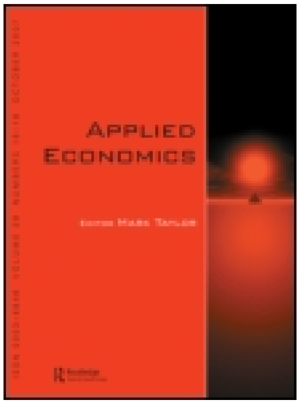

Applied Economics
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/raec20

Location, internationalization and performance of firms in Italy: a multilevel approach

Giorgia Giovannetti [a], Giorgio Ricchiuti [a] & Margherita Velucchi [b]

[a] Dipartimento Scienze Economiche, Università degli Studi di Firenze, via delle Pandette 9, Firenze 50127, Italy

[b] Dipartimento di Economia, Università Europea di Roma, V. degli Aldobrandeschi 190, Roma

Version of record first published: 20 Apr 2012.

To cite this article: Giorgia Giovannetti, Giorgio Ricchiuti & Margherita Velucchi (2013): Location, internationalization and performance of firms in Italy: a multilevel approach, Applied Economics, 45:18, 2665-2673

To link to this article: http://dx.doi.org/10.1080/00036846.2012.665597

Applied Economics, 2013, **45**, 2665–2673

Routledge
Taylor & Francis Group

Location, internationalization and performance of firms in Italy: a multilevel approach

Giorgia Giovannetti[a], Giorgio Ricchiuti[a,*] and Margherita Velucchi[b]

[a]*Dipartimento Scienze Economiche, Università degli Studi di Firenze, via delle Pandette 9, Firenze 50127, Italy*
[b]*Dipartimento di Economia, Università Europea di Roma, V. degli Aldobrandeschi 190, Roma*

Competition is increasingly global. However, location still matters: often firms cluster in the same geographic areas in order to exploit locational externalities and improve their competitiveness. This article 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 approach, we estimate and distinguish the effect of individual (firm level) and context (province level) variables on the performance of internationalized Italian firms. We show that both firms and province heterogeneity shape the results.

Keywords: exports; multilevel model; heterogeneity; multinational firms

JEL Classification: C19; F17; F23; L19

I. Introduction

In the last decade, the world has become increasingly interconnected. Firms behaviour has been strongly influenced by globalization; they have adopted articulated strategies, often moving to complex forms of internationalization in order to survive.

Against this background, this article analyses the performance of Italian firms highlighting the role of individual and context characteristics.[1] We use information both at firms and province level and a multilevel approach. While standard approaches do not consider the role of the context and assume independence of the observations, therefore achieving biased estimates, a multilevel approach allows to disentangle the effect of individual and context variables. Moreover, these models 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.

In what follows, 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 in different provinces. The original aspect of the approach followed, is that it allows us to identify those firms that over/under-perform with respect to the potentiality of their territory. We expect that a province with good infrastructures favours the internationalization process of firms located in that area. We identify both the magnitude of the firms' propensity to export and the provinces where most internationalized firms are located, also giving a graphical representation. This approach can also be used to derive policy implications. The article is structured as follows. Section II sketches the related (theoretical and empirical) literature. Section III introduces the multilevel approach, Section IV discusses data and statistical model, Section V presents the results. Section VI briefly concludes.

*Corresponding author. E-mail: giorgio.ricchiuti@unifi.it

[1] See Baldwin *et al*. (2008) and Mayer and Ottaviano (2007) for a recent analysis of Italian exporters. Contrary to ours, their analysis only focuses on firms' characteristics and does not consider the distinct influence of the socio-economic context.

Applied Economics ISSN 0003–6846 print/ISSN 1466–4283 online © 2013 Taylor & Francis
http://www.tandfonline.com
http://dx.doi.org/10.1080/00036846.2012.665597

II. The Literature

During the last decade, firms' performance has been influenced by a rapidly changing global environment and, as response, firms have adopted heterogenous strategies: some have entered new export markets, some have outsourced phases of production or tasks, some have integrated the production and located different phases in different countries becoming multinationals, etc..

This article is related to the literature dealing with the decision of internationalizing (i.e. serving foreign markets through export or Foreign Direct Investment (FDI)).

In a seminal article, Melitz (2003) explains firms' heterogeneity, with respect to foreign trade, within the context of a formal model. Heterogeneity is traced back to randomly allocated productivity. Helpman *et al.* (2004) include in a model along the line of Melitz (2003) the possibility for firms to engage in FDIs, strengthening the results and predicting a productivity ordering of firms according to their patterns of participation in international trade. The underlying idea is that there are relatively few firms able to compete in international markets and these firms are more productive, pay higher wages, employ more skilled workers and invest more in R&D (Bernard *et al.*, 2007). The recent empirical literature relying on firm data confirms the heterogeneity hypothesis of Melitz and Helpman *et al.*, showing significant differences between international and domestic firms. Mayer and Ottaviano (2007) confirm that exporters are more productive than domestic firms, foreign investors more productive than exporters, and so on. Further work on multiproduct firms (Mayer *et al.*, 2011) strengthens this findings by showing that the most productive firms export more products to more destinations. Two main channels drive the heterogeneity. On the one hand, export heterogeneity may be explained by firms' productivity (Bernard *et al.*, 2007; Mayer and Ottaviano, 2007; Moxnes, 2010). On the other, heterogeneity is driven by R&D activities: patents and new products are strictly related to the firms' performance in international markets (Costantini and Melitz, 2008).

Extending this perspective, we believe that the performance of firms in a globalized world depends on firms' specific characteristics, on their flexibility to react to market changes but also on the socio-economic environment. This perspective is the basis of the new economic geography literature (Krugman, 1991; Krugman and Venables, 1995). The aim is to highlight the role of (some) geographical variables on firms' location and performance. For instance, Mayer and Ottaviano (2007) distinguishes ultra-peripherical (unattractive and difficult to reach) from peripherical (attractive but more difficult to reach) and 'central' (easily reachable and attractive) areas. Starting from these two strands of the literature (i.e heterogeneous firms models and new economic geography), we use a model coping with both firms' specific characteristics, like propensity to export or technology level and context-related variables, like infrastructure level and presence of commercial networks in the area.

III. The Multilevel Approach

The existing statistical literature tackles the issue of hierarchical structure in the data using alternative methods. Among others, mixed effects models (Searle *et al.*, 1992) and contextual analysis (Iversen, 1991) allow to analyse data with a complex variance structure through maximum likelihood estimation.[2] However, the 'standard' one level approach to hierarchical data gives rise to biased estimates and SEs (Burstein *et al.*, 1978; Aitkin and Longford, 1986). A multilevel approach, instead, allows to take into account hierarchical levels in the data and obtain correct and efficient estimates (Snijders and Bosker, 1999; Maas and Hox, 2004), considering clustering as a characteristics of the data and not simply a temporary nuisance. This approach, widely used in several disciplines, easily combines information from more than one level of observation.

In our case, as mentioned above, we maintain that firms' behaviour 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' behaviour. When complex structure of data exists, standard regression models (such as the generalized linear models)[3] are not adequate as they do not take into account the data (hidden) hierarchical structure. For example, firms can be seen as nested in geographical locations (provinces) and, while the model's 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. They assume independence of the observations, while the performance of the firms working in the same province are likely to be positively correlated (Rabe-Hesketh and Skrondal, 2010). They share several unobserved factors at the institution level: same infrastructure, like seaports and airports; similar information; same quality of services. Specifically, multilevel models assume a nonhomogeneous and not constant correlation structure at higher level. This means that in a simple multilevel model like

$$y_{ij} = \alpha + \beta x_{ij} + u_i + e_j$$

where $i = 1, \ldots, n$ units are clustered in $j = 1, \ldots, k$ groups, the correlation between any two units i and j' will be

$$corr(y_{ij}, y_{i'j}) = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_e^2}, \quad \forall i \neq i'$$

thus allowing to better capture the variance of the system. A standard approach like OLS with clustered error, though considering that the correlation is not constant across the

[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] Comparison between Ordinary Least Square (OLS) estimates with clustered residuals and multilevel are available upon request. For the model estimated in this article, we show that, while the numerical value of the coefficients does not change, SEs do. This leads to differences in the statistical significance of the parameters.

units, assumes an homogeneous correlation structure within each cluster. This gives biased and not consistent estimates in case of hidden hierarchical data for which the correlation structure is likely to vary across groups (clusters/levels).[4] The consequence of the independence assumption is a poor quantification of uncertainty.[5]

In this article, we innovate with respect to the existing literature on firms' heterogeneity because we take into account two dimensions: the micro level relative to the firm and the macro level referred to the firm's geographical location (the province in which the firm is located). We therefore consider explicitly the relationship between the individual and the context, applying a multilevel model.

IV. The Model

As mentioned above, the 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 contextual variables that represent a 'higher level' (Z_{kj}, where k is the number of covariates and j the province).[6] Adopting for simplicity the linear specification (for a continuous outcome variable), a multilevel model can be written as (Snijders and Bosker, 1999)

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

with $i = 1, \ldots, n$ and $j = 1, \ldots, p$; $u_j \sim N(0, \tau^2)$. Where u_j and e_{ij}, are the so called second and first level residuals, normally distributed with variance σ_u^2 and σ_e^2. In particular, u_j represents the difference between the j-province and the total average.[7]

To test this model, we use an original dataset with information on internationalization processes of 4305 firms between 2001 and 2003, obtained by matching data from Capitalia (2005),[8] ICE-Reprint (2001–2003)[9] and AIDA.[10] We also link information on exports at a province level (obtained by the Italian statistical office, ISTAT), on province infrastructures (ISTAT, 2006) and on the presence of industrial districts in a given sector.[11]

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, innovation and R&D expenditures.[12] Other individual variables are related to models of international trade with heterogeneous firms in line with Mayer and Ottaviano (2007): the extensive margin (i.e. number of destination markets) and the internationalization mode (whether or not the firms also invest abroad). The 'context' variables are: the average propensity to export of the province – a variable that allows us to stress the importance of a possible geographical network-, the average number of countries where firms of the same province export and variables capturing the presence of infrastructure in the province (airports and commercial seaports).[13] Finally, we evaluate the presence of industrial districts in the firm sector, since an ample literature on the productivity of Italian firms highlights the importance of districts externalities (Menghinello *et al*., 2010).

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

$$Y_{ij} = \alpha + u_j \quad (2)$$

where α is the average of the overall population, $U_j \sim N(0, \tau^2)$ 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) is rejected, then there is a territorial effect (at a provincial level) and a multilevel model is appropriate. The last step is the estimation of the general model (1).

V. The Results

Table 1 reports the descriptive statistics. The average propensity to export per province is around 40%, while on average 30% of sales are exported. However SD is high. Italian firms are heterogeneous; ranging from highly internationalized firms to firms that export very little and often only to one market. On average, they export to few markets (2–3 areas) but again with large heterogeneity among firms. This is in line with the province average. Concerning 'context' variables, just 5% of firms belong to an industrial district in the same sector and in the same province, while airports are present in most Italian provinces.

In Table 2, we report the results of the likelihood ratio test on the second level significance (province). Test results show

[4] For an extended discussion on the theoretical characteristics of multilevel models and for a detailed comparison between multilevel approach and panel approach see Rabe-Hesketh and Skrondal (2010).
[5] In nonlinear models this assumption leads to a systematic reduction of the estimates of the regression coefficients.
[6] Hox (2002) and Hox and Maas (2005).
[7] Residuals u_j represent the second level casual effects of the model; they are the residuals of each province on the response variable. It is worth noting that adding a quadratic effect (as done in the article) does not affect the theoretical framework discussed in this section.
[8] Capitalia survey includes all firms with more than 500 workers and a representative sample of firms with less than 500 workers.
[9] ICE-Reprint dataset is the census of FDI (Mariotti and Mulinelli, 2005).
[10] 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.
[11] To study the effect of spatial aggregation on firms' export propensity, we use the province as the second level, since it is the most disaggregated level for which we have information on infrastructure. Using this detailed information we get better estimates, reducing the variability in the model. However, other different context level could be used like regions, sectors, technological level but this is beyond the scope of this article.
[12] See the Appendix for a detailed description of variables included in the model.
[13] Basile *et al*. (2011) note that not all regions/province 'obey a common linear specification of the industrial location model' (p. 2). We follow this suggestion in the empirical section.

Table 1. Descriptive statistics.

Variables	Average	SD	Minimum	Maximum
Propensity to export (%)	29.63	30.12	0	100
Average propensity to export (province, %)	39.76	6.73	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)	2.51	2.51	0	9
Average areas of export per firm (province)	2.51	0.56	0	4.2
Innovation (dummy)	0.62	0.48	0	1
District (dummy)	0.05	0.22	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

Notes: Number of observations included are 4305.
Size of classes: class 1 (11–20); class 2 (21–50); class 3 (51–100); class 4 (101–250), class 5 (>250).

Table 2. Likelihood ratio test

Likelihood ratio test	LR $\text{chi}^2(9) = 173.53$ p-value > 0.001

that a second level exists, supporting the use of a multilevel approach. Hence, we run a null and a general model. The chosen model specification has been detected inserting in the null model, first, the individual and, second, the context variables as shown in Table 3.[14]

Tables 3 and 4 report, respectively, model estimates for the whole sample and for exporters. Moreover, we run regressions for two sub-samples (small-medium versus large firms) to detect whether there are differences among these two groups. Finally, we believe that some variables (specifically, the number of markets where firms export at both individual and province level) may affect firm's performance in a nonlinear way. This nonlinearity could be due to the existence of threshold triggering different behaviours (e.g. entry in a new market), to spatial clustering knowledge and pecuniary externalities, or to problems of aggregating heterogeneous firms. Hence, to account for the variety of complex economic phenomena for which a linear relationship may be inconsistent, we also use a quadratic form, which allows us to capture decreasing or increasing marginal effects on propensity to export.

The whole sample

Focusing on the whole sample, context variables turn out to be more important than firms' level variables, especially in affecting small firms propensity to export. This confirms a vast, recent literature showing that a large size positively influences export propensity and that larger firms are able to benefit more from a stimulating context. From our model, it emerges that size positively affects the firm's propensity to export (especially medium size, classes 3 and 4). This can be referred to the interaction of context (more important for small firms) and individual (favouring large firms) variables.[15] R&D investments and high technology have the largest effect on the propensity to export of firms. Concerning the internationalization mode, firms that export to several foreign markets have an higher propensity to export than noninternationalized firms.[16]

When we introduce a quadratic effect in the model, we find that the number of markets of destination has a nonlinear effect on the firms' propensity to export. On average, a firm's export share increases with the number of destinations (increasing returns). However, there is an estimated threshold (five areas) above which this effect changes (decreasing returns). Above this level the cost of operating in additional markets is higher than the benefits the firms receive in terms of higher exports (possibly due to organizational difficulties and distance). Concerning the role of markets' number of destination on export propensity, we notice that the effect is positive and significant at firm level but not significant at province level (average), suggesting that this is strictly a firm level strategy. Still on the contextual variables of the quadratic specification, 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 located in that territory to export, independently of their size.

Finally, our data suggest that the presence of an industrial district has a positive impact: competitiveness is enhanced by the presence of a network of firms in the same sector and in the same area. The magnitude of the district effect is extremely high, both in the linear and quadratic specifications. It is, however, nonsignificant for large firms which are likely to have individual know how without relying on the network.

[14] We run several models considering numerous context and individual variables. We report here our chosen specification. Additional results are available upon request from authors.
[15] This empirical evidence emerges from sub-groups analysis, see third and fourth column of Table 3.
[16] 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).

Table 3. Model results: whole sample

Variables	Whole sample – linear	Whole sample – nonlinear	Small-medium firms size: Size 1–4	Large firms: Size 5
Individual variables				
Small-medium firms (Size = 2)	3.101	0.901	0.947	
	(2.91)***	(0.92)	(0.964)	
Medium firms (Size = 3)	5.976	2.803	2.738	
	(5.15)***	(2.62)***	(1.055)***	
Medium-large firms (Size = 4)	6.491	4.466	4.306	
	(4.96)***	(3.71)***	(1.190)***	
Large firms (Size = 5)	−0.916	3.779		
	(0.6)	(2.70)***		
Technological intensity	4.164	3.716	2.860	8.638
	(4.89)***	(4.76)***	(0.824)***	(2.434)***
R&D	5.708	2.266	2.187	−0.233
	(6.43)***	(2.75)***	(0.851)**	(3.093)
FDI	7.592	4.231	2.989	7.391
	(5.13)***	(3.11)***	(1.536)*	(3.128)**
Number of countries where firm exports	5.728	17.39	17.165	14.900
	(32.91)***	(39.39)***	(0.468)***	(1.720)***
Number of countries where firm exports (squared)		−1.481	−1.400	−1.314
		(28.33)***	(0.060)***	(0.173)***
Innovation	1.603	−0.524	−1.124	4.280
	(1.84)	(0.65)	(0.825)	(3.132)
Context variables				
Average number of countries where firm exports (by province)	−2.373	−3.409	−2.613	−26.919
	(2.90)***	(0.79)	(4.455)	(20.199)
Average number of countries where firm exports (by province squared)		0.171	0.097	3.904
		(0.19)	(0.933)	(3.871)
Propensity to export by province (average)	0.679	0.65	0.624	0.797
	(10.38)***	(10.51)***	(0.066)***	(0.192)***
Industrial district	7.094	3.534	3.290	6.866
	(4.12)***	(2.23)**	(1.626)**	(6.066)
Seaport	0.431	0.763	0.579	−0.113
	(0.39)	(0.74)	(1.063)	(3.901)
Airport	0.447	0.473	0.792	−0.391
	(0.56)	(0.64)	(0.767)	(2.945)
Constant	−15.021	−18.561	−18.687	17.916
	(5.25)***	(3.82)***	(4.931)***	(25.444)
Observations	4263	4263	3,782	481

Notes: Absolute value of *z* statistics are given within parentheses.
*, ** and *** denote significance at 10, 5 and 1% levels, respectively.

Analysis on size sub-samples show that small and large firms do not equally depend on the socio-economic context: small firms strongly benefit from the social capital that spills over industrial districts while large firms' propensity and performance strongly depend on their technology and innovation. This confirms a vast literature on the positive role of firms' size in stimulating their performance (see also Giovannetti *et al.*, 2010).

Exporters

Analysis on sub-sample of exporters (Table 4) shows that size is less relevant (for instance, being small does not negatively affect propensity to export) while technology and R&D investments are still very important. In this sub-sample, the role of destination markets is extremely important and has a nonlinear effect, with an estimated threshold number of markets slightly higher (around six areas) than for the whole sample. Belonging to an industrial district is significant just in the linear specification. Being close to an airport or seaport is not statistically significant. The average propensity to export by province is positive and highly significant in all different specifications, highlighting the importance of operating in a highly internationalized context.[17] Finally, the average number of destination areas by province for large firms shows a quadratic effect. Specifically, entering only few markets has a

[17] Note that for exporters the numerical value of the coefficients is systematically higher than for the whole sample, suggesting that especially small exporters benefit from the context (compare column 3 of Table 4 with column 3 of Table 3).

Table 4. Model results: exporters

Variables	Whole sample – linear	Whole sample – nonlinear	Small-medium firms size: Size 1–4	Large firms: Size 5
Individual variables				
Small-medium firms (Size = 2)	1.889	1.176	1.177	
	(1.34)	(0.85)	(1.388)	
Medium firms (Size = 3)	4.883	3.765	3.631	
	(3.30)***	(2.59)***	(1.457)**	
Medium-large firms (Size = 4)	6.467	5.862	5.613	
	(3.99)***	(3.68)***	(1.602)***	
Large firms (Size = 5)	2.898	5.155		
	(1.59)	(2.87)***		
Technological intensity	4.496	4.408	3.505	9.532
	(4.50)***	(4.50)***	(1.059)***	(2.504)***
R&D	4.067	2.709	2.538	0.964
	(3.82)***	(2.58)***	(1.114)**	(3.281)
FDI	5.271	4.122	2.578	8.465
	(3.24)***	(2.58)***	(1.842)	(3.118)***
Number of countries where firm exports	3.643	12.216	12.175	5.273
	(16.54)***	(15.70)***	(0.862)***	(2.270)**
Number of countries where firm exports (squared)		−0.949	−0.883	−0.409
		(11.47)***	(0.097)***	(0.214)*
Innovation	0.325	−0.851	−1.472	2.782
	(0.3)	(0.79)	(1.144)	(3.366)
Context variables				
Average number of countries where firm exports (by province)	−4.001	−5.732	−3.068	−52.903
	(3.84)**	(0.88)	(6.966)	(22.184)**
Average number of countries where firm exports (by province squared)		0.44	0.011	8.527
		(0.33)	(1.425)	(4.276)**
Propensity to export by province (average)	0.969	0.931	0.926	0.970
	(11.93)***	(11.35)***	(0.090)***	(0.208)***
Industrial district	3.856	2.95	2.185	10.183
	(2.03)**	(1.58)	(1.954)	(6.262)
Seaport	0.515	0.721	0.664	−2.685
	(0.37)	(0.52)	(1.483)	(4.217)
Airport	−0.103	0.147	0.563	0.778
	(0.11)	(0.15)	(1.028)	(3.069)
Constant	−8.496	−16.651	−20.220	66.382
	(2.26)**	(2.17)**	(8.016)**	(28.297)**
Observations	3165	3165	2746	419

Notes: Absolute value of *z* statistics are given within parentheses.
*, ** and *** denote significance at 10, 5 and 1% levels, respectively.

negative impact suggesting that sunk costs and lack of information prevail on the spillovers of being in an internationalized context. However, the positive and significant impact of the squared effect suggests that an increasing number of markets allow to overcome the initial costs.[18]

Provinces' performance on a map

Based on the selected general model, we can derive the predicted propensity to export for each province and represent it on a map (Fig. 1). Differences among provinces can also be analysed by looking at the random effects (empirical Bayes residuals) of the model (Fig. 2). These figures convey all the provincial-level factors that have not been observed: provinces with high, positive or negative residuals (dark and light grey respectively, in Fig. 2), reveal a different perspective. Specifically, positive values show the presence of unobserved contextual factors that increase the propensity to export, and vice versa. This graph representation allows us to highlight firms that over-perform (under-perform) with respect to the province context. In other words, in those provinces, firms have on average higher (lower) propensity to export than expected and their internationalization strategies are over-performing (under-performing). Among the provinces with positive residuals we find some located in the South of Italy (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, instead, show a propensity to export lower than predicted by the model

[18] Our results show that, if the average number of destinations per province is higher than three, then the positive effect prevail.

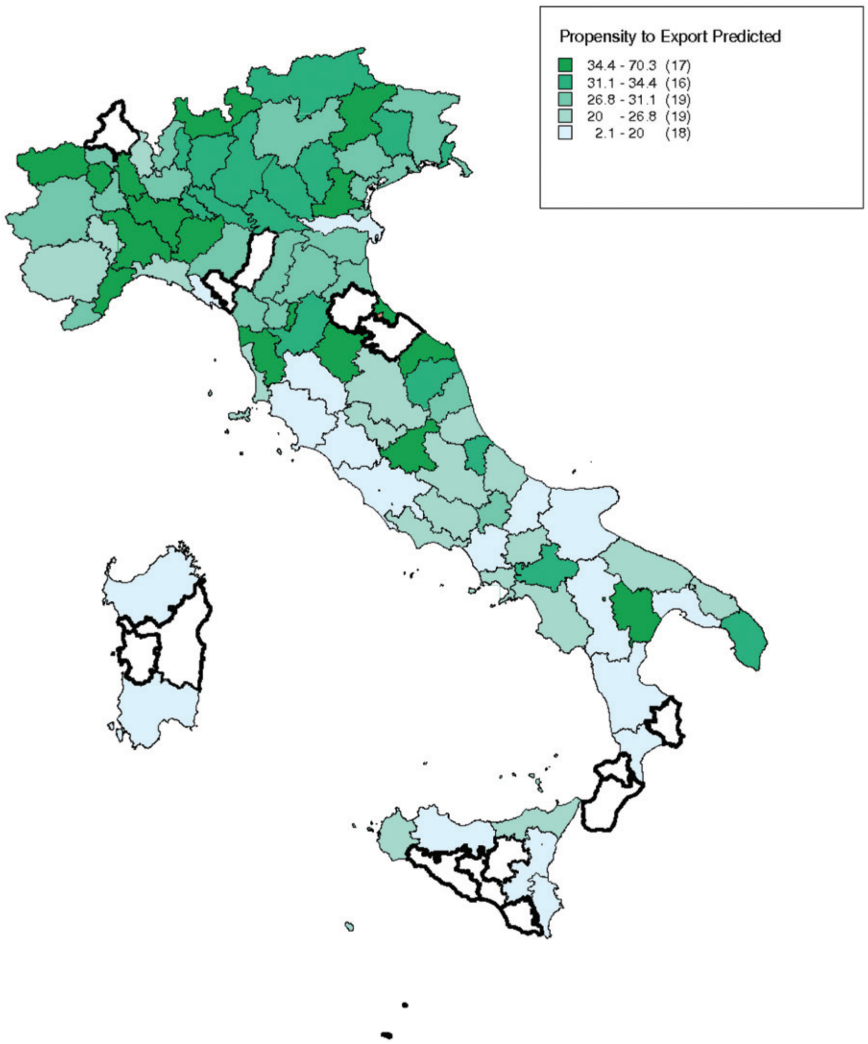

Fig. 1. Propensity to export predicted by the selected model for each province (quantiles)

with only context variables (infrastructure equipment, average propensity to export of the province, presence of industrial districts in the province). This suggests that firms in provinces with a favourable context may take more advantage of it. Among these, we find some provinces in the North-Italy like Alessandria, Belluno, Bolzano, Cremona, Ferrara, Sondrio, La Spezia, Trieste.

VI. Conclusive Remarks

Recent changes in the world economy have strongly influenced the firms' internationalization strategies. More complex and lighter strategies have been pursued by successful firms and new variables and models are needed 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 behaviour. To deal with this problem, in this article we use a multilevel approach. We merge different databases (ICE-Reprint, Capitalia, AIDA 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 spills over industrial districts while large firms propensity and performance strongly depend on their own technological intensity. For large firms, the individual characteristics prevail and these firms can succeed in international markets even if the socio-economic context of the provinces where they are located is unfavourable. For large exporters, however, an high average number of destination markets by province has a strong propulsive effect. From a province perspective we find that firms in same areas are over-performing with respect to their

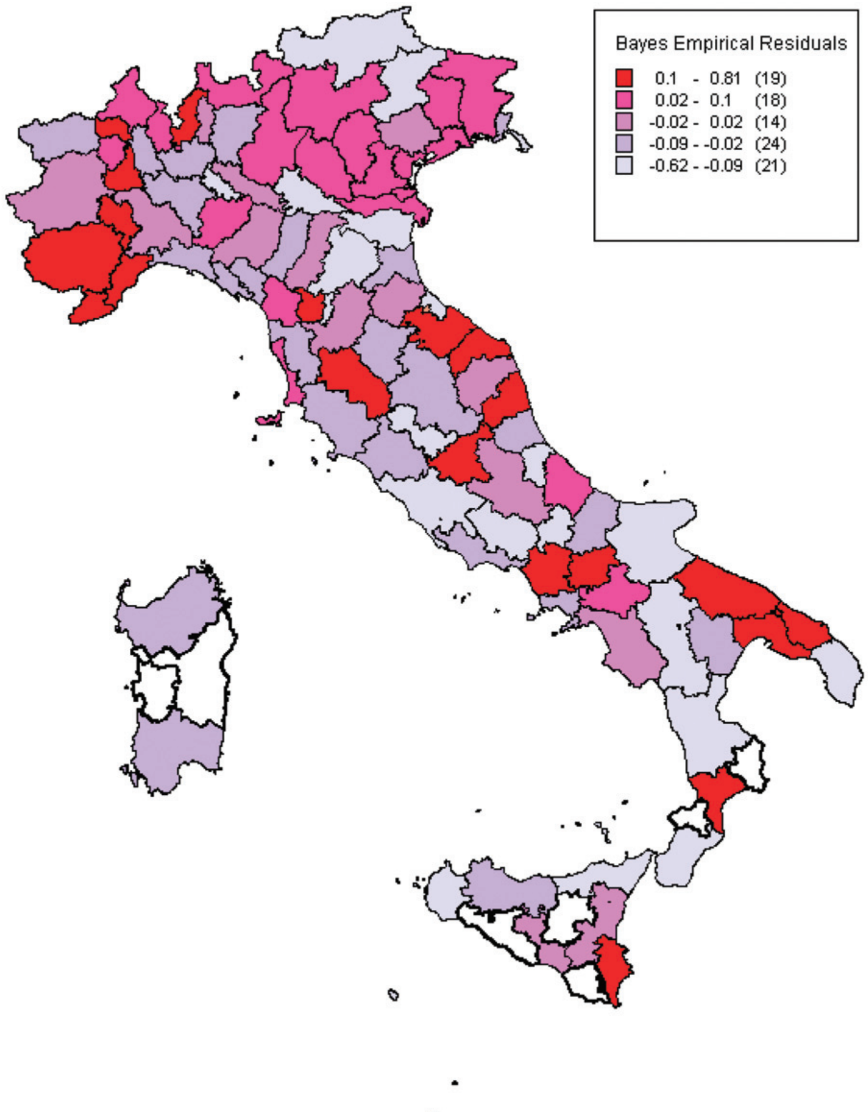

Fig. 2. Bayes empirical residuals (quantiles)

context while others, although operating in a stimulating environment, do not fully benefit from it. An export-oriented policy may use these information to adapt the policy tools to the heterogeneity of Italian firms.

Acknowledgements

Giorgia Giovannetti and Giorgio Ricchiuti gratefully acknowledge financial contributions from the FIRB project 'International fragmentation of Italian firms. New organizational models and the role of information technologies'. Margherita Velucchi gratefully acknowledges financial contribution from the research project No. 2005139545_003 funded by the MIUR. We also thank Fabrizio Onida and Alessandro Sembenelli as well as participants at workshops in Turin, Rome and Pisa for helpful comments.

References

Aitkin, M. and Longford, N. (1986) Statistical modelling issues in school effectiveness studies, *Journal of the Royal Statistical Society, A*, **149**, 1–43.

Baldwin, R., Barba Navaretti, G. and Boeri, T. (2008) *Come sta Cambiando l'Italia*, il Mulino, Bologna.

Basile, R., Benfratello, L. and Castellani, D. (2011) Spatial clustering and nonlinearities in the location of multinational firms, Quaderni del Dipartimento di Economia Finanza e Statistica No. 90, University of Perugia.

Bernard, A., Bradford, J., Redding, S. J. and Schott, P. K. (2007) Firms in international trade, *Journal of Economic Perspective*, **21**, 105–30.

Burstein, L., Linn, R. L. and Capell, F. J. (1978) Analyzing multilevel data in the presence of heterogeneous within-class regressions, *Journal of Educational Statistics*, **3**, 347–83.

Constantini, J. and Melitz, M. (2008) The dynamics of firm-level adjustment to trade liberalization, in *The Organization of*

Firms in a Global Economy (Eds) E. Helpman, D. Marin and T. Verdier, Harvard University Press, Cambridge, MA, pp. 107–41.
Giovannnetti, G., Ricchiuti, G. and Velucchi, M. (2010) Size, innovation and internationalization: a survival analysis of italian firms, *Applied Economics*, **43**, 1511–20.
Helpman, E., Melitz, M. and Yeaple, S. (2004) Exports versus FDI with heterogeneous firms, *American Economic Review*, **94**, 300–16.
Hox, J. (2002) *Multilevel Analysis: Techniques and Applications*, Erbaum, Mahwah, NJ.
ISTAT (2006) Le infrastrutture in Italia: un'analisi provinciale della dotazione e della funzionalità, Roma.
Iversen, G. R. (1991) *Contextual Analysis*, Sage University Press, Newbury Park.
Hox, J. J. and Maas, C. J. M. (2005) Multilevel analysis, in *The Encyclopedia of Social Measurement* (Ed.) K. Kempf-Leonared, Elsever Academic Press, San Diego, pp. 785–93.
Krugman, P. (1991) Increasing returns and economic geography, *Journal of Political Economy*, **99**, 483–99.
Krugman, P. R. and Venables, A. J. (1995) Globalization and the inequality of nations, *The Quarterly Journal of Economics*, **110**, 857–80.
Maas, C. J. M. and Hox, J. J. (2004) The influence of violations of assumptions on multilevel parameter estimates and their standard errors, *Computational Statistics and Data Analysis*, **46**, 427–40.
Mariotti, S. and Mulinelli, M. (2005) Italia multinazionale 2005: Le partecipazioni Italiane all'estero e estere in Italia, Rubettino Editore, Roma.
Mayer, T., Melitz, M. and Ottaviano, G. (2011) Market size, competition, and the product mix of exporters, NBER Working Papers 16959, National Bureau of Economic Research, Inc.
Mayer, T. and Ottaviano, G. M. (2007) The happy few: the internationalisation of European firms: new facts based on firm-level evidence. Available at www.bruegel.org (accessed 14 February 2012).
Melitz, M. (2003) The impact of trade on intra-industry reallocations and aggregate industry productivity, *Econometrica*, **71**, 1695–725.
Menghinello, S., De Propris, L. and Driffield, N. (2010) Industrial districts, inward foreign investments and regional development, *Journal of Economic Geography*, **10**, 539–58.
Moxnes, A. (2010) Are sunk costs in exporting country specific?, *Canadian Journal of Economics*, **43**, 467–93.
Rabe-Hesketh, S. and Skrondal, A. (2010) *Multilevel Modeling*, Vols 1–4, Sage, London.
Searle, S. R., Casella, G. and McColluch, C. E. (1992) *Variance Components*, Wiley, New York.
Snijders, T. A. B. and Bosker, R. J. (1999) *Multilevel Analysis*, Sage, London.

Appendix: Data Information

We match and merge to gain the intersection of different datasets: Capitalia (2005), ICE-Reprint 2000–2003, AIDA and ISTAT (2006).

Capitalia's *Observatory on Small and Medium Size Firms* is a survey on a representative sample of over 4000 Italian firms, providing information on R&D, innovation, destination markets for exports, etc. The Capitalia sample includes all firms with more than 500 employees and firms with less than 500 employees selected using a stratified design on location, industrial activity and size.[19] We added balance sheet information from AIDA, which provides standard data on budgets of Italian companies. Finally, we included information for modes of internationalization from the ICE-Reprint database. This is the census of foreign affiliates of Italian firms and provides information on number of employees and sales (for details, see Mariotti and Mulinelli, 2005).

Hence, our consolidated dataset provides information on firms' processes of internationalization, economic performance, innovative capacity and growth for 4289 manufacturing firms in the period 2001–2003.

Concerning variables included in the analysis, we use a specific question of the Capitalia survey to define the propensity to export as the share of firm's sales exported in 2003. From the same source we derive two dummy variables capturing innovative capacity and R&D expenditure, respectively. The variable on innovation is equal to one if in the period 2001–2003 the firm has introduced into the market an innovative product or it has set up either a new production process or an innovation in labour organization. The variable on R&D activities equals one if in the period 2001–2003 the firm has invested in R&D activities. From Capitalia, we draw the dummy variable technological intensity at 2003, based on the Pavitt taxonomy, that distinguishes firms belonging to high-tech and specialized sectors (1) from firms belonging to traditional and scale sectors (0). From a specific question of survey we get the number of destination' markets[20] in 2001–2003, for each firm included.

From AIDA we derive information on the firms size, using the number of employees in 2003. Particularly, firm's size is defined as follows: 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).

From ICE-Reprint we draw information on delocalization of production in the period 2001–2003 and we generate a dummy variable.

From ISTAT we get information on infrastructure (airport and seaport) and presence of industrial districts. Particularly, the industrial district dummy is one if the firm i, belonging to the sector k, is in the province j in which a district, belonging to the sector k, is recognized.

[19] For an extended discussion on the sample drawing, refer to Capitalia (2005).
[20] 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.