A Note on the Link between Firm Size and Exports

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This paper re-examines the link between firm size and exports in order to study the proposal that consists of increasing the firm size to raise exports as a way out of the current economic crisis. The elasticity of export propensity (percentage of exported sales) with respect to firm size depends on several firm characteristics. The new theories of international trade emphasize firm heterogeneity as the theoretical basis of this behaviour. In the context of this heterogeneity, the paper uses the quantile regression methodology to analyze the effect of firm size on export propensity of the firms, confirming the existence of a positive relationship that becomes less important as export propensity increases. The traditional estimate of this elasticity on the average of the export propensities distribution underestimates the effect at the bottom of the distribution and overestimates the effect on most of it.

1. Introduction

This paper analyzes the proposal that increasing the average firm size can raise exports of a country by studying this relationship at firm level. This relationship between firm size and export has been used in recent years in Spain to explain a paradoxical behaviour observed in the Spanish export share. Antrás (2011) indicates that, while competitiveness of the Spanish firms has declined and the export share of emerging countries (like China and India) has increased in recent years, it is surprising that the Spanish export share has remained constant in this context. His explanation is that only large firms would be causing the maintenance of the national total export share, because their unit labour costs have progressed better than other companies. Therefore, the firm size of exporters is a crucial variable to explain and to increase firm export intensity or propensity (percentage of sales exported)[1]. The small average size of Spanish companies with respect to the average size of the firms of the European Union is a disadvantage in this aspect. Therefore, there are proposals that seek to increase this size. This paper is in that line.

Although a positive relationship between size and export propensity has long been generally accepted (Wagner, 1995, Majocchi *et al.*, 2005), there are studies that point in other directions. Verwaal and Donkers (2002) cite papers from the 1980s and 90s where this relationship does not exist or even it is negative. More recently, Pla-Barber and Alegre (2007) does not find this relationship in a sample from French biotechnology industry, and Iyer (2010) finds that firm size has a negative effect on export intensity in New Zealand's agriculture and forestry. Due to such findings, Verwaal and Donkers (2002) refer to the relationship as an empirical puzzle.

The new international trade theories emphasize firm heterogeneity as an explanation of many of the behaviours observed in the international markets (Bernard *et al.*, 2007 and 2011 and Redding, 2010). According to this theory, not only are exporting firms very different from non-exporters (Bernard and Jensen, 1995), but there is also high heterogeneity within the firms of these two groups (Powell and Wagner, 2014). In the context of this

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[1] The fourth quarter 2012 report of BBVA Research about economic outlook Spain presents this same idea and recommends analyzing the date at firm level to solve this "Spanish puzzle".

heterogeneity, differences at the mean of a distribution of some variable or econometric estimates that only obtain valid results in this average are incomplete. Hence, empirical analyses along the distribution of a given variable are replacing those that only look at the mean. Wagner (2011) recommends this kind of analysis along the whole distribution of a given variable when the theoretical framework is firm heterogeneity and proposes the use of quantile regression as a way to do this. I will use the traditional cross-sectional quantile regression (Koenker and Basset, 1978) and the quantile regression for panel data with nonadditive firm fixed effects proposed by Powell (2013).

The rest of the paper is organized as follows. Section 2 describes the data used, the *Encuesta Sobre Estrategias Empresariales* (Survey on Companies' Strategies, hereinafter, ESEE) and the EFIGE dataset (project European Firms in a Global Economy: internal policies for external competitiveness supported by the European Commission). Section 3 presents the econometric specification used to estimate the mean of the elasticity of export propensity respect to firm size and the cross-sectional quantile regressions with the EFIGE dataset and the quantile regressions with nonadditive firm fixed effects with the ESEE dataset. Section 4 presents the estimates obtained and also the elasticity of value of exports with respect to the firm size, and it compares the mean estimates with the estimates along the distribution of export propensities and value of exports using the quantile regression. Section 5 summarizes and concludes.

2. The data

The data used in this paper are the *Encuesta Sobre Estrategias Empresariales* (Survey on Companies' Strategies, hereinafter, ESEE) and the EFIGE dataset. The ESEE originates from an agreement signed in 1990 between the Ministry of Industry of Spain and the SEPI Foundation, formerly the *Fundación Empresa Pública* (Public Firm Foundation). It is an unbalanced panel of Spanish manufacturing firms in operation since 1990. The database contains information about an average sample of 1,800 firms every year, and includes information about activity, products and manufacturing processes, customers and suppliers, costs and prices, markets covered, technological activities, income statements, accounting

balance sheets, employment and foreign trade. Firms with fewer than 10 employees were excluded from the survey. All firms with over 200 employees are included along with a random sample of the rest (firms with 10 to 200 employees).

The EFIGE is a cross section dataset that has recently been collected within the EFIGE project (European Firms in a Global Economy: internal policies for external competitiveness) supported by the European Commission[2]. This database, present for the first time in Europe, combines measures of firms' international activities (e.g. exports, outsourcing, FDI, imports) with quantitative and qualitative information on some 150 items ranging from R&D and innovation, labour organisation, financing and organisational activities, and pricing behaviour. The data consists of a representative sample (at the country level for the manufacturing industry) of almost 15000 surveyed firms (above 10 employees) in seven European economies (Germany, France, Italy, Spain, United Kingdom, Austria, and Hungary). It was collected in 2010, covering the years from 2007 to 2009. Special questions related to the behaviour of firms during the crisis were also included in the survey, but the sample is built to be representative for 2008.

In Table A1 of the Appendix we see that, while the average export propensity is higher in firms with more than 50 employees, the export propensity values obtained in the considered percentiles show that in the three groups of firms there coexist companies with high export propensity with others whose percentage of export sales is relatively small. The export intensity is the percentage of exported sales measured as percentage of the average value of export intensity in the 20 industries considered and for each 21 years included in ESEE dataset (1990-2010), and in the 11 NACE-CLIO industries and 166 regions (at the NUTS-1 level of aggregation) included in EFIGE dataset.

In the ESEE in 2010 there are firms with fewer than 50 employees whose propensity to export in the 95th percentile reaches 231.4% of the mean. Similar percentages are obtained in larger companies (280.8% in those with more than 50 and fewer than 250 employees and 258.6% in those with more than 249 employees). At the same time, the export propensity of the largest companies is very similar to the smaller ones in the 5th percentile: 2.6% for those

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[2] Altomonte and Aquilante (2012) describe this dataset with detail.

with more than 249 employees and 1.6% for those with fewer than 50 employees. In the EFIGE dataset there are more differences in the 5th percentile, but the percentages obtained in the 95th percentile are also quite similar in the three firm sizes considered.

In short, the high firm heterogeneity is clear. Although there is a positive correlation between firm size and export propensity for any size considered, between firms that export a lot we can find both small and large companies, and between firms that do not export much, too. Consequently, the analysis of the differences in the mean of the distribution is a quite incomplete exercise in this context of high heterogeneity. As a result, this paper proposes an analysis along the distribution of export propensities using the quantile regression.

3. Econometric specification

3.1. Mean estimates

To analyze the effect of firm size on export propensity in the average of distribution I estimate the equation (1) with the ESEE dataset[3]

$$P_{jt} = \alpha_j + \beta S_{jt} + \delta_t + u_{jt} \qquad (1)$$

where P_{jt} is the log of export propensity of the firm j in the year t; S_{jt} is the log of the firm size is measured by the number of employees in the firm j in the year t. With the ESEE dataset both firm fixed effects (α_j) and temporary fixed effects (δ_t) are included. With EFIGE it is not possible to include these fixed effects, so I include other controls (Z_j) available in the data and estimate equation (2)

$$P_j = \alpha + \beta S_j + Z_j'\gamma + \varepsilon_j \qquad (2)$$

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[3] It has previously been tested that there is no selection bias estimating the Heckman selection model (Heckman, 1979) with the sample of exporting and non-exporting firms. Vermeulen (2004) obtains this same result.

These controls are the countries, the industries, the firm age and others firm characteristics like importer of materials, importer of services, active outsourcer, passive outsourcer, foreign direct investor, global exporter, active abroad, employees to R&D activities, product innovation, process innovation, market innovation, organizational innovation, human capital, labour flexibility, credit request, credit obtained, family managed, family chief executive officer, foreign group, decentralized management, bonus for managers, quality certification, and competition from abroad.

3.2. Quantile regression

The effect on the mean of the distribution is incomplete when we assume firm heterogeneity. Such heterogeneity involves differences beyond that observed in the mean of the distribution, extending the majority of the same. To analyze this elasticity and taking into account such heterogeneity I will use the quantile regression methodology to estimate the elasticity at different percentiles of the distribution of export propensities. For the ESEE dataset, I will use the estimator for panel data with nonseparable disturbance proposed by Powell (2013), which has been used by Powell and Wagner (2014) in the context of the exporter productivity premium. According to these authors, we are interested in the Structural Quantile Function

$$S_{P_{jt}} = \alpha_t(\tau) + S_{jt}\beta(\tau), \quad \tau \in (0,1) \tag{3}$$

where $\beta(\tau)$ is the elasticity of export propensity with respect to firm size at τ th quantile. The Powell (2013) estimation technique means the estimates can be interpreted in the same manner as traditional cross-sectional quantile estimates[4]. Standard errors are estimated using bootstrap technique and are clustered by firm throughout.

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[4] When we introduce a separate additive term for the fixed effect in quantile regression the interpretation of the parameters of interest is not the same as traditional cross-sectional quantile estimates because the additive fixed effects change the underlying model (it is possible that observations with a large value of P_{jt}-α_j, are at the bottom of the P_{jt} distribution) and do not allow the parameters of interest to vary based on fixed effects.

Since with the EFIGE data it is not possible to include the firm fixed effects, the Structural Quantile Function is

$$S_{P_{jt}} = \alpha(\tau) + S_j \beta(\tau), \quad \tau \in (0,1) \tag{4}$$

4. Estimation Results

The estimate of the elasticity β of export propensity with respect to firm size in the average of distribution is in the first file of Table 1 and reaches 0.146 in the ESEE dataset and 0.078 in EFIGE dataset. That is to say, the size firm has a positive effect on the export propensity, although in an inelastic way.

In the rest of the files in Table 1 the results of this elasticity for the quantile regressions with the two datasets are shown. It is positive, statistically significant and less than unity, but it decreases as we move along the distribution of export propensities. In the ESEE dataset this elasticity is 0.201 at the 10th quantile and decreases to 0.099 at the 60th quantile. In the upper quantiles this elasticity is not statistically significant. The elasticity estimated in the EFIGE dataset is 0.128 at the 10th quantile and 0.030 at the 90th quantile. Consequently, the traditional estimate of this elasticity on the average of the export propensities distribution underestimates the effect at the bottom of the distribution and overestimates the effect on most of it. These same effects are obtained when the second order term (log of firm size square) is also included in the regressions. The estimates are available upon request.

The explanation for this result could be the influence of transaction costs on the relationship between firm size and export intensity, as noted in Verwaal and Donkers (2002). According to these authors, the firm size doest not capture all the economies in the context of export relationships, but it is necessary to include the size of the export relationship. They use the average annual value of transactions per foreign buyer as an explicative variable of export

intensity and an interaction term between this variable and the firm size. The export relationship size variable has a positive influence on export propensity and a moderating effect on the firm size and export propensity relationship, because the coefficient of export relationship size is positive and significant and the coefficient of that interaction term is negative and statistically significant. In my dataset there is no information about the number of foreign buyers and I can not include this size of the export relationship but, according to Verwaal and Donkers (2002), there is a positive correlation between size of the export relationship and export propensity. Consequently, the moderating effect of export relationship size on the elasticity of export propensity with respect to firm size is greater in firms with higher export propensities.

However, the export propensity has an upper bound (although I use a relative measure of the export propensity by industry and year) and the firms that have a higher export propensity can not increase it as much as firms with less export propensity. To check that this does not affect the previous result and to find greater robustness, I estimate the elasticity of value of exports with respect to firm size with de ESEE dataset.[5] Column 3 of Table 1 shows this elasticity and confirms the previous results. The estimate elasticity in the average of distribution of export values is unitary, but up to 30th quantile it is greater than unity and from there it is less than unity. Therefore, it is shown that the effect of firm size on exports – export intensity or value of exports– is smaller as exports rise.

4. CONCLUSIONS

The elasticity of export propensity with respect to firm size is positive, statistically significant and less than unity along the distribution of export propensities. However, this elasticity decreases as export propensity increases. So, the traditional estimate of this elasticity on the average of the export propensities distribution underestimates the effect at the bottom of the distribution and overestimates the effect on most of it. These quantile regression estimates include nonadditive firm fixed effects using the Powell (2013) estimation technique for panel data that means these estimates can be interpreted in the same manner as traditional cross-

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[5] With the EFIGE dataset is not possible to estimate this elasticity because the annual turnover is defined by ranges and there is no upper bound.

sectional quantile estimates. Consequently, the positive effect of firm size on export propensity is relatively more important in companies with less export propensity. I also estimate the elasticity of value of exports with respect to firm size in order to check the robustness of this result. The estimates obtained are similar.

This finding may have important policy implications in the discussion of the increase in exports that has been promoted lately in Spain and others countries as a way out of the current economic crisis, where the aim is that the increase of the foreign demand counters reduced domestic demand. According to the results obtained in this paper, it would be more efficient to direct public funds to increasing firm size for companies with less export intensity, because this would generate a greater increase in overall export intensity (or value of exports) due to the increase of export intensity being higher in these firms than others.

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APPENDIX

Table A1. Export intensity distribution by firm size

			Mean	Standard Deviation	5%	25%	Quantile 50%	75%	95%
E S E E	**1990**	Fewer than 50 employees	94.06	120.85	2.68	14.75	40.14	116.51	355.79
		Between 50-249 employees	113.72	127.53	2.69	21.45	71.01	172.05	331.69
		More than 249 employees	96.50	95.34	3.39	22.58	65.42	141.75	299.75
	2000	Fewer than 50 employees	75.26	90.02	1.37	10.94	37.27	105.71	265.40
		Between 50-249 employees	103.11	90.09	2.08	28.14	81.89	160.61	268.82
		More than 249 employees	115.88	82.88	6.99	47.48	103.37	173.94	263.37
	2010	Fewer than 50 employees	72.53	83.07	1.57	11.02	41.76	111.91	231.36
		Between 50-249 employees	116.43	98.07	4.14	34.55	98.18	174.75	280.77
		More than 249 employees	111.27	83.46	2.62	44.39	103.53	169.00	258.59
EFIGE		Less than 50 employees	91.12	79.24	4.76	26.54	73.68	133.33	242.42
		Between 50-249 employees	113.68	84.15	8.33	45.58	100.00	165.18	269.69
		More than 249 employees	125.60	76.14	16.9	71.49	114.50	170.67	253.91

The export intensity is the percentage of exported sales measured as percentage of the average value of export intensity in the 20 considered industries and 21 years included in ESEE dataset, and in the 11 industries and 166 regions included in EFIGE dataset.

Table 1. Mean estimates and quantile regression estimates of the elasticity of export propensity and the elasticity of value of exports with respect to firm size.

Dependent variable and dataset	Export propensity ESEE	Export propensity EFIGE	Value of exports ESEE
Mean estimate	0.146 (2.89)	0.078 (5.33)	0.991 (18.30)
Quantile			
0.10	0.201 (1.73)	0.128 (4.36)	1.014 (7.82)
0.15	0.146 (1.43)	0.112 (4.35)	1.057 (14.64)
0.20	0.206 (3.23)	0.091 (3.32)	1.114 (17.06)
0.25	0.222 (5.74)	0.090 (3.50)	1.068 (15.18)
0.30	0.183 (4.25)	0.064 (2.61)	1.004 (11.54)
0.35	0.152 (3.43)	0.072 (5.64)	0.962 (12.77)
0.40	0.097 (2.52)	0.074 (6.39)	0.904 (12.45)
0.45	0.094 (2.06)	0.077 (3.89)	0.945 (17.49)
0.50	0.112 (2.31)	0.081 (4.52)	0.938 (19.65)
0.55	0.114 (1.99)	0.077 (639)	0.925 (22.14)
0.60	0.099 (1.84)	0.067 (5.37)	0.900 (18.35)
0.65	0.066 (1.35)	0.053 (4.11)	0.890 (22.90)
0.70	0.037 (1.11)	0.050 (3.12)	0.867 (23.30)
0.75	0.004 (0.18)	0.039 (2.37)	0.862 (19.28)
0.80	0.005 (0.69)	0.040 (3.60)	0.795 (17.02)
0.85	0.004 (0.40)	0.033 (2.38)	0.772 (20.87)
0.90	0.022 (0.72)	0.030 (3.41)	0.773 (15.65)
Year fixed effects	Yes	Not	Yes
Firm fixed effects	Yes	Not	Yes
Others controls	Not	Yes	Not
Firms	3249	7807	3249
Observations	23079	7807	23079

t-statistics are in brackets. The export intensity is the percentage of exported sales measured as percentage of the average value of the export intensity in the 20 considered industries and 21 years included in ESEE dataset, and in the 11 industries and 166 regions included in EFIGE dataset. Standard errors are estimated using bootstrap technique and are clustered by firm throughout in ESEE dataset. Others controls in the EFIGE estimates are Countries, Industries, Age, Importer of materials, Importer of services, Active outsourcer, Passive outsourcer, FDI, Global exporter, Active abroad, Employees to R&D activities, Product innovation, Process innovation, Market innovation, Organizational innovation, Human capital, Labour flexibility, Credit request, Credit obtained, Family managed, Family chief executive officer, Family group, Decentralized management, Bonus, Quality certification, Competition from abroad.