FIRMS' HETEROGENEITY AND NUMBER OF EXPORT DESTINATIONS: A HURDLE NEGATIVE BINOMIAL REGRESSION APPROACH

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Abstract

Most of the literature on the link between firm's participation in international markets and firms' heterogeneity focuses on the choice of firms to export. This paper addresses on an aspect of firms internationalization so far little explored, the choice of the number of export destinations that can be considered as an indicator of the complexity of the export activity. As the outcome variables are a count with an excess of zeros, we operate in a hurdle regression model for count data framework. Besides the variables usually adopted in literature describing firms' heterogeneity, in order to explore the link among the firms efficiency in generating profits and the firms internationalization choices, we consider a set of profitability indexes. Results we obtain enlighten that the set of the variables related to the decision of exporting and that connected with the number international markets served is different. At first, it seems that not only the larger the number of markets served, the more productive, large and willing to invest is the firm (confirming the features found studying the propensity to export), but also that firms engaged in multiple markets seem to be older, financially stable, and willing to support organizational and managerial innovations.
By comparing the estimates regarding the propensity to export model and those of the model describing the number of export destinations, some main differences arise. At first the Return on Sales index become significant in the number of destinations model whereas this covariate was not relevant in explaining the propensity to export: it seems that the firms, the more opened to the international markets, are characterized by a better use of investment funds to generate earnings growth. Secondly, in the count model significance has been found for only one type of innovation, the managerial one, indicating that, although the innovation activity seems to be pivotal for exporting, once the firm exports, the change in the managerial and organizational structure become important to align to the more competitive market.

Key words: firms' internationalization, count data models, excess of zeros

JEL classification C2, F13, F23, L2

1. Introduction and brief review of the literature

Starting from the pioneering work of Bernard and Jensen (1995), the study of firm's internationalization choices is inextricably linked to the study of the firm heterogeneity. In the last fifteen years, in the attempt to understand the factors that differentiate the internationally involved firms from firms operating in the domestic markets, the research has taken many theoretical and empirical directions and a vast literature has highlighted the features of firms that successfully compete in the international market. In this framework, the relationships between the characteristics of the firm, such as productivity, size, and research and development (hereinafter R&D) activity, and its different choices about internationalization has been deepened. Exporters have been identified as larger, with a significantly better performance, offering higher wages, and having higher labor productivity with respect to domestic firms. For a detailed review of the literature on this subject see Greenway and Kneller (2007) and Wagner (2007).

The aim of the present study is to address an aspect of firms' internationalization that so far has been little explored, the choice of the number of export destinations. Following Barba Navaretti *et al.* (2010) the number of export destinations can be considered as an indicator of the complexity of the export activity. At the best of our knowledge, up to now while the relationship between productivity and export decision has been extensively investigated, much still remains to be said about the connection between firms' characteristics and the firm's decision regarding the number of countries to serve.

By operating in a macro-perspective, Eaton *et al*. (2004), with reference to France, highlight that the biggest part of exporting firms serve only few countries. Similarly, Mayer and Ottaviano (2008) observe that the number of exporters dramatically reduce with the increase in the number of markets served. Analogous results were obtained by Bernard *et al*. (2007) and by Castellani *et al*. (2010). Muuls and Pisu (2007) refer to Belgium and found a positive relationship that links the labor productivity with geographic and product diversification. Besides they observe that the productivity of exporters is increasing in the number of products and markets to which firms export. In summary, there is a high concentration in the international market since just a small share of firms serve many markets with many products but these firms account for a large share of total export value.

In general, the mentioned papers mainly provide aggregated descriptive statistics, while little has been done yet in the estimation of models that analyze the relationship between dimensions defining firm's heterogeneity and number of destination served.

Recently Barba Navaretti *et al*. (2010) in the report of the EFIGE project (European Firms in a Global Economy) funded by the European Commission, observe that with reference to different European countries only a small share of firms export to more than 20 markets. These authors, by estimating a linear regression model that links the various dimension of the firms' heterogeneity and the number of markets served provided a first approach to the study of this aspect in a micro-econometric perspective. Another contribution in this framework has been provided by Curzi and Olper (2010), who have studied the relationship between productivity and export intensity to low or high income destinations. They found that firms producing higher quality goods serve more foreign markets, in other words, that firms selling to a large number of destinations produce higher-quality products. At the end, Andersson *et al.* (2008) found that export premium for labor productivity is increasing in the number of countries which firms export to.

The contribution of this study lies in analyzing the connection between firms' heterogeneity and firms' decision regarding the number of countries to serve, in an appropriate micro-econometric framework. We refer to the Italian context. Since the number of export destination is defined on a discrete and non-negative support, we adopt a count data

regression model. The standard linear regression approach (and the OLS estimation method) does not take into account that the support of the outcome variable is limited to non-negative values, and then, unless the mean of the counts is particularly high, it leads to significant deficiency of the estimators. The linear regression approach is based on the assumption that the dependent variable is continuous, assumes a symmetrical Normal distribution of residuals, relies on the homoskedasticity assumption and all these hypothesis cannot be considered as plausible if the outcome variable is a count. Moreover, in this framework the excess of zeros characterizing the outcome variable, that arises when the firm does not export (zero number of destinations) leads us to choose the Hurdle Negative Binomial regression model: a two-component model made by a binary part for the yes/no choice and a truncated count part for non-negative counts. This model allows us to jointly model the decision (propensity) to export (yes/no) and the number of export destinations chosen for the exporting firms. The result that we obtained prove the advantages of using this kind of model as it allows to distinguish which variables are connected with the choice to export and which one are significantly connected to the number of destinations chosen once the company exports.

In order to explore the link among the firms' capability in generating profits and the firms internationalization choices, we consider a set of profitability indexes in addition to those usually adopted in literature that describe firms' heterogeneity. The use of profitability indicators represents a novelty in the study of the determinants of internationalization. Up to now there have been few studies that considered this kind of variables whereas the knowledge of the internal performance of the company can provide important information about its ability to achieve results and its use of resources, namely, the ability of the company to increase the value of resources through the process of transformation.

In the end, thanks to the wide availability of information in the dataset, we could analyze in more depth the innovative activity supported by the company. The innovative activity represents a focal point not only for the survival of the company but also for its openness to international markets. The study of Castellani e Zanfei (2007) showed that the companies most involved in the internationalization activity exhibit better economic and innovative performance. A further contribution of this work lies in an attempt to disentangle the relationships between the various forms of innovation and the different choices of internationalization.

For our analysis, we rely on detailed firm-level data from the 10th Survey on Manufacturing Firms (Indagine sulle Imprese Manifatturiere) carried out by Unicredit-Capitalia in 2007. The survey covers the 2004-2006 period and involves a large sample of Italian manufacturing firms.

The empirical evidences arising from this study disentangle the aspect of heterogeneity related to the decision to export from those defining the complexity of this choice through the number of markets served. On the first aspect, the estimated models support the familiar evidences already presented in literature: exporters are on average larger, more productive, more innovative and invest more (Bernard *et al.* 1995, Castellani and Giovannetti 2009, Castellani and Zanfei 2007, Greenaway and Kneller 2007, Mayer and Ottaviano 2008). With reference to the number of export destinations, our results show in general a conformity between the characteristics related to the propensity to export and those connected to the opening to more foreign markets. But some difference arises. At first, it seems that not only the larger the number of markets served the more productive, large and willing to invest is the firm (confirming the features found studying the propensity to export), but also that firms engaged in multiple markets seem to be older, financially stable, and willing to support organizational and managerial innovations. Moreover, we uncover interesting associations with the research and development and the innovation: different types of innovation are associated with different degrees of exposure to the international market.

The remainder of this work is organized as follows. Section 2 describes the data we use in our research, along with some descriptive statistics. Section 3 presents a brief description of the model used. Section 4 shows the results obtained and Section 5 concludes.

2. Data and variables description

In our research we use detailed firm-level data from the 10th Survey on Manufacturing Firms carried out by Unicredit, a pan-European financial institution, through the Observatory on Medium and Small Firms. The survey, covering the 2004-2006 period, is held every three years and it includes a wide range of both quantitative and qualitative information of a large sample of Italian manufacturing firms together with their balance sheets. The sample contains all Italian manufacturing firms with more than 500 workers while firms with fewer than 500 employees are selected on the basis of a stratified sample. In our research, we exploit the information contained in the survey, by focusing on firms' characteristics that might influence the choice of exporting and especially the number of destinations chosen. Indeed some of the questions relate to the internationalization choices, like the percentage of turnover obtained by export activity and the number of countries or areas with which the company trades. For the purpose of this work we utilize about forty variables which can be divided in five main categories: workers characteristics, profitability and productivity of the firm, firm type, propensity for innovation and R&D, and investment (for details on the considered variables see the Appendix, Table 1A).

The outcome variable, that is the number of export destinations, is a nonnegative integer-valued variable and it arises from a variable defining the export destinations, divided into the following areas: EU 15, new countries that joined the EU in 2004, Russia, other European countries including Turkey, Africa, Asia excluding China, China, Canada with U.S. and Mexico, Central and South America, and Australia and Oceania.

The first set of covariates describes the size of the firm and the main characteristics of the workforce: the percentage of white-collar workers, the percentage of employee dedicated to R&D, and the average annual wage per worker.

The second set of variables concerns the productivity and profitability of the firm. As a proxy for the overall productivity of the firm, we use labor productivity obtained by dividing the total value added by the number of employees. We then decided to use the natural logarithm of this variable because it is better suited to our type of analysis. This is followed by three indicators of profitability, observable since the presence on this data set of balance sheets' observation: ROE, ROS and ROIN. The ROE index measures the return on equity and then the profitability obtained by those who have invested capital in the enterprise by way of risk. It focuses exclusively on a specific category: the owners. The second is the ROS index; it represents the return on sales and is derived from the ratio between operating income and net revenues. This index is significant from a management perspective and provides information on cost-price dynamics within the company. The ROIN index instead detects the return on net invested capital, namely the capacity to generate wealth through the operating activities apart from financial choices. This parameter points out the efficiency and effectiveness of investment and operational decisions of the company and it should be preferred to the ROI index since the ROIN does not suffer the weaknesses and inconsistencies of the latter. Since both the ROE and ROS indexes showed anomalous values, we dropped them using the 0.5 and the 99.5 percentiles as lower and upper thresholds. By capital intensity we mean the capital per worker measured in Euro. Furthermore, for the purposes of our research, is important to understand the corporate structure both in terms of financial structure

and profitability: the debt ratio measures the company's financial structure by relating the financial debts (and then funding sources outside of the firm) with total assets.

The third set of variables describes the type and other characteristics of the firm, such as age, geographic location (North West, North East, Central and South), the industrial sector in which the firm operates, if the firm belongs to a consortium, and if it is a limited liability company or not.

The next set of variables highlights the propensity for innovation. There are four dummy variables that detect different types of innovation of the firm: product innovation, process innovation, organizational or managerial innovations related to product innovations, and finally organizational or managerial innovations related to process innovations.

The last set of variables concerns both investment in machinery, plant and equipment, and investments in Information and Communication Technologies (ICT).

Once defined the set of covariates used, we move to the description of the sample analyzed. In the Table 1 we report some descriptive statistics on the most significant variables. The original sample contained 5,137 observations but because of missing data the statistics are calculated on a reduced sample size. The median firm in the sample is characterized as follows: it employs about 30 workers, of which about 27% are white collar, has a labor productivity (value-added per worker) equal to 45 thousand Euros, has 26 years of age, a capital intensity (capital per worker) of 157,711 Euros and a return on sales of about 5.5%. The total number of observations ranges from 4,818 to 5,079 depending on the variable considered, moreover the average firm in our sample shows a percentage of employment in research and development amounting to 8% and a debt ratio of 67%, indicating a potentially unbalanced financial structure.

Table 1 about here

The following sections provide some descriptive statistics, which will be useful to analyze in more detail the differences between exporter and domestic firms. Table 2 shows the industry distributions by export status (exporters and domestic firms). The average size, measured as the average number of employees, of exporters and domestic firms for each sector are reported. There is also the number of exporting firms and the percentage of these over the total number of the firm in the sector. The column of export intensity shows the average percentage of output exported over total sales. Although some differences the sample under analysis shows a high percentage of exporting firms, about 61%. As shown in the table, the sectors with the highest percentage of exporting firms are: machinery and equipment, furniture and manufacturing and apparel and leather; while those with the lowest percentage are: wood, paper and publishing, and other non-metallic mineral products. Plant size is substantially larger for exporters (106 employees on average) than for non-exporters (60 employees). This is true for every industry except for the apparel and leather sector, where the size of the domestic firms slightly exceeds that of their counterparts. In some sectors such as rubber and plastic products and machinery and equipment, the exporting firms are about three times larger, and in the case of electrical machinery and office equipment, the difference is of about seven times (33 for domestic firms and 238 employees for exporters). These results are in general consistent with previous literature (Bernard and Jensen, 1995). As the percentage of firms that export (extensive margin), even the percentage of output shipped abroad by an average exporter does not vary much (intensive margin). In all sectors, exporters ship between 29 percent and 50 percent of their total product abroad, while the average export intensity is 41%.

Since the object of our study is to deepen the analysis of the connection between firms' heterogeneity and the choice of the number of destinations with which firms trade, in Table 3

are highlighted the average characteristics of exporting firms grouped into three classes depending on the number of destinations: from 1 to 3, from 4 to 6 and from 7 to 10.

Table 2 about here

Table 3 about here

There are important features differentiating companies that export to more destinations from those that trade with only a few areas. The size seems to be a significant variable, because the increase of the destinations is accompanied by a considerable increase in size passing from about 100 employees to over 300. The share of white-collars remains roughly stable around 35% as well as the average wage which decreases slightly. Another variable that differs appreciably is the export intensity: the increase in number of the zone served, in fact, is followed by the increase of the percentage of output shipped abroad. The labor productivity does not show a clear trend with respect to the number of destinations, and the capital intensity decreases, probably due to the increased number of employees. Of all indexes of profitability, only ROE shows a slight increase, while there are no sharp differences for the other two. The debt ratio shows a negative trend with the increase of the destination countries, a sign of a better and more solid financial structure for those firms that ship to more destinations. Almost all of the exporting firms are limited companies and only a negligible portion belongs to a consortium. Another variable that seems to be interesting is age, in fact, it shows a positive relationship passing from 31 to 46 years, perhaps because a greater permanence in the market is a symbol of stability and then a higher possibility to open onto new markets. The percentage of staff dedicated to R&D follows a rising trend up to 11% for firms with 7 or more destinations. For what concerns innovation, about half of the companies have carried out product innovations and process without substantial differences between the groups. The organizational and managerial innovations seem to follow a clear trend, especially those related to product innovations. The percentage grows when the number of countries served grows, perhaps indicating a need for optimization within the company when it gradually expands its own market. Finally, with regard to investment in machinery and equipment, we found a slight increase in the percentage from 77% to 82%, while there are no significant differences in relation to ICT investment. It is interesting to note how the number of firms decreases dramatically with the increase of the markets served, passing from over 2800 for the first group to only 74 for those firms exporting to 7 or more countries. This result is in line with those already presented in literature, as highlighted in the Introduction.

Focusing on the outcome variables, the number of export destinations, Figure 1 shows that is has a skewed distribution. Moreover the average and the standard deviation are respectively equals to 1.144 and 1.506, thus leading to a suspect overdispersion. In the end, the comparison of the observed with a Poisson distribution having the same average value reveals a possible excess of zeros.

Figure 1 about here

3. Count data models

In this section we briefly illustrate some features of count data models we consider. The Poisson regression model can be used even in the presence of overdispersion, but with appropriate modifications (Cameron and Trivedi, 1998; Winkelmann, 1997). In fact, the necessary condition to obtain a consistent estimator is the correct specification of the

conditional mean. In this case, such model can still be used if the standard error estimates are unbiased, for example by using robust standard errors. Indeed, the presence of overdispersion leads to an underestimation of the standard errors and then to overestimate the significance. Alternatively, other models that allow more flexibility and take into account the overdispersion observed can be used. One way to accommodate overdispersion is to consider the unobserved heterogeneity as Gamma distributed disturbance added to the Poisson. The negative binomial model is an example. This distribution is a conjugate mixture distribution for count data and a generalization of the Poisson distribution: it assumes that the conditional distribution of the response variable is Poisson, but the mean parameter for the subjects follows a Gamma distribution.

Due to the suspect on the presence of an excess of zeros in the outcome variable distribution, we consider also the hurdle type model (Mullahy, 1986; King, 1989) that is composed of two parts. The first part, through a logit/probit regression model, models the probability that a certain threshold value is exceeded. In our case, this threshold may divide the domestic firms which export to zero destinations from the exporting firms that, on the contrary, have crossed the threshold. The second part instead consists in a zero-truncated count model that concerns all the positive observations that exceed the chosen threshold. As in Cameron and Trivedi (1998, 2009), from a statistical point of view, the reason that leads to use this type of models is that in many empirical studies the observed overdispersion is caused by an excess of zeros, that is, when an inconsistent number of zeros (for the distribution chosen) is observed. In addition, hurdle models offers an interesting result in terms of the analysis of the phenomenon as they allow to separate and distinguish the two data generating processes: the first one that generates the zeros and the second that generates the positive observations. With reference to the outcome variable, let’s consider the question "how many destination areas of the products exported by your company have been in 2006?" The respondents who have answered "zero" may have done so for two different reasons: their company has never exported or, instead, their firm does export but did not so in 2006. Indeed from an economic point of view, this type of model can be interpreted as a two-stage decision process, making it particularly suited to the study of individual economic behavior. Summarizing, this type of model allowed us to identify, which variables are connected with the choice to export and which ones are significant to study the number of destinations chosen once the company exports.

4. Estimation results

In this section at first we present the results of the model selection process aimed to choose the one that best fits the data. Competitors are the Poisson model, the Negative Binomial and the Hurdle models (both Poisson and Negative Binomial). In the context of the Negative Binomial models we model overdispersion through the traditional NB2 (Cameron and Trivedi, 1998) that usually allows greater flexibility and fit better data. Secondly, we discuss the estimates referred to the model selected.

Concerning the specification it is to be noted that in order to limit possible simultaneity problems, which could affect the analysis, all regressors were calculated for the year 2004, unless otherwise indicated. Besides, from the estimated correlation matrix between covariates, it arises that the variables ROIN and ROS have a high correlation (0.80) and this led us to eliminate the variable ROIN from the model and keep instead the ROS index. Similarly, between the variables Capital Intensity and Average Wage a relevant correlation (0.9) can be observed and both of them show a high correlation with labor productivity. For

this reason we decided to drop both capital intensity and average wage variables and to keep labor productivity, since it provides a better fit and more reliable interpretation.

4.1 Model selection

In this section, we test the presence of overdispersion in our data and evaluate comparatively the performance of the different model specifications by comparing Negative Binomial versions versus the Poisson ones. In detail, we consider the following models: Poisson (P), Negative Binomial (NB), Hurdle Poisson (HP), Hurdle Negative Binomial (HNB). All these models are considered with logit specification for the binary part of the model. Due to missing data on the outcome variable and covariates the models are estimated on 4,079 firms.

The Table 4, where the value of the log likelihood and the information criteria AIC are reported, shows a substantial improvement in the log likelihood that goes from -5,903 in the P model to -5,559 in the HNB. The presence of overdispersion is confirmed by the LR test indicating that the Negative Binomial versions are always preferred to the Poisson ones (P vs. NB: χ^2=441.2, p-value=0.000; HP vs HNB: χ^2=563.4, p-value=0.000). This result is confirmed by the AIC statistic showing that NB and HNB models outperform the P and the HP ones.

Table 4 about here

By focusing on the information criteria, used in comparing non-nested models, we note that AIC value progressively decreases moving from 11874 for the P model to 11257 for the HNB model. This indicates that the latter is to be preferred over all the set of the models. To check the robustness of the result we also estimate a Zero-Inflated Negative Binomial model (Cameron and Trivedi, 1998) that, similarly to the hurdle one, deals with the excess of zeros in count data models. The LR test and the AIC statistics show a better performance of the HNB model against the Zero-Inflated Negative Binomial one (results are available upon requests).

Figure 2 shows the model fit to data relative to the exporting firms. The estimated model shows a very good fit for the number of destinations served. The estimated frequencies (expected HNB) and the observed frequencies are very close; moreover the fitted mean has a value of 1.83 close to the sample mean for exporters of 1.86. This last result further confirms the appropriateness of the HNB choice.

Figure 2 about here

4.2 Estimation Results

At first we present four estimated regression models with reference to the binary part of the HNB. In the first specification of the model (Model 1) we regress the Export Dummy (1 if the firm exports and 0 otherwise) on sector and macro-region dummies. In the second model (Model 2) we add the covariates related to the firm's structure, namely the size, the composition of the work force, the juridical form and the age. In the third model (Model 3) we also consider the variables related to productivity, profitability, and financial structure of the firm: labor productivity, profitability indices and debt ratio. In the last specification (Model 4) the regressors related to the different types of innovation and investment are added to the sets of mentioned covariates.

The Table 5 shows the estimates referred to the four models, LR tests results and tests comparing different model specification.

All LR tests strongly reject the hypothesis that the regressors are equal to zero, so we conclude that the Model 4 is the best one. As illustrated in the table, the results point to significant cross-sectorial differences. With respect to the sector of food beverage and tobacco (the excluded sector), the propensity to export is higher in the sectors of apparel and leather, furniture and machinery and equipment, while it is smaller in wood, paper and publishing, other non-metallic mineral products, fabricated metal products, and electrical machinery and office equipment. Quite surprisingly there are no significant differences in the propensity to export for the high-tech sectors. With regard to geographical areas, all three regions show a greater propensity to export than the South (the reference category). Besides the variables age, size and limited company are also significant. These variables show positive coefficients, this means that they positively influence the probability of exporting. In other words, the model shows that older firms and limited companies are more likely to be exporters and that the probability that a firm exports grows significantly with its size.

Table 5 about here

By considering the variables relating to productivity and profitability, it came to light a picture apparently not very clear. On the one hand, labor productivity shows a significantly positive relationship with the probability of exporting. This result is in line with previous studies, which report that exporters are on average larger and more productive (Barba Navaretti *et al*. 2010, Bernard *et al.* 1995, Castellani and Giovannetti 2009, Castellani and Zanfei 2007, Greeaway and Kneller 2007, Mayer and Ottaviano 2008). On the other hand, there is a striking negative relationship between profitability of sales and propensity to export. In fact, the ROS index shows a strong and significant negative relationship with the probability of exporting. One possible explanation may lie in the fact that exporting firms are facing fiercer competition once opened to international markets. In fact, opening up to new markets, the company could be forced to lower the price of its products in order to remain competitive in the international arena, thus decreasing the profitability of sales. From another point of view, a possible and interesting explanation for this may relate to the different nature of the indices analyzed. In fact, labor productivity is obtained from the value added, which measures the wealth generated by the firm, and represents the value that the firm adds, through the transformation activity, to goods and services used in production. This index does not take into account the cost of labor and other costs that are instead considered in the operating income used to derive the ROS index. Therefore, while the labor productivity measures the productivity of the company, the ROS index measure the profitability of sales. Moreover, the ROS index captures and describes the dynamics of price-cost within the company, provides information about the dynamics of internal management and it can also be used to assess performance in relation to cyclical fluctuations and changes in competitive environment. Thus, the negative sign found in our model could mean that the incidence of the export costs is captured by the operating income, and consequently by the ROS index, and then the observed negative relationship between return on sales and propensity to export could stem from the additional costs that the export activity requires. As evidence of this, we observe that the average value of the ROS index for exporting companies is 5.9%, while that of domestic firms is 6.6%.

The model also shows that the financial structure is an important aspect: in fact, the debt ratio exhibits a negative relationship with the propensity to export, suggesting that companies with a more solid financial structure are more likely to export.

By considering the variables related to the types of innovation and investment, we find that the most innovative companies are more likely to export. The percentage of personnel devoted to research and development shows a highly significant relationship, as evidenced in

the studies of Castellani (2007) and Barba Navaretti *et al*. (2010). The variables product innovation, process innovation, and organizational-managerial innovation related to product innovations show a positive relationship, confirming that the most innovative companies have a higher propensity to export. For what concerns the variables connected to investments, only those related to plant and equipment indicate a positive association with the propensity to export.

The framework outlined in this first part of the model appears quite clear: our results support the evidence that exporters are on average larger, more productive in terms of labor productivity, more innovative and invest more. We find no significant relationship with the percentage of white collar, and we also find a negative relationship that links export activities with the return on sales probably due to the additional costs incurred by the exporters.

In the next part we detect which variables are connected with the choice of the number of export destinations. Recall that this part of the model considers only the exporting companies, that is, only positive counts. The scheme used in building the final model is similar to the previous one. Table 6 shows the estimation results and LR tests. We also add to the table the estimates and the standard error of the overdispersion test (Alpha parameter).

All LR tests strongly reject the hypothesis that the regressors are equal to zero and support the conclusion that the Model 4 is the best one. As illustrated in the table 6, with respect to the sector of food beverage and tobacco (the excluded sector) the propensity to export to a larger number of destinations is higher in the sectors of machinery and equipment and furniture and lower in the sector of wood, paper and publishing and other non-metallic product. Considering only the exporting companies, we find no significant differences in the geographical areas indicating that there is no well-marked difference between the Italian macro-regions in terms of number of export destination.

For what concerns the firm's characteristics, it can be seen that the variables size, age and limited companies are significant. This result underlines that the limited liability companies and the older and larger firms are associated with a greater number of export destinations.

We also find an interesting negative relationship with the variable white collar share, indicating that firms trading with a higher number of markets are associated with a lower percentage of white collar workers. One possible explanation could lies in the Italian industrial structure, in fact, in the previous section of our research, we show that there is a greater propensity to export in sectors with low technological content and high-intensity work, perhaps indicating a higher proportion of blue collar needed. In this regard, we recall that the study Efige (Barba Navaretti *et al*. 2010) found a positive and significant relationship between blue collar share and intensive margin, then pointing out that the share of blue-collar workers is a factor that positively affects the export share. We therefore believe that there may be a positive relationship between blue collar share, export intensity and number of destinations chosen.

By considering the variables related to productivity, profitability and financial structure, the model highlights a positive and significant association between the labor productivity and the number of export destinations. Basically, the model confirms that the decision to export to a greater number of destinations is associated with higher labor productivity. It's also interesting to note that we observe a positive relationship between the return on equity (ROE index) and the number of countries served, while the variable ROS is no longer significant. We recall that the ROE index measures a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested, so it seems that the more opened firms are associated with a better use of investment funds to generate earnings growth.

Furthermore, the model points out that the financial structure plays an important role, a negative relationship between the degree of indebtedness and the number of exports destination suggests that a more solid financial structure is associated with an increase in the number of destinations chosen.

Table 6 about here

Finally, by considering variables describing innovations, it arises that only the variables organizational-managerial innovations related to product innovations and investment in plant and equipment have shown positive and significant relationships. So, it seems that the most innovative companies and those that invest in plant and equipment export to a larger number of countries.

It is interesting to note that, for what concerns the innovative activity, a significant relationship has been found with organizational and managerial innovation: that is, it seems that the export activities is helped by research and development and especially by those organizational innovations that change, and perhaps adapt, the structure of the company to new competitive environment. This hypothesis deserves further study; indeed it would be interesting to see the implications that different types of innovation have on the export activity.

To sum up, on the one hand some of the firm characteristics such as size, age, labor productivity, return on equity, innovative activity and investment, show a strong significance, indicating a positive relationship with the number of markets served. On the other hand, increasing indebtedness and a higher percentage of white-collar workers reveal instead a negative association.

It might be useful at this point to dwell on the differences found between the propensity to export model and the model describing the number of export destinations. At first, regarding sectors we find that some sectors including apparel and leather and fabricated metal products do not show significant relationships in the count model, while these variables are significant in the propensity to export model. Instead, in sectors of machinery and equipment, and furniture we see a propensity to export to a larger number of destinations, confirming the previous results, which identify these areas as those with a higher propensity to export. Moreover, the significant differences in the geographical areas identified in the previous model disappear once considered only the exporting companies.

It should also be noted that the significance of the profitability indices has changed. In fact, we observe a positive relationship between the return on equity (ROE index) and the number of countries served, while the variable ROS is no longer significant. This result confirms our previous hypothesis about the differential in return on sales between domestic firms and exporters. In fact, as previously stated, we believe that the negative relationship between ROS and propensity to export may be interpreted by considering the additional costs that an exporter has to bear in order to open new markets. In other words, while in the first part of the model was encountered a significant and negative relationship between ROS and propensity to export that somehow differentiates the domestic companies from those that export, in the second part of the model that considers only exporting firms, this difference disappears.

Finally, we find an interesting negative relationship with the white collar share and the number of markets served, and some differences concerning the innovation activity. More specifically, significance has been found with only one type of innovation, the managerial one, indicating that, although the innovation activity seems to be pivotal for exporting, once the firm exports, it becomes important the change in the managerial and organizational structure to align to the more competitive market.

Before moving to the last phase of our work, we propose a summary of the covariates effects separately for the two parts of the estimated model. In Table 7 we compare the significance of the variables and the sign of the estimated coefficient, which is the different impact on the outcome, with reference to the binary and to the positive count models.

Table 7 about here

We include only those variables that showed a significant relationship in at least one part of the model. *Yes*, and *No*, refer to the presence or absence of a significant relation and the sign on the side "+" or "-" refer to sign of the association found in our estimated model.

The table shows how some of the firm's characteristics are significantly associated with both the propensity to export and the number of destinations served. In particular, we uncover a significant relationship with size, age, productivity, investment and finally with organizational and managerial innovations. Summarizing, while on the one hand, the first part of the model confirm the already well-known evidence on the characteristics of exporting firms compared with the domestic ones, on the other hand the second part of the model point out that some of these characteristics are also linked to the number of countries served. It is also to be noted that the financial structure that showed a negative relationship in both parts of the model, indicating that a more balanced structure promotes export activities and the opening to more countries. Regarding the indices of profitability, we found a negative relationship of ROS with the propensity to export, perhaps due to the additional export costs that reduce the profitability of the sales, and in the second part of the model we found a positive relationship with the ROE index, stressing that firms with a higher return on equity are associated with a higher number of export destinations. Finally, some considerations about innovative activity: the results show that innovative activity and commitment in R&D are factors characterizing the exporting companies, in fact, we find positive relations with almost all types of innovations studied, from those related to product to those related to organizational and managerial restructuration. However, these relationships are no longer significant when taken into account only the exporting companies, which instead are positively associated only to a type of innovations, the organizational ones. So it seems that innovative activity in some way help the company to export, but that once it exports, opening to more markets is associated with organizational innovations that change and adapt the structure to the new competitive environment.

4.3 Marginal Effects

In the last part of our work we deal with the interpretation of coefficients of the second part of the model. As known, the estimated coefficient of the truncated part of the HNB model can be interpreted as semi-elasticity, that is, they indicate the percentage change in the dependent variable due to a one-unit increase in the regressor considered. However, a more useful way to analyze the impact on the dependent variable of changes in regressor coefficients is to use elasticities (reported in Table 8 only for significant variables).

Table 8 about here

The second column shows the elasticity while the third the standard error and last the mean value of the regressor. The elasticity of the variable size is 0.063, so a 10% increase in size is associated with a 0.63% increase in the number of export destinations. It seems to be particularly influential the effect generated by the change of variables such as age, labor productivity and debt ratio. As for the variable age, a 10% increase is associated with about 2% increase in the number of markets served. Following the same reasoning, a 10% increase

in the logarithm of labor productivity is associated with a 9.15% and increase in the number of export destinations. Instead, a 10% decrease in debt ratio and white collar share is associated with a 2% and 0.1% increase in the number of countries.

5. Concluding Remarks

Recent literature on the firm heterogeneity has shown that the firm characteristics are a key in determining the international activities. To the best of our knowledge, this work represents one of the first exploration of the relationship among firm's characteristics and number of chosen export destinations. One of the novelties consists in choosing suitable regression methods moving from the nature of the outcome variable. Exploiting a rich data set that combines data on firm's structural characteristics and economic performance with the data related to the exports activity and the number of markets served, we find evidence supporting recent trade theories on firm heterogeneity together with some new interesting associations.

Our results support the evidence that exporters are on average larger, more productive in terms of labor productivity, more innovative and invest more. Moreover, in this work we use some variables related to the internal structure of the company, such as indices of profitability, in order to investigate from a different point of view the determinants of internationalization activity. In this regard, we find an interesting negative relationship that links the return on sales with the propensity to export. Our thesis is that the differences in the return on sales between domestic firms and exporters are due to the fact that the ROS index captures the impact of the additional cost that the export activity requires.

We underline how different exposures to the international market, measured in terms of number of export destinations, are associated with different performances, in terms of productivity, size, profitability and innovation: firms engaged in multiple markets seem to be older, more productive, larger, financially stable, invest more, and willing to support organizational and managerial innovations. Besides, an interesting finding concerns the negative relationship between the white collar share and the number of export destinations. Our analysis shows that the Italian industrial structure favors mainly the export of low-tech and labor-intensive goods, thus indicating the need for a greater blue collar share. Finally, some considerations about innovative activity: we confirm that innovative activity and commitment in R&D are important aspect characterizing the exporting companies. However, taking into account only the exporting companies, we find that they are positively associated only to a type of innovations, the organizational ones, meaning that, opening to more markets is associated with organizational innovations that change and adapt the structure to the new competitive environment.

Several aspects deserve further studies to be confirmed and deepened. In this regard beside the number of destination, it would be interesting to focus on the behavior of exporting firms in terms of choice of the types of destinations, by distinguishing between low or high-income destinations.

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Table 1. Sample Description

Variable	Mean	Median	Std. Dev.	Num. of observ.
Number of employees	88	30	349	4950
Wage per worker (x 1000 euros)	34	21	143	4856
White collar (%)	35	27	1.42	5079
R&D personnel (%)	8	0	18.40	4829
Age	30	26	24.69	5061
Value-added per worker (x 1000 euros)	85	45	436	4818
Capital per worker (x 1000 euros)	379	158	3922	4856
Debt ratio (%)	67	70	0.203	5060
ROE (%)	4,7	0	0.021	5000
ROS (%)	6.2	5.5	0.066	5005

Table 2. Industry characteristics

		Exporters				*Domestics*
Ateco 2002	*Sector*	*Num. of exporters*	*%*	*Average firm size*	*Export intensity*	*Average firm size*
15-16	Food, beverage and tobacco	230	55	73	29	70
17	Textiles	231	68	95	43	48
18-19	Apparel and leather	242	72	67	44	72
20-21-22	Wood, paper and publishing	177	39	72	25	48
23-24	Chemical and petrochemicals	181	69	169	37	98
25	Rubber and Plastic products	174	66	94	36	26
26	Other non-metallic mineral prod.	141	40	124	41	74
27	Basic metals	129	68	198	44	117
28	Fabricated metal products	430	54	73	39	32
29	Machinery and equipment n.e.c.	582	77	116	50	44
30-31	Electrical machinery and office eq.	140	59	238	43	33
32	Radio, television and comm. eq.	67	71	126	45	65
33	Medical, and optical instruments	93	70	77	42	27
34-35	Motor vehicles and other transport eq.	91	68	222	43	129
36	Furniture; manufacturing n.e.c.	241	73	59	45	31
	Total	3149	61	106	41	60

a. Export intensity is the percentage of turnover due to export activity.

Table 3. Descriptive statistics of exporting firms, by number of destinations

	N° of destinations		
Characteristic	1 to 3	4 to 6	7 to 10
Average total employment	95	163	328
Wage per worker (x 1000 euros)	35	32	31
White collar (%)	37	35	34
Export \ sales (%)	39	60	65
Value-added per worker (x 1000 euros)	87	110	77
ROE (%)	4.3	5.5	7.4
ROS (%)	6.0	5.6	6.6
ROIN (%)	3.6	3.6	4.9
Capital per worker (x 1000 euros)	434	335	257
Debt ratio (%)	66	64	61
Limited company (%)	96	96	99
Average age	31	38	46
Consortium (%)	3.5	3.5	1.4
R&D personnel (%)	8.5	8.7	11
Product innovation (%)	53	61	51
Process innovation (%)	46	49	49
Org. innov. rel. to product (%)	14	15	35
Org. innov. rel. to process (%)	13	13	26
Inv. in plant or equipment (%)	77	80	82
Investment in ICT (%)	59	67	60
Number of observations	2845	230	74

Table 4. Model choice statistics.

	P	NB	HP	HNB
Log Likelihood	-5903.43	-5682.82	-5841.17	-5559.47
AIC	11874.72	11435.63	11746.34	11256.94
BIC	12089.38	11656.61	12247.67	11692.58
Number of Obs.	4079	4079	4079	4079

Table 5. HNB – Binary models

Dependent Variable: Export Dummy								
Covariates	*Model 1*		*Model 2*		*Model 3*		*Model 4*	
	Coeff.	*St.Err.*	*Coeff.*	*St.Err.*	*Coeff.*	*St.Err.*	*Coeff.*	*St.Err.*
Size			0.000	[0.000]	0.001**	[0.001]	0.001*	[0.000]
White collar			0.078	[0.128]	0.048	[0.121]	0.038	[0.084]
Limited Company			0.869***	[0.139]	0.922***	[0.146]	0.957***	[0.165]
Age			0.010***	[0.002]	0.007***	[0.002]	0.007***	[0.002]
Consortium			0.213	[0.192]	0.224	[0.198]	0.232	[0.209]
ln LP					0.151***	[0.048]	0.169***	[0.054]
ROE					-0.047	[0.153]	-0.076	[0.161]
ROS					-2.225***	[0.546]	-2.301***	[0.586]
Debt ratio					-0.614***	[0.182]	-0.551***	[0.194]
R&D pers.							0.006***	[0.002]
Product Inn.							0.201***	[0.082]
Process Inn.							0.144*	[0.082]
Org. inn. Related to Product							0.232*	[0.135]
Org. inn. Related to Process							0.168	[0.141]
ICT investment							0.102	[0.082]
Invest. in plant & equip							0.263***	[0.082]
Textiles	0.152	[0.149]	0.132	[0.154]	0.067	[0.159]	0.017	[0.169]
Apparel and leather	0.465***	[0.148]	0.507***	[0.155]	0.541***	[0.160]	0.560***	[0.171]
Wood, paper and publishing	-1.050***	[0.124]	-1.081***	[0.129]	-1.066***	[0.133]	-1.036***	[0.144]
Chemical and petrol.	0.201	[0.153]	0.123	[0.163]	0.054	[0.169]	0.009	[0.181]
Rubber and Plast. prod.	0.089	[0.152]	0.146	[0.157]	0.054	[0.169]	0.081	[0.172]
Other non-metallic prod	-0.881***	[0.132]	-0.943***	[0.140]	-0.981***	[0.146]	-1.036***	[0.159]
Basic metals	0.165	[0.174]	0.081	[0.185]	-0.086	[0.189]	-0.164	[0.198]
Fabricated metal products	-0.439***	[0.105]	-0.412***	[0.109]	-0.392***	[0.112]	-0.406***	[0.122]
Machinery & equipment	0.594***	[0.132]	0.577***	[0.138]	0.573***	[0.141]	0.532***	[0.151]
Electr. Machin. & off.eq.	-0.248*	[0.151]	-0.254*	[0.156]	-0.225	[0.163]	0.284*	[0.177]
Radio, telev. & comm. eq.	0.318	[0.242]	0.323	[0.251]	0.357	[0.260]	0.312	[0.277]
Medic., précis. & opt. eq	0.207	[0.203]	0.166	[0.204]	0.160	[0.213]	0.060	[0.225]
Motor vehicles.	0.162	[0.202]	0.163	[0.213]	0.178	[0.223]	0.205	[0.242]
Furniture	0.424***	[0.146]	0.486***	[0.153]	0.505***	[0.158]	0.543***	[0.169]
Northwest	0.819***	[0.098]	0.659***	[0.103]	0.683***	[0.107]	0.662***	[0.115]
Northeast	0.836***	[0.098]	0.659***	[0.103]	0.683***	[0.107]	0.662***	[0.115]
Central	0.656***	[0.113]	0.591***	[0.117]	0.641***	[0.123]	0.560***	[0.133]
Constant	-0.134	[0.103]	-1.232***	[0.180]	-2.302***	[0.561]	-3.575***	[0.628]
No. observations[a]	5122		4826		4587		4079	
Log Likelihood	-3222.44		-2987.15		-2810.98		-2471.02	
LR test–Mod. 1 vs. Mod. 2			450.6***					
LR test–Mod. 2 vs. Mod. 3					352.0***			
LR test–Mod. 3 vs. Mod. 4							680.3***	

Notes: Robust standard errors in squared brackets.
*Asterisks denote significance levels (***: p < 1%; **: p < 5%; *: p < 10%).*
The sample size are different due to different sets of missing data in the covariates

Table 6. HNB – Positive count models.

Dependent Variable: Number of Export Destinations								
Covariates	*Model 1*		*Model 2*		*Model 3*		*Model 4*	
	Coeff.	*St.Err.*	*Coeff.*	*St.Err.*	*Coeff.*	*St.Err.*	*Coeff.*	*St.Err.*
Size			0.001***	[0.000]	0.001***	[0.001]	0.001***	[0.000]
White collar			-0.023	[0.015]	0.028*	[0.013]	-0.027*	[0.014]
Limited Company			0.419**	[0.216]	0.505**	[0.233]	0.596**	[0.262]
Age			0.007***	[0.002]	0.007***	[0.002]	0.007***	[0.002]
Consortium			0.218	[0.187]	0.213	[0.181]	0.254	[0.192]
ln LP					0.070	[0.051]	0.095**	[0.049]
ROE					0.307*	[0.180]	0.324*	[0.190]
ROS					-0.626	[0.651]	-0.723	[0.643]
Debt ratio					-0.370*	[0.206]	-0.353*	[0.211]
R&D pers.							0.003	[0.002]
Product Inn.							-0.037	[0.085]
Process Inn.							0.028	[0.083]
Org. inn. Related to Product							0.361***	[0.121]
Org. inn. Related to Process							0.066	[0.124]
ICT investment							0.016	[0.078]
Invest. in plant & equip.							0.165*	[0.096]
Textiles	0.164	[0.161]	0.048	[0.164]	0.102	[0.171]	0.123	[0.175]
Apparel and leather	0.105	[0.150]	0.135	[0.145]	0.138	[0.146]	0.117	[0.148]
Wood, paper and publishing	-0.543***	[0.213]	-0.477***	[0.129]	-0.400*	[0.230]	-0.465**	[0.243]
Chemical and petrol.	0.082	[0.177]	0.146	[0.176]	0.139	[0.172]	0.088	[0.172]
Rubber and Plast. prod.	0.204	[0.177]	0.069	[0.171]	0.022	[0.166]	0.025	[0.175]
Other non-metallic prod.	-0.086***	[0.205]	-0.303	[0.193]	-0.297	[0.194]	-0.300*	[0.184]
Basic metals	0.077	[0.209]	0.075	[0.212]	-0.016	[0.225]	-0.194	[0.216]
Fabricated metal products	-0.064	[0.138]	-0.089	[0.137]	-0.121	[0.138]	-0.166	[0.141]
Machinery & equipment	0.475***	[0.122]	0.421***	[0.122]	0.443***	[0.126]	0.493***	[0.131]
Electr. Machin. & off.eq.	-0.463**	[0.196]	0.372*	[0.195]	-0.330*	[0.198]	-0.326	[0.203]
Radio, telev. & comm. eq.	0.308	[0.216]	0.313	[0.214]	0.188	[0.209]	0.113	[0.218]
Medic., précis. & opt. eq.	0.336*	[0.204]	0.307**	[0.149]	0.213	[0.218]	0.280	[0.216]
Motor vehicles	0.196	[0.221]	0.086	[0.221]	0.084	[0.235]	-0.033	[0.247]
Furniture	0.266*	[0.146]	0.307**	[0.149]	0.322**	[0.151]	0.343**	[0.157]
Northwest	0.255*	[0.136]	0.145	[0.143]	0.117	[0.138]	0.158	[0.143]
Northeast	0.248*	[0.139]	0.101	[0.144]	0.117	[0.139]	0.152	[0.144]
Central	0.174	[0.150]	0.107	[0.157]	0.104	[0.153]	0.150	[0.155]
Constant	-1.848***	[0.488]	-2.049***	[0.405]	-2.302***	[0.561]	-2.866***	[0.671]
Alpha	7.935***	[0.488]	4.744***	[1.816]	4.566***	[1.756]	3.041***	[0.894]
No. observations	3149		2946		2803		2480	
Log Likelihood	-3970.21		-3653.34		-3440.25		-3088.45	
LR test–Mod. 1 vs. Mod. 2			633.7***					
LR test–Mod. 2 vs. Mod. 3					426.2***			
LR test–Mod. 3 vs. Mod. 4							703.6***	

Notes: Robust standard errors in squared brackets.
*Asterisks denote significance levels (***: p < 1%; **: p < 5%; *: p < 10%).*
The sample sizes are different due to different sets of missing data in the covariates

Table 7. Synthesis of the role of covariates

Variable	*Binary model*	*Positive counts model*
Size	Yes +	Yes +
White collar	No	Yes -
Limited Company	Yes +	Yes +
Age	Yes +	Yes +
ln LP	Yes +	Yes +
ROE	No	Yes +
ROS	Yes -	No
Debt ratio	Yes -	Yes -
R&D pers.	Yes +	No
Product Inn.	Yes +	No
Process Inn.	Yes +	No
Org. inn. Related to Product	Yes +	Yes +
Investment in plant and equipment	Yes +	Yes +

Legend: *"Yes" if the variable has shown a significant relationship, "No" otherwise;*
" +, -" indicates the sign of the relation.

Table 8. Elasticities

Variable	*ey/ex*		*Std. Err.*	$\bar{x}$
Size	0.063	***	0.021	100.63
White collar	-0.009	*	0.005	37.32
Limited Company	0.417	**	0.210	96.44
Age	0.199	***	0.046	31.73
ln LP	0.915	*	0.502	10.76
Debt ratio	-0.193	*	0.129	65.67
Org. inn. Related to Product	0.057	***	0.014	0.14
Investment in plant and equipment	0.130	*	0.071	0.77

*Notes: Asterisks denote significance levels (***: $p < 1\%$; **: $p < 5\%$; *: $p < 10\%$)*

Figure 1. Number of Export Destinations, frequency distribution

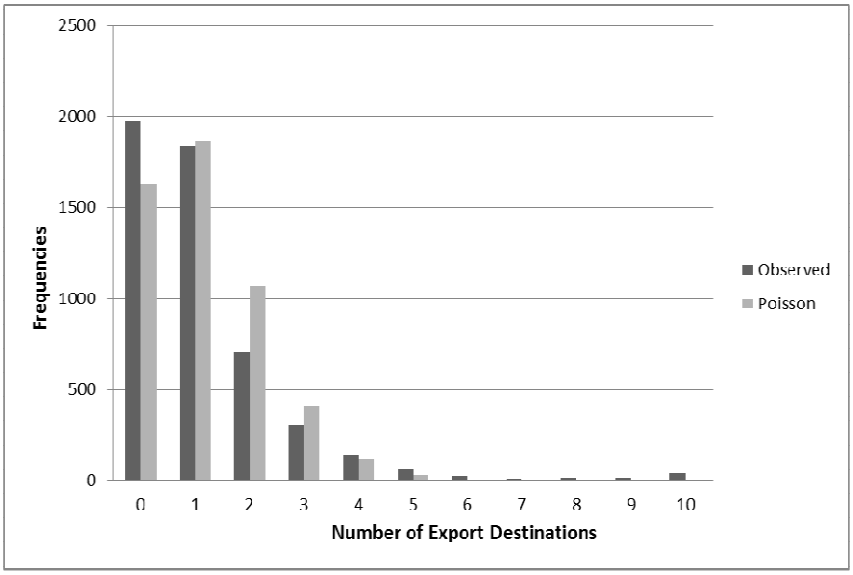
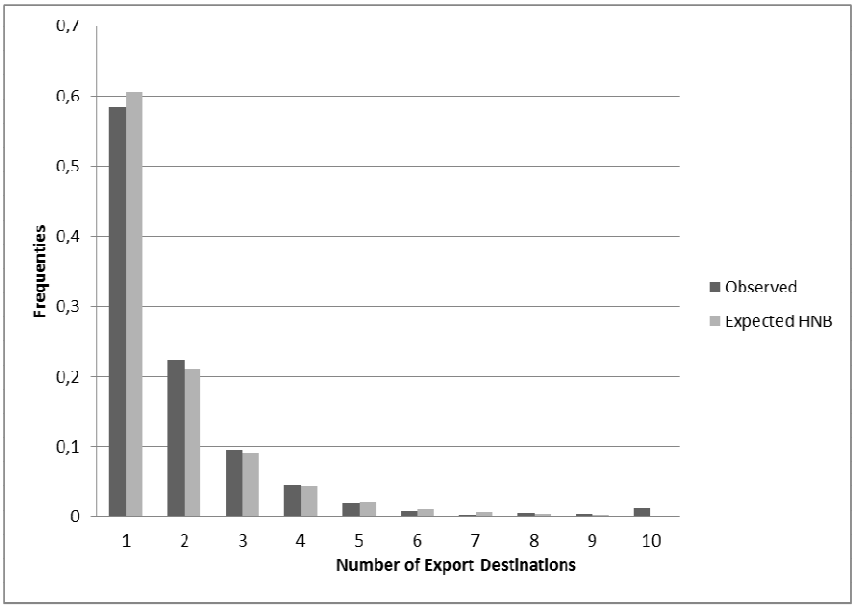


Figure 2. Observed and expected frequency distribution
of the number of export destinations



APPENDIX

Table 1A. Description of the relevant variables

Variable	Description
Outcome variable	
Number of export destination	Number of export destinations of each firm
Workers characteristics	
Average wage	Wage per worker in €
White collar	Share of white collars
R&D personnel	Share of employment who have carried out R&D activity in the period 2004 – 2006
Profitability and productivity	
Export share	Intensive margin: the percentage of turnover due to export activity
Ln labour productivity (ln LP)	Logarithm of Labour Productivity, calculated as the logarithm of the Value Added per worker
ROE[a]	Return on Equity: Net Income after Tax \ shareholder Equity
ROS[a]	Return on Sales: Operating Income \ Net Revenue
ROIN	Return on net investment : Net Operating Income \ Net capital
Capital Intensity	Capital per worker in €
Debt ratio	The percentage of firm's asset provided by debt, calculated as financial debt \ Net capital
Firm type	
Size	Number of employees
Limited company (ltd)	Dummy variable: 1 if the firm is a limited company, and 0 otherwise
Age	Firm's age in year, calculated in 2007
Consortium	Dummy variable: 1 if the firm belongs to a consortium, and 0 otherwise
Northwest	Dummy variable: 1 if the firm is located in the Northwest of Italy, and 0 otherwise
Northeast	Dummy variable: 1 if the firm is located in the Northeast of Italy, and 0 otherwise
Central	Dummy variable: 1 if the firm is located in the central Italy, and 0 otherwise
South	Dummy variable: 1 if the firm is located in the South of Italy, and 0 otherwise
Sector[b]	Set of Dummies variables related to the sector of the firm
Propensity to innovate and R&D (2004 - 2006)	
Product Innovation	Dummy variable: 1 if the firm has carried out some product innovation, and 0 otherwise
Process Innovation	Dummy variable: 1 if the firm has carried out some process innovation, and 0 otherwise
Organizational innovation related to product innovation	Dummy variable: 1 if the firm has carried out some organizational-managerial innovations related to product innovation, and 0 otherwise
Organizational innovation related to process innovation	Dummy variable: 1 if the firm has carried out some organizational-managerial innovations related to process innovation, and 0 otherwise
Investments (2004 - 2006)	
Investment in plant or equipment	Dummy variable: 1 if the firm, in the period 2004-2006, has invested in plant, machinery and equipment, 0 otherwise
Investment in ICT	Dummy Variable: 1 if the firm, in the period 2004-2006, has invested in hardware, software or in telecommunication networks, 0 otherwise