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Exchange rates, international trade and trade policies ☆

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ABSTRACT

This paper investigates the importance of exchange rates on international trade by analyzing the impact that exchange rate volatility and misalignment have on trade and then by exploring whether exchange rate misalignments affect governments' decisions regarding trade policies. The methodology consists of estimating fixed effects models on a detailed panel dataset comprising about 100 countries and 10 years (2000–2009). The findings of this study are generally in line with those of the recent literature in supporting the importance of exchange rate misalignment while finding that short term exchange rate volatility is generally not a serious concern. This paper also shows evidence supporting the argument that trade policy is used to compensate for some of the consequences of an overvalued currency, especially with regard to antidumping interventions.

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1. Introduction

The recent debate on persistent trade imbalances and the resurgence of non-traditional trade restrictive measures has led to a renewed interest in the effect of exchange rates on international trade. In spite of the increasing number of studies on the topic, the actual effect of exchange rates (misalignment and volatility) on international trade is still an open and controversial question. The theoretical literature on the issue provides little guidance, as the presumption that exchange rates directly affect trade depends on a number of specific assumptions which do not hold in all cases.

☆ The views expressed in this paper are those of the author and do not necessarily represent the views of the United Nations Conference on Trade and Development (UNCTAD) Secretariat or of UNCTAD Members.

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The most studied aspect of the relationship between the exchange rate and trade relates to exchange rate volatility. The basic argument for which an increase in exchange rate volatility would result in lower international trade is that there are risks and transaction costs associated with the variability of the exchange rate, and these reduce the incentives to trade. The findings of the economic literature on this issue have evolved in the last few decades. While early studies found adverse effects of exchange rate volatility on trade (Ethier, 1973; Cushman, 1983; Peree and Steinherr, 1989) subsequent studies report very small impacts (Huchet-Bourdon and Korinek, 2011), or effects only limited to developing countries (Arize et al., 2000). Moreover, the use of refined quantitative methods resulted in more skepticism about the causality of short term exchange rate volatility on international trade (Taglioni, 2002; Clark, 2004; Tenreyro, 2007). In summary, the relationship between the two variables is likely driven by underlining long term policy credibility rather than the short term causality (Klein and Shambaugh, 2006).[1] In addition, any relation between volatility and international trade could be driven by reverse causality, in which trade flows help stabilize real exchange rate fluctuations, thus reducing exchange rate volatility. In any case, there are several reasons why volatility is often not a critical issue for international trade. One particularly compelling argument is that the risks associated with volatile exchange rates are softened by the increasing number of financial instruments available (e.g. forward contract and currency options) that allow firms (especially large ones operating in countries where financial markets are more developed), to hedge against these risks (Aghion et al., 2009). Another critique is related to the presence of sunk cost in exporting (Krugman, 1989; Franke, 1991). The higher are the fix costs to exports, the less responsive are the firms (and therefore international trade) to exchange rate volatility. All this makes exchange rate volatility less of a critical issue for international trade. In modern cross-border transactions firms often decide to hedge against the risk in the exchange rate or to bear the cost associated to possible exchange rate fluctuations as part of their export strategy.

A second aspect of the relationship between the exchange rate and international trade pertains to currency misalignments. The influence of currency misalignment on international trade is largely driven by its impact on relative import prices (Mussa, 1984; Dornbusch, 1996).[2] An undervalued currency, whether determined by exogenous shocks or by policy, increases the competitiveness of the export and import-competing sectors at the expense of consumers and the non-tradable sector (Frieden and Broz, 2006). Therefore, the effects of misaligned currency on prices are similar to those of an export subsidy and import tax. The literature on the topic provides a great amount of evidence on just how responsive trade flows are to changes in relative prices consequent to movements in the exchange rates (Bernard and Jensen, 2004). Still, as in the case of volatility, there are a number of issues that greatly complicate the relationship between exchange rate misalignment and international trade (Staiger and Sykes, 2010). Of particular importance is the issue that part of the under or over valuation of the exchange rate is often absorbed by firms which do not fully adjust their price in the destination country (Goldberg and Knetter, 1997). Related to this is the presence of irreversible entry costs which acts as powerful incentives for firms to stay in the market even when there is substantial undervaluation of the importer currency (Baldwin, 1988; Froot and Klemperer, 1989). Finally, vertical integration and the role of production networks (the presence of a large share of imported inputs) make currency misalignment less important (Zhao and Xing, 2006; Powers and Riker, 2013).[3]

The final issue on the relationship between the exchange rate and trade regards the effect of exchange rate misalignments on trade policy. The rationale is that the stance of the exchange rate may indirectly

[1] A recent review on volatility and misalignment is provided in Auboin and Ruta (2011).

[2] Relative prices respond to exchange rate movements at least in the short run. In the long run, with no market distortions, relative prices return to their equilibrium level and thus the exchange rate has no effect on international trade or any other economic variable. However, this is largely a theoretical proposition as in practice there are many distortions which may hinder the adjustment of relative prices.

[3] A large number of studies have also focused on the relationship between exchange rate misalignments and international trade in terms of competitive devaluation. The empirical literature is generally supportive in finding evidence of the effects of exchange rate misalignments on economic growth. On one hand, an overvalued currency is generally found to hamper economic growth (Rajan and Subramanian, 2011). On the other hand, an undervalued currency is often found to stimulate economic growth (Rodrik, 2008; Korinek and Serven, 2010).

affect governments' decisions regarding other policies, especially those affecting international trade.[4] Most of the studies on this matter focus on contingent protection. For example, Bown and Crowley (2013) find evidence of a response to an overvalued exchange rate in the form of antidumping investigations applied by five industrialized economies in a period of about 20 years and in particular over the period characterized by the Great Recession (2008–2010). Most studies also support the general hypothesis that trade policy may be used to compensate for some of the effects of an overvalued currency (Knetter and Prusa, 2003; Irwin, 2005; Oatley, 2010).[5] Domestic firms that lose competitiveness as a result of appreciation of the exchange rate may lobby for restrictive trade policies. In practice, disputes over exchange rate policies among trading partners could foster an increase in domestic political pressures and unilateral action on trade (Copelovitch and Pevehouse, 2011).

This paper contributes to the understanding of the relationship between the exchange rate and international trade by empirically investigating all three aspects detailed above. In doing so the analysis utilizes a fixed effects estimating strategy applied on a detailed dataset comprising yearly data for about 100 countries for a period of 10 years (2000–2009). A novel contribution of this paper is to investigate whether exchange rates have an impact not only on temporary protection (antidumping) but also on tariffs. The main findings of this paper can be summarized as follows. First, the analysis indicates that the short-term effects of exchange rate volatility on trade are a concern only for developing countries. Generally, the relationship between the volatility and trade variables is most likely driven by the underlining long term policy credibility provided by currency unions and pegged exchange rates rather than short term volatility itself. The paper's second finding is that exchange rate misalignments do affect international trade flows in a substantial manner. Currency undervaluation is found to promote exports and restrict imports. In magnitudes misalignments across currencies result in trade diversion quantifiable in about one percent of world trade. Finally, this paper finds some evidence supporting the argument that trade policy is used to compensate for some of the repercussions of an overvalued currency. However, the policy response seems to be largely restricted to antidumping interventions. The evidence of a response in terms of a slower overall tariff liberalization in periods of currency overvaluation is small.

The remainder of this paper is organized as follows. Section 2 presents the empirical approach while Section 3 presents some descriptive statistics and the econometric results. Section 4 concludes.

2. Empirical strategy

In investigating the three aspects of the relationship between the exchange rate and trade, the empirical strategy takes advantage of a detailed bilateral dataset comprising of trade, trade policies, and exchange rate data. This database is constructed by bilateral trade data originating from UN COMTRADE and primary tariff data is from UNCTAD TRAINS .[6] Data on antidumping is from the World Bank Temporary Trade Barriers Database (Bown, 2010), while the data utilized for the construction of exchange rate indices originates from the Penn World Tables and from OANDA.[7] The database spans about 10 years (2000–2009) and comprises 95 countries. The sample covers all major countries and accounts for more than 90 percent of world trade. A more limited dataset is used for the analysis related to antidumping.

The estimating framework for assessing the effect of exchange rate volatility and misalignment consists of an econometric model where a set of fixed effects controls for gravity model variables. The relationship between exchange rate appreciation and trade policy is similarly explored with a fixed effects model. Before entering into the details of the estimating frameworks some discussion on the variables of interest is in order.

[4] For example, Eichengreen and Douglas (2010) suggest that protectionism in the early 1930s was at least as much a consequence of governments' exchange rate policies as a result of the collapse of aggregate demand.

[5] Fernandez Arias et al., 2004 examine the relationship between exchange rates and trade policy in a regional agreement context.

[6] Both trade and tariff data is available thru the WITS portal (wits.worldbank.org).

[7] Historical data on nominal exchange rates is available at www.oanda.com.

2.1. Measurement of exchange rate and trade policy variables.

Although there is voluminous literature on exchange rate volatility, there is no consensus on how to measure it. Volatility measures vary from simple deviations from an average level, to more sophisticated econometric estimations following co-integration methods (Lothian and Taylor, 1997).[8] I utilize the commonly used measure where cross exchange rate volatility is measured as the standard deviation of the first difference of the monthly exchange rate.[9] More formally, exchange rate volatility between countries k and j in year t is given by:

$$ERvol_{kjt} = std.dev.[\ln(ER_{kjt,m}) - \ln(ER_{kjt,m-1})] \quad (1)$$

where ER is the nominal exchange rate and m denotes months.[10] A value of $ERvol_{kjt}$ equal to zero implies no volatility as in the case of a fixed exchange rate regime. The standard deviation is calculated over a one-year period so as to measure short-run volatility. The aggregated volatility at the country level is simply the trade weighed average of bilateral volatility. This indicator is commonly referred to as the "effective volatility" of a country's exchange rate.

As with volatility, there are several methods to measure exchange rate misalignment. Since misalignment is simply the difference between the observed exchange rate and its estimated equilibrium level, the key issue is how to calculate the equilibrium exchange rate. Measures of the equilibrium exchange rate vary from simple approximations to complex estimates which take into account various possible determinants. The simplest measure of misalignment consists of the percentage difference of the observed level of the currency to its level in a reference period. This measure is clearly subject to the choice of the reference period and thus is more appropriate to measure appreciation or depreciation trends rather than misalignment itself. More common measures of misalignment utilize the currency deviations from its purchasing power parity (PPP) value. The PPP approach can be refined to various degrees as in the case of the fundamental equilibrium real exchange rate (FEER).[11] In general, the measurement of exchange rate misalignment is a controversial issue. Even the more sophisticated estimates are subject to critiques, as any estimate would depend on the estimating period and the included set of determinants.[12]

For the purpose of this paper, the measure of exchange rate misalignment follows a relatively simple PPP approach (Rodrik, 2008). This method consists of three steps. First, the real exchange rate term (RER) is computed as the nominal exchange rate divided by the PPP conversion factor. In more formal terms,

$$\ln(RER_{kt}) = \ln(ER_{kt}/PPP_{kt}) \quad (2)$$

where, as before, k denotes the country and t is time. When the RER exceeds one, it implies that the currency is valued below what indicated by its purchasing power parity. Second, to calculate the level of misalignment the RER needs to be confronted with the fact that price levels of non-traded goods are correlated with the country's level of development (Balassa–Samuelson effect). This is taken into account by regressing the RER on per capita GDP ($GDPPC$), or more formally:

$$\ln(RER_{it}) = \alpha + \beta \ln(GDPPC_{it}) + \phi_t + u_{it} \quad (3)$$

where φ_t is time fixed effects and u is an error term. Then, the measure of misalignment is given by the difference between the observed exchange rate and the exchange rate adjusted for the Balassa–Samuelson effect. The level of undervaluation or overvaluation between two countries is then

[8] Moreover, exchange rates may be endogenous as central banks may try to stabilize the exchange rate against main trading partners. To correct for this endogeneity, some of the measures of volatility use a conditional variance approach which allows for more information than the simple standard deviation method (Karolyi, 1995).

[9] Rose (2000).

[10] Often volatility is estimated in real rather than nominal terms. Empirically, it does not make much of a difference whether using real or nominal exchange rates as the measures are highly correlated in the short term.

[11] The FEER approach is the method favored by the IMF. However, their statistics on misalignment are strictly confidential and not publicly available.

[12] Determinants in the estimation of the FEER often include terms of trade, output per worker, government spending, net foreign assets and openness (Froot and Rogoff, 1995).

approximated simply by adding the respective levels of misalignments.[13] This variable is labeled Mis_EXrate_{kjt}.

In regard to trade policy variables, I utilize two alternative variables for capturing trade policy changes. The first variable is the change in the level of the overall tariff structure. This investigates whether countries may also be using trade policy as a substitute for persistent exchange rate overvaluation to deal with disequilibria of the trade balance. One argument for linking this variable to the exchange rate is that countries whose currency is appreciating would be less inclined to pursue trade liberalization as the overvalued currency already exposes domestic industries to increased foreign competition. The overall level of tariffs is measured by the tariff trade restrictiveness index (TTRI) calculated by Fugazza and Nicita (2013) and based on the work of Kee et al. (2008, 2009, 2013).[14]

In the construction of the TTRI, the aggregation across products uses import demand elasticities to take into account the fact that the imports of some goods may be more responsive to an overvalued exchange rate.[15] In formal terms, the TTRI faced by country j in exporting to country k is:

$$TTRI_{jkt} = \frac{\sum_{hs} x_{jkt,hs} \varepsilon_{jk,hs} T_{jkt,hs}}{\sum_{hs} x_{jkt}, hs \varepsilon_{jk,hs}} \tag{4}$$

where x indicates exports from country j to country k, ε is the bilateral import demand elasticity, T is the bilateral applied tariff, and hs are HS 6-digit categories. The TTRI reflects any preferential tariff imposed and faced by each country.

The second measure of trade policy is related to antidumping (AD) and follows the reasoning of the existing literature investigating the hypothesis that firms may lobby government to initiate ad-hoc policy intervention to counteract some of the effect of a trading partner's undervalued currency. In such cases, one would expect an increase of antidumping investigations when the misalignment between two currencies increases. The trade policy variable thus consists of the number of antidumping cases initiated during the year.[16] This variable is labeled $ADPolicy_{jkt}$.

2.2. Estimating frameworks

In order to test the relationship between exchange rates and trade, this paper employs a simple panel analysis on a dataset covering 95 countries from 2000 to 2009. The estimating framework applies two models. The first model is suited to explain the impact of the exchange rate on the level of trade, while the second model measures the impact of the exchange rate on trade policy.[17]

The relationship between trade and exchange rate volatility and misalignment is measured by a panel gravity model where a set of fixed effects controls for all the determinants of trade flows normally included in the standard gravity model specifications. More formally, the estimation of the effect on trade due to changes in the exchange rate is based on the following specification:

$$\ln X_{jkt} = \beta_0 + \beta_1 xrate_{jkt} + \beta_2 \ln(1 + TTRI_{jkt}) + \beta_3 GDP_{jt} + \beta_4 MR_{jkt} + \omega_j + \psi_k + \varsigma_t + \theta_{kj} + \phi_{jkt} \tag{5}$$

[13] In the calculation of exchange rates the reference currency is the US dollar.

[14] The authors show that the calculation of the TTRI can be greatly simplified in a partial equilibrium setting so as to take into account only own price effects, while ignoring cross price effects on import demand (Feenstra, 1995). In doing so, the TTRI can be calculated as a weighted average of the levels of protection (tariff and non-tariff measures) across products where the weights are functions of import shares and import demand elasticities.

[15] Intuitively, products where imports are less sensitive to prices (inelastic) should be given less weight because an overvalued exchange rate would have a lesser effect on the overall volumes of trade.

[16] By using changes instead of levels, the variable accounts for the fact the some countries may be more assiduous users of AD than others.

[17] Although these two models could possibly be more efficiently estimated in a simultaneous equation model context, that is beyond the purpose of this paper. In addition, by estimating the system in two separate equations the estimates may be not efficient but are still consistent, and any misspecifications in one of the equations will not affect the results of the other.

where the subscript j denotes exporters, k denotes importers and t denotes year; and where X is the value of total exports, *xrate* denotes the variables capturing volatility ($ERvol_{kjt}$) and misalignment (Mis_EXrate_{kjt}). The TTRI controls for changes in bilateral trade policies, ω_j, ψ_k, θ_{kj}, ς_t are a set of fixed effects and ϕ_{jkt} is an error term.[18] Multilateral resistance (Anderson and vanWincoop, 2003) is proxied by adding multilateral resistance variables as in Baier and Bergstrand (2009) and Baieret al. (2010). This methodology produces consistent estimates and, contrary to using country-time effects, allows the estimation of the impact of time varying country specific factors such as the exchange rate. The model is also estimated in a specification where country-pair fixed effects are replaced by standard gravity variables (distance, contiguity, language and colonial links). This accounts for the effect of pegged currencies which otherwise would be fully captured by country-pair fixed effects.

One issue of consideration is to what extent the above framework is consistent with the international fragmentation of production. Indeed, the use of foreign sourcing for intermediate inputs mutes exchange rate effects as any fluctuation in the exporter currency affects only on the share of domestic inputs. In practice, the estimates obtained by not controlling for intermediate inputs are likely to be biased (e.g. exchange rate devaluation would have a weaker effect on export competitiveness when intermediates are imported). Although relevant, this issue is not addressed in most of the existing literature and this paper because the required data on costs of production and origin of intermediates is not available, especially on a large scale.[19]

The second model tests the hypothesis that the choice and pace of trade liberalization may also be affected by exchange rates. This model empirically explores whether exchange rate misalignment has an effect on trade policy response in terms of tariffs and antidumping investigations. The general estimating equation is:

$$tradepolicy_{jkt} = \beta_0 + \beta_1 Mis\_EXrate_{jkt} + \beta_2 X_{jkt} + \beta_3 GDP_{jt} + \omega_j + \varsigma_t + \theta_{kj} + e_{jkt} \quad (6)$$

where subscripts are as above. This equation is estimated in a series of specifications where *tradepolicy* is measured by the TTRI ($TariffPolicy_{jkt}$) or by the number of antidumping investigations ($ADPolicy_{jkt}$).[20] Two additional variables, import growth (X_{jkt}) and *GDP* control for other factors that may influence the demand for protection (e.g. a sudden increase in imports or a decline in GDP). Country fixed effects (ω_j) control for time unvarying country specific characteristics and time fixed effects (ς_t) control for global macroeconomic shocks. Country-pair fixed effects (θ_{kj}) control for any time unvarying bilateral factors such as PTA that may influence bilateral trade policy.

3. Results

This section first presents some descriptive statistics related to the variables of interest. Then, it discusses the econometric results on the relationships between exchange rates, international trade and trade policy.

[18] Trade models dealing with policy variables often suffer from a problem of endogeneity. For example, countries may choose to stabilize the exchange rate with partners where trade flows are larger. Although the standard way to control for such endogeneity is by an instrumental variable approach, such endogeneity bias is best treated in a panel setting by country-pair fixed effects (Baier and Bergstrand, 2007). Besides controlling for gravity type variables such as distance and shared border, country-pair fixed effects control for any unobserved variable simultaneously affecting a change in tariffs and the level of trade.

[19] An exception is Powers and Riker (2013) which investigate the link between exchange rates and trade flows by accounting for the effects of a reduction in the value of an exporter's currency on its own costs of production as well as the costs of its international competitors. They find that the use of the value-added data generally leads to a substantial reduction in the elasticity of trade to the exchange rate. An additional problem is related to the measurement of exchange rate misalignments. The real effective exchange rate measure would also need to be adjusted in view of the international fragmentation of production (Bems and Johnson, 2012).

[20] As count data is generally not normally distributed, the anti dumping specification is estimated using negative binomial regression. The specification simplifies that of Bown and Crowley (2013) which use also country specific time varying macroeconomic determinants and policy space availability.

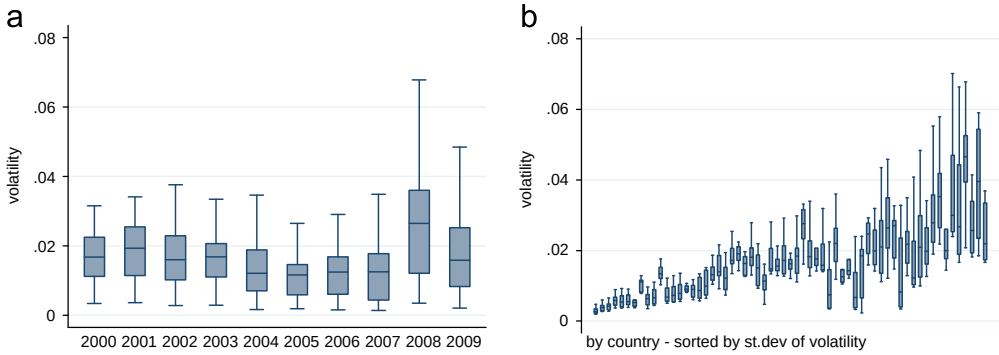

Fig. 1. (a) and (b) Exchange rate volatility, distributions by year and by country.

3.1. Descriptive statistics

Fig. 1a and b shows the distribution of effective short term exchange rate volatility[21] for each of the years between 2000 and 2009 and then for each currency across years.[22] As monthly exchange rate data is not always available the volatility variable is calculated only for 68 countries. Overall volatility bottomed during the period of 2004–2006 to sharply increase at the onset of the financial crisis. In just a few months at the end of 2008 some currencies oscillated 20 percent or more in relation to the major reserve currencies.

Fig. 1b shows that volatility is not a common problem to all currencies, but tends to be concentrated in about half of the currencies in the sample. That is, while about half of currencies are more or less aligned with those of their trading partners (say, because of managed or pegged exchange rates), the other half fluctuates more widely. Currency fluctuation may be detrimental to international trade as it increases the risk of cross border transactions.

In regard to currency misalignments, Fig. 2a and b illustrates their distribution for each year during the period of analysis and for each country. For the purpose of this graph, the misalignment is not bilateral but is computed as a trade weighted average as in the case of effective volatility. The graphs report the distribution of the average misalignment faced by the currency vis-à-vis a basket of currencies whose weight is determined by their trade importance. A value of misalignment above 0 implies overall overvaluation.

The first insight regarding misalignment is that currencies are generally not very aligned to their respective purchasing power parity level (especially in 2003, 2004 and the last two years of the analysis). A second insight is that while in the earliest years the majority of currencies were undervalued, the latest years show a trend towards a more fair valuation.[23] A third insight is that between 2000 and 2009 only a limited number of currencies maintained a relatively stable, but not necessarily aligned, valuation. For most currencies, their levels of valuation fluctuated substantially during the period of analysis. For about half of the currencies analyzed here, their valuation alternated between overvaluation and undervaluation. About 30 percent of currencies remained within undervalued levels, while about 20 percent remained constantly overvalued.

[21] Short term effective volatility is computed as the average intra-year volatility of a currency versus all other currencies weighed by imports. Although such index is biased towards stability as bilateral trade is often higher between countries with more stable cross rates, the index provides a good approximation for illustrative purposes. Note that the bias is not present in the empirical analysis as the exchange rate volatility is measured at the bilateral level.

[22] For every year the box plot includes all values between the 25th and 75th percentiles, while the bar represents the median. The interval between the lines outside the box comprises observations between plus and minus 1.5 times the interquantile range which is normally used as a bound to identify outliers.

[23] Given the economic turmoil of 2008 and 2009, this may seem surprising. However, this trend is largely a result of the progressive depreciation of the US dollar.

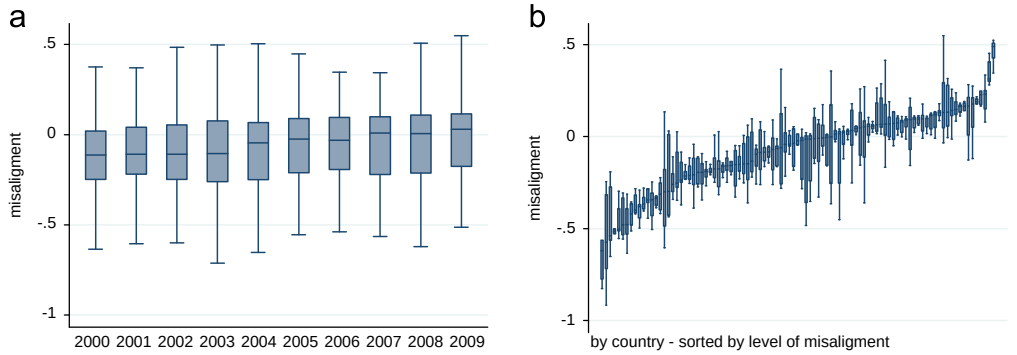

Fig. 2. (a) and (b) Currency misalignments, distributions by year and by country.

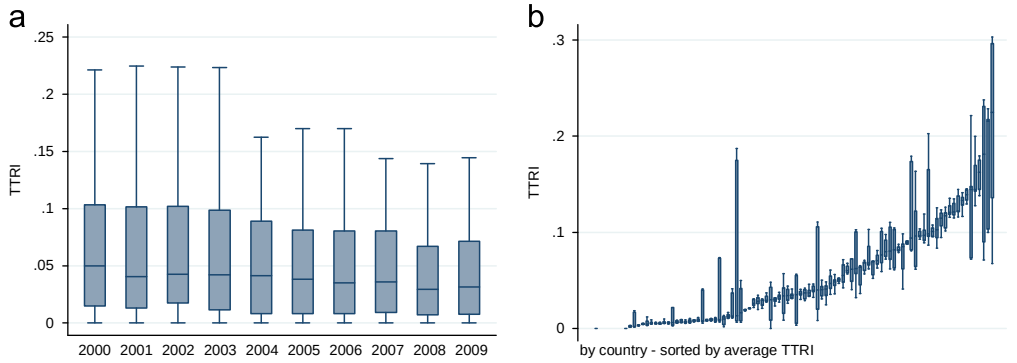

Fig. 3. (a) and (b) Tariff trade restrictiveness index, distributions by year and by country.

In relation to trade policy, Fig. 3a and b illustrates the distribution of the TTRI for each year, and then for each country. Tariff restrictions have been progressively reduced during the period of analysis. The average TTRI across countries went from about 5 percent of 2000 to about 3 percent of 2009. Such liberalization has been the result both of unilateral reductions of MFN tariffs as well as the increasing number of bilateral and regional trade agreements. At the country level, tariff liberalization has occurred in most of the countries in the analysis, especially in those where tariffs were higher to start with.

With regard to antidumping, the analysis is based on data available for 33 countries (with the European Union counting as one). The average number of antidumping investigations initiated each year is about 255. The use of antidumping was more frequent in the early years of the analysis and bottomed out in 2008 to later rebound in 2009. Although the use of antidumping procedures has spread, it is largely concentrated in a few countries. The five most intensive users account for more than half of the initiations, while ten countries account for more than three quarters.

Next are some simple figures on the cross-country correlation between exchange rate variables and import, export and trade policy. As a cautionary note, the analysis presented in this section is purely illustrative as it does not control for other determinants that may influence the exchange rate and/or trade. More compelling evidence on causality is presented in the discussion of the econometric results.

To start with exchange rate volatility and trade, please recall that effective volatility provides an indication of the stability of a currency with respect to the currencies of trading partners. One would expect that countries whose currencies are more volatile would engage in less trade because volatility increases trade costs. However, the cross country correlation between effective volatility and the export or import growth in Fig. 4a and b does not seem to support the hypothesis, at least in the short run.

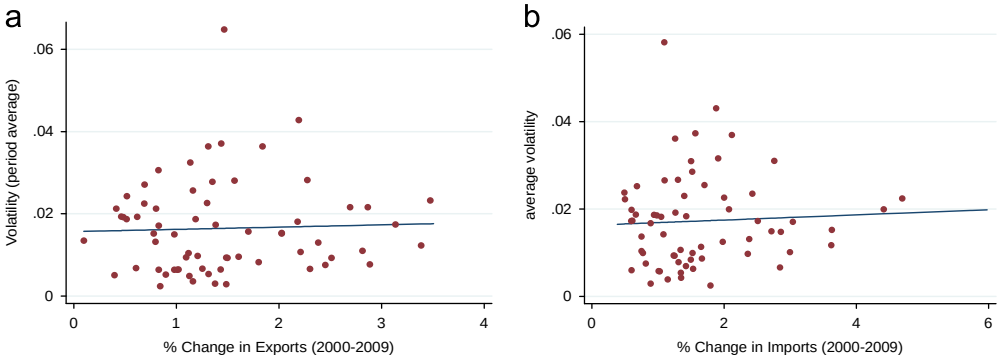

Fig. 4. (a) and (b) Exchange rate volatility and international trade.

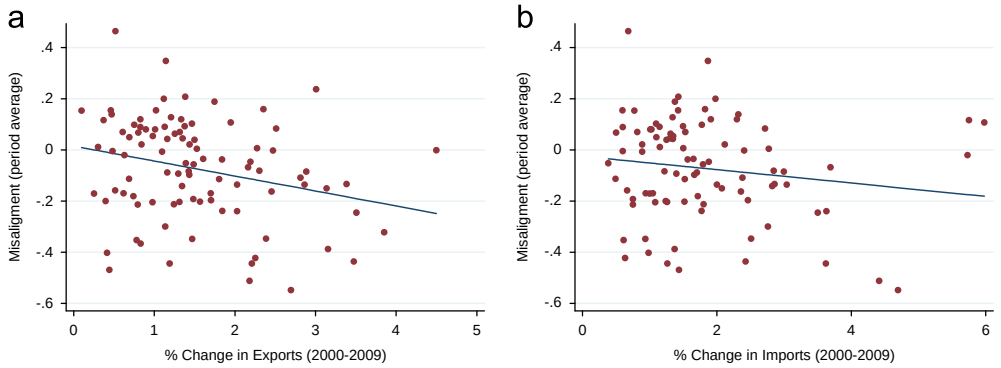

Fig. 5. (a) and (b) Exchange rate misalignment and international trade.

The effect of misalignment on international trade is related to the impact of the exchange rate on relative prices or tradable and non-tradable goods. Conceptually, an undervalued currency favors domestically produced tradable goods and thus protects domestic firms from imports and gives them an incentive to export. According to this principle, countries with undervalued currencies would have relatively higher exports and lower imports. The cross country evidence illustrated in Fig. 5a seems to support the argument that undervalued currencies promote exports, because exports have grown relatively more in countries whose currencies have remained undervalued. On the other hand, Fig. 5b suggests a weaker but still positive relationship between undervaluation and import growth. This is counterintuitive, as one would expect a negative correlation because undervaluation is expected to act as a tax on import, and thus lower imports, rather than raise them. One possible explanation is that the positive correlation between exports and undervaluation spreads also to imports because increases in exports have to be supported by increases in intermediate inputs. Although this argument may not be relevant to all countries, it may be sufficient to explain the weaker positive correlation in Fig. 5b.

With regard to the relationship between exchange rates and trade policy, Fig. 6a and b plots the average misalignment against the TTRI and the number of anti dumping investigations. Countries with overvalued currencies may find it more difficult to pursue trade liberalization. The rationale is that some countries may resist trade liberalization in order to counteract the surge in imports caused by an overvalued currency. This argument is supported by Fig. 6a, which shows that countries with overvalued currencies have liberalized tariffs relatively less.

With regard to antidumping, the argument is similar to that of tariffs. Countries with an overvalued currency may be more willing to use antidumping procedures to defend their domestic

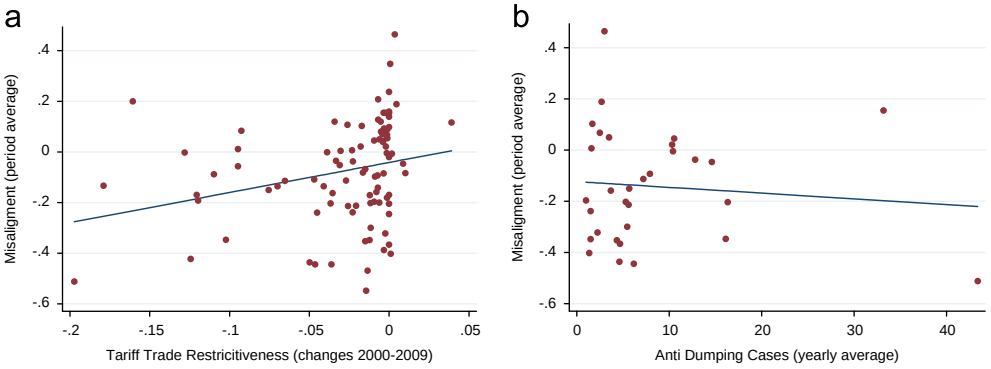

Fig. 6. (a) and (b) Exchange rate misalignment and trade policy.

industries. This argument is not substantiated by the raw data of Fig. 4b in which the weak negative correlation is largely driven by two outliers. There is no conclusive evidence that countries with under- or overvalued currencies are keener to use antidumping to counteract the effect of currency misalignment.

3.2. Econometric results

Although informative, the relationships between exchange rates and international trade presented in Section 3.1 are primarily for illustrative and preliminary purposes rather than for establishing causality. To better infer the effects of the exchange rate on international trade and trade policy, one needs to control for the multitude of determinates that may influence the variables of interest. This is done here by econometrically estimating the relationship between the exchange rate and international trade according to the models presented in Section 2.2. The purpose of the econometric estimation is to explore whether bilateral trade is affected by changes in the volatility and misalignment between two currencies once all other determinants of trade have been adequately controlled for. In practice, what matters for better assessing causality is not so much the cross country evidence but rather to what extent periods of exchange rate overvaluation or volatility – within each bilateral relationship – are associated with lower trade or slower trade liberalization.

Table 1 reports a series of specifications where the level of bilateral trade is regressed against the policy variables discussed above. These specifications are quite accurate in isolating the effects of exchange rate variables on international trade as a series of fixed effects controls for cross country variations, time specific factors and time-unvarying bilateral factors that could influence the level 7of trade. The change in trade policy is controlled for by the TTRI variable. Fixed effects also control for endogeneity of the exchange rate to trade (a country may be willing to pursue a more stable exchange rate with a major trading partner). This empirical approach provides an identification strategy to measure the effects of exchange rates on trade.

Specifications (1), (2) and (3) report the results where the level of trade (exports) is regressed on two exchange rate variables (bilateral volatility and bilateral misalignment) and controlled for trade policy, multilateral resistance and a full set of fixed effects (importer, exporter, time and country-pair). The results indicate that short term volatility does not have a significant impact on trade, while misalignment does. The negative coefficient on the misalignment term implies that exports decline when currencies become more overvalued. The results remain qualitatively similar when the two variables are used simultaneously. Note that the level of misalignment matters even when the model is estimated on the much smaller sample for which the volatility variable could be computed. This suggests that the significant effect of misalignment on trade is not driven by minor currencies.

Specifications (4), (5) and (6) report the same model but with the country-pair fixed effects replaced by the four standard gravity variables (distance, shared border, colonial links, and common language). Although these variables cannot control as well as fixed effects for bilateral trade

Table 1
Exchange rates and trade flows.

Dependent variable: log of exports						
	(1)	(2)	(3)	(4)	(5)	(6)
Log GDP importer	0.776***	0.770***	0.783***	0.676***	0.703***	0.684***
	(0.069)	(0.057)	(0.069)	(0.081)	(0.066)	(0.081)
Log GDP exporter	0.671***	0.562***	0.666***	0.588***	0.509***	0.583***
	(0.097)	(0.071)	(0.097)	(0.105)	(0.080)	(0.105)
Log distance				−1.176***	−1.290***	−1.176***
				(0.010)	(0.008)	(0.010)
Common border				0.0439	0.319***	0.044
				(0.036)	(0.035)	(0.036)
Colonial links				0.482***	0.478***	0.482***
				(0.032)	(0.030)	(0.032)
Common language				0.565***	0.631***	0.565***
				(0.023)	(0.020)	(0.023)
Misalignment		−0.101***	−0.0781**		−0.104***	−0.0767**
		(0.027)	(0.032)		(0.028)	(0.031)
Volatility	−0.377		−0.381	−1.797***		−1.802***
	(0.318)		(0.317)	(0.459)		(0.459)
Log (1+TTRI)	−1.084***	−0.917***	−1.080***	−1.517***	−1.466***	−1.514***
	(0.237)	(0.183)	(0.237)	(0.143)	(0.103)	(0.143)
Observations	38318	64770	38318	38318	64770	38318
Adjusted R^2	0.427	0.355	0.427	0.858	0.826	0.858

Robust standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

determinants (and for the possible endogeneity of the exchange rate variables to trade), it is important to estimate the model in this manner. The main reason is that country-pair dummies cancel the effect of perfectly aligned exchange rates (currency unions and fully pegged exchange rates that were in force during the entire period of analysis). Thus, removing country-pair fixed effects allows unvarying exchange rates to weigh in the estimation of the coefficients. While the results on misalignment remain virtually unchanged, the econometric results point to a strong significance of the volatility term. This suggests that volatility is important only when there is none, as in the case of currency unions or completely pegged exchange rates. However, this strong result is more likely driven by long term policy commitments related to currency union and pegged exchange rates rather than by short term volatility.[24] Although exchange rate volatility is not a concern, at least on average, volatility may still be of a concern for small firms or for firms operating in countries without well-developed financial markets (Aghion et al., 2009). To briefly check the robustness of the results to this issue, Specification (3) is amended with the inclusion of a term interacting the volatility variable with a dummy for developed countries. The results from this specification indicate that volatility is a significant determinant of international trade for developing countries: the effect of volatility is −1.52 and significant at the 5 percent level. On the other hand, the effect of volatility results almost insignificant for developed countries' trade.[25] Results are qualitatively similar when the estimation is performed separately for developing and developed countries.

In relation to misalignment, the econometric results can be used to provide an approximation of the aggregate impact that exchange rate misalignment causes upon trade diversion. The overall impact of misalignment on world trade is calculated by multiplying for each country-pair the measure

[24] The model of Table 1 is estimated on exports. Symmetric results for misalignment are found when the model is estimated on levels of imports. In this case, misalignment is positively correlated with imports. All considered, the results are supportive that currency overvaluation results in higher imports and lower exports. The opposite is true for undervalued currencies.

[25] The interaction term almost completely counteracts that of the volatility variable.

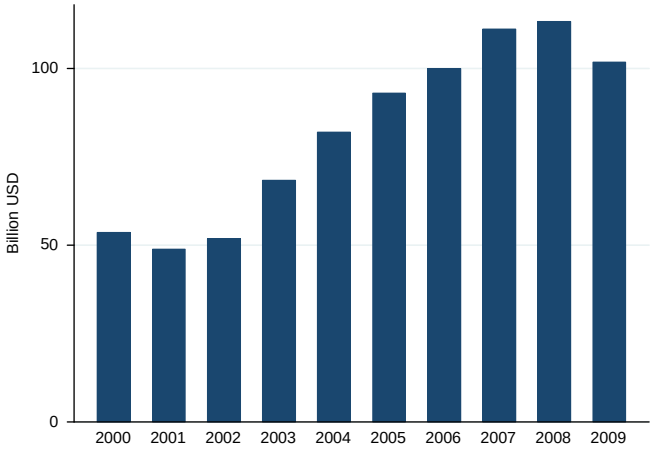

Fig. 7. Overall trade diversion effect of exchange rate misalignments.

Table 2
Exchange rate misalignment and trade policy.

Dependent variables: log (1+TTRI) and number of antidumping investigations				
	(1)	(2)	(3)	(4)
Log trade value		−0.0025***		0.0101***
		−(0.0002)		(0.0035)
Log GDP importer		−0.0202***		−0.0387
		(0.0020)		(0.0534)
Misalignment	0.0016*	0.0016*	0.16***	0.17***
	(0.0009)	(0.0009)	(0.0264)	(0.0265)
Observations	65068	65068	18466	18466
Adjusted R^2	0.629	0.632	0.262	0.275

Robust standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

of misalignment, the respective level of trade and the relevant coefficient. The figures are based on the results of specification (3) of Table 1. The impact is illustrated in Fig. 7 which shows the effect of overall currencies' misalignments on international trade for each year. In practice, the figure is to be interpreted as the value of world exports that is diverted from countries with overvalued currencies to countries with undervalued currencies. Note that this is an under-approximation of the overall effect of misalignments on world trade as it does not take into account trade disruption (part of the effect of misalignment on trade is not diverted but internalized by the domestic economy).

The trade diversion effect of misalignment is quantified in slightly less than one percent of world trade and varies between 50 billion USD in the 2000–2002 period to almost 120 billion USD in 2008. In other words, a completely aligned exchange rate system would shift about 120 billion USD of exports from countries with undervalued to countries with overvalued currencies.

Table 2 reports the results on the relationship between trade policy and exchange rate misalignment. All considered, there is evidence that exchange rate overvaluation impacts the choice and the pace of trade policy. However, its effect seems to be largely restricted to antidumping. The effect of overvaluation on tariff liberalization is more muted. More in particular, Specifications (1) and (2) report the results, testing for the hypothesis that a misaligned exchange rate may affect applied tariffs (TTRI). Specifications (3) and (4) report the results of exchange rate misalignment on antidumping.

In Specification (1) of Table 2 the TTRI is regressed on misalignment and a series of fixed effects. Country and time fixed effects control for country characteristics and global economic shocks. Country-pair fixed effects control for bilateral factors which may affect trade policy (e.g. regional trade agreements and import composition). The coefficient on misalignment has a positive sign indicating that periods of overvaluation are associated with less tariff liberalization. However, the effect of misalignment is relatively small and only marginally significant. Specification (2) shows substantially unaffected coefficients when two specific control variables (trade and GDP) are added. The signs on these variables are as expected. Trade and GDP are negatively correlated with the level of tariffs. This implies that tariff liberalization has happened relatively more slowly when trade or GDP has declined. In summary, the results suggest that exchange rate overvaluation is related to less tariff liberalization; however this evidence is not very strong. In magnitude, the average impact in terms of slower tariff liberalization is about 0.1 percent.

Specifications (3) and (4) report the results on the effect of exchange rate misalignment on the number of antidumping investigations initiated. As this is a count variable, the relationship between the two variables is estimated with a negative binomial model. The results indicate a strong relationship between misalignment and antidumping. Periods of exchange rate appreciation are positively related to the number of antidumping investigations. This outcome remains unchanged when the two control variables are added in Specification (4). As can be expected, the number of antidumping investigations is also found to increase with imports, but not with GDP. In finding a positive relationship between exchange rate overvaluation and antidumping investigation, these results are in line with those of the existing literature and in particular with the recent work of Bown and Crowley (2013) who use a more sophisticated methodology on a smaller set of countries.[26] More in general, these results suggest that antidumping investigations have been used to counteract exchange rate effects while countries with overvalued currencies have delayed any unilateral trade liberalization process.

4. Conclusions

This paper investigates the extent to which the exchange rate affects international trade and trade policy. The analysis is based on the econometric estimation of fixed effects models utilizing a bilateral dataset of trade flows, exchange rates and trade policy for about 100 countries comprising a period of 10 years.

The findings of this paper are generally in line with those of the recent literature supporting the importance of exchange rate misalignment while finding that short term exchange rate volatility is generally not a serious concern. More in detail, the results indicate that exchange rate misalignments do affect international trade flows in a substantial manner. Currency undervaluation is found to promote exports and restrict imports. In magnitude, misalignments across currencies result in trade diversion quantifiable in about one percent of world trade.

With regard to volatility, the analysis indicates that the short-term effect of exchange rate volatility on trade is a concern only for developing countries. More in general, most of the effects of lower volatility are indirect, and originate from long term exchange rate commitments such as currency unions and pegged exchange rates rather than short term exchange rate fluctuation. The limited importance of exchange rate volatility for developed countries is related to the increasing availability of financial instruments to hedge against exchange rate risks (e.g. forward contract and currency options) and to the increasing share of intra industry trade.

This study also finds evidence supporting the argument that trade policy is used to compensate for the effect of an overvalued currency. However, the policy response seems to be largely restricted to antidumping interventions. The evidence of a response in terms of a slower pace in tariff liberalization

[26] Larger results (a coefficient of about 0.3) are found when safeguards are also considered (in addition to antidumping) so as to cover the broader range of contingency protection measures. Even though safeguard investigations are rarely used, the larger coefficient suggests that safeguards may be a primary policy to counteract exchange rate overvaluation. Further analysis would be required to explore this possibility.

is more muted. Although this correlation should be better investigated, if confirmed it may have repercussions for the multilateral trade liberalization process, as large exchange rate misalignments may reduce the incentive to remove existing trade barriers. More significantly, those results imply that persistent exchange rate misalignments may increase the incentive to recur to non-traditional protectionist policies.

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