0%	52.0%	72.2%	20.7%	10.6	6.0	85.3	23.7	29.1%	98.0%
Liguria	414	46.4%	17.9%	38.6%	1.5%	38.6%	64.3%	20.7%	10.6	5.9	75.9	24.0	54.8%	78.1%
North East	***4,226***	***45.0%***	***16.7%***	***42.0%***	***1.5%***	***41.9%***	***63.1%***	***22.9%***	***10.6***	***5.9***	***76.1***	***21.6***	***46.9%***	***71.0%***
Trentino Alto Adige	629	42.3%	16.3%	36.6%	1.1%	37.0%	56.9%	17.1%	10.7	5.9	98.9	22.6	52.5%	64.8%
Veneto	1,910	45.0%	17.2%	44.5%	1.6%	42.1%	61.0%	22.7%	10.6	5.9	63.3	18.9	34.5%	61.1%
Friuli-Venezia Giulia	352	59.1%	23.4%	31.3%	0.8%	52.3%	71.9%	31.0%	10.6	5.9	113.1	22.4	63.2%	79.6%
Emilia Romagna	1,335	42.5%	14.4%	43.8%	1.8%	41.2%	66.5%	23.8%	10.6	5.9	74.1	24.9	57.7%	85.7%
Centre	***4,770***	***36.4%***	***12.7%***	***38.5%***	***1.3%***	***33.5%***	***59.5%***	***15.3%***	***10.7***	***5.8***	***62.3***	***17.8***	***79.3%***	***50.6%***
Toscana	1,563	42.8%	17.1%	42.2%	1.3%	40.8%	63.3%	17.1%	10.5	5.8	50.8	19.7	63.4%	51.0%
Umbria	506	32.8%	9.8%	40.7%	1.5%	29.6%	62.5%	17.5%	10.5	5.7	70.3	17.3	69.2%	23.0%
Marche	687	46.6%	16.5%	33.9%	1.4%	45.3%	67.0%	19.9%	10.5	5.7	51.6	18.2	36.0%	34.4%
Lazio	2,014	28.8%	8.7%	36.7%	1.2%	24.9%	53.2%	11.7%	10.9	5.9	72.9	16.5	109.0%	62.8%
South	***2,977***	***29.6%***	***8.5%***	***31.1%***	***1.0%***	***26.8%***	***53.6%***	***14.3%***	***10.5***	***5.4***	***54.3***	***16.1***	***56.8%***	***30.4%***
Abruzzo	247	44.9%	16.0%	33.6%	1.2%	41.7%	75.3%	15.9%	10.3	5.8	101.1	20.3	55.4%	40.0%
Molise	244	27.5%	6.6%	25.8%	0.9%	25.4%	48.8%	12.7%	10.6	5.3	18.8	15.2	42.4%	7.0%
Campania	1,059	30.1%	9.2%	28.5%	1.6%	27.6%	60.5%	16.7%	10.3	5.4	48.0	14.2	71.3%	55.2%
Puglia	568	39.3%	12.0%	43.0%	1.2%	34.3%	65.1%	10.2%	10.4	5.5	90.5	20.1	54.1%	23.9%
Basilicata	278	27.0%	6.4%	37.4%	0.4%	20.9%	41.4%	15.1%	10.9	5.4	34.8	16.3	51.6%	16.9%
Calabria	581	14.6%	2.6%	22.2%	0.3%	15.1%	28.4%	13.5%	10.8	5.1	34.9	14.4	42.3%	3.7%
Islands	***1,171***	***23.8%***	***6.2%***	***29.0%***	***1.0%***	***23.7%***	***39.9%***	***13.9%***	***10.7***	***5.4***	***40.0***	***16.8***	***60.2%***	***18.7%***
Sicilia	850	24.6%	6.8%	31.3%	1.0%	25.1%	39.5%	13.1%	10.8	5.4	40.5	16.9	60.5%	23.2%
Sardegna	321	21.8%	4.6%	23.1%	1.0%	20.2%	40.8%	15.9%	10.5	5.3	38.7	16.5	59.3%	6.9%

Note: See Appendix for definitions of variables. Time *t-2* refers to the previous survey wave

Table A3: The main variables across productive sectors

		At time t		*At time t-2*								
	Obs	**export propensity**	**export share**	**Innovation**	**R&D intensity**	**export propensity**	**inter-regional exchanges**	**Export spillovers**	**Productivity va per**	**Productivity tfp**	**Employees**	**Age**
Manufacturing	***10,371***	***47.9%***	***17.3%***	***40.2%***	***1.5%***	***44.9%***	***66.5%***	***21.2%***	***10.7***	***5.9***	***62.7***	***21.1***
Food products, beverages and tobacco	944	44.6%	12.6%	38.3%	0.9%	38.9%	64.9%	15.6%	10.5	5.5	34.3	26.4
Textiles, textile products, leather and footwear	1,125	55.3%	22.5%	39.4%	1.2%	55.4%	73.8%	22.8%	10.4	5.9	54.8	19.3
Wood and products of wood and cork	778	43.2%	13.9%	38.8%	1.1%	39.2%	65.0%	15.9%	10.5	5.5	44.9	19.5
Pulp, paper, paper products, printing and publishing	662	34.1%	8.8%	38.5%	1.1%	32.6%	60.7%	13.4%	10.8	5.6	42.7	20.9
Chemical, rubber, plastics and fuel products	1,274	55.3%	17.7%	42.9%	1.7%	50.9%	72.8%	31.3%	10.8	6.0	67.2	21.8
Basic metals and fabricated metal products	1,869	41.7%	13.4%	38.6%	1.4%	39.5%	64.8%	17.3%	10.7	5.8	47.9	21.9
Transport equipment	582	55.0%	22.5%	48.6%	2.5%	48.8%	69.8%	27.0%	10.6	6.1	145.5	17.5
Machinery and equipment n.e.c.	1,386	57.0%	25.8%	42.7%	2.0%	55.0%	69.6%	28.3%	10.7	6.0	73.5	20.7
Electrical and optical equipment	833	56.7%	22.2%	44.7%	2.2%	51.0%	70.2%	17.7%	10.8	6.0	67.4	19.3
Other manufacturing sectors	918	32.5%	11.8%	31.8%	1.1%	31.0%	49.2%	17.9%	10.8	6.1	82.1	21.2
Production services	***6,170***	***25.0%***	***7.7%***	***33.9%***	***1.2%***	***22.9%***	***48.7%***	***12.5%***	***10.5***	***5.6***	***77.2***	***16.5***
Transport and storage	1,940	31.3%	11.2%	29.0%	0.7%	28.0%	53.4%	15.3%	10.6	5.5	82.8	18.6
Information and communication	4,230	22.0%	6.1%	36.2%	1.4%	20.5%	46.5%	11.2%	10.5	5.6	74.6	15.5

Note: See Appendix for definitions of variables. Time *t-2* refers to the previous survey wave