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Abstract

This paper examines the relationship between firms' heterogeneity and the internationalization decision regarding the number of markets served through both exports and FDI. Theoretically, we base on Helpman et al. (2004) and Yeaple (2009) as a basic framework for understanding this connection. For the empirical analysis, we use firm-level information of manufacturing firms from seven EU countries, as collected in the EFIGE dataset. Two different methodologies have been employed in this study: first, in order to evaluate how firms' heterogeneity (related with productivity, size, R&D, years of establishment, centralized decision making, human and physical capital intensity), influences the decision to expand exports or foreign production beyond to a single foreign market, we estimate a multinomial logit model. The outcomes show that the increasing complexity in the internationalization strategies of multinationals is not independent of the different characteristics of the firms involved. Second, to determine the extent to which changes in firms' characteristics influence the number of foreign markets to be attended through exports or foreign direct investment, we estimate a quantile regression model. Our estimates confirm the significant role of firm heterogeneity on the scope of international activities. However, different results across quantiles are obtained, suggesting the existence of heterogeneous effects and non-linearities among the whole distribution of the number of foreign markets served.

Key words: Firm heterogeneity; Internationalization strategy; Export; FDI

JEL classification: F14; F21; F23; D24

1. Introduction

It is widely accepted that the internationalization performance of firms are related not only to the host country features, but also to the firms' characteristics. Several works emphasize the role of firm heterogeneity in their internationalization structure. According to this literature, more complex internationalization strategies, as selling or producing abroad, require higher costs; so only those firms that can afford them will be able to engage in one of them (Bernard and Jensen, 1999; Melitz, 2003; Helpman et al., 2004). Exporting firms incur in a transport cost associated with trade that it is not assumed by firms that sell only in the domestic market. But if a firm decides to avoid this variable cost of exporting, by opening a local affiliate, they must instead incur fixed costs associated with opening and managing a foreign affiliate. Consistent with these theoretical predictions, numerous empirical studies in this field have provided evidence relating the international performance of firms with their own characteristics (Bernard and Jensen, 1999; Head and Ries, 2003; Girma et al., 2005; Tomiura, 2007).

But the complexity of the internalization strategies extends also to the scope of multinational firms. Indeed, as mentioned by Barba-Navaratti et al. (2010), this higher complexity might explain indeed that only a small share of European firms export to a larger number of countries.[1] Eaton et al. (2004) also found that the number of French exporters dramatically reduces with the increase in the scope of destination markets. Similarly, Bernard et al. (2005), analysing the case of US firms, obtained that the vast majority of exporters exports only in small number of markets; with over one-third exporting to a single country. For the case of foreign investments, Yeaple (2008) shows that for US multinationals, only a few firms own affiliates in more than a handful of foreign markets.

Based on the model of Helpman et al. (2004), Yeaple (2009) and Chen and More (2010) examine theoretically how firms' characteristics explain the cross-country structure of multinational enterprises (MNEs), showing that more productive firms invest in a larger

[1] These authors show that European firms that are larger, more productive, older and endowed with more skilled labour, export to a higher number of countries.

number of markets.[2] However, except some descriptive studies, to the best of our knowledge, no empirical evidence exists concerning to the relationship between firms' characteristics and the scope of their internationalization activities. The aim of this paper is to fill this gap by analysing both theoretically and empirically the relationship between firm heterogeneity and firm's internationalization decisions regarding the number of foreign markets to be served through either exports or foreign direct investment (FDI). We adopt the approach of Helpman et al. (2004) and Yeaple (2009) as a basic framework for understanding this connection. We show that in scenarios in which the only way to serve foreign markets is through exports or alternatively by FDI, it is possible to establish a hierarchy of markets in accordance with their characteristics, and a precise relationship emerges between the number of markets served and firm characteristics. However, we display that in the case that both strategies (exports or FDI) are feasible, a similar relationship can only be established for firms serving markets through FDI. Furthermore, when both modes of internationalisation are viable, and in presence of quite realistic scenarios, it is not possible theoretically to determine an exact relationship between the number of markets served through exports or FDI and the characteristics of firms. Hence, the relationship between firm characteristics and the number of markets it serves, through each internationalization strategy, becomes basically an empirical question.

For the empirical analysis, we use firm-level information of manufacturing firms from seven EU countries, as collected in the EFIGE dataset. This dataset contains detailed information of firms what allows us to relate the higher complexity of firm's internalization with a large set of firm's characteristics. Two methodologies have been used for this purpose. First, in order to evaluate how firms' heterogeneity influences the decision to extend exports or foreign production beyond to a single foreign market, we estimate a multinomial logit model (MNL). The results show that firms serving a larger number of foreign countries through exports or FDI are, on average, more productive, larger, older and more capital intensive than their respectively pairs that only serve a single foreign market. These outcomes sustain that firm heterogeneity is associated with an increasing complexity of the internationalization strategy. Second, we analyze how changes in firms' characteristics influence the number of foreign markets to be attended

[2] Concretely, these authors analyse to what extend the influence of host country characteristics on firms' investment decision vary with firm' productivity.

through exports or FDI through the estimation of a quantile regression (QR) model. The outcomes of these estimations confirm, on the one hand, that for firms producing abroad, productivity, size, capital and R&D intensity are positively related with the number of destination markets. For exporting firms, apart from these firm's features, the decentralized decision making also becomes relevant. On the other hand, our estimates verify that firm heterogeneity exert a different impact on the scope of internationalization depending on the number of market served.

The rest of the paper is organized as follow. In the next section, we present a model to analyze the relationship between firm heterogeneity and the increasing complexity of the internationalization strategy. Section 3 shows some stylized facts of European manufacturing firms with internationalization activities. Section 4 describes the econometric methodology. Section 5 presents the estimation results and the final section concludes.

2. The model

As is usual in this type of literature, we rely on CES preferences and monopolistic competition, and more specifically, we follow Helpman et al. (2004) and Yeaple (2009) as a basic framework for understanding the relationship between firm heterogeneity and the increasing complexity of firm internationalization decisions. We begin assuming that firms produce only one variety of a differentiated good and that they compete in a monopolistically competitive environment. The representative consumer allocates their expenditure across different varieties of a representative industry in accordance with a CES subutility function, with elasticity of substitution across goods equal to σ >1. By maximizing this subutility function subject to country j total expenditure in a representative industry, E_j, we obtain the demand curve in country j for each variety produced in the representative industry of country i,

$$q_{ij} = \frac{p_{ij}^{-\sigma}}{\sum_{k=1}^{N} m_k p_{kj}^{1-\sigma}} E_j,$$

where q_{ij} is the quantity demanded in country j of the representative variety produced by a firm in the representative industry in country i; p_{ij} is the delivery price of a variety

produced in i and sold in j; m_j is the number of varieties produced in country j, and N is the total number of markets considered.

We also suppose that each firm producing a variety of the differentiated good is endowed with a productivity (output per unit labor) θ, draw from a common distribution $G(\theta)$. Given that in this framework firms are atomistic, each firm treats the elasticity of substitution, σ, as its own price elasticity of demand, and the delivery price set by a representative firm producing in country i and selling in j is,

$$p_{ij} = \frac{\sigma}{\sigma - 1}\frac{\tau_{ij} w_i}{\theta}$$

where $\frac{\tau_{ij} w_i}{\theta}$ is the marginal cost to serve country j by a firm producing in country i, which depends on three factors: 1) the firm's productivity, θ; 2) the composite input cost required to produce the representative variety in country i, w_i; and 3) the transport costs to serve country j from a firm located in country i, τ_{ij}, where τ_{ij} is the iceberg transport cost factor, with $\tau_{ij} > 1$ for all $i \neq j$, and $\tau_{ij} = 1$ for all $i = j$. Under these assumptions, the gross profit earned in each destination market j by a representative firm producing in country i is,

$$\pi_{ij} = Y_j \left(\frac{\tau_{ij} w_i}{\theta}\right)^{1-\sigma} \quad (1)$$

where Y_j is the mark-up adjusted total expenditure in a representative industry, with $Y_j = \frac{E_j}{\sigma P_j}$ and $P_j \equiv \sum_{k=1}^{N} m_k \, p_{kj}^{1-\sigma}$.

Following Yeaple (2009), we consider that all domestic firms have at least a production plant at home, $i = h$, and we assume that for serving domestic market the firm has not to incur in any additional fixed cost. However, for serving each foreign market j, the firm must incur in an entry fixed cost. As in Helpman et al. (2004), the magnitude of this fixed cost differs if the market is served by exports (f_j^X) or via foreign direct investment (f_j^I), with $f_j^I > f_j^X$ for all j. Thus, for firms which chooses to export from the domestic plant at home, the net profit earned in each destination market j is,

$$\pi_j^X = Y_j \left(\frac{\tau_{hj} w_h}{\theta}\right)^{1-\sigma} - f_j^X \tag{2}$$

Alternatively, if a firm decides to open a new plant in country *j*, the net profit earned in this market is,[3]

$$\pi_j^I = Y_j \left(\frac{w_j}{\theta}\right)^{1-\sigma} - f_j^I \tag{3}$$

Finally, assuming, on the one hand, that transport costs are high enough compared with differences in wage costs between countries, avoiding thus the appearance of export platforms, as in Yeaple (2009); and, on the other hand, that the relative marginal cost of serving the market *j* from home through exports rather than through a subsidiary in *j* is relatively small compared to the fixed costs of opening an affiliate in *j* relatively to the fixed cost to enter through exports (Helpman et al., 2004), we obtain the following inequalities,

$$1 < \left(\frac{w_j}{\tau_{hj} w_h}\right)^{1-\sigma} < \frac{f_j^I}{f_j^X} \tag{4}$$

Under these assumptions, both π_j^X and π_j^I are increasing functions with firm productivity, θ, but π_j^I increases faster than π_j^X, and there exists a range of productivities high enough for which the operating profits of serving a market through exports are positive and greater than the operating profits to serve it by FDI. In fact, from (2) and (3), and making use of (4), we have that there will be a pair of productivity cutoffs for each market *j* such as a firm from country *h,* with productivity θ, verifies $\theta_j^X \leq \theta < \theta_j^I$, serving so the market *j* by export, while if $\theta \geq \theta_j^I$ the firm engages in FDI and serves the market *j* through a subsidiary. Being

$$\theta_j^X = \theta\left(\pi_j^X = 0\right) = \left[\frac{1}{(\tau_{hj} w_h)^{1-\sigma}} \left(\frac{f_j^X}{Y_j}\right)\right]^{\frac{1}{\sigma-1}} \tag{5}$$

and,

[3] Remember that $\tau_{ij} = 1$ for all $i = j$.

$$\theta_j^I = \theta\left(\pi_j^X = \pi_j^I\right) = \left[\frac{1}{w_j^{1-\sigma} - (\tau_{hj} w_h)^{1-\sigma}}\left(\frac{f_j^I - f_j^X}{Y_j}\right)\right]^{\frac{1}{\sigma-1}} \quad (6)$$

From (5) and (6) is evident that an increase in Y_j (size of the market) reduce both cutoffs, inducing the less productive firms to engage in international activities. However, a reduction in the fixed or labor cost of serving the foreign market by exports, f_j^X and w_h respectively, as well as in the transport costs, τ_{hj}, will reduce the productivity cutoff of exporting, inducing the less productive firms to export to *j*. An increase in these variables, as well as a reduction in fixed or variable labor costs of serving the foreign market by a subsidiary, f_j^I and w_j respectively, will reduce the productivity cutoff necessary to enter *j* via FDI, encouraging thus to serve this market through a subsidiary.

According to Eq. (6) we can rank all markets, from the highest to the least attractive (according to the cutoff productivity), establishing a hierarchy of different markets, as in Yeaple (2009). So that, if a firm serves a market through a subsidiary will do the same in all other markets that are more attractive in the hierarchy. Therefore, the most productive firms will invest in a larger number of markets (because their productivity exceeds the cutoff productivity for a larger number of countries). Similarly, in a model without the possibility to serve foreign markets by mean of an affiliate, as in Melitz (2003), it is also possible to establish a similar hierarchy, concluding that more productive firms will serve a larger number of markets by exports.[4]

So, while the features of markets enables sort them according to how attractive they are to be served through exports or through FDI; firm characteristics determine which markets to serve and how do it. Note, however, that in this model more productive exporters will not necessarily export to more destinations markets. The reason is that when the firm can choose to serve each market between exports or FDI, the strict hierarchy between destinations need not be maintained for exports.

[4] In Helpman (2006) can be seen some cases where it is possible to establish a similar hierarchy to Yeaple (2009), but for exporting companies, using a static version of the Melitz (2003) model, considering just exporting and non-exporting firms. Similarly, Eaton et al. (2011) suggested a "hierarchy" of markets served through exports, such that exporters will only enter the k^{th} most attractive market if they are first in the market ranked $k-1$.

Consider for example two markets, l and k, such as $\theta_l^X < \theta_k^X$ and $\theta_l^I < \theta_k^I$. Let us assume that, given the market characteristics, the respective productivity cutoffs of exporting or investing in each of them can be arranged as follows: $\theta_l^X < \theta_k^X < \theta_l^I < \theta_k^I$. Now, consider two firms with productivities θ^{f_1} and θ^{f_2}, such as $\theta^{f_1} < \theta^{f_2}$, and $\theta_l^X < \theta_k^X < \theta^{f_1} < \theta_l^I < \theta^{f_2} < \theta_k^I$. Then, the firm endowed with productivity θ^{f_1} serves the two markets (l and k) by exports, but the firm with productivity $\theta^{f_2} > \theta^{f_1}$ will export only to one market (k).

Moreover, if we relax assumption (4), considering for example that there may be a difference large enough between home and foreign markets wages, so that $w_j < w_h$, and that the transport costs are low enough, it is possible that the optimum strategy for a firm will be invest in j and using this plant as an export platform to serve other markets. As stated by Chen and Moore (2010), if the model allows firms to export from foreign affiliates, and assuming sufficiently large plan-level scale economies, the number of the markets in which each firm will invest decreases.[5]

Finally, relaxing characteristics of the model, as for example the strict symmetry among market preferences for each firm's good,[6] or the horizontal nature of FDI, allowing so the firms pursue more complex integration strategies,[7] the hierarchy between markets is broken, and it would be no longer possible to establish a strict relationship between the firm's characteristics and the modes of serving foreign markets or their sourcing strategies.

In short, although it is possible to define scenarios in which we can establish a strict hierarchy between markets, emerging a positive correlation between the number of markets served by each firm and their own characteristics, the relaxation of some assumptions (bringing them to the current reality) will lead to a growing complexity of internationalization strategies by MNEs. Therefore, the relationship between firm productivity and the number of markets it serves, both via exports or through a subsidiary, becomes essentially an empirical question.

[5] See Chen and Moore (2010), p. 191.
[6] See Chen and Moore (2010), Eaton et al. (2011) or Crozet et al. (2012).
[7] See Helpman (2006).

3. Data description and stylized facts

This paper is based on firm-level data from EU-EFIGE/Bruegel-UniCredit dataset (EFIGE). This database contains quantitative and qualitative information from a representative sample of almost 15,000 surveyed manufacturing firms in seven European economies (Germany, France, Italy, Spain, United Kingdom, Austria and Hungary). The survey data collected in 2010 with a cross-section format covers the period from 2007 to 2009.

Table 1. Descriptive statistics of firm characteristics by internationalization strategy

	Domestic	Exporter	FDI
Firm (number)	3402	9184	719
% of total	25.569	69.072	5.404
TFP (01/07)	-0.225	-0.061	-0.192
TFP (08/09)	-0.293	-0.154	0.076
Size	36.748	67.604	200.854
K/L	4.371	4.807	5.006
HK	0.196	0.310	0.269
R&D	0.397	0.671	0.842
Age	2.415	2.540	2.678

Source: Authors' calculations based on EFIGE dataset.

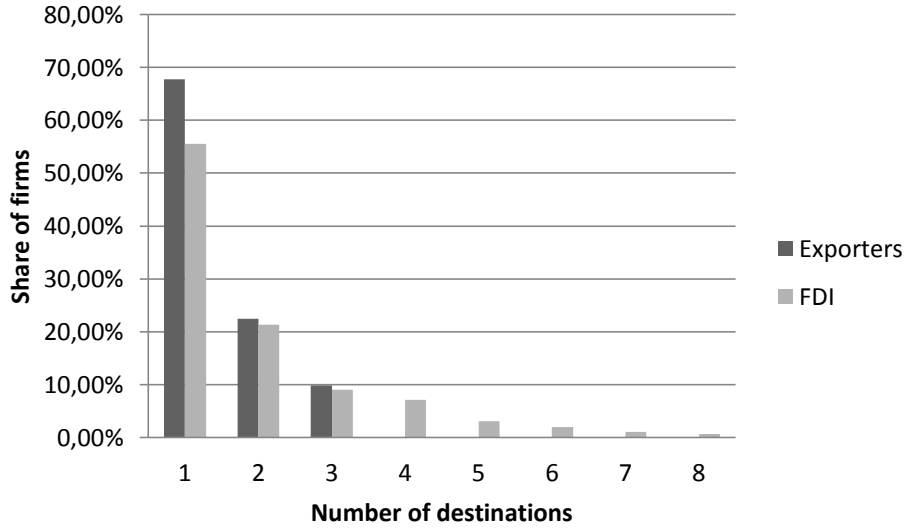
Table 1 provides different measures of firm characteristics by internationalization strategy. Concretely, we have divided the sample in three categories: domestic, exporter and FDI. The first category includes only firms that are non-active abroad, while the second and third categories includes exporters from home country and firms engaging FDI, respectively.[8] In order to capture the possible changes into TFP of firms over time, two different measures of total factor productivity have been used. Particularly, we include the average of TFP for the period 2001-07 and the TFP for the period 2008-09. Following previous literature, we also include total employment as a measure of firm' size (see, for instance, Kimura and Kiyota, 2006; Aw and Lee, 2008) and the logarithm of capital labor ratio to proxy capital intensity (Tomiura, 2007; Aw and Lee, 2008). Finally, we include other firm attributes, such as human capital, R&D intensities, and

[8] Take into account that the vast majority of firms engaging FDI (93%) are also involved in export activities.

the years of establishments (age) of the firms in order to go deeper into the connections between firm heterogeneity and its internationalization decisions.[9]

Several facts can be derived from this information. Firstly, as can be appreciated, the 74% of the firms in our sample are active internationally, indicating that the vast majority of the firms choose to expand internationally.[10] Secondly, most of the firms that expand abroad actively (93%) are exclusively exporters, while the rest (7%) are firms that engage in FDI projects. This probably reflects the different entry costs associated to each internationalization strategy, and particularly, the higher fixed investment costs that entail to set up a production plant abroad. These figures also reveal that, on average, non-active abroad firms are less productive, smaller, younger and less intensive in capital, human and R&D than those firms that participate in international activities. Furthermore, in line with previous studies, firms engaging FDI show higher values of the above mentioned characteristics than exporters (see e.g. Helpman et al., 2004; Tomiura, 2007).

Figure 1. Number of destination markets for exporters and firms engaging FDI.



Source: Authors' calculations from EU-EFIGE/Bruegel-UniCredit dataset.

[9] See Table A.1. in the Appendix for a detailed variable description.
[10] As mentioned in *The EU-EFIGE/Bruegel-UniCredit dataset* (Altomonte and Aquilante, 2012) report, the fact that the internationally active firms are more numerous in the sample with respect to the domestic firms derives from the truncation of the sample which considers a representative sample of manufacturing firms with a lower threshold of 10 employees.

Finally, Figure 1 shows as the number of both exporters and firms that engages in FDI activities dramatically reduce with the increase in the number of destination markets.[11] As pointed out by Barba-Navaretti et al. (2010), this could be due to the increase of the complexity of the internationalization strategies that entails to serve a greater number of markets. This higher complexity is probably related to the extra costs for each additional foreign market served through exports or FDI that firms have to bear in order to serve a larger number of destinations.[12]

4. Estimation methodology

In our model, we showed that depending on firm's characteristics and productivity cutoffs, it is possible to establish a sorting of firms with relation to the number of foreign markets they serve through either exports or FDI. In this section, we estimate a set of multinomial logit and quantile regression models to text the aforementioned conclusions.

Concretely, the MNL model is used here to estimate how divergences in firms' characteristics influence their internationalization strategy, and in particular to what extend the firms' heterogeneity affects the mean decision of serving more than one single market via exports or FDI.[13] To analyze the relationship between the firms' characteristics and the number of foreign markets attended at different points of the probability distribution, we employ a QR. This methodology originally developed by Koenker and Bassett (1978) allows us to provide an extensive description of the distributional effects of predictors.

As seen previously, in this study we consider several firm's characteristics; and particularly, productivity, the size and years of establishment, capital and R&D intensity, skills endowments and the centralized decision making. As a robustness test,

[11] Take into account that the eight markets considered in our study are as following: 15EU, other EU countries, other European countries not EU, China and India, other Asian countries (excluded China and India), USA and Canada, Central and South America, other areas.

[12] It seems plausible to assume that the larger the number of markets the higher will be (at least, on average) the distance related costs of exporting an exporter has to bear as well as the additional fixed costs of exporting. Similarly, for firms engaging FDI it is clear that they have to pay the costs of setting up a production plant for each market they decide to invest.

[13] As well known, this methodology provides an adequate framework to analyse firms' strategy decisions when the strategy election among alternatives is modelled as a function of the firms' characteristics.

we include two measures of productivity: the average of TFP for the periods 2001-07 and 2008-09. Moreover, according to Helpman et al. (2004), the dispersion of firm size may capture the joint effect of firm productivity and the elasticity of substitution. To disentangle both effects, we include further, instead of firm productivity, the total employment as a measure of firm' size (Kimura and Kiyota, 2006; Aw and Lee, 2008) and the log of capital labor ratio to proxy capital intensity (Tomiura, 2007; Aw and Lee, 2008). We also introduce, as mentioned previously, other firm attributes, such as human capital, R&D intensity, the age of firms and a variable reflecting firm's decision making (centralized/decentralized). See Table A.1. in the appendix for a detailed description of variables.

4.1. Multinomial logit model

We start estimating the MNL model to analyze how differences in firm's characteristics are associated with both decisions: internationalization and serving several foreign markets. Consistent with the random profit maximization framework (McFadden, 1974), the MNL assumes that each firm that faces a finite set of mutually exclusive strategy decisions, $s \in \{h, x_1, x_N, i_1, i_N\}$,[14] selects the strategy that yields the highest profit. The expected profit of a firm from each strategy consists of two components, the deterministic part, which depends on a strategy specific parameter, α_s, and on a set of observed firm characteristics, X, and the unobservable part, which is capture by a stochastic term, ε. That is,

$$\pi_s = \alpha_s + \beta_s X + \varepsilon_s \tag{7}$$

Given that ε is unknown, the final firms' strategy is predicted in terms of probability. More specifically, the probability that a firm selects one strategy *s* rather than other (denoted as *k*) can be described as,

$$Pr_s = P(\pi_s > \pi_k) \tag{8}$$

[14] In our case *s* represents the strategies of home country domestically oriented firms (*h*), export to a single country (x_1), export to multiple countries (x_N), engage FDI in a single country (i_1), and engage FDI in multiple countries (i_N). Take into account that we have divided the sample by this way, given the characteristics of our data (see Figures 1 and 2), where the vast majority of firms serve a single foreign market.

To solve the above equation, we should impose a probability density function on ε_s. In particular, if we assume that the error term is independently and identically distributed with type I extreme value distribution,[15] the probability that a firm chooses the strategy *s* is given by

$$Pr_s = \frac{exp[\alpha_s + \beta_s X]}{\sum_{k=1}^{K} exp[\alpha_k + \beta_k X]} \tag{9}$$

Since $\sum_k Pr_k = 1$the K sets of parameters $(\alpha,\ \beta)$ are not unique. So, to identify the parameters α_s and β_s, we need to fix the coefficients for one strategy to zero, in this case the strategy to serve domestically the home market (that is, $\alpha_h = 0$ and $\beta_h = 0$).[16] In fitting such a model, the estimated MNL model becomes,

$$Pr_s = \frac{exp\left[\tilde{\alpha}_s + \tilde{\beta}_s X\right]}{1 + \sum_{k=1}^{K} exp\left[\tilde{\alpha}_k + \tilde{\beta}_k X\right]} \tag{10}$$

where the coefficients $\tilde{\beta}_k = (\beta_k - \beta_h)$ represent now the effect of the X variables on the probability of choosing the k^{th} strategy over the alternative to locate in home country and serve it domestically. In the above equation, the constant term $\tilde{\alpha}_k = (\alpha_k - \alpha_h)$ depicts the fixed costs for each strategy that are invariant across firms.

4.2. Quantile regression

Next, to estimate the relationship between different firms' characteristics and the number of markets they operate, we employ the QR model. By using the conditional quantiles, $Q_q(y|X)$, the QR allows us to consider the impact of a regressor on the entire distribution of our dependent variable (and not uniquely on its conditional mean). This

[15] The iid assumption on the error term imposes the property of independence of irrelevant alternatives (IIA). According to this property, the ratio of probabilities of chose between two strategies depends only on the attributes of these two strategies, and is independent of the attributes of other possible alternatives.
[16] In the MNL, the *L* sets of parameters have not a unique solution. To identify parameters in the MNL model, it is necessary to identify one of the possible strategies as the base strategy and to set its parameters to zero. Thus, the remaining coefficients would measure the relative change with respect to the base group or strategy.

ability to provide a comprehensive description of the distributional effects has contributed to make QR popular in several research fields.[17] However, in the specific research field about the links between firm heterogeneity and the scope of the internationalization activities, applications are yet to come. Previous results have generally been reached by using standard ordinary least squares estimations (Chen and Moore, 2010), which contribute to explain the effects on the conditional mean value of the variable of interest, but not how the impact that a covariate have on this variable may vary at different quantiles. The QR provides however a complete view about the effects of the predictors, *X* (firms' characteristics) on the entire distribution of our response variable, *y* (number of foreign markets served in each internationalization strategy). Moreover, the quantile regression is less sensitive to strong skewness or outliers since it does not require the data follow a specific probability distribution, such as normal or Poisson distribution.

In this study different quantiles (q) are selected in order to highlighting the existence of heterogeneous effects and non-linearities.[18] Following Koenker and Bassett (1978), the parameter coefficients are estimated by minimizing the following objective function,

$$min\left[\sum_{i:y_i \geq Q_y(q)} q\left|y_i - Q_y(q|X)\right| + \sum_{i:y_i < Q_y(q)} (1-q)\left|y_i - Q_y(q|X)\right|\right] \qquad (11)$$

where $log\left(Q_y(q|X)\right) = \alpha_s + \beta_s X$.

For a count data model, the objective function is not differentiable, making it difficult to express the quantiles directly as a continuous function of predictor variables, and therefore smoothing approaches are needed in order to apply QR (Machado and Silva, 2005). In this work, we use the method developed by these authors to estimate the QR regarding how firms' characteristics affect the number of markets served.[19]

[17] See Yu et al. (2003) and Koenker (2005) for an overview of recent applications of this methodology.
[18] Note that selecting quantile $q = 0.5$ would refer to median regression, analogously to OLS when referring to average regression.
[19] Machado and Silva's jittering algorithm was implemented in statistical software by Miranda (2007).

5. Main results

5.1. Firm heterogeneity and complexity of firm internationalization

In Table 3, we report the results of estimating the MNL model considering separately the average of TFP for the periods 2001-07 and 2008-09. Table 4 shows the estimates when the size and the capital intensity of firms are included instead.[20] In these tables, the coefficients of each variable on the first four columns describe the influence of these covariates on the likelihood of a firm belonging to different internalization strategies relative to the base strategy of non-active abroad firms. Conversely, the last six columns are reporting the differences in the coefficients across these internationalization strategies.[21]

Several outcomes are derived from these estimates. First, the negative and significant effects of constant terms are reflecting the higher fixed costs to operate actively abroad relative to non-active abroad firms, conditional to all firm's characteristics. Second, the outcomes corroborate that firms involved internationally are more productive, larger, older and more capital and R&D intensive than non-active abroad firms.[22] Moreover, it is found that the variable related to centralized decision making is negative and significant, indicating that firms with an international activity have more decentralized structures than those that operate only in the domestic market. This agrees with some studies on internationalized firms in management literature which pointed out that when the degree of internationalization strategy increases, the parent firms find more useful to delegate more decisions, particularly to their foreign affiliates (Doz, 1986; Porter, 1986; Dyment, 1987; Bartlett and Ghoshal, 1989).

[20] See Table A.2 in the appendix to see the basic model results.
[21] Note that the constant parameters in each regression can be interpreted as the scale of fixed costs of each strategy as interpreted by Aw and Lee (2008).
[22] These results agree with previous studies (see e.g. Helpman et al., 2004; Tomiura, 2007).

Table 2. Multinomial logit regression of firm strategy decisions (TFP). Extended model.

Independent Variables	Exporter single	Exporter multi.	FDI single	FDI multi.	Exporter single Vs Exporter multi.	Exporter single Vs FDI single	Exporter single Vs FDI multi.	Exporter multi Vs FDI single	Exporter multi Vs FDI multi.	FDI single Vs FDI multi.
Constant	-0.21 (0.12)*	-1.96 (0.16)***	-4.82 (0.37)***	-5.96 (0.51)***	1.75 (0.13)***	4.62 (0.36)***	5.75 (0.51)***	2.86 (0.38)***	4.00 (0.51)***	1.13 (0.61)*
TFP (01/07)	0.47 (0.06)***	0.75 (0.08)***	1.28 (0.14)***	1.78 (0.15)***	-0.28 (0.06)***	-0.81 (0.13)***	-1.30 (0.14)***	-0.53 (0.13)***	-1.02 (0.14)***	-0.49 (0.17)***
HK intensity	0.37 (0.06)***	0.54 (0.07)***	0.29 (0.14)**	0.02 (0.16)	-0.17 (0.05)***	0.08 (0.13)	0.35 (0.15)**	0.25 (0.14)*	0.52 (0.16)***	0.27 (0.20)
R&D intensity	0.74 (0.05)***	1.21 (0.06)***	1.50 (0.15)***	1.96 (0.20)***	-0.47 (0.05)***	-0.76 (0.15)***	-1.22 (0.20)***	-0.29 (0.15)*	-0.75 (0.20)***	-0.46 (0.25)*
Centralized	-0.26 (0.06)***	-0.03 (0.07)	-0.58 (0.13)***	-0.88 (0.14)***	-0.23 (0.05)***	0.32 (0.12)***	0.62 (0.13)***	0.55 (0.13)***	0.85 (0.14)***	0.29 (0.18)*
Age	0.27 (0.04)***	0.39 (0.05)***	0.68 (0.12)***	0.87 (0.15)***	-0.12 (0.04)***	-0.40 (0.12)***	-0.59 (0.15)***	-0.28 (0.12)***	-0.47 (0.15)***	-0.59 (0.15)***
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	5110	2218	276	238						
Sample	9869									
Likelihood	-10937.18									
Constant	-0.23 (0.13)*	-2.19 (0.17)***	-5.21 (0.41)***	-5.83 (0.55)***	1.95 (0.14)***	4.97 (0.40)***	5.59 (0.51)***	3.02 (0.41)***	3.64 (0.55)***	0.62 (0.67)
TFP (08/09)	0.32 (0.05)***	0.46 (0.06)***	0.85 (0.15)***	1.17 (0.13)***	-0.14 (0.05)***	0.53 (0.14)***	-0.84 (0.12)***	-0.39 (0.14)***	-0.70 (0.13)***	-0.31 (0.17)*
HK intensity	0.35 (0.06)***	0.54 (0.07)***	0.21 (0.15)	-0.02 (0.18)	-0.18 (0.05)***	0.13 (0.14)	0.37 (0.17)**	0.3 (0.15)**	0.56 (0.17)***	0.23 (0.21)
R&D intensity	0.76 (0.05)***	1.28 (0.07)***	1.51 (0.14)***	2.18 (0.23)***	-0.51 (0.06)***	-0.75 (0.16)***	-1.41 (0.23)***	-0.23 (0.17)	-0.90 (0.23)***	0.66 (0.28)**
Centralized	-0.20 (0.06)***	0.01 (0.07)	-0.51 (0.14)***	-0.88 (0.15)***	-0.21 (0.06)***	0.30 (0.13)**	0.67 (0.15)***	0.51 (0.14)***	0.89 (0.15)***	0.37 (0.19)*
Age	0.28 (0.04)***	0.46 (0.05)***	0.84 (0.13)***	0.82 (0.16)***	-0.18 (0.04)***	-0.55 (0.13)***	-0.53 (0.16)***	-0.37 (0.13)***	-0.35 (0.16)**	0.02 (0.20)
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	4261	1931	235	199						
Sample	8804									
Likelihood	-9699.58									

Note: Standard errors are in parentheses where ***, ** and * respresent significance at 1%, 5% and 10% level respectively.

The results in the last six columns in each table show the ranking of the coefficients of each firm characteristic for those active abroad firms. Independently of the number of markets served, firms investing abroad have to pay a higher fixed cost, are more productive, larger, older, descentralized and more capital and R&D intensive than exporters. However, our results go a bit further showing that these firm characteristics are higher for exporters and investors which operate in more than a single foreign market. The estimates reveal that firms involve in a larger number of foreign markets through exports or FDI assume higher fixed costs than the respective peers involving in a single market. Additionally, we found that not only the most productive firms participate in FDI projects in a larger number of markets, as shown by Yeaple (2009) and Chen and Moore (2010), but also that the largest, oldest, the most decentralized and capital and R&D intensive firms do. Unlike previous works, we also obtain similar conclusions for exporters, corroborating that only those exporters with the highest values of early firm characteristics (except for the centralized decision making variable) are able to export in more than a single market. As mentioned, the only exception is that exporters with a higher scope show a lower decentralization in their decision making than those serving a single market. This is probably because managers who take decisions could be the same independently the number of foreign markets served through exports. However, some results regarding the human capital variable show that there are not statistical differences across firms involved in different internationalization strategies. We cannot either to establish a clear ranking related to the human capital intensity of firms and their internationalization decision.

Finally, our estimates reveal that oldest firms are more likely to invest abroad than export. We also found that firms serving more than one market are older than those firms serving a single market for each internationalization strategies, exports or FDI. Firms need to accumulate technological and human capital acquired along the years to obtain the knowledge that requires facing a higher complexity in their internationalization strategies: first, to move production facilities to a foreign market, and, second, to geographically expand these internationalization activities to a larger number of foreign markets.

Table 3. Multinomial logit regression of firm strategy decisions (size and capital intensity). Extended model.

Independent Variables	Exporter single	Exporter multi.	FDI single	FDI multi.	Exporter single Vs Exporter multi.	Exporter single Vs FDI single	Exporter single Vs FDI multi.	Exporter multi Vs FDI single	Exporter multi Vs FDI multi.	FDI single Vs FDI multi.
Constant	-1.66 (0.14)***	-3.73 (0.16)***	-8.95 (0.36)***	-10.84 (0.50)***	2.06 (0.13)***	7.28 (0.34)***	9.18 (0.49)***	5.21 (0.34)***	7.11 (0.49)***	1.89 (0.57)***
Size	0.46 (0.03)***	0.59 (0.03)***	1.27 (0.05)***	1.48 (0.06)***	-0.13 (0.02)***	-0.80 (0.04)***	-1.02 (0.05)***	-0.67 (0.04)***	-0.89 (0.05)***	-0.21 (0.07)***
HK intensity	0.50 (0.05)***	0.70 (0.06)***	0.82 (0.12)***	0.62 (0.15)***	-0.20 (0.04)***	-0.31 (0.12)***	-0.11 (0.14)	-0.11 (0.12)	0.08 (0.14)	0.19 (0.18)
R&D intensity	0.60 (0.04)***	1.11 (0.05)***	1.15 (0.14)***	1.55 (0.18)***	-0.51 (0.04)***	-0.55 (0.13)***	-0.95 (0.18)***	-0.04 (0.14)	-0.43 (0.18)**	-0.39 (0.22)*
Centralized	-0.24 (0.05)***	-0.11 (0.06)*	-0.49 (0.11)***	-0.76 (0.12)***	-0.12 (0.04)***	0.25 (0.11)**	0.51 (0.12)***	0.38 (0.11)***	0.64 (0.12)***	0.26 (0.15)*
Age	0.19 (0.03)***	0.30 (0.04)***	0.41 (0.09)***	0.55 (0.12)***	-0.10 (0.03)***	-0.22 (0.09)**	-0.36 (0.11)***	-0.11 (0.09)	-0.25 (0.11)**	-0.13 (0.14)
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	7185	3453	397	319						
Sample	14235									
Likelihood	-15713.39									
Constant	-1.66 (0.21)***	-4.87 (0.28)***	-7.89 (0.66)***	-9.88 (0.71)***	3.20 (0.22)***	6.23 (0.63)***	8.22 (0.68)***	3.02 (0.64)***	5.01 (0.69)***	1.98 (0.90)**
K/L	0.36 (0.03)***	0.68 (0.04)***	0.66 (0.11)***	0.92 (0.08)***	-0.31 (0.03)***	-0.30 (0.10)***	-0.55 (0.08)***	0.01 (0.10)	-0.24 (0.08)***	-0.25 (0.12)**
HK intensity	0.24 (0.07)***	0.32 (0.08)***	0.07 (0.16)	-0.36 (0.18)*	-0.07 (0.06)	0.17 (0.15)	0.60 (0.17)***	0.24 (0.15)	0.68 (0.17)***	0.43 (0.22)*
R&D intensity	0.77 (0.06)***	1.23 (0.07)***	1.56 (0.17)***	2.29 (0.24)***	-0.45 (0.06)***	-0.78 (0.17)***	-1.51 (0.23)***	-0.33 (0.17)*	-1.06 (0.24)***	-0.73 (0.29)**
Centralized	-0.32 (0.07)***	-0.15 (0.08)*	-0.69 (0.15)***	-1.14 (0.16)***	-0.16 (0.06)***	0.36 (0.14)***	0.81 (0.15)***	0.53 (0.14)***	0.98 (0.15)***	0.44 (0.20)**
Age	0.22 (0.04)***	0.35 (0.06)***	0.71 (0.13)***	0.72 (0.16)***	-0.13 (0.05)***	-0.48 (0.13)***	-0.50 (0.16)***	-0.35 (0.13)***	-0.36 (0.16)**	-0.01 (0.20)
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	4227	1850	231	205						
Sample	7866									
Likelihood	-8697.97									
Constant	-3.19 (0.25)***	-6.88 (0.31)***	-11.97 (0.70)***	-14.32 (0.82)***	3.69 (0.23)***	8.78 (0.65)***	11.12 (0.79)***	5.08 (0.65)***	7.43 (0.78)***	2.34 (0.96)**
Size	0.49 (0.04)***	0.66 (0.04)***	1.35 (0.07)***	1.48 (0.08)***	-0.16 (0.03)***	-0.85 (0.06)***	-0.98 (0.07)***	-0.68 (0.06)***	-0.81 (0.07)***	-0.13 (0.09)
K/L	0.34 (0.03)***	0.65 (0.04)***	0.57 (0.11)***	0.79 (0.09)***	-0.30 (0.03)***	-0.22 (0.10)**	-0.44 (0.08)***	0.08 (0.10)	0.15 (0.08)*	-0.22 (0.12)*
HK intensity	0.40 (0.07)***	0.55 (0.08)***	0.68 (0.17)***	0.34 (0.19)*	-0.15 (0.06)***	-0.28 (0.16)*	0.05 (0.18)	-0.12 (0.16)	0.21 (0.18)	0.34 (0.23)
R&D intensity	0.65 (0.06)***	1.04 (0.07)***	1.05 (0.18)***	1.73 (0.25)***	-0.39 (0.06)***	-0.40 (0.17)**	-1.08 (0.24)***	-0.01 (0.18)	-0.69 (0.24)***	-0.67 (0.29)**
Centralized	-0.21 (0.07)***	0.01 (0.08)	-0.29 (0.16)**	-0.70 (0.16)***	-0.22 (0.06)***	0.08 (0.14)	0.49 (0.15)***	0.31 (0.15)**	0.71 (0.15)***	0.40 (0.20)**
Age	0.16 (0.04)***	0.26 (0.06)***	0.45 (0.13)***	0.41 (0.16)***	-0.10 (0.05)**	-0.29 (0.13)**	-0.25 (0.15)*	-0.19 (0.13)	-0.15 (0.15)	0.03 (0.19)
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	4078	1769	218	199						
Sample	7866									
Likelihood	-8405.24									

Note: Standard errors are in parentheses where ***, ** and * respresent significance at 1%, 5% and 10% level respectively.

5.2. Relationship between firm characteristics and the number of markets served

The possible linkage between firms' characteristics and the scope of internationalization activities is here analyzed by estimating a QR model.[23] Concretely, in this section, we perform the QR of the extended model for both exporters and firms engaging FDI (see Tables 4, 5 and 6).[24] Results for the main quantiles for the different internationalization strategies are presented in the first four columns, while the last column reports the estimation to median regression (quantile 0.5).[25]

Table 4. Quantile regression TFP (01/07). Extended model.

Exporters	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	0.183***	0.319***	0.435***	0.604***	0.352***
	(0.033)	(0.043)	(0.042)	(0.037)	(0.042)
TFP (01/07)	0.032**	0.040**	0.025	0.023	0.025
	(0.015)	(0.019)	(0.016)	(0.016)	(0.017)
HK	0.041***	0.056***	0.046***	0.031*	0.055***
	(0.016)	(0.020)	(0.016)	(0.017)	(0.018)
R&D	0.109***	0.174***	0.145***	0.073***	0.183***
	(0.013)	(0.020)	(0.021)	(0.016)	(0.022)
Centralized	-0.039**	-0.047**	-0.032**	-0.021	-0.039**
	(0.017)	(0.020)	(0.016)	(0.019)	(0.019)
Age	0.004	0.010	0.030**	0.042***	0.020
	(0.011)	(0.015)	(0.013)	(0.012)	(0.014)
Observations	4211				
FDI	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	0.095	0.191	0.256	0.256	0.249
	(0.084)	(0.150)	(0.197)	(0.219)	(0.176)
TFP (01/07)	0.114***	0.198***	0.283***	0.281***	0.255***
	(0.039)	(0.062)	(0.080)	(0.090)	(0.069)
HK	-0.031	-0.052	-0.117	-0.090	-0.080
	(0.029)	(0.050)	(0.086)	(0.128)	(0.062)
R&D	0.057**	0.108**	0.230***	0.364***	0.145**
	(0.028)	(0.049)	(0.079)	(0.126)	(0.063)
Centralized	-0.045	-0.073	-0.141*	-0.099	-0.101
	(0.029)	(.050)	(0.084)	(0.108)	(0.067)
Age	0.014	0.016	0.046	0.126*	0.018
	(0.026)	(0.047)	(0.068)	(0.076)	(0.057)
Observations	530				

Note: Standard errors are in parentheses where ***, ** and * represent significance at 1%, 5% and 10% level respectively.

[23] As previously mentioned, this relationship has been analyzed by scarce studies providing in the vast majority of cases just descriptive statistics (Yeaple, 2009) or using OLS estimations (Chen and Moore, 2010), which have provided useful insights about a positive relationship between firms' productivity and number of markets served, as commented on throughout this paper, they focus on the average effect. Therefore, these methodologies sheds no light on the effects in other particular parts of the response variable (number of foreign markets served), where effects of firms characteristics may vary across different quantiles, implying differing behaviors depending on the number of markets previously served.

[24] Note that both Yeaple (2009) and Chen and Moore (2010) only analyzed this relationship for firms engaging FDI,

[25] See Tables A.3, A.4 and A.5 in the appendix to observe results on the basic models.

The outcomes show that a significant relationship exists between the different firm characteristics and their participation in a larger number of markets, for both exporters and firms engaging in FDI. These coefficients have similar signs in all quantiles and the mean, indicating that the effects of these variables, although may be different in magnitude, are consistent in terms of direction. For exporters, productivity, human capital, R&D and capital intensity exhibit a positive and significant relationship with the number of markets to be served, while a negative effect of centralized decision making is obtained for higher internationalization scope. This confirms that, as we conclude from the MNL estimates, firms exporting to a larger number of markets are more decentralized.

Table 5. Quantile regression TFP (08/09). Extended model.

Exporters	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	0.165***	0.293***	0.395***	0.568***	0.323***
	(0.035)	(0.046)	(0.046)	(0.038)	(0.043)
TFP (08/09)	0.031**	0.039**	0.028*	0.023	0.031*
	(0.014)	(0.018)	(0.016)	(0.014)	(0.017)
HK	0.044***	0.060***	0.055***	0.041**	0.061***
	(0.017)	(0.020)	(0.016)	(0.018)	(0.019)
R&D	0.121***	0.192***	0.168***	0.087***	0.201***
	(0.014)	(0.021)	(0.024)	(0.017)	(0.022)
Centralized	-0.038**	-0.045**	-0.028	-0.015	-0.034*
	(0.018)	(0.021)	(0.017)	(0.020)	(0.019)
Age	0.009	0-016	0.035***	0.047***	0.025*
	(0.012)	(0.016)	(0.014)	(0.012)	(0.014)
Observations	3672				
FDI	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	0.153	0.259	0.315*	0.204	0.322*
	(0.102)	(0.172)	(0.195)	(0.257)	(0.184)
TFP (08/09)	0.040	0.080*	0.189***	0.255***	0.129**
	(0.025)	(0.046)	(0.050)	(0.048)	(0.057)
HK	-0.024	-0.046	-0.110	-0.071	-0.068
	(0.032)	(0.056)	(0.088)	(0.142)	(0.073)
R&D	0.084***	0.152***	0.324***	0.458***	0.214***
	(0.029)	(0.049)	(0.082)	(0.154)	(0.066)
Centralized	-0.049	-0.083	-0.173**	-0.139	-0.147*
	(0.032)	(0.055)	(0.087)	(0.108)	(0.082)
Age	-0.010	-0.011	0.023	0.146*	-0.004
	(0.033)	(0.056)	(0.063)	(0.257)	(0.063)
Observations	447				

Note: Standard errors are in parentheses where ***, ** and * represent significance at 1%, 5% and 10% level respectively.

For investing firms, the size also exhibits a positive and significant relationship with respect to the number of foreign markets they serve. However, in this case, human capital is not significant in the explanation of the scope of foreign investments when included TFP. This is in line with our previous results that showed that this variable was

not relevant in the decision for foreign invest in some of the considered scenarios (see Tables 2 and 3).

Table 6. Quantile regression (size and capital intensity). Extended model.

Exporters	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	0.075	0.187**	0.333***	0.492***	0.245***
	(0.064)	(0.081)	(0.074)	(0.071)	(0.076)
Size	0.003	0.004	0.005	0.007	0.004
	(0.008)	(0.010)	(0.008)	(0.008)	(0.009)
K/L	0.019**	0.025**	0.022**	0.196*	0.024**
	(0.009)	(0.012)	(0.010)	(0.011)	(0.011)
HK	0.038**	0.047**	0.042***	0.036*	0.049**
	(0.019)	(0.023)	(0.017)	(0.020)	(0.020)
R&D	0.111***	0.170***	0.124***	0.058***	0.163***
	(0.016)	(0.023)	(0.023)	(0.018)	(0.025)
Centralized	-0.047**	-0.053**	-0.040**	-0.032	-0.048**
	(0.020)	(0.022)	(0.017)	(0.020)	(0.020)
Age	0.010	0.015	0.030**	0.042***	0.023
	(0.014)	(0.017)	(0.013)	(0.012)	(0.015)
Observations	3276				
FDI	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	-0.134	-0.266	-0.674**	-0.965***	-0.431
	(0.167)	(0.259)	(0.303)	(0.315)	(0.291)
Size	0.035**	0.064**	0.116***	0.211***	0.087**
	(0.016)	(0.028)	(0.041)	(0.043)	(0.035)
K/L	0.034*	0.059**	0.095***	0.086*	0.77***
	(0.019)	(0.025)	(0.034)	(0.050)	(0.030)
HK	-0.025	-0.059	-0.103	-0.040	-0.088
	(0.037)	(0.061)	(0.109)	(0.113)	(0.079)
R&D	0.078**	0.147***	0.265***	0.257	0.201***
	(0.033)	(0.057)	(0.091)	(0.168)	(0.073)
Centralized	-0.067*	-0.121**	-0.187**	-0.177*	-0.169**
	(0.035)	(0.060)	(0.090)	(0.097)	(0.081)
Age	-0.017	-0.021	0.034	0.123	-0.002
	(0.035)	(0.052)	(0.061)	(0.086)	(0.291)
Observations	433				

Note: Standard errors are in parentheses where ***, ** and * respresent significance at 1%, 5% and 10% level respectively.

The above mentioned effects although equal in term of direction differ in magnitude at different quantiles, suggesting the existence of heterogeneous effects and non-linearities. For firms investing abroad, we observe that the coefficients on productivity, size, capital and R&D intensities increase progressively from lowest quantiles until the highest ones.[26] This finding is suggesting that the impact of the different firms' characteristics on the number of foreign markets served will increase for firms engaging FDI in a larger number of markets. This may be explained by the fact that probably it is

[26] Recall that the quantile regression parameter estimates the change in a specified quantile of the response variable produced by one unit change in the predictor variable.

harder to invest in one additional market for those firms investing in a smaller number of markets than for firms than operate in a larger number of destinations.

However, results are rather different when we look at exporters. Our estimates show that the positive relationship between firms' characteristics and the number of markets they export increases only along the lowest quantiles. The marginal benefits from increasing the firm's productivity, physical and human capital and R&D intensities rapidly decrease after quantile 0.4. The firms' productivity variables have even a non-statistical effect in the highest quantiles. This could be due to the fact that, as showed in our model, there exists a cutoff productivity from which firms may change their internationalization strategy from export to FDI.

6. Conclusions

Recent literature on the firm heterogeneity has shown that the firm characteristics play a key role in determining their internationalization decisions. This study tries to bring more light to this literature by analyzing the relationship among firm's characteristics and the number of markets served through both exports and FDI. Based on Helpman et al. (2004) and Yeaple (2009)'s models, we show that, under some assumptions, it is possible to establish a hierarchy for exporters and investors depending on their own characteristics and the number of markets they operate. However, in a framework where both internationalization strategies coexists the model fails, and consequently, firms cannot serve foreign markets through exports and FDI according to an exact hierarchy.

Additionally, by exploiting a rich dataset that combines information on firm's characteristics and their internationalization activities with the number of markets served, we analyze empirically the relationship between firm heterogeneity and the increasing complexity of firms' internationalization decisions. To do that, we use two different methodologies: multinomial logit and quantile regression models.

Our results from the multinomial logit model confirm the evidence provided by some previous studies showing that non-active abroad firms are less productive, smaller, younger, and less capital, R&D and human capital intensives than active abroad firms, but furthermore, that firms engaging FDI show higher values for the previous firms'

characteristics than exporters. In this study, we have also included a variable related to the centralized decision making, finding a significant relationship between the degrees of complexity of internationalized firms with their internal performance. We also obtain that the increasing complexity of internationalization decisions, in terms of number of destinations, is associated with firm heterogeneity. Particularly it is shown that firms engaged in multiple markets through exports or FDI are more productive, larger, older, more capital, R&D and human capital intensive than those firms engaged in a single markets. For investing firms, they also are more decentralized.

The outcomes from the quantile regression verify the significant relationship between productivity, size, capital and R&D intensities and the number of destination markets for internationalized firms. Additionally, these estimates reveal that firm's characteristics exert a different impact on the number of market served depending on the scope of internationalization, showing however a different behavior for exporters and foreign investors. Concretely, it is obtained that for firms investing abroad the above firm's characteristics increase progressively from lowest quantiles until the highest ones, suggesting the existence of heterogeneous effects and non-linearities related to the number of markets. Nevertheless, when we only consider exporters, we find that the previous firm's characteristics only increase, and even are positively associated with the number of markets for the lowest quantiles. This result may suggest that once an exporter reaches a certain level of performance in terms of productivity, R&D and human capital intensities, changes from export to FDI in order to serve the foreign markets.

Several aspects deserve further studies to be confirmed and deepened. In this regard, it would be interesting to investigate the behavior of internationalized firms taken into account other firms' characteristics related to the organizational form and firm's structure.

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Appendix

Table A.1. Definition of variables.

Variable	*Definition*
TFP (01/07)	Solow residual of a Coob-Douglas production function estimated following the semi-parametric algorithm proposed by Levinsohn and Petrin (2003), 2001-2007.
TFP (08/09)	Solow residual of a Coob-Douglas production function estimated following the semi-parametric algorithm proposed by Levinsohn and Petrin (2003), 2008-2009.
Size	Measured in terms of ln(total employment).
K/L	Natural logarithm of capital labour ratio.
HK	Dummy for Human Capital: firm has a higher share of graduate employees with respect to national average share of graduates.
R&D	Dummy for R&D: firm employ more than 0 employees to R&D activities.
Centralized	Dummy for centralized/decentralized: It takes value 1 if the CEO/owner takes most decisions in every area and 0 if managers can take autonomous decisions in some business areas.
Age	Year of establishment (parent firm).

Source: EU-EFIGE/Bruegel-UniCredit dataset

Table A.2. Multinomial logit regression of firm strategy decisions (TFP). Basic model.

Independent Variables	Exporter single	Exporter multi.	FDI single	FDI multi.	Exporter single Vs Exporter multi.	Exporter single Vs FDI single	Exporter single Vs FDI multi.	Exporter multi Vs FDI single	Exporter multi Vs FDI multi.	FDI single Vs FDI multi.
Constant	0.70 (0.04)***	-0.23 (0.06)***	-2.61 (0.15)***	-3.19 (0.19)***	0.93 (0.05)***	3.31 (0.16)***	3.89 (0.19)***	2.37 (0.15)***	2.95 (0.20)***	0.57 (0.24)**
TFP (01/07)	0.62 (0.06)***	0.94 (0.08)***	1.56 (0.13)***	2.11 (0.14)***	-0.32 (0.06)***	-0.94 (0.12)***	-1.49 (0.13)***	-0.61 (0.12)***	-1.16 (0.13)***	-0.55 (0.16)***
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	5305	2312	288	244						
Sample	10248									
Likelihood	-11728.97									
Constant	0.73 (0.05)***	-0.23 (0.06)***	-2.53 (0.16)***	-3.03 (0.20)***	0.97 (0.05)***	3.27 (0.16)***	3.77 (0.20)***	2.98 (0.16)***	2.79 (0.21)***	0.49 (0.25)***
TFP (08/09)	0.40 (0.05)***	0.57 (0.06)***	1.05 (0.14)***	1.39 (0.12)***	-0.17 (0.05)***	-0.65 (0.13)***	-0.98 (0.11)***	-0.48 (0.13)***	-0.81 (0.12)***	-0.33 (0.16)**
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	4778	2011	247	206						
Sample	9125									
Likelihood	-10432.97									
Constant	-3.06 (0.22)***	-6.12 (0.27)***	-10.99 (0.58)***	-13.56 (0.59)***	3.05 (0.19)***	7.93 (0.53)***	10.49 (0.56)***	4.87 (0.52)***	7.43 (0.55)***	2.56 (0.71)***
Size	0.57 (0.04)***	0.74 (0.04)***	1.46 (0.07)***	1.66 (0.07)***	-0.17 (0.02)***	-0.89 (0.05)***	-1.09 (0.07)***	-0.71 (0.06)***	-0.91 (0.07)***	-0.20 (0.08)**
K/L	0.41 (0.03)***	0.72 (0.04)***	0.64 (0.10)***	0.85 (0.08)***	-0.30 (0.03)***	-0.23 (0.09)**	-0.44 (0.07)***	0.07 (0.09)	-0.13 (0.07)*	-0.21 (0.11)*
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	4227	1850	231	205						
Sample	8176									
Likelihood	-8931.07									

Note: Standard errors are in parentheses where ***, ** and * respresent significance at 1%, 5% and 10% level respectively.

Table A.3. Quantile regression TFP (01/07). Basic model.

Exporters	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	0.249***	0.447***	0.616***	0.762***	0.534***
	(0.006)	(0.010)	(0.007)	(0.006)	(0.009)
TFP (01/07)	0.044***	0.069***	0.049***	0.034***	0.060***
	(0.015)	(0.021)	(0.016)	(0.015)	(0.019)
Observations	4365				
FDI	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	0.139***	0.257***	0.426***	0.845***	0.317***
	(0.011)	(0.020)	(0.043)	(0.058)	(0.026)
TFP (01/07)	0.124***	0.228***	0.368***	0.335***	0.294***
	(0.038)	(0.060)	(0.062)	(0.089)	(0.068)
Observations	548				

Note: Standard errors are in parentheses where ***, ** and * respresent significance at 1%, 5% and 10% level respectively.

Table A.4. Quantile regression TFP (08/09). Basic model.

Exporters	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	0.253***	0.453***	0.616***	0.757***	0.537***
	(0.007)	(0.011)	(0.007)	(0.06)	(0.009)
TFP (08/09)	0.045***	0.069***	0.048***	0.029**	0.061***
	(0.014)	(0.019)	(0.016)	(0.014)	(0.019)
Observations	3806				
FDI	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	0.151***	0.281***	0.496***	0.911***	0.334***
	(0.013)	(0.023)	(0.053)	(0.056)	(0.031)
TFP (08/09)	0.048**	0.092**	0.210***	0.307***	0.126**
	(0.024)	(0.042)	(0.065)	(0.075)	(0.057)
Observations	548				

Note: Standard errors are in parentheses where ***, ** and * respresent significance at 1%, 5% and 10% level respectively.

Table A.5. Quantile regression (size and capital intensity). Basic model.

Exporters	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	0.067	0.172**	0.412***	0.594***	0.293***
	(0.056)	(0.076)	(0.058)	(0.059)	(0.072)
Size	0.016**	0.024**	0.018***	0.015*	0.021***
	(0.007)	(0.010)	(0.07)	(0.007)	(0.008)
K/L	0.027***	0.041***	0.029***	0.021**	0.035***
	(0.009)	(0.013)	(0.009)	(0.010)	(0.012)
Observations	3402				
FDI	$Q_y(0.2\|x)$	$Q_y(0.4\|x)$	$Q_y(0.6\|x)$	$Q_y(0.8\|x)$	Median
Constant	-0.258**	-0.408**	-0.721***	-0.700***	-0.567***
	(0.124)	(0.177)	(0.287)	(0.245)	(0.215)
Size	0.047***	0.082***	0.164***	0.228***	0.116***
	(0.014)	(0.024)	(0.036)	(0.034)	(0.034)
K/L	0.039**	0.063**	0.094**	0.107***	0.079**
	(0.019)	(0.025)	(0.048)	(0.036)	(0.032)
Observations	450				

Note: Standard errors are in parentheses where ***, ** and * respresent significance at 1%, 5% and 10% level respectively.