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INNOVATION ACTIVITIES AND LEARNING PROCESSES IN THE CRISIS. EVIDENCE FROM ITALIAN EXPORT IN MANUFACTURING AND SERVICES

Raffaele BRANCATI[1], Emanuela MARROCU[2], Manuel ROMAGNOLI[3], Stefano USAI[4]

SOMMARIO

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 from some regional and local industry characteristics is important both in terms of extensive and in terms of intensive performances on foreign markets.

[1] MET Economia, via Sabotino 2A, 00195 Roma, r.brancati@met-economia.it.
[2] Dipartimento di Scienze Economiche e Aziendali e CRENoS, Università di Cagliari, Via S. Ignazio, 78, 09124 Cagliari, e-mail: emarrocu @unica.it (corresponding author).
[3] MET Economia, via Sabotino 2A, 00195 Roma, e-mail: m.romagnoli @met-economia.it.
[4] Dipartimento di Scienze Economiche e Aziendali e CRENoS, Università di Cagliari, Via S. Ignazio, 78, 09124 Cagliari, e-mail: stefanousai @unica.it.

1. Introduzione

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 focus on heterogeneous firms rather than countries or sectors is a novelty in studies of international trade which dates back twenty years (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).

This paper contributes to this recent and still-growing research avenue by investigating firm export performance in Italy in recent years. We aim at investigating how much such a performance - in terms of participation and intensity - depends on internal firm determinants or on external factors. The former relate mainly to firms characteristics, namely their experience and innovative activity. A special emphasis is given to past successes of firms in terms of their ability to export both internationally (a common feature of empirical models since the pioneering contribution by Bernard and Jensen, 1999) and inter-regionally. The possibility to measure the importance of selling products across regional borders is a specific novelty made possible by the use of a new database, built by MET-Economia, which collects this type of information. Moreover, following previous contributions, we assess how the decision to export is driven by past success of firms in gaining a productivity premium or in investing and introducing an innovation, of different types: product, process and organisational.

Finally, we also address the role played by firm's location in affecting its decision to export and its relative performance in foreign markets., 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.

The main original contribution of this paper with respect to previous analysis on the Italian case (Sterlacchini, 2000, Becchetti e Rossi, (2001), Basile, 2001, Nassinbeni, 2001, Castellani and Zanfei, 2007, Castellani et al., 2010, Antonietti and Cainelli, 2011) rests on the use of the original database by MET-Economia. This database allows us to follow the recent original contribution by Harris and Li (2014) on UK who provide the first analysis for the whole tradable economy, including not only manufacturing but also services. Moreover, we are able to assess the importance of firms' past success not only in terms of productivity, innovation activity and international export but also in terms of ability to extend their market beyond regional boundaries. Finally, we test the robustness of our results with a comprehensive econometric analysis. To model the extensive margin we consider dynamic probability models by thoroughly tackling the often neglected issues related to endogeneity of the lagged dependent variable and to the initial conditions problem The firms' intensive margin is modelled by means of either the Tobit II-Heckman model or the two-part models. All methods have pros and cons, but results show a remarkable robustness across models.

The paper is structured as follows. The second section 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

1. 1. 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 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 etc. The literature unanimously recognizes that the pioneering paper is due to Melitz (2003), who builds a dynamic industry model with heterogeneous firms[5] 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[6].

However, differences in firms' level of efficiency are rationalized only when the link between exports and innovation is accounted for, as in Costantini and Melitz (2008), where openness to trade increases R&D returns and, therefore, creates incentives for firms' R&D investments. Aw et al. (2008) developed and systematized these relationships in a dynamic model where R&D investments, through their effect on 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)[7].

Another important dynamic element, which may lead to cumulative effects, is produced by learning by exporting. 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 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 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 this perspective, firms capabilities and their export performance, depends 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).

[5] This heterogeneity is not explained within the model. A key theoretical contribution, which tries after several works 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 (Elliot, 2014).

[6] 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)

[7] 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.

In conclusion, all theories emphasize 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, modeled and shaped by innovation activity, learning effects and industrial and regional spillovers.

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 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 test in order to assess the validity of the model also during the great crisis and to verify the relevance of specific variables.

Moreover, if we consider the industrial dimensional structure of Italian exporters, and the contribution of micro an small enterprises, we have also to analyze the persistence of sunk costs and other constraints for the presence of this kind of firms in the international markets. Recent years can show radical changes with respect to this phenomena.

1.2 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 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%.

Sunk entry costs may also be influenced by productivity, for only the more productive and profitable firms are able to incur large fixed costs when entering export markets. More generally, productivity has an important role in firm export propensity and export intensity and a number of studies provide evidence in support of this hypothesis (Aw et al., 2000; Bernard & Jensen, 1999; Greenaway & Kneller, 2004).

In addition to sunk entry costs, empirical literature have 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 favor of a positive effect on trade due to R&D expenditure and to product innovation, whilst process innovation seems to play a marginal role (Sterlacchini, 2000, Basile, 2001, Roper and Love, 2002, Cassiman et al. 2011; Becker and Egger, 2013). In the literature, there are also studies which find evidence of the reverse relation with a positive effect of a firm's export status on innovation (Damijan et al., 2010 and Bratti and Felice, 2012). All in all, these findings suggest that the causality link between productivity and export is strictly related to innovation activities, both measured in terms of input (R&D activities) and output (mainly product innovation).

Another important endogenous 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 in 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 (Krugman, 1993). 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 specialization 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 the Sweden, Koenig et al. (2010) for France, Greenaway and Kneller (2004) for UK, Lopez-Baso and Motellon (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, Becchetti e Rossi, (2001) 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.

The export performance of Italian firms has been investigated in many other contributions starting from Bonaccorsi (1992), who focuses on the importance of firm size, finding mixed results. Other contributions are Basile (2001), Sterlacchini (2000), Nassinbeni (2001), Castellani and Zanfei (2007), Castellani et al. (2010). More recent papers are Giovannetti et al. (2014) and Brancati et al. (2015), which make use of the same database analysed in this paper and Accetturo et al. (2011) and Costa and Lucchetti (2014), who investigate on Italian exporting firms' ability to face the latest financial and economic crisis.

3. Data and descriptive statistics

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

3.1 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 has been 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 geographical

region.[8] 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 dimension. 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 and its leverage
- Export performance both on foreign and on interregional 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.

3.2 Descriptive statistics

The main task of this paper is to study how innovative activity and learning processes have shaped Italian firms export performances during the period 2007-2013.

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 interrelated 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

[8] 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, Centra, Falorsi, Maresca (2015).

revenues. Non-exporting firms are considered as obtaining 0% of their revenues from international markets. Overall, exporters account for 39% of the sample amounting to 6,510 observations, with an average export revenue share equal to 13.7% (see Table 3).

Innovation activity is proxied by both innovative inputs and outputs variables. In terms of innovative inputs we consider R&D expenditures normalized by the firm's total turnover.[9] 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've 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 (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 the 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.

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.[10] Contrary to the value added per employee index, TFP has been 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

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, regardless of the proxy under consideration (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.

[9] In case the firm didn't undertake R&D investments in t-2, we impose an R&D expenditure very close to 0, and well below 1%, so as to be able not to lose the observation.

[10] Tfp has been estimated through the Levinsohn and Petrin (2003) technique by implementing the *levpet* STATA command.

Finally, firm's learning ability is accounted for by means of three different channels. The first one refers to the ability of enterprises to learn from their own past export experiences; 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 interregional trade past experiences. As a matter of fact we want to test whether enterprises approach the international environment through an intermediate step represented by national markets beyond regional borders. A positive correlation between past interregional trade experiences and current export performance could be explained through the presence of an domestic learning behavior. To this extent, we have computed a dummy variable taking value 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 a potential phenomenon of 'step-by-step-learning-to-export'.

As Table 3 reports, less than 40% of enterprises were exporters in the previous wave (t-2), 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 behaviors: 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. In terms of the inter-regional trade propensity, past exporters' shares among current exporters and non-exporters are closer, but still strongly in favor of a learning-from experience behaviors (see Table 4).

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 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 correlated both with defensive and aggressive strategies.

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, as in Krugman (1993), we want to test whether selected regional and local industry exogenous characteristics affect single enterprises export performance. In particular, three phenomena able to generate spillover effects are accounted for.

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 neighbors' 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:

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

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

The second and the third sources of spillover effects we are interest in are represented by the private and public regional expenditures in R&D.[11] Indeed, both variables represent a sort of 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 value 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).

4. Methodological issues and estimation strategy

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

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

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

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

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

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 (1984) and Wooldridge (2005, 2010), which, in nonlinear dynamic models, entails modelling the unobserved effect as a function of

[11] 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 .

the within mean of the exogenous variables included in the model and the initial value of the dependent variable:

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

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 emphasizing that previous works that have analyzed 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 favor 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.[12]

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 success, in both the international and external markets, local externalities and network relationships. Finally, we present a comprehensive set of results for 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. 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-Wooldridge (1978, 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.

Likewise previous contributions, firm's innovative activity positively affects its probability of exporting both via R&D investments and via innovative outputs. In particular, an enterprise which introduced an innovation in the previous period has, on average, a 1.5 percentage points greater probability of exporting at time t 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 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 (see Table 9). As a matter of fact, despite being always positive, process and organisational innovations' coefficients are never statistically significant. As highlighted before, the organisational innovation result may be interpreted as an outcome of two contrasting firms' strategies. As mentioned before, during the crisis, organisational innovations may have been part of either pro-active strategies positively correlated with export activities or defensive strategies 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.

[12]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).

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 enterprises attenuate informal barriers to international trade by carrying out export activities.

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).If we look at inter-regional exporters instead, this probability premium lowers considerably (5.3-5.5 percentage points). 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' subsample 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.

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

Among the other covariates, productivity is confirmed as playing a very important role (see Table 7). Its coefficients are always statistically significant at 1% level irrespective of the model specification. Furthermore, the export probability premium stemming from a marginal increase in productivity amounts on average to 4-5 percentage points. However, it is possible to argue that this very high level of significance partly follows from the strict correlation occurring between productivity and firm's innovation activity. As a matter of fact, R&D investments and product innovation may affect firm's decision to export by improving efficiency levels, thus by increasing its productivity. This would also explain the partial loss of significance (from 5% to 10%) experienced by the innovation dummy coefficient when value added per employee is substituted by the TFP (see Table 7).

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.

Firm size has a significant and positive impact on the export probability: the larger the firm, the higher its ability in burdening internationalisation costs. Similarly, 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.

Finally, according to our estimates the older the enterprise the smaller its chances to sell products abroad. 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.[13]

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 selection and positives processes. We first consider the Tobit II model, which accounts for possible correlation between the two processes. We report results for the two-step Heckman specification of the Tobit II model which, differently from the standard Tobit II model, is based on a univariate normality assumption 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.[14]

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

[13]We also checked for turning points in the age coefficients by introducing age squared values. However, the interaction term coefficient is never significant.

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

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 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

This paper tries to contribute to the rich tradition of studies on heterogeneous firms with an investigation on export performance in Italy in recent years. The contribution's originality rests on the special characteristics of the database which allows a specific emphasis on past experience in export, with the crucial distinction between international and intra-national markets, innovation and local industrial spillovers.

This paper confirms most previous results but offers also some interesting original outcomes.

First al all, we find out that probability of exporting and the intensity of the export depend on some specific features internal to firms: productivity, size and age have all the expected positive and significant impact while leverage has a negative and significant effects. Moreover, firm export performance depends significantly on its innovative activity: more in terms of output (innovativeness) that in terms of input (R&D expenditure). As far as the former aspect, product innovation always proves significantly correlated to export whilst process and organization innovation are never significant.

There is quite an important persistence in exporting in international markets. Past experience in international markets account for the larger share of probability of exporting. We also find that past successes in intra-national markets may also be an important boost for exporting activity today. Moreover we find that the effect of past experience in international markets may determine a different impact of productivity: if a firm is not an exporter the impact of productivity is a more crucial element for becoming an exporter.

As in latest contribution on spillover effects, there is also a role for some specific regional/sectoral effects due to previous experience of export which go beyond the catch-all influence of dummy variables. We find evidence of a local specialisation effect of exporting activity. Moreover we find that private R&D has a positive and significant effect whilst public R&D has a negative even though not significant impact

Finally, we have found that, once sunk costs are taken aside, and we focus on the determinants of the intensity of export, results are significantly different. First of all, innovation and R&D are no longer significant, nor is productivity. Other firms' features such as leverage, size and age are, on the contrary, still very important. Most importantly regional/sectoral effects have still a positive impact.

This contribution has still some potential issues to be explored. In particular, in future extensions of this very preliminary version we would like to explore the role of geographical position with different accessibility indicators and the performance of firms before and during the crisis.

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TABLES

Table A - Appendix

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

Table 1: Sample breakdown

	MET-firms	Two-period panel	Merge with CRIBIS
2007	24894		
2009	22340	11549	6016
2011	25090	13901	5797
2013	25000	10537	4728
TOTAL	*97324*	*35987*	*16541*

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**
export propensity	39%	0.49	0%	100%	54%	0.50	0%	100%
export share (%)	13.7	23.97	0	100	19.4	26.94	0	100
At t-2								
export propensity	37%	0.48	0%	100%	47%	0.50	0%	100%
inter-regional trade propensity	60%	0.49	0%	100%	66%	0.47	0%	100%
Innovation - all types	38%	0.49	0%	100%	71%	0.45	0%	100%
Innovation - main product	17%	0.37	0%	100%	32%	0.47	0%	100%
Innovation - process	19%	0.39	0%	100%	37%	0.48	0%	100%
Innovation - organization	23%	0.42	0%	100%	44%	0.50	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%	0.35	0%	100%	24%	0.43	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%	0.39	0%	100%	27%	0.44	0%	100%
Local network	41%	0.49	0%	100%	46%	0.50	0%	100%

Note: See Appendix for definitions of variables

Table 4: Exporters and non-exporters characteristics

	All firms		Innovators	
	Exporters	**Non exporters**	**Exporters**	**Non exporters**
# of obs	6,510	10,031	2,715	2,352
export share (%)	34.9	-	36.2	-
At 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

Table 5: The main variables across Italian regions and macroregions

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

Note: See Appendix for definitions of variables

Table 6: The main variables across productive sectors

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

Note: See Appendix for definitions of variables

Table 7: Export propensity models

	Linear Probability Model	Pooled Logit	Pooled Logit	Pooled Probit	Random Effects Logit model	Random Effects Probit model
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)*
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)*
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)			
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)*
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)*
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)*
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)*
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
Past export	0.5585	0.4654	0.4696	0.3527	0.3647
Past inter-reg trade	0.0551	0.0529	0.0539	0.0537	0.0555
Past inter-reg trade - non past exporters	0.0551	0.0482	0.0500	0.0472	0.0499
Past inter-reg trade - past exporters	0.0551	0.0610	0.0607	0.0651	0.0651
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
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**
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)*
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)*
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)*	*(0.028)*
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)*
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)*
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)*
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)*
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

	Tobit II model - two steps		Two-part model		Two-part model		Two-part model		Two-part model	
	Selection	*Share*	*Selection*	*Share*	*Selection*	*Share*	*Selection*	*Share*	*Selection*	*Share*
Pooled models	**Probit**	**Linear**	**Logit**	**Linear**	**Probit**	**Linear**	**Logit**	**Beta**	**Probit**	**Beta**
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)*	
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)*
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)*
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)*
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)*
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)*
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)*
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.