International Differences in Consumer Preferences and Trade: Evidence from Multicountry, Multiproduct Data*

Oleksandr Movshuk

Department of Economics,

Toyama University,

3190 Gofuku, Toyama 930-8555, Japan

E-mail: movshuk@eco.toyama-u.ac.jp

May 2005

(Comments welcome)

Abstract

In this paper, I examine a common neglect of international trade theories of demand-side differences, focusing in particular on their assumption of identical and homothetic preferences (IHP) across countries. Using data from the latest round of International Comparison Project for 1996, which contains data for 24 categories of consumption in 115 countries, the paper examines the plausibility of IHP, specifically the implication of identical consumption shares across countries. Applying a robust test for multivariate outliers to international consumption shares, the paper found a wide diversity in these shares. A large number of countries exhibited outlying patterns in their consumption shares, especially countries with total consumption per capita below roughly 5,000 international dollars. Conversely, the similarity of consumption shares was much more evident for of rich countries that exceeded the cutoff value. In the second part of the paper, I apply the sign test, rank test and Spearman rank correlation tests of Bowen et al. (1987) to test the relationship between idiosyncratic consumption shares and trade flows. The paper found that unusually large demand has the (expected) positive impact on imports, but the (unexpected) positive impact on exports, apparently indicating the 'home effect' from large domestic markets on expert competitiveness. However, the impact of demand differences on trade turned out highly insignificant in the subset of rich countries, implying that IHP may indeed be a feasible assumption for analyzing trade, but only among rich economies.

JEL classification numbers: F11, D12, C21.

* I am grateful to Kiyoshi Fujikawa, Keith Maskus and Eiichi Tomiura for useful comments on earlier drafts of this paper. The usual disclaimer applies.

Introduction.

Even though international differences in supply and demand can conceivably be sources of comparative advantages, the conventional trade theory has not considered demand differences as an important source of trade. A typical example is the Heckscher-Ohlin-Vanek theory of international trade. It focuses on international differences in factor endowment, and neutralizes the impact of demand by assuming identical and homothetic preferences (IHP) across the world. This assumption implies that representative consumers in all trading countries have a common utility function, and that international income differences have no effect on consumption shares. Taken together with the assumption of free trade and zero transportation costs, this pattern of preferences greatly simplifies the absorption side of the Heckscher-Ohlin-Vanek theory, with expenditure shares of traded goods affected by only relative prices, with no impact from different tastes or income levels across countries.

The feasibility of assuming IHP was repeatedly questioned in recent years. After all, the assumption is at odds with the Engel law that links increasing income levels with decreasing share of food expenditures. Davis and Weinstein (2001) acknowledged that the demand side of the Heckscher-Ohlin-Vanek model "cries out for more research" (p. 39), while Leamer (2002) pointed out that the "assumption that budget shares are independent of incomes works well theoretically, but rather badly violates the facts" (p. 11). Table 1 summarizes major studies that examined whether preferences are indeed identical and homothetic. In one of the most comprehensive studies, Hunter and Markusen (1988) tested the null hypothesis of homothetic preferences for 11 goods and services in 34 countries, and rejected the null hypothesis for 7 expenditure categories

(including food, in accordance with the Engel law). On the other hand, Dowrick and Quiggin (1994) tested the null hypothesis of identical preferences by applying the revealed preference approach to 10 and 38 expenditure categories in 60 countries. Surprisingly, the null hypothesis was violated only twice (out of 1700 pairwise international comparisons) with 10 expenditure categories, and was never violated with 38 expenditure categories.

Generally, there is little doubt that the idealized world of identical and homothetic preferences is a poor match to the actual consumption patterns in the world. However, it is much less clear whether deviations from this restrictive demand structure (which allow for non-homothetic and non-identical preferences) can provide a better explanation of trade flows, in comparison with the traditional focus on supply-side differences only.

Markusen (1986) was an early attempt of applying such a less restrictive demand structure to analyzing trade between rich North and poor South countries. He suggested an 'eclectic model' that blended scale economies, differences in endowments and non-homothetic preferences, and this model explained the low level of inter-industry trade between capital-abundant North and labor-abundant North. Chung (2000) considered how the inclusion of non-homothetic preferences in the Heckscher-Ohlin-Vanek theory could explain the vast amount of 'missing trade', pointed by Trefler (1995). Subsequently, Reimer and Hertel (2003) empirically demonstrated that allowing for non-homothetic preferences greatly improves the fit between predicted and observed factor content of trade[1].

[1] Specifically, the paper found that non-homothetic preferences can explain away about one-fifth of the "missing trade" and one-third of the "endowments paradox" mysteries.

Table 1. Summary of empirical evidence on identical and homothetic preferences

Paper	*Tested null hypothesis*	*Data used*	*Sample*	*Test result*	*Comment*
Balance, Forstner, Murray (1985)	Identical homothetic preferences	International data on trade, output, and consumption	13 commodities in 1980	The null hypothesis is rejected for every commodity	
Bowen, Leamer, Sveikauskas (1987)	Identical homothetic preferences and Hicks-neutral technological differences	International data on trade, output, and consumption	27 countries, 12 resource endow-ments in 1967	The null hypothesis is not rejected	Estimated parameters of technological differences were often implausible
Horiba (1979)	Identical homothetic preferences	Regional data on trade, output, and consumption	9 U.S. regions, 51 manufacturing industry in 1963	Two non-parametric tests support the null hypothesis, but one parametric test rejects it	Analysis of regional data may have a low power to identify taste differences
Davis, Weinstein, Bradford, Shimpo (1997)	Identical homothetic preferences and similarity of price structure across regions	Regional data on consumption expenditures	10 Japanese regions, 42 commodities in 1987	Except liquefied fuels, the null hypothesis is not rejected	Analysis of regional data may have a low power to identify taste differences
Dowrick, Quiggin (1994)	Identical preferences	International consumption expenditures	60 countries, 10 and 38 categories of expenditures in 1980	Data are consistent with the null hypothesis of identical tastes	The revealed preference approach has a low power when countries have dissimilar income levels (so that their budget lines do not intersect). Comparison of consumption bundles may mask taste differences for constituent commodities
Hunter, Markusen (1988)	Homothetic preferences	International consumption expenditures	34 countries, 11 goods and services in 1975	The null hypothesis is rejected for 7 goods and services, and is rejected for the whole demand system.	
Hunter (1991)	Homothetic preferences	International consumption expenditures and trade	34 countries, 11 goods and services in 1975	Non-homothetic preferences may account for one-quarter of international trade	

This paper also aims to demonstrate the importance of demand side differences for explaining international trade flows. Its major novel contribution is that demand differences are considered as an independent source of comparative advantages, rather than a 'fix' to improve the predictive performance of supply-side theories of international trade[2]. The relevance of international demand differences for international trade flows is examined with a rich dataset of 24 consumption categories in 115 countries.

Major findings can be briefly summarized as follows. While the assumption of identical and homothetic preferences implies that goods are consumed in the same expenditure shares, I found a substantial dispersion in these shares across the world. While previously this conclusion was reached by estimating a particular demand system, in this paper I use a more general, model-free approach to reach the same conclusion. Specifically, I applied a test of multivariate outliers directly to consumption shares, with an important advantage that the outcome is not conditional on the choice of a specific demand system. The largest number of unusual ('outlying') consumption shares was identified for expenditures on food (in agreement with the Engel law). Also, most of outlying consumption shares represented countries with low levels of per capita total consumption (with cutoff value of about 5,000 international dollars), indicating that the identical and homothetic preferences may indeed be an acceptable assumption for explaining trade, but only among rich countries.

In its second part, the paper examines these deviations from identical and homothetic preferences, and analyses whether unusually large (or small) normalized consumption shares can be associated with unusually large (or small) normalized exports

[2] In this respect, the paper is most closely related to Hunter (1991), who estimated that the introduction of non-homothetic, but identical, preferences may account for as much as one-quarter of trade flows.

and imports. This is done with the sign test and median test from the seminal paper by Bowen, Leamer and Sveikauskas (1987). I found a highly significant positive relation between consumption shares and import shares, in agreement to the prior expectation that unusually strong demand for a good is likely to result in extra imports. Surprisingly, there was once again a positive relation between consumption and export shares. I interpret this finding as another piece of evidence about 'home market effect', introduced by Krugman (1980) and recently verified empirically by Davis and Weinstein (2003), Hanson and Xiang (2004). Another noteworthy result occurred when the sample was restricted to the subset of 38 rich countries (using as a cutoff the value of 5000 international dollars for total per capita consumption). The identified relationships between consumption patterns and trade were no longer significant, once again indicating that demand differences may not play an important role for trade of rich economies.

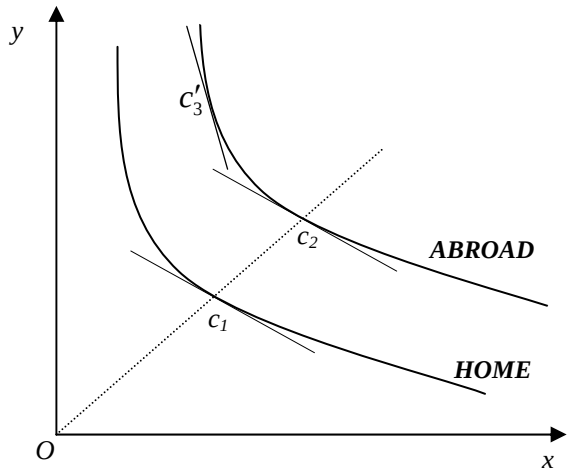
This paper is organized as follows. Section 1 discusses the impact of consumer preferences on international trade. Section 2 describes tests to examine the relationship between domestic demand and international trade, and describes data sources. Major results are reported in section 3. Section 4 contains major conclusions and directions for future research.

Section 1. Consumer preferences and international trade

To define IHP, consider a representative consumer who chooses between goods *x* and *y*. Homothetic preferences are defined as follows: for all $\lambda > 0$, the consumer prefers a bundle *x* to a bundle *y if* the consumer prefers bundle λx to λy. In words, the ordering of

consumer's preferences does not change if consumption bundles are scaled by a scalar λ. Homothetic preferences with $\lambda > 1$ are illustrated by Fig.1.

Fig. 1. Homothetic preferences



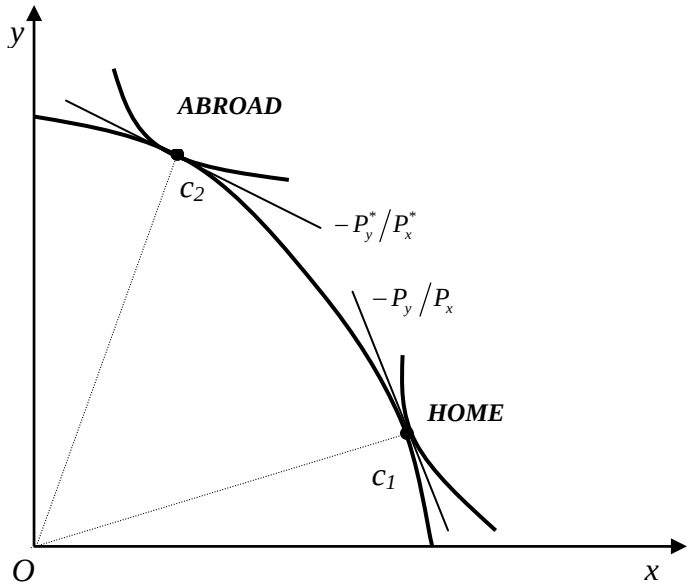
To define identical preferences, consider representative consumers in *Home* and *Abroad* and their respective social indifference curves. Preferences are identical and homothetic if, up to a scaling factor $\lambda > 0$, the shape of social indifference curves remains the same.

The assumption of IHP greatly simplifies the demand side of conventional trade theories. Consumer preferences can be deduced from a single indifference curve, regardless of income levels. Moreover, when consumers have different incomes, but face the same prices (due to postulated free trade), the consumers would demand goods in a proportion that is constant along the ray from the origin (in Fig. 1, this identical proportion in *Home* and *Abroad* is evident in the identical slope of Oc_1 and Oc_2). In other words, it is only relative prices of goods *x* and *y*, and not income or tastes, that determine the ratio in which *x* and *y* are consumed in *Home* and *Abroad*. Since the conventional

trade theory attributes differences in relative prices to only supply-side differences among nations (in productivity, factor endowments, etc), the use of IHP assumes away any impact of demand-side differences on international trade.

Conversely, if preferences are *non*-identical or non-homothetic, demand-side differences could be a source of comparative advantages. Fig. 2 illustrates the case of non-identical preferences in *Home* and *Abroad*.

Fig. 2. Non-identical preferences as a source of comparative advantages



Both countries share the same production possibility frontier. However, consumers in *Home* prefer *x* to *y*, while preferences in *Abroad* are the other way around. Note that now the ratio of *x* and *y*, as well as their consumption shares, are no longer identical in *Home* and *Abroad*. Relatively high demand for *x* in *Home* makes *x* relatively more expensive. The same holds for *y* in *Abroad*. Therefore, *Home* has the comparative advantage in *y*, while *Abroad* has the comparative advantage in *x*. In short, countries

export the good that they do not demand so much, and import the good they demand relatively more.

To show how non-homothetic preferences can give rise to international trade, suppose that preferences in *Home* and *Abroad* are identical, but preferences for *x* are non-homothetic. Let *x* be an inferior good. If income level in *Home* is higher relatively to *Abroad*, then *Home* would have the comparative advantage in *x* (due to lower domestic demand for this good), while *Abroad* will have comparative advantage in *y*. In general, the relatively rich country will export the good which has a relatively lower income elasticity of demand, reflecting different consumption shares for *x* and *y* in *Home* and *Abroad* due to the non-homothetic demand.

Section 2. Data and empirical tests.

To evaluate the effect of different consumption shares on national exports and imports, this paper will test whether deviations from 'typical' consumption shares is related to similarly defined deviations for exports and imports, with typical levels represented by median shares of a given commodity across countries.

Let countries be denoted by n $(n = 1,..., N)$, and commodities by k $(k = 1,..., K)$. The value of consumption, export and imports by defined by uppercase letters *C*, *X*, and *M*, and let the corresponding lowercase letters denote the corresponding shares in the total as follows: $c_{k,n} = \frac{C_{k,n}}{\sum_{k=1}^{K} C_{k,n}}$, $x_{k,n} = \frac{X_{k,n}}{\sum_{k=1}^{K} X_{k,n}}$, $m_{k,n} = \frac{M_{k,n}}{\sum_{k=1}^{K} M_{k,n}}$.

Let $\tilde{c}_k$, $\tilde{x}_k$ and $\tilde{m}_k$ denote median values of consumption, export and import shares of good *k* across all *N* countries. Terms $c_{k,n}$, $x_{k,n}$ and $m_{k,n}$ are made scale-invariant by the following normalizing transformations:

$$\hat{c}_{k,n} = \ln(c_{k,n}/\tilde{c}_k), \quad \hat{x}_{k,n} = \ln(x_{k,n}/\tilde{x}_k), \quad \hat{m}_{k,n} = \ln(m_{k,n}/\tilde{m}_k) \tag{1}$$

Note, in particular, that if countries demand the same share of each good (as they should under IHP), than the term $c_{k,n}$ would be zero. Also, a negative value of $\hat{c}_{k,n}$ indicates that consumption of commodity *k* in country *n* is lower than the 'benchmark' share $\tilde{c}_k$ (defined by median values for the full set of *N* countries). Conversely, positive value of $\hat{c}_{k,n}$ means that commodity *k* in country *n* is consumed in relatively high proportion than the benchmark international level $\tilde{c}_k$ for commodity *k*[3]. Trade shares $\hat{x}_{k,n}$ and $\hat{m}_{k,n}$ have the same interpretation.

(a) Data sources

Consumption shares $\hat{c}_{k,n}$ were computed from the latest benchmark study of the International Comparison Program (ICP). The ICP originated in the 1960s in the University of Pennsylvania, and at present is coordinated by the World Bank. Its primary goal is the calculation of purchasing power parities for major expenditure categories of national accounts. As a result, the database provides not only nominal consumption expenditures (in domestic currency), but also the corresponding set of purchasing power

[3] The use of benchmark levels in (1) makes these variables conceptually similar to IDIODEM variable in Davis and Weinstein (2003), where it was defined as a "measure of the extent of idiosyncratic derived demand [that] … measures the extent to which the relative demand for a good within an industry differs from that in the rest of the world" (p. 7).

parity (PPP) estimates. Importantly, great care is given in ICP to ensure that goods of similar quality are compared across countries.

For this paper, I used the latest available ICP database for 1996[4]. It includes consumption data for 115 countries (the largest number ever in the ICP's history). In total, 24 consumption categories were examined[5]. The full list of countries and expenditure categories is provided in Appendix tables A1 and A2.

The original sample of 115 countries includes a large number of developing countries that may have relatively unreliable estimates of consumption expenditures. To identify a subset of countries with relatively high quality of data, I used variance scores from Heston et al. (2004). The scores range from 0 to 5, with high scores identifying countries with high consistency in PPP estimates across different benchmark studies. The 'high quality' subset of countries had variance scores 4 or 5, and contained 76 countries.

To compute export and import shares $\hat{x}_{k,n}$ and $\hat{m}_{k,n}$, I used *World Trade Analyzer* database, released by Statistics Canada (2001). The database contains nominal bilateral trade flows at 4-digit level of Standard Trade International Classification (SITC, rev. 2) for almost all countries in the ICP sample of countries. Trade data turned out missing for only 7 countries from the original sample of 115 countries, and for only 4 countries from the 'high quality' subset of 76 countries[6]. Therefore, the impact of consumption on trade patterns could be analyzed with 108 and 72 countries. To calculate trade shares $\hat{x}_{k,n}$ and

[4] The dataset was downloaded from http://pwt.econ.upenn.edu/Downloads/benchmark/benchmark.html

[5] I excluded two expenditure categories from the original dataset ('restaurants, cafes and hotels' and 'other goods and services') because it is common to include in such residuals categories expenditures that are difficult to classify (Kravis et al., 1982, p. 49), making international comparisons for these expenditure categories less reliable.

[6] The list of countries with missing trade data is provided in Appendix table A3.

$\hat{m}_{k,n}$, I did not use trade figures for country *n* to the world, but only to the aggregate of countries that were included in this study (such as 108 countries of the full sample).

It was more difficult to match consumption categories in the ICP dataset with SITC categories in the *World Trade Analyzer*. Because there is no standard concordance for matching these two product classifications, I compiled a new concordance for 15 consumption categories in the ICP dataset[7]. The remaining 9 consumption categories were either nontradables, or no reliable match could be found for the in the SITC classification.

Taken together, the full sample of 115 countries accounted in 1996 for about 78.9 percent of the global GDP, and 89.4 of global exports of goods and services (World Bank, 2002). The corresponding share in the world's population was smaller (50.7 percent), mainly due to the exclusion of China and India from the ICP dataset.

(b) Empirical tests

As discussed in section 1, if there are demand differences (either due to non-identical preferences, or non-homothetic preferences), countries no longer consume goods in identical proportions. In addition, unusually strong demand for a good would change the composition of comparative costs across countries, and lead to increased imports and reduced exports of this good, as discussed in previous section. In this section, I describe tests that examine this assumed relationship.

These tests are based on the sign and median test, introduced in the seminal study by Bowen et al. (1987). The sign test compares the sign of normalized relative

[7] The concordance is reported in Appendix table A4.

consumption share $\hat{c}_{k,n}$ and the sign of corresponding export share $\hat{x}_{k,n}$, or the sign of import share $\hat{m}_{k,n}$:

$$Sign(\hat{c}_{k,n}) \neq Sign(\hat{x}_{k,n}) \qquad \text{for exports} \qquad (2a)$$

$$Sign(\hat{c}_{k,n}) = Sign(\hat{m}_{k,n}) \qquad \text{for imports} \qquad (2b)$$

where $n = 1,...,N; k = 1,...,K.$

The test compares the sign pattern of deviations from an international benchmark level for consumption shares, with similarly defined deviations in export or import shares. As in Bowen et al. (1987), the test focuses on the proportion of correct sign matches that are predicted by (2a) and (2b), that is, opposite signs for $\hat{c}_{k,n}$ and $\hat{x}_{k,n}$, and the same signs for $\hat{c}_{k,n}$ and $\hat{m}_{k,n}$.

In the rank test, the following relationships are examined:

$$\begin{aligned} &\hat{c}_{k,n} > \hat{c}_{l,n} \Leftrightarrow \hat{x}_{k,n} < \hat{x}_{l,n} \\ &\hat{c}_{k,n} < \hat{c}_{l,n} \Leftrightarrow \hat{x}_{k,n} > \hat{x}_{l,n} \end{aligned} \qquad \text{for exports} \qquad (3a)$$

and

$$\begin{aligned} &\hat{c}_{k,n} > \hat{c}_{l,n} \Leftrightarrow \hat{m}_{k,n} > \hat{m}_{l,n} \\ &\hat{c}_{k,n} > \hat{c}_{l,n} \Leftrightarrow \hat{m}_{k,n} > \hat{m}_{l,n} \end{aligned} \qquad \text{or imports} \qquad (3b)$$

where $n = 1,...,N; k,l = 1,...,K.$

In addition to comparing $\hat{c}_{k,n}$ with $\hat{x}_{k,n}$ and $\hat{m}_{k,n}$ two at a time, I compared their ranking across all *K* goods for each country $n = 1,...,N$, and the significance of the rank correlation was evaluated by the Spearman rank correlation coefficient ρ. In each case, exact p-values for the coefficient ρ were calculated by algorithm of Best and Roberts (1975). To save space, I will report only countries where the rank coefficient ρ was

significant at 5 percent significance levels, differentiating between correct rankings (negative between $\hat{c}_{k,n}$ and $\hat{x}_{k,n}$, and positive between $\hat{c}_{k,n}$ and $\hat{m}_{k,n}$), and incorrect rankings.

Up to now, the three tests used in this paper (sign tests (2a) and (2b), rank tests (3a) and (3b) and Spearman rank correlation) are very similar to the approach of Bowen et al. (1987) to evaluate the empirical performance of Heckscher-Ohlin-Vanek theory of trade. There is one important difference. Bowen et al. (*ibid.*) just reported the share of 'successful matches' in sign and rank tests. In contrast, this paper evaluates the statistical significance of these shares. Bowen et al. (*ibid.*) rejected the possibility of testing the statistical significance of their tests by claiming, "the rank and sign propositions based on the proportion of "successes" do not refer to any specific alternative hypothesis and thus leaves unclear the choice of significance level. Without knowing the proportion of successes expected under a specific alternative hypothesis, judging the relative performance of the H-O-V model is largely impressionistic" (p. 795).

Still, it is possible to define another expected proportion, but not under the alternative hypothesis, but under the null that postulates no relation between consumption and corresponding trade shares. With no relation between domestic demand and trade, the proportion of 'successful' and 'unsuccessful' matches in the sign and rank test should be equal to 0.5. Based on this observation, it is possible to test whether the median share of, say, 'successful matches' in a country n ($n = 1,...,N$) for all K goods is significantly different from 0.5. This can be done by the Wilcoxon test for two paired samples, where the second sample is just the column with K cells with 0.5. Essentially, this is a univariate version of the Wilcoxon test, about a specific value of population median. So

in addition to reporting p-value for the null hypothesis that the proportion of successful matches was 0.5, I will also report the median value of these 'successful matches' For this reason, reports of applying this test will include the median level of 'successful matches' across all *N* countries, and a p-value for the test.

Prior to applying these three tests, I also examined whether there was a significant variability among original consumption shares $c_{k,n}$ for a specific good *k* among N countries. The lack of international similarity in consumption shares indicates the lack of IHP across countries, so by checking the possible variability of consumption shares, we essentially examine the feasibility of this apparently restrictive treatment of demand conditions in the conventional trade theory. The variability is evaluated by a robust test of outliers in multivariate data, based on minimum covariance determinant (MCD) estimator, due to Rousseeuw (1984). If consumption shares are broadly similar across countries, this test should not identify a large number of multivariate outliers in the data.

The MCD estimator is essentially a robust version of Mahalanobis distance MD_i, a measure how far an i*th* row in multivariate data deviates from the sample's center (measured by sample mean $\bar{x}$):

$$MD(x_i) = \sqrt{(x_i - \bar{x})(Cov(X))^{-1}(x_i - \bar{x})'}$$

However, the Mahalanobis distance is susceptible to outliers, and significant multivariate outliers may have small values of MD_i. The problem is less serious with the MCD estimator, mainly because it uses a robust estimator of data center (denoted by *RC*) and a robust estimator of variance-covariance matrix *RCov* (for details of a fast algorithm to compute the estimator, see Rousseeuw, and Van Driessen (1999)):

$$MCD(x_i) = \sqrt{(x_i - RC)(RCov(X))^{-1}(x_i - RC)'} \quad (4)$$

In this paper, the MCD estimator was applied to 23 consumption categories listed in Table A2[8]. In addition, the possible dissimilarity was examined with several subsets of consumption categories that contained expenditures on (1) food, (2) beverages and tobacco, (3) clothing and footwear, (4) rent and fuel, (5) household maintenance, (6) transportation, (7) recreation and education (the composition of these subsets of expenditures is shown in Table A2).

Section 3. Test results

Results of applying MCD test for consumption share data are shown in Fig. 3 for the full sample of 115 countries, and in Fig. 4 for the 'high quality' sample of 76 countries. The figures show robust distances, with horizontal lines indicating critical values for the MCD distance statistic. The null hypothesis is that consumption shares are similar, with no significant outliers. Table 2 reports that with all 23 consumption categories, the test identified 25 and 13 outlying countries in sample of 115 and 76 countries, respectively. Interestingly, almost all of these countries were concentrated in a subset of poor countries, with an approximate cutoff of about 5,000 international dollars of total consumption expenditures per capita (the cutoff is shown by vertical lines in Fig. 3 and 4).

The number of outlying countries became even larger for a subset of food expenditures (31 and 19, respectively), and division by the cutoff value became even more marked. In addition, the number of outlying countries remained rather large for two more consumption categories ('beverages and tobacco' and 'household'), but for the remaining subsets of consumption categories, much fewer outlying countries were found

[8]One consumption category (education) had to be excluded to avoid the singularity problem in consumption shares.

(Table 2). Moreover, these outliers were distributed much more evenly among rich and poor countries.

Based on these results, three conclusions can be made. First, the large number of outlying countries with 23 consumption categories apparently was mainly due to idiosyncratic food shares. Second, two subsets of rich and poor countries can be identified. Third, the subset of relatively rich countries had much fewer number of regression outliers, indicating that demand pattern in these countries may indeed be described by IHP, with much less significant impact from demand differences on trade. To verify this conjecture, in addition to the original samples of 115 and 76 countries, a subset of 38 countries with total consumption exceeding the cutoff level, will be used in analyzing the relationship between domestic demand and international trade flows[9].

Table 3 reports the significance of sign test, rank test and Spearman rank correlation when they were applied to examine the relation between $\hat{c}_{k,n}$ and $\hat{x}_{k,n}$, and between $\hat{c}_{k,n}$ and $\hat{m}_{k,n}$. Consider results for the complete sample of 108 countries in Table 3. In studying the relationship between $\hat{c}_{k,n}$ and $\hat{x}_{k,n}$ (denoted by 'exports'), the median share of 'successful matches' (under the assumption of negative relation between $\hat{c}_{k,n}$ and $\hat{x}_{k,n}$) was 0.467 and 0.471 for sign test and rank tests, respectively. This indicates the prevalence of 'unsuccessful matches', based on postulated negative relation between $\hat{c}_{k,n}$ and $\hat{x}_{k,n}$. Moreover, the median share deviated significantly from the null level of 0.5 for the rank test (p-value was 0.003), and barely missed 0.05 significance level for the sign test (with p-value 0.053). On the other hand, for imports the prevalent outcome were

[9] This new subset of relatively rich countries is listed in Table A1.

'successful matches' between $\hat{c}_{k,n}$ and $\hat{m}_{k,n}$ (median shares for 108 countries were 0.600 and 0.562 for sign and rank tests). The deviation of these median shares from the null value of 0.5 was highly significant, with p-values less than 0.001 in both tests.

The application of Spearman rank correlations revealed the same pattern. For correlations between $\hat{c}_{k,n}$ and $\hat{x}_{k,n}$, there were 10 countries with significant ρ, but the sign of correlation was correct in only 2 countries. For imports, the outcome was the opposite: out of 11 countries, 10 had expected positive sign.

With 'high quality' sample of 72 countries, the general pattern remained essentially the same, but with one noteworthy change. The prevalence of 'incorrect matches' for exports remained, but it was no longer significant at 0.05 significance level (p-values for the sign and rank tests were 0.096 and 0.093, respectively).

The most dramatic change occurred when the sample of countries was restricted to 38 richest countries. Both for exports and for imports, the sign test and rank test were insignificant, with very large p-values. The number of countries with significant rank correlations dropped to one for exports, and none for imports. Apparently, the previously identified similarity of consumption shares for this subset of countries greatly reduced the scope for a significant impact by demand on international trade. In sum, while deviations from the idealized world of identical and homothetic preferences appear to be related with trade flows of countries with broad spectrum of income levels, the impact of demand on trade is much less visible for rich countries, to which the assumption of identical and homothetic preferences may be a feasible one.

(to be continued)

Fig 3. Test of multivariate outliers with MCD estimator (sample of 115 countries)

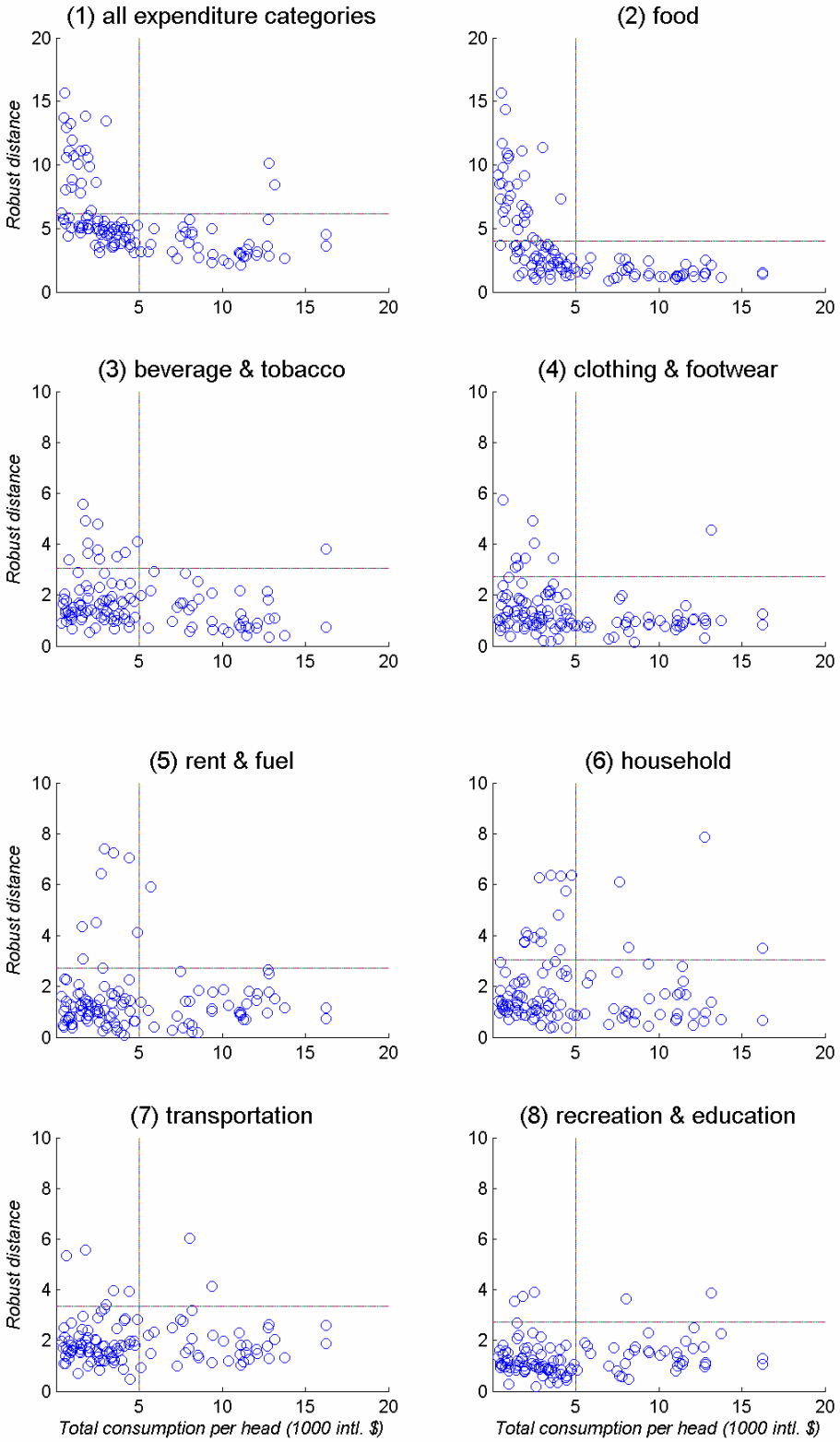


Fig 4. Test of multivariate outliers with MCD estimator (sample of 76 countries)

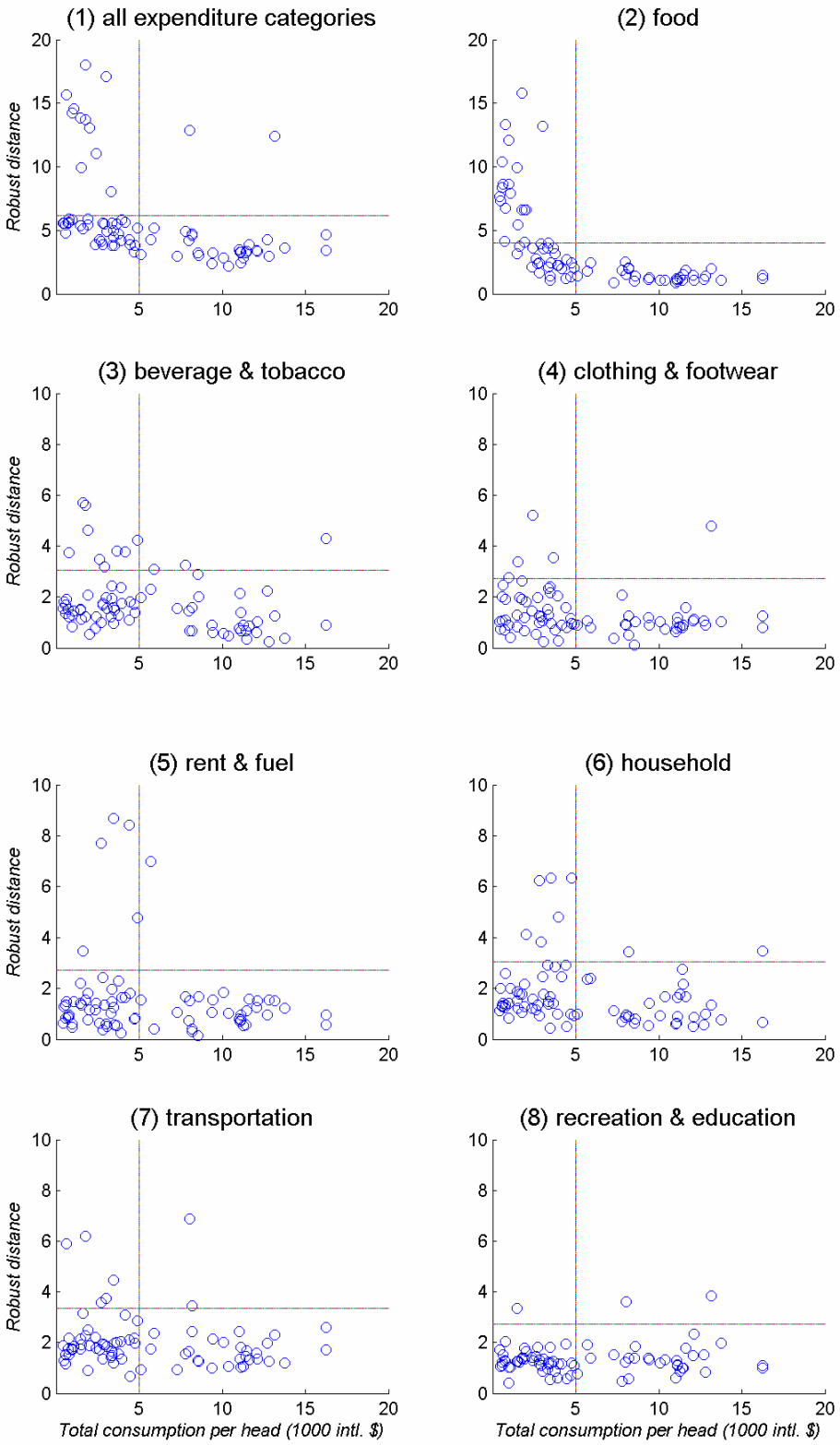


Table 2. The number of outlying countries in consumption shares

	Sample of 115 countries			Sample of 76 countries		
	Total	Poor	Rich	Total	Poor	Rich
1. All 23 consumption shares	25	23	2	13	11	2
Sub-categories:						
2. Food	31	31	0	19	19	0
3. Beverages & tobacco	13	12	1	12	9	3
4. Clothing & footwear	9	8	1	5	4	1
5. Rent & fuel	10	9	1	6	5	1
6. Household	19	14	5	8	6	2
7. Transportation	7	5	2	7	5	2
8. Education & recreation	5	3	2	3	1	2

Note: (a) multivariate outliers were tested by the MCD estimator (4);
(b) The division into rich and poor countries is done by the cutoff value of 5,000 international dollars of total consumption expenditures.

Table 3. The significance of sign test, rank tests, and Spearman rank correlation.

		The share of 'correct matches' in:				The number of significant rank correlations:	
		(a) sign test		(b) rank test			
Consumption shares in:		Sample median	p-value	Sample median	p-value	Correct	Incorrect
(a) sample of 108 countries							
	Exports	0.467	0.053	0.471	0.003	2	8
	Imports	0.600	<0.001	0.562	<0.001	10	1
(b) sample of 72 countries							
	Exports	0.467	0.096	0.476	0.093	2	5
	Imports	0.600	<0.001	0.590	<0.001	7	1
(c) sample of 38 countries							
	Exports	0.533	0.709	0.452	0.273	1	1
	Imports	0.533	0.588	0.500	0.942	0	0

Appendix table A1. List of full sample of 115 countries

Albania	Grenada[a, b]	Philippines
Antigua & Barbuda	Guinea	Poland[a]
Argentina[a]	Hong Kong[a,b]	Portugal[a,b]
Armenia	Hungary[c]	Qatar[c]
Australia[a,b]	Iceland[a,b]	Romania[a]
Austria[a,b]	Indonesia[a]	Russia[a]
Azerbaijan[a]	Iran[a]	Senegal[a]
Bahamas[c]	Ireland[a,b]	Sierra Leone
Bahrain	Israel[a,b]	Singapore[a,b]
Bangladesh	Italy[a,b]	Slovakia[a,b]
Barbados[c]	Jamaica	Slovenia[c]
Belarus	Japan[a,b]	Spain[a,b]
Belgium[a,b]	Jordan[a]	Sri Lanka[a]
Belize[a]	Kazakhstan[a]	St Kitts Nevis[a]
Benin[a]	Kenya[a]	St. Lucia[a]
Bermuda[c]	Korea Republic[a,b]	St.Vincent & Grenadines[a]
Bolivia[a]	Kyrgyzstan[a]	Swaziland
Botswana	Latvia[a]	Sweden[a,b]
Brazil[a]	Lebanon[a]	Switzerland[a,b]
Bulgaria	Lithuania[a]	Syrian Arab Republic
Cameroon	Luxemburg[a,b]	Tajikistan
Canada[a,b]	Macedonia	Tanzania
Chile[a]	Madagascar[a]	Thailand
Congo	Malawi[a]	Trinidad Tobago[a]
Cote D'Ivoire	Mali[a]	Tunisia
Croatia	Mauritius[a,b]	Turkey[a]
Czech Republic[a,b]	Mexico[a]	Turkmenistan
Denmark[a,b]	Moldova[a]	Ukraine[a]
Dominica[a]	Mongolia	United Kingdom[a,b]
Ecuador	Morocco	Uruguay[a]
Egypt[a]	Nepal[a]	USA[a,b]
Estonia[a]	Netherlands[a,b]	Uzbekistan
Fiji[a]	New Zealand[a,b]	Venezuela
Finland[a,b]	Nigeria[a]	Vietnam[a]
France[a,b]	Norway[a,b]	Yemen
Gabon	Oman[c]	Zambia[a]
Georgia[a]	Pakistan[a]	Zimbabwe
Germany[a,b]	Panama[a]	
Greece[a,b]	Peru	

[a]Country was in the 'high quality' subset of 76 countries

[b]Country was in the 'high income' subset of 38 countries

Appendix table A2. Consumption categories.

I. *FOOD*
1. Bread and cereals
2. Meat
3. Fish
4. Milk, cheese and eggs
5. Oils and fats
6. Fruits, vegetables, potatoes
7. Other food

II. *BEVERAGES & TOBACCO*
8. Non-alcoholic beverages
9. Alcoholic beverages
10. Tobacco

III. *CLOTHING & FOOTWARE*
11. Clothing
12. Footwear

IV. *RENT & FUEL*
13. Gross rent
14. Fuel and power

V. *HOUSEHOLD*
15. Furniture, floor coverings
16. Household textiles
17. Household appliances

VI. 18. *MEDICAL AND HEALTH SERVICES*

VII. *TRANSPORTATION*
19. Personal transportation equipment
20. Operation of transportation equip.
21. Purchased transport services
22. Communication

VIII. *RECREATION & EDUCATION*
23. Recreation and cultural services
24. Education

Appendix table A3. Missing data in StatsCanada

1. Sample of 108 countries
Antigua & Barbuda
Botswana
Dominica
Grenada
St. Lucia
St.Vincent & Grenadines
Swaziland

2. Sample of 72 countries
Dominica
Grenada
St. Lucia
St.Vincent & Grenadines

Appendix table A4. Concordance between ICP consumption categories and SITC (rev. 2) trade classification.

	ICP category	SITC trade classification
1.	Bread and cereals	04
2.	Meat	01
3.	Fish	03
4.	Milk, cheese and eggs	02, excl. 023
5.	Oils and fats	023+091+41+42
6.	Fruit, vegetables and potatoes	05, excl. 0583
7.	Other food	0583+06+07+09 (excl. 091)
8.	Non-alcoholic beverages	111
9.	Alcoholic beverages	112
10.	Tobacco	12
11.	Clothing	26+84
12.	Footwear	85
13.	Furniture, floor coverings	659+81+82
14.	Household textiles	658
15.	Household appliances	775

References

Ballance, Robert, Forstner, Helmut; Murray, Tracy, 1985. "On Measuring Comparative Advantage: A Note on Bowen´s Indices" *Weltwirtschaftliches Archiv,* 121, 346-350.

Best, D.J. and D.E. Roberts (1975) "Algorithm AS 89: The Upper Tail Probabilities of Spearman's *rho*". *Applied Statistics*, **24**, 377–379.

Bowen, Harry P., Leamer, Edward E, and Sveikauskas, Leo (1987). "Multicountry, Multifactor Tests of the Factor Abundance Theory," *American Economic Review*, 77 (5), 791-809.

Chung, Chul. 2000. "Factor Content of Trade: Nonhomothetic Preferences and 'Missing Trade'", *mimeo,* University of Michigan.

Davis, Donald R. and Weinstein, David E. (2003) "Market Access, Economic Geography and Comparative Advantage: An Empirical Test". *Journal of International Economics*, vol. 59, pp. 1-23.

Davis, Donald R., and David E. Weinstein (2001a). "An Account of Global Factor Trade", *American Economic Review*, December, 91(5), pp. 1423-1453.

Davis, Donald R., and David E. Weinstein (2001b). "The Factor Content of Trade", NBER working paper 8637. Forthcoming as a chapter in the *Handbook of International Trade*, edited by E. Kwan Choi and James Harrigan.

Davis, Donald R., David E. Weinstein, Scott Bradford, and Kazushige Shimpo. 1997. "Using International and Japanese Regional Data to Determine When the Factor Abundance Theory of Trade Works", *American Economic Review*, 97: 421-46.

Dowrick, Steve, and Quiggin, John, 1994. “International Comparisons of Living Standards and Tastes: A Revealed Preference Analysis”, *American Economic Review*, 84(1), 332-341.

Hanson, Gordon and Xiang, Chong (2004). “The Home-Market Effect and Bilateral Trade Patterns,” *American Economic Review*, 94 (4), 1108-1129.

Heston Alan, Summers, Robert and Aten, Bettina (2004), “Data Appendix for a Space-Time System of National Accounts: Penn World Table 6.1 (PWT 6.1)”, Center for International Comparisons at the University of Pennsylvania (CICUP), http://pwt.econ.upenn.edu/Documentation/append61.pdf.

Horiba, Yutaka, 1979. “Testing the Demand Side of Comparative Advantage Models," *American Economic Review*, 69, 650-661.

Hunter, Linda and James Markusen, 1988. “Per Capita Income as a Basis for Trade", in Robert Feenstra (ed), *Empirical Methods for International Trade*, MIT Press, Cambridge.

Hunter, Linda. 1991. “The Contribution of Nonhomothetic Preferences to Trade”, *Journal of International Economics*, 30, pp.345-358.

Kravis, I. B., Z. Kenessey, A. Heston and R. Summers (1975), *A System of International Comparisons of Gross Product and Purchasing Power*. Baltimore: Johns Hopkins University Press.

Leamer, Edward E. 2002. “Linking the Theory with the Data: That's the Core Problem of International Economics.” Forthcoming in James Heckman and Edward Leamer, eds. *Handbook of Econometrics*, Vol. 6.

Markusen, James R. (1986). "Explaining the Volume of Trade: an Eclectic Approach," *American Economics Review*, 76 (December), 1002-1011.

Matsuyama, Kiminori (2000) “A Ricardian Model with a Continuum of Goods under Nonhomothetic Preferences: Demand Complementarities, Income Distribution and North-South Trade," *Journal of Political Economy*, 108 (December 2000): 1093-1120.

Pena D., and Prieto F.J. (2001), "Multivariate Outlier Detection and Robust Covariance Matrix Estimation" (with discussion), *Technometrics*, 43 (3), 286-300.

Reimer, Jeffrey J. 2002. “Intermediate Goods and the Factor Content of Trade,” *mimeo*, Purdue University.

Rousseeuw, P.J. (1984), "Least Median of Squares Regression," Journal of the American Statistical Association, Vol. 79, pp. 871-881.

Rousseeuw, P.J. and Van Driessen, K. (1999), "A Fast Algorithm for the Minimum Covariance Determinant Estimator", *Technometrics*, 41 (3), 212-223.

Statistics Canada, 2002. *World Trade Analyzer*, 2002 CD-ROM. Ottawa: Statistics Canada.

Trefler, Daniel, 1995. "The Case of the Missing Trade and Other Mysteries", *American Economic Review*, v. 85, 1029-1046.

World Bank, 2002. *World Development Indicators 2001, CD-ROM*. Washington, D.C.: World Bank.