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Did Export Diversification Soften the Impact of the Global Financial Crisis?

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Did Export Diversification Soften the Impact of the Global Financial Crisis?

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Abstract

This study considers the role of export diversification in determining trade outcomes during the global financial crisis. The impact of export diversification (or concentration) is measured by assessing three different dimensions of specialization. First, concentration by geographic destination is considered; that is, whether the bulk of exports from a country go to many or few trading partners. Second, industry/sectoral concentration is considered; that is, whether a country's exports are scattered across many industries and sectors, or concentrated in just a few. Third, product concentration is considered; that is, whether countries produce many products within their export sectors or just a few. The workhorse gravity trade model is adapted with trade diversification as an additional trade cost, and the model solution is empirically tested on a dataset containing over 500 thousand observations for Latin America. Industry and product concentration are found to significantly affect the resilience of Latin American countries' trade during the global financial crisis – increasing the diversity of both export sectors and export products within sectors by one standard deviation reduces the quarterly decline in exports by approximately 4.7 percent. Diversifying exports across many different trading partners is not found to significantly affect outcomes.

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I. INTRODUCTION

The financial crisis that began with the 2007 collapse of the US subprime lending market and then spread through 2008-09 is remarkable for its global impact on trade. Recent studies have shown some success in empirically identifying the breadth of the crisis among a cross-section of countries by focusing on trade and financial channels of contagion. This study attempts to identify country-specific trade characteristics that are empirically linked to the severity of the crisis in each country, in terms of the decline of its exports.[2]

The exceptional speed and depth of the global trade collapse resulted in part from accelerating energy prices at the beginning of the period, a seizure in trade finance, and declining demand. These contributed to sudden export declines exceeding 20 percent in Europe, Emerging Asia, and the Americas.[3] Nonetheless, comparing the heterogeneity in the depth and duration of the trade declines across individual countries suggests that country-specific factors also contributed to either attenuating or intensifying the impact of the global shock. One factor that has been proposed previously in the trade literature as a driver of long-term growth is export diversification. For example, in studies such as Vernon (1966), Krugman (1979) and Grossman and Helpman (1991), export diversification increases long-term output growth. While the empirical evidence supporting the variations of this idea is mixed, one could also analyze its short-term effects in a broad global downturn. The degree of export concentration is studied here and found to play a statistically and economically significant role during the recent global financial crisis. Specifically, the level of trade concentration is compared across countries after controlling for other global factors in order to identify whether it intensifies or attenuates the global financial crisis on exports.

The impact of export concentration is measured by assessing three different dimensions of trade specialization. First, concentration of exports by geographic destination is considered; that is, whether the bulk of exports from a country go to many or few trading partners. Second, industry/sectoral export concentration is considered; that is, whether a country's exports are scattered across many industries and sectors, or concentrated in just a few.[4] Third, product export concentration is considered; that is, whether countries produce many products within their export sectors or just a few. A country's silk exports, for example, could vary in concentration across the different products classified within this category of exports, such as silkworm cocoons suitable for reeling, raw silk (not thrown), woven fabrics of silk or silk waste, etc. Prior studies have found an Engle curve type relationship regarding the benefits of export diversification and growth (e.g. Cabellero and Cowan (2006) empirically link export diversification to national income growth, and Hausmann and Rodrik (2003) show how sectoral export concentration can result from market failures and

[2] See Rose and Spiegel (2010) and Rose and Spiegel (2011) on this identification strategy and for a recent review of the evidence.

[3] Between January 2008 and March 2009 exports declined by over twenty percent in all of these regions. See Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute, (2009).

[4] For both geographic and product concentration, we consider not only the number of countries, but rather how exports weights are spread among destinations and products.

externalities). While a consensus has emerged that long-term growth is hampered by autarky, theory provides no clear indication of the net short-term effect of export concentration in a crisis.

The empirical analysis presented is based on a modified "gravity" model commonly employed in the trade literature, and which incorporates concentration measures as a proxy for trade costs.[5] This is motivated by, for example, Feenstra and Kee (2008), which gives evidence that export diversity increases country productivity. Hence trade diversification across products could determine crisis outcomes to the extent that the crisis had a stronger impact on less productive firms or sectors. As regards trading partners, diversifying across multiple countries could lower the average distance that goods travel while also diversifying export demand shocks. Nonetheless, non-linearities resulting from trade agreements, fixed shipping costs, scale economies, and other trade barriers complicate the incentives to diversifying trading partners. Similar complications regarding industry and product specialization motivate the agnostic posture of the model presented.

The model estimations make use of quarterly bilateral international trade data at the Harmonized System (HS) four digit level for fourteen Latin American economies. Several features of these data allow identification of the impact of trade concentration effects in regressions, including: (i) sufficient observations so as to plausibly capture the dynamics during the crisis, (ii) the quarterly frequency allows an empirical control for "multilateral resistance" of the gravity trade model through fixed effects linear regression, (iii) it allows for changes in total trade (in US dollar levels) to proxy for changes in trade volumes after controlling for commodity and other relevant international price indices, and (iv) estimating the impact of trade concentration on countries of a fairly homogeneous region reduces the risk that latent country and intra-regional differences bias the result because of omitted variables.[6]

The empirical results suggest that both product and industry diversification helped attenuate the impact of the crisis, whereas destination/geographic diversification did not. In the baseline regression, the impact of product, sector and destination diversification on the quarterly change in trade flows is estimated for Latin American economies, controlling for macroeconomic and trade factors. All else equal, exports are found to decline by approximately 4.7 percent for each decimal unit increase in the (Herfindahl based) industry trade concentration index (with a similar empirical result found for product diversification within export industries).[7] The evidence for geographic diversification is weaker and

[5] For example, Rose (2004a) or Anderson and Van Wincoop (2003). The analysis employed here borrows from Romeu and Wolfe (2010).

[6] For example, Rose (2004b) surveys the literature on trade, and finds that beyond the multiplicity of common trade costs proxies such as distance, common language, common colonizer, etc., other factors such as embassies, monetary unions and debt defaults determine trade.

[7] An increase in the Herfindahl index is associated with an increase in the concentration level. The size (0.1) of the base increase in the Herfindahl index considered in this study is consistent with trade concentration benchmarks set by the United States Department of Justice, as discussed below.

negative, i.e. more geographic diversification worsens the impact of the crisis on exports. As many of the economies employed here naturally concentrate their trade with the US because of geographic proximity and other factors, these results are consistent with Rose and Spiegel (2010) and Rose and Spiegel (2011), which suggest that proximity to the US during the crisis was at least not detrimental to outcomes for indicators of the incidence and severity of the crisis, such as real GDP growth in 2008, national stock markets, exchange rates, and credit ratings.

The paper is organized as follows. The next section shows the modified gravity trade model that structures the empirical analysis. The third section describes the database, summary statistics, and empirical results. The fourth section shows product level analysis, and the last section concludes.

II. Trade Concentration as an Additional Trade Cost

This section outlines a monopolistically competitive market framework based on Dixit and Stiglitz (1977) preferences, as employed more generally in Blanchard and Kiyotaki (1987), and in trade in Anderson and Van Wincoop (2003) (henceforth, AV). The framework presents the monopolistically competitive trade problem with firm-specific costs that allow a role for distinguishing potential trade concentration effects, and borrows from Romeu and Wolfe (2011).

Given a pre-determined income level (T_j) on traded goods, consumers living in $j=1$ to M economies, and p_{ij} prices for each consumer-supplier pair, where $i=1$ to N are nations that export goods to the home country, the utility of consumer country j is

$$U_j = \left(\sum_{i=1}^{N} C_{ij}^{\rho}\right)^{1/\rho} \quad 0<\rho<1, \;\; \sigma \equiv 1/(1-\rho), \quad s.t. T_j - \sum_{i=1}^{N} p_{ij} C_{ij}^{\rho} = 0. \tag{1.1}$$

The problem of the consumer j is reduced to maximizing across goods produced in each country i, C_{ij} , with imperfect substitutability and elasticity of substitution σ.

$$L = \left(\sum_{i=1}^{N} C_{ij}^{\rho}\right) - \lambda\left(\sum_{i=1}^{N} p_{ij} C_{ij}^{\rho} - T_j\right). \tag{1.2}$$

The Lagrangian in (1.2) maximizes the monotonic transformation U^{ρ} for simplicity. The first order conditions yield the following well known ratio:

$$C_{ij} = \left(\frac{p_{ij}}{p_{ik}}\right)^{-\sigma} C_{ik}. \tag{1.3}$$

Summing across j's expenditure on all suppliers,

$$C_{kj} = \left(\frac{T_j p_{kj}^{-\sigma}}{\sum_i p_{ij}^{1-\sigma}} \right) = \left(\frac{T_j p_k^{-\sigma} t_{kj}^{-\sigma}}{\sum_i p_{ij}^{1-\sigma}} \right), \quad with\ \ p_{kj} = p_k t_{kj}. \tag{1.4}$$

In (1.4), while the base price for supplier *k* is given by p_k, the final price paid by consumers is marked up by t_{kj} because of transport costs, trade barriers, and other factors to be specified below. Total expenditure by consumers j is given by $T_j = \sum_{i=1}^{N} p_{ij} C_{ij}^{\rho}$. Income to supplier *i* is defined as $T_i = \sum_{j=1}^{M} p_{ij} C_{ij}^{\rho} = \sum_{j=1}^{M} x_{ij}$. A price index faced by consumers is defined as the geometric average of the destination prices, and is given by $P_j = \left(\sum_i p_{ij}^{1-\sigma} \right)^{1/1-\sigma}$, which is analogous to the "multilateral resistance" price index in AV. Demand by consumers can then be expressed as:

$$C_{ij} = \left(\frac{T_j}{P_j} \right) \left(\frac{p_i t_{ij}}{P_j} \right)^{-\sigma}. \tag{1.5}$$

Exporter *i* faces demand given by:

$$T_i = \sum_j \left(T_j / P_j \right) \left(p_{ij} / P_j \right)^{-\sigma} p_{ij} = p_i^{1-\sigma} \sum_j \left(t_{ij} / P_j \right)^{1-\sigma} T_j \quad \forall i. \tag{1.6}$$

From (1.6):

$$p_i^{1-\sigma} = \frac{T_i}{\sum_j \left(t_{ij} / P_j \right)^{1-\sigma} T_j}; \tag{1.7}$$

Define the share of expenditure as:

$$\theta_j = T_j / \sum_j T_j = \left(T_j / T_W \right). \tag{1.8}$$

The total trade from country *j* to country *i* is:

$$x_{ij} = T_j P_j^{\sigma-1} p_i^{1-\sigma} t_{ij}^{1-\sigma} = \left(\left(T_j T_i / T_W \right) P_j^{\sigma-1} t_{ij}^{1-\sigma} \right) \Big/ \left(\left(\sum_j t_{ij} / P_j \right)^{1-\sigma} \left(T_j / T_W \right) \right) \tag{1.9}$$

Define the cost index for country *i* as:

$$\Pi_i = \left(\sum_j \left(t_{ij} / P_j \right)^{1-\sigma} \theta_j \right)^{\frac{1}{1-\sigma}} \tag{1.10}$$

Then trade between country *j* and *i* can be simplified to:

$$x_{ij} = \left(T_j T_i / T_W \right) \left(t_{ij} / P_j \Pi_i \right)^{1-\sigma}. \tag{1.11}$$

Using (1.7), the two price indices, P_j and Π_i are shown to be mutually dependent,

$$P_j = \left(\sum_i \left(t_{ij} / \Pi_j \right)^{1-\sigma} \theta_i \right)^{\frac{1}{1-\sigma}} \quad and \quad \Pi_i = \left(\sum_j \left(t_{ij} / P_j \right)^{1-\sigma} \theta_j \right)^{\frac{1}{1-\sigma}}. \tag{1.12}$$

As in AV, symmetry implies $t_{ij} = t_{ji}$, then $P_i = \Pi_i$, and $P_j^{1-\sigma} = \sum_i P_i^{\sigma-1} t_{ij}^{1-\sigma} \theta_i \quad \forall j$, and trade is:

$$x_{ij} = \left({T_j T_i}/{T_W} \right) \left({t_{ij}}/{P_j P_i} \right)^{1-\sigma} . \tag{1.13}$$

Identification of (1.13), is achieved by assuming that $P_j P_i$, the product of the "multilateral resistance" terms in (1.5), is not changing at the quarterly frequency. Hence, the fixed effects estimation of the log form of (1.14), which normalizes trade by the product of the partner country GDPs, identifies the trade costs. It is further assumed that the impact of export product, sector and destination concentration is reflected in t_{ij} in (1.14),

$$\left({x_{ij}}/{T_j T_i} \right) = T_W \left({t_{ij}}/{P_j P_i} \right)^{1-\sigma} . \tag{1.14}$$

Standard Herfindahl indices are employed to measure trade concentration. Given a group divided into *n* categories, the share of each of the *n* categories with respect to the group is squared, and the Herfindahl index results from the sum of the squared shares. Hence, the index varies between 0 (highly diversified) and 1 (highly concentrated). More formally:

$$H = \sum_{k=1}^{n} s_k^2 \tag{1.15}$$

where s_k is the share of the category with respect to the group. Of interest are three Herfindahl indices: the Herfindahl-product, the Herfindahl-destination and the Herfindahl-intra-industry-product indices. They are all time-varying and correspond to different aggregations of group-categories. The Herfindahl-product index considers the share of the value of each two digit level product exports with respect to all exports for one particular exporter-country and period. The Herfindahl-destination index considers the share of exports to one country relative to total exports for an exporter and period. Finally, the Herfindahl-intra-industry-product index is a more disaggregated version of the Herfindahl-product index: it takes into account the share of value of each four digit level product exports with respect to the overall value of the two digit level product exports for one particular country, period and two digit level exports. For example, the Herfindahl-intra-industry-product index for India, in the second quarter of 2007, for two digit level industry 50 (silk) results from the shares of four digit level products 5001 (silkworm cocoons suitable for reeling), 5002 (raw silk (not thrown)),…, and 5007(woven fabrics of silk or silk waste). Denoting each index by H_{it} yields:

$$H_{it}^{prod} = \sum_{k=1}^{99} [HS2\_value_k^{it}]^2 \tag{1.16}$$

$$H_{it}^{dest} = \sum_{j=1}^{16} [value_j^{it}]^2 \tag{1.17}$$

$$H_{ikt}^{intra-industry} = \sum_{m=1}^{N_k} [HS4_{valuem}^{ikt}]^2 \tag{1.18}$$

Where i is the exporter, j the importer, k the two digit level HS product, m the four digit level HS product and t the period.
$HS2\_value_k^{it}$ is the total exports value of two digit level industry k in country i in period $t. value_j^{it}$ is th is the total exports value of four digit level product m (that is a product included in the 2-digit level industry k) from country i in period t. In particular, note that m varies from 1 to N_k, where N_k is the number of four digit level products in the two digit level industry m.

Taking the log of both sides of equation (1.14) yields the baseline estimation, where the log of the distance between trading partners
(lnd_{ij}), the log of the ratio of exports from country i to j to their GDPs (ln $\left(\frac{x_{ij}}{y_i y_j}\right)$) and the "multilateral resistance" terms of country i (lnP_i) and country j (lnP_j)
are shown:

$$\ln\left(\frac{x_{ij}}{y_i y_j}\right) = \alpha + lnd_{ij} + lnP_i + lnP_j + \varepsilon_{ij} \qquad (1.19)$$

Commodity prices
ln $\left(commodity_{prices_t}\right)$), time fixed effects, and changes in the nominal exchange rate (ln $\left(\frac{\mathrm{FX_{it}}}{\mathrm{FX_{jt}}}\right)$) are included in the estimation to control for macroeconomic effects. Country fixed effects capture the "multilateral resistance" terms (lnP_i and lnP_j), which reflect the geometric average of the trading patterns' and world-wide trade costs, and are assumed to be broadly unchanging at the quarterly frequency. Two digit level industry fixed effects are also included, and crisis dummies are interacted with the trade diversification measures (the Herfindahl indices, H_{it}) to capture the impact of the crisis;

$$\ln\left(\frac{x_{ijkt}}{y_{it} y_{jt}}\right) = \alpha + lnd_{ij} + \ln\left(\frac{\mathrm{FX_{it}}}{\mathrm{FX_{jt}}}\right) + \ln\left(commodity\_prices_t\right) + H_{it}^{prod} + H_{it}^{dest} \ldots$$
$$\ldots + H_{it}^{prod} * dummy\_crisis_t + H_{it}^{dest} * dummy\_crisis_t + fixed\ effects + \varepsilon_{ijkt} \qquad (1.20)$$

Finally, the impact of intra-industry trade diversification (of four digit level products within two digit level industry) is captured with analogous equation:

$$\ln\left(\frac{x_{ijkt}}{y_{it} y_{jt}}\right) = \alpha + lnd_{ij} + \ln\left(\frac{\mathrm{FX_{it}}}{\mathrm{FX_{jt}}}\right) + \ln\left(commodity\_prices_t\right) + \ldots$$
$$\ldots + H_{ikt}^{intra-industry} + H_{it}^{dest} + H_{ikt}^{intra-industry} * dummy\_crisis_t + \ldots \qquad (1.21)$$
$$\ldots + H_{it}^{dest} * dummy\_crisis_t + dummy\_crisis_t + fixed\ effects + \varepsilon_{ijkt}$$

III. Summary Statistics and Estimation

A. Data Description

The data employed reflect the four digits Harmonized System (HS) of classifying exports and imports. Each observation records the quarterly value of exports or imports, the reporting country (exporter or importer), the partner country (importer or exporter) and the commodity code at the 4-digit level HS classification. The HS schedule classifies trade into 1,638 different commodity codes, the month and the value of transaction. For example, the database may report an export transaction of commodity 3402 (organic surf-act agents, preps & cleaning preps) from India to Brazil in February 2009. The reporting countries or regions used in this study are: Argentina, Australia, Brazil, Canada, China, European Union, India, Indonesia, Japan, Mexico, Russia, South Africa, South Korea, Turkey, United Kingdom and United States. Taken together, those countries represent over 90 percent of total world trade. The breath of trading partners of these reporting countries allows a high degree of coverage of global trade.

Reversing the reporting countries' exports and imports data yields a fairly comprehensive monthly panel bilateral database at the four digit level.[8] For example, although Bolivia is not a reporting country, its trade with the rest of the world is captured through its trade to the reporting countries. The database spans January 1990 to August 2010 and in total has more than 140 million observations (58,964,412 in imports and 81,427,050 in exports) and, of which, the Latin American subsample comprises a total of 538,935 observations.

The regressions are based on exports from Latin American countries to any of the sixteen reporting countries or regions in the world from the first quarter of 2000 until the last quarter of 2009, at the two-digit level HS classification. Restricting the analysis to the exports of this region lowers the risk that the estimated impact from trade concentration is biased because of omission of latent country or intra-regional differences, due to the relative homogeneity of its countries. While trade data are available at the monthly frequency, aggregating the data quarterly removes noise and allows the use of GDP data. Trade data prior to 2000, as well as for certain countries, are excluded as they are not consistently documented. The countries analyzed are Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Ecuador, Guatemala, Mexico, Panama, Paraguay, Peru, Uruguay and Venezuela.

B. Trade Collapse and Summary Statistics

Total aggregate exports from Latin America peaked in the third quarter of 2008 and bottomed out in the first quarter of 2009. Hence, the crisis period is defined as the fourth quarter of 2008 and the first quarter of 2009,[9] and the "*trade collapse*" measure used below is defined as the ratio of dollar value of exports between the first quarter of 2009 and third quarter of 2008. The *trade collapse* is intended to reflect the fall in exports related to the global financial crisis.

Table 1 shows the median value of the product and trading partner export diversification index by country, over the ten year period. The sample countries present very different levels of trade concentration; for example, Venezuela displays the highest degree of concentration by product, while Brazil is the more diversified economy in terms of products. For concentration by destination, Mexico, a member of NAFTA, shows the more concentrated

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[8] For instance, an export observation of shoes from Brazil to Ecuador in March 2003 would become an Ecuadorian import observation of shoes from Brazil in March 2003.

[9] This broadly homogeneous crisis period across countries, specific to Latin America, is one of the reasons regressions are restricted to that continent.

index, while Chile is the most diversified. The table also shows the trade collapse (the ratio of exports in the first quarter of 2009 to exports in the third quarter of 2008). The trade collapse was milder in Guatemala, where exports fell by 28 percent in this period, while Venezuela observed a 67 percent decline in exports.

Figure 1 graphs the trade collapse against the two-quarters-lagged Herfindahl product index. [10] The figure shows a negative relationship between product diversity and the size of the reduction in trade (i.e. the higher the concentration by product, the more severe the trade collapse). Figure 2 shows the analogous graph with the two-quarter lagged Herfindahl-trading partner index, and no statistically significant linear relationship emerges, nor is there an evident pattern in the graph. Hence, the anecdotal evidence favors product diversity as a factor in explaining the trade collapse over trading partner diversity. Figure 3 shows the analogous graph for intra-industry trade concentration. In the figure, the diverse industries of the economies are grouped together, and a significant linear relationship is found. Hence, this suggests that countries that concentrate exports on specific products or subsectors of a given set of export industries suffered a larger trade collapse than those that diversify products within export industries.

C. Results

The empirical forms of equation (1.14), given in equations (1.20) and (1.21) are estimated via pooled panel regression with the natural log of bilateral trade (exports values) normalized by GDP between the Latin American exporters and their trading partners as the dependent variable. The explanatory variables of interest are the two-quarters lagged Herfindahl index by product interacted with the crisis dummy and the two-quarters lagged Herfindahl index by trading partner interacted with the crisis dummy. Control variables in the regression include the natural log of the bilateral distance between exporter and destination countries; the two-quarters lagged Herfindahl index by product and by trading partner, the natural log of global commodity prices; the natural log of the bilateral nominal exchange rate between the exporter and destination countries; fixed effects for time, exporter-country, industry-level (at the two digit level of the Harmonized System), and destination-country. The Herfindahl index by product varies between 0 (highly diversified) and 1 (highly concentrated), and a marginal change in the index is interpreted as an increase of 0.1, which is the standard deviation of the regional product diversity indices in Table 1 excluding Venezuela. For comparison, the United States Department of Justice considers an industry with 0.1 Herfindahl index to be sufficiently concentrated to warrant surveillance of its industrial organization; transactions that increase the index by more than .01 in such markets raise antitrust concerns.

Table 2 (relating to equation (1.20)) shows the estimated impact of product diversification and trading partner diversification during the crisis. The estimated coefficient for product diversity suggests that a marginal increase of 0.1 in the export diversification Herfindahl index of a country's products prior to the crisis (increases imply greater concentration) would

[10] The Herfindahl indices are stable over the historical period considered here.

have experienced between 3.1 percent and 4.7 percent greater decline in exports during the crisis. In terms of economic significance, the results suggest that if a country such as Guatemala with a concentration index of 0.15 were as diversified as Brazil, with a concentration index of 0.05, then (holding the GDPs of both countries constant during the crisis) the level of bilateral export flows from Guatemala would have been 4.7 percent higher than actually observed. Consistent with the earlier anecdotal evidence, trading partner diversification is not statistically significant, and the estimated coefficient is small and positive.

Table 3 (relating to equation (1.21)) estimates the impact of intra-industry product diversification, which exploits the granularity of the industry-level data. Hence, the estimates reflect a different Herfindahl-intra-industry-product index per exporter and industry at the two-digit level HS classification and quarter. These industry-level results confirm the prior country-level results. The estimated impact of increased concentration is negative and statistically significant and very close to the coefficient in Table 2. An increase in the intra-industry product concentration would lead to a greater decline in exports between 3.6 percent and 4.7 percent. A significant (compared with Table 2) result is found for the impact of destination concentration on exports, which indicates that having had a more diversified destination of exports might have decreased total export growth during the crisis. While this result suggests concentrating exports on fewer trading partners is beneficial during the crisis, it could reflect the idiosyncratic region-wide proximity to the United States. Rose and Spiegel (2011), finds evidence that such proximity was at least not detrimental to crisis outcomes.

IV. Types of Export Products: The Role of Commodities vs. Manufactures

This section considers how concentration in certain types of products affected exports during the crisis. It seeks to identify the type of export product, manufactured or commodity goods, that attenuated the impact of the trade collapse for Latin American countries. Figure 4 shows the difference in trade shares before and after the crisis for the top five largest increasing and decreasing export categories during the crisis (based on the HS industry classification) for Mexico and Brazil. For both Brazil and Mexico, the biggest increases in shares are largely in commodity exports, while the sharpest decreases are in manufactured goods. Hence, the figure could be interpreted to suggest that commodity exports prevented a more profound trade collapse.[11]

To measure the product specific impact on exports, equation (1.20) is modified by interacting products with concentration variables.

[11] More study is warranted in this area. For example, relative productivity across sectors in each country may have also played an important role, i.e. these countries may both be relatively more productive in exporting commodities rather than manufactured items, and hence, the latter declined.

$$\ln\left(\frac{x_{ijkt}}{y_{it}y_{jt}}\right) = \alpha + lnd_{ij} + ln\frac{FX_{it}}{FX_{jt}} + \ln\left(commprices_t\right) + H_{it}^{prod} + H_{it}^{dest} + H_{it}^{prod} * crisis_t + \ldots$$
$$\ldots + H_{it}^{dest} * crisis_t + H_{it}^{prod} * I_k + H_{it}^{dest} * I_k + H_{it}^{prod} * crisis_t * I_k + H_{it}^{dest} * crisis_t * I_k + \varepsilon_{ijkt} \quad (1.22)$$

The product concentration interacted with crisis dummy interacted with product dummy coefficients ($H_{it}^{prod}*crisis_t*I_k$) reflects the impact of concentrating trade on one industry or product during the crisis. Given that the product concentration interacted with crisis dummy ($H_{it}^{prod}*crisis_t$) coefficient is negative in the prior regressions, a positive coefficient for the former one would indicate that product *k* helped to attenuate the trade collapse during the crisis. Figure 5 shows the ten largest and ten smallest estimated product coefficients. The figure shows mostly commodity products for the ten largest coefficients and mostly manufactured goods for the ten smallest ones. Note that the empirical results found are net of changes in commodity prices as (1.22) controls for these, which dropped significantly during the crisis. This result is cautiously interpreted as suggesting that concentration in commodities in this crisis helped to smooth the export collapse for Latin American countries, at least in terms of export volume.

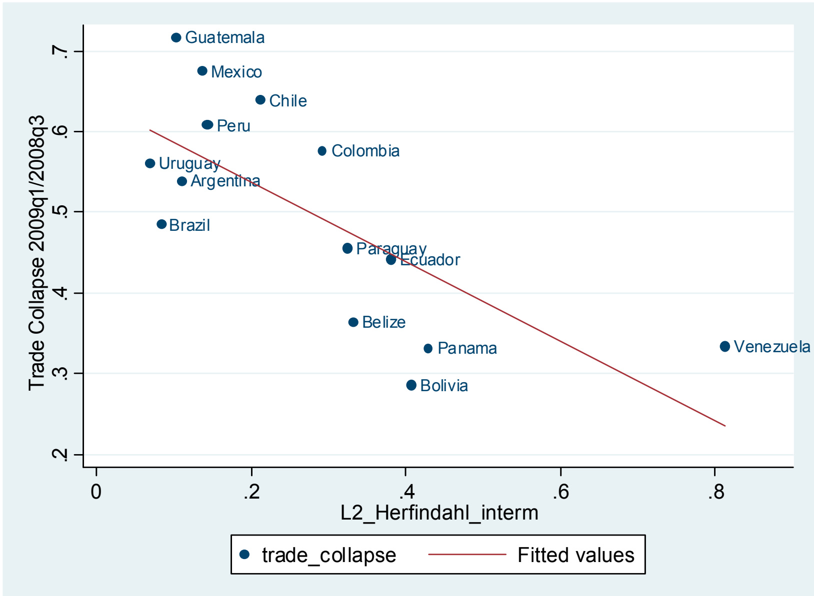
V. CONCLUSIONS

This study investigates how export industry, destination and product concentration influenced the export performance of Latin American countries during the financial crisis of 2008-09. A simple equilibrium model of trade is presented to structure the empirical analysis, in which export diversification enters in as a transaction cost. To estimate the impact of having greater trade diversification, the study employs a trade dataset disaggregated at the four digit level of the Harmonized System of classifying trade. The results presented suggest that product diversification attenuated the trade collapse. Weaker evidence is found that trading partner concentration helps trade performance, and there are several important caveats that warrant more work in this area. A natural extension, for example, would be to study whether these results hold for other regions.

In addition, preliminary evidence – which controls for changes in commodity prices during the crisis – is presented suggesting that concentration in commodities helped smooth the collapse in exports. Hence commodity exports may be less cyclical than other sectors, at least in terms of volumes, if not total export revenues. A more detailed analysis on how and why commodities helped smooth the trade collapse and what factors are driving this result is warranted, including, for example, the relative productivity across sectors and identifying the role of demand and supply shocks during the crisis.

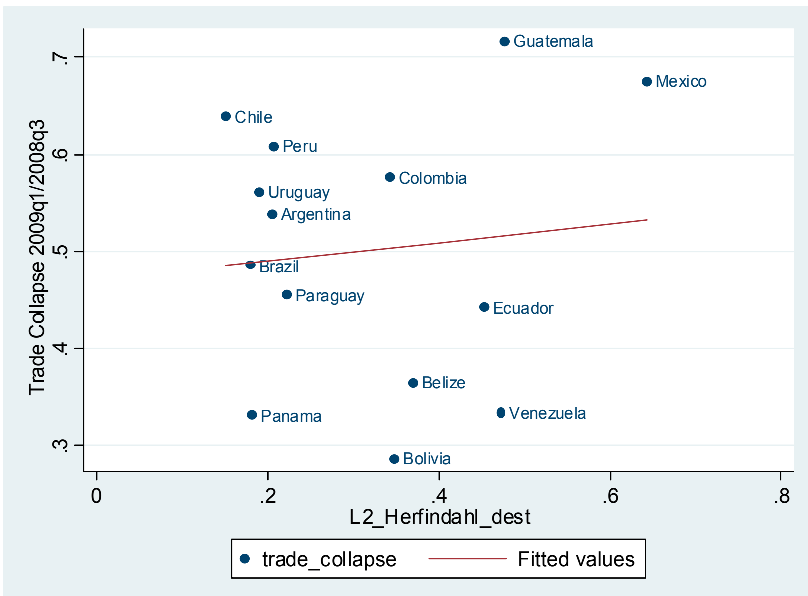
FIGURES

Figure 1. Product Diversification and Trade Collapse in Latin America



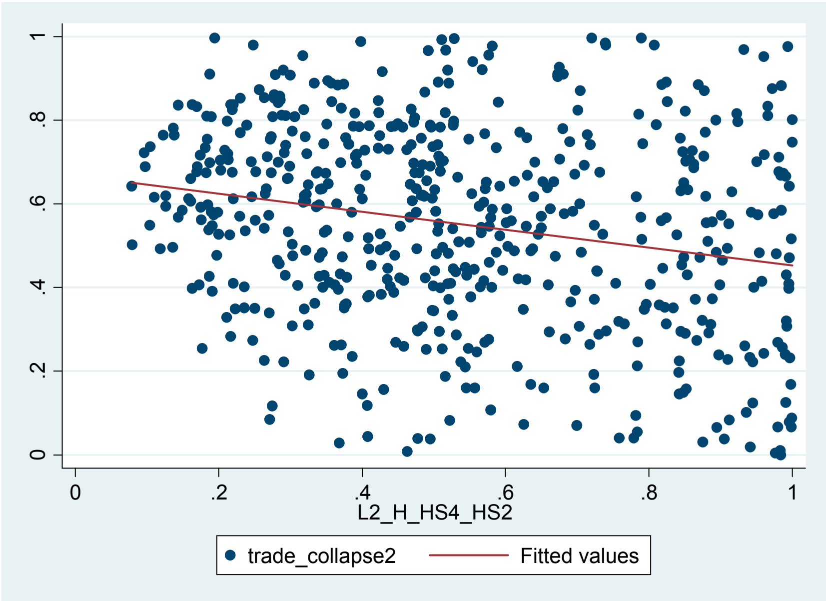
Source: GTS, Authors' estimates.
Note: Trade collapse between first quarter of 2009 and third quarter of 2008 as a function of the Herfindahl index by product at the third quarter of 2008.

Figure 2. Trading Partner Diversification and Trade Collapse in Latin America



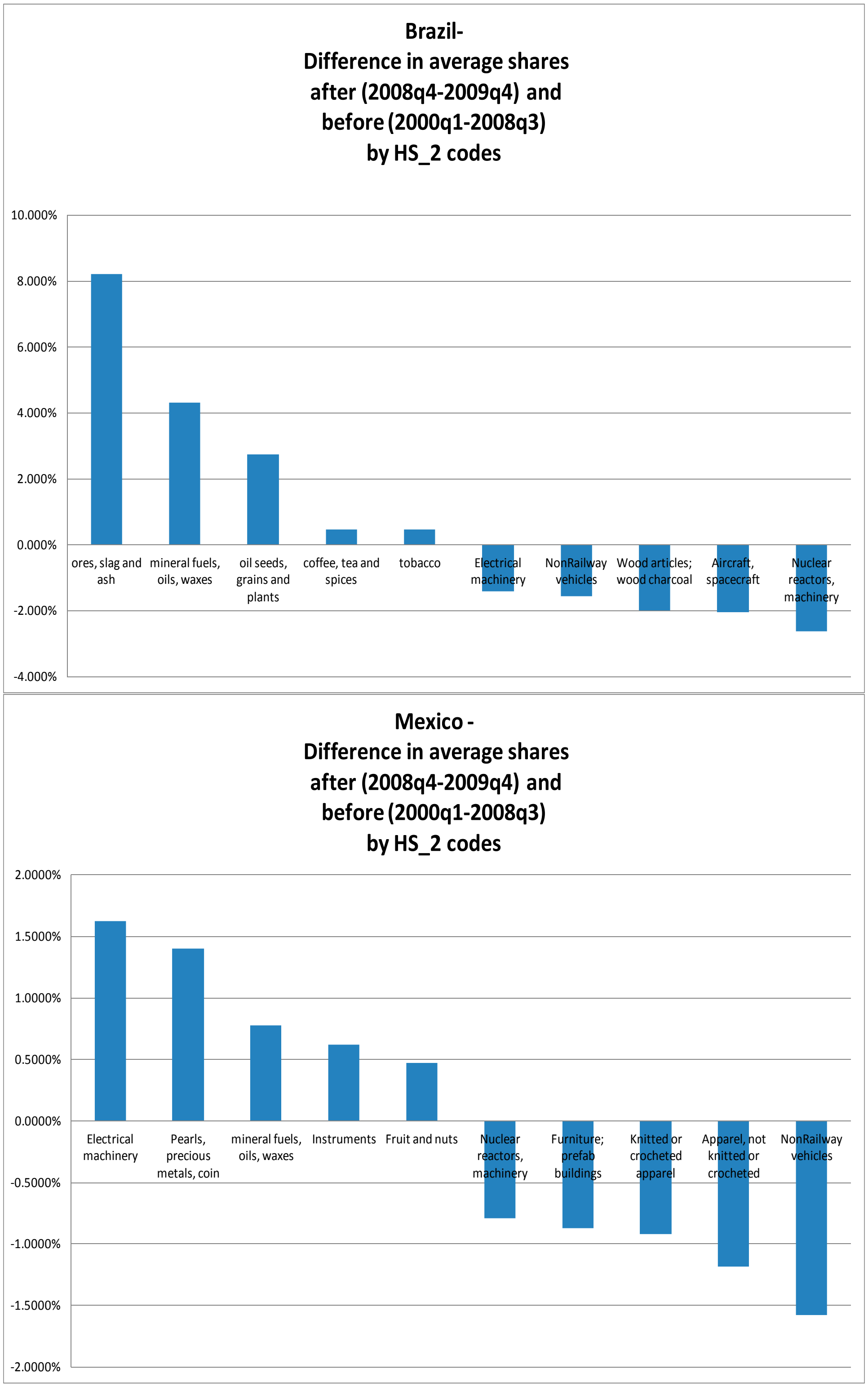
Source: GTS, Authors' estimates.
Note: Trade collapse between first quarter of 2009 and third quarter of 2008 as a function of the Herfindahl index by destination at the third quarter of 2008.

Figure 3. Trade Collapse and Intra-Industry Trade Concentration



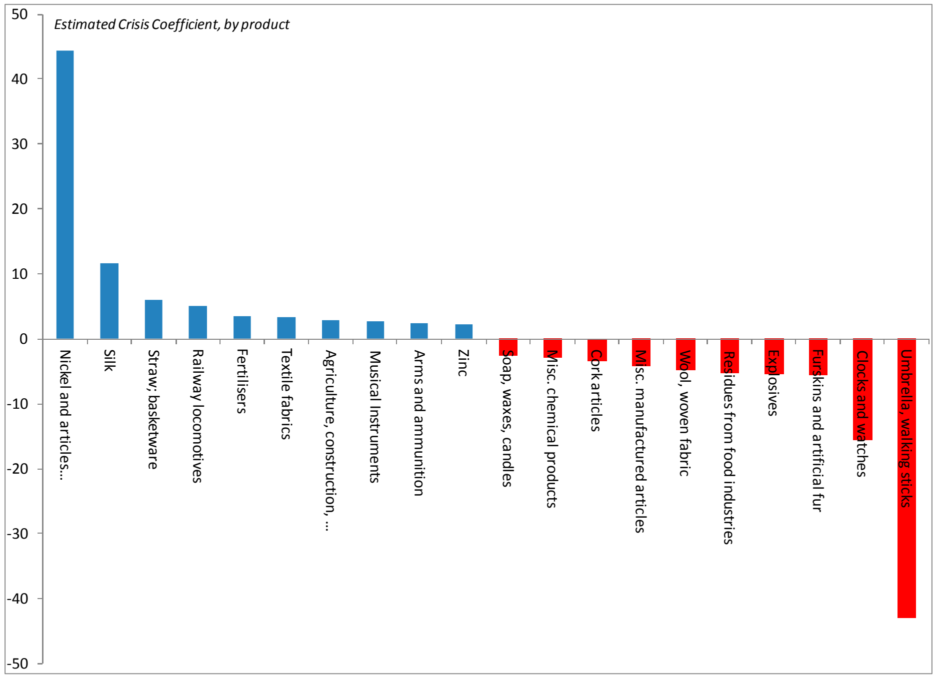
Source: GTS, Authors' estimates.
Note. Trade collapse is the ratio between the total exports at the 2-digit level industry of the exporter-country at the first quarter of 2009 and third quarter of 2008; All exporter countries for Latin America that are included in the regressions presented. The fitted line is the fit of a regression of the trade collapse as explained above on the Herfindahl intra-industry index by product. The estimated coefficient is significant at all conventional significance levels and equal to -0.215, i.e., an increase of 0.01 in the Herfindahl index would result in a fall of 2.15 percentage points in exports between the first quarter of 2009 and third quarter of 2008. For comparison, the US Justice Department considers an industry with 0.1 Herfindahl index to be sufficiently concentrated to warrant surveillance of the industry's organization, and transactions that increase the index by more than .01 in such markets raise antitrust concerns.

Figure 4. Mexico and Brazil: Impact of the Crisis by Product Code



Source: GTS, Authors' estimates.
Note: Trade change in the average share of trade following the trade collapse between first quarter of 2009 and third quarter of 2008 is shown by product for Mexico and Brazil.

Figure 5. The Impact on Exports by Product



Source: Author's estimates

Note: This figure shows the 10 largest and 10 smallest product coefficients of the section IV. Types of Export Products. A positive coefficient indicates that a higher concentration in this product help attenuated the trade collapse during the crisis.

TABLES

Table 1. Herfindahl Indices and Trade Collapse by Country

Exporter	median Herfindahl product	median Herfindahl destination	Trade Collapse (2009q1/2008q3)
Argentina	0.07	0.20	0.54
Belize	0.27	0.32	0.36
Bolivia	0.34	0.31	0.29
Brazil	0.05	0.19	0.48
Chile	0.17	0.17	0.64
Colombia	0.25	0.38	0.58
Ecuador	0.24	0.36	0.44
Guatemala	0.15	0.54	0.72
Mexico	0.13	0.71	0.68
Panama	0.25	0.33	0.33
Paraguay	0.21	0.28	0.46
Peru	0.16	0.21	0.61
Uruguay	0.07	0.18	0.56
Venezuela	0.74	0.57	0.33
Mean	*0.22*	*0.34*	*0.50*
Median	*0.19*	*0.31*	*0.51*
Std Dev.	*0.17*	*0.17*	*0.14*

Source: GTS, Authors' estimates.
Note: The table compares the Herfindahl indexes for product and trading partner diversification and the collapse in trade in the first quarter of 2009.

Table 2. Estimates of Bilateral Trade on Trade Concentration

	(1)	(2)	(3)
	Ln(Bilateral Trade by 2-digit level industry/GDP Exporter*GDP Destination)		
Ln(distance)	-0.606***	-0.605***	-0.605***
2 period lagged Herfindal-product index * dummy crisis	**-0.314****	**-0.419*****	**-0.472*****
2 period lagged Herfindal-destination index * dummy crisis	0.159**	0.096	0.100*
2 period lagged Herfindal-destination index	-0.861***	-0.931***	-0.793***
2 period lagged Herfindal-product index	0.005	-0.246*	-0.240*
Ln(global commodity prices)			-0.120***
Ln(bilateral nominal exchange rate exporter/destination countries)		-0.084***	-0.055***
Constant	-2.077***	-2.194***	-1.548***
	(0.157)	(0.157)	(0.188)
N	516727	522060	522060
R^2	0.877	0.878	0.878
Time fixed effects	YES	YES	NO
Exporter-country fixed effects	YES	YES	YES
Industry-level fixed effects	YES	YES	YES
Destination-country fixed effects	YES	YES	YES

Source: Global Trade Atlas and International Financial Statistics

Note: The estimates above are the results of a pooled panel regression whose dependant variable is the natural log of bilateral trade (exports values), normalized by GDP data, between one Latin American Exporter and one of its trade partners (whether in Latin America or not). The data is quarterly, from the first quarter of 2000 until the last quarter of 2009; The main explanatory variable is the 2 quarters lagged Herfindahl index by product interacted with the crisis dummy (periods for the crisis dummy: fourth quarter of 2008 and first quarter of 2009). The other explanatory variables are: 1) natural log of distance between exporter and destination countries; 2) 2 quarters lagged Herfindahl index by destination interacted with the crisis dummy; 3) 2 quarters lagged Herfindahl index by destination; 4) 2 quarters lagged Herfindahl index by product; The controls variables are: 1) natural log of global commodity prices; 2) natural log of the bilateral nominal exchange rate between the exporter and destination countries; The fixed effects are: 1) time; 2) exporter-country; 3) industry-level (at the 2-digit level of the Harmonized System); 4) destination-country; Herfindahl index by product varies between 0 (highly diversified) and 1 (highly concentrated): for each exporter-country and period, we compute the sum of the square of the shares of each 2-digit level exports (where shares are with respect to all exports); Herfindahl index by destination varies between 0 (highly diversified) and 1 (highly concentrated): for each exporter-country and period, we compute the sum of the square of the shares of each exports destination-country (where shares are with respect to all exports); Exporter-countries in this sample are: Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay and Venezuela; * significant at 10%; ** significant at 5%; *** significant at 1%; standard errors are robust to general forms of serial correlation and heteroskedasticity.

Table 3. Estimates of Bilateral Trade on Intra-Industry Concentration

	(1)	(2)	(3)	(4)
	Ln(Bilateral Trade by 2-digit level industry/GDP Exporter*GDP Destination)			
Ln(distance)	-0.734***	-0.737***	-0.651***	-0.653***
2 period lagged Herfindal-intra-industry-product index * dummy cri	**-0.387*** **	**-0.361** **	**-0.477*** **	**-0.469*** **
2 period lagged Herfindal-destination index * dummy crisis	1.755***	1.885***	1.552***	1.598***
2 period lagged Herfindal-destination index	10.515***	10.415***	10.708***	10.700***
2 period lagged Herfindal-intra-industry-product index	1.266***	1.249***	1.064***	1.062***
Dummy_crisis		-0.216*		-0.134
Ln(bilateral nominal exchange rate exporter/destination countries)			-0.404***	-0.403***
Ln(global commodity prices)				0.720***
Constant	-4.066***	-3.685***	-5.774***	-9.545***
N	159859	159859	159859	159859
R^2	0.825	0.825	0.609	0.608
Time fixed effects	YES	NO	YES	NO
Exporter-country fixed effects	NO	NO	NO	NO
Destination-country fixed effects	NO	YES	YES	YES

Source: Global Trade Atlas and International Financial Statistics

Note: The estimates above are the results of a pooled panel regression whose dependant variable is the natural log of bilateral trade (exports values) by 2-digit level industry, normalized by GDP data, between one Latin American Exporters and one of its trade partners (whether in Latin America or not). The data is quarterly, from the first quarter of 2000 until the last quarter of 2009; The main explanatory variable is the 2 quarters lagged Herfindahl intra-industry index by product interacted with the crisis dummy (periods for the crisis dummy: fourth quarter of 2008 and first quarter of 2009). The other explanatory variables are: 1) natural log of distance between exporter and destination countries;2) 2 quarters lagged Herfindahl index by destination interacted with the crisis dummy; 3) 2 quarters lagged Herfindahl index by destination; 4) 2 quarters lagged Herfindahl intra-industry index by product ; The controls variables are: 1) natural log of global commodity prices; 2) natural log of the bilateral nominal exchange rate between the exporter and destination countries; The fixed effects are: 1) time; 2) exporter-country; 4) destination-country; Herfindahl intra-industry index by product varies between 0 (highly diversified) and 1 (highly concentrated): for each exporter-country, industry and period, we compute the sum of the square of the shares of each 4-digit level exports (where shares are with respect to all exports at the 2-digit level industry); Herfindahl index by destination varies between 0 (highly diversified) and 1 (highly concentrated): for each exporter-country and period, we compute the sum of the square of the shares of each exports destination-country(where shares are with respect to all exports); Exporter-countries in this sample are: Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay and Venezuela; * significant at 10%; ** significant at 5%; *** significant at 1%; standard errors are robust to general forms of serial correlation and heteroskedasticity.

APPENDIX – INTRA-INDUSTRY MEASURES OF CONCENTRATION

In comparing a country with mostly IT industry exports to a second country with exports widely distributed across the IT, car and commodity industries, the second country would show a lower level of concentration, no matter the concentration of each of those industries in the second country. Nevertheless, the role of product concentration on the export flows during crises could also be related to the intra-industry concentration, and is not captured by the estimations in Table 2.

The intra-industry results reported in Table 3 are based on Herfindahl indices constructed to reflect the level of concentration of export of each country within each product category (at the HS two digit level, with a total of 99 categories). Hence, Table 3 employs a concentration index that captures how each one of the 99 two-level HS industry categories is concentrated among the 1,638 four-level HS product categories. From the prior example, one could consider if the first country, which is very concentrated in the IT industry as a whole, shows instead a high level of diversification within the IT industry, while the second country presents a high level of concentration within each of its 3 industries. The intra-industry Herfindahl indices used in Table 3 would show the opposite results, i.e. the first country would show a higher level of product diversification.

The results do not qualitatively change across the two specifications, industry and intra-industry concentrations. Nevertheless, further evidence is presented below analysis to confirm the intra-industry concentration is appropriate for this study. Nevertheless, intra-industry Herfindahl could be influenced by the natural structure of each industry/sector. For example, one two digit level industry could have two or three sub-categories at the four digit level whereas another two digit level industry may have ten or more four digit level sub-categories because of the 'natural structure' of each industry. The first case could then be associated with a higher Herfindahl index than the second. Nevertheless, Appendix Figure shows that most of the two digit level industries have one dominant four digit level product for each country-period. Moreover, in
Appendix Figure shows a simulated Herfindahl index by number of categories and industry structure. It suggests that for industries in which the main product generally represents more than 50 percent of the industry market, the number of categories is not an important factor determining the Herfindahl index. Hence, the choice of granularity of the measure of intra-industry concentration employed in this paper is unlikely to drive the results.

Appendix Figure 1. Median of the Maximum Product Share by Industry

HS_2	Median	HS_2	Median	HS_2	Median	HS_2	Median
0	1.00	25	0.80	50	1.00	75	0.61
1	1.00	26	0.86	51	0.62	76	0.80
2	0.59	27	0.92	52	0.68	78	1.00
3	0.66	28	0.51	53	0.98	79	0.93
4	0.64	29	0.52	54	0.78	80	0.97
5	0.78	30	0.85	55	0.64	81	0.58
6	0.81	31	0.85	56	0.89	82	0.70
7	0.65	32	0.54	57	0.85	83	0.71
8	0.78	33	0.67	58	0.73	84	0.48
9	0.98	34	0.76	59	0.79	85	0.57
10	0.93	35	0.65	60	0.71	86	1.00
11	0.82	36	0.63	61	0.41	87	0.91
12	0.91	37	0.70	62	0.46	88	1.00
13	1.00	38	0.71	63	0.77	89	1.00
14	1.00	39	0.43	64	0.76	90	0.56
15	0.81	40	0.86	65	0.77	91	0.79
16	0.92	41	0.73	66	0.74	92	0.59
17	0.94	42	0.79	67	0.99	93	0.68
18	0.98	43	0.73	68	0.73	94	0.76
19	0.81	44	0.51	69	0.70	95	0.64
20	0.68	45	1.00	70	0.64	96	0.82
21	0.77	46	1.00	71	0.77	97	0.78
22	0.88	47	1.00	72	0.88	98	0.97
23	0.96	48	0.51	73	0.68	99	0.81
24	0.99	49	0.73	74	1.00		

Source: GTS, Authors' estimates.
Note: the table shows median weight of the most important 4-digit category across countries for each 2-digit industry, and reveals a dominant product for most industries.

Appendix Figure 2. Simulated Herfindahl Index by Categories and Industry Structure

		Herfindahl Index								
Categories	Equally Shared	90:10	80:20	70:30	60:40	50:50	40:60	30:70	20:80	10:90
1	1.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2	0.50	0.82	0.68	0.58	0.52	0.50	0.52	0.58	0.68	0.82
3	0.33	0.82	0.66	0.54	0.44	0.38	0.34	0.34	0.36	0.42
4	0.25	0.81	0.65	0.52	0.41	0.33	0.28	0.25	0.25	0.28
5	0.20	0.81	0.65	0.51	0.40	0.31	0.25	0.21	0.20	0.21
6	0.17	0.81	0.65	0.51	0.39	0.30	0.23	0.19	0.17	0.17
7	0.14	0.81	0.65	0.51	0.39	0.29	0.22	0.17	0.15	0.15
8	0.13	0.81	0.65	0.50	0.38	0.29	0.21	0.16	0.13	0.13
9	0.11	0.81	0.65	0.50	0.38	0.28	0.21	0.15	0.12	0.11
10	0.10	0.81	0.64	0.50	0.38	0.28	0.20	0.14	0.11	0.10
15	0.07	0.81	0.64	0.50	0.37	0.27	0.19	0.13	0.09	0.07
20	0.05	0.81	0.64	0.49	0.37	0.26	0.18	0.12	0.07	0.05
25	0.04	0.81	0.64	0.49	0.37	0.26	0.18	0.11	0.07	0.04
30	0.03	0.81	0.64	0.49	0.37	0.26	0.17	0.11	0.06	0.04

Source: GTS, Authors' estimates.
Note: the table a simulated 2-digit Herfindahl index with varying the number of 4-digit sub-products (rows) and the weight of the most important product (columns) and suggests that above fifty percent weight, the index is robust to the changing number of 4-digit sub-products.

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