When Are Variety Gains from Trade Important? Domestic Productivity and the Cost of Protectionism*

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Abstract:

In an influential paper, Romer (1994) shows that the welfare gains from trade are substantially increased when trade liberalization expands the set of differentiated products available in an economy. However, in his model and subsequent research, the variety gains are magnified by the assumption of no or very limited competition between imported and domestic differentiated products. We extend the existing literature by endogenizing the domestic supply of differentiated products. In our model, those countries with a stronger comparative advantage in producing differentiated products will import fewer foreign goods and enjoy lower variety gains from trade. Moreover, higher trade barriers will hurt them less because these countries are more efficient in substituting for the disappearing foreign varieties with domestic varieties.

Next we take the model to the data, measuring the strength of a country's comparative advantage by its export performance. For an average good, doubling the importer's export performance relative to exporter's results in a 20 percent decrease in the number of imported varieties for a median trade barrier. The effect varies across sectors with 'machinery and transportation' and 'electronics' featuring the strongest effect. A direct welfare implication is that laggard countries or sectors stand to lose more from higher trade barriers.

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I. Introduction

Countries gain from international trade by having access to a wider range of intermediate and final goods. Do they just merely substitute domestic production by imports in inefficient sectors, or do they gain access to the new goods, blueprints, and ideas, whose domestic production is hardly possible? If the latter is true – as in Romer (1994) – then the access to foreign varieties results in first order welfare and productivity gains. Otherwise the gains from trade are only marginal.

Evaluating the variety gains from trade is an ongoing research effort. Romer (1994) shows in a calibrated model that, under certain circumstances, the GDP losses associated with the exit of foreign varieties can reach up to 20% as a result of only a 10% tariff. The size of the effect turned out to be an order of magnitude lower in the empirical test of Romer's model performed on the Costa Rican data by Klenow and Rodriguez-Clare (1997). Broda and Weinstein (2006) estimate that the US imported varieties have quadrupled between 1972 and 2001, which has increased the US welfare by 3% of GDP. These papers, however, assume no or very limited competition between foreign and domestic varieties: Romer (1994) considers a small open economy which is incapable to produce its own varieties; Klenow and Rodriguez-Clare (1997) allow for only one domestic variety in each sector; and Broda and Weinstein (2006) assume away the substitutability between foreign and domestic varieties by using a Cobb-Douglas upper-case utility function.

To assess the importance of domestic production in evaluating product variety gains from international trade, our model allows for multiple domestic varieties which can serve as substitutes to the foreign varieties. Moreover, the relative (importer-exporter) productivity in a given sector determines the importer's ability to substitute for foreign varieties: countries with a higher relative productivity will import fewer varieties and suffer smaller welfare losses from trade barriers than countries whose production is less efficient. To illustrate, in our numerical example, a 10% tariff will cause a 7.5% welfare loss if the importer is unable to produce its own varieties, a 3.75% welfare loss if the importer can produce its varieties at the same cost as the exporter, and only a 0.83% welfare loss if the importer is twice more productive than the exporter.

Estimating the welfare gains from trade under the assumption that foreign and domestic varieties are substitutes would require detailed data on domestic production. Unfortunately, such data is not available for many countries. Instead, as an indirect test of our main hypothesis, we derive testable predictions on the number of imported varieties.

As in Romer (1994), trade barriers have a negative effect on the number of imported varieties. However, in our model this effect is magnified by the relative importer-exporter productivity: the higher is the relative productivity, the more foreign varieties exit from the importer's market because of a trade barrier. To test this hypothesis we estimate the demand for imported varieties and show that the elasticity of the number of imported varieties with respect to trade barriers co-varies positively with the importer's relative productivity. Under the alternative, if domestic and foreign goods are not substitutes, the elasticity is independent of the importer's relative productivity.

We use a panel of bilateral trade data disaggregated at 6 digit Harmonized System commodity level from UN's COMTRADE that covers many bilateral pairs spanning from 1996-2003. We measure the number of imported varieties as the extensive margin, which represents the cross-section equivalent of the variety growth measure derived by Feenstra (1994), and the relative (importer-exporter) productivity by the corresponding relative export performance. This productivity measure is supported by a large body of theoretical and empirical literature on firm-level heterogeneity that establishes a strong link between a country's productivity and its export performance (e.g., Melitz 2003, Bernard et al. 2003).

Our findings are as follows. Pooling across goods, doubling a relative (importer-exporter) export performance yields a 20 percent decrease in the number of imported varieties for a median trade barrier. Also, if we rank importers according to their export performance, distance has a 39 percent stronger (negative) effect on the number of varieties for the 90th percentile importer compared with the 10th percentile importer. These effects vary across sectors with 'machinery and transportation' and 'electronics' featuring the strongest effect. A direct welfare implication is that laggard countries or sectors stand to lose more from higher trade barriers, even though they lose fewer varieties.

This paper relates, and contributes, to several lines of research. First, we contribute to a rapidly-growing literature evaluating the variety gains from trade. We extend the existing framework by allowing for the domestic production of varieties and showing that assuming away the substitutability between foreign and domestic varieties might significantly overstate the welfare gains form trade or reversely welfare losses from trade barriers.

Second, we identify additional factors determining the demand for foreign varieties. In addition to positive effects of country size and average productivity (measured by GDP per capita) – previously identified by Hummels and Klenow (2002, 2005) – we show that the number of imported varieties is increasing in the sector-specific productivity but decreasing in the relative (importer-exporter) productivity for a given sector. We also show that in sectors with high relative productivity the number of imported varieties is smaller, and demand for imported varieties is more responsive to variation in trade barriers. These findings are consistent with the empirical evidence provided by Kehoe and Ruhl (2002) who show that the untraded or least traded goods experience the highest trade growth after trade liberalization.

The rest of the paper is structured as follows: section II presents the model and solves for the equilibrium; section III takes the model's predictions to the data; and section IV concludes.

II. Theoretical Framework

We want to show that the productivity gap between importer and exporter affects negatively the number of differentiated goods the importer buys and the product variety gains from trade it enjoys. For this purpose we develop a general equilibrium model of trade. For simplicity, the world consists of 2 countries, Home and Foreign, indexed by h and f. Both countries have similar preferences: each country has $s=1,2,\dots,S$ sectors producing differentiated goods and one sector (indexed by 0) producing a single, homogeneous good.

As in Romer (1994), we endogenize the number of imported varieties by assuming fixed costs of adjusting to the market. As a result, the number of imported varieties increases in importer's market size and decreases in bilateral trade costs. However, contrary to Romer, we allow for the production of domestic varieties which endogenizes the number of imported varieties on importer's productivity. To be more specific, we implement this idea by combining the Armington and Dixit-Stiglitz preferences: each differentiated sector is modeled as an index of country-specific differentiated *goods*, where each good is a CES composite of many *varieties*. As a result, given a certain degree of substitutability between domestic and imported varieties, a more productive importer buys fewer foreign varieties. Finally, by allowing the productivity to vary across sectors, we are able to distinguish between the effects of aggregate and sector-specific differences in productivity.

A. Preferences

The preferences are symmetric in Home and Foreign, so for brevity we will set up the model only from Home's perspective. Home's representative consumer has a utility function which is Cobb-Douglas across sectors:

$$(1) \qquad U_h = q_{h0}^{\mu_0} \prod_{s=1}^{S} C_{hs}^{\mu_s} \qquad\qquad \sum_{s=0}^{S} \mu_s = 1,$$

where q_{h0} -- is Home's individual consumption of the numeraire;

$\mu_s > 0$ -- is a constant representing the expenditure share of sector *s*;

C_{hs} -- is a composite index of Home's individual consumption of differentiated goods in sector *s*.

The quantity index C_{hs} is a two-level CES subutility function. The upper-case subutility aggregates over goods from different countries with ε being the constant elasticity of substitution between these goods, while each good is a composite of many symmetric varieties with σ being the elasticity of substitution between any two of them:

$$(2) \qquad C_{hs} = \left\{ \left[\left(\sum_{u=1}^{N_{hhs}} q_{hhsu}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \right]^{\frac{\varepsilon-1}{\varepsilon}} + \left[\left(\sum_{v=1}^{N_{hfs}} q_{hfsv}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \right]^{\frac{\varepsilon-1}{\varepsilon}} \right\}^{\frac{\varepsilon}{\varepsilon-1}} \qquad \sigma > \varepsilon > 1,$$

where N_{hfs} -- is the set of varieties imported by Home from Foreign in sector *s*;

N_{hhs} -- is the set of varieties produced by Home and consumed domestically in sector *s*;

q_{hhsu} -- is Home's individual consumption of a domestic variety u in sector *s*;

q_{hfsv} -- is Home's individual consumption of an imported variety v in sector *s*;

The upper level preference structure assumes that domestic and imported varieties are substitutes. At one extreme, when $(\varepsilon-1)/\varepsilon \to 1$, the consumer regards domestic and foreign varieties as perfect substitutes. At the other extreme, when $(\varepsilon-1)/\varepsilon \to 0$, the consumer spends a constant share of her income on each group of varieties as in Cobb-Douglas utility function. If $\sigma = \varepsilon$, domestic and imported varieties enter the utility function symmetrically and the consumer perceives them as equally substitutable. We impose an assumption of $\sigma > \varepsilon$, in which case any two domestic varieties are better substitutes than any two domestic and foreign varieties. At the same time, given that $\varepsilon > 1$, the consumer has a decreasing marginal valuation for same country's varieties.

B. Production

Labor is the only factor of production. Home's endowment of labor is L_h where labor is assumed to move freely across sectors. Consequently, the wage w_h, defined in terms of the numeraire, is the same in all sectors. The numeraire sector is characterized by perfect competition and constant returns to scale. In Home, one unit of labor can produce β_h units of the numeraire traded at zero cost. We assume that the numeraire sector is large enough for both countries to have strictly positive output of the numeraire. The introduction of the numeraire in the model simplifies the balance of trade calculation and ties the wage to productivity in the numeraire sector.

In the differentiated sectors, monopolistically competitive firms produce the varieties of the differentiated goods and are free to enter and exit. The technologies are country and sector specific: Home's marginal cost in sector s is $\frac{1}{A_{hs}\beta_h}$ and the fixed cost of adjusting to market is $\frac{\alpha}{A_{hs}\beta_h}$ units of labor, while the corresponding parameters for Foreign are $\frac{1}{(A_{hs}/\varphi_s)\beta_f}$ and

$\frac{\alpha}{(A_{hs}/\varphi_s)\beta_f}$. In Krugman's (1980) framework the fixed cost of production limits the number of varieties the country produces. At the same time, *all* varieties produced are exported since there is no fixed cost of trade. Instead, Romer (1994) introduces fixed cost of entering the market for each foreign variety, which generates more realistic predictions[1]: the number of imported varieties increases in market size and decreases in trade costs. In our model we introduce a fixed cost of adjusting to market for all varieties. As a result, we are able to endogenize both the number of domestic and imported varieties.

To summarize, there are several levels at which we allow for differences in labor productivity. First, there is a difference across countries in aggregate labor productivity parameters (β_h and β_f); second, within each country, Home's labor productivity varies across sectors (A_{hs} has sector-specific index *s*); and, third, we allow for a sector-specific productivity gap between Home and Foreign (φ_s).

The trade costs are an ad-valorem in nature: the Home's exporter in sector *s* will be receiving $1/\tau_{hfs}$ dollars for each dollar of the delivered price, where $\tau_{hfs} > 1$. There is no transportation cost for domestically produced and sold varieties: $\tau_{hhg} = 1$.

C. Equilibrium Number of Traded Varieties

We start the derivation of equilibrium by finding the link between the nominal wage and productivity in the numeraire sector. Recall that the numeraire good is produced in both countries and is tradable at zero cost. As a result, wages are equal to the aggregate labor productivities.

(3) $\quad w_h = \beta_h \qquad w_f = \beta_f$,

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[1] see Hummels and Klenow (2002, 2005) for empirical evidence

Otherwise there is an opportunity for arbitrage. Note that β_i, $i \in \{h, f\}$, is not only labor productivity in the numeraire sector , but also a key component of the labor productivity in all sectors of country *i*: a 5% increase in β_i yields a 5% increase in labor productivity across all sectors. That is, we can interpret the variation in β_i as aggregate shocks to labor productivity in country *i*. This will be important in our discussion of the model's predictions.

Next we turn our attention to sector *s*'s varieties of the differentiated good imported by Home from Foreign. Preferences across varieties within a good are CES with σ being the elasticity of substitution between any two varieties originating from the same country. Building on the results of Dixit-Stiglitz (1977), the equilibrium price is symmetric across varieties of a country's good and it is equal to the monopolistic markup multiplied by the marginal cost:

(4) $$p_{hhs} = \frac{\sigma}{\sigma - 1}\frac{1}{A_{hs}} \qquad p_{hfs} = \frac{\sigma}{\sigma - 1}\frac{\tau_{hfs}}{A_{hs}/\varphi_s}.$$

The free entry condition determines that monopolistically competitive firms earn zero profit, which allows us to solve for the quantity per variety:

(5) $$Q_{hhs} = Q_{hfs} = \alpha(\sigma - 1).$$

Now let us derive the number of Home's domestic and imported varieties in sector *s*. In equilibrium, the marginal rate of substitution between any imported and domestic varieties is equal to the ratio of their prices:

$$\frac{N_{hhs}^{\frac{\varepsilon-1}{\varepsilon}\frac{\sigma}{\sigma-1}-1} q_{hhs}^{-1/\varepsilon}}{N_{hfs}^{\frac{\varepsilon-1}{\varepsilon}\frac{\sigma}{\sigma-1}-1} q_{hfs}^{-1/\varepsilon}} = \frac{p_{hhs}}{p_{hfs}}.$$

By substituting for the equilibrium prices and quantities using (4) and (5) we derive the relative number of varieties:

(6) $$\frac{N_{hfs}}{N_{hhs}} = \left(\varphi_s \tau_{hfs}\right)^{-\frac{\varepsilon(\sigma-1)}{\sigma-\varepsilon}}$$

To derive the number of domestic varieties, N_{hhs}, we use the fact that that the upper-case utility function is Cobb-Douglas:

$$\left[\left(N_{hfs}^{\frac{\sigma}{\sigma-1}} Q_{hfs}\right)^{\frac{\varepsilon-1}{\varepsilon}} + \left(N_{hhs}^{\frac{\sigma}{\sigma-1}} Q_{hhs}\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}} \left[\left(N_{hfs}^{-\frac{1}{\sigma-1}} p_{hfs}\right)^{-(\varepsilon-1)} + \left(N_{hhs}^{-\frac{1}{\sigma-1}} p_{hhs}\right)^{-(\varepsilon-1)}\right]^{-\frac{1}{\varepsilon-1}} = \mu_s L_h w_h,$$

where the first multiplier in square brackets is the quantity index and the second multiplier is the price index of sector s. Next we replace w_h with (3), p_{hhs} and p_{hfs} with (4), Q_{hhs} and Q_{hfs} with (5), and $\frac{N_{hfs}}{N_{hhs}}$ with (6), to get

$$\alpha \sigma N_{hhs}\left(\frac{1}{A_s}\right)\left[\left(\varphi_s \tau_{hfs}\right)^{-\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}} + 1\right] = \mu_s L_h \beta_h,$$

from which the number of varieties produced and sold domestically is:

(7) $$N_{hhs} = \frac{\mu_s L_h \beta_h}{\sigma \alpha} A_s \left[\left(\varphi_s \tau_{hfs}\right)^{-\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}} + 1\right]^{-1}.$$

By combining the result in (7) with the relative number of varieties (6), we find the number of varieties imported by Home in sector s:

(8) $$N_{hfs} = \frac{\mu_s L_h \beta_h}{\sigma \alpha} \left(\varphi_s \tau_{hfs}\right)^{-\frac{\varepsilon(\sigma-1)}{\sigma-\varepsilon}} A_s \left[\left(\varphi_s \tau_{hfs}\right)^{-\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}} + 1\right]^{-1}.$$

D. Welfare Effects

Now we are ready to show that the stronger is the domestic comparative advantage in sector s the less vulnerable is an importer to trade barriers. By plugging the equilibrium numbers of domestic and imported varieties, (7) and (8), and quantity per variety, (5), into utility function (1), we can determine the optimal utility level:

$$U_h^* = q_{h0}^{\mu_0} \prod_{s=1}^{S} \left\{ (\sigma-1) \left(\frac{\mu_s L_h \beta_h}{\sigma \alpha^{1/\sigma}} A_{hs} \right)^{\frac{\sigma}{\sigma-1}} \left[\left(\varphi_s \tau_{hfs} \right)^{-\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}} + 1 \right]^{\frac{\sigma-\varepsilon}{(\varepsilon-1)(\sigma-1)}} \right\}^{\mu_s} .$$

It is easy to show that the optimal utility level is decreasing in trade barriers:

$$(9) \qquad \varepsilon_{U_h^*, \tau_{hfs}} = \frac{\partial U_h^*}{\partial \tau_{hfs}} \frac{\tau_{hfs}}{U_h^*} = -\mu_s \frac{\sigma}{\sigma-1} \left[\left(\varphi_s \tau_{hfs} \right)^{\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}} + 1 \right]^{-1} < 0,$$

where the magnitude of the effect is weaker the higher is the productivity gap in sector *s*:

$$(10) \qquad \frac{\partial \left| \varepsilon_{U_h^*, \tau_{hfs}} \right|}{\partial (\varphi_s)} \frac{\varphi_s}{\left| \varepsilon_{U_h^*, \tau_{hfs}} \right|} = -\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon} \left[\left(\varphi_s \tau_{hfs} \right)^{-\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}} + 1 \right]^{-1} < 0 .$$

Let us provide a numerical example. Assume that the varieties of *s* consumed by Home consist of both domestically produced varieties and imported varieties. Furthermore let us assume the parameters of the model are μ_s=0.5, σ=3, $\varepsilon = 2$, and $\tau_{hfs} = 1$. If, as in Romer (1994), the domestic sector were infinitely less competitive than the foreign sector (which is a special case of our model when $\varphi_s \to 0$), the value of the elasticity evaluated at this point is $\frac{\partial U_h^*}{\partial \tau_{hfs}} \frac{\tau_{hfs}}{U_h^*} = -0.75$.

That is, a 10% tariff ($\tau_{hfs} = 1.1$) would decrease the welfare by 7.5%. If Home's productivity were as high as the Foreign's ($\varphi_s = 1$), a 10% tariff would increase the welfare by only a half of the previous magnitude (3.75%). Finally, if Home were twice as productive as Foreign in sector *s* ($\varphi_s = 2$), a 10% tariff would decrease Home's welfare by only 0.83%.

E. Comparative Statics

Since the data on the number of domestic varieties is unavailable, we will restrict our attention to formulating testable hypotheses with respect to the number of imported varieties.

The effects of aggregate, sector-specific, and relative productivities

In our model the aggregate labor productivity parameter, β_h, is equal to Home's wage. Therefore, any changes in β_h have no effect on costs in the differentiated sector since they are completely absorbed by wage changes w_h. As a result, β_h has no effect on the equilibrium quantities and prices of the differentiated varieties. β_h affects the numbers of varieties consumed in Home through only one channel – namely, through the changes in the aggregate income allocated to each sector. Thus, the number of imported varieties is increasing in the aggregate labor productivity of the country-importer:

(11) $$\frac{\partial N_{hfs}}{\partial \beta_h}\frac{\beta_h}{N_{hfs}} = 1 > 0 .$$

An increase in Home's productivity in sector *s*, A_{hs}, while keeping the productivity gap φ_s constant, is equivalent to a proportional increase of both Home's and Foreign's sector-specific productivity in *s*. Therefore, the number of imported varieties is increasing in A_{hs}:

(12) $$\frac{\partial N_{hfs}}{\partial A_{hs}}\frac{A_{hs}}{N_{hfs}} = 1 > 0$$

Finally, an increase in the productivity gap in sector *s*, φ_s, makes domestic varieties relatively cheaper to imported varieties, and thus Home imports fewer varieties:

(13) $$\frac{\partial N_{hfs}}{\partial \varphi_s}\frac{\varphi_s}{N_{hfs}} = -1 - \frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}\left[\left(\varphi_s \tau_{hfs}\right)^{-\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}} + 1\right]^{-1} < 0$$

The effect of the trade costs

A higher trade cost in sector *s* makes foreign varieties more expensive and thus decreases the number of imported varieties:

$$(14)\qquad \frac{\partial N_{hfs}}{\partial \tau_{hfs}}\frac{\tau_{hfs}}{N_{hfs}} = -\left\{1+\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}\left[1+\left(\varphi_s\tau_{hfs}\right)^{-\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}}\right]^{-1}\right\} < 0,$$

and the magnitude of the effect is increasing in the productivity gap in sector *s*:

$$(15)\qquad \frac{\partial\left|\frac{\partial N_{hfs}}{\partial \tau_{hfs}}\frac{\tau_{hfs}}{N_{hfs}}\right|}{\partial \varphi_s}\frac{\varphi_s}{\left|\frac{\partial N_{hfs}}{\partial \tau_{hfs}}\frac{\tau_{hfs}}{N_{hfs}}\right|} = \frac{\left[\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}\right]^2\left[1+\left(\varphi_s\tau_{hfs}\right)^{\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}}\right]^{-1}}{\left[1+\left(\varphi_s\tau_{hfs}\right)^{-\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}}\right]+\frac{\sigma(\varepsilon-1)}{\sigma-\varepsilon}} > 0.$$

That is, in a given sector, the higher the productivity gap between the importer and the exporter, the stronger the number of imported varieties reacts to changes in trade barriers. In other words, the larger elasticity reflects a lower dependence on foreign varieties. If domestic and foreign varieties are not substitutes ($\varepsilon = 1$), then the elasticity of the number of imported varieties with respect to trade costs becomes constant and is independent of the productivity gap. We take this prediction to the data by measuring the strength of a country's productivity by its export performance and we test whether an importer with stronger comparative advantage has a more sensitive demand for foreign varieties.

III. Empirics

We seek to confirm empirically that the elasticity of the imported number of varieties with respect to trade cost co-varies positively with importer's relative productivity. Alternatively, if domestic and imported varieties are not substitutes, the elasticity is constant and independent of importer's relative productivity.

A. Data and Variable Construction

We use a panel of bilateral trade data disaggregated at Harmonized System 6 digit level (more than 5,000 product categories) from the UN's COMTRADE, obtained through UNCTAD/World Bank WITS data system. Our sample covers 115 importers and 183 exporters spanning the years between 1996 and 2003. [2]

In our exercise, we need data on three variables: number of imported varieties, importer's productivity and trade costs.

Extensive margin – a measure of imported varieties

Empirical studies define a product variety either as a commodity category or a market-commodity category at different levels of commodity disaggregation imposed by data availability. We can measure imported varieties as a simple count of categories or as market-categories. The simple count assumes that varieties have equal prices and quantities and it gives the same weight to each variety. Alternatively, the literature employs a weighted count of the number of categories or market-categories, known as extensive margin, where the weights are the world trade in each category or market-category. The extensive margin is the cross-section equivalent of the product varieties measure derived by Feenstra (1994). The measure is more appropriate than the simple count because it allows varieties to be traded in unequal prices and quantities.

To formalize, following Feenstra and Kee (2004), the bilateral extensive margin in sector *s* can be defined as:

$$(16)\quad EM_{ij}^{s} = \frac{\sum_{v \in I_{ij}} M_{wjv}^{s}}{\sum_{v \in I_{wj}} M_{wjv}^{s}}.$$

[2] In our efforts to construct a balanced panel, we restrict our data sample to 8 years in which the number of reporting importers is roughly constant.

It represents the weighted average of the number of varieties v imported by country *i* from exporter *j*. The bilateral extensive margin weighs each category using the *j*'s world exports, M^s_{wjv}. EM^s_{ij} measures the share of the weighted number of varieties imported by *i* from *j* in the total number of varieties exported by *j*. Note that, if the world imports from *j* are equal across all varieties, then EM^s_{ij} represents the share of the simple count of varieties that *i* imports from *j* in the total number of varieties the world imports from *j*.

In our empirical exercise, we define a variety v as a 6 digit HS category and a product/sector *s* as a 2 digit HS category. We construct the bilateral extensive margin EM^s_{ij} for each year and for each 2 digit HS.

Relative export performance – proxy for domestic productivity

In order to estimate domestic productivity for many importers, we need data on domestic production for many countries which is not readily available. For our purposes, we can use export performance to proxy for domestic productivity. That is, we conjecture that a country with a more productive industry participates on the world markets and the more productive the industry is the more it exports. A large body of empirical literature on firm level heterogeneity shows that only firms above a productivity threshold become exporters, and the higher the aggregate productivity, the greater the number of firms that participate on the export markets (Bernard et. all – 2003).

We measure the export performance of country *i* using the REP (Relative Export Performance) index, also known as export-based Revealed Comparative Advantage (Richardson and Zhang 1999) or Balassa Index (Balassa 1965):

$$(17) \qquad REP_i^s = \frac{M_{wi}^s / M_{wi}}{M_{ww}^s / M_{ww}}$$

where M_{wi}^s and M_{wi} represents the world imports from exporter *i* for product *s* and for all products; M_{ww}^s and M_{ww} denote the world total trade for *s* and all products.

The REP index represents country *i*'s share of worldwide exports for product *s* relative to the world counterpart. The index also measures country *i*'s export performance. By using the share of product *s*'s exports in country *i*'s total exports, the REP index controls for country *i* having a higher REP index because it exports more of all products. Furthermore, constructing it relative to product *s*'s world share, we measure the importance of country *i*'s exports in product *s* relative to the world counterpart. Consequently, in a cross-country comparison, the REP index gives an appropriate ranking of countries' export performance in a sector.

Another proxy for a country's productivity employed in the literature is GDP per capita. While GDP per capita represents a measure of a country's overall level of development or average productivity, it does not capture its varying productivity and export performance across all sectors. For instance India has the highest performance in exporting silk while the United States ranks 37th in the group of 92 countries exporting silk in 1999. But in terms of GDP per capita the United States ranks 4th while India ranks 109th across all 142 countries in our sample. Across all countries and products the correlation between GDP per capita and the relative export performance is 0.19. GDP per capita becomes a better proxy for more capital-intensive sectors, but it is still an imperfect measure. Table 1 illustrates that the correlation is negative for some sectors such as silk, cotton, and coffee; positive but very small for others such as cereals and cocoa; and positive but significantly less than one for sectors such as apparel, chemical products electric machinery, and vehicles. Thus we argue that relative export performance represents a better proxy for the productivity varying across sectors than GDP per capita.

Since we are interested in importer *i*'s productivity relative to any exporter *j*, we construct the bilateral REP index which measures the export performance of country *i* relative to exporter *j*:

$$(18) \qquad REP_{ij}^{s} = \frac{M_{wi}^{s} / M_{wi}}{M_{wj}^{s} / M_{wj}} = \frac{REP_{i}^{s}}{REP_{j}^{s}}.$$

Distance – proxy for trade costs

Detailed data on trade costs such as transport costs and tariffs are sparse for a large number of countries. Thus, we proxy trade barriers by bilateral great circle distance. In particular we model trade costs as a function of distance - $\ln \tau_{ij}^{k} = \delta_k \ln d_{ij}$, where d_{ij} is the bilateral great circle distance between the capitals of trading partners. This assumption biases downward[3] the magnitude of our price elasticity of demand but we are only interested whether the productivity gap (measured by bilateral relative export performance) affects the elasticity to assess the importance of domestic varieties for a country's welfare and not in the precise magnitude of the effect.

B. Specifications and Results

We estimate the following specification based on the qualitative predictions of the model described in section II:

$$(19) \ \log EM_{ijt}^{s} = \alpha^{s} + \delta \log X_{it} + \gamma_1 \log d_{ij} + \gamma_2 \log REP_{it}^{s} + \gamma_3 \log REP_{ijt}^{s} + \gamma_4 \log d_{ij} * \log REP_{ijt}^{s} + \varepsilon_{ijt}^{s},$$

[3] According to Hummels (2001)'s estimation, δ_k is less than one.

where EM_{ijt}^{s} is the extensive margin of importer *i* from exporter *j* , for product *s*, at time t; X_{it} are the controls for importer *i*'s market size, at time *t* such as population and GDP per capita; REP_{it}^{s} is the export performance of importer *i* for product *s*, at time *t* and REP_{ijt}^{s} is the corresponding export performance of importer *i relative* to exporter *j*; and d_{ij} is the distance between *i* and *j*.

We include the importer's population and GDP per capita to capture the impact of its market size and average productivity on the bilateral extensive margin. Recall that the extensive margin represents the share of the weighted number of varieties imported by *i* from *j* in the total number of varieties exported by *j.* Thus, by construction, we control for any variation in exporter's market size, productivity or production structure that is constant across importers. Conditioning on a product and controlling for importer's market size at time t, an increase in bilateral distance decreases the extensive margin and the magnitude of the effect co-varies positively with importer – exporter REP. That is, to test whether domestic and foreign varieties are substitutes, we seek to confirm that the coefficient of the interaction term between distance and importer-exporter REP is negative ($\gamma_4 < 0$). If γ_4 is insignificantly different from zero than domestic and foreign product varieties are not substitutes and thus in evaluating product variety gains from international trade we can abstract from domestic varieties. Following our model's predictions we expect that:

i) the total effect of distance on the extensive margin to be negative ($\gamma_1 + \gamma_4 \overline{\log REP_{ijt}^{s}} < 0$);

ii) the total effect of importer-exporter relative REP on the extensive margin to be negative ($\gamma_3 + \gamma_4 \log \tau_{ij} < 0$);

iii) the impact of importer's REP on the extensive margin to be positive ($\gamma_2 > 0$)

Initially, we pool across all products (i.e. HS 2 categories), which is equivalent to assuming that the effect of trade costs proxied by distance on the bilateral extensive margin is identical across all products:

$$\begin{aligned}\log EM_{ijt}^{s} &= \alpha^{s} + \underset{(0.009)}{0.13}\log Pop_{it} + \underset{(0.01)}{0.23}\log CGDP_{it} - \underset{(0.01)}{0.18}\log d_{ij} + \\ &+ \underset{(0.009)}{0.19}\log REP_{it}^{s} - \underset{(0.02)}{0.09}\log REP_{ijt}^{s} - \underset{(0.002)}{0.01}\log d_{ij} * \log REP_{ijt}^{s} + \varepsilon_{ijt}^{s}\end{aligned} \tag{20}$$ [4]

If we rank importers according to their REP, distance has a 44% stronger (negative) effect on the number of varieties for the 90th percentile importer compared with the 10th percentile importer. Importer- exporter REP has a negative effect on the number of imported varieties: doubling sector-specific productivity gap decreases the number of imported varieties by 18% for a median trade barrier.

We then classify the HS 2 categories into eight industries: ‘agriculture,’ ‘textiles and garments,’ ‘wood and paper,’ ‘petroleum and plastics,’ ‘mining and basic metals,’ ‘machinery and transportation,’ ‘electronics,’ and ‘other manufactures.’[5] We report estimates for each industry in tables 3 and 4. The estimates for ‘agriculture,’ ‘textiles and garments,’ ‘electronics,’ ‘machinery and transportation,’ and ‘other manufactures’ provide statistically significant support for our hypothesis. The effects differ across industries with differentiated goods industries such as ‘electronics’ and ‘machinery and transportation’ featuring the strongest effects. Since industries such as ‘petroleum and plastics’, ‘wood and paper’ and ‘mining and basic metals’ can be considered homogenous goods and we model trade in differentiated products, it is not surprising that γ_4 is insignificant for these industries.

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[4] R^2 =0,13, N. obs.=2,934,360

[5] See Table 1 for a mapping between 2 digit HS categories and the industry classification (See also Feenstra and Kee 2004)

The domestic productivity may not be exogenous as we assume in our model. The number of imported varieties may increase an importer's productivity and thus export-performance through two channels that are outside of our model. First, if we consider imported varieties as inputs in production, more input varieties increase an importer's productivity under the assumption of gains from specialization (Romer – 1990, Feenstra and Kee -2004). Second, tougher competition from foreign varieties leads to intra-sector reallocations towards the most efficient firms and thus increases productivity (Melitz - 2003). If one or both sources of endogeneity operate then our estimates are biased upwards and controlling for it will only strengthen the impact of relative export performance on the number of imported varieties.

We instrument the contemporaneous relative export performance with the lag of the relative export performance under the assumption that they are highly correlated and that the contemporaneous extensive margin does not impact the lag of the export performance for a given sector:

(21)
$$\begin{aligned}\log EM_{ijt}^{s} = \alpha^{s} + \underset{(0.008)}{0.12}\log Pop_{it} + \underset{(0.009)}{0.19}\log CGDP_{it} - \underset{(0.01)}{0.16}\log d_{ij} + \\ + \underset{(0.008)}{0.20}\log REP_{it}^{s} - \underset{(0.02)}{0.13}\log REP_{ijt}^{s} - \underset{(0.002)}{0.008}\log d_{ij} * \log REP_{ijt}^{s} + \varepsilon_{ijt}^{s}\end{aligned}$$.[6]

In the IV regression, distance has 39% stronger (negative) effect on the number of varieties for the 90th percentile compared with the 10th percentile importer. Doubling sector specific productivity gap decreases the number of imported varieties by 20 % for a median trade barrier. The IV estimates increase slightly the effect of REP on the number of imported varieties and decrease the impact of distance but the support for our hypothesis remains strong. The IV estimates for each industry in tables 5 and 6 reinforce the OLS estimates and strengthen the impact of the relative

[6] $R^2 = 0.13$, N. obs. = 2,100,919

export performance on the extensive margin while the interaction term coefficient remains statistically significant with similar magnitudes.

IV. Conclusions

Romer (1994) shows that including the fixed costs of importing in a trade model with differentiated goods magnifies the importance of trade costs in the calculation of the welfare losses. A higher trade cost not only decreases the volumes of imported goods as in traditional models, but also shrinks the set of imported differentiated goods. This reduction in the number of imported varieties results in first-order welfare losses. However, the standard assumption in the literature is that importer's own varieties are in no competition with the foreign ones, which can potentially overstate the impact of protectionism on welfare if domestic and foreign varieties are substitutes.

This paper shows that the production of domestic varieties adjusts to changes in the number of imported varieties. And the substitutability between domestic and foreign varieties has important implications for evaluating the product variety gains from international trade. A country with higher sector productivity depends less on foreign varieties and its welfare losses because of higher trade barriers are smaller compared to those of a country whose production of domestic varieties is less efficient. For instance, a developing country with comparative disadvantage in electronics reaps higher benefits from trade liberalization than a country that is a world leader in producing varieties of electronics. The evidence provided in this paper strengthens the arguments for trade liberalization of a country's inefficient sectors irrespective of its aggregate level of development.

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Table 1: Relative Export Performance and GDP per capita

HS2	Description (2 digit HS)	Correlation with GDP per capita	Lowest REP countries	Highest REP countries
	Agriculture			
01	LIVE ANIMALS	0.01	Algeria, Oman, Gabon	Sudan, Jordan, Nicaragua
02	MEAT AND EDIBLE MEAT OFFAL	0.27	Nigeria, Gabon, Colombia	Uruguay, New Zealand, Denmark
03	FISH, CRUSTACEANS & AQUATIC INVERTEBRATES	0.02	Dominica, Bolivia, St. Lucia	Kiribati, Faeroe Islands, Greenland
04	DAIRY PRODS; BIRDS EGGS; HONEY; ED ANIMAL PR NESOI	0.36	Guinea, Gabon, Paraguay	New Zealand, Uruguay, Denmark
05	PRODUCTS OF ANIMAL ORIGIN, NESOI	0.13	Togo, Malawi, Algeria	Lebanon, Faeroe Islands, Mongolia
06	LIVE TREES, PLANTS, BULBS ETC.; CUT FLOWERS ETC.	-0.14	Nigeria, Bahamas, Macao	Kenya, Colombia, Ecuador
07	EDIBLE VEGETABLES & CERTAIN ROOTS & TUBERS	-0.19	Guinea, Andorra, Macao	Kenya, Cyprus, Ethiopia
08	EDIBLE FRUIT & NUTS; CITRUS FRUIT OR MELON PEEL	-0.24	Greenland, Gabon, Japan	St. Lucia, Ecuador, Dominica
09	COFFEE, TEA, MATE & SPICES	-0.46	Malta, Norway, Moldova	Burundi, Uganda, Rwanda
10	CEREALS	0.06	Guinea, Morocco, Belarus	Guyana, Argentina, Uruguay
11	MILLING PRODUCTS; MALT; STARCH; INULIN; WHT GLUTEN	0.04	Algeria, Macao, Guinea	Grenada, St. Vin. & Grenad., Uruguay
12	OIL SEEDS ETC.; MISC GRAIN, SEED, FRUIT, PLANT ETC	-0.29	Oman, St. Vin. & Grenad.., Gabon	Paraguay, Sudan, Ethiopia
13	LAC; GUMS, RESINS & OTHER VEGETABLE SAP & EXTRACT	-0.18	Trinidad & Tobago, Macedonia, Ghana	Sudan, Rwanda, Kenya
14	VEGETABLE PLAITING MATERIALS & PRODUCTS NESOI	-0.31	Saudi Arabia, Finland, Tunisia	Madagascar, Peru, Sri Lanka
15	ANIMAL OR VEGETABLE FATS, OILS ETC. & WAXES	0.01	Cuba, St. Vin.& Grenad., Bahamas	Benin, Bolivia, Senegal
16	EDIBLE PREPARATIONS OF MEAT, FISH, CRUSTACEANS ETC	0.18	Cameroon, Algeria, Ethiopia	Seychelles, Greenland, Iceland
17	SUGARS AND SUGAR CONFECTIONARY	-0.01	French Polynesia, Greenland, Armenia	Cuba, Guyana, St. Kitts & Nevis
18	COCOA AND COCOA PREPARATIONS	0.00	Zambia, Faeroe Islands, Mauritius	Cote d'Ivoire, Ghana,S.Tome&Principe
19	PREP CEREAL, FLOUR, STARCH OR MILK; BAKERS WARES	0.42	Turkmenistan, Algeria, Belize	Barbados, Trinidad & Tobago, El Salvador
20	PREP VEGETABLES, FRUIT, NUTS OR OTHER PLANT PARTS	0.14	Zambia, New Caledonia, Gabon	Belize, Moldova, Kenya
21	MISCELLANEOUS EDIBLE PREPARATIONS	0.35	Faeroe Islands,St. Vin.&Grenad.,Gabon	Barbados, Ireland, Cote d'Ivoire
22	BEVERAGES, SPIRITS AND VINEGAR	0.41	Niger, Gabon, Sudan	Bahamas, Moldova, St. Lucia
23	FOOD INDUSTRY RESIDUES & WASTE; PREP ANIMAL FEED	-0.01	Cuba, New Caledonia, Algeria	Bolivia, Peru, Argentina
24	TOBACCO AND MANUFACTURED TOBACCO SUBSTITUTES	-0.12	Bolivia, Ethiopia, St. Kitts and Nevis	Malawi, Tanzania, Cuba
25	SALT; SULFUR; EARTH & STONE; LIME & CEMENT PLASTER	0.04	New Caledonia, Sudan, C. African Rep.	Togo, Jordan, Senegal
26	ORES, SLAG AND ASH	-0.10	Greenland, Uruguay, Nepal	Guinea, Mongolia, New Caledonia
27	MINERAL FUEL, OIL ETC.; BITUMIN SUBST; MINERAL WAX	0.11	Mali, Guyana, Rwanda	Algeria, Nigeria, Oman

Table 1: Relative Export Performance and GDP per capita - cont'd

HS2	Description (2 digit HS)	Correlation with GDP per capita	Lowest REP countries	Highest REP countries
	Petroleum & Plastics			
28	INORG CHEM; PREC & RARE-EARTH MET & RADIOACT COMPD	0.16	Malawi, St. Vin. & Grenad., Macao	Niger, Bhutan, Jamaica
29	ORGANIC CHEMICALS	0.55	Suriname, Greenland, Turkmenistan	Ireland, Trinidad & Tobago, Barbados
30	PHARMACEUTICAL PRODUCTS	0.49	Mongolia, Madagascar, Gabon	Switzerland, Panama, Jordan
31	FERTILIZERS	0.20	Nicaragua, Benin, Uganda	Jordan, Belarus, Lithuania
32	TANNING & DYE EXT ETC; DYE, PAINT, PUTTY ETC; INKS	0.41	Gabon, Seychelles, Turkmenistan	Ant.& Barbuda, Switzerland, Barbados
33	ESSENTIAL OILS ETC; PERFUMERY, COSMETIC ETC PREPS	0.32	Turkmenistan, St. Vin.& Grenad., Gambia	Comoros, Dominica, Nepal
34	SOAP ETC; WAXES, POLISH ETC; CANDLES; DENTAL PREPS	0.34	Mongolia, Gabon, Bolivia	Dominica, Guatemala, Nepal
35	ALBUMINOIDAL SUBST; MODIFIED STARCH; GLUE; ENZYMES	0.50	Azerbaijan, Gabon, Guyana	New Zealand, Denmark, Lithuania
36	EXPLOSIVES; PYROTECHNICS; MATCHES; PYRO ALLOYS ETC	0.13	Venezuela, Morocco, Malawi	Zambia, Belarus, China
37	PHOTOGRAPHIC OR CINEMATOGRAPHIC GOODS	0.60	Gabon, Guinea, Azerbaijan	Japan, Belgium-Luxembourg., Netherlands
38	MISCELLANEOUS CHEMICAL PRODUCTS	0.57	Malawi, Ethiopia, Turkmenistan	Barbados, United Kingdom, Switzerland
39	PLASTICS AND ARTICLES THEREOF	0.55	Mongolia, Guinea, Algeria	Belgium-Luxembourg., Bahamas, Netherlands
40	RUBBER AND ARTICLES THEREOF	0.29	New Caledonia, Bhutan, Burundi	Sri Lanka, Serbia, Thailand
	Wood & Paper			
44	WOOD AND ARTICLES OF WOOD; WOOD CHARCOAL	-0.02	Faeroe Islands, Algeria, Turkmenistan	Latvia, Cameroon, Gabon
45	CORK AND ARTICLES OF CORK	0.17	Iran, Costa Rica, Saudi Arabia	Portugal, Morocco, Spain
46	MFR OF STRAW, ESPARTO ETC.; BASKETWARE & WICKERWRK	-0.29	Saudi Arabia, Belarus, Algeria	Madagascar, China, Philippines
47	WOOD PULP ETC; RECOVD (WASTE & SCRAP) PPR & PPRBD	0.42	Cameroon, Nigeria, Ghana	Chile, Brazil, Canada
48	PAPER & PAPERBOARD & ARTICLES (INC PAPR PULP ARTL)	0.46	Turkmenistan, Greenland, St. Kitts & Nevis	Finland, Sweden, Austria
49	PRINTED BOOKS, NEWSPAPERS ETC; MANUSCRIPTS ETC	0.56	Turkmenistan, Bhutan, Algeria	Andorra, Lebanon, Malta

Table 1: Relative Export Performance and GDP per capita - cont'd

HS2	Description (2 digit HS)	Correlation with GDP per capita	Lowest REP countries	Highest REP countries
	Textiles & Garments			
41	RAW HIDES AND SKINS (NO FURSKINS) AND LEATHER	-0.09	Gabon, Ghana, Trinidad & Tobago	Uruguay, Burkina Faso, Argentina
42	LEATHER ART; SADDLERY ETC; HANDBAGS ETC; GUT ART	0.29	Gabon, Nigeria, Greenland	China, Sri Lanka, India
43	FURSKINS AND ARTIFICIAL FUR; MANUFACTURES THEREOF	0.31	Nigeria, Egypt, Arab Rep., El Salvador	Denmark, Greece, Uruguay
50	SILK, INCLUDING YARNS AND WOVEN FABRIC THEREOF	-0.03	Venezuela, Argentina, Malta	India, China, Paraguay
51	WOOL & ANIMAL HAIR, INCLUDING YARN & WOVEN FABRIC	0.36	Nigeria, Honduras, Tanzania	Mongolia, Uruguay, New Zealand
52	COTTON, INCLUDING YARN AND WOVEN FABRIC THEREOF	-0.30	New Caledonia, Bahamas, Suriname	Mali, Burkina Faso, Benin
53	VEG TEXT FIB NESOI; VEG FIB & PAPER YNS & WOV FAB	-0.04	Oman, Nigeria, Honduras	Belarus, Latvia, Tanzania
54	MANMADE FILAMENTS, INCLUDING YARNS & WOVEN FABRICS	0.41	Guyana, Gabon, Ethiopia	Nepal, Belarus, Korea, Rep.
55	MANMADE STAPLE FIBERS, INCL YARNS & WOVEN FABRICS	0.20	Gabon, Guyana, Faeroe Islands	Turkey, Belarus, Indonesia
56	WADDING, FELT ETC; SP YARN; TWINE, ROPES ETC.	0.35	Gabon, Jamaica, Ethiopia	Andorra, St. Lucia, Nepal
57	CARPETS AND OTHER TEXTILE FLOOR COVERINGS	0.16	Nigeria, Cuba, Cameroon	Nepal, Iran, Islamic Rep., India
58	SPEC WOV FABRICS; TUFTED FAB; LACE; TAPESTRIES ETC	0.49	Guinea, Zambia, Malawi	St. Lucia, Andorra, Hong Kong
59	IMPREGNATED ETC TEXT FABRICS; TEX ART FOR INDUSTRY	0.51	Nigeria, Oman, Senegal	Taiwan, China, Korea, Rep., Turkey
60	KNITTED OR CROCHETED FABRICS	0.45	Cameroon, Azerbaijan, Gabon	Macao, Taiwan, China, Hong Kong
61	APPAREL ARTICLES AND ACCESSORIES, KNIT OR CROCHET	0.13	Gabon, Guinea, Nigeria	Macao, Honduras, El Salvador
62	APPAREL ARTICLES AND ACCESSORIES, NOT KNIT ETC.	0.12	Sudan, Algeria, Nigeria	Tunisia, Sri Lanka, Macao
63	TEXTILE ART NESOI; NEEDLECRAFT SETS; WORN TEXT ART	0.04	Greenland, Gabon, Seychelles	Andorra, Turkey, Portugal
64	FOOTWEAR, GAITERS ETC. AND PARTS THEREOF	0.13	Mali, Mongolia, Malawi	Cape Verde, Tuvalu, Albania
65	HEADGEAR AND PARTS THEREOF	0.27	Algeria, Iran, Islamic Rep., Nigeria	Macao, Sri Lanka, Nepal
66	UMBRELLAS, WALKING-STICKS, RIDING-CROPS ETC, PARTS	0.21	Algeria, Ecuador, Iran, Islamic Rep.	China, Panama, Hong Kong
67	PREP FEATHERS, DOWN ETC; ARTIF FLOWERS; H HAIR ART	-0.05	Malta, Costa Rica, Ecuador	Togo, Senegal, China
	Mining & Basic Metals			
68	ART OF STONE, PLASTER, CEMENT, ASBESTOS, MICA ETC.	0.43	Turkmenistan, Jamaica, Greenland	Greece, Jordan, Slovenia
69	CERAMIC PRODUCTS	0.33	Zambia, Turkmenistan, F. Polynesia	Jamaica, Portugal, Italy
70	GLASS AND GLASSWARE	0.37	Guinea, Sudan, Algeria	Czech Republic, Tuvalu, Belarus
71	NAT ETC PEARLS, PREC ETC STONES, PR MET ETC; COIN	-0.03	Azerbaijan, Moldova, Gabon	F. Polynesia, C. African Rep., Gambia
72	IRON AND STEEL	0.35	Greenland, Gambia, Nigeria	New Caledonia, Ukraine, Bhutan
73	ARTICLES OF IRON OR STEEL	0.44	Guinea, Suriname, Rwanda	Czech Republic, Poland, Ukraine

Table 1: Relative Export Performance and GDP per capita - cont'd

HS2	Description (2 digit HS)	Correlation with GDP per capita	Lowest REP countries	Highest REP countries
	Mining & Basic Metals – cont'd			
74	COPPER AND ARTICLES THEREOF	0.23	Bolivia, Belize, Mali	Zambia, Chile, Peru
75	NICKEL AND ARTICLES THEREOF	0.38	Macedonia, Guatemala, Cote d'Ivoire	New Caledonia, Russia, Australia
76	ALUMINUM AND ARTICLES THEREOF	0.37	Gabon, Cape Verde, Greenland	Iceland, Ghana, Russia
78	LEAD AND ARTICLES THEREOF	0.11	Gabon, Malawi, Greenland	Peru, Bulgaria, Macedonia
79	ZINC AND ARTICLES THEREOF	0.23	Oman, Macao, Guyana	Macedonia, Peru, Bulgaria
80	TIN AND ARTICLES THEREOF	0.09	Saudi Arabia, Cote d'Ivoire, Romania	Bolivia, Peru, Indonesia
81	BASE METALS NESOI; CERMETS; ARTICLES THEREOF	0.16	Tunisia, Cote d'Ivoire, Honduras	Zambia, Armenia, Norway
82	TOOLS, CUTLERY ETC. OF BASE METAL & PARTS THEREOF	0.55	Guinea, Niger, Guyana	Barbados, Israel, Sweden
83	MISCELLANEOUS ARTICLES OF BASE METAL	0.47	Turkmenistan, Bahamas, Gabon	Albania, Barbados, Austria
	Electronics			
85	ELECTRIC MACHINERY ETC; SOUND EQUIP; TV EQUIP; PTS	0.53	Nigeria, Guinea, Algeria	St. Kitts & Nevis, Malta, Philippines
	Machinery & Transportation			
84	NUCLEAR REACTORS, BOILERS, MACHINERY ETC.; PARTS	0.53	Turkmenistan, Paraguay, Benin	Singapore, Cape Verde, Hungary
86	RAILWAY OR TRAMWAY STOCK ETC; TRAFFIC SIGNAL EQUIP	0.40	Oman, Jamaica, Ethiopia	Slovakia, Czech Republic, Austria
87	VEHICLES, EXCEPT RAILWAY OR TRAMWAY, AND PARTS ETC	0.47	Gabon, Greenland, Bolivia	Canada, Spain, Slovakia
88	AIRCRAFT, SPACECRAFT, AND PARTS THEREOF	0.26	Uruguay, Suriname, Malawi	Ghana, France, Georgia
89	SHIPS, BOATS AND FLOATING STRUCTURES	0.48	Zambia, Cameroon, Oman	Ant.& Barb., St. Vin.& Grenad., Cyprus
	Other Manufactures			
90	OPTIC, PHOTO ETC, MEDIC OR SURGICAL INSTRMENTS ETC	0.59	Benin, Belize, Honduras	Israel, Japan, United States
91	CLOCKS AND WATCHES AND PARTS THEREOF	0.42	Algeria, Gabon, Nigeria	Switzerland, Hong Kong, Mauritius
92	MUSICAL INSTRUMENTS; PARTS AND ACCESSORIES THEREOF	0.04	Algeria, Iran, Islamic Rep., Venezuela	Indonesia, Czech Republic, Japan
93	ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF	0.46	Nigeria, Cote d'Ivoire, Ecuador	Andorra, Cyprus, Austria
94	FURNITURE; BEDDING ETC; LAMPS NESOI ETC; PREFAB BD	0.44	Gabon, Nigeria, Algeria	Slovenia, Poland, Estonia
95	TOYS, GAMES & SPORT EQUIPMENT; PARTS & ACCESSORIES	0.43	Algeria, Gabon, Nigeria	China, Montserrat, Hong Kong
96	MISCELLANEOUS MANUFACTURED ARTICLES	0.43	Gabon, Nigeria, Guyana	St. Kitts & Nevis, China, Hong Kong

Note: The correlation between Relative Export Performance and GDP per capita across all products is 0.19. All calculations are for 1999

Table 2: Variation in Extensive Margin, Relative Export Performance and Distance

Coefficient of Variation	**EM_{ijts}**	**REP_{ijts}**	**$Distance_{ij}$**
All industries	0.80	2.04	0.69
Agriculture	0.78	1.89	0.71
Petroleum & Plastics	0.76	2.19	0.68
Wood & Paper	0.74	2.09	0.70
Textiles & Garments	0.78	2.04	0.69
Mining & Basic Metals	0.86	1.98	0.68
Electronics	1.00	2.55	0.65
Machinery & Transportation	0.92	2.08	0.66
Other Manufactures	0.81	2.14	0.66

Note: For each importer(i) – year(t) – HS 2(s), calculate coefficient of variation $CoV(x_{ijts}) = stdev(x_{ijts}) / mean(x_{ijts})$. The table reports the median value of the coefficient of variation over all *its* for each industry.

Table 3: Dependent variable - Extensive margin

Industry	$Dist_{ij}$	REP_{its}	REP_{ijts}	$Distance_{ij}$ x REP_{ijts}	Pop_{it}	$CGDP_{it}$	N obs.	R^2
Agriculture	**-0.155** (0.011)	**0.073** (0.009)	**-0.032** (0.018)	**-0.007** (0.002)	**0.105** (0.011)	**0.212** (0.011)	712,729	0.10
Petroleum & Plastics	**-0.198** (0.016)	**0.256** (0.011)	**-0.200** (0.045)	-0.005 (0.005)	**0.133** (0.008)	**0.155** (0.013)	461,308	0.14
Wood & Paper	**-0.207** (0.017)	**0.125** (0.010)	**-0.180** (0.047)	0.005 (0.005)	**0.123** (0.010)	**0.198** (0.011)	177,663	0.15
Textiles & Garments	**-0.190** (0.016)	**0.193** (0.012)	-0.049 (0.033)	**-0.012** (0.004)	**0.142** (0.012)	**0.288** (0.013)	600,204	0.14
Mining & Basic Metals	**-0.204** (0.021)	**0.183** (0.012)	**-0.130** (0.048)	-0.005 (0.006)	**0.172** (0.011)	**0.257** (0.015)	458,444	0.12
Electronics	**-0.232** (0.022)	**0.573** (0.027)	**-0.238** (0.096)	**-0.037** (0.011)	**0.224** (0.018)	**0.281** (0.020)	69,183	0.21
Machinery & Transportation	**-0.157** (0.015)	**0.318** (0.018)	0.012 (0.047)	**-0.038** (0.005)	**0.136** (0.010)	**0.195** (0.013)	182,834	0.13
Other Manufactures	**-0.155** (0.011)	**0.319** (0.013)	**-0.136** (0.038)	**-0.018** (0.004)	**0.131** (0.010)	**0.253** (0.012)	271,995	0.15

Notes:
1. i- importer, j-exporter, t-year, s-HS2 category
2. All regressions include HS 2 fixed effects
3. All variables are in logs and robust standard errors are in parentheses
4. Observations are clustered by importers.

Table 4: The total effect of distance and bilateral REP on the extensive margin

Industry	Distance[1]	Doubling bilateral REP[2]
Agriculture	37%	-9%
Petroleum & Plastics	0%	-20%
Wood & Paper	0%	-18%
Textiles & Garments	52%	-10%
Mining & Basic Metals	0%	-13%
Electronics	260%	-56%
Machinery & Transportation	1787%	-32%
Other Manufactures	126%	-29%

Notes:

1. The total effect of distance is calculated for the 90th percentile importer relative to the 10th percentile importer.
2. The total effect of bilateral REP is evaluated for the median distance.

Table 5: Dependent variable - Extensive margin (IV Regression)

Industry	$Distance_{ij}$	REP_{its}	REP_{ijts}	$Distance_{ij}$ X REP_{ijts}	Pop_{it}	$CGDP_{it}$	Number of obs.	R2
Agriculture	**-0.133** (0.010)	**0.083** (0.009)	**-0.057** (0.018)	**-0.006** (0.002)	**0.090** (0.010)	**0.176** (0.010)	504,303	0.11
Petroleum & Plastics	**-0.175** (0.014)	**0.285** (0.011)	**-0.232** (0.043)	-0.005 (0.005)	**0.121** (0.008)	**0.137** (0.012)	334,666	0.16
Wood & Paper	**-0.176** (0.016)	**0.134** (0.010)	**-0.194** (0.051)	0.007 (0.006)	**0.106** (0.010)	**0.168** (0.010)	127,333	0.14
Textiles & Garments	**-0.162** (0.014)	**0.213** (0.011)	**-0.090** (0.007)	**-0.009** (0.003)	**0.118** (0.011)	**0.243** (0.012)	429,161	0.14
Mining & Basic Metals	**-0.179** (0.020)	**0.209** (0.012)	**-0.176** (0.056)	-0.002 (0.007)	**0.150** (0.011)	**0.220** (0.014)	330,470	0.12
Electronics	**-0.198** (0.019)	**0.554** (0.026)	**-0.276** (0.085)	**-0.031** (0.010)	**0.191** (0.016)	**0.243** (0.018)	51,152	0.21
Machinery & Transportation	**-0.138** (0.013)	**0.376** (0.017)	**-0.103** (0.046)	**-0.031** (0.005)	**0.121** (0.009)	**0.163** (0.012)	128,989	0.14
Other manufactures	**-0.132** (0.009)	**0.347** (0.012)	**-0.225** (0.035)	**-0.011** (0.004)	**0.111** (0.009)	**0.212** (0.011)	194,845	0.15

Notes:

1. i- importer, j-exporter, t-year, s-HS2 category
2. All regressions include HS 2 fixed effects
3. All variables are in logs and robust standard errors are in parentheses
4. Observations are clustered by importers

Table 6: The total effect of distance and bilateral REP on the extensive margin
IV Regression

Industry	Distance[1]	Doubling bilateral REP[2]
Agriculture	33%	-10%
Petroleum & Plastics	0%	-23%
Wood & Paper	0%	-19%
Textiles & Garments	48%	-17%
Mining & Basic Metals	0%	-18%
Electronics	247%	-55%
Machinery & Transportation	1008%	-37%
Other Manufactures	71%	-32%

Notes:

1. The total effect of distance is calculated for the 90th percentile importer relative to the 10th percentile importer.
2. The total effect of bilateral REP is evaluated for the median distance.