Usable Data? Matched Partner Trade Statistics as a Measure of International Transportation Costs.

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Abstract:

Data on transportation costs are difficult to obtain. In the absence of good data, many researchers have turned to indirect measures of transportation costs constructed using matched partner cif/fob ratios from IMF and UN data. We investigate whether these data are usable, by comparing their levels and variation to directly measured transport costs for the US and New Zealand. We find that IMF cif/fob ratios are badly error-ridden in levels, and contain no useful information for time series or cross-commodity variation. However, the IMF data do appear to reveal some meaningful cross-exporter variation that might be usefully exploited by researchers.

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I. Introduction

Transportation costs have begun to play a central role in theoretical and empirical analyses of international trade. Models designed to study economic geography, the behavior of multinational firms, the growth of fragmentation/vertical specialization, and the optimality of preferential trade arrangements all highlight trade costs. Trefler (1995) and Davis and Weinstein (2001) propose trade costs as a primary explanation for the celebrated absence of factor content in trade. Obstfeld and Rogoff (2002) point to trade costs as a key component in explaining six major puzzles in open economy macroeconomics. This work collectively suggests that high quality measures of transportation costs would be of great value to researchers.

Unfortunately, very few countries report detailed information on shipping costs as part of their trade statistics. Despite exhaustive effort, the authors of this study have only been able to identify lengthy time series on shipping for the imports of the US and New Zealand.[1] In the absence of direct measures, one alternative is to employ indirect measures of transportation costs constructed using a "matched partner" technique. In principle, exporting countries report trade flows exclusive of freight and insurance (fob), and importing countries report flows inclusive of freight and insurance (cif). Comparing the valuation of the same flow reported by both the importer and exporter yields a difference equal to transport costs.

The most comprehensive source of matched partner cif/fob ratios is the IMF Direction of Trade Statistics (DOTS). The advantage of the IMF DOTS data is breadth of coverage: they are available for many years (1948-present) and include those countries engaged in the vast majority of world trade.[2] Because of their availability and coverage, IMF cif/fob ratios have been used by several authors to assess the effect of transportation costs on trade.[3] Even UNCTAD's *Review of Maritime Transport*, the pre-eminent annual publication on international transportation and trade issues, relies heavily on IMF cif/fob ratios to calculate ad-valorem shipping costs on a worldwide basis.

The open question is whether the matched partner technique results in usable data, that is, a measure of shipping costs that approximates actual costs to a degree that researchers could be

[1] A few additional countries have transport data available in cross-section.
[2] Forty one of the largest countries are available in every year of the data, and well over one hundred countries are represented in most of the available time series.

comfortable substituting them for direct measures. Were the matched partner cif/fob ratios usable in this sense, it would be a great boon for trade researchers and plug an important hole in the data record.

There is good reason to be skeptical. The matched partner technique relies on independent reports of the same trade flow that may differ for reasons other than shipping costs. For example, statistical offices in the exporter and importer may value goods differently because the goods' price or the exchange rate changes mid-shipment. Importers may track shipments more carefully than exporters in order to levy tariffs, leading to valuation differences from missing exporter data. Comparing across exporters, one might see differences in cif/fob ratios if two exporters include different elements of inland shipping in the fob valuation. (Are goods valued at the factory gate? At dockside? After being placed on board?) When comparing across commodities, difficulties may exist if the importer and exporter disagree on the correct commodity classification of a particular good.

These discrepancies need not be large to have a considerable impact on the measured cif/fob ratio. For example, start with a cif/fob ratio of 1.06, which implies transportation costs of 6 percent ad-valorem. Now, increase the importer's cif value of trade by 1.5 percent and decrease the exporter's fob value by 1.5 percent. The cif/fob ratio becomes 1.09, changing implied transport costs by 50 percent.

Yeats (1978) provides an early examination of the quality of matched partner data by comparing cif/fob ratios constructed from UN COMTRADE data to shipping cost data collected from US imports in 1974. This analysis primarily consists of decomposing observed variation in matched partner cif/fob ratios into a portion attributable to shipping costs (signal) and a remaining unexplained portion (noise). Yeats finds that the matched partner cif/fob data contains a significant amount of noise. However, some exporters and some commodities report very little error, and the degree of signal appears to increase with aggregation.

Of course, data can contain errors and still be usable. The matched partner cif/fob data might strongly co-vary with direct measures of shipping costs despite being systematically wrong in levels. (Imagine a regression line with a slope of exactly one but a positive intercept.) Differences across exporters in valuation rules might mean that matched partner data are poor

[3] Examples include Geraci and Prewo (1977), Rose (1991), Harrigan (1993), Baier and Bergstrand (2001) and Limao and Venables (2001).

measures of cross-exporter variation. However, if those valuation rules change little over time, the matched partner technique may provide an excellent source of time series information. Finally, inconsistencies in goods classification could yield terrible measures of commodity-level shipping costs yet aggregate data would still closely match true costs.

The possibility that different data dimensions may vary in their quality is directly relevant to how we interpret the results from existing papers in the literature. Many papers use cif/fob ratios, but they typically exploit different dimensions of variation. For example, Rose (1991), and Baier and Bergstrand (2001) rely on panel variation in aggregate bilateral cif/fob ratios in order to relate trade growth to changes in transportation costs. Limao and Venables (2001) also relate trade volumes to cif/fob ratios, but exploit cross-sectional variation. Geraci and Prewo (1977) and Harrigan (1993) similarly employ cross-sectional variation, but directly address the quality problems with cif/fob ratios through an errors in variables approach.

Our goal in this paper is to inform researchers under which conditions the matched partner data are usable. We examine matched partner cif/fob ratios, constructed for aggregate trade from the IMF Direction of Trade Statistics (DOTS), and for commodity level trade from the UN COMTRADE database. We compare these data, in the cross-section and in the time series, to explicitly collected shipping cost data for the United States and New Zealand. The comparison emphasizes which dimensions (cross-exporter, cross-commodity, time series) of the matched partner data contain variation useful to researchers.

It should be emphasized that this analysis is not in any way intended as a criticism of the trade data provided by the IMF. Their purpose in compiling the Direction of Trade Statistics is to provide accurate statistics for balance of payments purposes, not to measure transportation costs. Accordingly, we do not believe it appropriate to criticize the data as “wrong”, as if the IMF had been doing a slipshod job of data collection. Instead we ask merely whether the cif/fob ratios as they exist can be gainfully employed as a measure of transportation costs.

Section II describes the data. Section III provides comparisons between freight rates measured using IMF and national source data. Section IV concludes.

II. Data Description

The matched partner cif/fob ratio technique can be applied to any data set that includes both importer and exporter report of the same trade flow. This paper analyzes aggregate bilateral cif/fob ratios constructed from the IMF DOTS data tapes and commodity-level bilateral cif/fob ratios constructed from the UN's COMTRADE database. The IMF data offer broad coverage of years and countries. They are also readily available to researchers and so are ideal for this analysis.

There are actually three IMF sources that report cif/fob ratios: the DOTS data tapes contain bilateral data aggregated over all commodities, while *DOTS* yearbooks and the *International Financial Statistics* (IFS) contain trade data that are aggregated over all commodities and partners for a particular importer. All report trade flows using as a primary source the UN's *COMTRADE* database, with *COMTRADE* supplemented in some cases by national data sources. In this study we employ only the DOTS data tapes. The reason is that the data tapes contain richer (bilateral) variation, and because the other two IMF sources contain significant data errors.

To explain, when comparing the three IMF sources one finds consistent reports on the level of trade for a given country. However, cif/fob ratios are not consistently reported. Indeed, there appears to be no correlation between cif/fob ratios obtained from the three IMF sources. Each *DOTS* yearbook reports multiple overlapping years, with later years attempting to reconcile previous discrepancies. These changes are usually small relative to the level of trade, with variations no greater than one to two percent annually. However, the changes can be large relative to cif/fob ratios so that the implied value of transport costs for a single year swings wildly about in different yearbooks. For example, the US cif/fob ratio for 1970 is reported variously as 1.13, 1.09, or 1.06, depending on which edition of the yearbook is consulted.

The *IFS* data are similarly unreliable, as the IMF relies heavily on a 10% imputation rule. If no importer (cif) data are available, the IMF imputes a value of 10% over the exporter's (fob) value; if no exporter data are available, a 9% reduction from the cif value is used to construct the fob number. Missing reports are a severe problem in the UN *COMTRADE* data underlying the IMF data. Between 1962 and 1983, the data contain reports on aggregate trade flows from both partners for fewer than 40 percent of the bilateral pairings.[4] As a consequence, approximately half of the available cif/fob ratios from the IFS are exactly equal to 1.1.

[4] Dropping those bilateral pairs with an implied negative transport cost (cif/fob ratios less than one), or with transport costs exceeding twice the value of the goods shipped, the data contain usable reports from both partners for fewer than 25 percent of pairings. The problem is much worse for commodity level data, which casts doubt on the accuracy of the aggregate figures.

Turning to the DOTS data tapes that form the basis of the study, we employ data from 1948 – 1997. Table 1a reports the number of importers, exporters, and number of cif/fob ratios available at 10-year increments. Note that the number of cif/fob ratios is not equal to the product of importers and exporters. A cif/fob ratio may be missing because the importer (cif) report is missing; the exporter (fob) report is missing; or both (which may indicate no trade took place). In addition, a large number of cif/fob ratios may lie outside a reasonable range of data variation. We define the reasonable range as (1,2), implying an ad-valorem transportation cost between 0 and 100 percent. Table 1b provides more detail on the source of missing data, reported on an unweighted (simple count), and trade-weighted basis. On an unweighted basis, around 12 percent of all bilateral pairs report cif/fob ratios in a reasonable range for the early years of the sample, with the number rising to almost half in later years. On a trade-weighted basis, around two-thirds of all observations lie in the reasonable range.

For comparison to the IMF DOTS and UN COMTRADE data we use data on ad-valorem transportation costs collected by two national data sources. Statistics New Zealand and US Census Bureau require firms to report the (fob) value of trade at the point of export as well as the charges paid in shipping the goods. The sum of the fob value and the shipping charge is the cif value. The data are available for 1974-1997 for the US via the "US Imports of Merchandise" CD-ROMS.[5] They are reported at a highly disaggregated level. To compare with the IMF DOTS data, we construct an aggregate ad-valorem transportation cost for each exporter by summing charges and fob values over all commodities, and taking the ratio. When comparing with the COMTRADE data, we sum over all commodities within each 2-digit SITC (rev 1) category.

The New Zealand data 1964-1986 come from the serial "New Zealand Imports" and contain aggregate values of trade valued cif and fob for each exporter. Statistics New Zealand provided a special extract of their trade data from 1988-1997 in electronic format, reporting fob values and transport charges at the five-digit SITC (rev 2) level for each exporter. The data source changes between periods, and the fob valuation of goods may not be the same in each case. Specifically, from 1964-1986 we observe NZ's cif and fob valuation of the good rather than an explicit field for transport charges as in 1988-1997. Among other problems, the earlier

[5] See Feenstra (1997) for details on these data.

NZ data imply negative transport costs for a handful of exporters in some years. Accordingly we check results to see if they are robust pre- and post-1988.

III. Analyzing Bilateral CIF/FOB Ratios

Throughout our analysis we model the national data source as the "true" value of the variable in question. We then examine whether the IMF data are equal to, or at least correlated with, the true variation. Before turning to the quality of the cif/fob ratios, we examine the accuracy of the IMF bilateral trade data in levels. Denote exporters by j, importers by i, and time by t, and denote data reported from the IMF with star superscripts. We can then relate the level of bilateral trade as reported by IMF and national data sources as follows[6].

(1.1) $$CIF_{ijt}^{*} = \alpha + \beta(CIF_{ijt}) + \varepsilon_{ijt}$$

(1.2) $$FOB_{ijt}^{*} = \alpha + \beta(FOB_{ijt}) + \varepsilon_{ijt}$$

If the data sources are very similar we should estimate $\beta = 1$, with a high R2.

Table 2 reports coefficient estimates from equations (1.1) and (1.2) separately for the US and for New Zealand, as well as for a pooled sample. For the US and in the pooled sample we find that the IMF data are highly correlated with the national data source with high R2, but the coefficient is significantly different from one. However, the coefficients on cif and fob valuations are quite close. This means that while the IMF data understate large trade flows, they do so uniformly for cif and fob valuations. In constrast, the cif and fob coefficients are quite different for the IMF data on NZ imports. The IMF data overstate large trade flows on a cif basis, but understate large trade flows on a fob basis. Further the regression fit is considerably lower, indicating a nontrivial degree of noise.

It is possible that some exporters have consistently better trade data owing to the quality of their national statistical agency. We also report estimates that restrict the set of exporters to

[6] US and IMF data are reported in nominal US dollars. These are deflated by the US GDP deflator. NZ data are reported in NZ dollars, and are first converted to US dollars at the (averaged) annual exchange rate then deflated with the US GDP deflator.

include only OECD countries. The US and the pooled data now have coefficients insignificantly different from one with high R2. The NZ data have coefficients close to one, but now show considerably worse fit. These patterns in trade levels will turn out to be reflected in the cif/fob ratios we examine below.[7]

The level of cif / fob ratios

The IMF data are reasonably well matched to national source data in trade levels. Are they also accurate measures of implied transportation costs? We first analyze aggregate bilateral cif/fob ratios. Figures 1 and 2 report the range of variation in implied ad-valorem freight rates, $f = (cif / fob) - 1$, for US and New Zealand imports appearing in national data and in the IMF data sources. The national data sources show that the vast majority of observations lie between 0 and 30 percent, with US Census and Statistics NZ data reporting roughly 99% and 80% of the observations in this range, respectively. In contrast, IMF data sources show around 40% of the observations lie in the 0-30 percent range for both US and NZ trade. Substantial fractions (38 percent for US imports; 28 percent for NZ) lie below zero, implying negative transportation costs. Transportation costs exceeding the value of the goods being shipped constitute nearly one-tenth of the IMF data.

For the remaining exercises in the paper, we restrict ourselves to analyzing only the IMF cif/fob ratios that lie in the (1,2) range, implying ad-valorem transportation costs of 0% to 100%. Employing only data in this range, we calculate the size of the error in the IMF data as follows. Again denoting IMF data with a *, define the error as

(1.3) $$E_{ijt} = \left| \ln(cif^{*}_{ijt} / fob^{*}_{ijt}) - \ln(cif_{ijt} / fob_{ijt}) \right|$$

Note that since cif/fob = 1 + f, for small values of the freight rate the error will be approximately equal to the difference in the freight rate observed in the two sources. The distribution of errors is reported in Figure 3. In over half of the cases, errors are less than 10 percent, which doesn't seem overly noisy. However, if we measured the errors in percentage terms relative to the ad-valorem freight rate $e = (f^{*} - f) / f$, the errors are much larger. That is, an error of .10 does not

[7] We also estimated equations (1.1) and (1.2) in logs. Results are similar for the US, but much worse for NZ, with

seem big, until compared to an ad-valorem freight rate of .05. In fact, more than four-fifths of our observations have errors at least as big as the implied ad-valorem rate being measured. Again, this is *after* throwing out the half of the IMF observations because they lie outside of reasonable bounds on shipping costs. If IMF data on the value of trade (cif and fob) are reasonably accurate, why are there such large errors when constructing the implied freight rates from the cif/fob ratio? The answer goes back to our example in the introduction – because we are taking a ratio, small errors are magnified.

Some countries have systematically lower errors than others. To show this, we calculate an analysis of variance of the errors in equation (1.3). We report the ANOVA in Table 3 using separate samples for the US and New Zealand, as well as a pooled sample. Treatment variables include years and exporters, and in the pooled sample, importers as well. This table reveals that 30-40 percent of variation in errors is exporter and year specific.

Which exporters have the least noisy data? Using the pooled sample, we calculate the mean and standard deviation of the error for each exporter and report these in Appendix Table 1. Richer exporters, presumably those with better national statistical agencies, have lower errors throughout the sample. The sample correlation between mean errors and per capita income is -0.21.

Some caution should be exercised in interpreting this result. Presumably if a country has low errors because of a better statistical agency, those low errors should exist for all importers. We constructed rankings like the appendix table separately for US and New Zealand imports and found that the rank correlation between the two lists was zero. In other words, an exporter may have smaller than average-sized errors in the US data, but average-sized errors in the New Zealand data. This gives us pause in hypothesizing about the size of errors in other import markets.

In summary, the levels of transportation costs implied by IMF cif/fob ratios are dramatically different from explicitly collected data on shipping costs. We conclude that it would be extremely unwise to make use of these data in exercises where the level of the cost is an important issue.

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an estimated elasticity of 0.4 and low R2.

Variation in cif / fob ratios

As we argued in the introduction, the cif/fob ratios may depart wildly from true values in *levels* while still containing useful information about *variation* in shipping costs. We next examine whether the variation in freight rates implied by the IMF cif/fob ratios reflects variation in explicitly measured freight rates taken from national data sources. We employ a simple panel regression.

(1.4) $$\ln(cif^*_{ijt} / fob^*_{ijt}) = \alpha + \beta \ln(cif_{ijt} / fob_{ijt}) + \varepsilon_{jt}$$

A test of data quality comes again from looking both at the regression coefficient and the R2. The closer each is to one, the better the data.

We estimate equation (1.4) separately for the US and New Zealand, as well as pooling over both countries. We also experiment with including year or exporter fixed effects. This allows us to examine whether IMF and national data sources co-vary on one dimension but not another. For example, it may be that the IMF data accurately capture cross-sectional variation in national data sources but fail to identify time series variation. Alternatively, one likely source of error lies in exporter-specific misreporting of trade flows. If this misreporting is consistent over time we can control for it with an exporter fixed effect.

We include only the 1974-1997 period that is present in all three (IMF, US, NZ) datasets in order to have consistent data frames across samples. Extending the NZ series back to 1964 does not qualitatively change any of the results. We also provide separate estimates that examine the last 10 years. Table 1 reveals that the number of observations lying in a reasonable range of implied transportation costs (0-100% ad-valorem) increases markedly in the last 10 years of the sample. We take this as a rough indicator that IMF data quality could be improving. Also the quality of the NZ data are markedly better in the last 10 years, coming directly from shipper's reports of transport charges.

We report results in Table 4. Considering variation across all exporters, freight rates constructed from IMF data are positively correlated with national source data. However, the regression fit is very poor with R2's of .00 and .02 for the US and New Zealand. Pooling the data helps slightly. The reason is that freight rates for New Zealand imports are systematically higher than the US imports in both IMF and national data sources, likely because NZ is a long distance from most export sources. (Imagine two spherical scatter clouds centered on (.1,.1) and (.2,.2). A regression fit separately through either reveals mostly noise, but the pronounced difference in the means of the US and NZ data yields some fit in the pooled regression.) Looking only at the higher quality data period, 1988-1997, we see only small changes relative to the entire sample

The regressions employing exporters fixed effects are instructive. The exporters fixed effects are jointly significant, which suggests that the level of freight rates from the IMF data are systematically related to the exporting country Why do exporter fixed effects figure prominently in the Table 3 regressions? We consider two explanations: exporter-specific measurement error and data variation linked to true variability in shipping costs.

Recall that the IMF data rely on the exporter's report of the trade flow to construct the cif/fob ratio. Systematic over- or under-reporting of trade by an exporter would show up precisely in the manner we see in Table 3, and we know from the analysis of variance in Table 2 that much of the error is exporter-specific. As a simple cut, we restrict our sample to OECD exporters and repeat the regressions, reporting them in Table 4. For the US importer and the pooled regressions we see a marked improvement relative to the "all exporter" set. For these samples we find 5 of 6 coefficients that are not significantly different from one in the long time sample. The data are still quite noisy, but we see that some signal is being revealed. The NZ data, in constrast, are much worse when restricted to OECD exporters. This is consistent with evidence in Table 2 showing that reporting errors in trade levels (cif and fob) are worse for NZ's trade with the OECD.

A second possibility is that exporter fixed effects matter because the IMF data are picking up true variation in the cross-section. Previous work shows that transportation costs are highly correlated with distance shipped and the weight/value ratio of the shipment.[8] We regress freight rates from the IMF on these variables to see if it is possible to discern the source of the cross-sectional signal in the IMF data.

$$\ln(cif^*_{ijt} / fob^*_{ijt}) = \alpha + \beta_1 \ln(DIST_{ij}) + \beta_2 \ln\left(wgt / val\right)_{ijt} + e_{ijt} \quad (1.5)$$

The distance variable is calculated as the Great Circle Distance between national capitals of the importer and exporter. To construct the aggregate weight to value ratio for each bilateral pair in each year we first use US Census Imports of Merchandise data to calculate an average weight/value ratio for each 4-digit SITC commodity in each year (deflating values by the US GDP deflator).[9] We then used the Statistics Canada World Trade Database for 1970-1997 to provide the value of trade between each bilateral pair in a 4-digit SITC commodity. Multiplying these values together provides a shipment weight for each bilateral pair x commodity x year. Summing weight and value over all commodities for a given pair and year allows us to obtain an aggregate weight to value ratio.

The results of the estimation are provided in Table 6. We employ four importer samples: US as importer, NZ as importer, the two pooled, and all importers in the IMF data. We also restrict the samples to include only OECD exporters. For comparison we also report the same regressions using national data on transport costs.

IMF cif / fob data is significantly related to the distance and aggregate weight/value variables, with coefficients similar to those from the pooled regression on national data. While the fit is quite low for both IMF and national data sets, there does appear to be an economically sensible signal in the data – shipping costs are higher for pairs that are further apart and ship heavy goods. Looking only at OECD exporters we see much better fits in the pooled regressions – 30 percent of the variation is explained by the included variables.

The distance variable has only cross-sectional variation, while the weight/value ratio varies over time only to the extent that the commodity composition of trade for a bilateral pair changes. We experiment with two approaches designed to pick up more of the time series variation in the IMF data. First we include oil prices. We find that increased oil prices raise shipping costs reported in the national data sources, but they do not robustly affect the IMF data.

Second, we allow the coefficients on distance and weight/value to vary yearly. This can be thought of as technological change. The distance between the UK and the US does not change and the commodity composition of trade changes little over time. However, shipping

[8] See Hummels (1999), Moneta (1959). Limao and Venables (2001) also explore the correlates of cif/fob ratios and employ data on exporter and importer infrastructure. Harrigan (1993) uses distance as an instrument for explaining cif/fob ratios.

technology does change and with it, the coefficients on these variables. We can't reject that these coefficients vary over time, but the resulting differences are quite small and are not robust across samples within the IMF data. That is, a year in which the distance coefficient is high for the US sample does not correspond to a year in which the coefficient is high for the NZ sample. Neither can we match this time series variation to estimates taken from national data sources.

From these two exercises we conclude that we have some (limited) ability to fit cross-section variation in the IMF data, but very little ability to say anything about the time series. If we restrict ourselves to examining only this signal portion of the IMF data, can we do a better job of matching freight rates from national data? We construct predicted values for IMF freight rates using the estimates from equation (1.5) and regress them on national source data with and without year fixed effects.[10]

We report results in Table 7. We find that the fitted rates match the national source data much more closely than the raw data. This is especially pronounced when examining OECD exporters only in the US importer and pooled samples.

This exercise indicates that the IMF data might be better used as part of an instrumental variables approach for estimation. When right hand side variables are measured with error, it is standard to use an instrumental variables approach to separate the signal from measurement error noise. The results in Table 5 reveal that the IMF data can be related to plausible correlates in the cross-section. The results in Table 6 reveal that fitted values might reasonably replace directly measured freight rates from national sources. An example of this approach can be found in Harrigan (1993) using matched partner cif/fob ratios from the OECD.

Commodity Level Regressions

Finally, we examine whether the matched partner technique yields usable information for cross-commodity transportation costs. For many purposes it is useful to have data on shipping costs at the commodity level. The IMF DOTS tapes include only aggregate flows and so we turn to UN COMTRADE data, which report matched partner trade flows down to the 5 digit level of SITC rev. 1. Unfortunately, missing and nonsensical data are a serious problem at this level. By

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[9] The weight/value ratio for each commodity is constructed as a trade weighted average of all shipments from all sources in that commodity.

[10] We do not employ exporter fixed effects. This is because the fitted IMF rates contain very little time series variation and are essentially exporter-specific.

aggregating up to 2-digit data we are able to find roughly 10 percent of observations that have matched statistics lying in a reasonable range of shipping costs (0 to 100 percent ad-valorem).[11]

We relate transportation charges implied by COMTRADE data to transportation charges from US data using regressions that are identical to those in equation (1.4), with the exception that commodity variation is also included. We have COMTRADE data for 1962-1983, providing an overlap with US data from 1974-1983.[12] We experiment with including year, exporter, and commodity intercepts, singly and in combination. Results are in Table 8.

The basic message is that commodity level variation in the COMTRADE freight data are negatively correlated with US freight data. The same is true whether we look at all exporters or only at OECD exporters. Including commodity intercepts flips the sign of the coefficient in the all exporter case, but this is not a particularly helpful regression. It essentially says that commodity level COMTRADE freight rates are positively correlated with directly measured rates only when we use intercepts to remove all commodity-specific variation!

IV. Conclusions

Directly measured data on transportation costs data are difficult to obtain. In the absence of directly measured data, many have turned to indirect measures of transportation costs constructed using a matched partner technique. We investigate whether these data are usable, by comparing their levels and variation (over goods, exporters, and time) to directly measured transport costs for the US and New Zealand.

We have four main results. One, we find that matched partner data depart radically from national source data in levels. Roughly half of all observations in the IMF DOTS database lie outside a reasonable range of variation (ad-valorem costs between 0 and 100%). The remaining observations contain substantial errors in levels. Two, variation in IMF freight data are significantly correlated with national source data, though they are quite noisy. The regression fit, which we regard as an indicator of the "signal" in the IMF data, improves when restricting one's attention to rich exporters (the OECD). Three, this signal is also significantly related to plausible

[11] Of the remaining observations, approximately 75 percent are missing data from one partner making it impossible to construct the cif/fob ratio. Another 15 percent contain matched statistics but the cif/fob ratio implies negative transport costs or costs exceeding the value of the shipment.

[12] Our commodity level data from NZ do not begin until 1988.

correlates – IMF freight data are positively related to the distance between trading partners and the weight of the goods shipped between them. Fitting the IMF data to these correlates yields a much closer match to national source data . Four, cross-commodity variation in freight rates constructed using the matched partner technique is *negatively* correlated with national source data.

From this we conclude that it would be very unwise to use data constructed from the matched partner technique for any exercise where the level of (as opposed to the variation in) transportation costs matters. Examples include choosing parameters for model calibration, or the use of shipping costs in structural regressions where one wants to directly interpret the magnitude of the coefficient. It would also be unwise to try and exploit any cross-commodity variation in the matched partner data.

However, the matched partner data may be useful as a rough control variable for aggregate bilateral transportation costs. They may be especially helpful if used in combination with an instrumental variables technique in which matched partner data are first fitted to plausible correlates and then employed as controls.

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Table 1 Data Availability
IMF CIF/FOB Ratios

	All IMF Data			CIF/FOB in (1,2) Range*		
Years	# of importers	# of exporters	# cif/fob ratios	# of importers	# of exporters	# cif/fob ratios
48	106	106	3153	85	83	1317
58	113	113	3751	97	95	1607
68	151	148	6197	137	135	2689
78	169	167	9149	144	143	3582
88	186	185	13877	186	184	6990
97	201	201	17790	201	201	12780

Percentage of Total Bilateral Pairings with…						
Years	Cif/Fob Unavailable		CIF/FOB Out of Range		CIF/FOB in Range	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
48	69.97	18.74	17.49	15.27	12.54	65.98
58	65.79	17.56	19.55	31.61	14.65	50.84
68	65.19	14.80	19.70	27.20	15.10	58.00
78	60.99	15.86	23.74	29.52	15.27	54.62
88	46.84	13.77	26.38	21.21	26.78	65.02
97	35.20	16.33	18.25	20.36	46.55	63.31

Notes:
1. The CIF/FOB ratio may be unavailable because a bilateral pair has zero trade or because only one partner in the pair reports a positive trade flow.
2. "In range" refers to CIF/FOB ratios lying in range (1,2). Below 1 implies negative transport costs. Above 2 implies transportation costs exceeding value of the shipment.
3. Weights are the percentage of that bilateral flow in observed world trade for that year.

Table 2 Comparing Trade Levels
IMF DOTS v. National Data Sources

Source of independent Variable	Dep. Var (Source: IMF data set)						
	CIF Level of Trade			FOB Level of Trade			# of obs
	Constant (se)	Coefficient (se)	R^2	Constant (se)	Coefficient (se)	R^2	
US Census	-143 (53)	.910 (.005)	.94	-217 (53)	.888 (.005)	.94	2169
Stats NZ	22 (5)	1.102 (.018)	.82	21 (4)	.913 (.017)	.82	845
Pooled US + NZ	-90 (37)	.908 (.004)	.94	-146 (38)	.886 (.004)	.94	3014
OECD Exporters							
US Census	-737 (025)	.990 (.011)	.96	-766 (228)	.991 (.010)	.97	326
Stats NZ	64 (15)	.997 (.041)	.71	53 (13)	.895 (.041)	.66	244
Pooled US + NZ	-352 (137)	.983 (.008)	.96	-379 (126)	.983 (.008)	.97	570

Table 3 Analysis of Variance on CIF/FOB Errors

Sum of Squares	Importer Sample			
	USA	NZ	Pooled Data	Polled Data
Model	15.95 (38%)	3.92 (29%)	16.09 (29%)	13.24 (23%)
Exporter	14.29 (34%)	3.52 (26%)	13.59 (24%)	13.24 (23%)
Year	1.49 (4%)	0.36 (3%)	1.88 (3%)	
Importer			1.28 (2%)	
Residual	26.04 (62%)	9.47 (71%)	40.34 (71%)	43.19 (77%)
Total	41.99	13.39	56.44	56.43

Table 4 Comparing CIF/FOB Ratios
IMF v. National Data Sources

Importer	Regression Results years 1974-97			Dummy variables		Regression Results years 1988-97		
	Coefficient (se)	R^2 (within R2)	# of obs	Year	Exporter	Coefficient (se)	R^2 (within R2)	# of obs
USA	.22 (.08)	.00	2169			.20 (.11)	.00	1061
	.12 (.08)	.00 (.00)	2169	yes		.15 (.11)	.00 (.00)	1061
	.28 (.10)	.00 (.00)	2169		yes	.36 (.15)	.00 (.01)	1061
NZ	.19 (.05)	.02	845			.19 (.06)	.02	555
	.18 (.05)	.02 (.01)	845	yes		.18 (.06)	.01 (.01)	555
	.14 (.09)	.02 (.00)	845		yes	.21 (.13)	.02 (.01)	555
Pooled US and NZ	.36 (.04)	.02	3014			.41 (.05)	.04	1616
	.35 (.04)	.02 (.02)	3014	yes		.40 (.05)	.04 (.04)	1616
	.43 (.05)	.03 (.02)	3014		yes	.47 (.06)	.04 (.05)	1616

Table 5 Comparing CIF/FOB Ratios
OECD Exporters Only

Importer	Regression Results years 1974-97			Dummy variables		Regression Results years 1988-97		
	Coefficient	R^2 (within R2)	# of obs	Year	Exporter	Coefficient	R^2 (within R2)	# of obs
USA	1.04 (.18)	.09	326			1.60 (.32)	.14	153
	1.06 (.21)	.09 (.08)	326	yes		1.63 (.34)	.14 (.14)	153
	.94 (.29)	.09 (.03)	326		yes	2.31 (.85)	.14 (.05)	153
NZ	-.02 (.23)	.00	244			-.34 (.37)	.01	156
	.06 (.23)	.00 (.00)	244	yes		-.33 (.40)	.01 (.00)	156
	.05 (.30)	.00 (.00)	244		yes	.16 (.52)	.01 (.00)	156
Pooled US and NZ	1.17 (.15)	.09	570			1.94 (.23)	.18	309
	1.25 (.16)	.09 (.10)	570	yes		2.05 (.24)	.18 (.20)	309
	1.61 (.04)	.09 (.13)	570		yes	2.69 (.26)	.18 (.28)	309

Table 6 Predicting CIF/FOB Ratios

Data Source	Importer	distance (log)	Aggregate Weight / Value (log)	R^2	# obs
IMF	US + NZ	.030 (.005)	.017 (.002)	.03	2916
	US	-.001 (.005)	.022 (.002)	.04	2090
	NZ	.055 (.015)	.016 (.005)	.02	826
	All	.026 (.001)	.012 (.0004)	.02	92762
National Data	US + NZ	.026 (.002)	.010 (.001)	.08	2916
	US	.010 (.001)	.008 (.0006)	.08	2090
	NZ	.002 (.008)	.024 (.003)	.09	826
OECD Exporters					
IMF	US + NZ	0.151 (.009)	.014 (.006)	.30	570
	US	.039 (.020)	.034 (.006)	.11	326
	NZ	0.127 (.036)	-.010 (.012)	.05	244
	All	.045 (.002)	.017 (.002)	.14	5184
National Data	US + NZ	.041 (.002)	.017 (.001)	.37	570
	US	.054 (.005)	.012 (.001)	.40	326
	NZ	.003 (.008)	.028 (.003)	.27	244

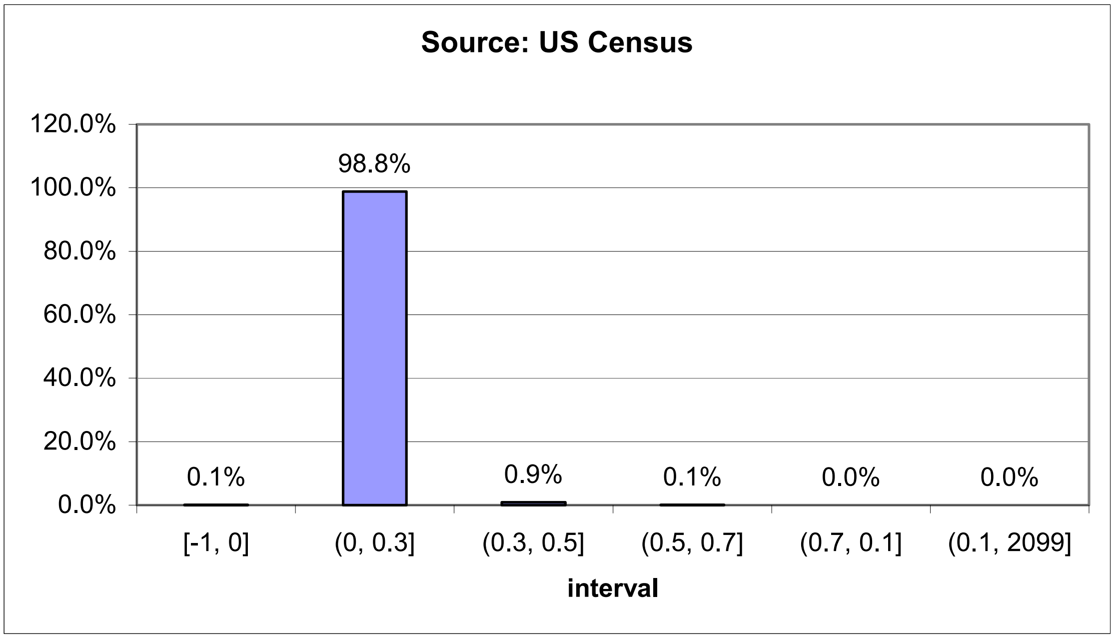
Table 7. Comparing Fitted IMF CIF/FOB Ratios to National Data

Importer	Dep Var: Fitted IMF CIF/FOB Ratios (logs)			Dummy variables
	Coefficient	R^2 (within R^2)	# of obs	Year
US	.16 (.01)	.05	2090	
	.13 (.01)	.05 (.04)	2090	yes
NZ	.05 (.01)	.03	826	
	.05 (.01)	.03 (.03)	826	yes
US + NZ	.108 (.007)	.07	2916	
	.107 (.007)	.07 (.08)	2916	yes
OECD Exporters				
US	.63 (.05)	.30	326	
	.51 (.06)	.30 (.20)	326	yes
NZ	-.10 (.05)	.02	244	
	-.08 (.05)	.02 (.01)	244	yes
US + NZ	1.07 (.08)	.27	570	
	1.11 (.08)	.27 (.28)	570	yes

Table 8 Comparing Commodity Level CIF/FOB Ratios
UN COMTRADE v. National Data Sources

Complete data set. (9831 observations)		Dummy variables included			OECD Exporters (3634 observations)	
Coefficient (se)	R^2	Year	Exporter	Commodity	Coefficient (se)	R^2
-.33 (.11)	.00				.15 (.18)	.00
-.33 (.11)	.00	yes			.16 (.18)	.00
-.62 (.01)	.08		yes		.09 (.19)	.02
.21 (.12)	.12			yes	-.20 (.20)	.20
-.62 (.11)	.08	yes	yes		.09 (.19)	.02
-.27 (.12)	.19		yes	yes	-.51 (.21)	.24
.21 (.12)	.12	yes		yes	-.19 (.20)	.20

Figure 1 – Distribution of ad-valorem freight rates in US imports 1974-1997



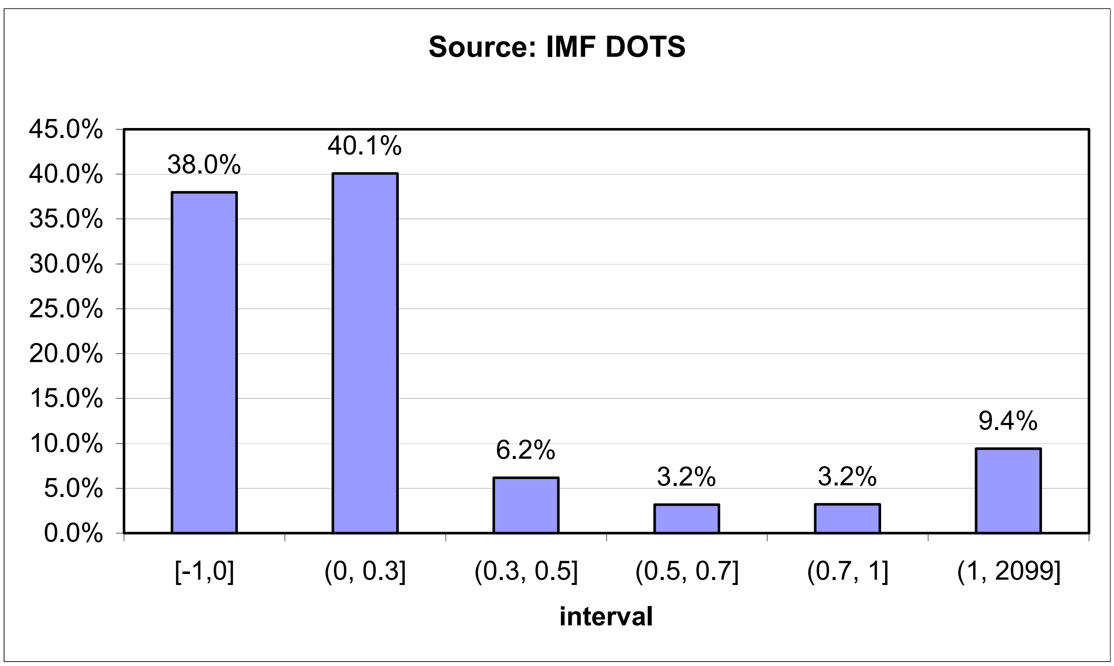
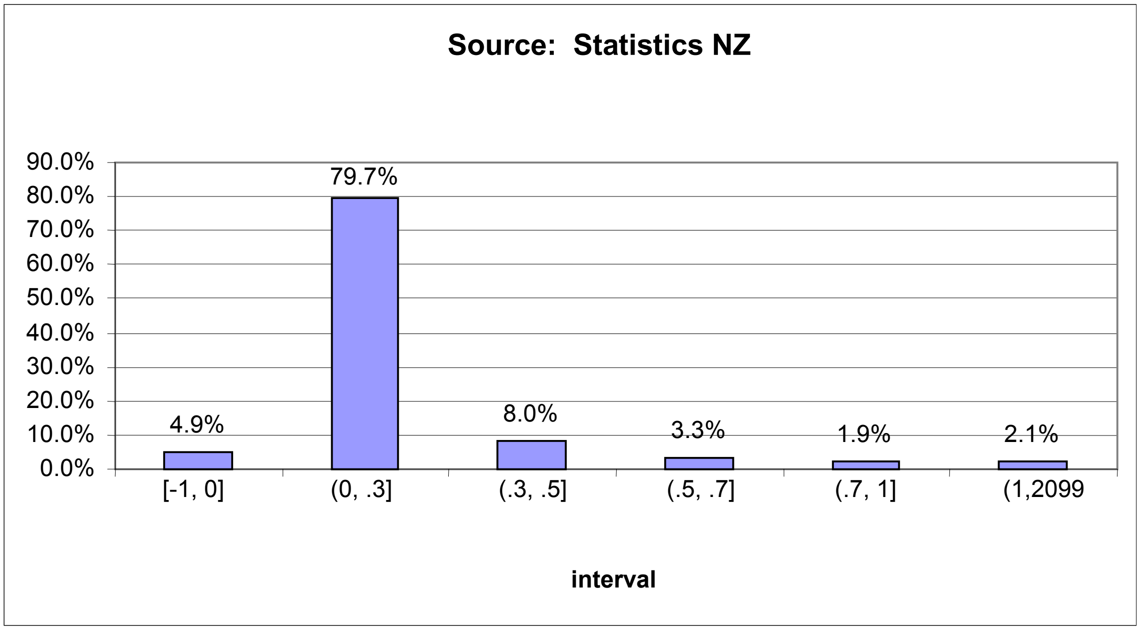


Figure 2 – Distribution of ad-valorem freight rates in New Zealand imports 1963-1997



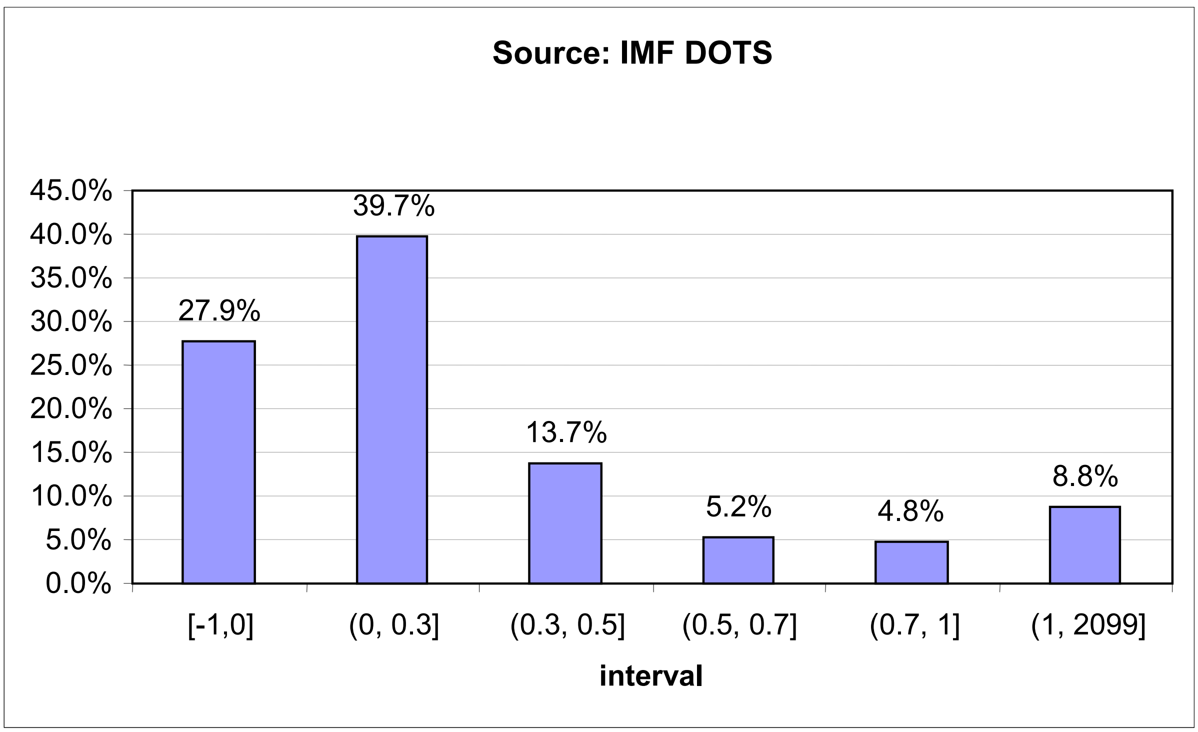
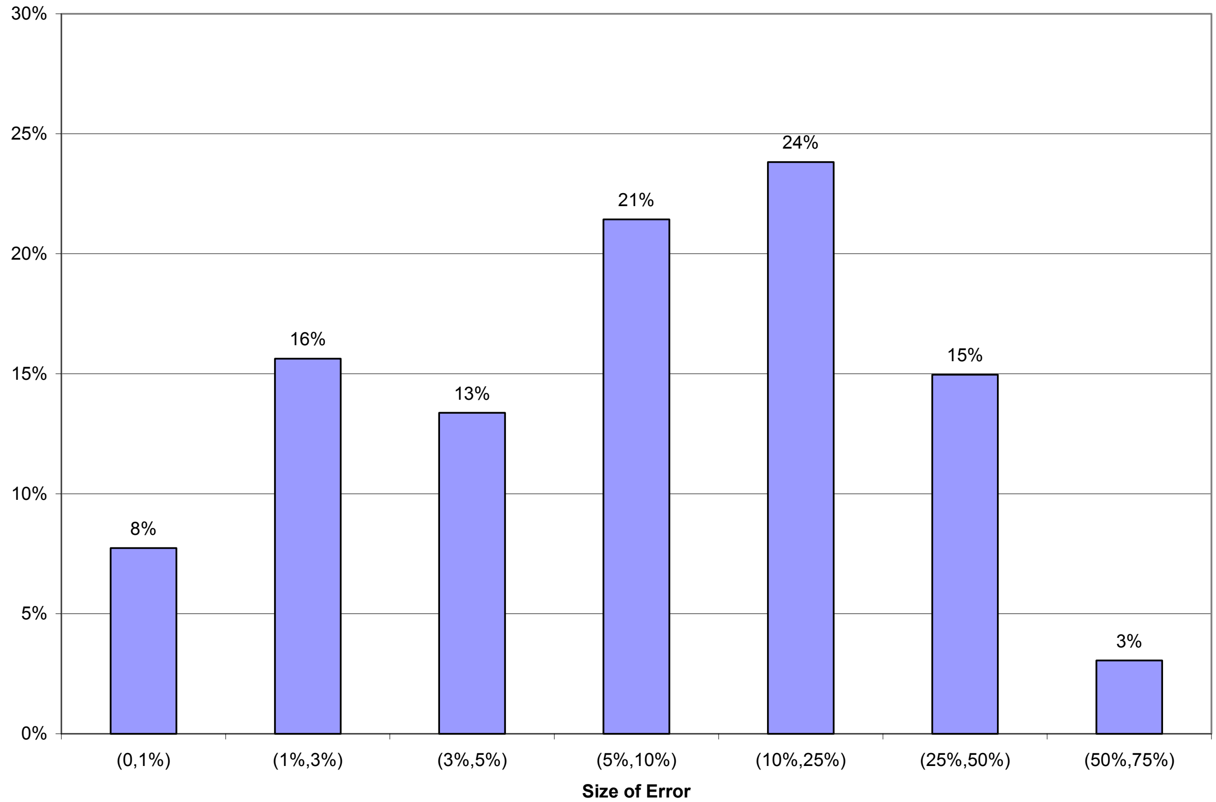


Figure 3 – Distribution of Errors in IMF Data



Notes:
Sample is restricted to CIF/FOB data lying in (1,2) range.
Error is calculated as percentage deviation of IMF DOTS rate from national source data

Appendix Table 1 – Errors in Measurement by Exporting Country
(Mean and standard deviation of errors)

Rank	Country	Mean	Std	N obs	Rank	Country	Mean	Std	N obs
1	AUSTRALIA	0.033	0.039	25	61	BERMUDA	0.129	0.156	16
2	ANGOLA	0.036	0.016	17	62	SAUDI ARABIA	0.131	0.154	28
3	NIGER	0.038	0.028	12	63	MALTA AND GOZO	0.131	0.152	15
4	NEW ZEALAND	0.039	0.026	24	64	PAPUA NEW GUINEA	0.131	0.134	25
5	JAPAN	0.042	0.038	42	65	SWITZERLAND	0.133	0.097	25
6	IRAQ	0.042	0.022	11	66	PHILIPPINES	0.133	0.098	46
7	THE GAMBIA	0.049	0.028	13	67	SPAIN	0.134	0.142	33
8	VIETNAM	0.049	0.048	10	68	ZIMBABWE	0.135	0.135	22
9	ST. KITTS-NEVIS	0.050	0.007	10	69	INDONESIA	0.136	0.096	37
10	LAOS	0.051	0.056	18	70	GUINEA	0.136	0.042	17
11	KIRIBATI	0.052	0.065	10	71	CONGO	0.136	0.141	15
12	CHAD	0.052	0.029	14	72	SRI LANKA	0.137	0.117	44
13	UNITED KINGDOM	0.054	0.044	25	73	BARBADOS	0.139	0.095	23
14	TRINIDAD & TOBAGO	0.054	0.049	17	74	DENMARK	0.140	0.115	25
15	BULGARIA	0.055	0.087	18	75	C. AFRICAN REPUBLIC	0.141	0.141	12
16	BELIZE	0.055	0.045	12	76	FRANCE	0.142	0.103	28
17	MOZAMBIQUE	0.055	0.094	18	77	ALGERIA	0.143	0.159	22
18	VENEZUELA	0.058	0.068	26	78	TURKEY	0.145	0.099	34
19	QATAR	0.061	0.102	24	79	MALAYSIA	0.147	0.084	37
20	ALBANIA	0.064	0.061	13	80	COLOMBIA	0.148	0.122	34
21	NETHERLANDS	0.064	0.056	38	81	HUNGARY	0.148	0.147	29
22	BELGIUM	0.066	0.069	26	82	SIERRA LEONE	0.150	0.162	12
23	MALAWI	0.072	0.086	31	83	SUDAN	0.153	0.110	22
24	SURINAME	0.072	0.083	19	84	SWEDEN	0.154	0.186	39
25	HONDURAS	0.074	0.063	23	85	CANADA	0.157	0.181	31
26	PAKISTAN	0.077	0.095	25	86	BANGLADESH	0.162	0.123	43
27	FIJI	0.078	0.089	21	87	LEBANON	0.165	0.199	20
28	EQUATORIAL GUINEA	0.078	0.090	11	88	COSTA RICA	0.171	0.157	34
29	ICELAND	0.080	0.126	25	89	UNTD.RP.TANZANIA	0.178	0.169	35
30	UGANDA	0.082	0.137	23	90	BOLIVIA	0.179	0.159	12
31	GERMANY	0.082	0.087	38	91	MADAGASCAR	0.180	0.134	21
32	MALI	0.085	0.135	17	92	IRELAND	0.181	0.154	17
33	MAURITIUS	0.086	0.056	20	93	JAMAICA	0.185	0.185	33
34	ECUADOR	0.086	0.082	30	94	PARAGUAY	0.188	0.142	16
35	BAHAMAS	0.087	0.115	15	95	GUYANA	0.188	0.153	29
36	CHILE	0.088	0.046	20	96	INDIA	0.189	0.131	43
37	TOGO	0.091	0.086	11	97	RWANDA	0.197	0.189	18
38	KUWAIT	0.091	0.132	21	98	ROMANIA	0.202	0.135	24
39	KOREA, REPUBLIC OF	0.092	0.079	25	99	GUATEMALA	0.207	0.166	23
40	THAILAND	0.093	0.108	41	100	HAITI	0.208	0.258	10
41	PERU	0.093	0.062	32	101	CYPRUS	0.210	0.140	12
42	PORTUGAL	0.094	0.075	37	102	USA	0.210	0.096	14
43	FINLAND	0.096	0.117	27	103	MOROCCO	0.211	0.144	31
44	LIBERIA	0.098	0.090	21	104	GHANA	0.218	0.173	21
45	AFGANISTAN	0.099	0.098	25	105	KENYA	0.219	0.168	32
46	POLAND	0.099	0.103	27	106	NIGERIA	0.220	0.162	24
47	BAHRAIN	0.100	0.110	21	107	CAMEROON	0.225	0.217	17
48	ITALY	0.102	0.080	29	108	TUNISIA	0.226	0.192	10
49	AUSTRIA	0.112	0.119	36	109	EL SALVADOR	0.228	0.157	21
50	SOMALIA	0.113	0.105	11	110	IVORY COAST	0.228	0.141	25
51	GABON	0.116	0.162	22	111	SYRIAN ARAB REPUBLIC	0.245	0.186	13
52	NEPAL	0.119	0.096	28	112	PANAMA	0.259	0.196	19
53	ETHIOPIA	0.121	0.142	23	113	URUGUAY	0.260	0.192	19
54	OMAN	0.124	0.182	22	114	ZAMBIA	0.261	0.198	11
55	GREECE	0.125	0.132	27	115	SOUTH AFRICA	0.292	0.184	30
56	BRAZIL	0.126	0.130	39	116	EGYPT	0.297	0.205	16
57	ISRAEL	0.126	0.144	24	117	DOMINICAN REPUBLIC	0.301	0.205	13
58	NORWAY	0.127	0.119	17	118	CHINA (MAINLAND)	0.301	0.184	19
59	NICARAGUA	0.128	0.106	22	119	MEXICO	0.387	0.145	23
60	ARGENTINA	0.128	0.087	34					