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Location, Internationalization and Performance of Firms in Italy: a Multilevel Approach

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Abstract

Competition is increasingly crossing borders. However, location still matters: the most successful competitors in an industry often cluster in the same geographic areas and companies use the advantages of location to compete at a global level. When competing across borders, firms can coordinate among different activities in a variety of ways to harness network advantages. This paper analyses how Italian firms' performance, proxied by their propensity to export, depends both on geographical and institutional context and on individual characteristics. Using a multilevel model, we estimate and distinguish the effect of individual (firm level) and context variables (province level) on the performance of internationalized Italian firms.
KEY WORDS: Exports, Multilevel Model, Heterogeneity
JEL classification: C1, F1, F2, L1

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1 Introduction

In the last decade, globalization has been increasingly crossing borders. Firms and their strategies have been strongly influenced by this phenomenon and companies have been required to operate on a multi-national scale to be successful. An increasing number of firms adopted complex new internationalization strategies to increase the level of their exports and/or imports (both semi-finished goods and raw materials), to increase the number of markets of destination, to invest in foreign firms and joint ventures. The performance of firms in a globalized world depends on specific firms' characteristics and on their flexibility to react to market changes. Also, when studying firms' performance, we deal with both firms' specific characteristics like their propensity to export or their technology level and with context-related variables like the infrastructure level and the presence of commercial networks in the area.

According to these considerations, firms working in the same province are likely to have positively correlated performance (presence of unobserved factors at the institution level e.g. same infrastructures - seaports and airports- network externalities, etc.) while standard approaches assume independence of the observations thus achieving biased estimates. To deal with these firms' characteristics, a multilevel approach can be useful to disentangle the effect of individual variables (i.e. size and technological level) and context variables (i.e. infrastructures). Multilevel models indeed allow to group observations in homogeneous geographical areas, where clustering is not an occasional nuisance, but an intrinsic characteristic of the population, explicitly considered in the model.

This paper focuses on the role of individual and context characteristics on the performance of Italian exporting firms[1]. We use data on firms performance and their propensity to export both at the firm level and at a provincial level (ISTAT) and on the existence and quality of infrastructure in the province (ISTAT). We distinguish the role of firms' level variables (size, technology, R&D expenditures, internationalization mode) from those context-related (industrial districts and infrastructures in the province) and test whether the propensity to export is different among provinces. We identify what are the factors that mostly affect the propensity to export of Italian firms. The original aspect of this approach is that we estimate the firm's propensity to export including contextual variables, identifying those firms that over-perform with respect to the potentiality of their territory

[1] See Baldwin et al, 2008, for a detailed analysis of Italian exporting firms during the last decade.

(province). We expect that a province with good infrastructures (airports, seaports or presence of industrial districts) favor the internationalization process of firms working in that area. To verify this hypothesis, we use a multilevel approach; we distinguish the effect of individual and context variables (at firms and province level, respectively) on the firms' propensity to export. Then, we use results estimates to represent on a map the average expected firms' propensity to export at a province level. This representation allows to identify both the magnitude of the firms' propensity to export and the provinces where most internationalized firms work. Finally, we use estimation residuals to verify whether firms located in a given province fully use the level of infrastructures and economic facilities of the area. We analyze whether there exist over/under performing firms in terms of propensity to export, given the model's estimated performance of the province. This method can be also used for policy purposes to implement new policies to stimulate efficient firms' investments abroad. The paper is structured as follows. Section 2 introduces the multilevel approach, section 3 discusses data and statistical model, section 4 presents the results and section 5 briefly concludes.

2 The multilevel approach

The multilevel analysis combines information from more than one level of observation in studying the determinants of various kind of firms' behavior. Concerning firms, their behavior is not only influenced by individual goals and characteristics but it is also shaped by the social and economic environment. The multilevel approach, by combining elements from both levels allows greater concordance between the theoretical views and the models employed for studying firms' behavior. Standard regression models (such as the Generalized Linear Models), indeed, are not adequate when complex structure of data exist as they do not take into account a crucial feature of the problem, namely the data (hidden) hierarchical structure. For example, firms can be seen as nested in geographical locations (provinces) and, while the model aim is to estimate the performance of the firms' system, the model outcomes are drawn at the individual (firm) level. From a statistical viewpoint, standard regression models make unsuitable assumptions on the variance-covariance structure since they assume independence of the observations, while the results of the firms working in the same province are positively correlated as they share several unobserved factors at the institution level (same infrastructure, like seaports and airports). The consequence is a poor quantification of uncertainty (and in nonlinear models also a systematic attenuation of the estimates of the regression coefficients).

Cluster analysis is an alternative to regression models when a hierarchical structure in dataset exists. "Mixed effects" models (Searle, Casella e McColluch, 1992) and contextual analysis (Iversen, 1991) allow to analyze data with a complex variance[2] through maximum likelihood estimation. The "standard" one level approach to hierarchical data give rise to biased estimates and standard errors (Aitkin and Longford, 1986; Burstein et al, 1978) while the multilevel approach does not (Snijders e Bosker, 1999; Maas e Hox, 2004).

The multilevel approach has been recently used in several disciplines (sociology, epidemiology, demography, etc.) to study data with hierarchical structure (individual, familiar, geographical, social, etc.). We take into account two dimensions: the micro level is relative to the firm, while the macro level is referred to its geographical location (the province in which the firm works). We explicit the relationship between the individual and the context using macro variables affecting individual strategies and behavior.

3 The Model

Multilevel approach allows to simultaneously model individual variables (X_{hij}, where h is the number of covariates and i is the firm working in the j-th province) and variables that represent a superior level (Z_{kj} where k is the number of covariates and j the province) as stated in Hox and Maas, 2005 and Hox 2002. Adopting for simplicity the linear specification (for a continuous outcome variable), a multilevel model can be written as (Snijders & Bosker, 1999; Goldstein, 2003)[3]:

$$Y_{ij} = \alpha + \sum_{h=1}^{r} \beta_h X_{hij} + \sum_{k=1}^{s} \gamma_k Z_{kj} + U_j \qquad (1)$$

with $i : 1, ...n$ and $j = 1, ...p$ $U_j \sim N(0, \tau^2)$.

[2]For example, geographically distinct levels are regions in countries or provinces in regions while socially distinct levels can be detected in ethnical or religious groups or different income classes within the same country.

[3]Residuals U_j represent the second level casual effects of the model; they are the residuals of each province on the response variable.

We use an original dataset matched and merged by Capitalia (2005) [4], ICE-Reprint (2001-2003)[5] and AIDA, obtaining information on internationalization processes of 4305 firms between 2001 and 2003.[6] We also, linked information about exports at a provincial level (ISTAT), about province infrastructures (ISTAT, 2006) and about the presence of industrial districts.

Our dependent variable is the firm's propensity to export as the percentage of production exported in 2003. The "individual" variables are: firm's size (proxied by sales classes), sector of activity (ATECO 2002), technological level and R&D expenditures[7]. Other individual variables are related to models of international trade with heterogeneous firms (Meyer and Ottaviano, 2008). Among these, the number of markets in which the firm exports and the internationalization mode. The "context" variables are the average propensity to export of the province to stress the importance of a possible geographical network, and variables capturing the presence of infrastructure in the province (presence of industrial districts, airports and commercial seaports).

The analysis includes three steps. The first step is the estimation of the following null model:

$$Y_{ij} = \alpha + U_j \tag{2}$$

Where α is the average of the overall population, U_j ~ $\mathrm{N}(0,\tau^2)$ is the error term that represents the deviation from the average for the j-th province. In the second step, we estimate the significance of the τ^2 parameter using a likelihood ratio test. The result of this test is extremely important: if the null hypothesis (absence of a second level in the data) turns to be rejected, then a territorial effect (at a provincial level) is evident and a multilevel model is appropriate. The last step is the estimation of the general model (1).

[4]Capitalia survey includes all firms with more than 500 workers and a representative sample of firms with less than 500 workers.

[5]ICE-Reprint dataset is the census of foreign direct investment (Mariotti e Mutinelli, 2005).

[6]In this work we include data on R&D, innovation activity, sectoral specialization and internationalization mode from Capitalia, data on investments abroad from Ice-Reprint and data on firm's size and production from AIDA.

[7]See Appendix 1 for a detailed description of variables included in the model.

4 The Results

Table 1 reports the descriptive statistics of our dataset. The average propensity to export per province and the average sales exported give a similar information: around 40% of sales are exported. However, this information has to be read together with an extremely high standard deviation. The Italian economic system of firms is heterogeneous: it includes highly internationalized firms and firms that export very little. Italian firms, on average, export towards few markets (only 3 areas) but, also for this variable, we find evidence of large heterogeneity among firms. Concerning "context" variables, note that both industrial districts and airports are present in most Italian provinces.

Table 1: Descriptive Statistics

Variables	Average	Standard Deviation	Minimum	Maximum
Propensity to export (%)	40.11	28.46	0,004	100
Average propensity to export (province, %)	39.82	6.75	6	90
R&D on sales (%)	0.45	0.50	0	1
Delocalization (%)	0.07	0.26	0	1
Areas of Export per firm (number)	2.52	2.51	0	9
Innovation (dummy)	0.62	0.48	0	1
District (dummy)	0.85	0.36	0	1
Seaport (dummy)	0.16	0.37	0	1
Airport (dummy)	0.59	0.49	0	1
Size (classes)	2.64	1.29	1	5
Technological intensity (dummy)	0.31	0.46	0	1

Note: number of observations included 4305.
Size classes: class 1 (11-20); class 2 (21-50); class 3 (51-100); class 4 (101-250), class 5 (> 250)

In Table 2, we report the results of the likelihood ratio test on the second level significance (province). Test results show that a second level exists, confirming the use of a multilevel approach to describe and forecast Italian firms propensity to export. Then, we run a null and a general model, to select the best specification for our data. The best model specification has been detected inserting in the null model, firstly, the individual and, secondly, the context variables as shown in Table 3[8].

Table 3 reports model estimates for the whole sample and two sub-samples (small-medium and large firms), distinguishing between context and individual variables. For the whole sample the former are more important than the latter in affecting especially small firms propensity to export. This confirms a vast, recent

[8] We run several models considering numerous context and individual variables. The selected model is the present one but additional results are available upon request from authors

Table 2: Likelihood Ratio Test

Likelihood Ratio Test	LR chi2(9) = 224.23
	p-value>0.001

literature showing that a large size positively influences export propensity. However, from our model emerges that medium size, more than large size, positively affects the firm's propensity to export (size class 3 or 4). This can be referred to the interaction of context (more important for small firms) and individual (favoring large firms) variables[9].

Regressions on size sub-samples show that small and large firms do not equally depend on the socio-economic context: small firms benefit from the social capital that spill over industrial districts while large firms propensity and performance strongly depend on their own investments in R&D and technology.

Among others individual variables, R&D investments and working in high-tech sectors have the largest effect on the propensity to export of firms. Concerning the internationalization mode, firms that work on several foreign markets or delocalize have an higher propensity to export than non internationalized firms[10]. The average export per province shows a positive and significant effect on the propensity to export of Italian firms. In other words, an highly internationalized geographical context stimulates firms working in that territory to export abroad their goods, independently of their size. Also, infrastructures like seaports and airports make firms internationalization easier[11]. Contrary to conventional wisdom, from our data emerges that the presence of an industrial district is only weakly significant (10%) for the propensity to export of firms. This is may due to the homogeneous distribution of industrial district throughout the Italian territory; thus, all else equal, competitiveness of firms operating in a given province is not pushed up by the presence of a network of firms working in the same sector, in the same area. However, estimates on sub-groups show that small firms are more sensitive to the industrial districts' social capital than large firms[12].

[9]This empirical evidence emerges from sub-groups analysis.

[10]Our model shows that for larger firms, complex internationalization mode are complementary to the export activity, as confirmed by the most recent theoretical literature (Bernard et al., 2007).

[11]Infrastructures represent a crucial issue for exporting firms. However, a deeper and more general analysis may be useful. In particular, data on the logistic component of infrastructure like storage. Unfortunately, to our knowledge, these data are not available at a provincial level for Italy..

[12]Results are available upon request.

Table 3: Model Results

Variables	Whole Sample	Large Firms	Small-Medium Firms
Individual variables:			
Small firms (Size= 2)	3.12		2.67
	[1.17]***		[1.17]***
Small-Medium firms (Size=3)	5.99		5.00
	[1.15]***		[1.15]***
Medium-Large firms (Size= 4)	6.57		5.27
	[1.86]***		[1.72]***
Large firms (Size= 5)	-1.28		
	[1.67]		
Technological Intensity	3.77	7.08	2.69
	[1.00]***	[3.32]***	[0.97]***
R&D	6.26	9.77	3.71
	[0.77]***	[1.94]***	[0.84]***
FDI	7.61	11.20	5.11
	[1.84]***	[3.68]***	[2.14]***
Number of countries where firm exports	5.72	1.85	7.12
	[0.31]***	[0.48]***	[0.27]***
Context variables:			
Propensity to export by prov. (av.)	0.62	0.55	0.58
	[0.05]***	[0.22]***	[0.05]***
Industrial District	3.04	0.91	3.00
	[0.84]***	[4.54]	[0.74]***
Seaport	2.33	-1.05	2.16
	[0.85]***	[5.50]	[0.63]***
Airport	0.010	-0.84	0.44
	[0.60]	[3.61]	[0.68]
Constant	-19.96	- 1.23	19.62
	[2.06]***	[10.54]	[2.18]***
Obs	4305	490	3815

Note: Robust standard errors in parentheses. * 10%; significant ** 5% significant; *** 1% significant

Based on the selected model forecasts, we can derive the predicted propensity to export for each province and represent it on a map (Figure 1). Differences among provinces can also be analyzed by looking at the random effects (empirical Bayes residuals) of the model. These convey all the provincial-level factors that have not been observed: provinces with high, positive or negative (yellow and blu, respectively, in Figure 1), residuals reveal a propensity to export that is "unexpected", given the estimates of our model. Specifically, positive values reveal the presence of unobserved contextual factors that increase the propensity to export, and viceversa. For the fitted model, the standardized empirical Bayes residuals at provincial level are presented in Figure 2. In those provinces with high positive values (yellow in the figure)[13], firms have higher

[13] See Appendix 2 for a detailed list of provinces in the highest and lowest class.

propensity to export than predicted by the model including only context variables. In other words, in those provinces firms have on average higher propensity to export than expected and their internationalization strategies are over-performing. Among these, some provinces from South of Italy like Avellino, Bari, Benevento, Caserta, Palermo, Caltanisetta, Cuneo, Cosenza, Catania, Catanzaro, Foggia and several tuscan provinces (Grosseto, Massa Carrara, Pisa, Prato, Pistoia, Siena). Provinces with negative residuals (blu in the figure), instead, show a propensity to export lower than predicted by the model with only context variables (infrastructure equipment, average propensity to export of the province, presence of industrial districts in the province). This suggests that firms working in provinces with a favorable context may take more advantage of it. Among these, provinces in the North-Italy like Alessandria, Belluno, Bolzano, Cremona, Ferrara, Sondrio, La Spezia, Trieste.

5 Conclusive Remarks

Recent changes in the world economies have strongly influenced the firms' internationalization strategies. More complex and lighter strategies have been found by successful firms and new variables have become important to understand this process. For example, firms-related variables like the number of markets where firms export but also context-related variables like the infrastructure equipment or the social capital of the territory where the firm works. These variables are difficult to be included in a single, standard model because variables are defined at different levels and capture different effects of firms behavior. To solve this problem, in this paper we employ a multilevel approach.We merge information from different databases (ICE-Reprint, Capitalia and ISTAT) including information at firm and provincial level to study the propensity to export of Italian firms (2001-2003). Our multilevel model shows that context variables (province related) influence the firms propensity to export, especially that of smaller firms. In other words, small and large firms do not equally depend on the socio-economic context in which they work: small firms largely benefit from the social capital that spill over industrial districts while large firms propensity and performance strongly depend on their own investments in R&D and technology. Our model also shows that not all firms benefit from the socio-economic context. For large firms the individual characteristics prevail and they can succeed in international markets even if their socio-economic context is not favorable. Other firms, instead, are not able to completely benefit from the dynamic, positive context. An export-oriented policy may use these information to adapt the policy tools to the heterogeneity of Italian firms.

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Appendix 1: Variables included

Individual variables:

1. Technological intensity: based on the Pavitt taxonomy, we derived a dummy variable that distinguishes firms belonging to high-tech and specialized sectors from firms belonging to traditional and scale sectors (0).

2. Firms size (employment): small firms (size=1, 11-20 employees), small-medium firms (size=2, 21-50 employees), medium-large firms (size=3 and 4, 51-250 employees) and large firms (size=5, more than 250 employees).

3. Number of geographic areas[14] where the firm exports.

4. Two dummies: delocalization and R&D activity.

Context variables on infrastructures and export levels per province are from ISTAT (industrial districts presence, seaports and airports).

Appendix 2: Provinces with highest and lowest model residuals.

Province with highest model residuals (> 0.086)

Ascoli Piceno Avellino Bari Benevento Caserta Chieti Caltanisetta Cuneo Cosenza Catania Catanzaro Foggia Grosseto Massa Carrara Palermo Pisa Prato Pistoia Salerno Siena Taranto Terni

[14] In Capitalia survey the following areas are included: EU15, last wave of EU enlargment 2004,other European Countries, Africa, Asia (China not included), China, NAFTA, South-America, Oceania.

Province with lowest model residuals ($<$ -0.102)

Alessandria Ancona Belluno Bolzano Cremona Ferrara Livorno Messina Mantova Pescara Ravenna Reggio Calabria Rimini Sondrio La Spezia Trieste Viterbo

Figure 1: Propensity to export predicted by the selected model for each province (quantiles)

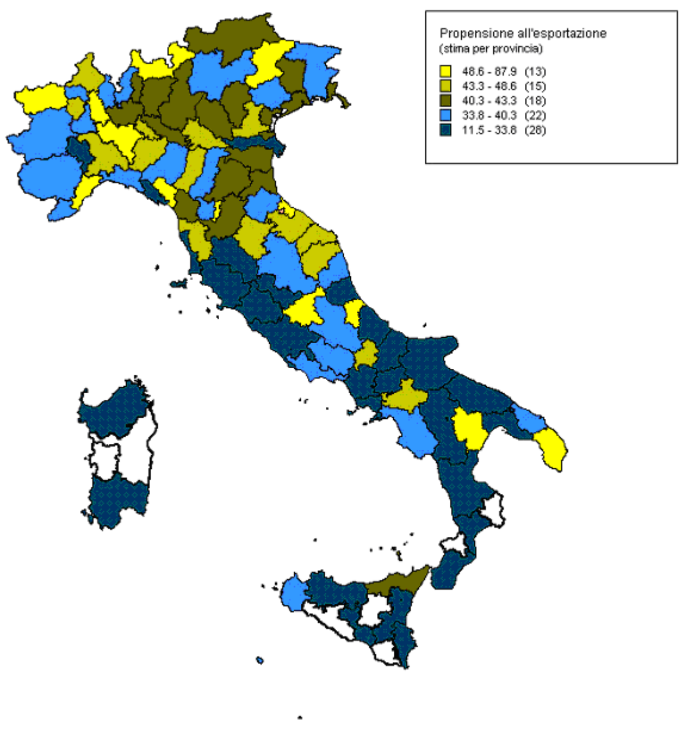

Figure 2: Bayes Empirical residuals (quantiles)