Reassessing the Link Between Firm Size and Exports

Pedro J. Hernández

Abstract

The small average size of Spanish firms has been put forward as the main impediment to their international competitiveness. This paper re-examines the link between firm size and exports. The new theories of international trade emphasize firm heterogeneity as the theoretical basis of export behavior. In the context of this heterogeneity, the paper uses the quantile regression methodology to analyze the effect of firm size on firm export propensity (percentage of exported sales). The paper confirms the existence of a positive relationship between firm size and export intensity but finds that the conventional estimates of the elasticity of export propensity with respect to firm size on the average of the export propensities distribution underestimate the effect at the bottom of the distribution and overestimate the effect on most of it. Consequently, policies aimed at increasing exports should concentrate their efforts on increasing the size of those firms with lower export propensity.

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1. Introduction

The new theories of international trade emphasize this firm heterogeneity to explain export status (Melitz, 2003 and Greenaway and Kneller, 2007). Firm size is a crucial variable for explaining firm productivity (García-Santana and Ramos, 2013), and both variables are determinants of whether firms choose to export. Several reports indicate that the small average size of Spanish firms is the main impediment to their international competitiveness. [1]

This paper analyzes the proposal that increasing a country's average firm size raises national exports, by studying this relationship at the firm level. The relationship between firm size and exports has been used in Spain in recent years to explain paradoxical behavior observed in the Spanish export share. Antrás (2011) indicates that, while recent years have seen a decline in the competitiveness of Spanish firms and an increase in the export share of emerging countries (e.g., China and India), the Spanish export share has, surprisingly, remained constant. His explanation for the phenomenon is that only large firms have an important influence on the national total export share because the unit labor costs of large firms have progressed better than smaller companies. Therefore, the firm size of exporters is a crucial variable to explain and increase firm export intensity or propensity (percentage of sales exported)[2]. The small average size of Spanish companies relative to the average size of European Union firms is a disadvantage in this respect. Therefore, there are proposals that seek to increase the country's average firm size. This paper examines the merits of these proposals for increasing a country's export propensity.

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[1] *Círculo de Empresarios* (Circle of Entrepreneurs, 2015) and *Consejo Empresarial para la Competitividad* (Business Council for Competitiveness, 2015). This small average size of Spanish firms appears to be the consequence of distortions in the tax system (Almunia and López-Rodríguez, 2014) and factors related to the firms' organization and internal management (Huerta and Salas, 2012).

[2] 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".

Although a positive relationship between firm size and export propensity has long been generally accepted (Wagner, 1995, Majocchi *et al.*, 2005), there are studies that point in other directions. Wolf and Pett (2000) and Bonaccorsi (1992) find that firm size has little or no influence, and Patibandla (1995) finds a negative relationship between firm size and export intensity. More recently, Pla-Barber and Alegre (2007) do not find this relationship in a sample from the French biotechnology industry, and Iyer (2010) finds that firm size has a negative effect on export intensity in New Zealand's agriculture and forestry sectors. 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 behaviors observed in international markets (Bernard *et al.*, 2007 and 2012; Redding, 2011). According to these theories, 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 heterogeneity, differences in the mean of a distribution of some variable, or econometric estimates that only obtain valid results at 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 type 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. This paper uses the traditional cross-sectional quantile regression model (Koenker and Basset, 1978) and the quantile regression model for panel data with non-additive firm fixed effects (Powell, 2015).

The rest of the paper is organized as follows. Section 2 describes the data used. Section 3 presents the econometric specification used to estimate the mean of the elasticity of export propensity with respect to firm size. Section 4 presents the quantile regression estimates and the elasticity of value of exports with respect to firm size. The section also 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 Business Strategies, hereinafter, ESEE) and the EFIGE dataset (project European Firms in a Global Economy: internal policies for external competitiveness supported by the European Commission). The ESEE for the period 1990-2010 is an unbalanced panel of Spanish manufacturing firms[3]. The database contains the following information for each year over the 1990-2010 period for a sample of approximately 1800 firms: activities, products, 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 are excluded from the survey. The survey contains information on 70% of all Spanish manufacturing firms with more than 200 employees, together with a random sample that covers 5% of the remaining firms (firms with 10 to 200 employees).

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[3] This survey originates from an agreement in 1990 between the Ministry of Industry and the SEPI Foundation, formerly the *Fundación Empresa Pública* (Public Firm Foundation).

The EFIGE is a cross-sectional 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[4]. This database, available 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, labor organization, financing and organizational activities, and pricing behavior. 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, spanning the years from 2007 to 2009. Special questions related to the behavior of firms during the crisis were also included in the survey, but the sample is built to be representative for 2008.

Appendix Table A1 shows export growth for Spanish manufacturing firms measured by its extensive margin (percentage of firms that report having exported) and intensive margin (average percentage of export propensity of each company), based on ESEE data. It should be mentioned that this increase has not occurred evenly across all firms, and if we analyze the behavior according to size, we note that there is high heterogeneity. For the EFIGE dataset, Table A1 shows that Spain has the lowest intensive margin.

Table 1 shows that the average export propensity is higher in firms with more than 50 employees. However, the export propensity values reported by percentiles show that for the three groups of firms categorized by size, there coexist companies with high export propensity alongside others whose percentage of export sales is relatively small. The export

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

intensity is the percentage of exported sales measured as a percentage of the average value of export intensity in the 20 industries considered and for each 21 years included in the 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.

Insert Table 1 about here

In the ESEE data for 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 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 quite similar across the three firm sizes considered.

The percentage of firms by size along the distribution of export propensities is shown in Table 2. The percentage of companies with over 249 employees located in the first quintile of the distribution of export propensities stands at approximately 25% for the considered period in the ESEE dataset, although there is a clear downward trend (39.4% achieved in 1990 and 13.7% in 2010). At the top of the distribution, the percentage of firms with fewer than 50 employees located in the fifth quintile of the distribution stands at approximately 21% throughout the period considered, and in this case there is no clear downward trend. In

the EFIGE dataset there are a few large firms in the first quintile, but the 56.6% of firms in the 5th quintile are small (less than 50 employees).

Insert Table 2 about here

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

3. Econometric specification

3.1. Mean estimates

To analyze the effect of firm size on export propensity in the average of the distribution, I estimate equation (1) with the ESEE dataset[5]

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[5] 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.

$$P_{jt} = \alpha_j + \beta S_{jt} + \delta_t + u_{jt} \quad , \tag{1}$$

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

$$P_j = \alpha + \beta S_j + Z_j'\gamma + \varepsilon_j \tag{2}$$

These controls are the countries, industries, firm age and other firm characteristics, such as importer of materials, importer of services, active outsourcer, passive outsourcer, foreign direct investor, global exporter, active abroad, the number of employees engaged in R&D activities, product innovation, process innovation, market innovation, organizational innovation, human capital, labor 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 in the presence of firm heterogeneity. Such heterogeneity involves differences beyond that observed in the mean of the distribution, extending the differences. To analyze the elasticity of export propensity with respect to firm size, taking into account firm heterogeneity, I use the quantile regression method to estimate the elasticity of export propensities at different percentiles of the distribution. For the ESEE dataset, I will use the estimator for panel data with non-separable disturbance proposed by Powell (2015),[6] 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 the τth quantile. With the Powell (2015) estimation technique, the estimates can be interpreted in the same manner as traditional cross-sectional quantile estimates. When we introduce a separate additive term for the fixed effects 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

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[6] Powell proposed this estimator in 2012 in a working paper titled "Unconditional Quantile Regression for Panel Data with Exogenous or Endogenous Regressors" (RAND).

large value of P_{jt} - α_j, are at the bottom of the P_{jt} distribution)[7]. Standard errors are estimated using the bootstrap technique and are clustered by firm.

Because the EFIGE dataset does not allow for inclusion of the firm fixed effects, the Structural Quantile Function is

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

4. Estimation Results

Estimates of the elasticity of export propensity with respect to firm size (β) in the average of distribution are presented in the first two columns of Table 3, reaching 0.146 in the ESEE dataset and 0.078 in the EFIGE dataset. That is, the firm size has a positive effect on the export propensity, although in an inelastic way. Table 3 also shows the elasticity of value of exports with respect to firm size for the ESEE dataset.[8] This estimate of elasticity is unitary.

Insert Table 3 about here

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[7] There are several other quantile panel data estimators with additive fixed effects (Koenker, 2004, Graham et al., 2009, Harding and Lamarche, 2009, Lamarche, 2010, Canay, 2011, Galvao, 2011, Ponomareva, 2011 and Rosen, 2012), but the interpretation of the estimates is very different. Powell (2015) lists the differences between his estimator and quantile panel data estimators with additive fixed effects. The disadvantage of this estimator is that limits you to one treatment variable.

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

Table 4 shows the estimates of these elasticities from the quantile regressions with the two datasets. The estimated elasticities are positive, statistically significant and less than unity, but the values decrease as we move along the distribution of export propensities. For the ESEE dataset, the elasticity of export propensity with respect to firm size is 0.201 at the 10th quantile and decreases to 0.099 at the 60th quantile. In the upper quantiles, this elasticity is not significantly different from zero. The elasticity estimated with the EFIGE dataset is 0.128 at the 10th quantile and 0.030 at the 90th quantile. In summary, the traditional estimate of this elasticity at the average of the export propensities distribution underestimates the effect at the bottom of the distribution and overestimates the effect on most of it. Similar effects are obtained when the second order term (log of firm size square) is also included in the regressions. The latter estimates are available upon request.

Insert Table 4 about here

Figure 1 shows the differences between mean and quantile estimates for the elasticity of export propensity with respect to firm size, where the mean estimates are the straight lines in the figure, and the quantile estimates are the discontinuous lines.

Insert Figure 1 about here

A plausible explanation for the result shown in the figure is 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, firm size does 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 cannot include a variable measuring size of the export relationship. However, according to Verwaal and Donkers (2002), there is a positive correlation between the 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 cannot increase it as much as firms with less export propensity. To check that this does not affect the previous result and to assess robustness, I estimate the elasticity of the value of exports with respect to firm size with the ESEE dataset. Column 4 of Tables 3 and 4 shows this elasticity and confirms the previous results. The estimated elasticity in the average distribution of export values is unity (Table 3), but up to the 30th quantile, it is greater than unity, and from there it is less than unity (Table 4). Therefore, it is shown that the effect of firm size on exports –export intensity or value of exports– is smaller as exports rise.

Figure 2 shows the differences between the mean and quantile estimates for the elasticity of value of exports with respect to firm size. These differences show a very similar profile to that shown in Figure 1.

Insert Figure 2 about here

5. Conclusions

The small average size of Spanish firms constitutes a large impediment to their international competitiveness and justifies policies that aim to eliminate those distortions or address those organizational factors contributing to small firm size. The new theories of international trade indicate that firm size is a crucial variable to understand why firms export. This paper analyzes the relationship between firm size and exports at the firm level.

The elasticity of export propensity with respect to firm size is found to be 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. The quantile regression estimates include non-additive firm fixed effects using the Powell (2015) estimation technique for panel data, which means that the estimates can be interpreted in the same manner as traditional cross-sectional quantile estimates. Consequently, the positive effect of firm size on export propensity is found to be 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 results and obtain similar results.

The study findings may have important policy implications, given that export growth is being promoted in Spain and others countries as a way out of the current economic crisis. The aim is for the increase in foreign demand to counter reduced domestic demand. According to the results obtained in this paper, policies aimed at increasing exports should concentrate their efforts on increasing the size of the firms with lower export propensity. The rationale is that it would be more efficient to direct public funds to increasing firm size for these companies because this would generate a greater increase in overall export intensity (or value of exports) because the increase in export intensity is higher in these firms than in others.

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APPENDIX

Table A1. The average export intensity

	The Survey on Business Strategies (ESEE)		The EFIGE dataset (2008)		
	Percentage of exporting firms	Average export intensity		Percentage of exporting firms	Average export intensity
1990	47.51	22.01 (24.15)	Austria	56.18	41.33 (33.65)
1995	59.09	27.91 (26.40)	France	45.41	28.77 (27.15)
2000	64.99	30.14 (26.83)	Germany	41.40	29.78 (24.37)
2005	62.13	30.47 (27.40)	Hungary	49.03	43.97 (34.96)
2008	63.27	30.62 (28.25)	Italy	63.48	34.45 (28.33)
2009	63.92	31.97 (28.70)	Spain	47.92	25.61 (25.83)
2010	65.42	32.48 (29.05)	United Kingdom	56.26	29.35 (28.66)

Standard deviations are in parenthesis. Sample weights used in the EFIGE dataset.

Table 1. Export intensity distribution by firm size

| | | | Mean | Standard Deviation | Quantile | | | | |
					5%	25%	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		Fewer 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 over 21 years included in ESEE dataset and in the 11 industries and 166 regions included in EFIGE dataset.

Table 2. Share of firms by size in the quintiles of the export intensity distribution

			Quintile				
			1	2	3	4	5
E S E E	1990	Fewer than 50 employees	37.23	32.49	23.59	23.56	26.70
		Between 50-249 employees	23.40	22.34	23.08	25.65	29.32
		More than 249 employees	39.36	44.16	52.82	50.79	43.98
	1995	Fewer than 50 employees	48.99	34.34	23.98	18.27	19.90
		Between 50-249 employees	23.74	27.78	31.12	31.47	33.16
		More than 249 employees	27.27	37.88	44.39	49.75	46.43
	2000	Fewer than 50 employees	49.59	37.86	24.07	17.70	20.33
		Between 50-249 employees	26.45	28.81	30.71	27.98	30.71
		More than 249 employees	23.55	32.92	45.23	53.91	48.96
	2005	Fewer than 50 employees	48.26	36.07	33.76	16.81	19.41
		Between 50-249 employees	28.70	31.15	33.76	33.19	38.82
		More than 249 employees	23.04	32.79	32.49	49.58	41.35
	2010	Fewer than 50 employees	54.58	44.27	28.52	23.28	22.52
		Between 50-249 employees	31.68	37.79	43.73	47.33	52.29
		More than 249 employees	13.74	17.56	27.76	29.39	25.19
EFIGE		Fewer than 50 employees	77.64	72.28	62.93	58.65	56.57
		Between 50-249 employees	19.22	20.68	25.93	28.41	30.68
		More than 249 employees	3.14	7.04	11.14	12.94	12.75

Table 3. Mean estimates of the elasticity of export propensity and the elasticity of value of exports with respect to firm size

Dataset	Elasticity of export propensity with respect to firm size		Elasticity of value of exports with respect to firm size
	ESEE	EFIGE	ESEE
Number of employees	0.146 (2.89)	0.078 (5.33)	0.991 (18.30)
Year fixed effects	Yes	No	Yes
Firm fixed effects	Yes	No	Yes
Other controls	No	Yes	Not
R^2	0.773	0.220	0.912
Firms	3249	7807	3259
Observations	23083	7807	23245

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 the 21 years included in ESEE dataset and in the 11 industries and 166 regions included in EFIGE dataset. Other 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, Labor flexibility, Credit request, Credit obtained, Family managed, Family chief executive officer, Family group, Decentralized management, Bonus, Quality certification, and Competition from abroad.

Table 4. Quantile regression estimates of the elasticity of export propensity and the elasticity of value of exports with respect to firm size.

Dataset	Elasticity of export propensity with respect to firm size		Elasticity of value of exports with respect to firm size
	ESEE	EFIGE	ESEE
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
Other 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 the ESEE dataset. Other 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, Labor flexibility, Credit request, Credit obtained, Family managed, Family chief executive officer, Family group, Decentralized management, Bonus, Quality certification, and Competition from abroad.

Figure 1. Elasticity of export propensity with respect to firm size
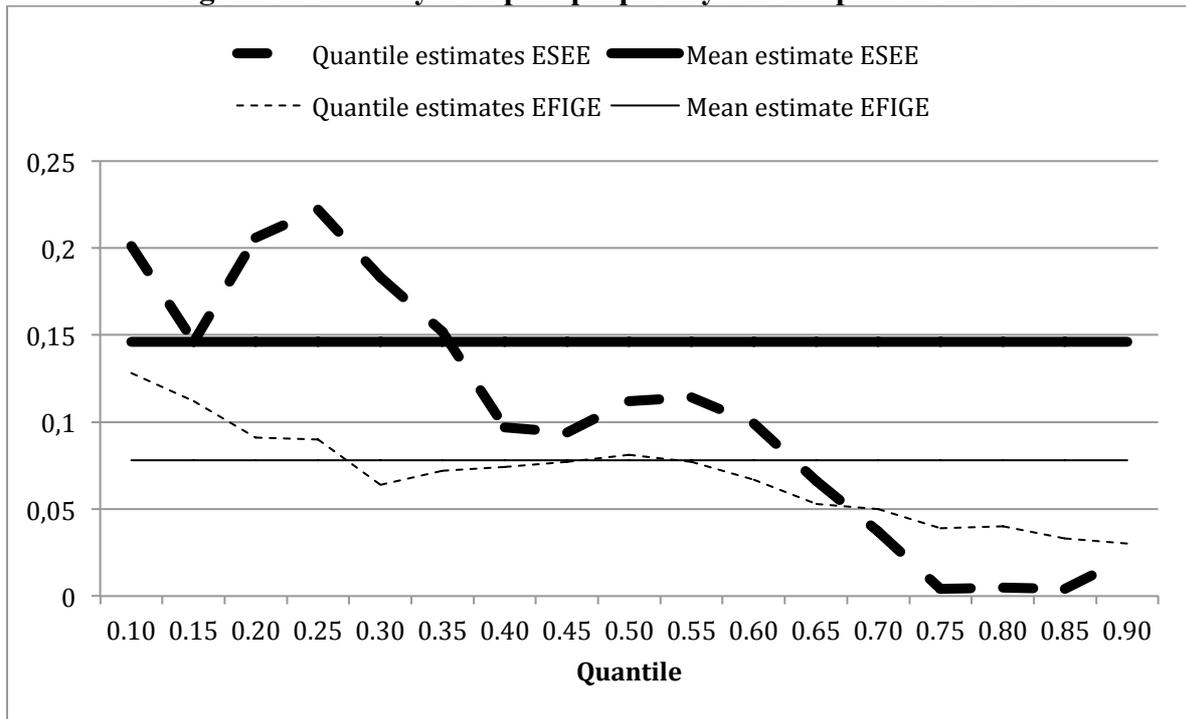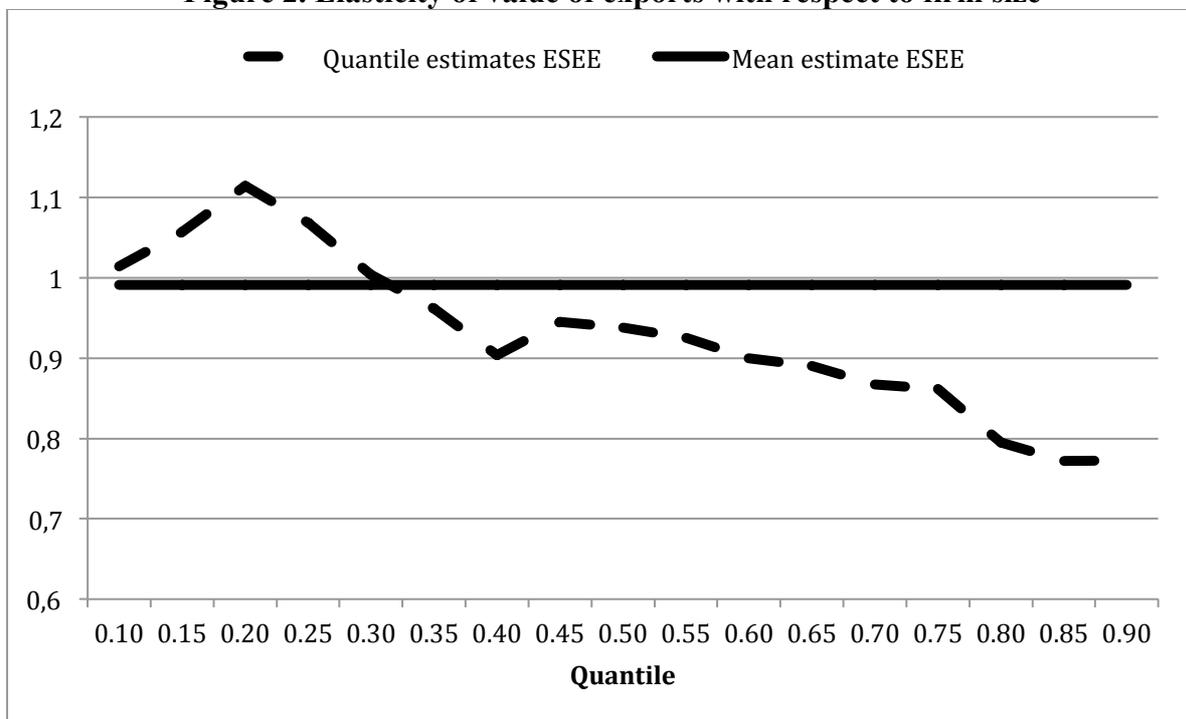

Figure 2. Elasticity of value of exports with respect to firm size

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The Editor