Why Don't Firms Export More? Product Quality and Colombian Plants

Eileen L. Brooks[*]
UC-Santa Cruz

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Abstract

Exporting firms around the world ship only a small fraction of their output overseas. For firms in a large country, such as the United States, this behavior can be explained by the existence of a large domestic market. For firms in a small lower income country, such as Colombia, the lower share of exports remains a puzzle. This paper begins by illustrating the failure of current models to explain plant export patterns in Colombia. Even models that do well in describing the US export distribution fail when confronted with the Colombian data. In response to this puzzle, this paper proposes a model in which wealthier individuals produce and consume higher quality products. Predictions of the model are tested on Colombian plant level data from 1981-1991. Overall, product quality is shown to be a significant factor in explaining the tendency for Colombian plants to under-export manufactured goods to the United States.

Keywords: International Trade, Exporting, Vertical Differentiation, Colombian Manufacturing, Sunk Costs, Firm Heterogeneity.

JEL Classifications: F12, F14, F17, L11, L20.

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[*] The author can be contacted at 231 Social Sciences I, UC Santa Cruz, Santa Cruz, CA, 95064, (831) 459-5397, FAX (831) 459-5900, ebrooks@ucsc.edu. I would like to thank Andrew Bernard, Dani Rodrik, Elhanan Helpman, Marc Melitz, Theo Eicher, Markus Mobius, Richard Caves, Sam Kortum, Marie Thursby, Yu-Chin Chen, Leeat Yariv, Paras Mehta, Jim Tybout, participants at the Dartmouth Conference on Firms and Trade, the SCCIE conference on international economics, and the 2000 Boulder EIIT conference for their comments and assistance. I am particularly indebted to Mark Roberts, Jim Tybout, and DANE for supplying me with the Colombian Manufacturing Census data, as well as Jon Haveman for concordance data and James Rauch for his classification of industries as differentiated or homogeneous. This material is based upon work supported under a National Science Foundation Graduate Research Fellowship. Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author and do not necessarily reflect the views of the National Science Foundation.

1. Introduction

Analyses of export sales in manufacturing surveys have established a puzzling phenomenon: most exporting firms sell only a small fraction of their output overseas.[1] For firms in a large country, such as the United States, this behavior can be explained by the existence of a large domestic market. In a small country, such as Colombia, the low export intensity of plants remains a puzzle. For example, among the 10-20 percent of Colombian manufacturing plants that exported during the 1980s, the average export share was roughly 20%.[2] The distribution of export shares for Colombia, in Figure 1, remained unchanged during the export boom of the 1980s. This phenomenon existed regardless of plant size, since the larger plants also had low export shares, as reported in Table 1.

These stylized facts are inconsistent with virtually any model of trade that incorporates varieties or firms; particularly considering that Colombia's market size was less than one percent of its primary export destination, the United States. The puzzle is amplified by the existence of sunk costs to exporting: after investing the time and energy to export to the U.S. market, it seems sub-optimal to sell small quantities to such a large market.[3]

This paper has two main parts. First, we show that the Helpman and Krugman (1985) and Bernard, Eaton, Jensen, and Kortum (2003) models cannot explain the average, distribution, and evolution of export intensities chosen by Colombian manufacturing plants. Second, we show that low product quality provides a significant explanation for why Colombian plants do not export more.

[1] See Bernard and Jensen (2003a), Bernard and Wagner (2001), or Roberts and Tybout (1996).
[2] Throughout this paper, export share will refer to the ratio of total export sales to total sales for a given plant. Regrettably, the data is not available to adjust for the gap between export prices and domestic consumer price levels.

The value of this study does not halt at the Colombian border. A lesson for trade researchers is that product quality should be considered when modeling exports from developing countries. Although this type of model exists at the country level, as in Linder (1961) and Young (1991), it has not yet been adapted to firm or variety-level studies.

Moreover, the results provide evidence of Engel Effects at the plant level. While Hunter and Markusen (1988) established the importance of Engel effects using aggregate data in an HOV model, this paper provides the first microeconomic evidence of Engel Effects.

The analysis proceeds as follows. Part 2 describes the data. Part 3 considers Colombian plant-level export intensities in light of existing models. Part 4 posits that income-induced consumption bias could explain the small export shares. In part 5 a static prediction of the theory is tested: that plants should have larger export shares when they are producing qualities more comparable to those of the United States. Part 6 concludes.

2. The Data

Plant-level data is obtained from the *Colombian Manufacturing Census*, which contains panel data for all manufacturing plants with ten or more employees from 1981-1991.[4] The variables used are: domestic sales, intermediate inputs, gross output, the white collar wage bill, the blue collar wage bill, the total book value of fixed assets, the total wage bill, the region, and the ownership structure at the plant level. Values are

[3] Evidence of sunk costs to exporting in Colombia is provided in Roberts and Tybout (1997b).
[4] The available data is more thoroughly explained in Roberts and Tybout (1996, 1997b).

expressed in thousands of current pesos, without adjustment for inflation or export price levels.

Note that export sales are reported-- without destination countries-- at the plant level. As a result, industry level trade destinations are used from *The World Trade Analyzer*, available from Statistics Canada. To proxy for quality, unit value data from US imports are taken from the *NBER Trade Database*, which is based upon Feenstra (1996). Because both of these data sets are indexed using the 4-digit SITC classification system, a concordance algorithm from the OECD was used to link the data with the *Colombian Manufacturing Census*, which is classified by the 4-digit ISIC revision 2 system.

3. Export Shares, Trade Costs, and Existing Models

In this section, we will argue that variable trade costs cannot explain the distribution of Colombian export shares along three lines. First, the average export share (conditional on exporting) was too low. In other words, the trade costs necessary to explain the low export shares are implausible. Second, the bimodal distribution of export shares is inconsistent with the variable trade cost explanation. Iceberg costs high enough to explain low average export shares should have made costs prohibitive for export intensive plants. Finally, the evolution of export shares over time rejects a theory of variable trade costs. During the export boom of the 1980s, export shares of individual plants remained the same despite a significant decline in trade costs.

3.1. Small Export Shares and The Helpman-Krugman Model

Considering Colombia's largest export destinations (as described in Table 2), the export share puzzle becomes even more apparent. A majority of Colombian exports were destined for economies that were not only larger than Colombia's, they were *twenty to* *one hundred times* larger than Colombia's. Why, given relative market sizes, did Colombian exporters only export 20% of their output on average?

Whether export shares were "too small" for variable trade cost models can be quantified in the context of the monopolistic competition model outlined in Helpman and Krugman (1985). In this section we will demonstrate that, after controlling for the effect of sunk costs to trade, small Colombian export shares imply iceberg trade costs that were above 100%.

To embark upon the trade cost calculation, we begin by deriving an export share using the Helpman and Krugman framework with iceberg trade costs.[5] The demand function of *domestic* residents for a *domestic* good in their model is:

$$D = \frac{p^{-\sigma}}{np^{1-\sigma} + n^*(p\tau)^{1-\sigma}} \alpha wL$$

where n is the number of domestic firms, n^* is the number of foreign firms, τ is the iceberg trade cost, p is the price of the goods, and αwL is the expenditure share for the industry. Using αwL^* as the expenditure share for the foreign industry, the demand function of *foreign* consumers for a *domestic* good is:[6]

$$D^* = \frac{(p\tau)^{-\sigma}}{n(p\tau)^{1-\sigma} + n^* p^{1-\sigma}} \alpha wL^*$$

Because the model is using iceberg transport costs, the firm output necessary to meet that demand is:[7]

[5] These equations are from Helpman and Krugman (1985), pp. 205-209.

[6] One could argue that the model should be designed to incorporate non-tradables, which would add a relative price index term to this equation. This should not dramatically change the result, however, since Colombia's non-tradables were cheaper than those of her trading partners.

[7] Because Helpman and Krugman use this step primarily to close the general equilibrium model, one could instead use D* to calculate plant export shares. In the tables, this would be equivalent to subtracting 1 from σ.

$$X = \frac{(p\tau)^{-\sigma}}{n(p\tau)^{1-\sigma} + n^* p^{1-\sigma}} \alpha w L^* \tau$$

Defining the export share as foreign sales divided by total sales and canceling terms, we can obtain:

$$\frac{Exports}{TotalSales} = \frac{X}{X+D} = \frac{\tau^{1-\sigma} \alpha w L^*}{\alpha w L + \tau^{1-\sigma} \alpha w L^*}$$

(Note that this equation assumes there is only one export destination per firm and only one variety per firm. [8])

Although an overly literal interpretation of the Helpman and Krugman model would require that all plants export to all countries, computing a realistic trade cost estimate requires acknowledging a fixed sunk cost to exporting. We therefore focus on the 10-20% of Colombian plants that export. Using GDP data, one can compute the uniform iceberg transport costs implied by the model for a given demand elasticity of substitution, σ (note the transition from export shares to an exports-domestic sales ratio):

$$\frac{Exports}{DomesticSales} = \tau^{1-\sigma} \frac{\alpha w L^*}{\alpha w L} \cong \tau^{1-\sigma} \frac{GDP^*}{GDP} \qquad (1)$$

Since we do not know the export destination by plant, we are forced to compare export-weighted trade flows with export-weighted averages of plant export shares.[9]

The implied tariff costs are listed in Table 3. Much of the interpretation rests upon selecting the appropriate elasticity of substitution for the primary exports of Colombia (chemicals, food, petroleum and textiles), which arguably should range

[8] This assumption has mixed implications. On the one hand, if a plant is producing many products, only one variety of which is exportable, then the effect will be to bias trade cost estimates upward. However, assuming that plants export only one good to only one country may balance out this effect because it is likely that many firms are exporting the same good to more than one country.
[9] This is a second-best methodology. Ideally, we would know where each plant is exporting to and use that information to directly compute implied transport costs at the plant level.

between 2 and 5.[10] In this range, the estimates for iceberg trade costs implied by small export shares seem unreasonable, at over 100%.

It is worth noting that one industry is exceptional, ISIC classification number 3116, Grain Milling Products, which includes the coffee-related manufacturing sector.[11] As is evident in Tables 1 and 3b, the coffee manufacturing industry appears to have exported large shares while the remaining sectors dramatically under-exported. However, even when the coffee sector is included, the estimated trade costs are roughly 50%. These estimated costs remain high, considering that excluding non-exporters from the analysis has already removed fixed sunk costs from consideration.

3.2 BEJK Revisited: The Failure to Explain Why Some Firms Do Export More

We now turn to the question of distribution. The export share distribution displayed in Figure 1 is bimodal: although the majority of firms exported a very small share of their output, there were also a small but significant number of very high intensity exporters. Note that these high intensity exporters were represented in many industries, including food, clothing, textiles, iron and steel.

Variable trade cost models cannot explain the within industry coexistence of many low intensity exporters alongside a few very high intensity exporters. Because the

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[10] As is summarized by Evans (2000), "the issue of an appropriate value for the elasticity of substitution between imports and domestic goods is a contentious one." (f. 23, p. 9) We propose a relatively low elasticity of substitution because only manufacturing products are considered. Hummels (2001) finds that elasticities at the 2-digit SITC level are largely between 3 and 8 for the U.S., New Zealand, Argentina, Brazil, Chile, and Paraguay. At the disaggregated level, Shiells *et al.* (1986) have found that the CES ranges between 1 and 12 for imports from all countries to the U.S. Feenstra (1994) offers methodological reasons why these estimates may be too low. He finds disaggregated values that range between 2.96 (typewriters) and 42.9 (silver bullion). It is also worth noting that we assume the same elasticity of substitution at home and abroad, an assumption which, if relaxed, could account for the small average export share as discussed by Tybout (2001).

[11] Although technically the ISIC revision 2 classifies coffee under industry code 3121, the Colombian census questionnaire asks plants to choose between "Grain Milling Products" (3116) and "Miscellaneous Food Products" (3121). As can be confirmed using industry-level export flow data from the *World Trade*

variable trade cost needed to explain a low average export share is high, the same large cost ought to be prohibitive for the high intensity exporters.

To illustrate this tension, we turn to the simulation by Bernard, Eaton, Jensen and Kortum (2003) – hereafter referred to as BEJK. Recognizing the failure of existing models to explain small American plant export shares, BEJK propose a Ricardian-style differentiated goods model. In the BEJK model, the production cost for each variety within each country is determined by drawing from a productivity distribution. Following Bertrand pricing, the lowest cost producer is the autarkic supplier of the product in each country. Under trade, producers vary across countries because of trade costs; otherwise, the producer with the lowest global productivity draw would supply the entire world. Trade costs are imputed using international trade flows, and are combined with productivity draws to determine which plant is the most productive supplier for each variety.

Due to the complexity generated by incorporating heterogeneous firm productivities into the model, the BEJK paper simulates this type of competition using two parameters. The first parameter, σ, is the elasticity of substitution across goods.[12] The second parameter, θ, is the dispersion of productivities within industries.

In the case of the United States, as demonstrated in Table 4a, the BEJK paper is successful at explaining the distribution of plant-level export shares. However, the large size of the U.S. economy is certainly in their favor. Consider an example in which a plant in the U.S. and a plant in Colombia export to Spain. In the case of a U.S. plant, if

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Analyzer, most coffee-related manufacturers selected "Grain Milling Products" as their industry classification on the survey.

[12] The σ in the BEJK model is equal to the Helpman-Krugman σ subtracted by 1. This is due to the different way in which iceberg trade costs enter their export demand specifications.

the plant were only exporting to Spain, the BEJK model would predict its export share in the same fashion as the Helpman and Krugman prediction in Equation 1. Without trade costs, the predicted export share for the U.S. model would be 4%. In contrast, if a Colombian plant is exporting to Spain, the corresponding maximum export share is 59%, because Colombia has a much smaller domestic market than the U.S.

As predicted, the BEJK simulation is unsuccessful for Colombia. The results in Table 4b demonstrate that under no set of parameters is the distribution of export shares for Colombia successfully matched by the simulation.[13] The fact that some of the plants *do* export large quantities of their output makes the Colombian case particularly challenging for the simulation. The BEJK model can explain small average export shares when the elasticity of substitution is set very high. However, the same large trade costs preclude the existence of high intensity exporters.

3.3 The Export Boom and Export Shares

Variable trade cost models also cannot explain the pattern of Colombian export growth in the 1980s. During the latter half of the decade, Colombia experienced an export boom, caused by a long-run devaluation in the real exchange rate (see Roberts and Tybout 1997a). If trade costs explain low export shares, this decline in variable export costs should have caused export intensities to increase. In contrast, the Colombian data suggests that export shares remained constant during an episode of export growth. Figure 2 shows that export growth in Colombia over the 1980s was largely a function of plants beginning to export, rather than a growth in plant-level export shares. Table 5

[13] I am indebted to BEJK, and especially Sam Kortum, for providing me with their simulation for the U.S.

demonstrates that average plant export shares did not increase over the sample, despite a doubling of the economy-wide export share.[14]

Moreover, there was no growth in the export shares of the original exporting plants. Classifying cohorts by the year the plant began exporting, Table 6 reports the number of plants that continued to export, as well as their average export shares.[15] Note that 1981 exporters that continued to export over the sample did not increase their export shares significantly. This lack of change is surprising, considering that many of the 1981 firms stopped exporting over the sample. This evidence suggests that, despite a decline in variable trade costs, plant export shares remained unaffected.

4. Why Firms *Don't* Export More: The Role Of Quality and Income

In light of these observations, we propose a theory of income-induced consumption bias. Under this theory, high intensity exporters reflect producers of high quality products that export to wealthy consumers in easily accessible markets. In contrast, low intensity exporters face lower demands abroad because their quality does not appeal to consumers in richer countries.

More formally, imagine a world with two types of individuals, Rich and Poor, and two qualities of products, High and Low. Rich people consume only High quality products, while Poor people can afford only Low quality products. Furthermore, for the sake of simplicity, assume that Rich people can produce only High quality products, and Poor people can produce only Low quality products. One possible justification for this

[14] A few causes of the slump in average export shares from 1983-1987 seem plausible. To begin, the real exchange rate was overvalued in the first half of the sample. Thus, the change in goods volume is probably not as large as the change in export shares documented in the graph. The slump in average exporter share appears to be most correlated with the total number of firms in the sample, which is a rough proxy for overall economic performance. Taxes and subsidies in the sample do not appear to account for the variation in export shares.

assumption is that wealthier producers have greater access to both physical and human capital.[16]

Trade between two countries in this framework happens on two entirely distinct levels - one level is a “Rich World Economy” and the other level is a “Poor World Economy.” In the case of differentiated products, this simple example can be modeled by analyzing trade in two completely distinct tiers of the Helpman and Krugman (1985) increasing returns to scale framework.

Consider two countries, Home and Foreign. Home and Foreign are endowed with Rich people (R_H) and Poor people (P_H). Foreign is relatively more abundant in Rich people:

$$\frac{R_H}{P_H} < \frac{R_F}{P_F}$$

There are two ways in which small export shares could arise in this simple example. First, high trade costs could explain small export shares. However, the empirical evidence suggests that trade costs are not the vital factor. Second, small export shares could reflect differences in income brackets abroad. Specifically, returning to the Helpman and Krugman example in Section 2.1, a firm producing a product for the Poor would have an export-domestic sales ratio of:

$$\frac{Exports}{DomesticSales} = \tau^{1-\sigma} \frac{P_F}{P_H}$$

This interpretation can explain the exporting behavior observed in Section 3. Low average export shares are explained by the low quality of Colombian products. At

[15] Note that 1981 includes all firms that exported in 1981, and is not restricted to those that began exporting in 1981.

the same time, a few firms can have large export shares in this example because they are producing a higher quality product for an income bracket that has many more consumers abroad than at home. Moreover, if small export shares were driven by the ratio of the size of various income levels across countries, one would not expect much change in a decade.

5. Empirically Testing the Product Quality – Export Share Relationship

The question remaining is whether the empirical evidence supports the theory that quality differences explain small Colombian export shares. Morawetz (1981) provides case-study evidence from the Colombian garment industry that supports the theory that some firms are producing an entirely different level of quality than others. Describing a low quality producer, he offers an example of a producer of boy's shirts that faded in the wash. The manufacturer responded to complaints by suggesting the shirts should be labeled "Dry Clean Only". In sharp contrast, a high quality producer differs in product quality and customer service. To quote a Colombian jacket-maker, "we have thirty people in our quality control department and we haven't had a complaint yet. We know that if just one order arrives defective in New York, we've lost the client."[17]

Reaching beyond anecdotal evidence, this section examines whether product quality differences are a statistically significant explanation for low export shares in Colombia. Note, however, that testing this theory requires an additional degree of sophistication. The model predicts a positive correlation between export quality and export shares *only if* the goods are being sold to a wealthier country. It would predict a

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[16] A more general theory that would be consistent with this assumption is offered by Flam and Helpman (1987).
[17] Morawetz (1981), p. 111.

negative relationship between export shares and quality when plants export to Colombia's poorer neighbors, such as Ecuador.

5.1. Testing the Quality Gap Hypothesis

The pivotal variable used in the regressions is called "quality gap," and is generated as the percentage difference between the unit value of exports for Colombia and the G7 countries.[18] More specifically, the quality gap variable is computed as:

$$QualityGap = \frac{(ColombianUnitValue - G7UnitValue)}{ColombianUnitValue}$$

The quality gap statistic is calculated at the lowest possible level of aggregation and then aggregated (and classified under the ISIC system) using the industry value of Colombian exports as weights.

We begin our analysis with a simple cross-sectional regression using industry data. Note that the average exporter share is an unweighted average of the export shares of all exporting plants in the industry for a given year. For the year 1991, the highest average exporter share for a major industry was 0.499 (Food) whereas the lowest share was 0.089 (Paper). Using quality gap as the independent variable and average exporter share as the dependent variable, the results are in Table 7a. When analyzing all of the manufacturing industries without regard for product differentiation or export destination, the quality gap coefficients are positive. This suggests that relative improvements in Colombian product quality increased the average export share. However, when all industries are included, the coefficient on the quality gap variable is statistically significant at the 95% level in only one of the four specifications.

[18] The unit value of exports is calculated by dividing the total value of imports to the U.S. in a given industry by the total volume of imports to the U.S. in the same industry. Note that the G7 unit value is computed with the remaining six countries, since the U.S. does not export to itself.

5.2. Isolating Industries Export Differentiated Products to the U.S.

Two additional restrictions are necessary to affirm the theory of income induced consumption bias. First, the theory relies upon the differentiation of product varieties, so the empirical analysis should include only industries that produce differentiated products. Industries are therefore classified as homogenous, reference-priced, or differentiated using the methodology in Rauch (1999).[19] When using only differentiated product industries, in Table 7b, the regression coefficients rise dramatically.

Second, the theory implies that higher quality products should increase plant export shares only when the goods are being shipped to wealthier countries. Industries should therefore be restricted to those that export to wealthier countries. To address this concern, we identify the industries that export over 25% of their output to the United States.[20] In addition to theoretical considerations, this subset is important because the quality gap is measured in terms of imports going into the U.S. In Table 7c, further restricting the industries to those that export to the U.S. causes the quality gap coefficients to increase once again.

To summarize, the statistical relationship between relative qualities and export shares is driven by industries producing differentiated products that are being sold to the United States - precisely the pattern that the model predicts. In all regressions using the plant and industry data, this internal consistency was observed: the coefficient on the quality gap variable is larger when analyzing industries composed of differentiated products and/or industries that export large fractions of their output to the United States.

[19] In particular, goods are "homogenous" if they are listed in commodities price indexes and "reference priced" if they are listed in trade journals. After classifying the individual 4-digit ISIC industries, they were compared with the result of a Colombian export-weighted concordance of Rauch's SITC index. The classification is very similar to the "Liberal" classification in the Rauch paper.

5.3. Introducing Plant-Level Considerations

Although the quality gap measure is only available at the industry level, plant-level variables can be used to control for alternate theories to explain small export intensities. Using variables to control for plant size, outsourcing, factor intensities, location, prior exporting experience, and ownership structure, the quality gap measure remains significant for the appropriate subset of industries reported in Table 8. Particularly considering that industry-level data is being used to test a plant-level phenomenon, the fact that adding plant-level variables only slightly decreases the quality gap coefficient demonstrates the importance of product quality in explaining small export shares. Moreover, the internal consistency of these estimates continues to affirm the theory of income-induced consumption bias: coefficients increase when the relevant subset of industries, containing those that produce differentiated products and export more than 25% of their output to the U.S., is separated out.

Specifically, the plant-level variables included are: the logarithm of domestic sales, intermediate inputs divided by gross output, the skilled-unskilled labor ratio, and the capital-labor ratio. Binary variables are also added to control for regions, whether the plant exported in the previous year, and corporations.

The binary variable for whether the plant exported in the previous year is significant in all of the regressions in Table 8. It appears that, while plant export shares are relatively stable over time, the export shares reported in the first year of exporting are roughly half as large. We attribute this observation to the fixed annual nature of the manufacturing survey: companies that began exporting at the end of the fiscal year will have reported low export shares for the first year.

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[20] The 25% level was selected because it split the Colombian industries roughly in half.

The logarithm of domestic sales is included to control for plant size. According to many micro-economic studies, including Bernard and Jensen (2003b), size increases the probability of a plant exporting. Moreover, one might imagine that larger production facilities are more able to produce more exports in addition to supplying the domestic market. Somewhat surprisingly, the coefficient on size is negative and significant in the regressions. One possible explanation for the negative coefficient is that the definition of export share (export sales divided by total sales) has domestic sales in its denominator. Second, size increases the propensity for plants to export, potentially causing them to export smaller quantities. Because the coefficient on the size variable is negative in the export share regressions, the regressions were also run using the logarithm of export sales as the dependent variable. The statistical significance of the quality gap coefficient did not change substantially; however, the coefficient on the size variable becomes positive and significant, ranging between 0.9 and 1.

Intermediates, defined as total intermediate inputs divided by gross output, are included in the regression to control for outsourcing or assembly plants. The coefficient on intermediates is significant in all of the regressions; however, the quality gap results are not affected by it. When data for foreign raw material imports is included as a new variable with intermediates in the regression, it is not statistically significant. When included alone, the foreign materials variable is positive and significant (albeit less significant than the intermediates). In either case, the effect of including the outsourcing variable does not affect the quality gap coefficient.

Additional variables are included which do not affect the quality gap coefficients. Regional controls are included to separate Bogota, Cali, and Medillin from other regions.

To control for differences in risk aversion and transaction costs, corporations are separated from other ownership structures. The skill-intensity of labor and the capital-labor ratio are included to control for relative factor abundance. None of these variables significantly alter the quality gap coefficients.

5.4. Testing for Selection Bias

One remaining concern is the role of plant self-selection into the export market. The regressions reported here do not formally incorporate the decision to export in the analysis. However, in a variety of Heckman (1979) two-step estimations, we cannot reject the hypothesis that the plant's choice of export intensity is independent of the decision to export. As we saw during the evolution of export growth over the 1980s, plants appeared to choose their export intensities independently prior to the decision of whether or not they exported. Nonetheless, the results should be interpreted as conditional on exporting.

6. Conclusion

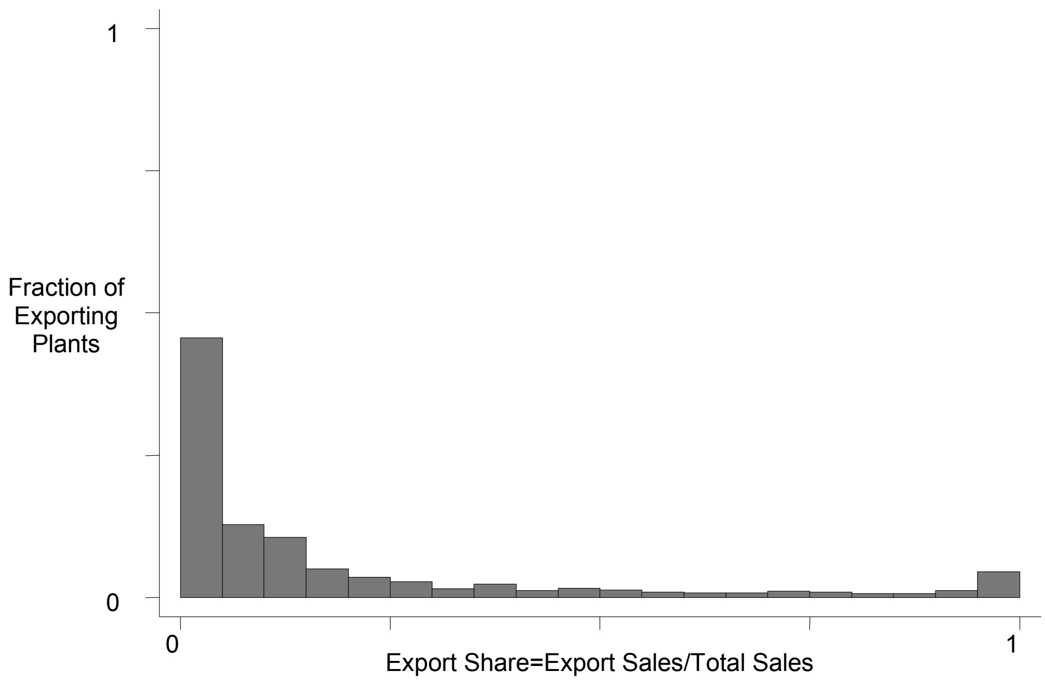
This paper asks why Colombian manufacturing plants have had a tendency to under-export. Even when Colombian plants exported to larger economies, export intensities remained low. The puzzle is compounded by the fact that, within many industries, a few Colombian plants reported export shares over 90%. This existence of high-intensity exporters suggests that trade costs were not prohibitive. The export share phenomenon becomes even harder to explain in the context of booming exports during the 1980's. Although exports doubled during the decade, the export shares of individual plants remained the same. Exports grew because plants entered the export market.

Existing models, including BEJK (2003) and Helpman-Krugman (1985), are unable to explain this puzzle. In the model developed here, the U.S. consumers demand higher average quality goods than Colombian consumers because they are generally wealthier. The model attributes small Colombian plant shares to the small demand of wealthy countries for low quality goods.

The static predictions of the model are supported empirically. Plant export shares increased as the relative quality of Colombian exports improved. This relationship is even stronger in industries that tended to export to the U.S. or produced differentiated products. These results are robust to the inclusion of many plant level control variables.

This paper suggests that trade is inhibited well beyond the previously estimated "sunk costs model of trade." Our results suggest that product quality should be considered when analyzing export decisions at the plant level, particularly in developing countries. Similar products may appeal to entirely different consumer markets because of quality differences.

Figure 1: Histogram of Plant-Level Export Shares in 1985[a]
(Source: Colombian Manufacturing Census)



[a] Both exports and total sales are reported on the manufacturing survey in pesos; export price deflators are unavailable.

Figure 2: The Growth of Colombian Exports
(Source: Colombian Manufacturing Census)

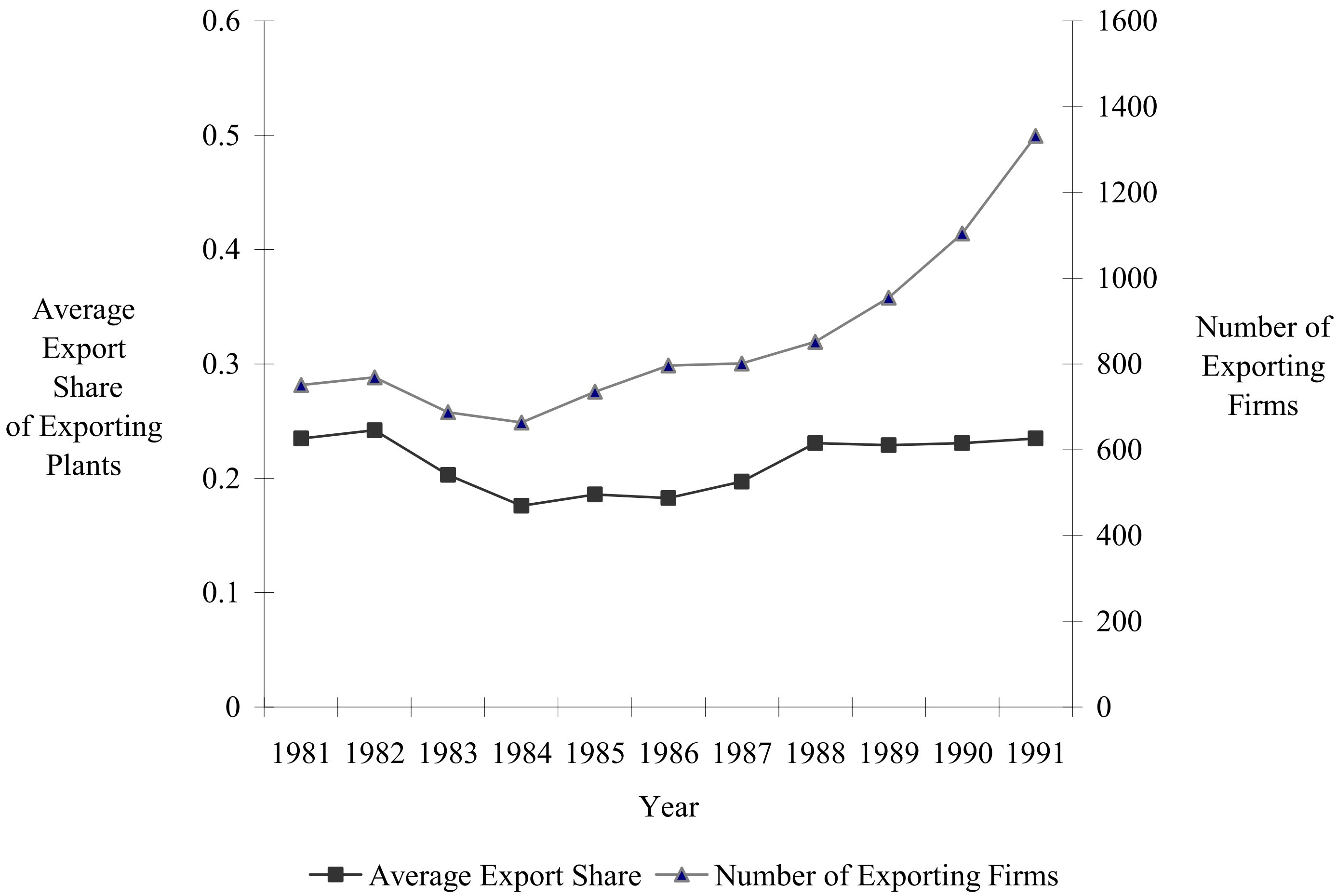


Table 1: The Average Plant-Level Export Shares

(Source: Colombian Manufacturing Census)

Year / Exporter Type	Sample Mean	Sample Standard Deviation	Number of Observations
1985 / All Exporters (Weighted by Plant)	0.186	0.278	735
1990 / All Exporters (Weighted by Plant)	0.231	0.297	1104
1985 / All Exporters (Weighted by Sales)	0.142	0.224	735
1985 / Large Exporters[a] (Weighted by Plant)	0.173	0.275	476
1985 / Except Coffee[b] (Weighted by Plant)	0.162	0.241	706
1985 / Coffee[b] (Weighted by Plant)	0.749	0.373	29

[a] Plants are considered "Large Exporters" if their total sales exceeds industry average.
[b] "Coffee" refers to plants in the industry group that includes coffee-related manufacturing and grain milling.

Table 2: Colombia's Top Ten Export Destinations in 1985 and 1990

(Source: *Statistics Canada*; *World Development Report*; Frankel and Wei, 1998)

1985: Trading Partner	Circular Distance (miles)	Percent Share Exports	1985 GDP (mil $)	1990: Trading Partner	Circular Distance (miles)	Percent Share Exports	1990 GDP (mill $)
USA	3829	34.84	3946600	USA	3829	47.65	5392200
Germany	9000	15.45	624970	Germany	9000	9.04	1488210
Japan	14326	4.30	1327900	Japan	14326	3.93	2942890
Netherlands	8865	3.58	124970	Panama	774	3.33	4750
Venezuela	1027	3.52	49600	Netherlands	8865	3.28	279150
UK	8509	3.43	454300	France	8639	2.94	1190780
Sweden	9697	2.73	100250	Venezuela	1027	2.56	48270
France	8639	2.64	510320	UK	8509	2.49	975150
Italy	9391	2.56	358670	Chile	4250	2.34	27790
Spain	8030	2.41	164250	Spain	8030	1.95	491240
Colombia			34900	Colombia			41120

Table 3(a): Trade Costs Implied By Plant-Level Export Shares Excluding Coffee

(Percent additional trade cost)

Year/Data Set	Constant Elasticity of Substitution			
	σ=1.5	σ=2	σ=3	σ=5
1985				
Balanced Panel[a]	8728%	840%	207%	75%
Complete Data	5318%	636%	171%	65%
1990				
Balanced Panel	10355%	922%	220%	79%
Complete Data	1056%	240%	84%	36%

Source: Author's calculation using *Colombian Manufacturing Census*, *World Trade Analyzer*, and *World Development Report*.

Table 3(b): Trade Costs Implied By Plant-Level Export Shares Includes Coffee

(Percent additional trade cost)

Year/Data Set	Constant Elasticity of Substitution			
	σ=1.5	σ=2	σ=3	σ=5
1985				
Balanced Panel	411%	126%	50%	23%
Complete Data	407%	125%	50%	23%
1990				
Balanced Panel	2193%	379%	119%	48%
Complete Data	217%	78%	33%	15%

Source: Author's calculation using *Colombian Manufacturing Census*, *World Trade Analyzer*, and *World Development Report*.

[a] The balanced panel is composed of plants covered by the manufacturing survey in every year from 1981 until 1991. This data tends to be more reliable and verifiable, but excludes any plants that began or ceased production during the period.

Table 4(a): The Results of the BEJK Simulation for the U.S. in 1991

% Export Intensity	Percentage of Exporting Plants θ=3.60[a] σ=1[b]	σ=4	θ=8.28 σ=1	σ=4	σ=6	σ=8	Census US Data 1991
0 to 10	49	80	49	55	64	79	66
10 to 20	26	18	26	25	25	19	16
20 to 30	9.2	1.4	9.5	8.5	6.9	1.3	7.7
30 to 40	5.0	0.0	4.9	4.5	3.8	0.0	4.4
40 to 50	3.2	0.0	3.2	3.4	0.0	0.0	2.4
50 to 60	2.5	0.0	2.4	3.1	0.0	0.0	1.5
60 to 70	2.5	0.0	2.5	0.1	0.0	0.0	1.0
70 to 80	2.5	0.0	2.5	0.0	0.0	0.0	0.6
80 to 90	0.0	0.0	0.0	0.0	0.0	0.0	0.5
90 to 100	0.6	0.0	0.5	0.6	0.6	0.6	0.7

Table 4(b): The Results of the BEJK Simulation for Colombia in 1991

% Export Intensity	Percentage of Exporting Plants θ=3.60 σ=1	σ=4	θ=8.28 σ=1	σ=4	σ=6	σ=8	Census Data With Coffee	Excl. Coffee
0 to 10	0.0	78	0.0	4.4	39	77	49	50
10 to 20	0.0	21	0.0	30	22	21	16	16
20 to 30	31	0.4	28	11	32	1.0	8.9	9.3
30 to 40	7.0	0.6	7.9	12	4.3	0.5	6.8	7.0
40 to 50	7.9	0.0	8.7	28	1.5	0.0	3.5	3.7
50 to 60	0.5	0.0	0.7	9.3	0.2	0.0	3.2	3.3
60 to 70	29	0.0	29	1.2	0.4	0.0	2.1	2.2
70 to 80	19	0.0	20	3.0	0.8	0.0	1.7	1.6
80 to 90	0.2	0.0	0.4	0.2	0.0	0.0	2.3	2.2
90 to 100	5.3	0.0	4.9	1.0	0.0	0.0	7.3	4.9

[a] θ is BEJK's parameter for within industry variation in productivity.
[b] σ is BEJK's parameter for the constant elasticity of substitution. Note that, when comparing export demand functions, BEJK's σ is Helpman-Krugman's σ subtracted by 1.

Table 5: Evolution of Plant-Level Export Shares Over the Sample

(Source: Colombian Manufacturing Census)

Year	Plant Count N	Economy-Wide Intensity	Exporter Count N	Mean Exp. Share
1981	6791	0.058	751	0.235
1982	7067	0.070	769	0.242
1983	6248	0.077	688	0.203
1984	6247	0.077	663	0.176
1985	6406	0.067	735	0.186
1986	6684	0.103	797	0.183
1987	6972	0.097	801	0.197
1988	7244	0.093	852	0.231
1989	7586	0.107	954	0.229
1990	7533	0.126	1104	0.231
1991	7304	0.118	1332	0.235

Table 6(a): Number of Exporting Plants Classified by Initial Export Year

(Source: *Colombian Manufacturing Census*)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Total
1981	751											751
1982	606	163										769
1983	509	86	93									688
1984	449	62	54	98								663
1985	439	62	47	58	129							735
1986	420	57	46	52	82	140						797
1987	402	49	38	52	68	71	121					801
1988	395	47	36	48	55	58	85	128				852
1989	394	41	38	50	56	50	75	84	166			954
1990	371	34	33	48	46	54	65	61	99	293		1104
1991	378	43	35	44	48	58	63	60	94	224	285	1332

Table 6(b): Evolution of Average Plant-Level Export Shares by Cohort

(Source: Colombian Manufacturing Census)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1981	0.235										
1982	0.243	0.239									
1983	0.196	0.241	0.205								
1984	0.180	0.231	0.193	0.114							
1985	0.200	0.217	0.242	0.153	0.117						
1986	0.193	0.206	0.237	0.207	0.114	0.158					
1987	0.199	0.202	0.271	0.196	0.097	0.212	0.211				
1988	0.206	0.207	0.313	0.186	0.083	0.234	0.251	0.360			
1989	0.220	0.218	0.313	0.203	0.164	0.239	0.286	0.322	0.185		
1990	0.207	0.243	0.281	0.196	0.191	0.202	0.290	0.317	0.206	0.248	
1991	0.222	0.210	0.272	0.228	0.146	0.206	0.338	0.308	0.251	0.316	0.165

Table 7. Quality Gap Regressions At The Industry Level

Dependent Variable: Average Export Intensity of Exporting Plants in the Industry.

	(1)	(2)	(3)	(4)
		7(a) Data from all Industries		
Quality Gap	0.068	0.011	0.011*	0.019
	(0.055)	(0.024)	(0.005)	(0.017)
Constant	0.205*	0.158*	0.194*	0.249*
	(0.024)	(0.019)	(0.001)	(0.039)
N	78	73	749	7965
R^2	0.018	0.001	0.011	0.006
		7(b) Differentiated Goods Industries		
Quality Gap	0.149*	0.080*	0.049	0.046*
	(0.055)	(0.036)	(0.025)	(0.022)
Constant	0.228*	0.173*	0.211*	0.240*
	(0.031)	(0.025)	(0.004)	(0.042)
N	48	45	459	5806
R^2	0.136	0.048	0.035	0.014
		7(c) Differentiated Goods Industries that Export to the U.S.		
Quality Gap	0.176*	0.124*	0.084*	0.071*
	(0.062)	(0.052)	(0.025)	(0.028)
Constant	0.269*	0.194*	0.269*	0.259*
	(0.043)	(0.035)	(0.008)	(0.054)
N	29	22	234	3179
R^2	0.196	0.202	0.092	0.018
Data Unit	Industry	Industry	Industry	Exporting Plant
Fixed Effects	No	No	Year	Year
Clustering	No	No	Year	SIC and Year
Sample Period	1990	1985	1982-1991	1982-1991

* Indicates statistical significance at the 95% level. Robust standard errors are reported in parentheses. Industries are defined by the ISIC revision 2 classification. Industries without exporters are excluded.

Table 8. Clustered Regression Results For Plant-Level Export Shares 1982-1991

Dependent Variable: Average Export Intensity of Exporting Plants in the Industry.

	(1)	(2)	(3)	(4)	(5)	(6)
Quality Gap	0.012	0.012	0.015	0.044*	0.046*	0.054*
	(0.009)	(0.009)	(0.010)	(0.015)	(0.015)	(0.015)
New Exporter	-0.143*	-0.143*	-0.157*	-0.162*	-0.163*	-0.175*
	(0.007)	(0.007)	(0.008)	(0.010)	(0.010)	(0.012)
Size	-0.072*	-0.073*	-0.067*	-0.083*	-0.085*	-0.077*
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Intermediates	0.307*	0.306*	0.319*	0.297*	0.299*	0.270*
	(0.035)	(0.035)	(0.040)	(0.052)	(0.052)	(0.056)
Cali/Medellin	0.000	0.000		-0.027*	-0.028*	
	(0.006)	(0.006)		(0.009)	(0.009)	
Other Region	0.117*	0.118*		0.075*	0.077*	
	(0.010)	(0.010)		(0.013)	(0.013)	
Corporation	0.053*	0.054*		0.072*	0.074*	
	(0.009)	(0.009)		(0.013)	(0.012)	
K/L	1.3×10^{-7}*			0.001		
	(3.9×10^{-8})			(0.001)		
Skill Premium	-0.002			-0.017*		
	(0.004)			(0.003)		
Constant	0.846*	0.857*	0.845*	1.005*	1.014*	0.984*
	(0.037)	(0.038)	(0.040)	(0.054)	(0.057)	(0.061)
N	7255	7378	7378	2864	2942	2942
R-Squared	0.386	0.389	0.330	0.414	0.411	0.370
Industry Type	All Manufacturing Industries			Produce Differentiated Goods, 25% of Exports are to the U.S.		
Fixed Effects	Year			Year		
Clustering	Year and Industry			Year and Industry		

* Indicates statistical significance at the 95% level. Robust standard errors are reported in parentheses. Industries are defined by the ISIC revision 2 classification. Only exporting plants are included.

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