Innovation activities and learning processes in the crisis.

Evidence from Italian export in manufacturing and services

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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 regional and local industry 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

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, theories have been developed, starting from Melitz (2003), to model the presence of a large heterogeneity among firms and the consequent selection mechanism into foreign markets, both in terms of participation (extensive margin) and its intensity, usually measured by the quota of sales abroad on total sales (intensive margin).

These studies mainly conceive the firm's internationalization process as a straightforward outcome of having gained sufficiently high productivity levels (Melitz, 2003). Even when other determinants are accounted for (Constantini and Melitz, 2008), their major role is to contribute to further productivity improvements.

Our approach aims at addressing this matter from a different perspective. First of all, 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 does not perfectly overlap with the extent to which firm's performance hinges on foreign markets. 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.

In particular, firm's innovative activity is proxied by input and output variables, the former measuring the effort put into this process via R&D expenditures, while the latter detecting the actual introduction of an innovative outcome. Our hypothesis is that innovative activity directly relates to internationalization processes by helping enterprises in gaining temporary quasi-rents along their technological trajectories (Dosi et al. 1990 and Barletta et al., 2014). Thus, it is not only important to look at the actual introduction of innovations but also at the effort exerted in such a process. Furthermore, as we explain in section 3, it would be misleading to include only either one of the two variables in the case of Italy where there are many innovative enterprises carrying out informal research and development activities (Santarelli and Sterlacchini, 1990).

As for the 'learning-to-export' abilities, we refer to Penrose (1959) by suggesting that firm's management may draw on experience to increase its knowledge and, thus, ultimately, its ability to overcome international trade barriers. Therefore, under this perspective, firms at the beginning of the considered period may have a higher probability to survive in foreign markets if they are already accustomed to the foreign environment. This entails having acquired valuable information on the legal and institutional framework of foreign countries, on foreign consumers preferences and on how to establish and reinforce distributions channels abroad. In a similar vein, we are also interested in past trade in inter-regional

markets within national boundaries. As a matter of fact, the 'learning-to-export' process can be facilitated if a firm has already tackled the difficulties related to accessing an unfamiliar market. Although the institutional environment is the same all over the home country, regional markets could be highly differentiated in terms of local demand or distribution networks. Therefore, enterprises active in inter-regional markets may face lower sunk costs when approaching foreign markets.

Apart from past trade experience, we also look at the local environment as a possible source for 'learning-to-export' effects via spillover phenomena. While most of the empirical contributions tackle this issue by just including control dummy variables, we consider specific variables, which relate either to the sector, to the region or to local industry characteristics. More specifically, we consider the degree of local industry internationalisation and Research and Development (R&D) expenditure (both private and public) at the regional level. The former is expected to reduce information costs and induce imitation behaviour, while the latter may create knowledge spillovers.

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. Secondly, given that our analysis refers to the period 2007-2013, which comprises the recent financial and economic crises, we provide novel evidence confirming the relevance of the main determinants of export performance identified by the theoretical and empirical literature on international trade. Moreover, our analysis is based on the application of appropriate econometric methodologies to an extended and updated new database from the MET surveys, which are specifically designed to study Italian firms' characteristics and strategies, with particular focus on internationalization processes, innovative behaviour and network relationships. More specifically, we model foreign market participation by means of dynamic probability models 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 modelled by means of Tobit II-Heckman models or by two-part models (Cameron and Trivedi, 2005).

Our empirical analysis builds on the recent literature 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. Such data allow us to follow the recent original contribution by Harris and Li (2012) on UK, 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) provide the firm with a valuable set of skills and knowledge 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..

Furthermore, innovation activity exerts a positive effect both on the internationalisation process and on the degree of foreign markets penetration. In particular, the introduction of a new product, together with the degree of effort exerted in the innovation activity, help the firm to penetrate new markets, whereas only R&D expenditure is significantly correlated with the intensive margin. Therefore, despite new products are helpful to sell goods and services on foreign markets, a high degree of effort in the innovative activity is needed to be successful in terms of sales.

On the contrary, 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 within the territory they are located in 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 briefly presents the rich theoretical and empirical background within which this research is located in order to highlight its original contents. The third section offers an extensive account of the characteristics of the MET-database and describes the main features of the phenomena under examination. The fourth and the fifth section presents the methodology and the main results, respectively. Section six concludes.

2. Theoretical and empirical background

Theories

The decision by a firm to export is, basically, made in light of a comparison of costs and benefits of selling products in the home and in the foreign market. According to traditional Heckscher-Ohlin model this decision is taken by perfectly competitive homogenous firms, which act as one in presence of comparative advantages due to different factor endowments across sectors and countries. New trade theories 'a la Krugman (1979) introduce imperfect competition but firms are still thought as a unique entity, because trade costs are mainly made of homogeneous transport expenses and tariffs.

Only with Baldwin (1989) and Dixit (1989), theories introduce fixed sunk costs faced by firms to enter into export markets. These sunk costs of entry are mainly due to informal barriers and includes incomplete information about international markets, uncertainty about contract enforcements, unfamiliarity with market characteristics abroad, difficulties in the establishment of distribution channels and the costs of complying with new or more developed product standards. The pioneering paper of Melitz (2003) develops this scenario by conceiving a dynamic industry model with heterogeneous firms[1] which incur a fixed cost to export and this significantly alter the distribution of the gains from trade across firms. In fact, only the most efficient ones are able to export and to obtain higher profits. Less efficient firms may be forced out of the industry[2].

However, differences in firms' level efficiency are rationalized only when the link between exports and innovation is accounted for by Costantini and Melitz (2008), who suggest that openness to trade may increase R&D returns and, therefore, create incentives for firms' R&D investments. Aw et al. (2008) develop and systematize these relationships in a dynamic model where R&D investments, through their effect on

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[1] This heterogeneity is not explained within the model. A key theoretical contribution which tries to endogenize firms' differences is Yeaple (2005). Initially identical firms have the possibility to adopt high-technologies, low unit costs of production or more intensive use of capital, and consequently enhance their productivity and finally start or increase their export flows.

[2] This is the main rationale to explain why trade may generate industry productivity gains at the macro level without necessarily improvements of the productive efficiency of individual firms at the micro level (Falvey et al., 2004)

future productivity, increase the profits from exporting, and participation in the export market raises the return to R&D investments. A similar link is suggested also by the evolutionary vision/perspective, according to which the introduction of product and process innovations may allow exporting firms to gain temporary quasi-rents along their technological trajectories (Dosi et al. 1990 and Barletta et al., 2014)[3].

Another important dynamic element, which may lead to cumulative effects, is produced by learning-to-export. Clerides et al. (1998) base their model on a simple intuition: if exporting generates efficiency gains, then firms, which begin to export, should thereafter exhibit a change in their productivity trajectories. In a similar fashion, within this model, if the presence of exporters generates positive externalities, firms in the same industry or located in the same region may exhibit changes in their cost process or in their productivity which makes breaking/entering/accessing in a foreign market easier and/or less costly.

Along this analytical path, Krugman (1992) and Aitken et al. (1997) argue that the local host environment may create important technological and pecuniary spillovers, which affect firms' performance and, thus, their potential to export. At the same time, externalities may appear in those sectors where technological progress displays high levels of opportunity and cumulativeness (Nelson and Winter, 1982; Malerba and Orsenigo, 1997). According to these two perspectives, firms capabilities and their related export performance depend not only on internal features and innovation efforts, but also on their capacity to absorb knowledge and ideas from other geographically and/or technologically proximate firms (Cohen and Levinthal, 1990).

In conclusion, all theories stress that exporting increases expected profits, which induce entry, push up the productivity threshold for survival and drive out the least efficient firms along a series of Schumpterian waves of creative destruction. A process which is continuously modelled and shaped by innovation activity, learning effects and industrial and regional spillovers.

Empirics

The theoretical literature has made clear that there are important firms' characteristics, which affect costs and benefits of entering a new market. In particular, participation to export is analytically determined by a combination of sunk-costs and firm productivity. In empirical counterparts, the set of firm characteristics has included factors such as productivity, size, age, human capital, capital-intensity, ownership, previous performance and experience and many others.

It is worth noting that previous experience, proxied by lagged export status or performance, almost always explains most of the variation in the data. Its coefficient is usually interpreted as evidence of sunk-costs: firms that have already faced and overcome international entry barriers in the past are more likely to export today compared to firms that did not (Aitken et al., 1997; Bernard and Jensen, 1999; Clerides et al., 1998; Greenaway and Kneller, 2004; Roberts and Tybout, 1997). Bugamelli and Infante (2003) focus mainly on the measurement of these sunk costs in the case of Italian firms and find a remarkable value: past experience in foreign markets increases the probability of exporting by about 70%. A measure which is almost double the percentage proposed by Bernard and Jensen (2004) for US plants: having exported last period increases the probability of exporting today by 39%.

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[3] It is worth noting that within this literature there is a dual relationship between exports and productivity, whereby firms exogenously self-select themselves into the export market, they experience a faster productivity growth thanks to foreign competition. The same applies to the casual linkage between innovation and trade.

The ability of firms to deal with these sunk costs is clearly influenced by firm performance, for only the more productive and profitable firms are able to incur the large fixed costs of entering export markets. Another reason for a positive link between productivity and export is due to the behaviour of forward-looking firms which improve their performance today in order to become sufficiently competitive to face foreign markets and, therefore, become an exporter tomorrow. A large number of studies (Aw et al., 2000; Bernard and Jensen, 1999; Greenaway and Kneller, 2004, among many others), as a result, prove that firms self-select into exporting activities and that productivity is crucial in determining the probability of entering the foreign markets.

In addition to sunk entry costs, the empirical literature has proposed a set of firm characteristics which are related directly or indirectly to productivity and create a potential further mechanism which drives firms into exporting. The first most obvious feature, which may enhance productivity, relates to the firm's decision to invest in research and development and their related ability to introduce new innovation. More specifically, there is 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).[4]

Another important internal firm characteristic, which is often considered as a potential determinant of export propensity is its dimension, expressed in terms of employees or sales (Wakelin, 1998). The main rationale is that larger firms may exploit economies of scale in production and 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.

Moreover, the age of a firm has been shown to affect export activity, even though it is not analytically clear in which direction. On the one hand, the involvement of a firm with international markets can be envisaged as a gradual development process, which needs some preliminary experience within regional and national markets (Roberts and Tybout, 1997). On the other hand, age can be perceived as a neutral factor because firms can be either 'genetically' export-oriented or not.

Finally, the geographical location may influence the overall efficiency of firms and therefore their ability to compete successfully in foreign markets. Firms may have two types of locational advantages: first and second nature geography. The former are related to exogenous attributes of a territory, such as latitude, natural resource endowment, climate, proximity to the coast. The latter are associated to features, which depend on the interaction among economic agents within the boundaries of a certain location and they are evidently endogenous. Second-nature geography includes specialisation and urbanization economies, local knowledge spillovers and other regional endowments. 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. Recently there have been some interesting studies for specific developing countries (Rodríguez-Pose et al., 2013, for Indonesia and Mukim, 2012, for India) and one for a multi-country setting with both developed and developing countries (Farole and Winkler, 2013). Finally, for Italy, Becchetti and

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[4] Although the evidence supporting the self-selection hypothesis is more robust, there are also studies which provide some evidence on positive effects of a firm's export status on innovation, that is a phenomenon of learning by exporting (Damijan et al., 2010 and Bratti and Felice, 2012).

Rossi, (2000) and Antonietti and Cainelli, (2011) have investigated the presence of local externalities affecting export activity of Italian firms in the past: in 1989-91 in the former paper and in 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 have focused their attention on more general characteristics of export performance of Italian 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 explain part of the heterogeneity in export behaviour 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)[5] 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.

The strong decrease in industrial production in recent years can have induced some changes in the relevance of these determinants: the stagnation of Italian internal demand and the presence of some international markets as the only dynamic component of aggregate demand can have induced effects on the relevant model for export's performance. This possible change needs appropriate testing in order to assess the validity of the model also during the great crisis started in 2008 and to verify the significance of specific phenomena. Moreover, if we consider the industrial dimensional structure of Italian exporters and the contribution of micro an small enterprises, it is also relevant to test whether the effects sunk costs and other constraints are still crucially determining the access of this kind of firms in the international markets. Recent years can show radical changes with respect to this phenomenon.

3. Data and descriptive statistics

This section presents the database employed in our analysis: we briefly describe its setup as well as its composition; then, we provide some descriptive statistics as to the phenomena we are interested in.

The structure of the dataset

The empirical analysis in this paper is carried out by using 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), currently made up of four waves (2007, 2009, 2011 and 2013) covering a time span starting before the Lehman collapse (wave 2007) until the most recent sovereign debt crisis (wave 2013). This survey is specifically conceived to study Italian firms' characteristics and strategies, with particular attention to their internationalization processes, innovative behaviours and network relationships. The representativeness of results is warranted by a sample design stratified along three dimensions: size class, sector and

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[5] This contribution uses the same MET database analysed 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 induce positive effects on Italian firms' innovative activity and performance.

geographical region.[6] 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.

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 believe that current performance is explained by experience in the past, the selected sample includes only firms appearing at least in two consecutive waves (see the middle column in Table 1). Furthermore, we merge MET dataset with CRIBIS D&B balance sheet database in order to collect information on firm's economic performance and financial structure. This process ends up with an unbalanced panel containing 16,541 observations as reported in the last column of Table 1.

Likewise, Italian firms' population, 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 account for a wide set of information at the firm level 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
- Group and local network memberships.

Furthermore, some local industry and regional characteristics are included in order to study spillover effects. Table A1 in the Appendix reports the full list of variables together with a brief description.

Descriptive statistics

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[6] 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).

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 previous contributions in the field, though, we emphasize that firm's decision to sell products abroad (extensive margin) and the degree of its foreign market penetration (intensive margin) are two distinct 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 i*nnovative inputs* and *outputs* variables. In terms of innovative inputs, we consider R&D expenditures normalized by the firm's total turnover.[7] 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: this dummy takes value 1 when the firm has introduced one or more innovations.
- Product innovation: this dummy takes value 1 when the firm has either introduced a new product on the market or radically changed an old one.
- Process innovation: this dummy takes value 1 when the firm has changed its production process.
- Organizational innovation: this dummy takes value 1 when the firm has changed its organizational pattern.

As shown in Table 3, 38% of firms have introduced at least one innovation in the previous wave (at time *t-2*). This share increases to 71% when the analysis is restricted to innovators, suggesting that such attitude is persistent through time. In terms of types of innovation, enterprises change their organization more often than they introduce new products on markets (23% with respect to 17%). We interpret this statistics 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, Greenaway and Kneller, 2007 and Bernard et al. 2012), 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

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[7] 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, so as to keep the observation.

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.

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

The learning efforts on how to compete in foreign markets are studied by including firms' experience through the past exporter status. Indeed, a significant relationship between past and current exporter statuses would imply that firms improve their knowledge on markets along with their permanence (see, for example, the cost function argument suggested by Clerides et al., 1998). However, unlike previous studies, we are interested both in international and in inter-regional trade past experiences. More specifically, we intend to test whether firm's current approach to the international environment is facilitated by past experience in national markets beyond regional borders.. We have computed a dummy variable taking the value of 1 when the firm has sold its products on national markets by exploiting MET information about firm's export markets. Thus, lagged values of this variable are used 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 split between 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. In fact, regional and sectoral descriptive statistics show a great degree of heterogeneity which could be produced by the influence of the local environment on firms' performances (see Tables 5 and 6). In other words, firms appear to adapt in accordance with their surroundings. Thus, we intend to test whether selected regional and local industry exogenous characteristics affect single enterprises export performance. In particular, three possible sources of spillover effects are considered.

The first one refers to the local industry degree of internationalization measured as the share of exporters belonging to the same sector and located within the same region of the enterprise under consideration (Export spillovers). Indeed, enterprises located in an environment showing a high degree of internationalization should be able to learn easily how to export by imitating their neighbours' routines. Thus, we expect this measure to be positively correlated with export performance.

To compute this index we take advantage of MET survey estimates. In order to keep out any information regarding the firm under consideration, the variable is computed as follows:

$$Export\ spillover_{itsr} = \begin{cases} \dfrac{\#\ exporters_{tsr}}{\#\ firms_{tsr}-1} & if\ i\ is\ not\ an\ exporter\ at\ t \\[2em] \dfrac{\#\ exporters_{tsr}-1}{\#firms_{tsr}-1} & if\ i\ is\ an\ exporter\ at\ t \end{cases}$$

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

The second and the third sources of spillover effects are represented by the private and public regional expenditures in R&D.[8] Indeed, both variables represent a proxy for the degree of dynamism of the local environment which may enhance the firm export performances.

Learning processes through networking phenomena are captured by two dummy variables. The first one takes the value of 1 whenever the enterprise belongs to a group of firms while the second one takes value 1 whenever the enterprise takes part in a local network. The term 'local network' is used to label any stable and persistent set of relations between the enterprise and other firms/institutions located in the same environment. Overall 14% of the sample firms belong to a group while 41% participate to a local network (see Table 3). While both variables are positively correlated with innovation activities, 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).

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.[9] 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 presence of entry sunk costs may hinder less productive firms from penetrating foreign markets.

Finally, Table 5 and 6 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.

Table 5 shows that Italy is divided into two systems also 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.

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[8] Both these variables have been extracted from the Italian National Institute of Statistics (ISTAT) website http://dati.istat.it/?lang=en&SubSessionId=dfeae74e-2bcf-420c-95fc-db8a012ec51c&themetreeid=-200.
[9] 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 provide the necessary components for the TFP estimation.

Table 6 suggest 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.

In the following sections, we test the relative importance of the industrial specialization at the regional level in affecting the decision process of firms to enter foreign markets and, once they are exporters, their ability to widen their market shares.

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:

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

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:

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

The model can be estimated by using both pooled or random effects specifications. Being a dynamic model we have to address the well-known initial conditions problem. This arises because the lagged dependent variable is correlated with the unobserved heterogeneity term, making the usual assumption on the exogeneity of the regressors no longer valid, which in turn, cause inconsistency of the estimators. 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 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 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 and to the estimators 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). As for the functional form, for robustness we estimate both logit and probit specifications.

Moreover, in all the estimated models to guard against possible simultaneity problems, all the explanatory variables are included with a two-year lag (previous wave of the MET survey).

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 counterparts. 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 more appropriate when the dependent variable is a share, as it is the case for the export intensity.

It is worth noting that the two-part models are very similar to the Zero-One Inflated Beta models (Buis, 2010; Ferrari and Cribari-Neto, 2004; Ospina and Ferrari, 2010; Paolino, 2001), which are based on the assumption that the variable of interest is the result of three different processes: one for the zero values; one for the unity values; and the third one for the values in-between, which being bounded in the interval (0,1) are supposed to follow a Beta distribution. However, in the case of exports and on the basis of firms'

behaviour, it is not reasonable to assume that the unity values follow a completely different process with respect to the other positive values. Therefore, we specify the two-part model by assuming for all the positive values either a linear model, which allows for comparisons with the Tobit II model, or a Beta model.[10]

As for the first part of the model, contrary to the Zero-Inflated Beta specification, we prefer to model the probability of observing a positive value, rather than a zero value.

In the next section, we discuss in detail the results obtained from the export propensity 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. Finally, we present a comprehensive set of results for the export intensity.

5. Results

5.1. Extensive margin model

Table 7 reports the estimates of the extensive margin models. In particular, columns (1)-(4) refer to pooled models, while columns (5) and (6) refer to panel random effects models controlling for unobserved heterogeneity at the firm level. In column (1) we report the linear probability model, which serves as a benchmark with respect to the non-linear counterparts. 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) and Wooldridge (2005) approach. All estimates include time, sector-specific and macro-regional fixed effects. Furthermore, column (3) shows the estimates of a pooled logit model employing total factor productivity (*TFP*) instead of value added per worker to measure the firm-level productivity.

For the main export determinants, in Table 8 we report the average marginal effects computed for the overall sample and by distinguishing between the sub-sample of past exporters and non past exporters.

Likewise previous contributions, firm's innovative activity positively affects its probability of exporting both via R&D investments and via innovative outputs. In particular, focusing on the pooled logit estimates, an enterprise which introduced an innovation in the previous period has, on average, a 1.5 percentage points greater probability of exporting in the current period with respect to the one referring to non-innovators (see Table 8). 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. Even though the nature of these 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 7.5 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 (thus to export decision) than innovative inputs. In a similar vein, Table 8 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

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[10] Beta models are estimated in Stata by using the *Betafit* code, written by Buis, Cox and Jenkins (2010), which can be downloaded from Martin L. Buis homepage, http://maartenbuis.nl/software/betafit.html. Since Betafit ignores the zero and unity values, we follow Smithson and Verkuilen (2006) and apply the Beta models to the export share variable (y) transformed according to the formula, y-transformed=(y*(NT-1)+0.5)/NT, where NT is the number of observations, so that the unity values become slightly smaller (in our case 0.9999698).

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.

When the innovation variable is broken down by type, it turns out that the 1.5 percentage point premium is mainly driven by product innovation. This is evident from the empirical models reported in Table 9, where innovation was included by considering its different types, product, process and organization.[11] 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.

In terms of learning processes, past international and inter-regional trade experiences are crucial in shaping firm's exporting strategy. Indeed, both variables show positive and significant coefficients even when firm-level effects are accounted in the random effects specifications (see the last two columns in Table 7). 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 35-47 percentage points (see Table 8). 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 Bugamelli and Infante did not include innovation variables among their set of regressors, this may have induced an upward bias in their estimate for the past export premium.

If we look at inter-regional exchanges instead, the export probability premium lowers considerably (5.3-5.5 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 (see Table 8). Firms 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 both the degree of local industry internationalisation and the total amount of private expenditure in R&D at the regional level. In other words a firm has a higher probability to sell its products abroad the larger the number of surrounding exporting enterprises as well as the greater the effort surrounding enterprises put in dynamic activities. On the contrary, regional public R&D expenditure negatively affects firm's incentive to export. However, the level of significance of this variable is almost always at 10%, so we can't conclude there is a strong evidence against these types of public interventions.

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[11] In table 9 we report results only for the Pooled Logit and the Random Effects Logit specifications; similar results were found for the Probit counterparts.

Finally, learning processes through network relationships seem not to play a significant role in enhancing the participation of Italian firms in foreign markets: in fact neither group nor local network memberships appear to exert statistically significant effects (see Table 7).

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 7) is always statistically significant at 1% level irrespective of the model specification and the proxy considered, value added per worker or total factor productivity. Furthermore, the export probability premium stemming from a marginal increase in productivity amounts on average to 4-5 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 with that computed among past non-exporters, 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.[12]

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.

Finally, 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.

5.2. Extensive and intensive margin models

In Table 10 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. We first consider the Tobit II model, which accounts for possible correlation

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[12] 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.

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 and it is thus expected to be relatively more robust (Cameron and Trivedi, 2005). The probit model for the selection process features the same specification as the pooled dynamic probit model presented in the previous section, whereas the linear model for the positive export shares includes the same set of explanatory variables, 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 (first column of Table 10), indicating that the propensity to export and the export share are negatively correlated, we also consider two-part models because they rely on less restrictive assumption with respect to the Tobit II model. Given that the selection part of the two-part models is represented by either the pooled dynamic logit or pooled dynamic probit model, whose results were presented in the previous section, in what follows we focus on the most salient results obtained for the export share part of the models. We recall that the latter is modelled according to either a linear or a Beta distribution-based specification.

Differently from the extensive margins' case, the innovative activity and the labour productivity do not seem to play any role in influencing export shares. As far as the latter is concerned, the estimated coefficient is positive but not significant at conventional levels. Conversely, R&D intensity turns out to be a significant determinant of export intensity, but only in the case of the linear specification. Age, on the contrary, turns out to be significant, exhibiting a negative coefficient, as it was the case for the export propensity, only when we consider the Beta model. The local network variable becomes significant in the export share models, its negative effect could be due to a regional orientation of the firms, which tend to reduce the intensity of their presence in the international markets. As in the case of the extensive margin models, leverage and regional public R&D exert a negative effect also on export intensity, whereas evidence based on all specifications points to a positive and significance effect of size and localized externalities, in the form of both export spillovers and regional private R&D.

In order 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 10 with the actual ones, E(share)=0.137, E(share| share>0)=0.349, we find that both the Tobit II-Heckman model and the two-part linear model outperform the two-part model based on the Beta distribution The latter turns out to overestimate both the unconditional and the conditional expected value. In terms of the conditional expected value the two-part linear model is closer to the observed value than the Tobit II model. Although the Beta specification was deemed to be more appropriate, given the bounded feature of the response variable, in the case of our sample it provided the worst performance.[13]

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, in particular for the Italian case, are not directly comparable with ours because the export share is modelled by means of a fractional probit model (Antonietti and Cainelli, 2011), which assumes that the zero and the unity values represent very low or very high proportions which are

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[13]A similar unexpected result on the poor performance of the Beta model was also found in Hoff (2007).

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 behaviour.

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.

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 help the enterprise 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.

Finally, 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 nonetheless 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 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.

References

Aitken, B., Hanson, G. H. and Harrison, A. E. (1997), Spillovers, foreign investment, and export behavior, Journal of International Economics, 43, 103-132.

Andersson, M. and Weiss, J.F. (2012), External trade and internal geography: Local export spillovers by industry characteristics and firm size, Spatial Economic Analysis, 7, 421-446.

Antonietti, R. and Cainelli, G. (2011), The role of spatial agglomeration in a structural model of innovation, productivity and export: a firm-level analysis, Annals of Regional Science, 46, 577-600.

Arellano, M. and Bond, S. (1991), Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, Review of Economic Studies, 58, 277-297.

Arulampalam, W. and Stewart, M.B. (2009), Simplified Implementation of the Heckman Estimator of the Dynamic Probit Model and a Comparison with Alternative Estimators, Oxford Bulletin of Economics and Statistics, 71, 659-681.

Aw, B.Y., Roberts, M.J. and Winston, T. (2007), Export Market Participation, Investments in R&D and Worker Training, and the Evolution of Firm Productivity, The World Economy, 30, 83-104.

Baldwin, R. (1989), Sunk Cost Hysteresis, NBER Working Paper No. 2911.

Barletta, F., Pereira, M. and Yoguel, G. (2014), Schumpeterian, keynesian, and endowment efficiency: some evidence on the export behavior of Argentinian manufacturing firms, Industrial and Corporate Change, 23, 797-826.

Basile, R. (2001), Export behaviour of Italian manufacturing firms over the nineties: the role of innovation, Research Policy, 30, 1185-1201.

Becchetti, L. and Rossi, S. (2000), The Positive Effect of Industrial District on the Export Performance of Italian Firms, Review of Industrial Organization, 16, 53-68.

Becker, S. and Egger, P. (2013), Endogenous product versus process innovation and a firm's propensity to export, Empirical Economics, 44, 329-354.

Bernard, A. B. and Jensen, J.B. (1995), Exporters, Jobs, and Wages in U.S. Manufacturing: 1976–1987, Brookings Papers on Economic Activity: Microeconomics, 67-119.

Bernard, A. and Jensen, J.B. (1999), Exceptional exporter performance: cause, effect, or both?, Journal of International Economics, 47, 1-25.

Bernard, A. and Jensen, J.B. (2004), Why some firms export?, Review of Economics and Statistics, 86, 561-569.

Bernard, A.B., Jensen, J.B. and Lawrence, R.Z. (1995), Exporters, jobs, and wages in us manufacturing: 1976-1987, Brookings Papers on Economic Activity. Microeconomics, 67-119.

Bernard A.B., Jensen J.B., Redding, S.J. and Schott, P.K. (2012), The Empirics of Firm Heterogeneity and International Trade, Annual Review of Economics, 4, 283-313.

Bonaccorsi, A. (1992), On the Relationship between Firm Size and Export Intensity, Journal of International Business Studies, 23, 605-635.

Brancati, R., Centra, M., Falorsi, P.D., Maresca, A. (2015), L'indagine MET: logica, conduzione e metodologia, in Brancati, R. (ed.), Le strategie per la crescita: Imprese, Mercati e Stato. Indagine MET 2015. Roma: Meridiana Libri.

Bratti, M. and Felice, G. (2012), Are exporters more likely to introduce product innovations? The World Economy, 35, 1559-1598.

Bugamelli, M. and Infante, L. (2003), Sunk Costs of Exports, Temi di discussione n. 469. Bank of Italy.

Buis, M.L. (2010), Stata tip 87: Interpretation of interactions in non-linear models, The Stata Journal 10, 305-308.

Buis, M.L., Cox, N.J. and Jenkins, S.P., Betafit code for Stata, http://maartenbuis.nl/software/betafit.html

Cameron, A.C. and Trivedi, P.K. (2005), Microeconometrics, Methods and Applications. Cambridge University Press: New York.

Cassiman, B. and Golovko, E. (2011), Innovation and internationalization through exports, Journal of International Business Studies, 42, 56-75.

Castellani, D. and Zanfei, A. (2007), Internationalisation, innovation and productivity: How do firms differ in Italy?, The World Economy, 30, 156-176.

Castellani, D., Serti F. and Tomasi, C. (2010), Firms in international trade: Importers' and exporters' heterogeneity in Italian manufacturing industry, The World Economy, 33, 424-457.

Chamberlain, G. (1982), Multivariate Regression Models for Panel Data, Journal of Econometrics, 18, 5-46.

Clerides, S. K., Lach, S. and Tybout, J.R. (1998), Is Learning By Exporting Important? Micro-Dynamic Evidence From Colombia, Mexico, And Morocco, The Quarterly Journal of Economics, 113, 903-947.

Cohen, W. and Levinthal, D. (1990), Absorptive capacity: a new perspective on learning and innovation, Administrative Science Quarterly, 99, 569-596.

Constantini, J. and Melitz, M.J. (2008), The Dynamics of Firm-Level Adjustment to Trade Liberalization. In The Organization of Firms in a Global Economy, Helpman, E., Marin, D. and Verdier, T. (eds), Harvard University Press: Cambridge MA, pages 107-141.

Damijan, J.P., Kostevc, C. and Polanec, S. (2010), From Innovation to Exporting or Vice versa, The World Economy, 33, 374-398.

Dixit, A. (1989), Entry and Exit Decisions Under Uncertainty, Journalof Political Economy, 97, 620-638.

Dosi, G.K., Pavitt, L. and Soete, L. (1990), The Economics of Technical Change and International Trade. Harvester Wheatsheaf: London.

Falvey, R., Greenaway, D., Yu, Z. and Gullstrand, J.(2004), Exports, Restructuring and Industry Productivity Growth, University of Nottingham, GEP Research Paper 2004/40.

Farole, T. and Winkler, D. (2014), Firm location and the determinants of exporting in low- and middle-income countries, Journal of Economic Geography, 14, 395-420.

Ferrari, S.L.P. and Cribari-Neto, F. (2004), Beta regression for modelling rates and proportions, Journal of Applied Statistics, 31, 799-815.

Giovannetti, G., Marvasi, E. and Sanfilippo, M. (2014), Supply Chains and the Internalization of SMEs: Evidence from Italy, RSCAS Working Papers 2014/62, European University Institute.

Greenaway, D. and Kneller, R. (2004), Exporting and Productivity in the United Kingdom, Oxford Review of Economic Policy, 20, 358-371.

Greenaway, D. and Kneller, R. (2007), Industry Differences in the Effect of Export Market Entry: Learning by Exporting? Review of World Economics, 143, 3, 416-32.

Harris, R. and Li, Q.C. (2012), Export-market dynamics and firm level productivity: evidence for UK tradable sectors, Industrial and Corporate Change, 21, 649-670.

Heckman, J.J. (1981), Heterogeneity and state dependence, in Rosen S. (ed.), Studies in Labor Markets, Chicago Press, Chicago, IL.

Hoff, A. (2007), Second stage DEA: comparison of approaches for modelling the DEA score, European Journal of Operational Research, 181, 425-435.

Koenig, P., Mayneris, F. and Poncet, S. (2010), Local export spillovers in France, European Economic Review, 54, 622-641.

Krugman, P.R. (1979), Increasing returns, monopolistic competition, and international trade, Journal of International Economics, 9, 469-479.

Krugman, P.R. (1992), Geography and Trade, MIT Press Cambridge, MA.

Levinsohn, J. and Petrin, A. (2003), Estimating production functions using inputs to control for unobservables, The Review of Economic Studies, 70, 317-341.

López-Bazo E. and Motellón E., (2013) Firm exports, innovation, … and regions, AQR Working Papers 201305, University of Barcelona.

Malerba, F. and Orsenigo, L. (1997), Technological regimes and sectoral patterns of innovative activities, Industrial and Corporate Change, 6, 83-117.

Malerba, F., Orsenigo, L. and Peretto, P. (1997), Persistence of Innovative Activities, Sectoral Patterns of Innovation and International Technological Specialization, International Journal of Industrial Organization, 15, 801-826.

Melitz, M.J. (2003),The impact of trade on intra-industry reallocations and aggregate industry productivity, Econometrica, 71, 1695-1725.

Mukim, M. (2012), Geography and exporting behavior: evidence from India, Policy Research Working Paper series 5979, The World Bank, February.

Mundlak, Y. (1978), On the pooling of time series and cross-section data, Econometrica, 46, 69-85.

Nassimbeni, G. (2001), Technology, innovation capacity, and the export attitude of small manufacturing firms: a logit/tobit model, Research Policy, 30, 245-262.

Nelson, R. and Winter, S.G. (1982), An Evolutionary Theory of Economic Change. Harvard University Press: Cambridge.

Orme, C.D. (1997), The initial conditions problem and two-step estimation in discrete panel data models, mimeo, University of Manchester.

Orme, C.D. (2001), Two-step inference in dynamic non-linear panel data models, mimeo, University of Manchester.

Ospina, R. and Ferrari, S.L.P. (2010), Inflated Beta Distribution, Statistical Papers, 51, 111-126.

Paolino, P. (2001), Maximum likelihood estimation of models with beta-distributed dependent variables, Political Analysis, 9, 325-346.

Penrose, E.T. (1959), The theory of the growth of the firm. Oxford University Press: Oxford.

Roberts, M.J. and Tybout, R.J. (1997),The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs, American Economic Review, 87, 545-564.

Rodríguez-Pose A., Tselios, V., Winkler, D. and Farole, T. (2013), Geography and the determinants of Firm Exports in Indonesia, World Development, 44, 225-240.

Roper, S. and Love, J.H. (2002), Innovation and export performance: evidence from the UK and German manufacturing plants, Research Policy, 31, 1087-1102.

Santarelli, E. and Sterlacchini, A. (1990), Innovation, formal vs informal R&D and firm size: some evidence from Italian manufacturing firms, Small Business Economics, 2, 223-228.

Smithson, M. and Verkuilen, J. (2006), A better lemon squeezer? Maximum likelihood regression with beta-distributed dependent variables, Psychological Methods, 11, 54-71.

Sterlacchini, A. (2000),The determinants of export performance: A firm level study in Italian manufacturing, Review of World Economics (WeltwirtschaftlichesArchiv), 137, 450-472.

Wagner, J. (2007), Exports and productivity: A survey of the evidence from firm-level data, The World Economy, 30, 60-82.

Wagner, J. (2012), International trade and firm performance: a survey of empirical studies since 2006, Review of World Economics, 148, 235-267.

Wagner, J. (2014), Credit constraints and exports: a survey of empirical studies using firm-level data, Industrial and Corporate Change, 23, 1477-1492.

Wakelin, K. (1998), Innovation and export behaviour at the firm level, Research Policy, 26, 829-841.

Wooldridge, J. (2005), Simple solutions to the initial conditions problem in dynamic, nonlinear panel data models with unobserved heterogeneity, Journal of Applied Econometrics, 20, 39-54.

Wooldridge J.M. (2010). Econometric Analysis of Cross Section and Panel Data. The MIT Press: Cambridge.

Yeaple, S.R. (2005), Firm Heterogeneity, International Trade and Wages, Journal of International Economics, 65, 1-20.

Table 1: Sample breakdown

Year	MET-firms	Two-period panel	Merge with
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

Note: Composition of the final sample both in terms of firm size class and in terms of firm geographical location. Size classes 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
Group	19%	39%	0%	100%	27%	44%	0%	100%
Local network	41%	49%	0%	100%	46%	50%	0%	100%

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

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
Group	26%	15%	32%	21%
Local network	39%	42%	42%	51%

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

Table 5: 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	Regional public R&D	Regional private R&D	Productivity va per worker	Productivity tfp	Employees	Age
North West	*3,397*	*50.5%*	*18.6%*	*40.7%*	*1.8%*	*47.6%*	*68.7%*	*20.2%*	*35.1%*	*110.8%*	*10.6*	*5.9*	*88.0*	*22.5*
Piemonte	1,277	49.8%	17.2%	43.2%	1.8%	47.9%	69.1%	19.8%	38.3%	144.5%	10.5	5.9	102.6	20.7
Valle D'Aosta	143	32.2%	10.5%	35.0%	0.6%	23.1%	39.2%	15.2%	14.9%	45.2%	10.8	5.3	23.0	19.8
Lombardia	1,563	53.7%	20.8%	39.8%	2.0%	52.0%	72.2%	20.7%	29.1%	98.0%	10.6	6.0	85.3	23.7
Liguria	414	46.4%	17.9%	38.6%	1.5%	38.6%	64.3%	20.7%	54.8%	78.1%	10.6	5.9	75.9	24.0
North East	*4,226*	*45.0%*	*16.7%*	*42.0%*	*1.5%*	*41.9%*	*63.1%*	*22.9%*	*46.9%*	*71.0%*	*10.6*	*5.9*	*76.1*	*21.6*
Trentino Alto Adige	629	42.3%	16.3%	36.6%	1.1%	37.0%	56.9%	17.1%	52.5%	64.8%	10.7	5.9	98.9	22.6
Veneto	1,910	45.0%	17.2%	44.5%	1.6%	42.1%	61.0%	22.7%	34.5%	61.1%	10.6	5.9	63.3	18.9
Friuli-Venezia Giulia	352	59.1%	23.4%	31.3%	0.8%	52.3%	71.9%	31.0%	63.2%	79.6%	10.6	5.9	113.1	22.4
Emilia Romagna	1,335	42.5%	14.4%	43.8%	1.8%	41.2%	66.5%	23.8%	57.7%	85.7%	10.6	5.9	74.1	24.9
Centre	*4,770*	*36.4%*	*12.7%*	*38.5%*	*1.3%*	*33.5%*	*59.5%*	*15.3%*	*79.3%*	*50.6%*	*10.7*	*5.8*	*62.3*	*17.8*
Toscana	1,563	42.8%	17.1%	42.2%	1.3%	40.8%	63.3%	17.1%	63.4%	51.0%	10.5	5.8	50.8	19.7
Umbria	506	32.8%	9.8%	40.7%	1.5%	29.6%	62.5%	17.5%	69.2%	23.0%	10.5	5.7	70.3	17.3
Marche	687	46.6%	16.5%	33.9%	1.4%	45.3%	67.0%	19.9%	36.0%	34.4%	10.5	5.7	51.6	18.2
Lazio	2,014	28.8%	8.7%	36.7%	1.2%	24.9%	53.2%	11.7%	109.0%	62.8%	10.9	5.9	72.9	16.5
South	*2,977*	*29.6%*	*8.5%*	*31.1%*	*1.0%*	*26.8%*	*53.6%*	*14.3%*	*56.8%*	*30.4%*	*10.5*	*5.4*	*54.3*	*16.1*
Abruzzo	247	44.9%	16.0%	33.6%	1.2%	41.7%	75.3%	15.9%	55.4%	40.0%	10.3	5.8	101.1	20.3
Molise	244	27.5%	6.6%	25.8%	0.9%	25.4%	48.8%	12.7%	42.4%	7.0%	10.6	5.3	18.8	15.2
Campania	1,059	30.1%	9.2%	28.5%	1.6%	27.6%	60.5%	16.7%	71.3%	55.2%	10.3	5.4	48.0	14.2
Puglia	568	39.3%	12.0%	43.0%	1.2%	34.3%	65.1%	10.2%	54.1%	23.9%	10.4	5.5	90.5	20.1
Basilicata	278	27.0%	6.4%	37.4%	0.4%	20.9%	41.4%	15.1%	51.6%	16.9%	10.9	5.4	34.8	16.3
Calabria	581	14.6%	2.6%	22.2%	0.3%	15.1%	28.4%	13.5%	42.3%	3.7%	10.8	5.1	34.9	14.4
Islands	*1,171*	*23.8%*	*6.2%*	*29.0%*	*1.0%*	*23.7%*	*39.9%*	*13.9%*	*60.2%*	*18.7%*	*10.7*	*5.4*	*40.0*	*16.8*
Sicilia	850	24.6%	6.8%	31.3%	1.0%	25.1%	39.5%	13.1%	60.5%	23.2%	10.8	5.4	40.5	16.9
Sardegna	321	21.8%	4.6%	23.1%	1.0%	20.2%	40.8%	15.9%	59.3%	6.9%	10.5	5.3	38.7	16.5

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

	Obs	export propensity	export share	Innovation	R&D intensity	export propensity	inter-regional exchanges	Export spillovers	Productivity va per worker	Productivity tfp	Employees	Age
		At time t					At time t-2					
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

Table 7: Export propensity models

	Linear Probability Model	Pooled Logit	Pooled Logit	Pooled Probit	Random Effects Logit model	Random Effects Probit model
Innovative efforts						
Innovation	0.013 **	0.110 **	0.096 *	0.063 **	0.129 **	0.072 **
	(0.007)	(0.048)	(0.052)	(0.027)	(0.056)	(0.031)
R&D intensity	0.001 **	0.009 **	0.009 **	0.005 **	0.011 **	0.006 **
	(0.0005)	(0.004)	(0.005)	(0.002)	(0.005)	(0.003)
Learning processes						
Past export	0.558 ***	2.312 ***	2.292 ***	1.393 ***	1.973 ***	1.175 ***
	(0.008)	(0.074)	(0.081)	(0.044)	(0.105)	(0.063)
Past inter-regional trade	0.055 ***	0.378 ***	0.382 ***	0.217 ***	0.440 ***	0.247 ***
	(0.007)	(0.048)	(0.052)	(0.027)	(0.057)	(0.032)
Export spillovers	0.001 ***	0.005 **	0.004 *	0.003 **	0.006 **	0.003 **
	(0.0003)	(0.002)	(0.002)	(0.001)	(0.003)	(0.001)
Regional public R&D	-0.025 **	-0.160 *	-0.244 ***	-0.090 *	-0.195 *	-0.109 *
	(0.011)	(0.084)	(0.092)	(0.047)	(0.102)	(0.057)
Regional private R&D	0.022 ***	0.174 ***	0.169 ***	0.100 ***	0.214 ***	0.120 ***
	(0.006)	(0.047)	(0.051)	(0.027)	(0.060)	(0.033)
Group	0.006	0.017	-0.014	0.012	0.022	0.014
	(0.008)	(0.060)	(0.065)	(0.033)	(0.072)	(0.040)
Local network	-0.007	-0.035	-0.031	-0.020	-0.051	-0.029
	(0.006)	(0.045)	(0.049)	(0.025)	(0.053)	(0.029)
Firm characteristics						
Productivity - va per worker	0.026 ***	0.196 ***		0.111 ***	0.236 ***	0.132 ***
	(0.003)	(0.023)		(0.013)	(0.028)	(0.015)
Productivity - tfp			0.131 ***			
			(0.020)			
Size	0.026 ***	0.174 ***	0.075 ***	0.100 ***	0.215 ***	0.121 ***
	(0.002)	(0.018)	(0.019)	(0.010)	(0.025)	(0.014)
Age	-0.004	-0.856 ***	-0.947 ***	-0.466 ***	-0.956 ***	-0.528 ***
	(0.004)	(0.211)	(0.227)	(0.119)	(0.245)	(0.137)
Leverage	-0.007 ***	-0.045 **	-0.013	-0.024 **	-0.055 **	-0.029 **
	(0.003)	(0.022)	(0.024)	(0.012)	(0.026)	(0.014)
Constant	-0.186 ***	-4.452 ***	-3.035 ***	-2.590 ***	-5.301 ***	-3.001 ***
	(0.039)	(0.307)	(0.214)	(0.172)	(0.401)	(0.221)
Log-likelihood	-6,978.51	-7,177.59	-6,064.56	-7,168.49	-7,159.15	-7,153.27
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 parenthesis.

Table 8: Selected average marginal effects

	Linear Probability Model	Pooled Logit	Pooled Probit	Random Effects Logit model	Random Effects Probit model
Innovation	0.0133	0.0149	0.0153	0.0153	0.0157
Innovation - non past exporters	0.0133	0.0140	0.0145	0.0140	0.0145
Innovation - past exporters	0.0133	0.0164	0.0166	0.0176	0.0176
R&D intensity	0.0024	0.0021	0.0021	0.0022	0.0023
R&D intensity - non past exporters	0.0024	0.0021	0.0021	0.0021	0.0022
R&D intensity - past exporters	0.0024	0.0022	0.0022	0.0023	0.0024
Past export	0.5585	0.4654	0.4696	0.3527	0.3647
Past inter-regio trade	0.0551	0.0529	0.0539	0.0537	0.0555
Past inter-regio trade - non past exporters	0.0551	0.0482	0.0500	0.0472	0.0499
Past inter-regio trade - past exporters	0.0551	0.0610	0.0607	0.0651	0.0651
Productivity	0.0446	0.0469	0.0472	0.0497	0.0508
Productivity - non past exporters	0.0446	0.0501	0.0500	0.0531	0.0539
Productivity - past exporters	0.0446	0.0414	0.0423	0.0439	0.0454

Note: The effects for R&D intensity and Productivity (va per worker) are computed for one standard deviation change with respect to the mean value. Non past exporters: 10476 observations; Exporters: 6065 observations.

Table 9: Export propensity models by innovation type

	Pooled Logit			Random Effects Logit model		
	Product	**Process**	**Organization**	**Product**	**Process**	**Organization**
Innovative efforts						
Innovation by type	0.153 **	0.054	0.051	0.173 **	0.063	0.061
	(0.064)	(0.058)	(0.053)	(0.072)	(0.067)	(0.062)
R&D intensity	0.008 **	0.010 **	0.011 **	0.010 **	0.012 **	0.013 **
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Learning processes						
Past export	2.313 ***	2.319 ***	2.320 ***	1.974 ***	1.979 ***	1.980 ***
	(0.074)	(0.074)	(0.074)	(0.105)	(0.105)	(0.105)
Past inter-regional trade	0.380 ***	0.378 ***	0.377 ***	0.442 ***	0.439 ***	0.439 ***
	(0.048)	(0.048)	(0.048)	(0.057)	(0.057)	(0.057)
Export spillovers	0.005 **	0.005 **	0.005 **	0.006 **	0.006 **	0.006 **
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Regional public R&D	-0.157 *	-0.161 *	-0.161 *	-0.191 *	-0.195 *	-0.195 *
	(0.084)	(0.084)	(0.084)	(0.102)	(0.102)	(0.102)
Regional private R&D	0.173 ***	0.173 ***	0.173 ***	0.212 ***	0.213 ***	0.212 ***
	(0.047)	(0.047)	(0.047)	(0.060)	(0.060)	(0.060)
Group	0.021	0.020	0.019	0.026	0.025	0.024
	(0.060)	(0.060)	(0.060)	(0.072)	(0.072)	(0.072)
Local network	-0.030	-0.026	-0.027	-0.044	-0.039	-0.040
	(0.045)	(0.045)	(0.045)	(0.053)	(0.053)	(0.053)
Firm characteristics						
Productivity - va per worker	0.197 ***	0.197 ***	0.197 ***	0.237 ***	0.237 ***	0.237 ***
	(0.023)	(0.023)	(0.023)	(0.028)	(0.028) *a*	(0.028)
Size	0.176 ***	0.176 ***	0.175 ***	0.217 ***	0.217 ***	0.216 ***
	(0.018)	(0.018)	(0.018)	(0.025)	(0.025)	(0.025)
Age	-0.847 ***	-0.849 ***	-0.846 ***	-0.945 ***	-0.947 ***	-0.943 ***
	(0.211)	(0.211)	(0.211)	(0.245)	(0.245)	(0.245)
Leverage	-0.046 **	-0.045 **	-0.046 **	-0.056 **	-0.055 **	-0.055 **
	(0.022)	(0.022)	(0.022)	(0.026)	(0.026)	(0.026)
Constant	-4.464 ***	-4.414 ***	-4.409 ***	-5.307 ***	-5.255 ***	-5.250 ***
	(0.307)	(0.306)	(0.307)	(0.401)	(0.400)	(0.400)
Log-likelihood	-7,177.16	-7,179.77	-7,179.75	-7,158.86	-7,161.33	-7,161.29
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. All models contain the terms required to account for initial conditions and for the endogeneity of the lagged dependent variable. Clustered Standard Errors in parenthesis.

Table 10: Export intensity

Pooled models	Tobit II model - two steps Selection Probit	Tobit II model - two steps Share Linear	Two-part model Selection Logit	Two-part model Share Linear	Two-part model Selection Probit	Two-part model Share Linear	Two-part model Selection Logit	Two-part model Share Beta	Two-part model Selection Probit	Two-part model Share Beta
Innovative efforts										
Innovation	0.063 **	-0.003	0.110 **	-0.001	0.063 **	-0.001	0.110 **	-0.027	0.063 **	-0.027
	(0.027)	(0.007)	(0.048)	(0.008)	(0.027)	(0.008)	(0.048)	(0.039)	(0.027)	(0.039)
R&D intensity	0.005 **	0.001 *	0.009 **	0.001 **	0.005 **	0.001 **	0.009 **	-0.0001	0.005 **	-0.0001
	(0.002)	(0.0005)	(0.004)	(0.0005)	(0.002)	(0.0005)	(0.004)	(0.003)	(0.002)	(0.003)
Learning processes										
Past export	1.393 ***		2.312 ***		1.393 ***		2.312 ***		1.393 ***	
	(0.043)		(0.074)		(0.044)		(0.074)		(0.044)	
Past inter-regional trade	0.217 ***		0.378 ***		0.217 ***		0.378 ***		0.217 ***	
	(0.027)		(0.048)		(0.027)		(0.048)		(0.027)	
Export spillovers	0.003 **	0.001 ***	0.005 **	0.002 ***	0.003 **	0.002 ***	0.005 **	0.005 ***	0.003 **	0.005 ***
	(0.001)	(0.0003)	(0.002)	(0.0003)	(0.001)	(0.0003)	(0.002)	(0.001)	(0.001)	(0.001)
Regional public R&D	-0.090 *	-0.031 **	-0.160 *	-0.036 **	-0.090 *	-0.036 **	-0.160 *	-0.197	-0.090 *	-0.197
	(0.047)	(0.013)	(0.084)	(0.015)	(0.047)	(0.015)	(0.084)	(0.130)	(0.047)	(0.130)
Regional private R&D	0.100 ***	0.022 **	0.174 ***	0.025 ***	0.100 ***	0.025 ***	0.174 ***	-0.176	0.100 ***	-0.176
	(0.028)	(0.009)	(0.047)	(0.009)	(0.027)	(0.009)	(0.047)	(0.115)	(0.027)	(0.115)
Group	0.012	0.012	0.017	0.013	0.012	0.013	0.017	0.007	0.012	0.007
	(0.033)	(0.008)	(0.060)	(0.010)	(0.033)	(0.010)	(0.060)	(0.050)	(0.033)	(0.050)
Local network	-0.020	-0.022 ***	-0.035	-0.023 ***	-0.020	-0.023 ***	-0.035	-0.111 ***	-0.020	-0.111 ***
	(0.025)	(0.007)	(0.045)	(0.008)	(0.025)	(0.008)	(0.045)	(0.038)	(0.025)	(0.038)
Firm characteristics										
Productivity - va per worker	0.111 ***	0.004	0.196 ***	0.006	0.111 ***	0.006	0.196 ***	0.015	0.111 ***	0.015
	(0.012)	(0.004)	(0.023)	(0.004)	(0.013)	(0.004)	(0.023)	(0.021)	(0.013)	(0.021)
Size	0.100 ***	0.022 ***	0.174 ***	0.026 ***	0.100 ***	0.026 ***	0.174 ***	0.075 ***	0.100 ***	0.075 ***
	(0.011)	(0.003)	(0.018)	(0.003)	(0.010)	(0.003)	(0.018)	(0.019)	(0.010)	(0.019)
Age	-0.466 ***	-0.006	-0.856 ***	-0.008	-0.466 ***	-0.008	-0.856 ***	-0.076 **	-0.466 ***	-0.076 **
	(0.120)	(0.005)	(0.211)	(0.006)	(0.119)	(0.006)	(0.211)	(0.031)	(0.119)	(0.031)
Leverage	-0.024 **	-0.010 ***	-0.045 **	-0.011 ***	-0.024 **	-0.011 ***	-0.045 **	-0.042 **	-0.024 **	-0.042 **
	(0.012)	(0.003)	(0.022)	(0.004)	(0.012)	(0.004)	(0.022)	(0.021)	(0.012)	(0.021)
Constant	-2.590 ***	0.269 ***	-4.452 ***	0.214 ***	-2.590 ***	0.214 ***	-4.452 ***	-0.405	-2.590 ***	-0.405
	(0.172)	(0.050)	(0.307)	(0.055)	(0.172)	(0.055)	(0.307)	(0.288)	(0.172)	(0.288)
Lambda Mills	-0.039 ***									
	(0.007)									
Implied *rho*	-0.149									
E(share|X, Z)		0.137		0.137		0.137		0.169		0.169
E(share|X, Z, share>0)		0.306		0.321		0.321		0.429		0.429

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 models.

Variable name		Definition	Source
International and interregional trade			
export propensity	export_D	dummy = 1 if the firm sells at least part of its products/services abroad	MET database
export share	export_share	share of revenues stemming from export activities	MET database
inter-regional trade propensity	nation_D	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	inn_all	dummy = 1 if the firm has introduced one or more innovations	MET database
Innovation - main product	prod_inn_p	dummy = 1 if the firm has either introduced a new product on the market or radically changed an old one	MET database
Innovation - process	proc_inn	dummy=1 if the firm has changed its production process	MET database
Innovation - organization	org_inn	dummy=1 if the firm has changed the organisation of its activity	MET database
R&D intensity	R&D intensity	natuarl logarithm of the R&D expenditure at time t, normalised by total turnover at time t	MET database
R&D dummy	R&D dummy	dummy=1 if the firm carries out R&D activity	MET database
Productivity measures			
Productivity - va per worker	lvaemp	natural logarithm of the Value Added per employee at time t	MET database, CRIBIS D&B
Productivity - tfp	ln_tfp	natural logarithm of the firm's Total Factor Productivity	CRIBIS D&B
Financial and structural chacteristics			
Leverage	ln_leverage	natural logarithm of the financial leverage of the firm	CRIBIS D&B
Age	ln_age	natural logarithm of the age of the firm computed as the difference between time t and the date of its establishment	MET database
Employees	Size (emp)	number of employees	MET database
Group	Group	dummy=1 if the firm belongs to a group of enterprises at time t	MET database
Local network	Local network	dummy=1 if the firm belongs to a local network of firms at time t	MET database
Regional and sectoral exogenous factors			
Export spillovers	export_s_g_d	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	ln_rd_pub_gdp	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	ln_rd_priv_gdp	natural logarithm of the private expenditure in R&D at the regional level, normalised by the regional GDP at time t	ISTAT