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DO MULTILATERAL TRADE LINKAGES EXPLAIN BILATERAL REAL EXCHANGE RATE VOLATILITY?

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Do Multilateral Trade Linkages Explain Bilateral Real Exchange Rate Volatility?

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Abstract

This paper investigates the impact of multilateral trade linkages on bilateral real exchange rate volatility by examining a particular channel —the extent of the effects of differences on import intensities (GDP's share of imports of a given product and origin) between trade partners—of long-run real exchange rate volatility. I exploit a large panel of cross-country data over the years 1970–97 and construct a micro-founded index to capture this effect. In the estimations I address carefully endogeneity issues by testing not just exogeneity but also the presence of weak instruments. As robustness check and under the latter I estimate LIML and Fuller(1) regressions to ensure unbiased coefficients. Results strongly support the hypothesis that a pair of countries with a larger difference in the import intensities from the rest of the world faces a larger bilateral real exchange rate volatility. This result turns to be robust to the inclusion of bilateral trade a commonly argued moderator of volatility and other controls. These empirical findings are consistent with recent international trade models that highlight multi-country trade linkages.

Keywords: Real exchange rate volatility; Import Intensity Differences; Multicountry analysis
JEL classifications: F30; F40

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1 Introduction

During recent years there has been an increasing amount of research focusing on the macroeconomic effects of real exchange rate volatility. This efforts range from research that addresses the impact of volatility on economic growth to a more traditional focus on the study of its impact on bilateral trade levels. In this paper I try to answer a significantly less studied question–What is the impact of multilateral trade linkages on bilateral real exchange rate volatility? I answer this question by examining the impact of a particular channel–the extent of the difference on import intensities between trade partners–on long-run real exchange rate volatility.

Based on Anderson and van Wincoop (2003)'s model I derive theoretically an important channel through which multilateral trade affects real exchange rate volatility and provide empirical evidence supporting the existence of this channel. Specifically, I emphasize the interaction of two countries with all the other countries in the world, rather than just their bilateral interaction. I argue that heterogeneity in the suppliers of goods and import intensity, and differences in traded goods (our IID Index, –defined as import intensities as the GDP share of imports of a given good from any particular country) affect the relative price indices ratio of two countries and, hence, the real exchange rate and thus affect how shocks diffuse across countries.

Under fairly general assumptions the price index of a given country will be a function of the import intensities of traded goods (i.e. import shares in the GDP). Thus, import intensity differences will permit the diffusion of third country shocks by introducing uncompensated movements in the price index ratio of a given pair of countries. In the opposite extreme, equal import intensity for all goods in a given pair of countries implies equal price index composition, therefore equal price index movements and null relative price index ratio movements. Thus, trade with rest of the world and IID are central in transmitting third country shocks to relative bilateral price indexes and hence a key determinant of real exchange rate volatility.

Before describing in further detail the contributions of this paper, I briefly contextualize them in the literature on real exchange rate volatility determinants and effects. Thus, I must first address certain questions: why should real exchange rate volatility be considered an interesting topic of inquiry? And, does it cause any pervasive effect in macroeconomic performance? Based on the answer to this latter question, as will be addressed shortly, that for a wide range of macroeconomic phenomena is that real exchange rate volatility, its effects, and –for the purposes of this paper– most importantly its determinants turn to be an interesting topic of research.

Recently, Aghion et al. (2006) find that in countries with low level of financial development the effective real exchange rate volatility reduces growth. In their model exchange rate volatility negatively affects the performance of credit-constrained firms thereby reducing aggregate growth. The simultaneous work of Bagella et al. (2006) confirm the negative impact of volatility on growth, while Bagella et al. (2004) also find that volatility is negatively related to income levels. Even before these results were available it had been argued that volatility could have an impact on growth due to the impact that volatility it might have on investment levels. Indeed, Serven (1998, 2002) finds a negative relationship between investment and macroeconomic volatility. In particular, Serven (2002) finds that for the case of developing countries real exchange rate volatility reduces investment once it exceeds a certain threshold level.

The impact that real exchange rate volatility has on the level of trade it has been widely studied since the seventies. Recently, there has been a surge in this literature, which suggests that bilateral real exchange rate dampens levels of bilateral trade,. The survey of Bahnami-Oskooee and Hegerty (2007) presents a brief review of the theoretical literature and an extensive survey of the empirical literature on this topic. This survey reveals that there have been substantial efforts in quantifying the effect of exchange rate volatility on trade and almost none on the impacts that trade has on volatility, although a significant part of the literature recognizes this effect. A few years ago there was an important attempt to address this less studied effect by Broda and Romalis (2003)- focusing on the impact of bilateral trade- but it was never published.

Considering the evidence of endogeneity between trade an exchange rate volatility most of recent research focuses on the impact of volatility on trade using instrumental variables or cointegration techniques, although there is some research that uses none. Evidence from this aspect has been found for developed and developing countries. Using instrumental variables Byrne et al. (2008) finds a negative effect of bilateral real exchange rate volatility on US bilateral trade. By the same token Baaka et al. (2007) using cointegration techniques find a negative impact of bilateral real exchange rate volatility on exports of East Asian countries to Japan and the US. Arize et al. (2008), also using cointegration, contribute with evidence for the total level of exports of eight Latin American countries and its relationship with real exchange rate volatility; along the same lines Bouoiyour and Rey (2005) contribute with evidence for Morocco and Takaendesa et al. (2006) for South Africa. While Arize et al. (2008) and Bouoiyour and Rey (2005) using neither instruments nor using cointegration find that real exchange rate volatility negatively affects trade, Takaendesa et al. (2006) using cointegration techniques find that volatility does not affect South African exports. Related to this literature is the work of Shambaugh and Klein (2006) who study the impact of fixed exchange rate regimes in the levels of bilateral trade. The authors find that there is large and positive effect on trade between a base country and a country pegged to it. Additionally, countries that peg to a common third country also experience increases in their levels of bilateral trade but only when these countries belong to a larger arrangement - as was the case with Bretton Woods.

Notwithstanding these important research efforts, still the question of what drives real exchange rate volatility remains unanswered besides its known impact on macroeconomic performance. Indeed, Hausmann et al. (2006) find that developing countries are close to three times more volatile than industrial countries, and that these differences can not be explained by the fact that developing countries face greater shocks or recurrent currency crisis. Thus, the understanding of what drives real exchange rate volatility remains as a very important topic of inquiry. In this paper we try to contribute to a deeper understanding of the determinants of real exchange rate volatility by focusing on a less studied trade mechanism.

But why do we focus on bilateral exchange rates if most of the macroeconomic effects depend on effective (multilateral) real exchange rates? We do so because effective or multilateral real exchange rates are generally computed as a trade-based geometric-weighted average of bilateral real exchange rates (See Bayoumi et al. (2006)). Therefore, if we were able to explain real exchange volatility in a meaningful manner, we would be explaining effective real exchange rate volatility as well. Thus, bilateral fluctuations will be passed through to effective or multilateral real exchange rates in a weighted manner, with those weights based on trade data.

We argue that heterogeneity in the suppliers of goods and differences in import intensities of traded goods impact how shocks diffuse across countries, and thereby affect the relative price indices of two countries. For example, let's consider two countries that are geographically close to each other and are of similar sizes and have similar levels of income. Traditional trade theory predicts that they will have a similar set of supplier-countries for traded goods and that their imports will be of similar amounts. Therefore, ceteris paribus, shocks from countries around the world will diffuse to these two countries in a similar manner (via trade), which in turn will lead to similar movements in their prices indices thus lowering bilateral real exchange rate volatility. At the opposite extreme, let us consider the case of two distant countries that have very different geographies and have different sizes and incomes. Traditional gravity models predict that these countries will demand goods in different amounts from a different set of providers. Most importantly, these differences in import intensities will be responsible for an heterogeneous diffusion of the remaining trade partners' shocks within the pair of countries, which will manifest in a different composition of their prices index whose movements would be in this manner decoupled, thereby increasing real exchange rate volatility.

In our empirical analysis we used a theoretically derived index of multilateral trade (IID) as explanatory variable of real exchange rate volatility. Recognizing the endogeneity between these variables, in our estimations we use an instrumental variables approach. However, we are not just interested on the quantifying the effect that differences on import intensities have on volatility, but also in comparing this effect to that of bilateral trade measures. For this reason we estimate regression with each variable, but also test for their joint effect.

In our estimations, given the limited number of instruments available, we not only test for exogeneity and validity of instruments by means of overidentification tests, but we also test for weak instruments following Stock and Yogo (2002) procedure. As a robustness check and, or under the presence of weak instruments we estimate our model by LIML and Fuller(1) techniques, whose results are unbiased under these circumstances.

The first insight that can be obtained from our analysis is that there are significant differences in the IID index levels and standard deviations for different groups of country pairs. In particular, developed-developed country pairs exhibit the smallest mean and standard deviation of the IID index, and the developed-developing country pairs show the greatest difference in import baskets. Thus, the data shows that countries with similar levels of development have more similar import baskets and that the largest differences are found in country pairs with different levels of development. Additionally, developing-developing country pairs exhibit the greatest standard deviation of the IID index. Second, multilateral trade explains significantly more of the volatility of the real exchange rate than bilateral trade. Thus, a one standard deviation increase in our Import Intensity Differences Index (IID) has, in some cases, more than ten times the impact of any of the bilateral measures for the overall sample. Third, the impact of a one standard deviation increase in the IID index on volatility for the developed-developed pairs of countries is smaller than for other country pair group, whereas the impact of one standard deviation increase in the IID for developing-developing country pairs is the largest. Fourth, the impact of a one standard deviation increase in the Bilateral Trade Index (measureing bilateral trade intensity) and bilateral trade decreases the bilateral exchange rate volatility with similar magnitudes for all country pairs. Regarding the derived elasticities, we obtain that for the overall sample the elasticity of IID around its mean is close to one, whereas for bilateral trade measures these elasticities are close to 2%. Nonetheless, this huge difference in the magnitude of elasticities, the bilateral trade index and its level show significantly larger variances than the IID index. For this reason, the impact of one standard deviation increase in the IID index is between four and ten times the impact of bilateral trade level under similar changes. In summary, our results show that the impact of import intensity differences is not just statistically significant but also economically meaningful and has a larger impact on volatility than traditional bilateral trade measures.

These results are found by exploiting a large cross-country dataset to examine the importance of differences in import intensities and bilateral trade on bilateral real exchange rate volatility. Though most tests in the empirical literature studying real exchange rates rely on the time series properties of the data, our specifications also rely on the cross-sectional dimension for identification. 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.[1] We further control for other standard economic variables such as the natural logarithm of the product of real GDP, the natural logarithm of Herfindahl index of export concentration, exchange rate regime variables and money volatility.

The emphasis on more than just bilateral relationships complements the recent work of Kose

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

and Yi (2006), and Fitzgerald (2008) who highlights the impact of trade costs and multi-country trade interactions on the behavior of macroeconomic variables. While Kose and Yi (2006) study whether the standard international business cycle model explain the relation between trade and co-movement, Fitzgerald (2008) studies the extent to which trade costs help us to understand the low volatility of consumer price inflation considering the high volatility of nominal exchange rates. Our research differs from this latter work in at least three aspects. First, we focus on bilateral exchange rate volatility rather than inflation. Second, we develop a new proxy measure for the impact of multilateral trade on real exchange rate volatility and show that this common trade measure is consistent with a general class of trade models. Third, we test for the impact of multilateral trade and bilateral trade rigorously taking into account the endogeneity of trade with respect to bilateral real exchange rate volatility.

The remainder of the paper is structured as follows. Section 2 describes Anderson and van Wincoop (2003) model, which we use to motivate our empirical strategy and ergo, to explain the main empirical findings. Section 3 presents the empirical methodology and data. Section 4 presents the results. Section 5 concludes.

2 Theoretical Underpinnings

From Anderson and van Wincoop (2003)'s model (henceforth refered to AVW) of multilateral trade, we derive one main testable implication regarding the relationship between bilateral real exchange rate volatility and trade: the bilateral real exchange rate volatility increases on the extent of the differences in the multilateral import intensities between two countries.

In AVW's model, the consumer derive utility from the consumption of a composite **CES** good. Regarding the supply side, the model adopts Armington's assumption that products are differentiated by origin and that each country receives a fixed endowment of its differentiated good. Finally, the model assumes that there are trade costs, and that these are payed by the exporter.

The utility function of the representative consumer is given by:

$$U_j \quad = \quad U(Cj) = \left(\sum_i c_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

Let's denote the price of the consumption bundle by P_j. From this set up it is possible to derive AVW's gravity equation and price indexes relationship:

$$x_{ij} = \frac{Y_i Y_j}{Y_W}\left(\frac{t_{ij}}{P_i P_j}\right)^{1-\sigma} \quad (1)$$

$$(P_j)^{1-\sigma} = \sum_i (P_i)^{\sigma-1}(t_{ij})^{1-\sigma}\frac{Y_i}{Y_W} \quad (2)$$

with x_{ij} the imports of country j for i's goods, t_{ij} is the transport cost between country i and j. We denote by Y_i the income of country i, Y_W the value of the world traded goods.

Equations (1) and (2) show that even in the case of two countries with equal levels of income, the differences in their trade costs with other countries will introduce a gap in their import demands, thereby affecting the composition of their price indices.

Totally differentiating (2), we obtain the following relationship:

$$d\ln P_j = \sum_i \frac{x_{ij}}{Y_j}\left(\frac{1}{1-\sigma}\left(1-\frac{Y_i}{Y_W}\right)d\ln Y_i - d\ln P_i\right) \quad (3)$$

Based on this expression we analyze the evolution of bilateral real exchange rate volatility and its relationship with multilateral trade. We express the logarithm of the real exchange rate of countries j and k as:

$$\ln RERjk = \ln\left(\frac{P_j}{P_k}\right)$$

Totally differentiating the previous expression and using equation (3) we get that the changes in the bilateral real exchange rate can be expressed as:

$$d\ln\left(\frac{P_j}{P_k}\right) = \sum_i \left(\frac{x_{ij}}{Y_j}-\frac{x_{ik}}{Y_k}\right)\cdot\left(\frac{1}{1-\sigma}\left(1-\frac{Y_i}{Y_W}\right)d\ln Y_i - d\ln P_i\right)$$

Denoting by σ_i^P, $\sigma_i^{GDP}\sigma_i^{dGDP}$ $i=1,\ldots,n$ the variances of the log of the price indices, GDP and GDP growth respectively. Assuming for the sake of clarity of exposition that $d\ln P_i$, $d\ln Y_i$ and dY_i are i.i.d. and that world's GDP is constant, we can express the bilateral real exchange rate volatility as a function of the differences on import intensities from goods imported from all countries:

$$VAR(RER_{jk}) = \Omega\cdot\sum_i\left(\frac{x_{ij}}{Y_j}-\frac{x_{ik}}{Y_k}\right)^2 \quad (4)$$

with $\Omega = \left(\sigma^P + \frac{\sigma^{GDP}+\frac{\sigma^{dGDP}}{Y_W^2}}{(1-\sigma)^2}\right)$.

The sum of the terms between parentheses in equation (4) corresponds to what we identify as import intensity differences (IID) between countries. We will generalize this term in our empirical section and then we will use it as explanatory variable in our regressions specifications. We expect that the larger the IID, the greater the bilateral real exchange rate volatility.

The intuition of the previous result is as follows. The summery term in equation (4), corresponds to the differences in the import intensities between countries. This term captures the implicit differences in the price indexes of both countries whose bilateral real exchange rate is studied. Thus, larger differences in import intensities capture larger differences in their import (consumption) bundles and hence price indexes. Larger differences imply that price indexes move differently as a consequence of third country shocks. Indeed, greater differences imply more decoupled price indexes movements and greater real exchange rate volatility. This brings the main result of the model: third country shocks affect bilateral exchange rates through trade.

For the more general case in which there is covariance between prices and GDP, the dependence of real exchange rate volatility on the IID term does not change, but it will imply the addition of terms associated with the covariances times the multiplication of the difference terms between parentheses.[2]

3 Quantifying Trade Intensities and Empirical Specification

Quantifying the impact of trade linkages on exchange rate volatility is not straightforward. However, the model explored above outlines some common themes that help shape our empirical analysis. On one hand, in a world with transport costs countries will demand different quantities of goods and will have different sets of providers of goods. More generally, differences in preferences and factor endowments will also introduce differences in import intensities. This asymmetry introduces real exchange rate volatility because countries will have different price indices, which in turn are subject to different sources and magnitudes of shocks.[3]We use this intuition to quantify the volatility impact of other variables, such as trade costs or differences in preferences, which are otherwise elusive objects to measure. We first construct a measure based on actual trade with third countries. Furthermore, and following the traditional focus of the literature, we also present measures of bilateral trade based in the consideration that bilateral trade is a common source of shocks in the price indices that cancel out each other thereby reducing bilateral real exchange rate volatility.

Two indices are defined; one referring to the multilateral trade and the other to bilateral trade. The first index corresponds to the import intensity difference index (IID). This index calculates how similar a pair of country's imports in each sector are relative to each country's total imports.

[2]More generally, when shocks on prices and GDP and its change are correlated across countries the expression for the RER includes n*(n-1) terms that depend on the covariances of each variable for each pair of countries. Thus, the number of additional terms makes implausible to deal with this additional complexity. At this respect, our aim is more modest by trying to test a first order effect of import intensity differences on RER volatility once you account for endogeneity and other factors.

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

In this case, similar import demands will be correlated with similar price indices and therefore are a source of relative price stability. The second index calculates bilateral trade as a share of the two countries' total imports (BM Index). Finally, we also add the level of bilateral trade in our empirical analysis.

3.1 Definition of Indices

Import Intensity Differences Index (IID)

This index is the empirical counterpart of equation (4) and captures the difference in the import bundles of a given pair of countries. Our theoretical model predicts that the greater this difference is, the larger the real exchange rate volatility. Let us start by considering a world with N countries, S sectors/goods, and M_{iks} is imports of good s of country i from country k. Then, the generalized import intensity differences index (IID) for countries i and j is constructed as follows:

$$\text{IID Index}_{ij} = \sum_{k=1}^{N} \sum_{s=1}^{S} \left(\frac{M_{iks}}{M_{is}} - \frac{M_{jks}}{M_{js}} \right)^2, \tag{5}$$

where M_{is} is country i's total imports in sector s. The smaller the index, the more similar the structure of two countries' imports is. Therefore, greater values capture the heterogeneity in the supplier of goods and on import intensities. It is noteworthy to mention that this index corresponds to a generalization of the first term in equation (4) given that we have multiple goods traded for each pair of countries. Nonetheless this generalization effort, the index presents an important difference within the term that we identify as the import intensity differences in equation (4). This difference lies in the fact that in equation (4) the sum of the difference terms also includes the difference in consumption of the domestic good. As the only available good data comes from trade data, our IID index misses this component. Despite this fact, our IID index is as far as you can go with the empirical formalization of the model given the data available. Similar constraints were also faced by Fitzgerald (2008).

Bilateral Import Index (BM) and bilateral trade.

We use measures of relative and absolute bilateral trade intensity as an empirical complementary hypothesis. As we have seen it has been argued that bilateral trade dampens bilateral real exchange rate. Thus, we test this hypothesis and compare these estimates with those of the IID index. We also test jointly the hypothesis that multilateral and bilateral trade matter for real exchange rate volatility. The BM index for countries i and j is constructed as follows:

$$\text{BM Index}_{ij} = \frac{\sum_{s=1}^{S} (M_{ijs} + M_{jis})}{M_i + M_j}, \tag{6}$$

where the variables are defined similarly as for IID index. The index is normalized by total imports in order to capture the relative trade intensity between a given pair of countries. However, in our estimations we additionally use the log of the level of total bilateral trade as an explanatory variable. This is -as an empirical counterpart of the previous relative measure- and allows us to capture bilateral trade scale effects.

3.2 Characteristics of Indices

The World Trade Database for 1970–97 is used 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, disaggregated at the 4-digit SITC level. This is still quite a high level of aggregation, but yields both inter-temporal variation, as witnessed in Figures 1-3, as well as cross-sectional variation. Figure 1 illustrates the evolution of the IID Index for the period under study. The figure shows an inverted U-shaped curve that has its peak during the 1980s. Figure 2 describes the evolution of the BM Index, which declines initially but increases at the end of the 1990s. Finally, Figure 3 plots the path of bilateral trade (in natural logarithms) over time. As well documented in the literature, there is a dramatic increase in world trade since the mid-1980s, which can be explained by a fall in trade costs but also changes in the structure of trade, such as "vertical specialization" (Yi (2003)). The increase in the IID Index that starts at the end of the 1970s and that peaks in the 1980s also corresponds nicely with the vertical specialization of trade period.[4] Table 1 summarizes these data across country pairs: developed-developed, developed-developing, and developing-developing.

The first column in Table 1 shows the number of observation across country pairs. The second column shows the mean of bilateral real exchange rate volatility, measured by the standard deviation of the rates of change, across country pairs. The developed-developed country pairs group shows the lowest volatility with a standard deviation average of 10%. In contrast the developing-developing country pairs show the highest volatility with 18%. Developed-Developing country pairs have an intermediate level of volatility with 15%.

The third and fourth columns show the mean and standard deviation of the IID. It is observed that the differences in import baskets are larger for the developed-developing country pairs with and mean of 0.28. The differences are smaller for country pairs with the same level of development. Thus

[4] The increase, 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. The first part of 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.

developing-developing country pairs have a mean of 0.26 and developed-developed a significantly smaller 0.16 mean.

The fifth column shows the mean of the bilateral trade index. This index has its maximum among developed-developed country pairs and it is significantly smaller for country pairs in different categories. The seventh column shows the mean of bilateral trade. In this column it is observed that developed-developed country pairs trade significantly more than the other two country pair categories and, in turn there is larger bilateral trade between developed and developing countries than between developing countries. The sixth and eight columns show the significantly large standard deviations of these bilateral trade measures.

3.3 Regression Framework

Given the definition of the indices, we test the main hypothesis that the difference in import intensities by means of the IID index have a positive impact on real exchange rate volatility. Based on the existing literature we additionally test whether measures of bilateral trade are negatively related to volatility. For these purposes in a first stage we use the following linear regression model of bilateral real exchange rate volatility:

$$\sigma_{ij,t}^{RER} = \alpha + \beta \mathbf{INDEX}_{ij,t-1} + \gamma \mathbf{X} + \mu_i + \mu_j + \delta_t + \varepsilon_{ij,t}, \tag{7}$$

where $\sigma_{ij,t}^{RER}$ is the real exchange rate volatility measure between $t-1$ and t; **INDEX** includes either one or a combination of the trade related variables; $\mathbf{X}$ 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, (iii) exchange rate regime variables and (iv) money volatility; μ_i and μ_j are country fixed effects vectors; and δ_t is a vector of time dummies. Additionally, we also consider the impact of our indexes in a preliminary set of pooled regressions, which we also report. These equations are estimated in five-year panels with robust standard errors. The key parameters that are estimated are the components of β, which are expected to be greater than zero for the case of the Import Intensities Differences Index and to be less than zero for the measures of Bilateral Trade.

The inclusion of the income variables captures the fact that aggregate volatility should fall with the level of development.[5] The export concentration measure is included to capture how diversified a country's export sector is, and is measured using a Herfindahl index.[6] One should expect that the

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

[6] 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 more diversified the export structure of a given economy is, the smaller is the impact of external shocks and the lower the swing in the exchange rate. The exchange regime variables capture whether any of the two countries are pegged, whether the peg is between each other, and if they have a common base country (whether pegged or floating). These exchange rate indicators are meant to capture the obvious fact that nominal exchange rate volatility may be affected 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.[7] Finally, we add to some specifications money volatility as a recognition that monetary factors can contribute in an important way to real exchange rate volatility.

In a first stage we estimate the pooled and simple country-time fixed effects regressions and in a second stage we add instrumental variables to the estimation in recognition to the fact that there might be reverse causation between real exchange rate volatility and trade as suggested the literature. Thus, we estimate the system:

$$\sigma_{ij,t}^{RER} = \alpha + \beta \mathbf{INDEX}_{ij,t} + \gamma \mathbf{X_{ij,t}} + \mu_i + \mu_j + \delta_t + \varepsilon_{ij,t}, \quad (8)$$

$$\mathbf{INDEX_{ij,t-1}} = \zeta Z_{i,j,t} + \eta X_{,i,j,t} + \nu_i + \nu_j + \rho_t + \xi_{ij,t}, \quad (9)$$

where Z is a matrix of instruments of our multilateral and bilateral trade variables. Among them we consider traditional trade determinants such as bilateral distance, common language, measures of remoteness of each country, and free trade agreements. Considering the evidence presented by Berthelon and Freund (2008) who find that the effect of distance on trade has changed over time in some specifications we interacted bilateral distance with decade dummies. This gives an additional time variation to our set of instruments besides that contributed by our measure of remoteness.

Given the restricted set of instruments available, we not only look whether the set of instruments is valid by means of the Hansen J over-identifying restrictions' test but also whether our instruments are weak by comparing the Wald F test statistic of our estimations with Stock and Yogo (2002) critical values. Under the presence of weak instruments IV estimates are biased and the size of the Wald tests are affected, thereby inducing misleading interpretation of estimation results. In particular, the weak instruments theory goes beyond the concern of exogeneity of instruments by focusing on its relevance. There are at least two alternative definitions of weak instruments as presented by Stock and Yogo (2002). One establishes that a set of instruments is weak if the bias of the IV estimator, relative to the bias of the OLS, exceeds a certain level. The second definition establishes that instruments are weak if conventional levels of confidence of Wald tests based on

SITC level.

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

IV estimates have a size that exceeds its original level by a given amount. Stock and Yogo (2002) provide tables of F-tests critical values depending on the used estimator and whether the researcher is concerned about bias or size distortion. The statistical software we use, Stata, provides these critical values and are the ones we use in our inference.

Under the presence of weak instruments there are some alternative estimation techniques that permit us to overcome the bias of a two stage IV estimation (TSLS) . Indeed, estimations with limited information maximum likelihood (LIML) show smaller bias than TSLS estimations. In particular, when the instruments are fixed and the errors are symmetrically distributed, LIML is the best median unbiased k-class estimator to second order. (See Stock et al. (2002)) Another alternative are Fuller k-estimators. With fixed instruments and normal errors the Fuller-k with estimation parameter b=1 is the best unbiased to second order estimator.

For the reasons presented above, we test for weak instruments and we estimate additionally LIML and Fuller(1) regressions that permit to corroborate or improve our TSLS estimation, thereby guaranteeing the validity of our inference.

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3.4 Data Summary

The bilateral real exchange variable is constructed using a nominal exchange rate and CPI data from the Global Financial Database in order to maximize country-pairs. [8]The volatility measure is calculated by first taking the annual real exchange rate change each month (as log differences); 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). Taking the volatility of the rate of change has one main advantage over taking the volatility of the log level, which is that the resulting measure is in invariant to the country-pairs RER-ratio and base year. We then compute the standard deviation of these annual changes over 5 years periods (i.e.,between $t-1$ and t) as our measure of long-run volatility. [9]

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 by Heston et al. (2002), with missing data 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 (2004)s data, but we lose observations.[10] We use Rose (2000) database for bilateral

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

[9]In Bravo-Ortega and Di Giovanni (2005) 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.

[10]We would like to thank Jay Shambaugh for sharing all these data with us, as well as discussions concerning the

distance, common language and major free trade agreements. Finally, we use Bravo-Ortega and Di-Giovanni (2006)'s remoteness measure and the IMF's International Financial Statistics database for the construction of our money volatility measure.

4 Results

The main results can be summarized as follows. First, the import intensity differences index (IID) is significant in all baseline and extended specifications, and economicaly meaningful. The estimated coefficients for this measure of multilateral trade survive the inclusion of bilateral trade measures, and are often much larger (in absolute value) than the bilateral trade (BM) index.[11] These results provide strong evidence in favor of the main hypothesis of this paper.

4.1 Pooled Regressions

Table 2 presents regressions where the data are pooled and only annual time effects are considered. The advantage of these regressions is that they allow us to recover rough correlations and to see how the model fits in the cross-section and within which time periods. However, we refer to the results that control for country-fixed effects as the baseline estimations due to the fact that we are interested in studying within country variations on RER volatility. Therefore, we do not discuss the pooled results in depth. In Table 3 the data is also pooled, but includes other controls besides the trade related variables.

Tables 2 and 3 show that all the coefficients across all the specifications significant. The first three columns in Table 2 consider the variables on their own, but in Table 3 the impact of our multilateral and bilateral trade measures are estimated conditionally on the impact of other controls. The positive coefficient on the multilateral trade index (IID) confirms the null hypotheses that the real exchange rate volatility is positively correlated to this measure, by the same token bilateral trade measures show a negative correlation with volatility as has been show in the literature. Table 3 also shows that less diversified export baskets and greater money volatility are positively correlated to RER volatility, while currency pegs are negatively correlated to volatility.

comparability of the two classifications systems. Indeed, the classifications are highly-correlated post-1973.

[11]Note that at first sight it is hard to compare the coefficients of the indices given that IID enters in our specifications as levels and bilateral measures in logs. Taking this into account Table 8 quantifies the impact of each variable appropriately. We have both bilateral measures in logs because this has the advantage of allowing a comparison on whether relative bilateral trade or total trade is more important. We also carried out robustness check by using as a dependant variable the log of the real exchange rate volatility. Overall regardless of the specification the results do not change significantly with respect to the significance and signs reported in this paper.

4.2 Fixed Effects Regressions

Table 4 presents the unconditional relationship between the indices and real exchange rate volatility, however this time the regressions also include country fixed effects and time effects. The point estimates on all of the indices show the expected signs and are highly significant. Nonetheless, given that we expect endogeneity between trade and bilateral exchange rate volatility, these results simply indicate that the correlations shown in the pooled regression are kept once country fixed effects are controlled for. This implies that the correlations found in Tables 2 and 3 prevail, not just on the cross section, but also within countries. The IID index's coefficient shows a positive correlation, which implies that the more similar the import demand structure that two countries share, the lower their bilateral exchange rate volatility. Finally, the measures of bilateral trade (BM and Bilateral Trade) show a negative correlation, which implies that the greater the bilateral trade the smaller the volatility. This result is standard 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 seems to be as important than how much two countries trade with each other relative to the rest of the world.

In Tables 5, 6, and 7, the impact that import intensity differences and bilateral trade have on volatility are estimated by Two Stage Least Squares, Limited Information Maximum Likelihood and, in some cases, as a robustness check with Fuller (1) regressions. Remember our methodological discussion in which we noted that under the presence of weak instruments LIML and Fuller(1) are unbiased estimators.

In a first stage the same set of instruments are used for the bilateral trade variables and for the Import Intensity Differences index. The instrumental variables used are common language and bilateral distance. It is expected that countries that share a common language are likely to more easily engage in commercial relationships and at the same time, based on gravitational models' predictions, countries that are located more closely should trade more (See Anderson and van Wincoop (2003) and Berthelon and Freund (2008)). Similar arguments can be made for the multilateral measures. By the same token, countries with a common language are more likely not just to trade more between them but also more likely to have the same trade partners, regarding bilateral distance, countries that are located closely are also more likely to have a larger set of common suppliers. Additionally, regression (3) in Table 5 (a) and regressions (2) and (4) in Table 5 (b) incorporate the difference in remoteness and its interaction with bilateral distance. A similar set of instruments is used in Tables 6(a) and 6 (b).[12]As with bilateral distance countries that are located at similar levels of remoteness should show a larger set of common suppliers and hence they

[12]In a first set of regressions (not reported) we tested some specifications using difference in remoteness as explanatory variable in our second stage, however this variable shows as not statistically significant, This test was inspired by the work of Bravo-Ortega and Di-Giovanni (2006)

are more likely to have similar import intensities and this effect should be decreasing in bilateral distance.

Tables 5 (a) and 5 (b) show that all three variables keep their significance after using instrumental variables and that in all three cases the magnitude of the coefficients increases significantly with respect to the non-IV case, in particular for the IID case. These results are what is expected for a single variable regression that presents endogeneity problems by showing a downward bias in the non IV estimation.

In the first stage regressions for the IID index we obtain the expected positive sign for bilateral distance and the difference in remoteness and the expected negative coefficient for common language and the interaction of the difference in remoteness and bilateral distance. For the bilateral variables, we obtain in the first stage regression a positive coefficients for common language and negative for bilateral distance, when we add difference in remoteness and its interaction with bilateral distance we obtain a negative and positive sign respectively. Regarding the over identifying tests the null of valid instruments can not be rejected in the three specifications with IID whereas that for bilateral trade this is the case just for two out of the four regressions presented. Finally, the Wald F test statistics are all over the threshold suggested by Stock and Yogo, which implies a bias smaller than 5% in the case of TSLS and a maximal size for LIML smaller than 10%.

Tables 6(a) and 6(b) present the baseline estimations with controls, country and time fixed effects and instrumental variables. The controls include the export Herfindahl index, the product of real GDPs, exchange rate regimes variables and money volatility. The indices are once again very significant and the magnitude of the coefficients do not change substantially compared to the unconditional regressions of Tables 5(a) and 5(b). Most of the controls are also highly significant. The positive coefficient on the export Herfindahl index implies 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. The positive impact of real GDP is at odds with previous existing literature on macroeconomic volatility and income (See Ramey and Ramey (1995); Acemoglu and Zilibotti (1997)). Two of the variables related to exchange rate regimes are significant and exhibit the expected negative signs; i.e., countries that do not have flexible exchange rate regimes have lower volatility. However, the pegged to the same base variable results not significant. Finally, we observe that money volatility has a positive impact on real exchange rate volatility. Regarding the over-identifying tests, the null of valid instruments can not be rejected in the three specifications with IID, whereas that for bilateral trade the p-values of the Hansen's J test are significantly smaller still the null can not be rejected at standard confidence levels in all regressions but number (2) and (4) of Table 6(b). Finally, the Wald F test statistics of regression (1) in Table 6(a) implies a bias smaller than 5% in the estimated coefficient. In turn the Wald F statistic of the LIML estimates in regressions (2) and (3) imply a maximal LIML size below 10%. Finally, in Table 6(b) all Wald F statistics are over the thresholds suggested by Stock and Yogo, which implies a bias smaller than 5%.

Tables 7(a) and 7(b) consider a "horse race" between the IID index and the two bilateral trade variables under the full set of controls. These regressions are a good test of whether the third country trade intensity matters for real exchange rate volatility given bilateral trade. Furthermore, the specifications reported also allow a quantitative comparison of the two effects. In all regressions we add as instruments bilateral distance interacted with time dummies so that we introduce further time variation to the set of instruments and we also include three major free trade agreements dummies that include NAFTA, the European Union and Mercosur. We expect that countries that have signed these agreements will share a larger set of common suppliers and therefore the chances of having more similar import intensities should be greater. In Table 7(b) we add as instruments the difference in remoteness and its interaction with bilateral distance. For these regressions the IID index turns to be significant at the 1% confidence level and shows the expected positive sign. The bilateral trade index shows a positive sign and is significant at the 5% level in the three specifications of each table. The log of bilateral trade results statistically significant at five percent in all specifications and it also shows a positive sign.[13]Regarding the over-identifying tests the null of valid instruments cannot be rejected in all specifications. Finally, the Wald F test statistics for regressions estimated by TSLS (regressions (1) and (4) in tables 7 (a) and 7 (b)) are well below Stock and Yogo's threshold of 5% bias, implying biases around 30%. Given these results we chose to add an additional check of robustness by carrying out LIML and Fuller(1) estimations. The Wald F statistic of the LIML and Fuller(1) estimates in Table 7 (a) imply a maximal LIML size below 10% and a Fuller (1) relative bias smaller than 10% in regression (3) and below 20% in regression (6). Finally, in Table 7 (b) all Wald F statistics are well below the thresholds suggested by Stock and Yogo for a relative bias close to 30%. In estimation (2) and (4) the maximal size for LIML is smaller than 10% and the relative bias in specification (3) is smaller than 10% and smaller than 5% in specification (6), for the case of Fuller(1) estimates. In summary, the TSLS regressions show significant biases in the estimated coefficients. However, as theory predicts the LIML and Fuller estimation does a much better job, by significantly reducing the TSLS biases.

Table 8 shows an assessment of the results reported in the previous tables. The first row summarizes the estimated coefficients for IID standing alone, IID conditional on bilateral trade measures, and coefficients for each one of the bilateral measures. From the second row, below the impact on volatility of a one standard deviation increase on the IID, the log(BM) and bilateral trade are shown. As in Table 1, we compute the effects for the overall sample, but also distinguish among developed-developed, developed-developing, and developing-developing country pairs. For

[13]This results contradicts previous results and deserves further research. We do not look further explanations as the main aim of this paper is to test the impact of multilateral trade linkages rather than bilateral trade on real exchange rate volatility.

the interpretations of these results we must keep in mind that our dependent variable enters in levels in our estimations as informed by theory. Thus, the figures of this table show relative effects of the trade measures under study across different groups of countries. The main insight that can be obtained from this table is that IID index explains significantly more of the volatility of the real exchange rate than the BM index and bilateral trade. Thus, a one standard deviation increase in this index has between four and ten times the impact of any of the bilateral measures for the overall sample. Given that developed-developed country pairs exhibit the smallest standard deviation of the IID index (and also the smallestmean) the impact in this group of countries is smallest, whereas the impact of the IID for developing-developing country pairs is the largest, and in this case, is fourteenth times larger than the effect of any bilateral measure.

Table 8(b) delves into the economic significance of the impact that IID, and BM indexes and bilateral trade have on volatility. For this purpose the first row of the table reports the implicit elasticities that are computed starting from our estimations and evaluated around the mean of the IID and real exchange rate volatility correspondingly. At first sight there are striking differences in the orders of magnitude. Indeed, IID elasticity is between 17 and 54 times larger than the elasticities of the bilateral measures. However, in order to properly evaluate the economic impacts we must evaluate the impact that such elasticities have on volatility by interacting them with a one standard increase on the independent variables. Thus, we obtain that while a one standard deviation increase in IID implies an increase in real exchange rate volatility between 24% and 77% for the whole sample, a one standard deviation increase in BM index decreases volatility in 6%. On the case of bilateral trade this impact is 14% for the whole sample.

Overall, these results confirm the importance of the impact of the import intensity differences across and within countries on the real exchange rate volatility, as well as highlighting its prominence relative to bilateral trade. These results can be understood in the context where multilateral country effects must be considered when examining bilateral relationships.

5 Conclusion

This paper examines the impact of multilateral trade linkages on bilateral real exchange rate volatility. In particular, we highlight a distinct channel through which these costs affect volatility: the impact of import intensity differences across countries. We postulate that the similarity in import baskets dampens bilateral real exchange rate volatility through their common impact on both of the price indices that define the bilateral real exchange rate.

We first review recent trade literature and the implications it has with respect to real exchange rate volatility. Next, based on the work of Anderson and van Wincoop (2003)we develop a micro-funded index of import intensity differences (IID) and empirically test for its impact on bilateral real exchange rate volatility using a large cross-country panel dataset of country pairs. We compare this index impact with those of bilateral trade measures, traditionally considered as moderators of volatility. In our estimations we carefully address the endogeneity between trade and real exchange rate volatility. In this effort we do not just test for exogeneity of instruments but also whether our instruments set is weak. As a robustness check and in order to overcome the problem of weak instruments,we also carry out LIML and Fulller(1) estimations which are unbiased under their presence. The results strongly confirm that differences in import intensities increase bilateral real exchange rate volatility.

One of our main findings imply that for the case of a given pair of countries a one standard deviation increase in the IID index around its mean implies an increase in bilateral real exchange rate volatility between 64 and 87 percentage points depending on the level of development of the country-pair. Thus, the impact can be considered large in both absolute and economic terms. These results are robust to a wide set of controls and to the inclusion of bilateral trade measures.

The trade channel highlighted in this paper can help to understand the expected impact that has on a country's real exchange rate volatility to join a trade union with similar trade partners. Our results would predict that this fact would decrease bilateral and thus overall real exchange rate volatility by removing trade barriers that could impact positively on import intensity differences. The results also highlight the potential impact of trade policies that distort a country's import demands far apart from those of its main trade partners, thereby increasing bilateral real exchange rate volatility.

We view this paper as a continuation on the efforts to formally analyze the impact of trade and its determinants on macroeconomic volatility and other international macroeconomic issues. In particular, our paper stresses that multilateral trade can be an important part of bilateral macroeconomic volatility.

References

Acemoglu, Daron and Fabrizio Zilibotti, "Was Prometheus Unbound by Chance? Risk, Diversification and Growth," *Journal of Political Economy*, August 1997, *105* (4), 709–51.

Aghion, Philippe, Philippe Bacchetta, Romain Ranciere, and Kenneth Rogoff, "Exchange Rate Volatility and Productivity Growth: The Role of Financial Development," 2006. Swiss Finance Institute Research Paper Series No 06/16.

Anderson, James E. and Eric van Wincoop, "Gravity with Gravitas: A Solution to the Border Puzzle," *American Economic Review*, March 2003, *93* (1), 170–92.

Arize, Augustine C., Thomas Osang, and Daniel J. Slottje, "Exchange-rate volatility in Latin America and its impact on foreign trade," *International Review of Economics and Finance*, 2008, *17*, 33–44.

Baaka, Saang Joon, M. A. Al-Mahmoodb, and S. Vixathepc, "Exchange rate volatility and exports from East Asian countries to Japan and the USA," *Applied Economics*, 2007, *39*, 947Ð959.

Bagella, Michele, Leonardo Becchetti, and Iftekhar Hasan, "The anticipated and concurring effects of the EMU: exchange rate volatility, institutions and growth," *Journal of International Money and Finance*, 2004, *23*, 1053–1080.

_ , _ , and _ , "Real effective exchange rate volatility and growth: A framework to measure advantages of ßexibility vs. costs of volatility," *Journal of Banking and Finance*, 2006, *30*, 1149–1169.

Bahnami-Oskooee and Scott Hegerty, "Exchange rate volatility and trade flows: a review article," *Journal of Economic Studies*, 2007, *34 No. 3*, 211–255.

Baldwin, Robert E., "The New Protectionism: A Response to Shifts in National Economic Power," in Dominick Salvatore, ed., *The New Protectionist Threat to World Welfare*, Elsevier Science Publishing Co. New York 1987, pp. 95–112.

Baxter, Marianne and Robert G. King, "Measure Business Cycles: Approximate Band-Pass Filters for Economic Time Series," *Review of Economics and Statistics*, November 1999, *81* (4), 575–93.

Bayoumi, Tamim, Jaewoo Lee, and Sarma Jayanthi, "New Rates from New Weights," *IMF Staff Papers*, 2006, *Vol. 53, No. 2.*

Berthelon, Matias and Caroline Freund, "On the conservation of distance in international trade," *Journal of International Economics*, 2008, *75*, 310Ð320.

Bouoiyour, Jamal and Serge Rey, "Exchange Rate Regime, Real Exchange Rate, Trade Flows and Foreign Direct Investments: The Case of Morocco," *African Development Review/Revue Africaine de Developpement*, 2005, *17(2)*, 302–34.

Bravo-Ortega, Claudio and Julian Di-Giovanni, "Remoteness and Real Exchange Rate Volatility," *IMF Staff Papers*, 2006, *53.*

Broda, Christian and John Romalis, "Identifying the Relationship Between Trade and Exchange Rate Volatility," 2003. Mimeo, Federal Reserve Bank of New York and Chicago Graduate School of Business.

_ **and** _ , "Identifying the Effect of Exchange Rate Volatility on the Compositiona and Volume of Trade," February 2004. Mimeo, Federal Reserve Bank of New York and Chicago Graduate School of Business.

Byrne, Joseph, Julia Darby, and Ronald MacDonald, "US trade and exchange rate volatility: A real sectoral bilateral analysis," *Journal of Macroeconomics*, 2008, *30*, 238–259.

Fitzgerald, Doireann, "Can trade costs explain why exchange rate volatility does not feed into consumer prices?," *Journal of Monetary Economics*, 2008, *55*, 606–628.

Hausmann, Ricardo, Ugo Panizza, and Roberto Rigobon, "The long-run volatility puzzle of the real exchange rate," *Journal of International Money and Finance*, 2006, *25*, 93–124.

Heston, Alan, Robert Summers, and Bettina Aten, "Penn World Table Version 6.1," October 2002. Center for International Comparisons at the University of Pennsylvania (CICUP).

Hodrick, Robert J. and Edward C. Prescott, "Postwar U.S. Business Cycles: An Empirical Investigation," *Journal of Money, Credit and Banking*, February 1997, *29* (1), 1–16.

Kose, M. Ayhan and Kei-Mu Yi, "Can the standard international business cycle model explain the relation between trade and comovement?," *Journal of International Economics*, 2006, *68*, 267 Ð 295.

Ramey, Garey and Valerie A. Ramey, "Cross-Country Evidence on the Link Between Volatility and Growth," *The American Economic Review*, December 1995, *85* (5), 1138–51.

Reinhart, Carmen M. and Kenneth S. Rogoff, "The Modern History of Exchange Rate Arrangements: A Reinterpretation," *Quarterly Journal of Economics*, February 2004, *119* (1), 1–48.

Rose, Andew K., "One Money, One Market: The Effect of Common Currencies on Trade," *Economic Policy*, 2000, *15* (30), 7–46.

Serven, Luis, "Macroeconomic Uncertainty and Private Investment in Developing Countries," 1998. Policy Research Working Paper 2035, World Bank.

_ , "Real Exchange Rate Uncertainty and Private Investment in Developing Countries," 2002. Policy Research Working Paper 2823, World Bank.

Shambaugh, Jay and Michael Klein, "Fixed Exchange Rates and Trade," *Journal of International Economics*, 2006, *70*, 359–83.

Shambaugh, Jay C., "The Effects of Fixed Exchange Rates on Monetary Policy," *Quarterly Journal of Economics*, February 2004, *119* (1), 301–352.

Stock, James and Motohiro Yogo, "Testing for Weak Instruments in Linear IV Regression," 2002. NBER Technical Working Paper No 284.

_ , **Jonathan Wright, and Motohiro Yogo**, "A Survey of Weak Instruments and Weak Identification in Generalized Methods of Moments," *Journal of Business and Economics Statistics*, 2002, *20(4)*, 518–29.

Takaendesa, P., T. Tsheole, and M. Aziakpono, "Real Exchange Rate Volatility and Its Effect on Trade Flows: New Evidence from South Africa," *Journal for Studies in Economics and Econometrics*, 2006, *30(3)*, 79–97.

Yi, Kei-Mu, "Can Vertical Specialization Explain the Growth of World Trade?," *Journal of Political Economy*, February 2003, *111* (1), 52–102.

6 Appendix.

Figure 1: Import Intensity Differences Index (1970-1997).

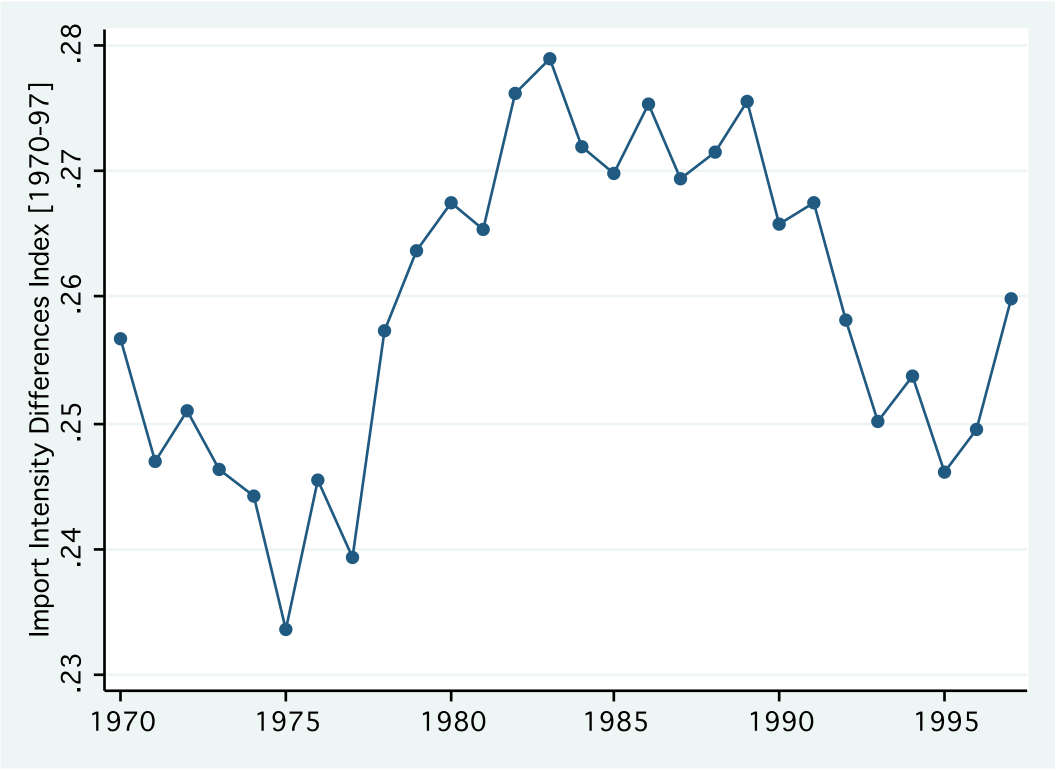

Figure 2: Bilateral Trade Index (1970-1997).

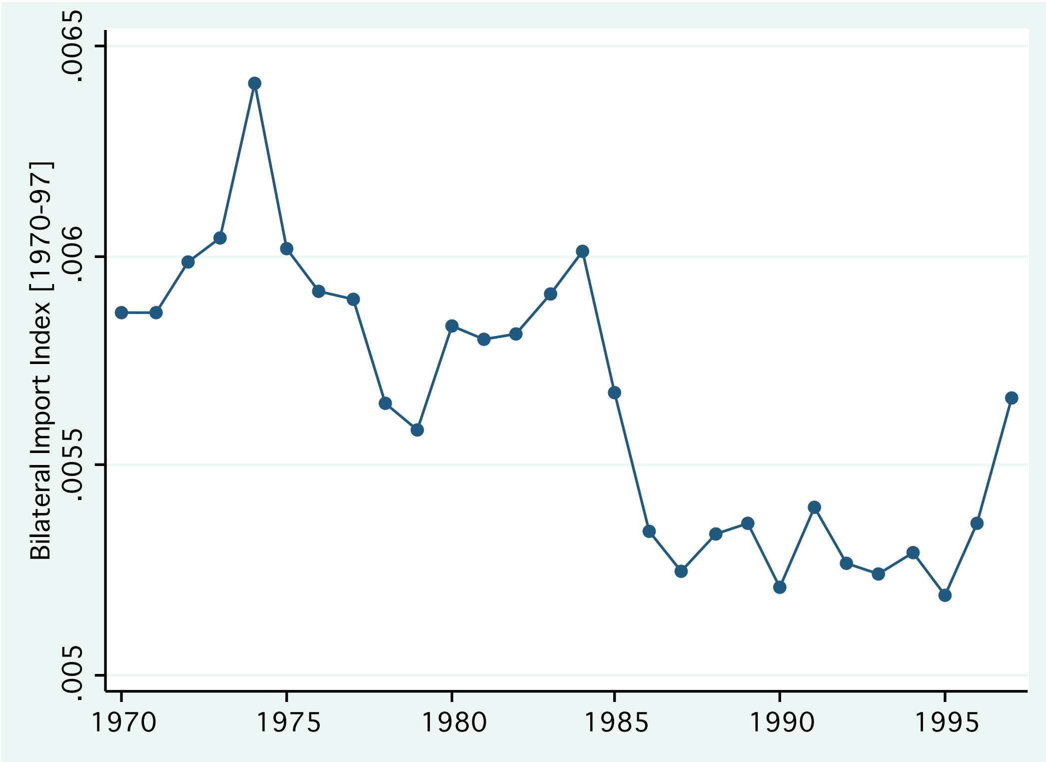

Figure 3: Bilateral Trade Level (1970-1997).