Bilateral Trade Flows and Income-Distribution Similarity

By

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Abstract

This paper proposes three new measures of income-distribution similarity. The new measures are used to evaluate the effect of demand overlaps on bilateral trade flows in the context of the gravity model of trade. National income distributions will be used to calculate the income similarity indices that measure how much each country pair overlaps in terms of their income distribution and population. A higher demand overlap will imply a more similar demand structure and therefore more trade. The implications are different for different types of goods. With these new income-distribution similarity indices we aim to test some of the predictions made in recently developed models concerning bilateral trade and also inter and intra-industry trade.

JEL classification: F10, F14, D31

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Introduction

During the last decades, the role of income distribution has been a relatively neglected area in international economics. Even though consumer studies usually find consumer preferences non-homothetic, most trade theories assume that preferences are homothetic, giving a very small role to demand patterns as factors that explain international trade. Only recently, there seems to have been a surge in the literature. Specially, some attention has been directed to the role of within country distribution of income in trade models (Francois and Kaplan, 1996; Matsuyama, 2000; Mitra and Trindade, 2005).

In the empirical side, the traditional way of testing the effect of a similar demand structure on trade is by introducing the differences in average income per capita between countries as an additional explanatory factor of trade flows in a gravity model (Linder, 1961; Arnon and Weinblatt, 1998; Martinez-Zarzoso and Nowak-Lehmann D., 2004; Hallak, 2006).

The common way of testing the relationship between income differences and trade has been to let average per capita income be a proxy of demand (Hallak, 2009). Though, consumer studies clearly indicate that consumer demand changes with the level of income. If consumers change the proportion of which they consume certain goods as their income increases, this implies that aggregate demand is affected not only by the average level of income, but also by how income is distributed.

The increasing availability of income data in recent time makes possible to model the distribution of income within a country. The main aim of this paper is to calculate the overlapping income structure between two trading partners that could be considered as closely related to the demand structures in both countries. The method we propose is able to identify the market for which consumers have the same income levels in any two countries given the distribution of income within the respective country. Chul Choi, Hummels and Chiang (2009) used a similar method but their main focus is different since they study the link between cross-country differences in income distribution and variations in import variety and price distributions.

We assume that consumers change their consumption pattern as their income changes. Bertola, Foellmi and Zweimüller (2006) developed a framework for analyzing non-homothetic demand, which illustrates the assumptions behind our proposed method. We assume that the overlap between the respective density functions of income within each country could be considered as a proxy for the overlapping demand between trading partners.

According to Francois and Kaplan (1996) product categories that are more differentiated are likely to be more sensitive to differences in income distribution than homogeneous goods. Falvey and Kierzkowski (1987) and Flam and Helpman (1987) developed general equilibrium frameworks and concluded that overlapping income distributions generates intra-industry trade (IIT). The findings also suggest that income similarity increase trade for differentiated goods. Some authors divided products into different subgroups according to the definitions by Rauch (1999). This classification has been widely used in empirical studies using sectoral trade data such as Feenstra, Markusen and Rose (2001) and Tang (2006). Rauch (1999) divides internationally traded goods into three groups: Goods traded on organised exchanges, goods not traded on organised exchanges but possessing what this author calls reference prices and all other goods. Goods in the two first categories could be considered as homogeneous goods whereas those in the third one could be considered as differentiated goods. Differentiated goods that are more sophisticated and therefore tastes and familiarity between markets are more important for the exchange. Consequently, it could be expected that income similarities plays a more significant role in explaining trade of differentiated goods than in explaining trade of homogeneous goods. Instead, we decided to take advantage of the 3-digit level classification and do a separate analysis for 9 different 2-digit categories.

According to Dalgin, Trindade and Mitra (2008) a classification that distinguishes among necessities and luxuries would be desirable to study the relationship between income inequality and trade. They construct such a classification based on US household data for 2001. The classification is more appropriate for developed countries with similar income levels to the US. Since we use a sample of more than a hundred countries we decided to stick to the 2-digit categories.

We make four important contributions to the previous literature. First, we compute three new indices of income-distribution similarity for pair of countries than can be also used with other purposes. Second, we examine the effect of bilateral income-distribution similarities on bilateral trade flows using an augmented gravity model of trade and applying the most recent estimation techniques. Third, the model is also estimated for disaggregated trade data and for nine different categories of goods and for groups of countries in different stages of development. Finally, we also analyzed the effect of income-distribution similarities on intra and inter-industry trade. To our knowledge we are the first to examine empirically this relationship.

A summary of our results follows. Using the three distribution-based measures as a proxy for demand similarities in gravity models we find consistent and robust support for the hypothesis stating that countries with more similar income-distributions trade more to each other. The hypothesis is also confirmed at disaggregated level, both for homogenous and for differentiated product categories.

The outline of the paper is as follows. Section 2 discusses the theoretical framework. The methodology of calculating the income overlap between countries is presented in Section 3. Section 4 presents the empirical results followed by some conclusions and suggestions for further research in Section 5.

2. Theoretical Framework

For many years the theories of international trade focused on *supply side* factors as the main explanation for the causes of international trade. Most of this theories have been based on the assumption that tastes are homothetic and identical across countries, like for example the Heckscher-Ohlin framework. Although these assumptions were useful to simplify the modeling framework and to focus on the supply side based explanations for trade, both are inconsistent with the empirical evidence. Tastes cannot be considered identical for all consumers in a country (Hunter and Markusen, 1988; Hunter, 1991). Accepting this fact, both income distribution and income per capita should be considered as important *demand side* determinants of international trade flows.

An early exception to the main strand of theoretical models is the well-known Linder hypothesis (Burenstam Linder, 1961). He departs from traditional trade theory where *supply side* factors are the main determinant of trade. He considered that the traditional theories are not useful in explaining why countries would engage in both export and import of the same type of products and considers that demand for a product has to appear first in the producer country and then this product can be exporter to other countries that have similar demand structures.

A second strand of the theoretical literature that also considered *demand side* factors in models of international trade is based on imperfect competition and product differentiation models and on the fact that consumers love variety and their utility increases when they are able to import a higher number of varieties from abroad (Krugman, 1980; Helpman and Krugman, 1985). However, their explanation is not based on the intuition given by Linder (1961) -consumers with similar incomes consume similar goods- that could be a better candidate to explain why countries trade only a limited number of varieties.

More recently, Mitra and Trindade (2005) work out a theory that incorporates demand-side considerations in a systematic way, by focusing on the role of inequality in the determination of trade flows and patterns. They find that with non-homothetic preferences, when countries are similar in all respects but asset inequality, trade is driven by specialization in consumption, not production. They also find a V-shaped relationship between the ratio of inter-to intra-industry trade and country's inequality. This ratio turns out to be zero (all trade is intra-industry trade) when the tow countries' inequality levels are identical.

With respect to the related empirical literature, we find several studies that tried to test the Linder hypothesis, but mixed results have been found as summarized in McPherson, Redfearn and Tieslau (2000, 2001). In most cases a gravity framework was used and differences in income per capita is the variable selected to measure income similarities between trading pairs (Arnon and Weinblatt, 1988; Arad and Hirsch, 1981; Choi, 2002; Martínez-Zarzoso and Nowak-Lehmann, 2004; Choi, 2002; Hallak, 2009). Hallak (2009) focuses on product quality and shows that failure to confirming the Linder hypothesis in past studies could be due to aggregation bias. He finds support for the Linder hypothesis by testing product goods separately. The abovementioned studies consider the income distribution between countries. A few recent studies considered the within country distribution of income instead. Francois and Kaplan (1996), Chul Choi et al. (2009); Hunter (1991); Matsuyama (2000) and Mitra and Trindade (2005); Bohman and Nilsson (2007) are some of them.

The focus of this paper is on similarities of within country distribution of income between pairs of countries and their relationship with bilateral trade flows. Our main departure from the abovementioned studies is that we follow a different approach to calculate income-distribution similarities between countries. A numerical approximation is used that does not affect the preciseness of the results and differs from the "minimum integral" approach followed by some of the related works.

3. Income-distribution overlaps between countries

We propose three different measures of demand similarity for each pair of countries based on their income distributions. National income distributions are derived from two main data sources. Income data are drawn from the Penn World Tables 6.2 (Heston, Summers and Aten, 2006), which report the real GDP per capita in constant international dollars (chain series, base year 2000), available for most countries. However, for three particularly populous countries, namely Bangladesh, Russia and Ukraine we estimated the initially missing values[1]. Our second data source is the inequality dataset proposed by Grün and Klasen (2008) based on the WIDER database. Their adjusted Gini dataset is derived by using several estimation techniques and has substantive advantages in terms of comparability, overcoming the problems related to the raw Ginis available in the WIDER database, which are not fully comparable over time and across countries[2].

The national income distributions will be modeled by a log-normal distribution. Formally, the log-normal distribution LN(μ, σ) is defined as the distribution of the random variable Y = exp (X), where X ~ N(μ, σ) has a normal distribution with mean μ and standard deviation σ. It can be shown that the density of LN(μ, σ) is,

$$f(x;\mu,\sigma) = \frac{1}{x\sigma\sqrt{2\pi}} e^{-(\log(x)-\mu_i)^2 / 2\sigma^2}, \quad x > 0 \tag{1}$$

The Gini coefficient G of LN(μ, σ) is given by,

$$G = 2\Phi\left(\sigma/\sqrt{2}\right) - 1 \tag{2}$$

where Φ is the distribution function of the standard normal distribution. Therefore, the parameters μ and σ of LN(μ, σ) can be determined from the mean E(Y) and the Gini coefficient G as follows.

$$\sigma = \sqrt{2}\Phi^{-1}\left(\frac{G+1}{2}\right), \qquad \mu = \log(E(Y)) - \sigma^2/2 \tag{3}$$

[1] For Bangladesh we calculated the values for the two initial years 1970, 1971 using the average income per capita growth rate of the rest of the decade. For Russia and Ukraine we used the derived (Penn World Tables 5.6) USSR growth rates to estimate the average income for the years before 1990.

[2] As inequality does not change too dramatically over time, we assume the first real observation of the Gini in any given country to be equal to its initial level of inequality. Starting from this initial level we used a moving average to catch changes in trends of inequality. Unfortunately, there is no reliable inequality data for the populous Democratic Republic of Congo, hence we used the neighboring Central African Republics' Gini as a substitute.

Holzmann, Vollmer and Weisbrod (2007) provide a more detailed description of this methodology including a discussion of the log-normal distributions goodness of fit for income data.

The measures for the similarity of the demand structure ($DS1_{ij}$, $DS2_{ij}$ and $DS3_{ij}$) are now rather straightforward obtained by calculating the overlaps of the income distributions density functions. Figures 1 and 2 illustrate the different concepts for a given pair of countries and for the years 1970 and 2003. China and the U.S. have been selected for this example. Note that the figures focus on the part of the graph where the two densities overlap, an important part of China´s distribution is cut out for a better visibility of the overlap. Recall that each density function has area of one regardless of the countries size, the overlap of two density functions can therefore be interpreted as the overall similarity of the two populations. A numerically convenient (and easy to replicate) way to calculate this is to split the x-axis into very small intervals (say of length US$ 100) and to calculate the share of each countries population that falls into this interval with the log-normal distributions quantile function. The overlap then is the minimum of the two numbers for each particular interval, the overall overlap is the sum over all intervals[3].

The measure $DS1_{ij}$ can be interpreted as the overall similarity of the two countries populations. $DS1_{ij}$ is an index value that ranges from 0 to 1, it is symmetric (i.e. $DS1_{ij} = DS1_{ji}$). However, for trade not only the overall similarity of the demand structure is of importance but also the number of potential customers. Hence we propose two additional measures of demand similarity which takes this into account. Therefore we multiply each countries log-normal density by the respective populations; the areas are no longer equal to one for all countries but equal to each countries population (right graph in figures 1 and 2). For the calculation of $DS2_{ij}$ and $DS3_{ij}$ we proceed as before. Instead of comparing the share of each countries population that falls into a particular interval we now multiply this share by the countries population and take the minimum as the population weighted overlap. We name the sum over all intervals $DS2_{ij}$, it can be interpreted as the number of people which have a match in the other country in terms of income[4]. $DS2_{ij}$ is also symmetric (i.e. $DS2_{ij}=DS2_{ji}$). We define $DS3_{ij}$ as $DS2_{ij}$ divided by country *i*'s population. $DS3_{ij}$ can be interpreted as the percentage of country *i*'s population that has a match in country *j*'s in terms of income. $DS3_{ij}$ is an index, which value ranges from 0 to 1, and it is not symmetric.

[3] Another possibility would be to integrate the area under the curves, but this is inconvenient since log-normal densities can have either one or two intersections. Our numerical approximation does not affect the preciseness of the result, because the interval length is chosen small enough.

[4] We assume that every individual in country *i* can only have one match in country *j*.

Let us now briefly illustrate the three different measures using China and the United States. In 1970 both the overlap and the population weighted overlap of the two densities are virtually zero, for about 825,000 people a match is found in the other country's population. All the mass of the U.S. density is right of the Chinese density, this means that the top percentile in the Chinese income distribution in 1970 was approximately as well of as the bottom percentile in the United States. This picture changes over time, the simple overlap and the population-weighted overlap both increase drastically from 1985 to 1995 and again from 1995 to 2003. In 2003 the overlap of the two densities is 22 percent, this corresponds to 128,216,000 people that have a match in the other country. Only 10 percent of the Chinese population, but as much 44 percent of the U.S. population, has a match in the other country's population. This makes China an extremely important market for the United States these days.

4. Empirical strategy

4.1 Model specification

One of the main devices used to analyse the determinants of international trade flows is the gravity model of trade. Recently, some authors have referred to this model as the "workhorse" of empirical trade studies (Bayoumi and Eichengreen, 1997). A (traditional) gravity equation augmented with income distribution variables is specified and estimated for aggregate and for disaggregated data.

According to the generalized gravity model of trade, the volume of sectoral exports between pairs of countries X_{ijk} is a function of their incomes (GDPs), their incomes per capita, their geographical distance, a set of dummies and a measure of income-distribution similarity, as shown by the equation

$$X_{ijk} = \beta_0 \; Y_i^{\beta_1} Y_j^{\beta_2} YH_i^{\beta_3} YH_j^{\beta_4} DIST_{ij}^{\beta_5} F_{ij}^{\beta_6} IDI^{\beta_7} \; u_{ijk} , \qquad (4)$$

where Y_i (Y_j) indicates the GDPs of the exporter (importer), YH_i (YH_j) are exporter (importer) GDP per capita, $DIST_{ij}$ measures the distance between the two countries' capitals (or economic centers), and F_{ij} represents any other factors aiding or preventing trade between pairs of countries. u_{ijk} is the error term. IDI is one of the income-distribution indices derived in the previous section.

For estimation purposes, and with time dimension added, we first specify an augmented version of Model 4 in log-linear form which is given by:

$$\ln X_{ijkt} = \alpha_1 + \phi_{t1} + \chi_{i1} + \varphi_{j1} + \beta_{11} \ln Y_{it} + \beta_{21} \ln Y_{jt} + \beta_{31} \ln YH_{it} + \beta_{41} \ln YH_{jt} + \\ + \beta_{51} \ln DIST_{ij} + \beta_{61} com\_lang_{ij} + \beta_{71} border_{ij} + \beta_{81} IDI_{ijt} + \upsilon_{ijkt} \quad , \tag{5}$$

where ln denotes variables in natural logs, X_{ikjt} are product k exports from country i to country j in period t at current US$.

Y_{it}, Y_{jt} indicate the GDP of countries i and j, respectively, in period t at constant PPP US$.

YH_i and YH_{jt} denote the income per capita of countries i and j, respectively, in period t at constant PPP US$ per thousand inhabitants. $DIST_{ij}$ is the great-circle distance between countries i and j.

The model includes dummy variables for trading partners sharing a common language ($lang_{ij}$) and for pair of countries with a common border (adj_{ij}). ϕ_t are specific time effects that control for omitted variables that are common for all trade flows but vary over time. χ_i and φ_i are exporter and importer effects that proxy for multilateral resistance factors. υ_{ijkt} denotes the error term that is assumed to be well behaved.

A high level of income in the exporting country indicates a high level of production, which increases the availability of goods for export. Therefore, we expect β_1 to be positive. The coefficient of Y_j, β_{21}, is also expected to be positive since a high level of income in the importing country suggests higher imports. The coefficient estimate for income per capita of the exporters and the importers, β_{31} and β_{41}, may be negatively or positively signed, depending on the mix of commodities (supply) and the mix of goods demanded, which is different for each country. A higher income per capita in the exporter country could indicate higher capital-labor endowments and higher exports of capital-intensive goods (lower exports of labor-intnesive goods), whereas a higher income per capita in the importer country could indicate that the country will import more differentiated goods (less necessities).

We now consider, in second place, a modification to the previous specification that includes country-and-time effects to account for time-variant multilateral price terms, as proposed by Baldwin and Taglioni (2006) and Baier and Bergstrand (2007). As stated by Baldwin and Taglioni (2006), including time-varying country dummies should completely eliminate the bias stemming from the "gold-medal error" (the incorrect specification or omission of the terms that Anderson and van Wincoop (2003) called *multilateral trade resistance*). The main shortcoming of this approach is that it involves estimation of *2NT* (*N*=countries, *T*= years) dummies for unidirectional trade, in our case, (2X104*6) dummies. Nevertheless, within the panel, we have *2N (N-1)T* observations, and with *N* relatively large (104), there are still many degrees of freedom. The specification that accounts for the multilateral price terms in a panel data framework is given by

$$\ln X_{ijkt} = \alpha_2 - \ln P_{it}^{1-\sigma} - \ln P_{jt}^{1-\sigma} + \gamma_1 IDI_{ijt} + \gamma_2 com\_lang_{ijt} + \gamma_3 border + \varepsilon_{ijkt} \tag{6}$$

where $P_{it}^{1-\sigma}$ and $P_{jt}^{1-\sigma}$ are time-varying multilateral (price) resistance terms, that will be proxied with *2NT* country and time dummies and ε_{ijt} denotes the error term that is assumed to be well behaved. The other variables are the same as in Equation 5, above.

Finally, a third alternative specification is based on Helpman, Melitz and Rubinstein (2008). The authors developed a two-stage estimation procedure that uses a selection equation in the first stage and a trade-flow equation in the second. They showed that the traditional estimates are biased and that most of the bias is due to the omission of the extensive margin (number of exporters), rather than to selection into trade partners. As a robustness check, and in line with Helpman et al. (2008), we also estimate the proposed system of equations. The first equation specifies the log of bilateral exports from country i to country j as a function of standard variables (distance, common language, island), dyadic fixed effects, and a variable, $\omega_{ij,}$ that is an increasing function of the fraction of country i firms that export to country j. The second equation specifies a latent variable that is positive only if country i exports to country j. The resulting equations are

$$\ln X_{ijkt} = \alpha_3 + \omega_{ij} + \phi_{t3} + \chi_{i3} + \varphi_{j3} + \beta_{13} \ln Y_{it} + \beta_{23} \ln Y_{jt} + \beta_{33} \ln YH_{it} + \beta_{43} \ln YH_{jt} + \\ + \beta_{53} \ln DIST_{ij} + \beta_{73} border_{ij} + \beta_{83} IDI_{ijt} + \mu_{ijkt} \tag{7}$$

and

$$z_{ijkt} = \theta_0 + \zeta_t + \varsigma_i + \xi_j + \theta_1 \ln Y_{it} + \theta_2 \ln Y_{jt} + \theta_3 \ln YH_{it} + \theta_4 \ln YH_{jt} + \\ + \theta_5 \ln DIST_{ij} + \theta_6 com\_lang_{ij} + \theta_7 border_{ij} + \theta_8 IDI_{ijt} + \eta_{ijkt} \tag{8}$$

where ς_i are fixed effects of the exporting country, ξ_j are fixed effects of the importing country, and ϕ_{t3} and ζ_t denote time-specific effects. The new variable, $\omega_{ij,}$ is an inverse function of firm productivity. The error terms in both equations are assumed to be normally distributed: $\mu_{ijkt} \sim N(0,\sigma^2_\mu)$, $\eta_{ijkt}= (\mu_{ijkt}+ \nu_{ijkt}) \sim N(0, \sigma_\mu + \sigma_\nu)$. Clearly, the error terms in both equations are correlated, therefore we will also correct for the sample selection introducing the inverse Mills ratio in equation (8). Helpman et al. (2008) construct estimates of the ω_{ij}s using predicted components of Equation 8. They proposed a second stage non-linear estimation that corrects for sample selection bias and for firm heterogeneity bias. They also decompose the bias and find that correcting only for firm heterogeneity addresses almost all the biases in the standard gravity equation. They implement a simple linear correction for unobserved heterogeneity by adding

$$\hat{z}^{*}_{ijk} = \phi^{-1}(\hat{\rho}_{ijk}) \qquad (9)$$

where $z^{*}_{ijk} = \dfrac{z_{ijk}}{\sigma_{\eta}}$ and ϕ (.) is the cdf of the unit-normal distribution. $\hat{\rho}_{ijk}$ is the predicted probability of exports from country j to country i, using the estimates from the panel-probit Equation 8. We decomposed the bias and used the inverse Mills ratio as a proxy for sample selection and the linear prediction of exports as a proxy for firm heterogeneity, both obtained from Equation 8.

4.2 Estimations and results

The descriptive statistics presented in section 3 indicate that income overlap patterns that account for income distribution within countries incorporate valuable information that averages values (differences in income per capita) are not able to capture. Now the income-overlap indices are introduced in a gravity model to evaluate its effect on the flows of export between countries. A similar within-income-distribution between countries is expected to have a positive effect on bilateral exports. Similarity in income-distributions is also expected to be more important for differentiated goods than for homogenous goods.

In order to investigate whether the effect of income-distribution similarities affect differently homogenous and differentiated goods, we depart from the usual approach of using Rauch's classification of goods[5]. Instead, we ran separate regressions for each good at 2 and 3 digits ISIC. We expect that for more sophisticated goods, for which the buyer cannot as easily evaluate the product and the search costs make buyers stick to producers they are familiar with, hence income-distribution similarities are going to play a more important role. On the contrary, for more homogeneous goods, income-distribution similarities could play a minor role.

[5] According to which homogenous goods are goods traded on organized exchanges and those for which there exist price lists published, whereas differentiated goods are traded through networks in which already existing links play a central role.

The estimates are calculated at the ISIC 3-digit level since that involves fewer observations taking the value of zero. In estimating the gravity models we apply the different estimation techniques outlined in the previous section to explore the robustness of our results. Panel-fixed-effect estimations and Heckman estimations are applied. Several previous studies used Tobit estimates as a means to include trade links where there is no trade (Hallak, 2006 and McPherson et al., 2000). However, Tobit estimates are very sensitive to non-normal distributions of the dependent variable and are not accounting for selection bias. Instead, we use the procedure proposed by Heckman and also the one proposed more recently by Helpman et al (2008). This is important because accounting for links where export specific products are not observed (that is the case using disaggregated exports); result in considerable amounts of zero observations. In addition we also estimated a generalized linear model using the Poisson and the gamma distributions, as an alternative way of including the zero trade flows in our estimations.

Table 2 presents the results of different estimation techniques for all categories of goods with the three indices proposed and also with additional variables measuring income differences and inequality that have been used before in the literature, namely, absolute differences in per capita income and gini coefficients. The effect of the proposed indices on trade is always positive and significant. The specification with index2 presents the better performance in terms of R^2, and information criteria (AIC, BIC). The interpretation of each index is different. With respect to index1: An increase in 1 percentage point in index1 increases exports by 0.85%, whereas with respect to index2: An increase in 1 percent of the population with similar income in both countries rises exports by 0.4 percent. Finally, with respect to index3: A 1 % increase in similarity of income as the share of the population of country *i* increases exports by 0.4 percent. It is also worth noting that the effect of the indices on exports is also varying over time. Figure 3 shows the evolution over time of the estimated coefficients obtained in cross-sectional regressions for each year. A clear increase in the coefficients over time is observed, indicating that the influence of income-distribution similarities on exports is higher today than in the past. However, when he sample was restricted t to OECD countries, the opposite trend was observed, the coefficients slightly decrease over time and also lose significance.

Secondly, Table 3-5 present estimates for different categories of goods and considering indices 1, 2 and 3, respectively. Our main interest here is the sign and significance of the income-distribution similarity variable. The estimates from the, regressions confirm the hypothesis that the higher the demand overlap, the more do countries trade with differentiated goods ( ). When compared to the results from regressions made on more homogeneous goods ( ), the estimated demand overlap parameter is as expected larger for differentiated goods. This difference is statistically significant for all specifications.

Thirdly, we estimate equations 2 and 3 for OECD countries. Table 6 shows the results. The first five columns are estimates from equation 2, with country and year dummies and columns 6-10 shows the results when exporter-and-time and importer-and-time dummies are added as explanatory variables as specified in Equation 3.

Next, we take the zero flow observations into account. Results from four different estimation techniques are presented in Tables 7 and 8. Columns 1and 2 (Table 7, 8) report the first and second step results from estimated a Heckman selection model. Columns 3 and 4 (Table 7, 8) report the first and second step results from estimated a Helpman et al. (2008) model. The main results concerning the effect of income distribution similarities on trade remain almost unchanged with respect to the log-linear model (Table 2). For example, the effect of a 10 % increase in income-distribution similarities increases exports by 3.9 % according to the log-linear model (excluding zero trade) and by 4% according to the Heckman and Helpman et al. models and by 3.6% according to the gamma specification.

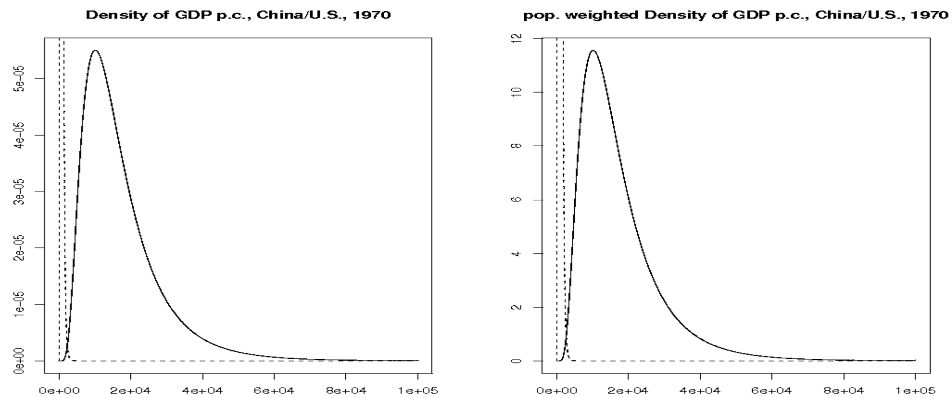
Finally, Table 9 presents the results for the models estimated in order to test the relationship between intra and inter-industry trade and income-distribution similarity. Columns 1-3 present the estimates of OLS regressions for which the dependent variable is a logistic transformation of the intra and inter-industry trade indices and of the ration between inter and intra industry trade. Columns 4-6, on the other hand report estimates of a logit model for which the dependent variable is not transformed. Mitra and Trindade (2005) found an V-shaped relationship between the ratio of inter-industry to intra-industry trade and a country's inequality. Since their theory describes trade between countries that are identical in all respects other than inequality, this prediction will be tested for developed countries belonging to the same regional integration agreement (EU countries)

5. Conclusions

In this paper, we have suggested three alternative measures of income distribution similarity between countries; these measures are used to proxy for demand similarities between pair of countries over time. Trade theory in conjunction with some stylized facts indicates that preferences are non-homothetic; hence not only the average income but also the distribution of income could influence aggregate demand. Ideally, the full distribution of income should be considered when demand similarities between countries are measured.

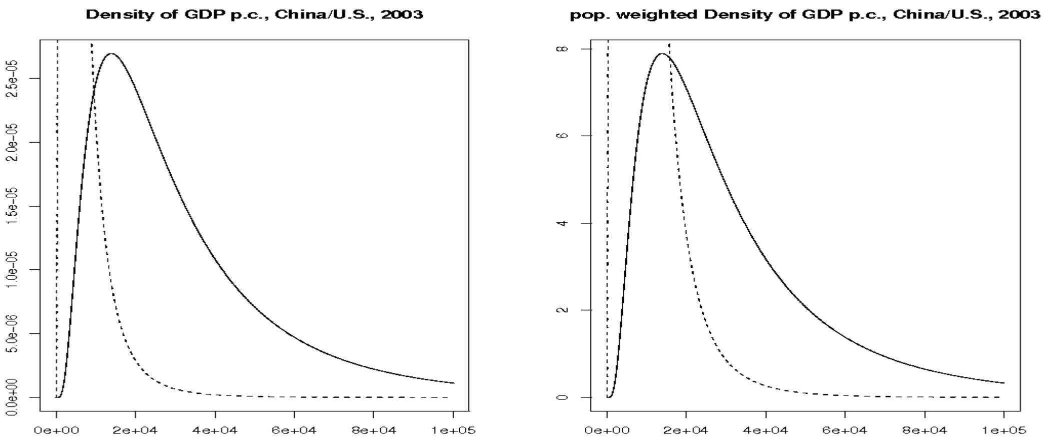
Using the three distribution-based measures as a proxy for demand similarities in gravity models we find consistent and robust support for the hypothesis stating that countries with more similar income-distributions trade more to each other. The hypothesis is also confirmed at disaggregated level, both for homogenous and for differentiated product categories. The larger the overlap in income distribution between two countries the higher will be the extent of trade between the two. In line with the theoretical predictions we also find that overlap in income distribution has a stronger effect for more sophisticated goods in comparison with more homogenous ones.

Figure 1 Illustration of Overlaps for China and the U.S., 1970



Left figure: Density of GDP p.c. for China (dashed line) and the U.S. (solid line). Right figure: Density of GDP p.c. For China (dashed line) and the U.S. (solid line) multiplied with population size.

Figure 2 Illustration of Overlaps for China and the U.S., 2003



Left figure: Density of GDP p.c. for China (dashed line) and the U.S. (solid line). Right figure: Density of GDP p.c. For China (dashed line) and the U.S. (solid line) multiplied with population size.

Figure 3. Evolution of the effect of income distribution similarities on exports over time

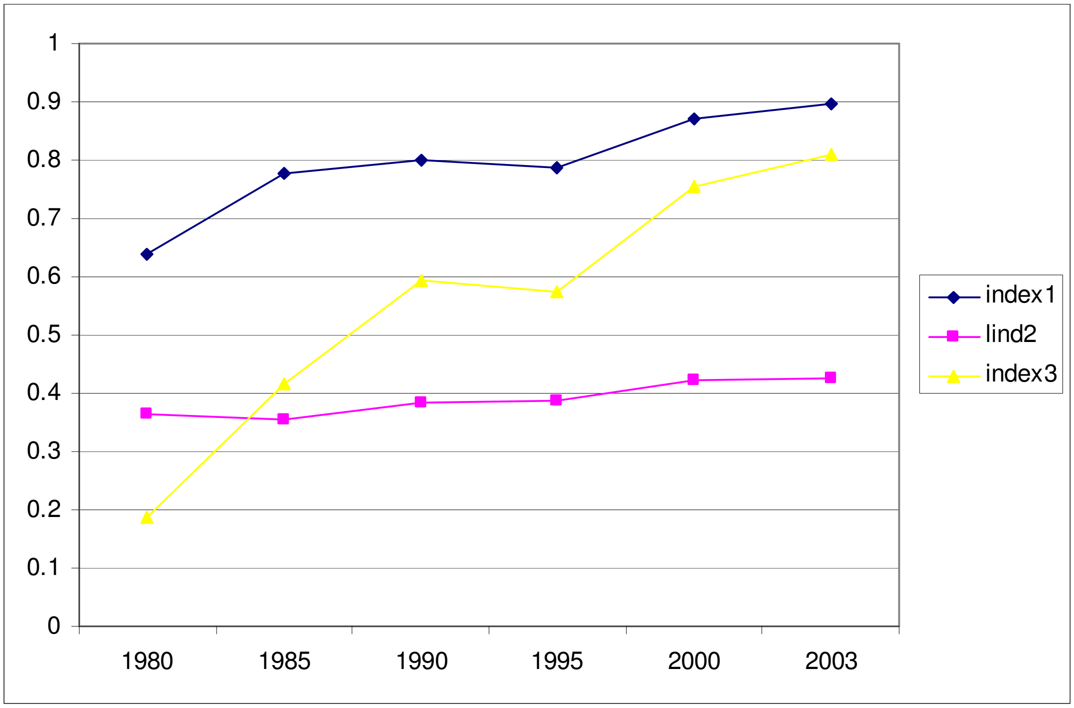


Table 1 Development of the different measures over time (example China and the U.S.)

Year	DS1	DS2	DS3 CHN	DS3 USA
1970	.002	825	.001	.004
1975	.004	1462	.002	.007
1980	.008	3574	.004	.015
1985	.023	9599	.009	.039
1990	.054	26079	.023	.102
1995	.114	58117	.048	.216
2000	.165	88347	.070	.311
2003	.221	128216	.100	.438

DS 1 and 3 are index values (range 0 to 1). DS 2 is measured in thousands of people.

Table 2. Income similarity and exports (Equation 2)

	Baseline	Index 1	Index 2	Index 3	Inc_dif	Gini_dif	Gini_j
lx	**m0**	**m1**	**m2**	**m3**	**m4**	**m5**	**m6**
IDI	**-**	0.852	0.391	0.625	-0.351	-0.0003	-0.0010
	-	56.663	73.47	34.456	-67.399	-3.898	-4.7960
lyhc	1.249	1.248	1.272	1.277	1.245	1.255	1.249
	39.864	39.698	40.619	40.619	39.873	39.994	39.853
lyhd	0.874	0.796	0.743	0.806	0.71	0.875	0.876
	38.038	34.653	32.381	35.026	30.924	38.069	38.111
lyc	0.009	0.009	0.009	0.009	0.008	0.009	0.009
	4.142	3.998	3.919	4.18	3.448	4.084	4.155
lyd	0.002	0.001	0.0001	0.001	0.0001	0.002	0.002
	1.025	0.731	0.158	0.284	0.242	1.016	1.016
ldist	-1.199	-1.131	-1.112	-1.162	-1.124	-1.1990	-1.1990
	-216.972	-199.185	-197.039	-205.643	-198.882	-216.9750	-216.9770
border	0.767	0.637	0.635	0.703	0.608	0.7670	0.7670
	37.995	31.302	31.478	34.736	29.898	38.0040	38.0060
com_lang	0.759	0.717	0.762	0.74	0.736	0.7590	0.7590
	60.846	57.683	61.676	59.366	59.388	60.8350	60.8410
cons	-4.142	-4.334	-7.527	-4.224	-3.072	-4.118	-4.078
	-11.482	-12.179	-21.012	-11.851	-8.549	-11.533	-11.431
R-squared	0.422	0.426	0.429	0.424	0.428	0.422	0.422
N	481766	481766	481766	481766	481766	481766	481766
ll	-1108065	-1106434	-1105306	-1107440	-1105795	-1108056	-1108051
rmse	2.41403	2.405874	2.400248	2.410905	2.402687	2.413991	2.413964
aic	2216573	2213313	2211057	2215326	2212036	2216559	2216548
bic	2219034	2215785	2213529	2217798	2214508	2219031	2219020
Time dummies	yes	yes	yes	yes	yes	yes	yes
X, M dummies	yes	yes	yes	yes	yes	yes	yes

Note:

Table 3. Sectoral results (INDEX1)

INDEX1	**Food Products**	**Beverages&Tobacco**	**Textiles and Footwear**	**Wood, paper**	**Chemicals, Rubber, Plastic**	**Pottery, Glass, ceramic products**	**Iron, steel. Other metals**	**Transport equipment**	**Machinery and other manufactures**
OLS_robust	**m311**	**m313**	**m32**	**m33**	**m35**	**m36**	**m371**	**m384**	**m38**
gini_j	-0.001	0.0002	0.0002	-0.001**	-0.001**	-0.001**	-0.001	-0.001	-0.001***
index1	0.630***	0.695***	0.621***	0.789***	0.993***	1.015***	0.720***	1.157***	1.092***
lyc	0.007	0.002	0.016***	0.017***	0.006	0.020***	-0.002	0.003	-0.006
lyd	-0.004	0.017*	0.001	-0.001	0.007	-0.006	0.009	0.003	-0.004
lyhc	0.596***	0.492***	1.114***	1.117***	1.509***	1.127***	0.964***	2.093***	1.816***
lyhd	0.777***	0.602***	0.954***	0.983***	0.636***	0.830***	1.017***	0.995***	0.841***
ldist	-1.285***	-1.072***	-1.089***	-1.348***	-1.222***	-1.304***	-1.478***	-1.257***	-1.279***
border	0.817***	0.711***	0.759***	0.590***	0.594***	0.778***	0.242***	0.933***	0.520***
com_lang	0.827***	0.537***	0.798***	0.967***	0.629***	0.743***	0.682***	0.983***	1.160***
cons	6.592***	1.676	-5.570***	-4.602***	-4.483***	-4.099***	0.549	-12.150***	-6.498***
R-squared	0.603	0.446	0.49	0.524	0.448	0.548	0.551	0.676	0.683
N	23435	20108	69078	66683	97443	44734	31454	20158	88241
ll	-47794.5	-44024.12	-152594.3	-144027.5	-219317	-91378.03	-67694.47	-41942.16	-180648.5
rmse	1.868831	2.172809	2.207128	2.101448	2.300055	1.870597	2.089257	1.949005	1.876775
aic	96036.99	88492.23	305634.5	288502.9	439082	183196.1	135836.9	84330.31	361747
bic	97842.88	90248	307673.4	290543	441207.1	185111.9	137708.7	86094.55	363859.2
t dum	yes	yes	yes	yes	yes	yes	yes	yes	yes
X, M dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes

Table 4. Sectoral results (INDEX2)

INDEX2	m311	m313	m32	m33	m35	m36	m371	m384	m38
gini_j	-0.001	0	0	-0.001**	-0.001**	-0.001**	-0.001	-0.001	-0.001***
lind2	0.302***	0.316***	0.317***	0.370***	0.479***	0.519***	0.384***	0.419***	0.509***
lyc	0.007	0.002	0.016***	0.017***	0.006	0.019***	-0.002	0.002	-0.003
lyd	-0.005	0.016*	0	-0.003	0.005	-0.008*	0.007	0.001	-0.004
lyhc	0.631***	0.524***	1.123***	1.140***	1.539***	1.145***	0.992***	2.138***	1.799***
lyhd	0.750***	0.567***	0.916***	0.932***	0.567***	0.761***	0.968***	0.948***	0.976***
ldist	-1.262***	-1.068***	-1.066***	-1.328***	-1.199***	-1.285***	-1.454***	-1.249***	-1.264***
border	0.799***	0.706***	0.753***	0.586***	0.593***	0.774***	0.219***	0.967***	0.570***
com_lang	0.863***	0.575***	0.830***	1.011***	0.685***	0.804***	0.718***	1.028***	1.169***
_cons	3.781***	-0.932	-8.204***	-7.584***	-8.321***	-8.157***	-2.749**	-15.511***	-13.913***
R-squared	0.605	0.447	0.492	0.526	0.452	0.554	0.555	0.677	0.683
N	23435	20108	69078	66683	97443	44734	31454	20158	88241
ll	-47726.8	-43995.01	-152428.6	-143837.7	-218915.8	-91064.26	-67575.24	-41914.56	-180715.1
rmse	1.86344	2.169666	2.20184	2.095476	2.290604	1.857522	2.081353	1.946339	1.878182
aic	95901.6	88434.03	305303.1	288123.4	438279.5	182568.5	135598.5	84275.11	361878.2
bic	97707.48	90189.8	307342	290163.5	440404.6	184484.4	137470.3	86039.35	363981
t dum	yes	yes	yes	yes	yes	yes	yes	yes	yes
X, M dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes

Table 5. Sectoral Results (Index 3)

INDEX3	**m311**	**m313**	**m32**	**m33**	**m35**	**m36**	**m371**	**m384**	**m38**
gini_j	-0.001	0	0	-0.001**	-0.001**	-0.001**	-0.001	-0.001	-0.001***
index3	0.767***	0.474***	0.572***	0.553***	0.762***	0.496***	0.404***	0.732***	0.980***
lyc	0.008	0.002	0.016***	0.018***	0.006	0.020***	-0.002	0.002	-0.003
lyd	-0.005	0.017*	0	-0.002	0.006	-0.006	0.008	0.002	-0.004
lyhc	0.615***	0.551***	1.135***	1.158***	1.539***	1.185***	0.981***	2.125***	1.787***
lyhd	0.764***	0.617***	0.952***	0.993***	0.647***	0.865***	1.040***	1.025***	1.071***
ldist	-1.290***	-1.099***	-1.105***	-1.380***	-1.254***	-1.354***	-1.511***	-1.310***	-1.320***
border	0.828***	0.773***	0.796***	0.657***	0.662***	0.882***	0.311***	1.028***	0.647***
com_lang	0.834***	0.552***	0.807***	0.992***	0.653***	0.782***	0.705***	1.018***	1.143***
cons	6.547***	1.42	-5.524***	-4.598***	-4.345***	-4.116***	0.719	-11.867***	-9.755***
R-squared	0.603	0.444	0.489	0.521	0.445	0.542	0.549	0.672	0.676
N	23435	20108	69078	66683	97443	44734	31454	20158	88241
ll	-47788.85	-44056.47	-152663.3	-144190.8	-219587.1	-91664.69	-67770.22	-42075.47	-181650.6
rmse	1.86838	2.176307	2.209336	2.106603	2.306439	1.882623	2.094295	1.961938	1.8982
aic	96025.69	88556.94	305772.7	288829.7	439622.1	183769.4	135988.4	84596.95	363749.2
bic	97831.58	90312.71	307811.6	290869.8	441747.2	185685.3	137860.2	86361.18	365852.1
t dum	yes	yes	yes	yes	yes	yes	yes	yes	yes
X, M dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes

Table 6. Trade and income similarity in OECD countries. Estimation of equations 2 and 3

With M, X and T dummies						**With X-and-time and M-and-time dummies**					
OECD countries	m1	m2	m3	m4	m5		m1	m2	m3	m4	m5
index1	0.237					index1	0.196				
	1.878						1.463				
lind2		0.29				lind2		0.294			
		11.931						12.129			
index3			0.359			index3			0.367		
			5.298						5.424		
ginidif				1.051		ginidif				1.329	
				3.161						3.532	
yhdif					-0.13	yhdif					-0.099
					-1.778						-1.266
ldist	-1.173	-1.17	-1.173	-1.175	-1.173	ldist	-1.173	-1.17	-1.173	-1.175	-1.173
	-63.142	-62.976	-63.166	-63.393	-63.146		-63.307	-63.128	-63.336	-63.586	-63.314
border	0.619	0.582	0.608	0.624	0.619	border	0.618	0.581	0.606	0.623	0.619
	16.047	15.081	15.724	16.184	16.065		16.146	15.154	15.795	16.268	16.169
com_lang	0.786	0.804	0.785	0.802	0.791	com_lang	0.789	0.806	0.787	0.808	0.792
	18.412	18.821	18.376	18.616	18.488		18.522	18.934	18.488	18.774	18.561
cons	4.527	0.99	2.171	3.01	4.631	cons	17.666	15.08	17.582	17.813	17.856
	2.138	0.477	1.057	1.449	2.167		59.195	42.907	65.066	67.074	67.212
R-squared	0.468	0.47	0.469	0.468	0.468	R-squared	0.472	0.473	0.472	0.472	0.472
N	54245	54245	54245	54245	54245	N	54245	54245	54245	54245	54245
ll	-119156.4	-119086.8	-119144.4	-119153.2	-119156.6	ll	-118887.2	-118814.5	-118873.8	-118882.1	-118887.4
rmse	2.177455	2.174664	2.176971	2.177326	2.177461	rmse	2.170201	2.167293	2.169664	2.169999	2.170212
aic	238412.8	238273.7	238388.7	238406.4	238413.1	aic	238226.4	238080.9	238199.5	238216.3	238226.9
bic	238857.9	238718.7	238833.8	238851.5	238858.2	bic	240238.1	240092.6	240211.2	240228	240238.6

Table 7. Considering also zero trade (Index1)

	Heckman 1	Heckman2	Probit	Helpman et al.
index1	0.268	0.921	0.47	0.928
	27.778	61.05	26.951	60.46
lyc	0.002	0.008	0.004	0.008
	1.943	3.926	1.893	3.76
lyd	-0.004	0.001	-0.006	0.001
	-3.076	0.487	-2.837	0.29
lyhc	0.07	1.234	0.179	1.235
	4.062	40.815	5.688	39.47
lyhd	0.377	0.812	0.662	0.813
	27.301	36.323	26.386	35.21
ldist	-0.486	-1.225	-0.864	-1.232
	-126.157	-171.292	-124.59	-167.1
border	0.279	0.717	0.492	0.734
	18.587	34.994	18.35	34.91
com_lang	0.401		0.692	
	51.362		50.067	
zhat1				0.014
				3.744
invmills2				0.461
				7.808
lambda		0.279		
		8.925		
cons	0.777	-3.586	0.805	-3.847
	3.754	-10.382	2.154	-10.478
R-squared				0.422
N	645960	481443	645296	481443
ll			-219347.4	-1107311
rmse				2.41398
aic		.	439138.9	2215068
bic		.	441664.7	2217540

Table 8. Considering also zero trade (Index2)

	exp_tv Heckman 1	lx Heckman2	exp_tv Probit	lx Helpman et al.	exp_tv Poisson	exp_tv Gamma
lind2	0.16	0.405	0.099	0.407	0.079	0.362
	26.797	74.974	31.476	74.088	2.299	29.407
lyc	0.004	0.008	0.002	0.008	0.015	0.011
	1.891	3.846	1.972	3.689	1.653	1.886
lyd	-0.007	-0.001	-0.004	-0.001	0.005	0.007
	-3.016	-0.477	-3.306	-0.672	0.745	1.721
lyhc	0.197	1.258	0.08	1.259	1.246	1.333
	6.268	41.652	4.653	40.388	9.058	17.39
lyhd	0.669	0.777	0.378	0.778	0.979	0.64
	26.656	34.755	27.41	33.766	8.631	13.001
ldist	-0.855	-1.232	-0.48	-1.239	-0.677	-1.031
	-122.341	-174.022	-123.791	-169.226	-47.441	-80.667
border	0.503	0.736	0.281	0.752	1.143	0.743
	18.821	36.057	18.808	36.001	20.643	19.883
com_lang	0.714		0.414		-0.04	0.675
	51.768		53.155		-0.808	24.971
zhat2				0.013		
				3.399		
invmills		0.413		0.58		
		13.248		9.776		
cons	-0.738	-6.771	-0.176	-7.016	-8.373	-5.317
	-1.944	-19.451	-0.838	-18.963	-5.692	-6.596
R-squared				0.424		
N	645296	481443	645960	481443	645960	645960
ll	-219326			-1106366	-1.73E+10	-5431013
rmse				2.409249		
aic	439096			2213179	3.46E+10	1.68E+01
bic	441621.8			2215651	3.46E+10	-6.23E+06

Table 9. IIT and income similarity

	ols	ols	ols	logit	logit	logit
	m1	m2	m3	m4	m5	m6
	LIIT	**LTB**	**LTR**	**IIT**	**TB**	**TR**
index1	1.493	-1.493	1.281	2.136	3.439	2.137
	17.076	-17.076	13.411	37.31	0.889	37.331
index1sq	-0.273	0.273	-0.269	-0.454	-2.482	-0.454
	-3.372	3.372	-3.013	-8.399	-0.657	-8.413
cons	-3.241	3.241	-3.743	-1.676	33.241	-1.676
	-53.406	53.406	-56.693	-39.015	17.795	-39.025
R-squared	0.076	0.076	0.064			
r2_p				0.267651	0.169277	0.2677101
N	316584	316584	226814	654876	47095	654821
ll	-725753	-725753.1	-508671.9	-332171	-354.1873	-332114.9
rmse	2.39614	2.396141	2.280123			
aic	1451946	1451946	1017784	664782	824.3746	664669.8
bic	1454292	1454293	1020057	667288.3	1332.45	667176.1
Time dummies	yes	yes	yes	yes	yes	yes
X, M dummies	yes	yes	yes	yes	yes	yes

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