Real Exchange Rate Volatility, Trade and the Common Supplier Effect*

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Abstract

This paper examines the impact of the commonality of a country's trade partners and bilateral trade on real exchange rate volatility. We construct new measures of trade commonality and bilateral trade and use a large panel of cross-country data over 1970–97 to test these channels. Results strongly support the hypothesis that countries with more common sets of suppliers of traded goods and larger bilateral trade experience smaller bilateral real exchange rate volatility. This result is robust across different sub-samples. These empirical findings are shown to be consistent with recent international trade models that highlight multi-country trade linkages.

Keywords: Real exchange rate volatility; Commonality of trade; Multicountry analysis
JEL classifications: F30; F40

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1 Introduction

What is the impact of trade linkages on real exchange rate volatility? This paper aims to answer this question by examining the impact of a particular channel — the commonality of trading partners — on *long-run* real exchange rate volatility empirically by exploiting a large panel of cross-country data over 1970–97 and constructing some novels measures to capture this commonality. Results strongly support the hypothesis that countries with more common sets of suppliers of traded goods experience smaller bilateral real exchange rate volatility. This result is robust to the inclusion of bilateral trade, as well as across different sub-samples. These empirical findings are shown to be consistent with recent international trade models that highlight multi-country trade linkages.

Recently, researchers have begun focusing on the impact of different characteristics of trade models on the international macroeconomy. For example, as Obstfeld and Rogoff (2001) so elegantly show, small trade costs can have large effects on many macroeconomic phenomena — arguably solving six international macroeconomic puzzles.[1] Anderson and van Wincoop (2004) provide a comprehensive survey on recent trade literature that quantifies and studies the impact of trade costs, as well as highlighting their impact on the macroeconomy.

In this paper we highlight an important channel through which trade affects real exchange rate volatility and provide empirical evidence supporting the existence of the channel. Specifically, we emphasize the interaction of two countries with all other countries in the rest of the world, rather than just their bilateral interaction. We argue that heterogeneity in the suppliers of traded goods impacts how shocks diffuse across countries, and thereby affect the relative price indices of two countries. For example, two countries that are close to each other and have similar technological endowments will have a similar set of supplier-countries for traded goods. Therefore, *ceteris paribus*, shocks to countries around the world will diffuse to the two countries in a similar manner (via trade), which in turn will lead to similar movements in their prices indices that cancel out each other, thus lowering bilateral real exchange rate volatility. This channel complements the traditional one of bilateral trade, which implies that both trade economies will be partially affected by each others' shocks, thereby impacting real exchange rate volatility.

Though the relationship between exchange rate volatility and trade has traditionally be con-

[1] Another strand of the literature, exemplified by the work of Backus, Kehoe and Kydland (1992, 1995), is the international real business cycle literature. The models in this literature try to quantitatively replicate patterns found in the data and emphasize goods trade in a two-country setting, but have not been completely successful and have left several puzzles open. One such puzzle is the "price anomaly", which arises when models cannot generate terms of trade (and thus real exchange rate) volatility as high as that found in the data. Recent work, such as Ravn and Mazzenga (2004), have tried to solve this anomaly by modeling the impact of bilateral trade costs in more depth, but results have been mixed. Heathcote and Perri (2002) have had more success by concentrating on frictions in the financial market. Meanwhile, Alessandria (2004, 2005) has concentrated on the importance of search costs. Finally, see Atkeson and Burstein (2005) for some recent work that exploit modern trade models to try and match relative price patterns seen in the data.

sidered in a bilateral context (e.g., recent work on the impact of currency unions on trade such as Rose 2000), the commonality of trade between two countries and a common third partner is in fact quite important relative to bilateral trade (Kose and Yi 2005). In fact, imports from common industries-countries as a fraction of two countries' total imports (captured by our *common supplier index*, CS Index) are actually larger than the two countries' bilateral imports as a share of their total imports.[2] The common supplier index is 0.019 vs. 0.005 for the bilateral import index in our full sample for the period 1970–97, and this difference holds across country-pairs in different levels of economic development as well as for different decades (Table 1). Furthermore, there are significant differences between developed-developed country-pair trade and developing-developing country-pair trade. The first group's common supplier index is 4.6 percent on average, whereas the second group's is only 1.3 percent, a striking 350 percent difference. The bilateral import indices also exhibit a substantial gap: 1.8 percent for developed-developed country pairs and 0.3 percent for developing-developing country pairs — a gap of over 600 percent between groups. These differences are important to keep in mind when considering the significance of the results in this study.

Our baseline estimates imply the impact of a one standard deviation increase in the common supplier index implies a five percentage point decrease in bilateral real exchange rate volatility over five years. For the developed group of country-pairs the baseline result implies that an increase in one standard deviation of this sub-sample's common supplier index reduces volatility by about three percentage points, whereas for the developing group of country-pairs this effect reaches six percent. These effects are significant, economically large, and robust to different specifications. Moreover, the effects survive when both common supplier and bilateral indices are included in the regressions. Furthermore, the common supplier index is also significant in the various sub-samples. We interpret these results as support for our hypothesis.

These results are found by exploiting a large cross-country dataset to examine the importance of common suppliers and bilateral trade on bilateral real exchange rate volatility. Though most tests in the empirical literature that studies real exchange rates rely on the time series properties of the data, our specifications also rely on the cross-sectional dimension for identification.[3] In particular, we use panel data covering the period of 1970–97 over five year periods, where the unit of observation is the country-pair.[4] Detailed trade data are exploited in order to construct a

[2]The CS Index aggregates the total value of goods that two countries import from a common supplier relative to the two countries' total imports. Thus, if country 1 and country 2 import an amount of good A from country 3, the sum of each country's imports of good A will be added to the numerator. This index and other indices will be formalized in Section 3.

[3]There are several papers in the empirical literature that highlight the importance of trade costs (whether they be physical, institutional, or informational) playing a predominant role in causing deviations from the law of one price (LOOP) and purchasing price parity (PPP). For example, Engel and Rogers (1996) explicitly control for distance and the border to capture the effects of a myriad of trade costs on price dispersion across the United States and Canada. Furthermore, the existence of trade costs motivate "commodity points" and the use of threshold autogressive models in testing for PPP and LOOP relationships (Obstfeld and Taylor 1997).

[4]Broda and Romalis (2004) is another recent paper that also exploits panel estimation in examining exchange rate

common supplier index of traded goods, which is used as a proxy to measure the channel through which trade costs affect exchange rate volatility. This variable has the advantage of varying over time, therefore it is not lost when controlling for country-pair fixed effects like other geographical proxies for trade costs (e.g., distance). Another index of the commonality of industry imports as well, as a bilateral import index and total bilateral trade are also tested. We further control for other standard economic variables, and estimate the model across different sub-samples of the data (defined by level of development).

Before delving into the empirical findings, the paper examines some theoretical explanations that are consistent with the empirical specifications. The existence of trade costs, and/or cross-country differences in preferences or technology are essential in relating real exchange rate volatility to differences in trade patterns across countries, but the underlying trade structure need not be unique. We emphasize this fact by drawing on recent work in the international trade literature, such as Anderson and van Wincoop (2003) and Eaton and Kortum (2002). The common mechanism in all these models that delivers the result to support our empirical work is the dependency on the trade structure that the diffusion of supply and demand shocks have on price levels of trading partners. Thus, both the existence of common industry trade with third countries, or the level of bilateral trade decrease the real exchange rate volatility, by transmitting shocks simultaneously to trade partners — shocks that therefore can cancel out when measuring the evolution of the real exchange rate.

The emphasis on more than just bilateral relationships complements the recent work of Kose and Yi (2005), and Fitzgerald (2005) who highlights the impact of multi-country interactions in the context of the exchange rate disconnect puzzle. This paper differs from this work in that we develop new proxy measures for the impact of trade costs on real exchange rate volatility, test for the importance of common multilateral trade and bilateral trade rigorously, and show that these common trade measures are consistent with a general class of trade models.

The remainder of the paper is structured as follows. Section 2 describes models that can explain the main empirical findings. Section 3 presents the empirical methodology and data. Section 4 presents the results. Section 5 concludes.

2 Possible Theoretical Explanations

This section examines a set of models that are consistent with the empirical specifications that are tested below. It is important to note that these explanations are not meant to provide structural models to test, but instead outline the main intuition of the empirical strategy, and provide possible explanations that can potentially be incorporated into a more complex setting.

volatility.

The first model presented follows Anderson and van Wincoop (2003) multi-country gravity model. The main insight of this paper is its ability to derive a gravity equation of trade from a model with relatively few restrictions, while highlighting the trade 'resistance' due to multi-country trade.[5] We use this model to derive a relationship between real exchange rate volatility, levels of trade and relative size. Under demand shocks this model predicts that countries with similar levels of trade with respect to the same provider of goods will have smaller real exchange rate volatility. The second model is a simplification of Eaton and Kortum (2002)'s model, which generalizes the Ricardian world to many countries.

2.1 Anderson and van Wincoop (2003): Gravity with Gravitas

Anderson and van Wincoop's model is based on several key building blocks. The first assumption is that there are N countries, and that each one of them specializes in the production of one differentiated good, with the supply of each good being constant. The second key assumption is the fact that all consumers have identical CES utility functions. Third, Anderson and van Wincoop assume that the trade costs are born by the exporter.

Given these assumptions and some manipulations Anderson and van Wincoop derive the gravity equation:

$$x_{ij} = \frac{y_i y_j}{y^W} \left(\frac{t_{ij}}{P_i P_j} \right)^{1-\alpha}, \tag{1}$$

where x_{ij} is the nominal demand from region j for goods produced in i, y_i (y_j) is country i's (j's) nominal income, y_W is the world's nominal income, t_{ij} are trade costs between country i and j, and P_i (P_j) is country i's (j's) price index. Given (1), we in turn derive the following relationship between prices, levels of trade and relative income or size:

$$\log\left(\frac{P_i}{P_j}\right) = \frac{1}{N(1-\alpha)} \left(\sum_{m=1}^{N} \log\left(\frac{x_{mj}}{x_{mi}} \frac{y_i}{y_j} \right) + (1-\alpha) \log\left(\frac{t_{mi}}{t_{mj}} \right) \right), \tag{2}$$

where x_{mi} is nominal demand from region i for goods produced in m and x_{mj} is nominal demand from region j for goods produced in m. If there are shocks to the income or to preferences in countries i or j, and therefore imports, there will be volatility in the relative prices. One of the interesting features of this model is that given transport costs, there will generally exist different amounts of imports for goods m from countries i and j and therefore real exchange rate volatility.

From equation (2) we can express the real exchange rate volatility as follows:

$$\sigma_{ij}^{RER} = \sigma\left(\frac{x_{1j}}{x_{1i}}, ..., \frac{x_{nj}}{x_{ni}}, \frac{y_i}{y_j}; \alpha \right). \tag{3}$$

[5] Note that a Ricardian model with N countries and N goods is a particular case of Anderson and van Wincoop's model.

Consider the case in which all countries have the same income and they just differ in their locations. First, suppose country i is located close to country j. Import demands will be fairly similar and when faced by demand shocks the volatility of the real exchange rate will be relatively small. The result arises because the ratios of imports inside of the logarithms are close to one. Suppose now that country i is located close to all countries but j, and that country j is located further apart from all countries. Given transport costs the level of imports of country i from any country but j will be greater than any import of country j from the same countries. Thus, the respective terms inside the logarithm will be significantly greater than one. Under these circumstances demand shocks will have a significantly greater impact on real exchange rate volatility than in the previous example.

The two previous examples point out to the fact that similar countries (considering location given income levels) will face smaller real exchange rate volatility than two countries with very dissimilar locations. This transmission mechanism highlights the impact that different level of multilateral trade have on price indices, and therefore on their volatility. The model in the next section adds the possibility of different providers of goods and preferences, which implies not just having different demands for goods, but different sources of these goods, and therefore an additional source of real exchange rate volatility.

2.2 Eaton and Kortum (2002): Multi-Country Model

We next study Eaton and Kortum (2002)'s multi-country Ricardian model. Specifically, given technological differences and trade barriers, any two countries may have different trading partners for a given good. Therefore, though each country's import basket is composed of the same goods, any good may be provided by a different supplier. As a result, the diffusion of each country's idiosyncratic shocks to other countries' price indices will be heterogeneous.

Before deriving the solution for the real exchange rate volatility, we present some preliminary information to aid in the derivation. The intuition behind the result is quite straightforward, but the simple derivative of volatility with respect to trade costs cannot be signed unambiguously. See Bravo-Ortega and di Giovanni (2005) for a full derivation and calibration of the model.[6]

Technological shocks

Eaton and Kortum (2002) begin with Dornbusch, Fischer and Samuelson (1977) as a starting point. The particularity of this new model is that it allows for extension of Dornbusch et al. (1977)'s

[6] Further note that Eaton and Kortum (2002)'s model does not explicitly model the non-tradable sector and thus the following discussion is in terms of trade goods only. However Bravo-Ortega and di Giovanni (2005) show how the results for the trade sector will map into overall price volatility.

model to a multi-country setting through the introduction of uncertainty in country i's efficiency in producing good $j \in [0,1]$, that we denote $z_i(j)$. As in Eaton and Kortum (2002) we assume that country i's efficiency follows a Fréchet distribution, conditional on idiosyncratic shocks. A key assumption that facilitates the determinations of each country's price index is that this distribution applies to all goods.

Production is assumed to be constant returns to scale, and costs are assumed to be equal across goods in a country, but differ across countries. Furthermore, trade costs are modeled as an iceberg transport cost between countries i and n, $\tau_{ni} > 1$. Given perfect competition, shoppers in each country n (there are N countries) seek out the cheapest supplier of a given good, and maximize a CES utility function.

Given the assumptions made concerning production and consumption of tradable goods across countries, a country's exact price index has the solution:[7]

$$p_n = \gamma \Phi_n^{-1/\theta} = \gamma \left(\sum_{i=1}^{N} T_i (c_i \tau_{ni})^{-\theta} \right)^{-1/\theta},$$

where $\gamma = \left[\Gamma \left(\frac{\theta+1-\rho}{\theta} \right) \right]^{1/(1-\rho)}$, T_i is a country i's state state of technology, c_i is country i's input cost, τ_{ni} is an iceberg transport cost between countries i and n ($\tau_{ni} > 1$ if $n \neq i$ and $= 1$ if $n = i$), and θ regulates comparative advantage across countries.

Note that the previous equation implies that for the case of two countries whose trade is restricted to two different sets of trade partners,[8], their price indices will be different because they demand goods from different sets of suppliers *(ceteris paribus)*.

We are interested in determining the volatility of two countries' bilateral real exchange rate given idiosyncratic technological shocks. Therefore, shocks to T_i are of interested. We therefore assume that these technological shocks are lognormal. In particular,

$$T_i = \tilde{T}_i \exp(\varepsilon_i), \text{ with}$$
$$\varepsilon_i \sim n\left(0, \sigma_\varepsilon^2\right),$$

where $\tilde{T}_i > 1$, and may also $= T > 1 \;\forall\; i$. This assumption essential posits that the steady-state/long-run technological level of countries may or may not differ. Furthermore, it is assumed that $\mathrm{Cov}\{\varepsilon_i, \varepsilon_j\} = 0 \;\forall\; i \neq j$.[9]

Real Exchange Rate Volatility

[7]See Eaton and Kortum (2002) for the full derivation.

[8]This situation can be modeled as having infinite bilateral trade costs with some countries.

[9]This assumption may be again be considered extreme, but greatly simplifies the analysis. Furthermore, empirical results support the main conclusions of the model.

It is not possible solve for an exact closed-form of solution real exchange rate volatility in the multi-country model, but we are able to find a closed-form solution by using a first-order Taylor approximation around the steady-state:[10]

$$\begin{aligned}\mathrm{Var}\left\{\log\left[\frac{p_1}{p_2}\right]\right\} \approx \Upsilon & \left(\underbrace{\frac{\sum_{i=1}^{N}\tilde{T}_i^2(c_i\tau_{1i})^{-2\theta}}{\left[\sum_{i=1}^{N}\tilde{T}_i(c_i\tau_{1i})^{-\theta}\right]^2}}_{[1]} + \underbrace{\frac{\sum_{i=1}^{N}\tilde{T}_i^2(c_i\tau_{2i})^{-2\theta}}{\left[\sum_{i=1}^{N}\tilde{T}_i(c_i\tau_{2i})^{-\theta}\right]^2}}_{[2]} \right) \\ & - 2\Upsilon\left(\underbrace{\frac{\sum_{i=1}^{N}\tilde{T}_i^2(c_i^2\tau_{1i}\tau_{2i})^{-\theta}}{\sum_{i=1}^{N}\tilde{T}_i(c_i\tau_{1i})^{-\theta}\sum_{i=1}^{N}\tilde{T}_i(c_i\tau_{2i})^{-\theta}}}_{[3]} \right),\end{aligned} \tag{4}$$

where $\Upsilon = \left(\frac{e^{\sigma_\varepsilon^2}\left[e^{\sigma_\varepsilon^2}-1\right]}{\theta}\right) > 0$.

The three terms are a cumulative weighting that reflects the composition of country 1's (country 2's) consumption of goods from the rest of the world. In particular, by inspection it is easy to see that as τ_{1i} (τ_{2i}) approaches 1 (*the frictionless world scenario*), that [1] ([2]) will only depend on relative technological and cost differentials (i.e., as world of frictionless trade), which in turn will imply that the shocks to other countries will pass directly to country 1's (country 2's) price index one-for-one resulting in zero volatility. This results comes from the fact that both countries will have the same set of providers of goods, which is captured by the corresponding price indices. Therefore, term [1] ([2]) will increase as trade costs increase. This in turn implies an increase in bilateral real exchange rate volatility. The third term [3] essentially reflects a covariance term, which captures how shocks have an impact on the two countries baskets. In sum, the three terms show how similarities in trade costs and technology viz. the rest of the world for a country pair have an effect on bilateral real exchange rate volatility.

For example, one may think of two countries that are very close to each other and have similar technologies. In this case, terms [1]-[3] will be quite small, and shocks will diffuse similarly across both economies, thereby resulting in lower real exchange rate volatility than if the two countries were farther apart or had very different technological endowments. For the same two countries suppose now that due to trade agreements, say, both countries have different set of suppliers despite the fact of being located closely. In this case the impact of different set of providers is captured by a different price indices that will be subject to different technological shocks, thus introducing real exchange rate volatility.

[10]See Bravo-Ortega and di Giovanni (2005) for its derivation.

Another example can help better understand equation (4). Suppose that there are two countries, one located in the north pole and the other in the south pole of a sphere. Suppose additionally that there is a group of countries located on the equator, and that have the same technology and factor costs. The real exchange rate volatility between the countries located at the two poles will be zero because technological shocks will diffuse equally to their respective price indices. Indeed, the sum of terms [1] and [2] will be equal to term [3]. In this case, even if there are differences in the technologies or costs in the countries located along the equator real exchange rate volatility will be close to zero. However, for any other country pair of the proposed configuration there will exist volatility because of the loss of symmetry.

The Anderson–van Wincoop and Eaton–Kortum models enable us to study the relationship between trade and real exchange rate volatility. These models do not provide a structural specification to estimate, however, but highlight the relevant ideas that will underlie our empirical strategy. In particular, the two models provide distinct theoretical settings, which were originally used to explain trade patterns in of the presence trade costs. We, in turn, apply these models to derive real exchange rate expressions that emphasize the role of trade on the construction of countries' price indices.

Before turning to our empirical strategy, it is worthwhile to briefly discuss the relationship between trade costs and real exchange rate volatility. In a frictionless world, i.e., one without trade costs, there will never exist differences in the set of suppliers nor in two countries' demands regardless of the theoretical framework assumed (e.g., assumptions about size, preferences, income, etc.). However, the existence of small trade cost will be enough to break the symmetry between countries by introducing heterogeneity in the set of suppliers and demands. The multidimensional nature of trade costs between a set of countries ($n > 2$) makes it impossible to clearly assess the impact of a fall in trade costs (bilateral or multidimensional) on trade and therefore on real exchange rate volatility. The only exception to this statement, however, is the unambiguous negative relationship that exists between bilateral trade costs and bilateral trade. Despite these considerations, we can still state that similar countries with *globally similar trade cost structures* will have a more similar set of suppliers and demand for goods, regardless of their geographical locations.

3 Quantifying the Commonality of Trade and Empirical Specification

Quantifying the impact of trade linkages on exchange rate volatility is not straightforward. However, the models explored above outline some common themes that help shape the empirical analysis. On one hand, say, in a world with transport costs countries will demand different quantities of goods and will have different sets of providers of goods. This asymmetry introduces real exchange rate volatility because countries will have different price indices, which in turn are subject to different sources of shocks.[11] We use the intuition from these models to quantify the volatility impact of variables, such as trade costs or differences in preferences, which are otherwise elusive objects to measure. We first construct measures based on actual trade with third countries. Furthermore, the extent of bilateral trade will help to dampen the impact of idiosyncratic shocks among trade partners. We therefore also use bilateral trade.

Three indices are defined. The first is a common supplier index (CS Index) that identifies how common a pair of countries providers of goods is relative to the countries' total imports. A larger CS Index implies that the two economies are more linked to common sources of shocks (via trade), and should therefore experience smaller bilateral real exchange rate volatility. The second index, which complements the CS Index, defines an industry import index (IM Index). This index is similar to a Herfindahl index and calculates how similar a pair of country's imports in each sector relative to each country's total imports are. In this case, similar import demands will be correlated with similar price indices and therefore are a source of relative price stability. The third index calculates bilateral trade as a share of the two countries' total imports (BM Index). A larger BM Index implies smaller volatility because there will be a common source of shocks in the price indices of the countries under study. Finally, the level of bilateral trade is also considered

3.1 Definition of Indices

Common Supplier Index

A common supplier index is constructed using bilateral trade data. It would be ideal to use a weighted measure of prices for traded goods, but these data are not available. Therefore, the index is based on the relative value of goods that any two countries import from a common country. Using highly disaggregated trade data would also be ideal, but as will be discussed in Section 3.4 we must rely on more aggregated data.

The index is constructed as follows. Consider a world with N countries, S sectors/goods, and M_{qrs} is imports of good s of country q from country r. Then, the index of common suppliers for countries i and j can be written as:

$$\text{CS Index}_{ij} = \frac{\sum_{k=1}^{N}\sum_{s=1}^{S} 1\left(M_{iks} > 0, M_{jks} > 0\right)\left[M_{iks} + M_{jks}\right]}{M_i + M_j}, \tag{5}$$

where 1 is the indicator function. The numerator captures the value of imports from common suppliers for countries i and j, while the denominator uses countries i and j's total imports from the

[11] Note that all discussions are based on the prices of *traded* goods, but we will refer to price indices in general for simplicity.

world as a normalization. This normalization helps to deal with the effect of country size — i.e., the probability of two large countries importing a larger amount of a good from a given country is higher than that for two smaller countries, *ceteris paribus*, simply because of sheer size of the countries (and not, for example, trade costs). Moreover, the normalization bounds the index between 0 and 1.

Industry Import Index

The IM index for countries i and j is constructed as follows:

$$\text{IM Index}_{ij} = 1 - \sum_{k=1}^{N} \sum_{s=1}^{S} \left(\frac{M_{iks}}{M_{is}} - \frac{M_{jks}}{M_{js}} \right)^2, \tag{6}$$

where the variables are defined similarly as for the CS Index, and M_{is} is country i's total imports in sector s. The larger the index the more similar is the structure of two countries' imports (given that the double-summation is subtracted from 1). Under the assumptions of zero trade costs and homothetic demands this index will take the value one, and will imply equal demand for goods and therefore equal price indices for the two countries. Therefore, values smaller than one capture deviations from this assumption.

Bilateral Import Index

The BM index for countries i and j is constructed as follows:

$$\text{BM Index}_{ij} = \frac{\sum_{s=1}^{S} (M_{ijs} + M_{jis})}{M_i + M_j}, \tag{7}$$

where the variables are defined similarly as for the CS and IM indices. The index is normalized by total imports in order to be able to compare it conceptually with the other two indices of commonality of trade. However, total bilateral trade is also considered in (log) levels.

3.2 Characteristics of Indices

The World Trade Database for 1970–97 is exploited to construct the trade indices. This database provides the broadest coverage of trade at the sector level over time for worldwide annual bilateral trade flows, which are disaggregated at the 4-digit SITC level. This is still quite a high level of aggregation, but yields both intertemporal variation, as witnessed in Figure 1, as well as cross-sectional variation. Figure 1(a) illustrates the evolution of the CS Infex for the period under study. The figure shows a U-shaped curve that has two peaks at the end of the 1980s and the end of the 1990s. Figure 1(b) shows the evolution of the IM Index, whose evolution is very similar to the one of the CS Index. Figure 1(c) describes the evolution of the BM Index, which declines initially but increases at the end of the 1990s. Finally, Figure 1(d) plots the path of bilateral trade (in natural logarithms) over time. As well documented in the literaure, there is a dramatic increase in world trade since the mid-1980s, which can be explained by a fall a trade costs but also changes in the structure of trade, such as "vertical specialization" (Yi 2003). The secular increase in the CS Index starting in the 1980s also corresponds nicely with the vertical specialization of trade.[12] Table 1 summarizes these data across time and over country groups.

It is also important to consider whether the indices are a reasonable proxy for trade costs. Work in the international trade and macroeconomics literatures often uses physical distance between countries as a proxy for potential trade costs. However, distance is a non-time-varying "catch all" variable, which may be interpreted in many different ways. In the context of the discussion thus far, two countries that are close to each other (geographically) will naturally also face similar physical trade costs with other countries in the world to some degree.[13] Therefore, it is expected that the indices and distance are negatively related, since two countries that are far apart may also have differing trade partners. Figure 2 plots the three indices and bilateral trade (all in logarithms) against (log) distance for the sample of country-pairs used in the formal analysis below. All values are the average value between country-pairs over 1970–97. Figure 2(a) illustrates the relationship between the CS Index and the logarithm of the bilateral distance. As intuition suggests there is a strong negative correlation between these variables. The hypothesis that the further apart the countries the smaller is the number of common supplier of goods that they have seems to be confirmed by the data. The relationship between IM Index and distance, Figure 2(b), is not very strong however. Finally, as expected, there exists a strong negative relationship between the BM Index and distance and bilateral trade and distance; Figures 2(c) and 2(d) respectively.

Table 2 confirms these plots in a regression analysis using data averaged over the whole sample period. All four trade measures are negatively correlated with the distance, and strongly significant. However, the point estimate for the IM Index is much smaller (in absolute terms) than for the other measures. Overall, these results are evidence that the further apart two countries are the less common are their suppliers of goods and the lower their bilateral trade.

Finally, it is also interesting to examine the bivariate relationship of real exchange rate volatility and the indices in Figure 3. Figure 3(a) plots the relationship between the logarithm of the real exchange rate volatility and the logarithm of the CS Index and shows a negative correlation between these variables. This (unconditional) result is preliminary evidence that the larger the set of

[12] The fall and then slow rise again of the index in the latter part of the 1970s and early 1980s may be due to several factors. This period of time marked high rises in oil prices that depressed global trade in general. Furthermore, this period also witnessed the era of "new protectionism", where protectionist trade policy relied heavily on quantity restrictions (Baldwin 1987). Investigating the causes of this U-shape pattern is beyond the scope of this paper, but is a potential avenue of interesting future research.

[13] Of course, distance between two countries is only one dimension of potentially many other physical trade costs (e.g., geography within a country or proximity to seaports.)

common providers of goods that a pair of countries has the smaller their exchange rate volatility. The same negative correlation occurs for the IM Index in Figure 3(b). Figures 3(c) and 3(d) exhibit a weakly negative correlation between volatility and the measures of bilateral trade.

3.3 Regression Framework

Given the definition of the indices, we test the null hypothesis that they are negatively related to real exchange rate volatility using the following linear regression model of bilateral real exchange rate volatility:

$$\sigma^{RER}_{ij,t} = \alpha + \beta \mathbf{INDEX}_{ij,t-1} + \gamma \mathbf{X} + \mu_{ij} + \delta_t + \varepsilon_{ij,t}, \tag{8}$$

where $\sigma^{RER}_{ij,t}$ is the natural logarithm real exchange rate volatility measure between $t-1$ and t; **INDEX** includes either one or a combination of the trade indices (in logs);[14] $\mathbf{X}$ is a matrix of controls, which includes (i) the natural logarithm of the product of real GDP of i and j, (ii) the natural logarithm of countries i and j's Herfindahl index of export concentration, and (iii) exchange rate regime variables; μ_{ij} is a vector of country-pair fixed effects; and δ_t is a vector of time dummies. We also consider the impact of bilateral distance in a preliminary set of pooled regressions, which we report.[15] This equation is estimated in five year panels, and the standard errors are clustered at the country-pair level.[16] The key parameters that are estimated are the components of β, which are expected to be less than 0.

The inclusion of the income variables captures the fact that aggregate volatility falls with the level of development.[17] The export concentration measure is included to capture how diversified a country's export sector is, and is measured using a Herfindahl index.[18] One should expect that the more diversified the export structure of a given economy the smaller is the impact of external shocks and the lower the swing in the exchange rate. The exchange regime variables capture whether any two countries are pegged, whether the peg is between each other, if they have a

[14] Taking logs exchange rate volatility and especially the indices drops observations with value 0. However, dropping these observations do not alter the results in the level-on-level regressions, and the log-on-log specification facilitates interpretation. Furthermore note that the sample is constrained to volatilities that are less than 100 percent.

[15] We also experimented with other variables. For example, drawing from the optimum currency literature (Bayoumi and Eichengreen 1998, Devereux and Lane 2003, Engel and Rose 2002) the impact of the correlation of output shocks across countries was also explored, but did not yield significant results and cut the size of the sample due to data limitation.

[16] We also used ten year panels and results were generally robust.

[17] See Acemoglu and Zilibotti (1997) and Ramey and Ramey (1995).

[18] We define country i's Herfindahl index, H_i, as:

$$H_i = \sum_j \left(\frac{X_{ij}}{X_i} \right)^2,$$

where X_{ij} is country i's exports of good j, and X_i is country i's total exports. Goods j are disaggregate at the 4-digit SITC level.

common base country (whether pegged or floating).[19] These exchange rate indicators are meant to capture the obvious fact that nominal exchange rate volatility may be dampened by different regimes. Furthermore, the inclusion of a same base variable also captures potential third-country links that may have an impact on bilateral trade, and thus bias the results.[20] Finally, equation (8) is also estimated for sub-samples, which are dependent on the country-pair level of development: (i) developed-developed, (ii) developed-less developed, and (iii) less developed-less developed.[21]

3.4 Data Summary

The bilateral real exchange variable is constructed using nominal exchange rate and CPI data from Global Financial Database in order to maximize country-pairs.[22] The volatility measure is calculated by first taking the annual real exchange rate change (in log differences) each month; e.g., we take the change between Feb94–Feb95, and then Mar94–Mar95, and so on (i.e., a "rolling window" of annual real exchange rate changes).[23] We then compute the standard deviation of these annual changes over 5 years time periods (i.e., between $t-1$ and t as our measure of long-run volatility.[24]

The Herfindahl index is calculated using data from the World Trade Database. Income and income per capita data are primarily taken from the Penn World Tables (Heston, Summers and Aten 2002), with holes filled in from the World Development Indicators and the International Financial Statistics. Finally, the exchange rate regime variables are taken from Shambaugh (2004). We also experimented with data from Reinhart and Rogoff (2004). The results were very similar to when using Shambaugh's data, but we lose observations.[25]

4 Results

The main results can be summarized as follows. First, the commonality indices (CS and IM) are significant in all baseline specifications, as well as in many sub-samples. Moreover, the estimated coefficients for these indices survive the inclusion of bilateral trade, and are very often larger (in

[19] We also experimented with Rose's currency union variable, but lost a significant number of observations given concordance-issues between datasets. Results were robust in the limited sample, however.

[20] See Shambaugh (2004) for a detailed description on the construction of the base variable.

[21] The developed and less developed country samples are based on income groups taken from the World Development Indicators.

[22] We also experimented with data from the International Financial Statistics, but lost observations. However, our results were robust to using this data source.

[23] Taking the volatility of the log change has two advantages over taking the volatility of the log level: (i) the resulting measure is in invariant to the country, and (ii) the measure allows us to interpret the coefficients in the regressions as essentially elasticities.

[24] We also experimented in detrending the real exchange rate data using common filtering techniques: Hodrick and Prescott (1997) and Baxter and King (1999), but results did not vary qualitatively.

[25] We would like to thank Jay Shambaugh for sharing all these data with us, as well as discussions concerning the comparability of the two classifications systems. Indeed, the classifications are highly-correlated post-1973.

absolute value) than the bilateral trade (BM) index.[26] These results provide strong evidence in favor of the hypothesis of this paper.

4.1 Pooled Regressions

Table 3 first considers regressions where the data are pooled and only annual time effects are considered. The advantage of these regressions is that they allow us see how the model fits in the cross-section and within time, as well as estimate the impact of one non-time-varying variable of interest, bilateral distance. However, we refer to the results that control for country-pair effects as the baseline estimations due to consistency considerations.[27] Therefore, we do not discuss the pooled results in depth.

The most striking result in looking at Table 3 is the significance of all the indices across all the specifications. The first four columns consider the indices on their own, while the last four columns pair up the commonality of trade indices (CS Index and IM Index) with the bilateral trade indices (BM Index and Bilateral Trade). The negative coefficient on all these indices confirms the null hypotheses that the real exchange rate volatility is negatively related to the commonality and bilateral trade for a pair of countries. It is also interesting to note that the Distance coefficient is significant (and positive as expected) for the first three specifications, but not when including bilateral trade. This result is especially surprising given that the relationships between distance and the CS Index and BM Index are the strongest according to the regressions of Table 2. However, the impact of Distance decreases and becomes insignificant for all but one specification when including more than one index. We next turn to the baseline specifications, which include country-pair fixed effects.

4.2 Fixed Effects Regressions

Table 4 explores the unconditional relationship between the indices and real exchange rate volatility, though the regressions also include country-pair and time fixed effects. The point estimates on all of the indices are negative as expected, and are highly significant. The CS Index and real exchange rate volatility are negatively related, with a precisely estimated elasticity of -0.02. This result implies that the larger the set of common suppliers the smaller the volatility as implied by our theoretical discussion. The IM Index also shows a negative relationship, which implies that the more similar the import demand structure that two countries hold, the lower their exchange rate volatility. This result should be consistent with similar price indices and therefore similar impacts of demand and supply shocks. Finally, the measures of bilateral trade also show a negative sign, which implies that the greater the bilateral trade the smaller the volatility. This result is standard

[26]Note that it is hard to compare the coefficients of the indices with that of bilateral trade in levels.

[27]Haussman tests rejected they null hypothesis of no difference between the pooled and fixed effects regressions.

in the literature, but it also interesting to note that the point estimates on the BM Index and Bilateral Trade are quite similar in magnitude. Therefore the magnitude of absolute trade is as important (or more) than simply how much two countries trade with each other relative to the rest of the world.

Table 5 presents the baseline estimations, which include controls, and country-pair and time fixed effects. The controls include the export Herfindahl index, the product of real GDP's, and exchange rate regimes variables. The indices are once again very significant, and the magnitude of the coefficients do not change substantially compared to the unconditional regressions of Table 4. The controls are also highly significant. The positive coefficient on the export Herfindahl index implies that that the more diversified the export structure of the countries the lower their exchange rate volatility. This result follows from the fact that external shocks have a smaller impact in economies that are more diversified. One potential explanation for the negative impact of real GDP is that the larger economies are, the smaller will the transmission of shocks into prices be. This fact is consisting with previous existing literature on macroeconomic volatility and income.[28] Finally, the variables related to exchange rate regimes are jointly significant and exhibit the expected signs; i.e., countries that do not have flexible exchange rate regimes have lower volatility.

For the whole sample, the baseline estimates imply the impact of a one standard deviation increase in the common supplier index implies a five percentage point decrease in bilateral real exchange rate volatility over five years. For the developed group of country-pairs the baseline result implies that an increase in one standard deviation of this sub-sample reduces volatility in about three percentage points, whereas for the developing group of country-pairs this effect reaches six percent. For the whole sample and in the case of the bilateral trade index, the baseline estimates imply the impact of a one standard deviation increase implies a seven percentage point decrease in bilateral real exchange rate volatility over five years. For the developed-pair group of countries this result implies that an increase in one standard deviation reduces volatility in about five percentage points, whereas for the developing-pair group this effect reaches eight percent. If the developing countries had trade levels of developed countries the reduction in volatility due to the common supplier index in the former group would be six percentage points, and ten percentage points in the case of the bilateral trade index. These effects are significant, economically large, and robust to different specifications. Moreover, the effects survive when both common supplier and bilateral indices are included in the regressions.

Table 6 considers a "horse race" between the commonality of trade and bilateral trade (with full controls). This regression is a good test of whether the commonality of trade matters for real exchange rate volatility given bilateral trade. Furthermore, the specification also allows a quantitative comparison of the two effects. Again all variables show the expected signs and are

[28] See Acemoglu and Zilibotti (1997) and Ramey and Ramey (1995).

significant at the one percent level. The results imply that the measures are indeed complementary, and that both increasing the level of common suppliers and the level of bilateral trade decreases volatility. A similar story holds when examining the results for the import demand structure and bilateral trade.

Table 7 breaks sample into developed and developing country pairs: developed-developed, developed-developing, and developing developing countries. The table only reports the coefficients of the indices from each the twelve underlying regressions, which include all controls and fixed effects. In the developed-developed sample (column 1), only the CS Index and the IM Index are significant at the ten percent level. This result can be partly explained by the fact that more developed economies have lower price volatility and therefore less variance to be explained (see summary statistics in Table 1). Results are much stronger for the developed-developing sample (column 2), where the four indices are significant at the one percent level. The strength of this result makes sense given that these country pairs show a relatively high real exchange rate volatility and have significant differences in their set of providers, the most unequal demands and the lowest level of bilateral trade, all of which could be due to the significant differences in income within this sample and trade specialization. Finally, the developing-developing sample (column 3) shows the CS Index and the bilateral trade variables as significant at the one percent level. The IM Index is significant only at the ten percent level.

Table 8 replicates the analysis of Table 7 but this time controlling for the commonality and bilateral measures at the same time, besides the regular controls. In the developed-developed sample the only index that is significant is the CS Index, but only at the ten percent level. For the developed-developing sample, all pairs of indices are significant at the ten percent level or better. The indices that are the most significant are the IM Index and both measures of bilateral trade. Finally, for the developing-developing sample the only the BM Index is significant below ten percent level, while the CS Index and bilateral trade are the most significant.

Overall, these results confirm the importance of the commonality of trade on real exchange rate volatility, as well as highlighting its importance relative to bilateral trade. These results can be understood in the context of the models that we highlight, where other country effects must be considered when examining bilateral relationships. In particular, trade costs and other country characteristics will interact so that demand and supply shocks from third countries will affect bilateral real exchange rate volatility. As modeled, the transmission of these shocks affect bilateral volatility via the country pairs' commonality of suppliers of goods.

5 Conclusion

This paper examines the impact of trade linkages on real exchange rate volatility. In particular, we highlight a distinct channel through which these costs affect volatility: the impact of the heterogeneity of the set of suppliers of traded goods between countries; as well as on their levels of bilateral trade. We postulate that the commonality of trade with third partners and bilateral trade dampen real exchange rate volatility through their common impact on both of the price indices that define the bilateral real exchange rate.

We first show how some recent trade models are consistent with the channel we highlight. Next, we develop measures of the commonality of trade that help proxy for the impact of trade costs, preferences and technology, and test for the impact of these indices to real exchange rate volatility using a large cross-country panel dataset of country pairs. Results confirm the main hypothesis that a increase in the commonality of trade decreases bilateral real exchange rate volatility. One of our main findings imply that for the case of developing countries a one standard deviation increase in the common supplier index and in the levels of bilateral trade imply a decrease of over 10% in bilateral real exchange rate volatility, which is large in both absolute and economic terms. Our main results are robust to a set of controls and in different sub-samples of the data.

The main channels highlighted in this paper can help in considering the exchange rate impact of a country joining a trade union with its main trading partners, where the expectation would be a decrease in real exchange rate volatility. Furthermore, we view this paper has a good starting point to more formally analyze the impact of trade and its determinants on macroeconomic volatility and other international macroeconomic issues. Indeed, one line of potential research would be to try and incorporate the channel that we emphasize into a dynamic general equilibrium macroeconomic model. Incorporating such a multi-country setting into a sophisticated intertemporal environment will not be easy, but doing so offers another channel that will help in resolving various puzzles/anomolies in the literature.

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Table 1. Summary Statistics

			CS Index		IM Index		BM Index		Log(Trade)	
Sample	Obs.	sd(RER)	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Full Sample Period										
Full	16821	0.168	0.019	0.032	0.748	0.171	0.005	0.015	5.018	3.306
Developed-Developed	1486	0.099	0.046	0.037	0.847	0.097	0.018	0.034	8.615	2.562
Developed-Developing	8030	0.162	0.019	0.029	0.719	0.158	0.003	0.010	5.822	2.756
Developing-Developing	7305	0.189	0.013	0.031	0.760	0.188	0.003	0.011	3.402	3.088
1970s										
Full	5104	0.144	0.019	0.034	0.761	0.162	0.005	0.016	4.633	3.395
Developed-Developed	502	0.092	0.047	0.041	0.844	0.084	0.018	0.036	8.181	2.488
Developed-Developing	2491	0.133	0.018	0.029	0.728	0.147	0.004	0.011	5.471	2.858
Developing-Developing	2111	0.170	0.013	0.034	0.780	0.181	0.003	0.011	2.802	3.095
1980s										
Full	5231	0.195	0.018	0.033	0.739	0.175	0.005	0.014	5.261	3.186
Developed-Developed	482	0.106	0.044	0.040	0.840	0.103	0.017	0.032	8.644	2.522
Developed-Developing	2581	0.191	0.018	0.031	0.704	0.160	0.004	0.010	6.020	2.611
Developing-Developing	2168	0.221	0.012	0.031	0.759	0.193	0.004	0.011	3.605	3.000
1990s										
Full Sample	6486	0.165	0.020	0.030	0.746	0.175	0.004	0.015	5.125	3.305
Developed-Developed	502	0.100	0.046	0.030	0.857	0.104	0.020	0.034	9.023	2.610
Developed-Developing	2958	0.161	0.021	0.026	0.725	0.163	0.003	0.008	5.945	2.765
Developing-Developing	3026	0.180	0.014	0.030	0.748	0.188	0.003	0.012	3.676	3.088

Notes: Statistics are calculated for the sample used in all estimations and cover the period 1970–97. sd(RER) is the average of the five-year standard deviations of bilateral real exchange rate volatility. 'CS': Common Supplier; 'IM': Industry Import, 'BM': Bilateral Import; 'Trade': real bilateral trade.

Table 2. Relationship between trade indices and bilateral distance

	(1) CS Index	(2) IM Index	(3) BM Index	(4) Bilateral Trade
Log(Distance)	-1.138**	-0.026**	-1.268**	-1.202**
	(0.042)	(0.007)	(0.048)	(0.065)
Constant	3.477**	-0.134*	2.351**	14.348**
	(0.352)	(0.062)	(0.397)	(0.543)
Observations	3952	3952	3952	3952
R^2	0.155	0.003	0.151	0.079

Notes: The indices are the average values over the sample for the period 1970–97, and are in natural logarithms. 'CS': Common Supplier; 'IM': Industry Import, 'BM': Bilateral Import. Standard errors in parentheses: + significant at 10%; * significant at 5%; ** significant at 1%.

Table 3. Determinants of bilateral real exchange rate volatility: Baseline pooled specification for full sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Common Supplier Index	-0.036**				-0.025**	-0.011**		
	(0.004)				(0.004)	(0.004)		
Industry Import Index		-0.094**					-0.076**	-0.090**
		(0.016)					(0.015)	(0.016)
Bilateral Import Index			-0.034**		-0.020**		-0.032**	
			(0.004)		(0.005)		(0.004)	
Bilateral Trade				-0.044**		-0.038**		-0.044**
				(0.004)		(0.004)		(0.004)
Distance	0.037**	0.073**	0.033*	0.022	0.023	0.017	0.032*	0.019
	(0.013)	(0.012)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Export Herfindahl Index	0.063**	0.069**	0.071**	0.068**	0.066**	0.067**	0.072**	0.069**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Real GDP	-0.010**	-0.025**	-0.008+	0.016**	-0.004	0.015**	-0.006	0.018**
	(0.004)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
P-value of sig. for xrate vars	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	16231	16231	16231	16231	16231	16231	16231	16231
R^2	0.100	0.090	0.100	0.110	0.100	0.110	0.100	0.110

Notes: Exchange rate volatilities are calculated using rolling twelve month natural logarithm real exchange rate changes over five-year periods. All controls are beginning of period and are in natural logarithms. Robust clustered standard errors in parentheses:; $^{+}$ significant at 10%; * significant at 5%; ** significant at 1%. Regressions include annual fixed effects. Robust standard errors in parentheses: + significant at 10%; * significant at 5%; ** significant at 1%.

Table 4. Determinants of bilateral real exchange rate volatility: Baseline specification without controls for full sample

	(1)	(2)	(3)	(4)
Common Supplier Index	-0.020**			
	(0.004)			
Industry Import Index		-0.072**		
		(0.017)		
Bilateral Import Index			-0.020**	
			(0.006)	
Bilateral Trade				-0.026**
				(0.006)
Observations	16821	16821	16821	16821
Country Pairs	4224	4224	4224	4224
R^2	0.113	0.112	0.112	0.113

Notes: Exchange rate volatilities are calculated using rolling twelve month natural logarithm real exchange rate changes over five-year periods. All controls are beginning of period and are in natural logarithms. Robust clustered standard errors in parentheses:; $^{+}$ significant at 10%; * significant at 5%; ** significant at 1%. Fixed effects regressions include country-pair and annual fixed effects. Robust standard errors in parentheses: + significant at 10%; * significant at 5%; ** significant at 1%.

Table 5. Determinants of bilateral real exchange rate volatility: Baseline specification with controls for full sample

	(1)	(2)	(3)	(4)
Common Supplier Index	-0.017**			
	(0.004)			
Industry Import Index		-0.071**		
		(0.017)		
Bilateral Import Index			-0.017**	
			(0.005)	
Bilateral Trade				-0.023**
				(0.005)
Export Herfindahl Index	0.055**	0.057**	0.057**	0.058**
	(0.007)	(0.007)	(0.007)	(0.007)
Real GDP	-0.096**	-0.102**	-0.092**	-0.077**
	(0.025)	(0.025)	(0.025)	(0.026)
Exchange Rate Regime Variables	Yes	Yes	Yes	Yes
H_0: all $\gamma_i^{err} = 0$ (P-value)	0.0000	0.0000	0.0000	0.0000
Observations	16821	16821	16821	16821
Country Pairs	4224	4224	4224	4224
R^2	0.123	0.123	0.123	0.124

Notes: Exchange rate volatilities are calculated using rolling twelve month natural logarithm real exchange rate changes over five-year periods. All controls are beginning of period and are in natural logarithms. Exchange rate regime measure are: (i) country 1 pegged or not, (ii) country 2 pegged or not, (iii) country 1 is pegged to country 2 (or vice versa), (iv) country 1 and country 2 share the same base country (for pegging or floating). Variables are from Shambaugh (2004). Robust clustered standard errors in parentheses:; $^+$ significant at 10%; * significant at 5%; ** significant at 1%. Fixed effects regressions include country-pair and annual fixed effects.

Table 6. Determinants of bilateral real exchange rate volatility: Multilateral vs. bilateral specification with controls for full sample

	(1)	(2)	(3)	(4)
Common Supplier Index	-0.014**	-0.012**		
	(0.005)	(0.004)		
Industry Import Index			-0.070**	-0.070**
			(0.017)	(0.017)
Bilateral Import Index	-0.013*		-0.017**	
	(0.005)		(0.005)	
Bilateral Trade		-0.019**		-0.023**
		(0.005)		(0.005)
Export Herfindahl Index	0.056**	0.057**	0.058**	0.059**
	(0.007)	(0.007)	(0.007)	(0.007)
Real GDP	-0.087**	-0.074**	-0.087**	-0.073**
	(0.025)	(0.026)	(0.025)	(0.026)
Exchange Rate Regime Variables	Yes	Yes	Yes	Yes
H_0: all $\gamma_i^{err} = 0$ (P-value)	0.0000	0.0000	0.0000	0.0000
Observations	16821	16821	16821	16821
Country Pairs	4224	4224	4224	4224
R^2	0.124	0.124	0.124	0.125

Notes: Exchange rate volatilities are calculated using rolling twelve month natural logarithm real exchange rate changes over five-year periods. All controls are beginning of period and are in natural logarithms. Exchange rate regime measure are: (i) country 1 pegged or not, (ii) country 2 pegged or not, (iii) country 1 is pegged to country 2 (or vice versa), (iv) country 1 and country 2 share the same base country (for pegging or floating). Variables are from Shambaugh (2004). Robust clustered standard errors in parentheses:; $^+$ significant at 10%; * significant at 5%; ** significant at 1%. Fixed effects regressions include country-pair and annual fixed effects.

Table 7. Determinants of bilateral real exchange rate volatility: Baseline specification with controls for sub-samples

	(1) Developed-Developed	(2) Developed-Developing	(3) Developing-Developing
Common Supplier Index	-0.034+	-0.016*	-0.016**
	(0.018)	(0.006)	(0.006)
	[0.203]	[0.167]	[0.100]
Industry Import Index	0.138	-0.183**	-0.038+
	(0.247)	(0.042)	(0.020)
	[0.201]	[0.170]	[0.100]
Bilateral Import Index	-0.028	-0.024**	-0.011
	(0.026)	(0.008)	(0.007)
	[0.202]	[0.168]	[0.100]
Bilateral Trade	-0.020	-0.026**	-0.019**
	(0.025)	(0.008)	(0.007)
	[0.201]	[0.168]	[0.101]
Observations	1486	8030	7305
Country Pairs	253	1703	2268

Notes: Exchange rate volatilities are calculated using rolling twelve month natural logarithm real exchange rate changes over five-year periods. All controls are beginning of period and are in natural logarithms. Robust clustered standard errors in parentheses:; $^{+}$ significant at 10%; * significant at 5%; ** significant at 1%. Fixed effects regressions include country-pair and annual fixed effects. R^2 in square brackets.

Table 8. Determinants of bilateral real exchange rate volatility: Multilateral vs. bilateral specification with controls for sub-samples

	CS Index	IM Index	BM Index	Bilateral Trade	R^2
			Developed-Developed		
(1)	-0.030+		-0.020		0.204
	(0.018)		(0.027)		
(2)	-0.032+			-0.012	0.203
	(0.018)			(0.026)	
(3)		0.159	-0.030		0.202
		(0.240)	(0.026)		
(4)		0.154		-0.021	0.202
		(0.241)		(0.025)	
			Developed-Developing		
	CS Index	IM Index	BM Index	Bilateral Trade	R^2
(5)	-0.012+		-0.020*		0.168
	(0.007)		(0.008)		
(6)	-0.011+			-0.023**	0.168
	(0.007)			(0.008)	
(7)		-0.177**	-0.022**		0.171
		(0.041)	(0.008)		
(8)		-0.176**		-0.024**	0.171
		(0.041)		(0.008)	
			Developing-Developing		
	CS Index	IM Index	BM Index	Bilateral Trade	R^2
(9)	-0.014*		-0.006		0.101
	(0.006)		(0.007)		
(10)	-0.012+			-0.015*	0.101
	(0.006)			(0.007)	
(11)		-0.038+	-0.011		0.100
		(0.020)	(0.007)		
(12)		-0.039+		-0.019**	0.101
		(0.020)		(0.007)	

Notes: Developed-Developed: 1486 Observations, 253 Country Pairs; Developed-Developing: 8030 Observations, 1703 Country Pairs; Developing-Developing: 7305 Observations, 2268. Exchange rate volatilities are calculated using rolling twelve month natural logarithm real exchange rate changes over five-year periods. All controls are beginning of period and are in natural logarithms. 'CS': Common Supplier; 'IM': Industry Import, 'BM': Bilateral Import. Robust clustered standard errors in parentheses:; + significant at 10%; * significant at 5%; ** significant at 1%. Fixed effects regressions include country-pair and annual fixed effects.

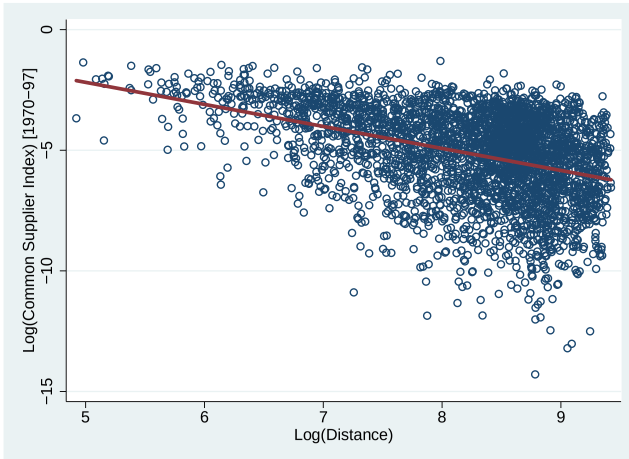
(a) Common Supplier Index

(b) Industry Import Index

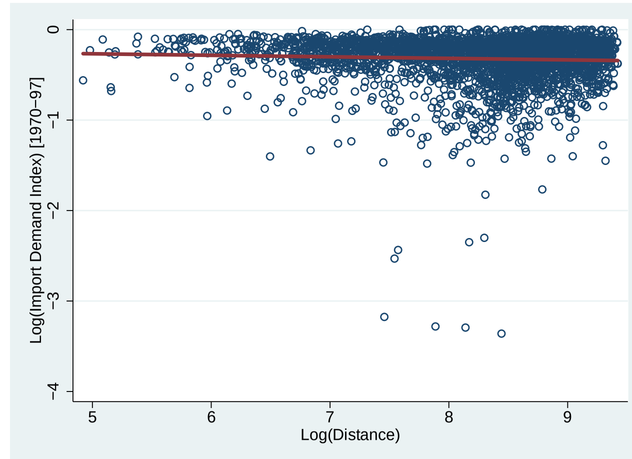
(c) Bilateral Import Index

(d) Bilateral Trade

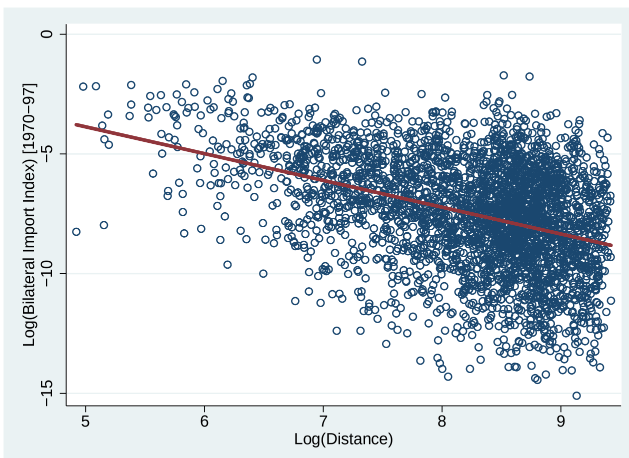
Figure 1. World Trade Measures over Time



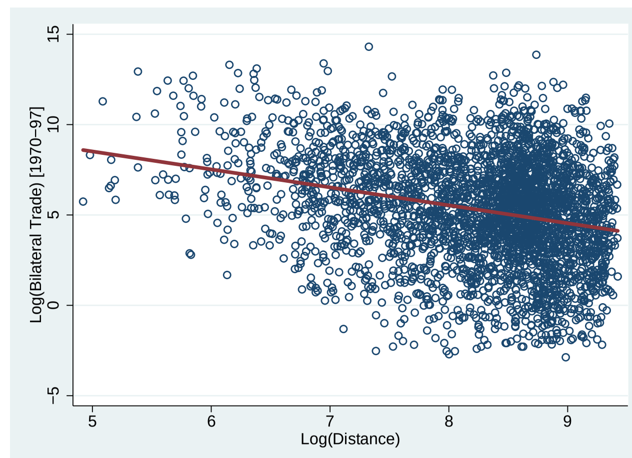
(a) Common Supplier Index



(b) Industry Import Index

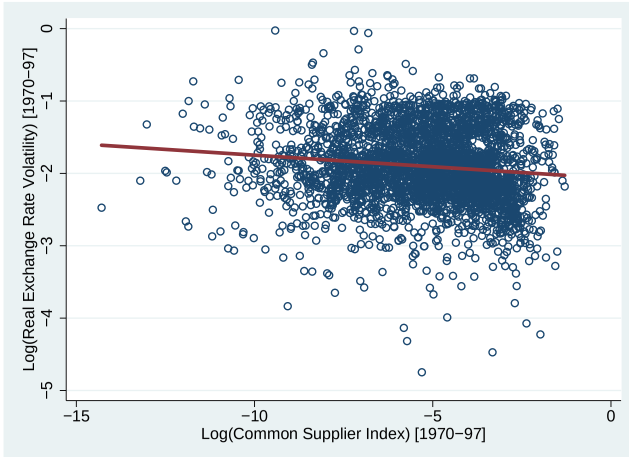


(c) Bilateral Import Index

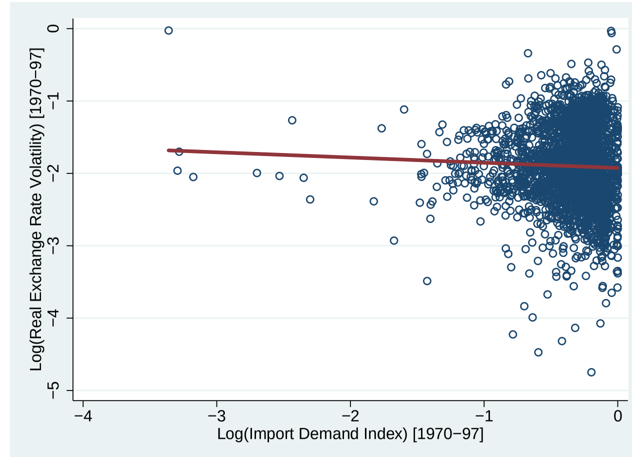


(d) Bilateral Trade

Figure 2. Trade Measures vs. Distance

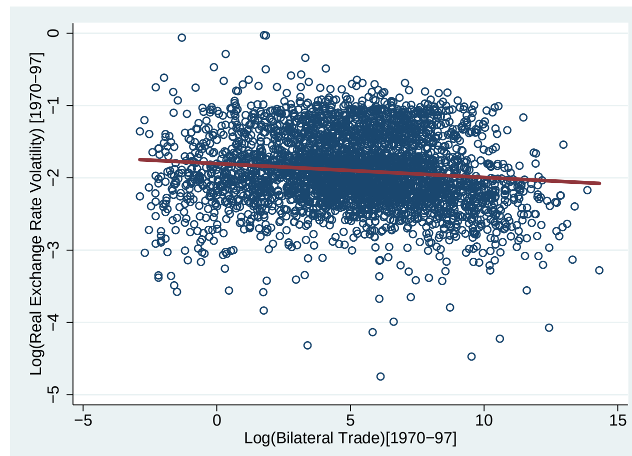


(a) Common Supplier Index



(b) Industry Import Index

(c) Bilateral Import Index



(d) Bilateral Trade

Figure 3. Real Exchange Rate Volatility vs. Trade Measures