The Variety and Quality of a Nation's Exports

David Hummels
Purdue University and NBER

Peter J. Klenow
Stanford University and NBER

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Abstract

Large economies export more in absolute terms than do small economies. We use data on shipments by 126 exporting countries to 59 importing countries in 5,000 product categories to answer the question: *how?* Do big economies export larger quantities of each good (the *intensive* margin), a wider set of goods (the *extensive* margin), or higher quality goods? We find that the extensive margin accounts for around 60% of the greater exports of larger economies. Within categories, richer countries export higher quantities at modestly higher prices. We compare these findings to some workhorse trade models. Models with Armington national product differentiation have no extensive margin, and incorrectly predict lower prices for the exports of larger economies. Models with Krugman firm-level product differentiation do feature a prominent extensive margin, but overpredict the rate at which variety responds to exporter size. Models with quality differentiation, meanwhile, can match the price facts. Finally, models with fixed costs of exporting to a given market might explain the tendency of larger economies to export a given product to more countries.

1. Introduction

Virtually every theory of international trade predicts that a larger economy will export more in absolute terms than a smaller economy. Trade theories differ, however, in their predictions about *how* larger economies export more. Models that assume Armington (1969) national differentiation emphasize the *intensive* margin: an economy twice the size of another will export twice as much but will not export a wider variety of goods. Monopolistic competition models in the vein of Krugman (1981) stress the *extensive* margin: economies twice the size will produce and export twice the range of goods. Vertical differentiation models, such as Flam and Helpman (1987) and Grossman and Helpman (1991), feature a quality margin, namely richer countries produce and export higher quality goods.

These divergent predictions imply very different consequences for welfare. If larger economies intensively export more of each variety, the prices of their national varieties should be lower on the world market. In large-scale Computable General Equilibrium (CGE) models with distinct national varieties, the simulated welfare changes associated with trade liberalization are dominated by such terms-of-trade effects (see Brown, 1987). In Acemoglu and Ventura (2002), these effects prevent real per capita incomes from diverging across countries with differing investment rates. These authors argue that richer countries face lower export prices, and that this is the critical force maintaining a stationary world income distribution.[1]

To the extent larger economies export a wider array of goods or export higher quality goods, lower export prices are no longer a necessary consequence of size. Rather than sliding down world demand curves for each variety, bigger economies may export more varieties to

[1] Davis and Weinstein (2002) build on the Acemoglu and Ventura model in estimating terms-of-trade-driven welfare losses to U.S. natives from in-migration.

more countries. Or they may export higher quality goods at higher prices. If variety and quality margins dominate, then growth and development economists must rely on other forces – such as technology diffusion and diminishing returns to capital – to tether the incomes of high and low investment economies. Furthermore, the welfare effects of trade liberalization could be very different than is typically found in many CGE models.

In this paper we use highly detailed U.N. data on exports in 1995 in order to assess the importance of the extensive, intensive, and quality margins in trade. The data cover exports from 126 countries to each of 59 importers in over 5,000 6-digit product categories. To check robustness we also examine exports by 124 countries to the U.S. in 1995 in over 13,000 10-digit product categories. We decompose a nation's exports into contributions from intensive versus extensive margins, and further decompose the intensive margin into price and quantity components. We then relate each margin to country size (PPP GDP) as well as to its components: workers and GDP per worker.

Of special interest are the extensive and quality margins. There are many possible ways to define the extensive margin (counting categories exported, counting categories over a certain size, weighting categories in various ways). We measure the extensive margin in a manner consistent with consumer price theory by adapting the methodology in Feenstra (1994), which appropriately weights categories of goods by their overall importance in exports to a given country. The quality margin is not directly observable but can be inferred by examining projections of price and quantity on GDP and its components. That is, if large exporters systematically sell high quantities at high prices, this is consistent with these exporters producing higher quality goods. We also show how to alternatively interpret the projections of price and quantity in terms of unmeasured, within-category variety.

Our findings are as follows. The extensive margin accounts for about 60 percent of the greater exports of larger economies. The intensive margins are dominated by higher quantities of each good rather than higher unit prices. Richer countries export higher quantities of each good at modestly higher prices, consistent with higher quality. Countries with more workers export higher quantities of each good, but at no higher prices. These patterns hold for both the U.N. data with broad geographic coverage, and U.S. data with more detailed product coverage.

The large extensive margins are inconsistent with Armington models, which have no extensive margin and imply that larger economies face lower export prices. In contrast, Krugman-style models with firm level product differentiation predict that larger economies will produce and export more varieties, consistent with the large extensive margins we find (assuming a strictly increasing relationship between varieties produced and varieties exported). However, these models predict that variety will expand in proportion to exporter size, which overstates the size of the observable extensive margin in the data. Further, the Krugman model predicts that a country will export to all markets if it exports to any markets in a category, a prediction strikingly at odds with the evidence. Countries typically export to a strict subset of markets, with larger economies exporting to decidedly more markets. This suggests that fixed costs of exporting a given product to a given market, as modeled by Romer (1994), may be important.

Our investigation builds on the empirical work of many predecessors. Feenstra (1994) applied his method to U.S. imports of six manufactured goods and found evidence of substantial import variety growth. Funke and Ruhwedel (2001) found that the variety of both exports and imports are positively correlated with per capita income across 19 OECD countries. Head and Ries (2001) looked for home market effects in U.S. and Canadian trade in order to empirically distinguish increasing returns and national product differentiation models. They found the evidence mostly consistent with national product differentiation. By comparison, we examine model implications for extensive (increasing returns) versus intensive (national product differentiation) margins, along with price and quantity effects that each implies. Schott (2003) found that richer countries export to the U.S. at higher unit prices within narrow categories. Countries more abundant in physical and human capital likewise export a given variety at higher unit prices. Like Schott, we use data on export prices in narrow categories for countries of differing income levels. Unlike his study, we examine a broad range of importers and use quantity data along with price data to extract information about quality differences.

The rest of the paper proceeds as follows. In Section 2 we briefly outline the predictions of some trade models for the various margins. We discuss the data we use in Section 3, and this guides how we define the extensive and intensive margins (and the latter's price and quantity components) in Section 4. In Section 5 we present our empirical findings, and in Section 6 we offer conclusions and possible directions for future work.

2. Export Margins in Various Models

In Table 1 we summarize what four trade models predict for the size of the intensive and extensive margins, and for the price and quantity components of the intensive margin. In all of these models, exporter variation in workers and productivity will cause variation in the quantity of output and exports, but along different margins. The predictions for the intensive and extensive margins are stark and well-known, but the price and quantity variations within the intensive margin are more subtle. In the exposition below we describe the implications of the models for prices and therefore the value of output for each exporter. Then, a projection of each margin on output (or on output per worker and number of workers) provides information on how well the models describe the data.

To help explain the Table 1 entries, consider the following general environment. Consumers in country m buy from up to J countries in each of I observable categories of goods. Goods are differentiated both across categories and across producing countries *within* categories. For example, midsize cars and trucks may be distinct observable categories, but within a category Japanese midsize cars are differentiated from German midsize cars. For simplicity we adopt a Dixit-Stiglitz formulation with a single elasticity of substitution $\sigma > 1$ between goods in different categories and goods from different countries. Consumers maximize utility given by

(1) $$U_m = \left[\sum_{j=1}^{J} \sum_{i=1}^{I} Q_{jmi} N_{jmi} \, x_{jmi}^{1-1/\sigma} \right]^{\frac{\sigma}{\sigma-1}}$$

subject to

(2) $$\sum_{j=1}^{J} \sum_{i=1}^{I} N_{jmi} p_{jmi} x_{jmi} \leq Y_m .$$

Here Q_{jmi} is the *quality* of varieties exported by country j to country m in category i.[2] N_{jmi} is the number of symmetric varieties exported from j to m *within* category i. (We assume for simplicity that these within-category varieties are symmetric.) x_{jmi} is the number of units (quantity) exported from j to m per variety in category i, and p_{jmi} is the price of each of the

[2] We let quality enter the utility function without an exponent so that it is in "price units", i.e., equivalent to a lower price. This is purely a normalization. Quality is a demand shifter in (1), raising the quantity a country can export to a market at a given price.

units. If country m does not buy from country j in category i (say, because j does not produce any varieties in category i), then $x_{jmi} = 0$ and $N_{jmi} = 0$. Y_m is country m's income.

If midsize car models are an observable category, then Japan's exporting of multiple, differentiated midsize car models to the U.S. would be an example of $N_{jmi} > 1$. Of course, the more disaggregated the trade data the more cross-category variety is captured by the observable categories (the I's). In the data section we examine the sensitivity of our results to changing levels of aggregation. And, although unobserved within-category varieties N are not directly distinguishable from quality Q, we will be able to draw some inferences about the role of each using price and quantity data.

We now explain the entries in Table 1.[3] In doing so we focus on exporter j variation that feeds into proportional variation across all markets m and categories i. That is, market-specific and category-specific proportional constants are omitted. We also express all objects relative to an exporter for which the following variables are normalized to 1: I, Q, N, x, p, A (productivity), L (employment), and Y. We assume that A and L differ exogenously across countries. We summarize variety within and across categories as $V = NI$ (=1 in the reference country).

Armington

In Armington's (1969) national differentiation model, each country produces a single variety in each category ($V_j = 1$ for all j, given the normalization), so there is no extensive margin. Quality likewise does not vary across countries ($Q_j = 1$ for all j). A country with more workers or higher productivity simply produces more of each variety ($x_j = A_j L_j$). This intensive

[3] We refer the reader to Hummels and Klenow (2002) for a more detailed exposition.

margin results in lower prices for each variety. The effect on export prices is smaller the larger the elasticity of substitution σ between varieties: $p_j = (A_j L_j)^{-1/\sigma}$. Country j 's GDP is $Y_j = p_j x_j V_j = (A_j L_j)^{1-1/\sigma}$. Taking logs and rearranging, country j 's export quantities and prices can be expressed as

(3) $$ln(x_j) = \frac{\sigma}{\sigma - 1} ln(Y_j / L_j) + \frac{\sigma}{\sigma - 1} ln(L_j)\text{, and}$$

(4) $$ln(p_j) = \frac{-1}{\sigma - 1} ln(Y_j / L_j) + \frac{-1}{\sigma - 1} ln(L_j)\ .$$

These expressions are the basis of the price and quantity entries in the first row of Table 1. In this Armington world, larger economies intensively export higher quantities at lower prices.[4]

Many CGE models of trade liberalization employ a modified Armington structure that differs from the stark assumptions in this base model. In particular, they employ exporter-specific weights in the utility function calibrated so that exporter prices and country size do not systematically co-vary in the cross-section. These weights can be thought of as quality *Q* or unobserved variety *N*. However, since the weights are fixed, the implications of the base Amrington model still apply to time-series. That is, changes in exporter size or income are predicted to yield changes in output and prices as in first-differenced versions of equations (3) and (4).

[4] An alternative to expression (4) is $ln(p_j) = -1/\sigma\ ln(A_j) - 1/\sigma\ ln(L_j)$. For empirical estimation, this expression would allow consistent estimation of the effect of exogenous variables. With (4), in contrast, the effect of employment on prices will be biased downward (upward in absolute terms). Higher L lowers income per worker for a given A, so controlling for Y/L requires a higher A. The coefficient on L in (4) therefore captures the effect on export prices of higher L combined with enough higher A to keep Y/L unchanged. As we discuss below, we focus on (4) because Y/L is directly observable, whereas one must know σ (and quality if it varies across countries) to derive A.

Acemoglu and Ventura

Acemoglu and Ventura (2002) add endogenous capital accumulation and an endogenous number of varieties to the Armington model. They posit constant returns to capital in the production of each variety, and a fixed labor requirement for producing each variety. The number of varieties a country produces is then proportional to its employment $(V_j = L_j)$. A country with higher productivity (A_j, broadly construed to include physical capital) produces more of each variety $(x_j = A_j)$. Higher production of each variety translates into lower prices for each variety: $p_j = (A_j)^{-1/\sigma}$. Country j 's GDP is $Y_j = p_j x_j V_j = (A_j)^{1-1/\sigma} L_j$. Greater Y/L, but not greater L, is associated with producing higher quantities of each variety and selling them at lower unit prices:

(5) $$ln(x_j) = \frac{\sigma}{\sigma-1} ln(Y_j / L_j) \text{, and}$$

(6) $$ln(p_j) = \frac{-1}{\sigma-1} ln(Y_j / L_j) .$$

The second row of Table 1 summarizes this model's predictions.

Krugman

Krugman (1979, 1980, 1981) modeled countries as producing an endogenous number of varieties.[5] With fixed output costs of producing each variety, the number of varieties produced in a country is proportional to the size of the economy $(V_j = Y_j = A_j L_j)$. In this simplest Krugman world, all countries export the same quantity per variety ($x_j = 1$ for all j) and export at

[5] See also Ethier (1979, 1982).

the same unit prices ($p_j = 1$ for all j). Neither unit prices nor quantity per variety vary with GDP per worker or the number of workers. These results are stated in the third row of Table 1.

The Krugman model has the property that, conditional on producing a variety, a country exports this variety to all other markets. A corollary is that, conditional on exporting in a category, a country exports in this category to all other countries. In models with fixed costs of exporting to each market, such as Romer (1994), a country may instead export to a strict subset of markets, or even to no markets at all despite producing in the category. When we discuss our empirical findings in Section 5 below, we will present evidence on export destinations to address this issue.

Quality Differentiation

Suppose quality varies across countries (Q_j differs across j) but productivity and variety do not ($A_j = 1$ and $V_j = 1$ for all j). Countries with more workers produce more of each variety $(x_j = L_j)$. A country's unit prices reflect both the level of employment and the level of quality: $p_j = Q_j(L_j)^{-1/\sigma}$. GDP is $Y_j = Q_j(L_j)^{1-1/\sigma}$. Also, $Y_j / L_j = Q_j(L_j)^{-1/\sigma} = p_j$. Quantity per variety should positively project on exporter employment but be unrelated to exporter GDP per worker; prices for varieties should project positively on GDP per worker but be unrelated to employment. These results are shown in the final row of Table 1.

More generally, we can use consumer first order conditions from (1) and (2) to express quality and within-category variety in terms of the observed prices and quantities and the elasticity of substitution between varieties:

(7) $$ln(Q_j) + \frac{1}{\sigma} ln(N_j) = ln(p_j) + \frac{1}{\sigma} ln(N_j x_j).$$

Note that the observed quantities per category are actually $N\,x$, rather than the theoretically ideal x. Also note that quality and within-category variety are isomorphic (up to a scalar) in this expression. We return to this issue when discussing the empirical results.

3. Data Description

We draw export data from two sources. We use worldwide data from UNCTAD's Trade Analysis and Information System (TRAINS) CD-ROM for 1995. The TRAINS project combines bilateral import data collected by the national statistical agencies of 76 importing countries, covering all exporting countries (227 in 1995). The data are reported in the Harmonized System (HS) classification code at the 6-digit level, or 5,017 goods, and include shipment values and quantities. For a subset of these countries (126 of the 227 exporters and 59 of the 76 importers), we have matching employment and GDP data (discussed below). The 59 importers represent the vast majority of world imports, so total shipments for each exporter reported in TRAINS closely approximates worldwide shipments for that exporter.

Our calculation of the extensive margin may be sensitive to the level of aggregation at which we measure exports. That is, a country may export total variety $V=NI$, but only categories I are observable. As data become more aggregated, variety shifts from the observable I to the unobservable within-category N. For example, were we to use the output data available in internationally comparable form at roughly the 2-digit level, we would find that most countries produce and export in all sectors.[6] We would then obtain much smaller extensive margins, with

[6] Prominent CGE models typically feature fewer than 50 manufactured goods, primarily because of the dearth of output data, and therefore include no extensive margins in their analysis. The most disaggregated model we could find in the CGE literature is that employed by the U.S. International Trade Commission. It has roughly 500 sectors, still an order of magnitude fewer than the 6-digit HS codes we use. Also, its structure is fundamentally different than the models under consideration here. It has a U.S. vs. rest-of-world focus, contains no data on rest-of-world output, and allows for no cross-country differences in varieties either in cross-section or over time.

most variety differences relegated to the intensive margin. By using more detailed export data with 5,017 6-digit HS categories, we can do a better job of assigning variety differences to the extensive margin.

We also use U.S. data with more product detail from the "U.S. Imports of Merchandise" CD-ROM for 1995, published by the U.S. Bureau of the Census. The data are drawn from electronically submitted Customs forms that report the country of origin, value, quantity, freight paid, duties paid, and HS code for each shipment entering the United States. The 10-digit HS scheme includes 13,386 highly detailed goods categories. The data include all countries shipping to the United States, a total of 222 in 1995. We have data on employment and output in 1995 for 124 of these exporters.[7]

In both datasets, we measure prices as unit values (value/quantity). Quantity (and therefore price) data are missing for approximately 16 percent of U.S. observations and 18 percent of worldwide observations for 1995.[8] When the U.S. data include multiple shipments from an exporter in a 10-digit category, we aggregate values and quantities. The resulting prices are quantity-weighted averages of prices found within shipments from that exporter-category.

Data on national employment and GDP at 1996 international (PPP) prices come from Heston, Summers and Aten (2002). We use PPP GDP, as opposed to GDP at current market exchange rates, to avoid any mechanical association between an exporter's price and GDP through the value of its market exchange rate. All of our empirical results are robust to using GDP valued at market exchange rates instead of PPP exchange rates.

[7] The remaining 98, primarily very small or former Soviet-bloc countries, comprise only 5% of U.S. trade in 1995.

[8] The likelihood that quantity data are missing is uncorrelated with aggregate employment and GDP per worker, so our analyses should not be biased by dropping these observations.

4. Decomposition Methodology

We now construct empirical counterparts to the intensive margin (px), the category extensive margin (I), and the price (p) and quantity (x) components of the intensive margin. To do so, we adapt Feenstra's (1994) methodology for incorporating new varieties into a country's import price index when preferences take the form of our equation (1). Feenstra shows that the import price index is effectively lowered when the set of goods expands.

Instead of comparing varieties imported over time, we compare varieties imported from different exporters at a point in time. In this case, comparing export prices for country j relative to a reference country k requires an adjustment for the size of each exporter's goods set. The appropriate adjustment is the extensive margin. For the case when j's shipments to m are a subset of k's shipments to m, the extensive margin is defined as

(8)
$$\mathrm{EM}_{jm} = \frac{\sum_{i \in I_{jm}} p_{kmi} x_{kmi}}{\sum_{i \in I} p_{kmi} x_{kmi}}.$$

This is a cross-exporter analogue of Feenstra's new varieties adjustment to an import price index. I_{jm} is the set of *observable* categories in which country j has positive exports to m, i.e., $x_{jmi} > 0$. (In our empirical implementation the I categories will be 5,017 6-digit U.N. Harmonised System product codes.) Reference country k has positive exports to m in all I categories. (In our empirical implementation k will be rest-of-world.) EM_{jm} equals country k's exports to m in I_{jm} relative to country k's exports to m in all I categories.

The extensive margin can be thought of as a weighted count of j's categories relative to k's categories. If all categories are of equal importance, then the extensive margin is simply the fraction of categories in which j exports to m. More generally, categories are weighted by their importance in k's exports to m. An advantage of evaluating a category's importance without reference to j's exports is that it prevents a category from appearing important solely because j (and no other country) exports a lot to m in that category.[9]

The corresponding intensive margin compares nominal shipments for j and k in a common set of goods. It is given by

(9) $$\mathrm{IM}_{jm} = \frac{\sum_{i \in I_{jm}} p_{jmi} x_{jmi}}{\sum_{i \in I_{jm}} p_{kmi} x_{kmi}}.$$

IM_{jm} equals j's nominal exports relative to k's nominal exports *in those categories in which j exports to m* (I_{jm}). The ratio of country j to country k exports to m equals the product of the two margins:

(10) $$\frac{\sum_{i=1}^{I} p_{jmi} x_{jmi}}{\sum_{i=1}^{I} p_{kmi} x_{kmi}} = \mathrm{IM}_{jm}\ \mathrm{EM}_{jm}.$$

To see a simple example of the intensive versus extensive decomposition, compare German and Belgian exports to the U.S., using $k =$ rest-of-world for the reference country in each case. Given the size of each, it is not surprising that Germany's exports to the U.S. are 6.2 times larger than Belgium's. Some of this comes through a greater number of categories shipped – Germany ships in 79 percent of the 5017 6-digit HS codes, while Belgium ships in 51 percent. Were all categories of equal weight this would yield an extensive margin for Germany that is 1.55 times larger than Belgium's. This leaves an intensive margin (i.e., exports per category) for

[9] A disadvantage is that a country may appear to have a large extensive margin because it exports a small amount in

Germany that is 4 times larger than Belgium's. However, not all categories are of equal weight. Germany ships in categories that are a larger share of rest-of-world exports to the U.S., the numerator in equation (8). Incorporating the weighted counts, Germany's extensive margin is 1.65 times greater than Belgium's, and its intensive margin is 3.75 times larger.

We now turn to decomposing the intensive margin into price and quantity indices. Suppose that quality (Q) and within-category variety (N) vary across categories i for each importer m. This encompasses preferences that place more weight on some goods than others. As a baseline case, assume further that quality and within-category variety do not vary by exporter. (In our empirical analysis, we will test these assumptions.) For this baseline case, Feenstra (1994) derives an exact price index for the intensive margin of country m's imports from j versus k:

(11) $$P_{jm} = \prod_{i \in I_{jm}} \left(\frac{p_{jmi}}{p_{kmi}} \right)^{w_{jmi}} .$$

In (11), w_{jmi} is the logarithmic mean of s_{jmi} (the share of category i in country j's exports to m) and s_{kmi} (the share of category i in k's exports to m, where $i \in I_{jm}$):

$$s_{jmi} = \frac{p_{jmi} x_{jmi}}{\sum_{i \in I_{jm}} p_{jmi} x_{jmi}}, \; s_{kmi} = \frac{p_{kmi} x_{kmi}}{\sum_{i \in I_{jm}} p_{kmi} x_{kmi}}, w_{jmi} = \frac{\dfrac{s_{jmi} - s_{kmi}}{\ln s_{jmi} - \ln s_{kmi}}}{\sum_{i \in I_{jm}} \dfrac{s_{jmi} - s_{kmi}}{\ln s_{jmi} - \ln s_{kmi}}}$$

categories in which k exports a lot. As we discuss in the next section, we do not find this to be the case empirically.

We decompose the intensive margin into the price index (11) and an implicit quantity index:[10]

$$\text{IM}_{jm} = P_{jm} X_{jm} . \tag{12}$$

Expressions (8) through (12) define our decomposition of country j's exports to a given market m (relative to k's exports to m). The functional forms in (8) through (12) are all based on Feenstra's (1994) theory. To implement the decompositions, we need to choose a reference k. For each market m, we choose k to be all exporters to m other than j. In our dataset we always find $I_{jm} \subseteq I$, i.e., country j exports to m in a subset of the categories exported by k to m. For measuring j's extensive margin, it means the importance of different categories is determined by the broadest possible set of other countries. Similarly, for measuring the price and quantity components of the intensive margin, j's prices and quantities are compared to those of all other countries exporting to m.

For our implementation with U.S. data, we employ equations (8) through (12) with the import market $m =$ the U.S. The U.N. TRAINS data contain 59 import markets. We summarize each exporter's margins across all the markets as follows. We first decompose country j's exports to each market $m \subseteq M_{-j}$, where M is the set of countries for which import data are

[10] Feenstra incorporates the extensive margin into a broader price index. The analogue for cross-country exports is

$$\frac{\sum_{i=1}^{I} p_{jmi} x_{jmi}}{\sum_{i=1}^{I} p_{kmi} x_{kmi}} = [P_{jm} (\text{EM}_{jm})^{-1/(\sigma-1)}] \, [X_{jm} (\text{EM}_{jm})^{\sigma/(\sigma-1)}] .$$

The first bracketed term is a price index that reflects how higher EM_{jm} lowers the cost of obtaining utility through imports from country j. The second bracketed term is a quantity index incorporating the impact of the lower effective price on demand for country j exports.

available. We then take the geometric average of country j's decompositions across the M_{-j} markets to get

$$\mathrm{IM}_j = \prod_{m \in M_{-j}} (\mathrm{IM}_{jm})^{a_{jm}} \qquad \mathrm{EM}_j = \prod_{m \in M_{-j}} (\mathrm{EM}_{jm})^{a_{jm}}$$

$$P_j = \prod_{m \in M_{-j}} (P_{jm})^{a_{jm}} \qquad X_j = \prod_{m \in M_{-j}} (X_{jm})^{a_{jm}}.$$

The weight a_{jm} is the logarithmic mean of the shares of m in the overall exports of j and W_{-j-m}, respectively (normalized so that a_{jm}'s sum to 1 over the set M_{-j}).

5. Empirical Results

For each exporting country, we construct overall exports, the intensive margin, the extensive margin, and the price and quantity components of the intensive margin. We then regress the natural log of each margin on the exporter's log GDP relative to rest-of-world log GDP. Separately, we regress each margin on exporter GDP per worker and log employment, both expressed relative to the rest of the world. The regression samples are cross-sections of exporting countries in 1995. An Appendix Table presents each of these variables for all 126 countries.

This approach has two advantages. First, because OLS is a linear operator, the regressions additively decompose the margins along which larger economies export more. Second, by projecting each margin on GDP etc., our conclusions are more robust to measurement error. For example, the level of the extensive margin can be sensitive to the inclusion of very small trade flows that one might argue should rightly be ignored. But a projection of the extensive margin on log GDP is not sensitive to this unless there is a systematic relationship between the measurement error and exporter GDP.[11]

Although we will be comparing our findings to each model's predictions, we are not aiming to formally test each model. The models were deliberately stark and can all be easily rejected. Our goal is instead to identify model ingredients that may help explain the facts. This will hopefully prove useful for future work developing a single model consistent with the facts.

Table 2 presents the extensive and intensive margins in the 1995 U.N. data. The data cover exports by 126 countries to 59 markets in 5,017 categories. Each regression has 126 observations, one for each exporting country. All of the coefficients in the Tables are significantly different from zero (p-values below 1%) unless otherwise noted. The first row shows that larger economies export substantially more to the typical market. The second and third rows report that, with respect to GDP, around 38% of this occurs on the intensive margin and the other 62% on the extensive margin. Figure 1 plots the extensive margin against GDP for the 126 countries. Table 2 shows further that the extensive margin plays a more prominent role for richer economies (66%) than for economies with more workers (59%).

Table 3 breaks the intensive margin into its price and quantity components. Within categories and to a given market, countries with twice the GDP per worker export 34% higher quantities at 9% higher prices. Countries with twice the employment tend to export 37% higher quantities at no higher or lower prices. Economies with twice the GDP export 36% higher quantities at 2% higher prices, not far from the elasticities with respect to employment.

[11] We experimented with discarding small trade flows, with cutoffs at various levels in absolute and percentage of exports terms. The cutoffs did not materially alter extensive margin projections on GDP or its components.

The results in Tables 2 and 3 do not conform to the predictions of any single model in Table 1. This is not surprising given that the models are polar cases. The Armington model has no extensive margin, omitting a channel that constitutes more than half the exports of larger economies. Within the intensive margin, Armington predicts higher quantities per variety and lower prices. Countries with higher GDP do export higher quantities per category, but not nearly to the extent predicted by the model. Just as striking, larger economies do not export their varieties at lower prices. Richer countries export at modestly higher prices, and countries with more workers export at no lower prices. Typical elasticities of substitution estimated at the 6-digit level are between five and ten (see Hummels, 1999). The Armington model therefore predicts price elasticities in the range -0.11 to -0.25. The coefficient on GDP per worker is ten standard errors away from this, and the coefficient on employment is eight standard errors away.

Like the Armington model, the Acemoglu and Ventura model predicts richer countries will export higher quantities of each variety at a lower price. To match facts about the world income distribution, Acemoglu and Ventura (2002) need the elasticity of substitution to be small (around 2.6), and the elasticity of price with respect to GDP per worker to be large and negative (around -0.6). In contrast, the empirical price effects are small and go in the wrong direction. This suggests that diminishing returns and technology diffusion may be needed to ensure a stationary world income distribution.

The Krugman model does feature a prominent extensive margin, consistent with evidence assuming there is a strictly-increasing relationship between production of varieties and exporting of observable categories. The Krugman model's predictions for prices and quantities are also closer to the data than are the predictions of the Armington and Acemoglu and Ventura models, but discrepancies remain. Richer economies and those with more workers have notably higher export quantities. This could be consistent with the Krugman model if larger economies produce more varieties *within* 6-digit categories. The level of aggregation at which one measures the extensive margin clearly affects how it varies according to country size. If variety differences exist at more disaggregated levels (e.g. 8-digit or 10-digit), then we will capture only some of the variety differences in the extensive margin with 6-digit data, and some will be in the intensive margin. This can be seen most clearly by re-defining the extensive margin at more aggregated data levels. Table 4 displays the covariation of country size with extensive margins measured at the 6, 5, 4, 3, 2, and 1-digit levels. As we aggregate, the size of the extensive margin (and its covariation with country size) naturally declines.[12]

One fact difficult for the Krugman framework to explain is the higher price of rich country exports. Quality differentiation would seem to be necessary. The simple quality differentiation model described above has no extensive margin, which is at odds with the large extensive margins documented in Table 2. But this model has an ingredient which can help explain some of the price and quantity facts in Table 3. By exporting higher quality goods, richer economies can export higher quantities without lowering the prices of their varieties on world markets. Quality is a demand shifter in our specification of utility in (1), raising the quantity a country can export to a market at a given price. The polar version of the quality model – with no variety margin – overstates the price margin for richer economies, but fits the (absence of any) price margin for countries with more workers. It understates the quantity margin with respect to GDP per worker, and overstates it with respect to employment.

[12] In an earlier draft (Hummels and Klenow, 2002), we used ten-digit data for U.S. imports to disaggregate further and obtain still-larger extensive margins.

Putting the polar quality differentiation model aside, how much does quality vary with exporter income? We would like to extract quality from the price and quantity margins using equation (7) above. We cannot disentangle quality from within-category variety, however, unless we have detailed data on the precise number of varieties per good from another source. For an example of this sort of calculation, consider Japanese versus South Korean car exports to the U.S. In 1995, dollar sales of Japanese models in the U.S. exceeded dollar sales of South Korean models by a factor of 28.[13] Japan exported 56 different car models to the U.S. in 1995, whereas South Korea exported 8 car models.[14] We would therefore attribute a factor of 7 out of the 28 total to more Japanese varieties (a 58% extensive margin in log terms), and the remaining factor of 4 to the intensive margin. The average unit price of Japanese models was almost 2.4 times the average unit price of South Korean models ($18,371 vs. $7,768). The number of cars sold per Japanese model exceeded units sold per South Korean model by a factor of 1.7 (38,800 vs. 22,900). Based on these figures, the 42% intensive margin consisted of 26% higher prices and 16% higher quantities. Using an elasticity of substitution $\sigma = 5$ and equation (7), we would infer that Japanese models were 2.6 times the quality of South Korean models. And we would say Japanese cars had lower quality-adjusted prices (2.6 times the quality for 2.4 times the price), explaining their higher unit sales per model.

Without similar data on within-category variety, we cannot do these calculations for all categories of goods. But we can ask what our estimates imply for quality and within-category variety under particular assumptions. We start by supposing that within-category variety does

[13] The data are from Ward's Motor Vehicle Facts & Figures. In our calculations below, we include domestic production of models exported to the U.S. in sales of models exported to the U.S.

not vary with exporter Y/L or L. Then we can use expression (7), our estimates in Table 3, and estimates of the elasticity of substitution taken from the literature to infer quality variation.[15] Based on estimates in Hummels (1999), we consider $\sigma = 5$ and $\sigma = 10$. These values correspond to markups of 25% and 11%, respectively. We also entertain $\sigma = 2.6$, which is Acemoglu and Ventura's (2002) required value. The top panel of Table 5 reports the implied quality elasticities: countries with twice the Y/L tend to export 13% to 23% higher quality varieties, and countries with twice the L tend to export 3 to 14% higher quality products. If the quantity margin is increasing in country size, our construction implies that their quality-adjusted prices must be lower. This is in the spirit of the Armington and Acemoglu and Ventura models. At −.13 (standard error .02), however, the quality-adjusted price elasticity with respect to Y/L is a long way from the −.63 required by Acemoglu and Ventura with their $\sigma = 2.6$.

We next suppose that within-category variety varies with exporter size, but quality does not. The middle panel of Table 5 applies (7) to this case. Under the three values for σ, economies with twice the Y/L export 59 to 129% more varieties per category, and economies with twice the Y export 29 to 35% more varieties. These elasticities are large compared to the increase in the extensive margin when going from 6 digits to 10 digits in the U.S. import dataset. Moreover, the quality-adjusted price facts are problematic for the "all variety" assumption: if quality does not co-vary with exporter size, why are prices higher for high Y/L exporters?

[14] There are only 7 six-digit categories covering passenger motor vehicles in the U.N. data, so Japan exported an average of 8 car models to the U.S. per six-digit car category. This illustrates that a country can be exporting more than one variety to a given market in a six-digit category, i.e., within-category variety.

[15] This assumes the existence of a single elasticity of substitution, whereas this elasticity surely varies by category.

Finally, suppose both quality and within-category variety are a function of exporter size, but quality-adjusted prices are not. In this case, observed prices perfectly capture quality variation so the quality elasticities simply equal the price elasticities, as is typically assumed in the literature. If a country's exports are representative of their production, the implication would be that quality differences are the proximate cause of 9% of differences in Y/L across countries. Within-category variety is left to explain the quantity elasticities. As the third panel of Table 5 shows, the implication would be that economies twice the size export about 34% more varieties within categories. In this case, a hybrid of the Krugman model and the quality differentiation model could potentially fit all of the facts.

Fixed Costs of Exporting?

As we mentioned while describing the polar models in Section 2, the Krugman model has an extensive margin because of fixed costs of production. But the Krugman model has no extensive margin in exports *conditional on production*. This does not accord well with the facts. Bernard *et al*. (2003) report that most manufacturing plants in the U.S. do not export, which means that the failure to export in a category need not imply zero production in that category. Eaton, Kortum and Kramarz (2003) find similar results for French manufacturing firms. Further, they find that conditional on exporting, firms may export to only a strict subset of markets. We find similar patterns at the national level in our data. Conditional on exporting in a category, countries export to, on average, fewer than 13% of the destination countries actively importing in that category. (When we weight destination markets by GDP, the mean number of destinations rises to 27%.) However, the larger the economy, the more destinations for its exports in each category. Across the 125 exporters, those with twice the GDP tend to export to 11% (standard error 1%) more GDP-weighted markets, conditional on exporting in a category. Interestingly, export destinations relate more closely to a country's number of workers (elasticity 14%, s.e. 1%) than to its income per worker (elasticity 4%, s.e. 2%).

A model that could match these facts would need three characteristics: firms can produce but not export, firms can export to some but not all markets, and the number of markets an exporter reaches should co-vary positively with exporter size. Bernard et al. (2003) use the Ricardian model developed by Eaton and Kortum (2002) to get extensive margins in trade as a result of trade barriers and the distribution of productivity. What is not clear to us is whether such a Ricardian model can explain why larger economies have larger extensive export margins.

Fixed costs of exporting each variety to each market – as in Romer (1994) – combined with some Ricardian heterogeneity might explain this phenomenon of larger economies exporting to more markets. The logic of such a model might work as follows. Bigger countries produce more distinct varieties because of fixed costs of production (Krugman). Because of fixed costs of exporting to each market (Romer), only those varieties with sufficiently low marginal cost (relative to quality) will be profitable to export to a given market. Some destination markets will have lower thresholds for profitable entry than others, say due to variation in their size. In any particular category, a larger country will be more likely to produce at least one variety that can profitably be exported to a given market. Hence larger countries should be more likely to export to smaller markets in each category. (Large and small countries alike should export to the largest markets.)

Robustness Checks

We carried out a number of checks to see if our results are robust to the sample of countries, the sample of goods, and the inclusion of additional covariates. First, we decomposed exports for a sample of 124 countries exporting to the U.S. in 1995. The US data contain more commodity detail, reporting 10-digit HS categories (13,386 categories compared to the 5,017 in the 6-digit U.N. data). We estimated that the extensive margin accounts for 53% of the additional exports to the U.S. by larger economies.[16] As in the U.N. data, the extensive margin is more prominent for richer exporters (64%) than for exporters with more workers (47%). Economies with twice the Y/L export 47% higher quantities at 13% higher prices to the U.S. market. Countries with twice the L export 62% higher quantities at 5% lower prices. Overall, exports by 124 countries to the U.S. tell a broadly similar story to the exports by 121 countries to 59 countries.

Returning to the larger set of importers, we split our exporter sample by Y/L, performing the regressions separately for the richest 61 and poorest 60 exporters. The relative importance of the extensive and intensive margins is quite similar for the top and bottom *Y/L* samples. More interesting is the behavior of the price and quantity margins, as reported in Table 6. In both samples, countries with higher L export higher quantities per variety with no significant differences in prices. This is very similar to our findings with the pooled sample. However, the coefficient on Y/L does vary across samples. In the top sample, higher Y/L is associated with higher prices and no greater quantity per variety. In the bottom sample, higher Y/L is associated with higher quantity per variety with no significant differences in prices.

[16] When calculated at the six-digit level, the extensive margin accounts for 45% of the total.

These results suggest markedly different patterns of specialization across the samples. In the high Y/L sample we see results consistent with pure quality differentiation – higher prices but no higher quantities per variety. In the low Y/L sample, we see a story consistent with within-category variety – higher quantity per variety at the same prices.

Our second set of robustness checks examined sensitivity to the goods included in the sample. One possibility is that the models of trade described in Section 2 only apply to differentiated products. Many countries may simply lack the natural resources to export in certain commodity categories. To address this we examined two samples designed to isolate differentiated goods. First, we included only those HS codes that correspond to manufacturing categories, as defined by Standard Industrial Trade Classification categories 5-8, omitting commodity categories 0-4. Second, we included only those HS codes belonging to Rauch's (1999) differentiated products 4-digit SITCs. The excluded products are those Rauch classified as reference priced or traded on organized exchanges.[17] Results were similar using either differentiated goods classification scheme.

When looking at differentiated goods only, we found much larger overall export elasticities with respect to Y and Y/L than we found for the entire sample of goods. A likely explanation is that the share of differentiated goods in exports is rising in Y/L, and our elasticity picks this up. However, the contribution of the intensive and extensive margins to the overall export elasticity was very similar to the full sample of goods, as was the contribution of the price and quantity components to the intensive margin.

[17] The mapping from six-digit HS codes to Rauch's version of four-digit SITCs (revision 2) was not perfect. We could not determine a Rauch classification for about 25% of the 5000 hS categories, so we excluded these as well.

We also explored the robustness of our results to the inclusion of additional covariates. It may be that certain margins comove with certain factors that contribute to Y/L more than others. Accordingly, we broke Y/L into components: physical capital (K/L), human capital (H/L), and *TFP*. The relative size of the extensive and intensive margins were very similar for Y/L and each component separately. Point estimates on the price and quantity components did reveal some differences. However, the standard errors on these estimates were quite large, and the differences were not statistically significant.

We next explored whether the results changed when we included measures of trade barriers. For the U.S. dataset, we used (total duties + total freight)/(nominal exports). We then calculated a trade barrier index for each exporter relative to the rest of the world, aggregating over categories in a manner identical to the exporter price indices in equation (11). The coefficient on this barrier index was negative and highly significant in all but the price regressions. Roughly 70 percent of the barrier index's effect on exports was on the intensive margin, and, within that, all on the quantity component. When we added this variable as a control, however, none of the coefficients on Y/L, L, or Y was altered by even one standard error.

For the U.N. countries and categories, data on tariffs and freight costs are not readily available. In their stead we deployed distance to markets as a crude proxy for transport costs. For exporter j, we calculated distance to market m, weighted by m's share of world output in 1995 at market exchange rates, then summed over markets. Including this crude proxy had no material effect on any of the exporter size coefficients.

6. Conclusion

Larger economies export more in absolute terms than smaller economies. In this paper we decompose a country's exports into margins that account for these differences. We analyze the extent to which larger economies export higher volumes of each good (the intensive margin), export a wider set of goods (the extensive margin), and export higher quality goods.

Using 1995 trade data for many countries in many product categories, we find that the extensive margin accounts for 62% of the greater exports of larger economies. Within categories, richer countries export more units at higher prices to a given market, consistent with producing higher quality. Our estimates imply that quality differences could be the proximate cause of around 9% of country differences in real income per worker.

These calculations are useful for distinguishing features of trade models that correspond more or less well to the data. Such distinctions can be extremely important in determining the welfare consequences of access to trade. Armington models of national product differentiation include no extensive margin, and so fail to explain the largest margin by which the exports of large and small economies differ. Because they lack this margin, these models also imply that the greater exports of larger economies will be accompanied by lower export prices. In the Acemoglu and Ventura model (2002), these terms-of-trade effects result in a stationary world income distribution despite disparate investment rates.

Krugman-style models with products differentiated by firms come closer to fitting the facts on intensive/extensive export margins. To match the positive relationship between prices (and quantities) and exporter income per worker, however, requires modifying these models to include quality differentiation. Also, the simplest Krugman model implies that a country exports each variety to all other countries. In the data, in contrast, countries export to a strict subset of actively importing destinations in most categories. But larger economies export to more destinations (conditional on exporting in a category), perhaps reflecting fixed costs to exporting a variety to each foreign market.

We considered only a few models, chosen because they had the clearest predictions for how exports should vary with an economy's size. Other models feature an extensive margin and could perhaps match some or all of the facts we have documented. For example, the Ricardian model developed by Eaton and Kortum (2002) predicts variation in the extensive margin as a function of trade barriers and the distribution of productivity. And Kehoe and Ruhl (2002) use a Ricardian model to fit the large extensive component in post-liberalization trade growth (e.g., after NAFTA).[18] A Ricardian model, or even a factor-proportions model, might be constructed that could generate covariation between exporter size and the extensive margin. We leave this question for future work.

[18] Hillberry and McDaniel (2002) also document a large extensive margin in post-NAFTA trade growth.

Country	Overall	EM	IM	P	X	Y	L	Y/L
ALBANIA	0.00017	0.0950	0.0018	0.6652	0.0028	0.00027	0.0006	0.4629
ANGOLA	0.00123	0.0872	0.0141	0.9452	0.0150	0.00040	0.0022	0.1825
ARGENTINA	0.01804	0.3507	0.0514	1.0298	0.0499	0.01055	0.0061	1.7285
AUSTRALIA	0.02085	0.5375	0.0388	1.0468	0.0371	0.01192	0.0038	3.1791
AUSTRIA	0.01432	0.5004	0.0286	1.3682	0.0209	0.00497	0.0016	3.1426
BANGLADESH	0.00207	0.0788	0.0263	0.7543	0.0349	0.00516	0.0123	0.4208
BARBADOS	0.00009	0.0145	0.0063	0.9700	0.0065	0.00011	0.0001	1.9531
BELGIUM	0.01185	0.4697	0.0252	1.5210	0.0166	0.00624	0.0018	3.5045
BELIZE	0.00011	0.0216	0.0052	0.9913	0.0053	0.00004	0.0000	1.3108
BENIN	0.00011	0.0241	0.0044	0.7453	0.0060	0.00017	0.0011	0.1532
BOLIVIA	0.00062	0.0628	0.0098	0.5812	0.0169	0.00057	0.0012	0.4613
BOTSWANA	0.00005	0.0309	0.0016	0.8325	0.0019	0.00025	0.0002	1.2177
BRAZIL	0.02215	0.4688	0.0472	0.9109	0.0519	0.03256	0.0251	1.2948
BULGARIA	0.00320	0.3566	0.0090	0.7101	0.0126	0.00166	0.0017	0.9717
BURKINA FASO	0.00010	0.0172	0.0060	1.1832	0.0051	0.00025	0.0020	0.1253
CAMEROON	0.00185	0.1226	0.0151	0.8316	0.0182	0.00072	0.0027	0.2614
CANADA	0.12114	0.8237	0.1471	1.3168	0.1117	0.02009	0.0063	3.1747
CAPE VERDE IS.	0.00001	0.0095	0.0013	1.2534	0.0011	0.00004	0.0001	0.5753
CENTRAL AFR.R.	0.00007	0.0180	0.0041	0.7375	0.0056	0.00010	0.0007	0.1598
CHAD	0.00012	0.0019	0.0622	0.9531	0.0653	0.00018	0.0010	0.1789
CHILE	0.00715	0.1630	0.0439	0.8575	0.0512	0.00354	0.0023	1.5316
CHINA	0.09336	0.7043	0.1326	0.5627	0.2356	0.11010	0.4409	0.2497
COLOMBIA	0.00775	0.2297	0.0337	0.9497	0.0355	0.00622	0.0074	0.8387
COMOROS	0.00001	0.0003	0.0253	2.7082	0.0093	0.00002	0.0001	0.2595
CONGO	0.00079	0.0963	0.0082	0.5932	0.0138	0.00013	0.0005	0.2490
COSTA RICA	0.00276	0.1294	0.0213	0.9932	0.0215	0.00052	0.0005	0.9588
CYPRUS	0.00073	0.1919	0.0038	1.0713	0.0036	0.00034	0.0001	2.4111
DENMARK	0.00855	0.3556	0.0240	1.4531	0.0165	0.00363	0.0012	3.0929
DOMINICA	0.00002	0.0109	0.0022	0.9544	0.0023	0.00001	0.0000	1.0981
DOMINICAN REP.	0.00349	0.1476	0.0237	1.0724	0.0221	0.00085	0.0010	0.8239
ECUADOR	0.00290	0.1160	0.0250	0.8954	0.0280	0.00130	0.0015	0.8853
EGYPT	0.00387	0.2460	0.0157	0.7040	0.0224	0.00617	0.0072	0.8579
EL SALVADOR	0.00181	0.1014	0.0178	0.9374	0.0190	0.00069	0.0007	0.9317
ETHIOPIA	0.00037	0.0207	0.0179	1.0100	0.0177	0.00087	0.0104	0.0839
FIJI	0.00041	0.0300	0.0138	1.0772	0.0128	0.00012	0.0001	1.0730
FINLAND	0.00750	0.2984	0.0251	1.6114	0.0156	0.00281	0.0011	2.6613
FRANCE	0.03479	0.6675	0.0521	1.7267	0.0302	0.03616	0.0113	3.2003
GABON	0.00163	0.0838	0.0194	0.8697	0.0223	0.00029	0.0002	1.2634
GAMBIA	0.00002	0.0056	0.0043	0.8616	0.0050	0.00003	0.0002	0.1608
GERMANY	0.08620	0.7864	0.1096	1.6029	0.0684	0.05288	0.0173	3.0620
GHANA	0.00118	0.0636	0.0186	1.0232	0.0181	0.00064	0.0035	0.1834
GREECE	0.00109	0.1194	0.0091	0.6785	0.0134	0.00383	0.0018	2.1361
GRENADA	0.00001	0.0059	0.0021	0.9074	0.0023	0.00001	0.0000	0.7563
GUATEMALA	0.00310	0.1559	0.0199	0.5810	0.0342	0.00110	0.0012	0.9171
GUINEA	0.00037	0.0339	0.0108	0.6755	0.0160	0.00051	0.0013	0.3796
GUINEA-BISS	0.00004	0.0102	0.0037	0.9338	0.0039	0.00002	0.0002	0.1172
GUYANA	0.00027	0.0232	0.0117	0.7461	0.0157	0.00006	0.0001	0.4984
HAITI	0.00016	0.0593	0.0027	0.8935	0.0031	0.00031	0.0013	0.2428
HONDURAS	0.00188	0.0893	0.0210	0.9313	0.0226	0.00034	0.0007	0.4626
HONG KONG	0.01922	0.5653	0.0340	0.7898	0.0430	0.00464	0.0013	3.5626
HUNGARY	0.01208	0.5248	0.0230	0.8746	0.0263	0.00259	0.0017	1.4888
ICELAND	0.00143	0.0543	0.0264	1.0553	0.0250	0.00016	0.0001	2.6059
INDIA	0.01167	0.4468	0.0261	0.7478	0.0349	0.05684	0.1802	0.3155
INDONESIA	0.01913	0.4510	0.0424	0.8574	0.0495	0.02110	0.0331	0.6378

Country	Overall	EM	IM	P	X	Y	L	Y/L
IRAN	0.01111	0.1676	0.0662	0.9334	0.0710	0.00871	0.0074	1.1735
IRELAND	0.00520	0.2553	0.0204	2.6907	0.0076	0.00182	0.0006	3.1197
ISRAEL	0.00704	0.4028	0.0175	1.7373	0.0101	0.00263	0.0009	2.9943
ITALY	0.03330	0.6559	0.0508	1.4725	0.0345	0.03520	0.0098	3.6090
IVORY COAST	0.00343	0.1723	0.0199	0.9943	0.0200	0.00076	0.0022	0.3395
JAMAICA	0.00114	0.0643	0.0176	0.9345	0.0189	0.00028	0.0005	0.5353
JAPAN	0.20249	0.7245	0.2795	1.5742	0.1775	0.09345	0.0346	2.7007
JORDAN	0.00036	0.0630	0.0057	0.7170	0.0079	0.00046	0.0004	1.1307
KENYA	0.00116	0.0698	0.0166	0.9699	0.0171	0.00100	0.0056	0.1775
LESOTHO	0.00008	0.0223	0.0037	0.7441	0.0050	0.00008	0.0004	0.2008
LUXEMBOURG	0.00032	0.0291	0.0110	1.3189	0.0084	0.00042	0.0001	5.5689
MACEDONIA	0.00095	0.1510	0.0063	0.8711	0.0072	0.00026	0.0004	0.7295
MADAGASCAR	0.00062	0.0701	0.0088	1.0592	0.0083	0.00032	0.0024	0.1315
MALAWI	0.00024	0.0209	0.0113	0.8715	0.0130	0.00019	0.0018	0.1096
MALAYSIA	0.03207	0.5439	0.0590	0.7632	0.0773	0.00527	0.0031	1.7290
MALI	0.00009	0.0112	0.0081	0.9216	0.0087	0.00023	0.0020	0.1175
MALTA	0.00120	0.1758	0.0068	1.0070	0.0068	0.00014	0.0001	2.3851
MAURITANIA	0.00053	0.0189	0.0283	0.7817	0.0362	0.00009	0.0005	0.1827
MAURITIUS	0.00113	0.0710	0.0160	1.2357	0.0129	0.00037	0.0002	1.7430
MEXICO	0.05416	0.7441	0.0728	0.9614	0.0757	0.01945	0.0133	1.4661
MOROCCO	0.00703	0.2582	0.0272	1.0825	0.0251	0.00265	0.0035	0.7505
MOZAMBIQUE	0.00015	0.0197	0.0076	1.0780	0.0070	0.00037	0.0033	0.1143
MYANMAR	0.00028	0.0179	0.0155	1.1762	0.0132	0.00012	0.0013	0.0930
NAMIBIA	0.00069	0.0479	0.0145	1.2190	0.0119	0.00020	0.0002	1.0254
NEPAL	0.00024	0.0366	0.0065	0.8302	0.0078	0.00077	0.0037	0.2065
NETHERLANDS	0.01405	0.5770	0.0244	1.3072	0.0186	0.00953	0.0030	3.1340
NEW ZEALAND	0.00689	0.2317	0.0297	1.1116	0.0268	0.00187	0.0007	2.5738
NICARAGUA	0.00038	0.0503	0.0076	0.9370	0.0081	0.00024	0.0006	0.4067
NIGER	0.00014	0.0454	0.0031	1.0653	0.0029	0.00022	0.0019	0.1185
NIGERIA	0.00753	0.1442	0.0522	1.0612	0.0492	0.00302	0.0229	0.1322
NORWAY	0.04077	0.6081	0.0670	1.0653	0.0629	0.00305	0.0009	3.3580
PAKISTAN	0.00323	0.1280	0.0252	0.8230	0.0306	0.00686	0.0146	0.4710
PANAMA	0.00212	0.1128	0.0188	0.9338	0.0202	0.00043	0.0004	1.0565
PAPUA N.GUINEA	0.00161	0.0369	0.0435	1.0555	0.0412	0.00045	0.0009	0.5245
PARAGUAY	0.00149	0.0435	0.0342	0.8176	0.0418	0.00076	0.0009	0.8515
PERU	0.00227	0.1072	0.0212	0.5710	0.0371	0.00306	0.0043	0.7105
PHILIPPINES	0.00748	0.3538	0.0211	0.8916	0.0237	0.00626	0.0120	0.5235
POLAND	0.01859	0.5796	0.0321	0.6757	0.0475	0.00829	0.0073	1.1401
PORTUGAL	0.00185	0.2320	0.0080	0.7786	0.0102	0.00379	0.0019	2.0199
ROMANIA	0.00467	0.3539	0.0132	0.6788	0.0194	0.00315	0.0048	0.6614
RUSSIA	0.02952	0.4717	0.0626	0.7140	0.0876	0.03207	0.0316	1.0150
RWANDA	0.00005	0.0132	0.0038	0.9657	0.0039	0.00014	0.0013	0.1048
SENEGAL	0.00056	0.0463	0.0122	0.8845	0.0138	0.00035	0.0017	0.2120
SEYCHELLES	0.00003	0.0054	0.0064	0.9198	0.0070	0.00002	0.0000	1.4883
SIERRA LEONE	0.00005	0.0200	0.0023	0.9766	0.0024	0.00012	0.0007	0.1706
SINGAPORE	0.03144	0.5684	0.0553	1.2248	0.0452	0.00234	0.0009	2.7300
SLOVAK REPUBLIC	0.01188	0.4845	0.0245	0.7214	0.0340	0.00149	0.0011	1.4020
SLOVENIA	0.00766	0.4371	0.0175	0.9052	0.0194	0.00074	0.0004	1.8846
SOUTH AFRICA	0.01276	0.4025	0.0317	0.9216	0.0344	0.00833	0.0056	1.4882
SOUTH KOREA	0.04143	0.6480	0.0639	1.0438	0.0612	0.01820	0.0080	2.2864
SPAIN	0.00879	0.4232	0.0208	1.2794	0.0162	0.01909	0.0066	2.8861
SRI LANKA	0.00145	0.1271	0.0114	0.9960	0.0114	0.00163	0.0032	0.5121
ST.VINCENT&GRE	0.00006	0.0068	0.0088	1.0039	0.0088	0.00002	0.0000	1.0275
SWEDEN	0.01593	0.4803	0.0332	1.7166	0.0193	0.00537	0.0019	2.7783

Country	Overall	EM	IM	P	X	Y	L	Y/L
SWITZERLAND	0.04794	0.6361	0.0754	2.0872	0.0361	0.00508	0.0016	3.0915
SYRIA	0.00339	0.1377	0.0246	0.9140	0.0269	0.00162	0.0015	1.1121
TAIWAN	0.04611	0.6414	0.0719	0.7758	0.0927	0.00926	0.0039	2.3607
TANZANIA	0.00037	0.0495	0.0074	0.9282	0.0080	0.00040	0.0059	0.0681
THAILAND	0.01784	0.5016	0.0356	0.8367	0.0425	0.01189	0.0134	0.8865
TOGO	0.00010	0.0244	0.0040	0.6217	0.0065	0.00011	0.0007	0.1513
TRINIDAD&TOBAGO	0.00134	0.0847	0.0158	0.7757	0.0203	0.00034	0.0002	1.6386
TUNISIA	0.00640	0.3365	0.0190	1.1116	0.0171	0.00145	0.0012	1.1681
TURKEY	0.01449	0.4092	0.0354	0.9373	0.0378	0.01114	0.0114	0.9807
U.K.	0.03305	0.7645	0.0432	1.4843	0.0291	0.03478	0.0123	2.8229
U.S.A.	0.30966	0.9121	0.3395	1.3582	0.2500	0.27972	0.0594	4.7114
UGANDA	0.00053	0.0250	0.0211	0.8922	0.0237	0.00045	0.0039	0.1153
URUGUAY	0.00286	0.1257	0.0227	1.0327	0.0220	0.00083	0.0006	1.3687
VENEZUELA	0.01382	0.2073	0.0667	0.8223	0.0811	0.00455	0.0032	1.4221
YEMEN	0.00047	0.0439	0.0107	0.8394	0.0127	0.00039	0.0016	0.2472
ZAIRE	0.00132	0.0939	0.0140	0.5389	0.0260	0.00041	0.0091	0.0451
ZAMBIA	0.00040	0.0253	0.0158	0.9948	0.0159	0.00021	0.0013	0.1693
ZIMBABWE	0.00122	0.0966	0.0126	1.0044	0.0125	0.00085	0.0022	0.3795
mean	0.01345	0.2282	0.0299	1.0119	0.0294	0.0087	0.0093	1.2476

NOTES:
All variables are for 1995.
Overall = EM*IM
EM = Extensive Margin, a cross-market geometric average of equation (8) in the text.
IM = Intensive Margin, a cross-market geometric average of equation (9) in the text.
P = Prices, as cross-market geometric average of equation (11) in the text.
X = Quantity Margin, a cross-market geometric average of equation (12) in the text (IM = P*X).
Y = Country GDP relative to the rest-of-the-world.
L = Country employment relative to the rest-of-the-world.
Y/L = Country GDP per worker relative to rest-of-world GDP per worker.
The variables are shown here in levels; for the regressions, the variables were logged.

Figure 1

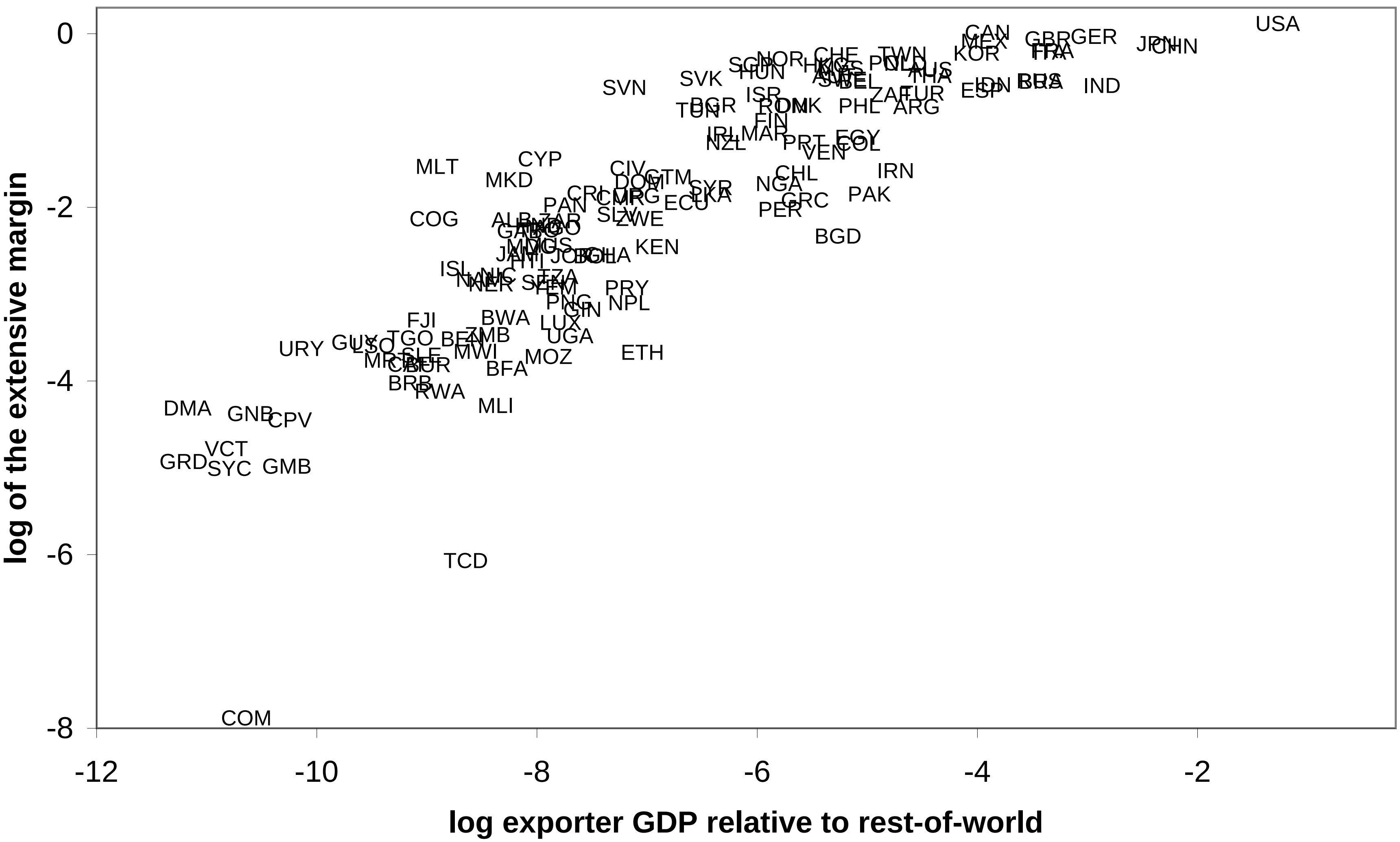
log of the extensive margin
0
-2
-4
-6
-8
-12
-10
-8
-6
-4
-2
log exporter GDP relative to rest-of-world

Table 1

Model Predictions for Export Margins

	Intensive (*px*)	**Extensive (*V*)**	**Price (*p*)**	**Quantity (*x*)**
Armington	1	0	-1/(σ-1)	σ/(σ-1)
Acemoglu & Ventura				
Y/L	1	0	-0.6	1.6
L	0	1	0	0
Krugman	0	1	0	0
Quality Differentiation	1	0		
Y/L			1	0
L			0	1

Notes: For discussion of each model, see Section 2 in the text. Entries are model predictions for how exports increase with respect to exporter size. A single entry indicates the same elasticity with respect to both *Y/L* (GDP per worker) and *L* (employment). The Acemoglu and Ventura price and quantity elasticities with respect to Y/L are equal to -1/(σ-1) and σ/(σ-1), but these take on the values -0.6 and 1.6 for their case of σ = 2.6.

Table 2

Extensive and Intensive Margins

Independent Variable → **Dependent Variable ↓**	***Y/L***	***L***	Adj. R^2	***Y***	Adj. R^2
Overall Exports	1.29 (0.07)	0.89 (0.04)	0.86	1.00 (0.04)	0.83
Intensive Margin	0.44 (0.05)	0.36 (0.03)	0.60	0.38 (0.03)	0.60
	34%	**41%**		**38%**	
Extensive Margin	0.85 (0.05)	0.53 (0.03)	0.79	0.61 (0.03)	0.74
	66%	**59%**		**62%**	

Notes: All variables are in natural logs. Number of exporting countries = Number of observations = 126. Standard errors are in parentheses. For definitions of each margin see equations (8), (9) and (10). Percentages describe the contribution of each margin to the overall export elasticity. *L* = 1995 employment in the exporting country relative to the sum of employment in the other 125 exporters. *Y* = 1995 PPP GDP in the exporting country relative to the sum of GDP in the other 125 exporters. *Y/L* is simply the ratio of these two variables.

Data Sources: UNCTAD for 1995 exports to 59 countries by 126 countries in 5,017 6-digit categories. Heston, Summers, and Aten (2002) for employment and PPP GDP.

Table 3

Price and Quantity Components of the Intensive Margin

Independent Variable → **Dependent Variable ↓**	***Y/L***	***L***	Adj. R^2	***Y***	Adj. R^2
Prices	**0.09** (0.02)	-0.01 (0.01)	0.14	0.02 (0.01)	0.01
Quantities	**0.34** (0.05)	**0.37** (0.03)	0.58	**0.36** (0.03)	0.58

Notes: All variables are in natural logs. Number of exporting countries = Number of observations = 126. Standard errors are in parentheses. For definitions of the price and quantity components see equations (11) and (12). *L* = 1995 employment in the exporting country relative to the sum of employment in the other 125 exporters. *Y* = 1995 PPP GDP in the exporting country relative to the sum of GDP in the other 125 exporters. *Y/L* is simply the ratio of these two variables.

Data Sources: UNCTAD for 1995 exports to 59 countries by 126 countries in 5,017 6-digit categories. Heston, Summers, and Aten (2002) for employment and PPP GDP.

Table 4

The Extensive Margin at Various Levels of Aggregation

Regressor →	Y_j/L_j	L_j	Y_j
6 digit	66%	59%	62%
5 digit	64%	56%	59%
4 digit	62%	49%	54%
3 digit	48%	34%	39%
2 digit	39%	25%	30%
1 digit	15%	9%	11%

Notes: Number of exporting countries = Number of observations = 126. For the definition of the extensive margin see equation (8). The percentages describe the contribution of each margin to the overall export elasticity. *L* = 1995 employment in the exporting country relative to the sum of employment in the other 125 exporters. *Y* = 1995 PPP GDP in the exporting country relative to the sum of GDP in the other 125 exporters. *Y/L* is simply the ratio of these two variables.

Data Sources: UNCTAD for 1995 exports to 59 countries by 126 countries in 5,017 6-digit categories. Heston, Summers, and Aten (2002) for employment and PPP GDP.

Table 5

What Prices and Quantities Imply for Quality, Quality-Adjusted Prices, and Within-Category Variety

		σ	*Y/L*	*L*
If All Quality	Quality	2.6	.23	.14
		5	.16	.07
		10	.13	.03
	Prices - Quality	2.6	-.13	-.14
		5	-.07	-.07
		10	-.03	-.04
If All Variety	Variety	2.6	.59	.35
		5	.82	.33
		10	1.29	.29
	Prices - Quality	NA	.09	.00
Some of Each	Variety (= Quantity)	NA	.34	.37
	Quality (= Price)	NA	.09	-.01

Notes: Entries in the last two columns are elasticities with respect to *Y/L* and *L*. These are based on using estimates in Table 3 in equation (7). σ = the elasticity of substitution between different varieties. NA means independent of σ. *L* = 1995 employment in the exporting country relative to the sum of employment in the other 125 exporters. *Y* = 1995 PPP GDP in the exporting country relative to the sum of GDP in the other 125 exporters. *Y/L* is simply the ratio of these two variables.

Data Sources: UNCTAD for 1995 exports to 59 countries by 126 countries in 5,017 6-digit categories. Heston, Summers, and Aten (2002) for employment and PPP GDP.

Table 6

Prices and Quantities: Top vs. Bottom Y/L

Sample	Independent Variables → / Dependent Variable ↓	***Y/L***	***L***	Adj. R^2
Richest 61 countries	Prices	**0.39** (0.06)	0.00 (0.02)	0.37
	Quantities	0.03 (0.17)	**0.39** (0.04)	0.61
Poorest 60 countries	Prices	-0.05 (0.04)	**-0.04** (0.02)	0.06
	Quantities	**0.39** (0.11)	**0.38** (0.05)	0.49

Notes: All variables are in natural logs. Standard errors are in parentheses. For definitions of the price and quantity components see equations (11) and (12). *L* = 1995 employment in the exporting country relative to the sum of employment in the other 125 exporters. *Y* = 1995 PPP GDP in the exporting country relative to the sum of GDP in the other 125 exporters. *Y/L* is simply the ratio of these two variables.

Data Sources: UNCTAD for 1995 exports to 59 countries by 126 countries in 5,017 6-digit categories. Heston, Summers, and Aten (2002) for employment and PPP GDP.

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