Variable Export Price Elasticity, Product Quality, and Credit Constraints: Theory and Evidence from Greek Firms

Online Data Appendix (not intended for publication)

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A. Trade and balance sheet data

The Intrastat and Extrastat databank collects information and produces statistics on dispatches and arrivals of goods in European Union countries and replaced customs declarations as the source of trade statistics. In particular, the national authorities collect data on the identification number allocated to the party responsible for providing information, the reference period, the flow (arrival, dispatch), the value and quantity of the goods in net mass (weight excluding packaging) and the supplementary unit (litre, m^2, number of items, etc.) if relevant, and their destination. Firms whose annual trade amount is above a certain value are responsible for providing information and this threshold value is re-defined so that a minimum amount of data is collected for each trade flow. Each year, national authorities define their thresholds, set in such a way, so as to collect data relating to at least 97% of all dispatches.

The classification of all reported exported goods (approximately 2500 products) follows the Standard International Trade Classification (SITC) system. Our dataset consists of manufacturing products in the following sectors: *chemicals* (Section 5), *machinery and transport equipment* (Section 7), *other manufactured goods* (Sections 6 and 8). We calculate unit prices using the following rule for quantities. If the number of non-available observations for each product is smaller (exceeds) 5% of the total number of the product's observations, then the primary product quantities (labeled “Other Quantities”) are used. In turn, the price is unit value calculated by dividing the value by the quantity of each product. Unit values that exceed 10 times the median or are lower than 10% of the median price are removed from the dataset.

Financial data are obtained from ICAP, which is the largest Greek firm that provides business information. ICAP supplies balance sheet information and reports other key variables such as firm age and employment. In total, roughly 35.000 firms are included in the ICAP database. To maintain comparability with export data we keep only those firms that belong (via the NACE classification system) to categories which appear at least once over the years of our export sample.

We follow Feenstra et al. (2014) and clean the sample for mis-measurement and for very small firms by ensuring that key financial variables, such as total assets and sales are not missing. We remove all observations that do not satisfy the following criteria. (i) The sum of fixed and liquid assets is lower than total assets. (ii) Total firm sales are positive. (iii) The share or export revenue to total sales is less than unity. (iv) Export revenue should exceed 10000 Euro in total, 1000 Euro for each destination, and 100 Euro for each product-destination pair.

B. Credit scores

Credit scores are available for roughly 10.000 (exporting and non-exporting) firms annually, out of which about 3.000 are classified as exporters. The methodology developed and applied by ICAP for assigning credit scores to Greek companies consists of two parts. Part 1 offers an initial rating based on the segmentation of companies according to the availability of financial data, legal status, size and activity sector, commercial information, and derogatory information on private firms. Part 2 enhances the results of Part 1 with an analyst assessment of qualitative characteristics.

The statistical method used in Part I predicts the default probability of companies based on a sample of all ‘defaulted’ and a sample of ‘non-defaulted’ companies. These samples are then used as inputs to create random samples with replacements, to identify “prospective” explanatory variables which are used as independent variables in logistic regressions. The optimal combination of independent variables is derived using the stepwise variable selection method. The result of the above process is (a) the selection of independent variables used in the final model, (b) the estimation of their coefficients and (c) the resulted estimated default probability. The decision about the final credit score is made by the Analyst and the Rating Committee. Table A1 describes the credit-rating categories and associated firm characteristics.

C. Benchmark price regressions: Manova and Zhang (2012) specifications

For comparison purposes of our dataset on Greek exporters to prior literature, Tables A2 and A3 reproduce the main regressions in Manova and Zhang (2012) who analyzed pricing patterns of Chinese exporters.

We first focus on firm-specific characteristics as determinants of export pricing. In particular, we examine average firm-specific prices and aggregate the data to the firm-product level by summing sales and quantities across markets. Hence, firm *f*'s average export price for product p across all destinations d is given by the $price_{fp} = \frac{\sum_d revenue_{fpd}}{\sum_d quantity_{fpd}}$. Product fixed effects are included to control for systematic differences across goods in consumer appeal, comparative advantage, transportation costs, units of measure, and other product characteristics that affect all manufacturers equally. So any effects are identified purely from the variation across firms within a given SITC5 code. Columns (I.1) and (I.2) of Table A2 examine the correlations between export prices and worldwide export revenues and quantities sold across firms selling a given product. We find that firms that have smaller worldwide revenues or sell lower quantities tend to charge a higher average export price within a given product. We also examine the relationship between firms' export prices and number of destinations to account for the co-movements of prices with the number of trade partners that buy product *p* from firm *f*. As displayed in Column (I.3) of Table A2, exporters that supply fewer countries charge a higher average price.

We next examine the variation in export prices across firms selling in a given market, where a market is defined as a destination-product pair, by accounting for large differences in the market environment across destinations that may influence firms' export pricing decisions (e.g. all Greek shoe manufacturers exporting to Germany). The export price of firm *f* selling product *p* in destination *d*, $price_{fpd}$, is regressed on the corresponding revenues and quantities by accounting for destination and product fixed effects. The latter implicitly control for product characteristics that are invariant across manufacturers and trade partners. Destination fixed effects control for characteristics of the destination country that affect all products and firms selling there, such as consumer income, transportation costs, regulatory restrictions, legal institutions, inflation and exchange rates. The coefficient on revenues and quantities are thus identified purely from the variation across firms within very fine segments of the world economy (Manova and Zhang, 2012).

Columns (II.1)-(II.3) of Table A2 report the results from these regressions. Specifically, in Columns (II.1) and (II.2) we find that firms setting a higher export price earn smaller revenues and sell smaller quantities. In Column (II.3), export prices are additionally regressed on a multiplicative term between revenues and a dummy for differentiated goods, based on Rauch (1999). From an empirical perspective, Bastos and Silva (2010) provide evidence that unit values within differentiated products are more heterogeneous compared to other categories, suggesting that Rauch's classification is well suited for their identification. As in Manova and Zhang (2012), the coefficient on this term is positive and significant, which indicates that the effect of sales on prices is stronger among non-homogeneous products. The coefficient on revenues retains its negative sign.

We then investigate the variation of export prices across trade partners within firm-product pairs by studying the correlation between export prices and revenues across destinations. Towards this end, in addition to product fixed effects, we include firm fixed effects that control for firm attributes such as overall production efficiency, managerial talent, labor force composition, and general input quality. These attributes affect firm export performance equally across products and are invariant across export markets. As a result, the coefficient of interest is identified purely from the variation in prices across destinations within a given manufacturer and product line. Column (II.4) of Table A2 reports again a negative correlation between export price and sales, and Column (II.5) reports a negative correlation between export price and quantities. When we include the interaction term between revenues and differentiated goods in Column (II.6), the correlation between revenue and price remains negative and insignificant, whereas the interaction term has a positive sign.

The aforementioned specifications treat destinations symmetrically. Yet, the behavior of export pricing is likely to be affected by destinations characteristics such as market size, income, and bilateral distance. Manova and Zhang (2012) have found that Chinese export prices are higher in smaller, richer, more proximate, and more central markets. In similar regressions, Görg et al. (2010) find a negative relationship between export prices and market size and a positive one between unit values and GDP/capita and distance using a sample of Hungarian firms. Baldwin and Harrigan (2011) focus on U.S. top, and hence richer, 100 export destinations and find that average U.S. export prices fall with the importer's GDP, proximity and remoteness, and vary either positively or negatively with income depending on the econometric specification. Following the aforementioned and other related empirical literature, we examine the behavior of aggregate export prices at the product level by running gravity-type regressions of product-specific unit values. We use data on population and GDP per capita from the World Bank's World Development Indicators, and obtain bilateral distances from CEPII. Remoteness, which proxies geographical isolation from most other nations or closeness to small countries but far away from big economies, is measured as a weighted average of a country's bilateral distance to all other countries in the world, using countries' GDP as weights.

The results are presented in Table A3. We first focus on aggregate prices, which would equal the unit value of the product-level data: first, export values and quantities across all firms that sell a specific SITC code to a given market are summed and then the average export price for each destination-product is obtained by dividing total revenues by total quantities. Column (1) of Table A3 shows that prices of Greek exporters are higher in richer, bigger, more distant, and more remote markets. When the analysis is performed for destinations above the median (rich) and below the median (poor) income per capita, we find that some patterns differ. Column (2) of Table A3 shows that average export prices to rich destinations are now not affected by market size. Export prices are higher in more central markets. By contrast, when poor destinations are considered in Column (3) of Table A3, we find that average export prices fall with income and increase with distance, and they do not respond to market remoteness.

Columns (4)-(8) of Table A3 focus on firm-product-destination prices and explore how the destination characteristics affect prices. We include firm and product fixed effects such that the estimated coefficients are identified from the variation in prices across destinations for a given firm and for a given product. The overall picture is that Greek firms charge higher prices for the same product in richer and remote markets.

D. First stage regressions

We test for underidentification and weak identification in the first stage regressions of Tables 3 and 4 by using the method of Sanderson and Windmeijer (2016).

The Sanderson-Windmeijer (SW) first-stage chi-squared Wald statistic is distributed as chi-squared with (IE−NEN+ 1) degrees of freedom under the null that the particular endogenous regressor of interest is underidentified, where IE is the number of excluded instruments and NEN is the number of endogenous regressors. For the models under investigation, the SW Chi-sq statistic (robust to heteroskedasticity and clustering on afm) is calculated to take the values reported in Tables A4 and A5 with 1 d.f. The value reported has corresponding p-value = 0.000 in all cases in Table A4 and in the vast majority of specifications in Table A5. This means that there is strong evidence to reject the null hypothesis of under-identification, and so it is possible to conclude that the excluded instruments are "relevant".

The SW first-stage F-statistic is the F form of the SW chi-squared test statistic and can be used as a diagnostic for whether a particular endogenous regressor is "weakly identified". In particular, the F-statistic can be compared against the critical values for the Cragg-Donald F-statistic for one endogenous regressor reported in Stock and Yogo (2005). The estimated SWF-statistic reported in Table A4 indicate a maximal bias of below 10% implying that there is no evidence to suspect that our models are heavily affected by the problem of weak instruments. With very few exceptions, this is also the case in Table A5.

Note that in our case with two or more endogenous regressors there is a difference in the null hypotheses of the SW and the KP tests reported in Tables 3 and 4. For example, the SW test for underidentification will fail to reject the hypothesis that a particular endogenous regressor is unidentified, whereas the Kleibergen-Paap rk Wald test of underidentification will fail to reject the hypothesis that *any* of the endogenous regressors is unidentified.

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TABLE A1. Description of ICAP credit scores and associated firm characteristics

Credit score	**Firm description**	**Firm characteristics**
***AA* (lowest credit risk)**	able to honor obligations even under severe distressed conditions	exceptional financial strength, very strong business growth and important market position
***A* (very low credit risk)**	able to honor obligations even under severe distressed conditions	very strong financials, strong business growth and important market position
***BB* (very low credit risk)**	likely to be affected very marginally by severe distressed conditions	significant financial strength, stable business growth and competitive market position
***B* (low credit risk)**	likely to be affected slightly by severe distressed conditions	satisfactory financial strength, stable business growth and relatively competitive market position
***C* (moderate credit risk)**	sensitive to market and economic conditions	moderate financial strength, stable business level and relatively declining competitive market position
***D* (relatively increased credit risk)**	rather sensitive to market and economic conditions	below average financial strength and negative business growth and declining competitive market position
***E* (increased credit risk)**	very sensitive to market and economic conditions	low financial strength and substantially negative business growth and low competitive market position
***F* (significantly increased credit risk)**	has or is very likely to have in the short term a problem in honoring financial obligation	significantly low financial strength and competitive market position
***G* (very high credit risk)**	significant problems in honoring financial obligation	encumbered financial strength, business put in jeopardy
***H* (highest credit risk)**	very significant problems in honoring financial obligation	extremely encumbered financial strength, business put in jeopardy significantly

TABLE A2. Reproducing the specifications of export pricing by Manova and Zhang (2012): firm-level variables

	I. dependent variable: p_{fp}			II. dependent variable: p_{fpd}					
	(I.1)	(I.2)	(I.3)	(II.1)	(II.2)	(II.3)	(II.4)	(II.5)	(II.6)
revenue	-0.041*** (-7.30)			-0.011*** (-2.94)		-0.028*** (-4.41)	-0.041*** (-8.57)		-0.065*** (-9.70)
quantity		-0.216*** (-52.39)			-0.146*** (-37.08)			-0.181*** (-46.50)	
#destinations			-0.083*** (-7.28)						
revenue X differentiated good						0.019** (2.45)			0.027*** (3.20)
R-squared	0.785	0.838	0.785	0.871	0.891	0.878	0.811	0.851	0.817
#observations	15691	15691	13164	33106	33106	27378	33106	33106	27378
#products (clusters)	1811	1811	1811	1811	1811	1474	1811	1811	1474
#firms	2169	2169	2169	2169	2169	2010	2169	2169	2010
#destinations	173	173	173	173	173	172	173	173	172
Table in Manova and Zhang (2012)	III, column 1	III, column 2	V (Panel A), column 1	IV, column 1	IV, column 2	IV, column 3	VI, column 1	VI, column 2	VI, column 4

Notes: All variables are in logs. All regressions include a constant term and product fixed effect with clustered standard errors (*t*-statistics in parentheses). P_{fp} denotes average prices across destinations and *revenue* and *quantity* are sums across destinations. P_{fdp} denotes the firm price of a product to a destination with prices defined as revenue over quantity. Columns (II.1)-(II.3) include firm and product fixed effects and account for the variation across firms. Columns (II.4)-(II.6) include destination and product fixed effects and account for the variation across destinations.

TABLE A3. Reproducing the specifications of export pricing by Manova and Zhang (2012): gravity-type regressions

dependent variable	p_{dp} (all)	p_{dp} (rich)	p_{dp} (poor)	p_{fpd}	p_{fpd}	p_{fpd}	p_{fpd}	p_{fpd}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
gdp per capita	0.091*** (7.26)	0.076*** (3.31)	-0.074* (-1.82)	0.110*** (10.65)				0.115*** (10.13)
gdp	0.022*** (4.60)	-0.002 (-0.27)	0.048*** (3.67)		0.015*** (4.15)			-0.004 (-0.98)
distance	0.030*** (3.32)	0.117*** (5.28)	0.036** (2.44)			0.012** (2.00)		-0. -0.001 (-0.17)
remoteness	0.169*** (2.60)	-0.170* (-1.70)	0.123 (0.93)				0.112** (2.02)	0.148** (2.55)
product FE	YES	YES	YES	YES	YES	YES	YES	YES
firm FE	NO	NO	NO	YES	YES	YES	YES	YES
R-squared	0.874	0.878	0.917	0.873	0.872	0.872	0.871	0.872
#observations	15080	11721	3359	31839	31839	31751	32194	31080
#products (clusters)	1796	1702	1150	1799	1799	1799	1806	1796
#firms	2168	1835	1129	2168	2168	2168	2168	2168
#destinations	149	75	74	173	173	173	173	173
Table in Manova and Zhang (2012)	II, column 1	II, column 2	II, column 3	VII, column 1	VII, column 2	VII, column 3	VII, column 4	VII, column 5

Notes: All variables are in logs. t-statistics in parentheses. All regressions include a constant term with clustered standard errors. P_{dp} denotes average prices across firms.

TABLE A4. Summary results for first-stage regressions of Table 3

Equation number (column) in Table 3 of paper	Test statistic	*price*	*price x financial rating*	*price x distance*	*price x per-capita GDP*	*price x population*
(1)	*Underid*	128.14	223.40			
	Weak id	113.89	198.57			
(2)	*Underid*	116.21	103.81			
	Weak id	104.21	93.09			
(3)	*Underid*	161.36		409.73		
	Weak id	144.34		366.52		
(4)	*Underid*	125.00			166.68	
	Weak id	111.86			149.17	
(5)	*Underid*	132.67				477.60
	Weak id	118.72				427.40
(6)	*Underid*	165.90	209.78	379.94	189.79	527.75
	Weak id	148.38	187.62	339.80	169.74	472.00
(7)	*Underid*	163.34	103.09	383.24	172.01	480.17
	Weak id	147.41	93.03	345.86	155.23	433.34
(8)	*Underid*	167.85	206.44	346.94	186.91	498.40
	Weak id	150.11	184.62	310.27	167.16	445.72
(9)	*Underid*	159.94	102.27	356.69	173.93	479.59
	Weak id	144.33	92.29	321.88	156.95	432.78

Notes: 'Underid' reports the values of the Sanderson-Windmeijer multivariate F test of excluded instruments and *'Weak id'* reports the Sanderson-Windmeijer test for underidentification. The number of columns corresponds to the number of the IV regressions depicted in Table 3.

TABLE A5. Summary results for first-stage regressions of Table 4

Equation number (column) in Table 4 of paper	Test statistic	***price***	***price x financial rating***	***price x distance***	***price x per-capita GDP***	***price x population***
(1)	*Underid*	47.62	72.24			
	Weak id	40.94	62.11			
(2)	*Underid*	47.62	59.92	242.61	77.19	403.64
	Weak id	42.25	53.16	215.24	68.48	358.10
(3)	*Underid*	28.86	19.00	227.93	76.20	408.88
	Weak id	23.91	16.91	202.85	67.82	363.89
(4)	*Underid*	90.89	151.57			
	Weak id	79.92	133.28			
(5)	*Underid*	129.84	137.99	464.08	173.16	439.68
	Weak id	115.45	122.70	412.65	153.97	390.95
(6)	*Underid*	118.83	80.65	459.82	174.82	423.57
	Weak id	106.37	72.19	411.63	156.50	379.18
(7)	*Underid*	133.25	87.69			
	Weak id	105.62	69.50			
(8)	*Underid*	130.19	84.86	251.25	130.26	281.31
	Weak id	106.12	69.17	204.79	106.17	229.28
(9)	*Underid*	112.03	41.95	252.95	128.52	282.94
	Weak id	91.74	34.36	207.14	105.25	231.70

Notes: 'Underid' reports the values of the Sanderson-Windmeijer multivariate F test of excluded instruments and *'Weak id'* reports the Sanderson-Windmeijer test for underidentification. The number of columns corresponds to the number of the IV regressions depicted in Table 4.