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World Trade Organization

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THE RELATIONSHIP BETWEEN EXCHANGE RATES AND INTERNATIONAL TRADE: A REVIEW OF ECONOMIC LITERATURE

Marc Auboin and Michele Ruta

WTO

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THE RELATIONSHIP BETWEEN EXCHANGE RATES AND INTERNATIONAL TRADE: A LITERATURE REVIEW

Marc Auboin and Michel Ruta [1]

Abstract

This paper surveys a wide body of economic literature on the relationship between currencies and trade. Specifically, two main issues are investigated: the impact on international trade of exchange rate volatility and of currency misalignments. On average, exchange rate volatility has a negative (even if not large) impact on trade flows. The extent of this effect depends on a number of factors, including the existence of hedging instruments, the structure of production (e.g. the prevalence of small firms), and the degree of economic integration across countries. Exchange rate misalignments are predicted to have short-run effects in models with price rigidities, but the exact impact depends on a number of features, such as the pricing strategy of firms engaging in international trade and the importance of global production networks. This effect is predicted to disappear in the long-run, unless some other distortion characterizes the economy. Empirical results confirm that short-run effects can exist, but their size and persistence over time are not consistent across different studies.

Keywords: Exchange rates, volatility, misalignments, international trade

***JEL* classification**: F10, F31, F55, O19, G21, G32

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The relationship between currencies and trade has been the object of a wide policy debate in recent times.[2] This paper reviews part of the relevant academic literature that attempts to model and estimate the impact of exchange rate volatility and misalignments on international trade. The review, therefore, abstracts from other important factors that may have a (more or less direct) bearing on the relationship between exchange rates and trade, such as the factors behind the determination of exchange rates, the impact of exchange rate regimes, or the relationship between exchange rate policies and global imbalances.

I THE EARLY LITERATURE: TESTING THE DIRECT EFFECT OF EXCHANGE RATE UNCERTAINTY

A. DIRECT LINKS VERSUS INDIRECT LINKS

This section focuses on the direct links between exchange rates and trade, in particular the heavily debated question as to whether exchange rate uncertainty reduces the incentives to trade internationally. This particular question appeared to be a prime focus of academic interest when exchange rate volatility increased after the end of the gold exchange standard (IMF, 1984). The Secretariat is providing a review of both the "early" (1973-late 1990's) and "recent" literature (2000's), the latter being only relevant in the light of the earlier.

Policy-makers have always been attentive to the effects of exchange rate misalignments, not the least because the IMF precludes competitive devaluations.[3] The issue gained greater prominence in the economic debate from the 1990s onwards, when sustained deviations of exchange rates from their equilibrium values were suspected, rightly or wrongly, to be at the origin of global current account imbalances. From a macroeconomic point of view, exchange changes can have strong effects on the economy, as they may affect the structure of output and investment, lead to inefficient allocation of domestic absorption and external trade, influence labour market and prices, and alter external accounts. Hence, exchange rate shifts affect international trade both in direct and indirect ways. The indirect links are hard to isolate macro-economically, complex to describe, and empirically hard to test, as they have second, third or fourth round effects. This is why exchange rates are often treated in models as external (exogenous) variables.

B. THE UNCERTAINTY GENERATED BY EXCHANGE RATE RISKS

As explained in the first IMF study on the matter (1984), exchange rates can in principle influence trade in many ways. Real exchange rates, which are the relative prices of tradable to non-tradable products, have a potentially strong impact on the incentive to allocate resources (capital and labour for example) between the sectors producing tradable and non-tradable goods. Real exchange rates are also a measure of real competitiveness, as they capture the relative prices, costs, and productivity of one particular country vis-à-vis the rest of the world.

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[2] This research has initially been conducted in the context of the WTO Working Group on Trade, Debt and Finance (WGTDF), which had requested to the WTO Secretariat to prepare "an update review of available literature and research (on the relationship between exchange rates and international trade), particularly in the light of the crisis that started in 2008". The original document has been issued publicly as WT/WTGTDF/W/57, and was discussed by WTO Members at the WGTDF meeting on October 24, 2011. This document has been re-formatted by the authors to fit the requirements of a working paper. As any such working paper, particularly when this paper analyses the literature at a point in time, it is very much a work in progress, that built on earlier reviews and itself will need to be updated in the future.

[3] The terms "depreciation" and "devaluation" are used here interchangeably as the fall of the value of a country's currency relative to another currency or to a basket of currencies. The latter term generally refers to the specific case where the currency was previously pegged to a metallic anchor such as gold or to another currency.

After a period of thirty years of relative stability of both nominal and real exchange rates under the Bretton-Woods system, increased volatility of exchange rates from the early 1970's triggered a rich and lively debate on the channels through which such increased volatility could affect the real economy. The concerns of the trading community, which had negotiated substantial reductions in border protection when the Gold Exchange Standard determined exchange rates, were particularly strong. At the request of the then Director-General of the GATT (on behalf of the General Council), the IMF examined the effects of greater exchange rate volatility on global trade. While concluding that the evidence concerning a negative effect of the increased volatility of exchange rates on global trade were slim, the 1984 IMF study clearly laid down the channels by which such increased volatility could affect trade. It described, for example, how sustained misalignment of exchange rates away from levels that reflected inflation or cost differentials sent incorrect price signals which could destabilize international trade flows; how misalignment could inflict adjustment and resource misallocation costs on an economy if it changed investment decisions and resulted in shifts in resources between the sectors of an economy that were not justified by relative cost and productivity differentials; and how misalignment might destabilize levels of protection against foreign competition provided by price-based trade restrictions, generating pressure for compensating trade restrictions to protect current patterns of supply.[4]

Among all these transmission channels, the early (1970s and 1980s) theoretical analyses and models of the relationship between exchange rates and international trade focused primarily on the commercial risk involved in conducting international transactions and the uncertainty generated by short-term or longer-term volatility. How this uncertainty affected the decision to trade, its expected profitability, and eventually the allocation of resources between tradable and non-tradable goods and services was, then, the main target of attention.

One simple but relatively well known example of how exchange rates affect trading firms is provided in a seminal paper by Clark (1973), who describes the hypothetical case of a firm, producing under perfectly competitive conditions a single product containing no imported input, entirely for export markets. The firm is paid only in foreign currency, hence the proceeds of its exports in domestic currency depend on the (unpredictable) level of the exchange rate. In the model, the firm is assumed to be small and to have limited access to currency hedging. In addition, because of the high cost of adjusting its levels of production to other factors than demand, it is also assumed that its output will not change in reaction to favourable or unfavourable changes in the profitability of its exports deriving from exchange rate shifts. Uncertainty about future exchange rates directly translates into uncertainty about future receipts in domestic currency. Thus the firm in question must determine a level of export that incorporates this uncertainty. If one considers that the firm maximizes its profit and has a risk aversion higher than zero, a prime condition for this firm to produce is that its marginal revenue exceeds its marginal cost to compensate for the exchange risk it bears. Hence, in this situation, in which the firm's variability of profits depends only on the exchange rate, greater volatility of that exchange rate - with no change necessarily in its average level - results in a reduction of output and exports, reflecting reduced exposure to exchange rate risk. In other words, this basic model, later refined by Hooper and Kohlhagen (1978), establishes a rather negative relationship between exchange rate volatility and international trade.

The view that an increase in exchange rate volatility will have adverse effects on the volume of international trade is relatively widespread in studies conducted throughout the 1970s and 1980s (in addition to Clark, Hooper and Kohlagen, see also, inter alia, Baron (1976), Cushman (1983), Gros (1987), De Grauwe and Verfaille (1988), Giovannini (1988), Bini-Smaghi (1991) and others, at a period of increased volatility (IMF, 1984). However, these conclusions rest on relatively stringent assumptions, which have been scrutinized and relaxed by other authors - notably the assumption of perfect competition, the large role of the invoicing currency, the absence of imported inputs, the high aversion to risk, and the absence of exchange rate hedging financial instruments. This led the way to

[4] Document WT/GC/444.

more sophisticated multi-country models with diversified firms, in which the relationship between exchange rates, the supply of goods and the decision to trade became more ambiguous.

For example, in the presence of imported inputs, the contraction in the supply of exports is smaller, as acknowledged by Clark himself, because when an exporter imports inputs from a country whose currency depreciates, there is some offsetting effect on declining export revenues in the form of lower input costs. One may also take into account the possibility of firms hedging effectively against short-term fluctuations, and the likelihood of larger firms evolving in a multi-currency environment, in which the effect of fluctuations in one or the other direction on total profitability cancel out. The extent to which firms can allocate their output between the domestic and international market (and among international markets) also matters, as well as the risk aversion of firms towards price uncertainty. These factors led suggested that the link between greater exchange rate volatility and reduced trade flows was less robust than had initially appeared. On the other hand, the notion that exchange rate volatility affected could not be entirely dismissed and may be relevant in some cases. For example, while many exporters can diversify their currency risk by mixing local and foreign currency invoicing (depending on their market power), exporters still faces a risk: when a firm invoices in foreign currency, it faces a price risk. When it invoices in the domestic currency, it faces a quantity risk (the quantity demanded is uncertain because the price facing the buyer is itself uncertain). Therefore, not only revenues become uncertain, but production costs as well (Baron,1976).

In several models, the effect of increased volatility of exchange rates on trade depends heavily on the level of risk aversion of traders (De Grauwe,,1988); Dellas and Zilberfarb, 1993). Risk-neutral traders are unlikely to be affected by exchange rate uncertainty but risk adverse ones will, albeit in different degrees. Paradoxically, for very risk-adverse traders, exporting more could be a response to increased volatility, in order to compensate for the expected fall in revenue per exported unit. As indicated by De Grauwe (1988), while "exporters are universally made unhappy by the volatility of exchange rates, some may decide that they will be better off exporting more". In this particular case, he stresses that the dominance of income effects over substitution effects results in a positive relationship between exchange rate fluctuations and the volume of trade.[5] The existence of a positive relationship between exchange rate volatility and exports was later confirmed theoretically by Broll and Eckwert (1999), but only for firms that are able to react flexibly to changes in exchange rates and re-allocate their products among markets accordingly. Such action is likely to optimize the gains from trade in an environment of increased volatility but would only work if the firms in question have large domestic markets at their disposal, allowing them to rely on the domestic market in any case. As indicated by the authors, "the export strategy is like an option because the domestic market is certain whatever the realized exchange rate turns out to be. The domestic price is the "strike" price of the real export option." However, a more volatile exchange rate also implies a higher risk of exposure for international firms - with this effect working in the opposite direction. The authors conclude that the net effect of exchange rate uncertainty on production and exports in their model would depend on the degree of relative risk aversion of the firm.

The availability of financial hedging through forward exchange markets helps reduce the uncertainty generated by fluctuations of nominal exchange rates, although firms have unequal access to hedging facilities and may display different behaviour according to which side of the hedging position they stand. While Baron (1976) suggests that, in a world in which the only source of uncertainty is linked to exchange rates fluctuations, perfect forward markets neutralize the effects of exchange rate volatility on the volume of trade; Viaene and de Vries (1992) nuanced this conclusion by suggesting that forward markets create "losers" and "winners" among exporters and importers which are on the

[5] In De Grauwe's model, exchange rate variability has two effects on risk-adverse firms: an income effect, whereby the expected reduced utility derived from higher uncertainty of profits leads the firms to increase its sales abroad, and a substitution effect, whereby higher uncertainty deriving from volatile exchange rate would lead the firm to reduce trade. At the highest level of risk aversion, the income effect exceeds the substitution effect.

opposite sides of the forward transactions. Besides, as noted by the IMF (1984), foreign exchange hedging contracts are not necessarily available in all countries and to all categories of firms. Contracts are typically relatively large, maturities short, and fees high. Besides, they only cover a limited share of possible fluctuations during the proposed maturities - as by definition it is hard to anticipate the magnitude of such fluctuations. Hence, it is generally accepted that larger exporting firms are in a better position than smaller firms to benefit from exchange rate hedging. Caporale and Doroodian (1994) confirm that hedging is available but generates costs and difficulties related to the firms' lack of foresight as to the timing and volume of foreign exchange transactions. Obstfeld and Rogoff (1998) study the hedging "behaviour" of firms in relation to their risk aversion. They find that risk-adverse firms will hedge against exchange rate movements, but hedging costs and exchange rate uncertainty will translate into higher export prices, which will adversely affect (world) output and consumption.

The assumption that exchange rates affect trade because firms cannot adjust production and factor inputs according to exchange rate fluctuations has also been relaxed by several authors Gros, (1987) and De Grauwe, (1992) have worked with a wider spectrum of cases than those described by Clark. If firms can adjust factors of production upwards and downwards according to world prices, they are indeed likely to sell more when international prices in foreign currency are high (with a limit set by the production capacity of the "flexible" factor) and less when such prices are low. However, this will depend on risk aversion towards profit uncertainty, with risk adverse firms less likely to export more as exchange rate volatility creates a higher profit variance, with less risk adverse firms ready to sell more even in a context of profit uncertainty (the opportunities created by price variability would offset the uncertainty about profit-making).

Somewhat more recent theoretical models of hysteresis in global trade show that the high variability of exchange rates and associated uncertainty can influence the decision to enter or exit foreign trade markets, in the presence of "sunk" costs (in particular, Dixit, 1989; Krugman,,1986; Franke,1991). The concept of "sunk" costs is linked to the fixed costs involved in setting up production networks for export-oriented products, marketing tools and distribution infrastructures, and it fits well with the newer realities of modern trade patterns. In the presence of such costs, firms would tend to be less reactive to short-term fluctuations in exchange rates, in a sort of "wait-and-see" attitude. However, the deeper and longer these fluctuations, the greater the incentive to stay out of international markets for firms that have not come in yet, and of staying in for firms having already invested entered the market. In other words, exchange rates encourage firms towards inertia.

Some models emphasize the effects of exchange rate variability more on the composition than on the gross volume of trade. Kumar (1992) indicates that while the relationship between exchange rate fluctuations and gross levels of trade is ambiguous, fluctuations have a positive impact on intra-industry trade. The logic of the argument is that the exchange rate risk acts as a "tax" on the comparative advantage of the exporting sector relative to the domestic sector. If comparative advantage is reduced, economies of trading countries will become less specialized and intra-industry trade will increase at the expense of inter-industry trade. In this model, exchange rate risk reduces net trade, which is the difference between gross trade and intra-industry trade.

While the literature has focused mainly on the impact of exchange rate uncertainty on the incentive effects on trade, a few authors have examined the "reverse" correlation on the effects of international trade on exchange rates. Mundell's (1961) optimal currency hypothesis suggests a reverse causality, whereby trade flows stabilize real exchange rate fluctuations, thus reducing real exchange rate volatility. Broda and Romalis (2003) add in the introduction of their paper that such causality ought to be addressed, as "most of the existing studies have focused on the effects of exchange rate regimes or volatility on trade by assuming that the exchange rate process is driven by exogenous shocks and is unaffected by other variables. By definition, this implies that the effect of trade on volatility is inexistent rather than jointly estimated with the effect of volatility on trade. (This) is not a benign assumption. (Our) figures show a strong positive relationship between real exchange rate volatility and distance between trading partners. Since distance cannot be affected by volatility, this strong

relationship suggests that greater distance between countries significantly increases bilateral exchange rate volatility through the effect of distance on the intensity of commercial relationships such as trade. Ignoring the causal effect of trade on volatility results in overestimates of the true impact of exchange rate volatility on trade." The paper finds that deeper bilateral trading relations dampen real exchange rate volatility and are more likely to lead to a currency union. Controlling for that reverse causality, they also find that currency unions enhance trade by 10 to 25 per cent.

The question arose as to whether, in the examination of the literature on the direct link between exchange rate and trade, using real or nominal exchange rate would make a difference from an analytical point of view. In fact, most authors deal primarily with real exchange rates. The probability that the variability of nominal exchange rates did not translate into that of the real exchange rate would be small, occurring only during exceptionally high periods of domestic inflation. In empirical studies, both variables are generally tested (cf. next section).

C. THE UNCERTAINTY GENERATED BY EXCHANGE RATE RISKS

Reflecting the relatively inconclusive state of early theoretical models regarding the effects of exchange rate variability on trade, the vast empirical work conducted by academics and policy-oriented economists in support of theoretical considerations leaves no less ambiguous evidence. As indicated by Taglioni (2002), "it is customarily presumed that the adverse effect of exchange rate volatility (on trade flows), if it exists, is certainly not large".

This conclusion is shared by and large by Ozturk (2006), which contains a fairly comprehensive account of the empirical surveys dedicated to the impact of exchange rate variability, published between the 1970s and the early 2000s. The broad results of the 43 surveys examined by him are summarized in Table 1 (Annex I). The surveys show differences in specifications, estimation techniques, sampling, and data sets. It concludes on a rather wide mix of evidences, some in favour and some against the hypothesis of a negative relationship between exchange rate volatility and trade.

These mixed conclusions are perhaps best illustrated in the IMF's 2004 study on exchange rate volatility and trade flows, see IMF (2004). The survey updated the earlier one completed in 1984, and hence incorporated the outcome of two decades of improvements in estimation techniques, data and theory. It allowed for an exploration of the effects of exchange rate volatility on trade along several new dimensions, for example by type of volatility (short- and long-run, real and nominal, and other characteristics), by country group (with useful distinction by regions and income levels), and by type of trade (using disaggregated data across different types of goods).

The IMF's conclusion that there was no "obvious negative relationship between aggregate exchange rate volatility and aggregate trade" does not differ fundamentally from that of the 1984 study, but it is enriched by considerations regarding bilateral trade. As indicated on page 41, "when we turn to bilateral trade, we do find evidence that exchange rate volatility tends to reduce trade, (although) this negative effect is not robust to alternative ways of controlling for factors that could affect trade."

This conclusion needs to be elaborated. In its examination of the relationship between exchange rate volatility and trade, the IMF looked at the time paths of the two variables and found no obvious (negative) association. World trade increased steadily between 1970 and 2000, while the path of exchange rate volatility was less smooth. Exchange rate volatility showed an upward trend from the early 1970's through the end of the 1980s, before moderating, with strong regional bulges such as in the case of transition economies from Eastern Europe (1990-94) and of the Asian crisis in 1997-98. As indicated in the study (page 44), negative associations in such cases "may not reflect a causal relationship, but rather are the manifestation of the effects of a common set of factors that both raise currency volatility and reduce trade. For example, the Asian crisis led to a large decline in the imports of the affected countries and major movements in their exchange rates, but the fall in domestic demand was the most important factor reducing import volumes, not currency volatility. Similarly, the

breakup of the Soviet Union caused widespread currency dislocations in many transition economies, resulting in substantial falls in output and trade, and huge changes in many exchange rates that were part and parcel of the transition process. In order to estimate the specific impact of exchange rates (…) on trade flows, it is necessary to take account of the separate effects of the myriad of factors that determine the level of exports and imports". The IMF does this using a gravity model which tests other determinants besides exchange rates of trade patterns such as distance/geographical positions, GDP (or demand), and many other factors that may affect transaction costs relevant to bilateral trade.[6]

The detailed results indicate that long-term real exchange rate volatility "has a significant negative effect on trade - if exchange rates were to rise by one standard deviation in our sample, trade would fall by 7 per cent, (…) an effect that is comparable to the estimates found by previous studies (page 48). However, the authors do not find the relationship to be "robust to certain reasonable perturbation of the specification".[7] When testing whether exchange rate variability had a different effect in differentiated or homogeneous products, the IMF wrote that "recent developments in the economics of trade suggest that a given increase in transaction costs (of which exchange rate volatility is a component) could have a larger, negative effect on trade in differentiated products than on trade in homogeneous products (…), but, as with aggregate trade, estimation results show that this theoretical prior is not robust" (page 52). The IMF remains equally cautious on whether the effects of exchange rate variability differ across country groups, by acknowledging hedging opportunities were less developed in developing countries and hence could be associated with less trade in these countries. This proposition proved, once again, not to be so robust when subjected to quantitative tests. What comes across relatively strongly from the study, though, is that members of a currency union tend to trade more - the IMF's core results confirming those of Rose (1999). As indicated in page 53, "the trade-enhancing benefits of currency unions apparently far exceed gains from a reduction in exchange rate volatility and are preserved over time". On balance, the IMF concludes that "for both aggregate and disaggregated trade, there is empirical evidence pointing to a generally small negative effect of exchange rate volatility on trade, but this evidence is not overwhelming and not robust across different empirical specifications."

An interesting policy conclusion in the very last paragraph of the study indicates that "prior consideration suggest that there do not appear to be strong grounds to take measures to reduce exchange rate movements from the perspective of promoting trade flows. Note that this does not rule out the possibility that exchange rate fluctuations can affect the economy through other channels. For example, currency crises - special cases of exchange rate volatility - have required painful adjustment in output and consumption. However, in this case, appropriate policies are those that help to avoid the underlying causes of large and unpredictable movement in exchange rates, rather than measures to moderate currency fluctuations directly for the purpose of enhancing trade."

Results of other leading authors confirm on aggregate those of the IMF: volatility decreases trade, although the effect is small and the results are not entirely robust to changes in specifications. Bilateral trade seems to be more affected than aggregate trade.[8] Trade in differentiated products is

[6] The gravity model used by the IMF performs relatively well empirically, yielding coefficients and estimates in line with expectations deriving from other empirical work, and from economic theory. The coefficient for distance is statistically significant and negative, and the coefficient for GDP and other economic masses is equally statistically significant and positive. Other control variables yield the expected signs and significance.

[7] Specifically, when time varying country fixed effects are allowed, which are suggested by theoretical work on the gravity model specification, "the analysis does not reveal a negative association between volatility and trade" (page 55). However, on page 49, it is stated that "a negative effect is still observed when we control for unobservable cultural, economic, historical, geographical and other factors specific to a given pair of countries rather than individual countries.

[8] Several papers submitted by WTO members point to the impact of exchange rate shifts on bilateral trade or on the aggregate the trade balance. For example, Rincon (1999) finds that, over the period 1979 to 1995,

more affected than trade in commodities; and participation in a currency union had rather strong positive effects on trade flows. Of particular interest is the work of Dell'Ariccia (1998), which looks at the impact of exchange rate volatility on the bilateral trade of EU 15 Members and Switzerland over twenty years, from the mid-1970s to the mid-1990s. Depending on the measures of variability, he found a negative association between exchange rates and trade, and that trade would increase by 3 per cent to 13 per cent if this variability were brought down to zero. Rose (1999) found relatively similar results (small but significant negative effects) with a wider data set - with trade also increasing by comparable levels should the variability disappear between highly economically integrated trading partners.9 In addition, both Dell'Ariccia and Rose found a fairly strong impact of a currency union on trade, as they tested the so-called "third country" effects of the volatility on trade, which tend to increase the impact of exchange rate variability over regional trade. Wei (1998) tested empirically - using data on 1,000 country pairs - the hypothesis according to which the difficulty in finding large and negative effects of exchange rate volatility on trade was due to the availability of hedging instruments. He found that there was no evidence in the data to support the validity of the hedging hypothesis, and that for country pairs with large trade potential, exchange rate volatility deterred goods trade to an extent larger than typically documented in the literature (generally between 5 and 10 per cent in the volume of bilateral trade).

No method of estimation and underlying theoretical model was found to be "superior" to others in describing and computing the impact of exchange rate variability on trade flows. In a general equilibrium framework, the complex interactions of all the major macroeconomic variables were taken into account in a multiple country environment. In such models, all the implications of exchange rate changes were tested, even if offsetting one another. In partial equilibrium models, the direct effect of exchange rate changes can only be tested on another variable (level of trade) regardless of whether volatility affects the other variables that influence trade. Bacchetta and Van Wincoop (2000) used a general equilibrium model, in which uncertainty arises from monetary and fiscal policy, to examine the impact of volatility on the levels of trade and welfare in a context of both fixed and flexible arrangements. One interesting outcome illustrating the complexity of the exchange rate-trade relationship is that monetary stimulus in a country, that leads to the depreciation of its exchange rate may not have much effect on trade, as the depreciation of the exchange rate on the one hand reduces imports, but on the other hand, the increase in domestic demand linked to the monetary stimulus may boost imports in an offsetting movement. Of course, the net effect will depend on a whole set of variables, from demand elasticities for imports to supply-side factors, such as the desire or ability of domestic producers to adjust prices to the depreciation of the currency. Similarly, standard macroeconomic theory describes the J-curve effects of exchange rate depreciations (see section (d) of part B.), generally with a sufficient degree of detail to establish that real effects of nominal exchange rate changes will depend on a complex set of variables that will or will not induce domestic firms to increase exports or domestic consumers to increase imports. Such variables include the extent of imported inflation, whether exporting firms are price-takers or price-makers, the price-setting mechanisms of firms, and so on).

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exchange rate depreciation of the Colombian currency had an important role in the short- and long-term improvement of the Colombian trade balance.

[9] In earlier work, though, Rose (1991) had found no evidence of a negative relationship between exchange rates and trade on a set of G-7 countries in the 1980s.

II. THE LATER LITERATURE: TESTING THE EFFECT OF EXCHANGE RATE MISALIGNMENT

A. EXCHANGE RATE LEVEL AND TRADE

As indicated by the OECD (2011a), the economic crisis has had a "differentiated impact on the world economies and on their trade, thereby changing trade patterns in some cases". The on-going debate about exchange rate movements and their impact on trade balances rebounded in the aftermath of the crisis, with concerns about unemployment and slow recovery strengthening the sensitivity and vigilance towards those countries suspected of "exporting" their way out of the crisis at the expense of their trading partners. Such concerns already existed in the 2000s, in an international environment characterized, inter alia, by the development of global external imbalances.

The policy and academic debate shifted somewhat at this time, away from the effects on trade of exchange volatility towards the effects of sustained exchange rate depreciation or perceived exchange rate misalignments. This meant emphasis fell less on the effects of variability and more on the real level of the exchange rate10 While this shift in focus reflects the policy concerns regarding the potential impact of sustained currency misalignment, economic research shows that new global patterns of trade have rendered the effects of exchange rates on trade even more complex. In this area research is still it its infancy.

1. Theoretical work: transitory or permanent effects?

Exchange rates can depart from their equilibrium level for two reasons. First, as a result of government intervention directly aimed at altering the real exchange rate (currency manipulation). In this respect, governments and/or central banks possess a number of policy instruments that can affect the real value of the exchange rate, including the introduction of capital controls or targeted intervention in foreign exchange markets. Second, misalignments can be the unintended side effect of macroeconomic policies aimed at achieving domestic objectives, or the result of distortions in the international financial architecture or in domestic structural conditions. There is an academic debate on the extent to which the real exchange rate is a variable that policy makers can influence, see for instance, Eichengreen (2007) and Rodrik (2008). In addition, to ascertain the root cause of a currency misalignment is often a difficult matter in practice. The ensuing discussion will abstract from the cause of the misalignment and will, instead, focus on its trade effects in the long- versus the short-run.

Standard economic theory defines the long-run as the period in which all prices are fully flexible. Put differently, in the long-run prices have the time to adjust to any policy change (or other shock). In this context, money is like a veil to the real economy, an intuition that dates back at least to David Hume's essays on money and the balance of trade. In particular, when markets have no distortions, an exchange rate misalignment - such as a devaluation of the currency - has no long-run effect on trade flows or on real economic activity, as it does not change relative prices. The short-run, on the other hand, can be different. The reason is that, if some prices in the economy take time to adjust (i.e. are "sticky"), movements in nominal exchange rates can alter relative prices and affect both the allocation of resources between non-tradable and tradable sectors and international trade flows.

The short-run trade effects of exchange rate misalignments, however, are not straightforward, see Staiger and Sykes (2010). Recent macroeconomic literature shows that these effects depend, among other things, on the currency in which domestic producers invoice their products. For instance, if producers set their price in the home currency (or if domestic wages are sticky), an unanticipated devaluation lowers the price of domestic goods relative to foreign goods. This case, which has been much debated in policy circles in recent times, has similarities (even if it is not perfectly equivalent)

[10] As noted in the last sub-section of part B, research on the impact of exchange rate volatility and trade has nevertheless continued and deepened.

to the imposition of a combination of export subsidy and import tariff on all goods –an argument first made by Keynes in 1931.11 However, the trade effect of a devaluation would be different if domestic producers were to set their price in the buyers' currency or in a vehicle currency, such as the US Dollar or the Euro. In the latter cases, the theory suggests that a devaluation would still have real effects, but such consequences would not be equivalent to export promotion, but rather to import restrictions, see Staiger and Sykes (2010). These authors conclude that understanding the short-run impact of an exchange rate devaluation on trade flows is conceptually more difficult than it may appear at first sight.

The above argument abstracts from the possibility of market failures. For instance, in the presence of information problems (e.g. the quality of export goods is unknown to foreign consumers), it has been argued that the level of exports may be inefficiently low (Bagwell and Staiger, 1988; Bagwell, 1991). A high-quality exporter may need to signal quality, which is costly. Firms may also have common uncertainty about the profitability of exporting, and such common uncertainty suggests the existence of a coordination problem -- see, in particular, the study by Freund and Pierola (2010) on exports from Peru. In this context, the undervaluation of the exchange rate may have long-run effects if it allows exporters to enter foreign markets, thus overcoming the initial inefficiency. Specifically, if this logic is correct, one would expect that currency depreciation is associated with entry into new markets and new product lines (i.e. the extensive margin of trade), and that it is not (or not completely) undone in the long-run when prices adjust. Moreover, as market failures are considered to play a more prominent role in developing as opposed to developed economies, one should expect that these long-run effects are weaker for the latter group of countries.

A related literature analyses the relationship between the exchange rate and income growth. Economists have long known that avoiding overvaluation of the currency is an important factor for a country's economic performance (Rodrik, 2008). While economic models have rarely formalized the association between overvaluation and slow growth, most accounts link it to macroeconomic instability (Fischer, 1993; Easterly, 2005). A related question is whether the undervaluation of the currency can have benign effects on a country's performance. A series of recent papers by Hausman et al. (2005); Eichengreen (2007); Rodrik (1986 and 2008); Korinek and Serven (2010) show that a devaluation can play an important part in the growth process of developing countries. The logic is still related to the possibility of market failures. Specifically, these models assume that market imperfections (e.g. learning externalities, product market failures) are more prominent in the tradable sector relative to the non-tradable. As a result, undervaluation has a positive impact on growth as it alleviates the economic costs of market distortions by promoting the expansion of the tradable activities. However, an economic argument can also be made that an exchange rate undervaluation can hamper growth by providing a wrong signal to economic agents, which may lead to factor misallocation (Haddad and Pancaro, 2010).

The literature on exchange rates and growth does not directly address the question of the trade effects of a currency undervaluation or overvaluation. Economic logic suggests that there are at least two opposite effects at work. An undervaluation of the currency has a direct negative effect on the exports of other economies that specialize in the production of goods that are relatively close substitutes and compete for market share in similar export markets. On the other hand, income growth of trading partners has an indirect positive effect on export performance.

Ultimately, whether exchange rates undervaluation can have an effect on trade in the short- and or the long-run is an empirical question (see the discussion below). And specifically, one would argue that whether the long-run effects materialize depends on whether the market failures discussed above are empirically important. Whatever the answer to these questions, economic theory suggests two important caveats. First, according to the so called "targeting principle" in economics, policies that

[11] Several authors made this point, including among others Bergsten (2007) and Mattoo and Subramanian (2009).

target directly market failures are efficient (i.e. first-best). Therefore, changes in the level of the exchange rate that address distortions only indirectly can at most be second-best (among others, Rodrik, 2008). Specifically, a real undervaluation creates unnecessary distortions by imposing a consumption tax on tradable goods. The second caveat is that the extent to which currency undervaluation is expected to have trade (or growth) effects depends on what other countries will do. Even if one takes the view that an exchange rate undervaluation has a positive long-run effect on exports and growth, this would not hold if all countries undervalue at once (among others, Blair Henry, 2008).

2. Empirical work: devaluations, growth and export surges

The issue of exchange rate levels and their relationship with other major economic variables such as growth, income, current account balances, consumption and trade have led to a great deal of discussion since the beginning of the mid-2000s, in particular when global imbalances started to widen.

Even if the literature has not yet achieved a definitive consensus regarding the best definition of the long-term equilibrium real exchange rate, Nassif et al. (2011) recall that various empirical papers have studied the impact that exchange rate overvaluations or undervaluations can have on growth. In particular, some studies have found that overvaluation hinders economic growth (Razin and Collins, 1999; Johnson et al., 2007; Rajan and Subramanian, 2009; Gala, 2008). Others have found that undervaluation boosts growth (Rodrik, 2008 and Berg and Miao, 2010). Furthermore, other studies suggest that the relation between exchange rates and growth is non-linear. For example, Williamson (2008) argues that a small undervaluation can benefit growth. In the particular case of Brazil, for the period 1996-2009, Barbosa et al. (2010) found that both real appreciations and depreciations can have negative effects on growth. Similarly, Haddad and Pancaro (2010) in a panel of 187 countries for the period 1950-2004 found that a real undervaluation has a positive effect on the economic growth of low income countries in the short-run, but a negative effect in the long-run.

A number of papers have looked at the empirical relationship between exchange rate devaluation and export surges. A series of studies have focused on the specific experience of certain countries and/or regions. For instance, Fang et al. (2006) analyse the effect of exchange rate depreciation on exports for eight Asian economies (Malaysia, Philippines, Indonesia, Japan, Singapore, Chinese Taipei, Republic of Korea and Thailand). They find that a depreciation encourages exports for most countries, but its contribution to export growth is weak and varies across countries. They argue that the reason for this finding is that a depreciation raises exports, but the associated exchange rate risk (variability) has an offsetting effect. Bernard and Jensen (2004) focus on the US between 1987 and 1992. In analysing the sources of manufacturing export booms, they find that changes in exchange rates were an important determinant of export increases. Most of the increase in exports was on the intensive rather than the extensive margin (i.e. increasing export intensity among existing exporters rather than from new entry into exporting). Finally, Arslan and van Wijnbergen (1993) study the export boom of Turkey in the 1980s and assess the relative contribution of different factors, such as export subsidies, import growth in the Middle East and exchange rate depreciation. They find that the steady real depreciation of the Turkish Lira played an important role in the surge in exports.

Two recent studies focus on a cross-country analysis. Freund and Pierola (2008) examined the determinants of 92 episodes of export surges, which they defined as increases in manufacturing exports of at least 6 per cent that lasted for a period of seven years or longer. They found that large depreciations of the real exchange rate were an important determinant of export surges for developing countries. Specifically, an undervalued exchange rate had a positive effect by facilitating entry in new export products and new markets. These new products and markets accounted for 25 per cent of export growth on average during the surge in developing countries. Haddad and Pancaro (2010) provide further evidence of the links between the real exchange rate and export expansion. They found a positive association between the two variables, but only for low per capita income countries.

Specifically, in developing economies with per capita income below 2,500 USD, an increase in 50 per cent in real undervaluation is associated with an annual 1.8 per cent increase in export over gross domestic product (GDP) in the corresponding five year period. However, they find that in the long-run the effect of a real exchange rate undervaluation on exports becomes statistically insignificant for all income levels.

3. The trade balance and the J-curve debate

Under the J-curve effect, often explained in international economics textbooks (e.g. Krugman and Obstfeld, 2003), the depreciation of the real exchange rate is often synonymous with a deterioration of the trade balance of a given country in the short-run, because most import and export orders are placed several months in advance. The value of the pre-contracted level of imports rises in terms of domestic products, which implies that there is an initial fall in the current account. Moreover, if there is a high import content of exports, firms may need some time in order to adopt new production techniques.The increase in import prices may be partly or fully offset by the substitution, if available, of imported goods by local goods, but this implies an adjustment in the capacity of domestic firms which requires time. Besides, in order to increase their sales abroad exporters may need to adjust their capacity to reach foreign consumers, which may also take time. In the long-run, when these adjustments have taken place, a real exchange rate depreciation may improve the current account.

In this respect, the OECD has in particular studied the trade impact of changes in exchange rates for the world's three largest economies, namely the United States, the euro-zone and China (OECD, 2011a). They found that on aggregate, short-run exchange rate movements impact trade but that "their effect is difficult to interpret; in some cases, the impact is positive, in others the impact is negative. These patterns are in line with other studies which conclude that short-run effects do not seem to follow a specific pattern". They also find a more pronounced impact of exchange rates on exports of agricultural goods than on manufactured goods. According to the authors, one reason for this may be the relatively "greater ease to change suppliers of agricultural goods than manufacturing, owing to the fact that the former are more homogeneous than the latter". Moreover, "the price transmission mechanisms may be different in agriculture as compared with manufacturing and mining products".

Details of the study show that the value of trade between the United States and China would be more affected by currency changes than that of the US-euro area or the euro area-China. The model applies a hypothetical 10 per cent depreciation of the various currencies on bilateral trade, based on 2008 trade data. According to model results, a hypothetical 10 per cent depreciation of the US dollar (or a 10 per cent appreciation of the Yuan) would have implied an increase in the US agricultural trade surplus of around US dollar 5 billion and a decrease of the manufacturing trade deficit of some $30 billion. The authors put these results in perspective by indicating that this hypothetical depreciation would have reduced the US bilateral trade deficit with China from an actual US dollar 270 billion in that year to US dollar 235 billion, a decrease in the deficit by some 13 per cent. The OECD considers that this outcome goes in the direction of some recent academic papers (Evenett, 2010) suggesting that the trade imbalance between the United States and China is due to a number of factors, of which the exchange rate is (only) one.

Model results show that Euro-area trade with China would be less affected by movements of the exchange rate. According to OECD calculations, a 10 per cent depreciation of the euro (equal to a 10 per cent appreciation of the Yuan) would only reduce the euro-zone trade deficit towards China by 9 billion euros, to 109 billion euros. The composition of trade seems to partly explain this lesser effect of the exchange rate, as the demand of traded goods with China seems to be less elastic to prices. Besides, the OECD "indicates" that "international price movements in the agricultural sector are also somewhat mitigated by tariff structures which include a large share of specific (as opposed to ad valorem) tariffs." In the case of euro area trade with the United States, a 10 per cent depreciation of the euro would have resulted in a 20 billion euros increase in the existing trade surplus of the euro-

zone of 50 billion euros vis-à-vis the United States (3 billion in the farming sector, 17 billion in manufacturing).

As in most other macroeconomic studies, the main driver of trade flows was found to be income/demand levels, i.e. domestic income/demand for imports and foreign income/demand in the case of exports. This finding was generally robust both at the bilateral and global trade levels, and also at the country and sector levels. The OECD, however, cautions in conclusion regarding some of the limitation of such studies. In some cases, the coefficients of the estimates are not stastistically significant. In the cases where coefficients are significant, their impact can move in either direction -- positive or negative. As written by the OECD, "this analysis confirms much of the existing literature in that short-run effects of the exchange rate on trade are limited. This analysis does not confirm the existence of the J-curve in the short-run although it may point to a longer-term interpretation of the J-curve, (whereby) a short-term deterioration of the trade balance is followed by a long-run improvement.

In a companion paper, the OECD (2011b) examined the impact of exchange rate shifts on trade in two small open economies - Chile and New Zealand - and found that small economies trade tends to be more impacted by exchange rate changes than larger economies such as the United States, the euro-zone and China. This finding is consistent with earlier theoretical and empirical literature. The OECD simulated hypothetical depreciations or appreciations of 10 per cent of these countries' exchange rates to see their impact on their bilateral trade with the United States, the euro-zone and China. It found that smaller, open economies such as New Zealand and Chile have to bear the full adjustment of exchange rate changes, relative to less trade-dependent, large economies. One reason is that smaller economies have less a diversified production and export base, and hence are less in a position to move into exports that have greater price elasticity, when exchange rate appreciation results in potentially more costly exports. The argument is symmetrical for depreciations, i.e. the number of domestic producers is smaller and hence insufficient to substitute for imports when prices increase. In the long-run, though, the relationship seems to be less certain. For example, the impact of a 10 per cent depreciation of the Chilean Peso depends very much on the trading partner and the sector concerned. Imports from China and the euro-zone are relatively less affected than imports from the United States (largely as a result of the latter's high agricultural content). A 10 per cent appreciation of the Peso has a relatively large (positive) impact on Chile's exports to China, a large importer of extractive products - a result not so surprising because of the relative inelasticity of China's imports of copper (Chile's main export) to international prices. The simulations confirm the observation of the companion paper, that many fundamentals affect the relationship between exchange rate and trade, namely, the price elasticity of each traded product, the country's market share of the product concerned, the product composition of exports and imports, the pricing strategy of importers and exporters, etc. Many of these parameters work in opposite directions. Therefore, the study concludes that the level of the exchange rate is only one factor that influences trade balances.

4. Heterogeneous firms and global production chains

Until the mid-2000s most of the literature looked at the impact of exchange rate changes on aggregate imports and exports. Since then, progress has been made in gathering information on firm-level exports and can be examined in the context of "new-new" trade models, in which the differences in behaviour among firms (heterogeneity) drive macroeconomic variables. The concept of "heterogeneity" of firms has opened a new flow of literature describing the "optimal" behaviour of firms based on their specific cost structure, pricing strategy and performance.

Adopting this approach, a particularly interesting paper by Berman et al. (2009) examines both at the theoretical and empirical levels why high- and low-performance firms react differently to exchange rate changes (performance being measured in this model by a mix of productivity and quality benchmarks). The authors assume that fixed export costs generate a selection process by which only the best performing firms are likely to engage into exports, although exchange rate depreciation will

provide an incentive for new firms, albeit not necessarily the most efficient, to enter export markets. They find that, following a depreciation of the exchange rate, the high-performing firms are more likely to (partially) "absorb" the exchange rate movement in their mark-ups, rather than increase their export volumes. Low performing firms tend to adopt the inverse strategy, i.e. they do not change export prices according to exchange rates shifts. One of their conclusions is that since the highest performing firms are the largest exporters, the prices of tradable goods are relatively insensitive to exchange rate movements.[12] It follows that exporting, because it requires a high level of performance, induces firms to absorb exchange rate movements into prices - hence exchange rates have only a limited effect on import prices and trade volumes as a result of the "natural" selection process of exporting.

The export sector is not the only one where analytical progress has been made. The improvement in input-output tables and data by sector has also allowed a more thorough examination of the linkages between the external and domestic sectors of an economy following a shock - such as real exchange rate changes. In a recent paper by Rusher and Wolff (2009), trade balance adjustments would only happen if the exchange rate affected the competitiveness of both the (externally) tradable and non-tradable sectors. In other words, the relationship between trade balances and real exchange rates would not be statistically significant if only the tradable sector was taken into account. In a single market, despite the low level of substitution of goods between the two sectors, competitive effects of the exchange rate would have to pass-through from the tradable to the non-tradable sector to have an impact eventually on the trade balance.

Product-level analysis has been one feature of the work conducted by Bahmani-Oskoosee and Wang (2007), who examined the impact of exchange rates on trade flows between the United States and its trading partners, notably with China, Japan, Korea (Rep. of), Thailand and others. Trade flows were broken down to the individual commodity level. In this work, the use of trade data at the commodity level (two or three-digit industry trade data) permits the identification of industries that have been sensitive to exchange rate changes. The paper studying US-China trade over the period 1978-2002 finds that the evolution of the bilateral real exchange rate had an impact on many of the 88 industries tested, although wide differences exist among products. It seems that the appreciation of the dollar against the Yuan decreased US export earnings in 18 industries, while it increased import values in 40 industries. The asymmetrical impact of the exchange rate seems in this case to be attributable to a lower price elasticity of Chinese demand to US manufacturing products rather than of US demand to Chinese manufacturing exports.

A final consideration is that the relationship between exchange rates and trade is not an immutable one. As recently as 30 years ago, products were assembled in one country, mostly using inputs from that same country. The emergence of global supply chains in recent decades has been accompanied by a dramatic expansion of aggregate international trade flows, as intermediate goods increasingly cross national boundaries several times during production. As a result of this development in the world economy, most imports should be stamped "made in the world" rather than in any specific country. In this environment, the relationship between exchange rates and trade flows may be substantially different. For example, when the competitiveness of national exports depends upon the availability of imported components, or when the final goods imported have a large national content that is reimported after processing abroad, then an exchange rate devaluation may have a negative short-run impact on national export industries. Similarly, the cost of exchange rate volatility may be more pronounced when intermediate goods have to cross several borders because buyers and suppliers

[12] Simulations showed that above median-performance French firms in their panel react to a 10 per cent depreciation by increasing destination-specific export prices in euros by some 2 per cent. Below median performance firms kept their prices unchanged. The inverse was true for export volumes. The high performance firms kept their export volumes unchanged while below median performance firms increased their export volumes by 6 per cent in the face of a10 per cent depreciation.

are located in different countries. These simple observations suggest that the relationship between exchange rates and trade varies over time, as changes in the world economy materialize.

For instance, Zhao and Xing (2006) analyse the effect of exchange rates on the outsourcing decision of multinational enterprises (MNEs) and show that in this context currency appreciation has unconventional effects. The paper proposes a theoretical model with multiple destinations for outsourcing in countries with relatively low production costs. MNEs can shift their production to the next lowest cost country as a result of the appreciation in one country in order to minimize costs. Specifically, there are two consequences of the appreciation. First, the appreciation may or may not narrow the wage gap enough to lead to a repatriation of the MNE to the higher cost country (supposedly the country of origin of the MNE), depending in which country the currency appreciation takes place. Second, the overall production cost or cost structure of MNEs would increase. Hence, currency appreciation in a developing (low cost) country may well have a negative impact on the advanced economy, depending on the structure of global supply chains.

The effects of exchange rate appreciation on trade in the context of global supply chains are addressed in several recent country studies. For instance, the IMF Spillover Report on China (IMF, 2011) analyses the main factors of concern for a large set of countries following a shock originating in China. An issue taken up in the report is the impact that a potential RMB revaluation would have on the world economy. The report finds that, in the absence of other structural reforms (such as financial sector reforms), an appreciation would lead to lower output in China and lower Chinese demand for intermediate goods from other Asian countries, implying a suboptimal equilibrium. As a consequence, a RMB appreciation would benefit final goods producers such as Japan and the Republic of Korea, but it may (initially) hurt intermediate goods producers in emerging Asia.

Arunachalaramanan and Golait (2011) examine the effect of a revaluation of the Chinese RMB on India's bilateral trade balance with China. They find that an appreciation of the RMB against the Rupee would not improve the bilateral trade balance from the Indian perspective. The authors argue that there are two main reasons that explain their result. First, the long-run price-elasticity of demand for Indian goods in China is lower than that for Chinese goods in India. Should Indian exports to China be cheaper, Chinese consumers would not easily substitute domestic for foreign goods. Second, Chinese electronics and machinery goods, which represent up to 40 per cent of total imports from China, are very important for domestic production in India. Therefore, an appreciation of the RMB would raise the cost of intermediate products that are not easily substitutable in the short-run.

B. EXCHANGE RATE VOLATILITY AND TRADE

The stream of literature on exchange rate volatility and trade has continued to produce both theoretical and empirical papers, without changing the broad thrust of previous, relatively inconclusive analyses and evidence.[13]

From a theoretical point of view, one of the main recent contributions comes from Brollet et al. (2006), who studied optimum production decisions by an international firm using portfolio theory. It is shown that an increase in exchange rate risk (or expectation thereof) could have a negative, positive or neutral impact on trade. The impact depends upon the elasticity of risk aversion with respect to the standard deviation (or the mean) of the firm's random profit. These results tend to confirm those of Bacchetta and Van Wincoop (2000). Empirical papers continue to provide a wide range of evidences, in some cases finding a robust negative relationship between exchange rate volatility and trade, in other cases not. Despite progress in estimation techniques and data sets, the outcome of the empirical literature remains as inconclusive as it has been in the previous three decades. As well summarized by Coric and Pugh (2010), which looked in detail at all the recent empirical work: "on average, exchange

[13] The IMF has brought the attention of the Secretariat to several of the studies and references contained in this section.

rate variability exerts a negative effect on international trade. Yet, […] this result is highly conditional. […] [A]verage trade effects are not sufficiently robust to generalize across countries." All in all, they found 33 studies emphasizing a negative relationship between exchange rate variability and trade volume and 25 studies leading to the inverse conclusion. Most of these studies are mentioned, with greater detail, by Ozturk (2006), in Annex I.

Among the recent empirical studies that find a positive correlation between exchange rate volatility and aggregate exports, one can mention Klein and Shambaugh (2006), which is also in agreement with the previously mentioned line of thought that defends the existence of a positive effect of currency unions on trade (a survey of empirical work on the positive trade effects of currency unions has just been completed by Eicher and Henn (2009)).14 Rahman and Serletis (2009) found that exchange rate uncertainty has had a generally negative and significant effect on recent US exports, but that exports responded asymmetrically to positive and negative exchange rate shocks. In a gravity model using 25 years of quarterly data and co-integration techniques, Chitet et al. (2010) examined the real exports of five emerging East Asian economies among themselves, as well as to thirteen industrialised countries. The paper provides strong evidence that exchange rate volatility has had a statistically significant negative impact on the exports of those emerging East Asian economies. They also tested the impact of exchange rate volatility of third countries to establish whether a rise in exchange rate volatility between the importing country and other exporting countries encouraged bilateral exports between two trading partners. Their findings tend to confirm that not only absolute volatility but also relative volatility is important for bilateral export flows of emerging East Asian economies. They conclude that exchange rate volatility in East Asian economies has a significant negative impact on export flows to the world market. Ozturk and Kalyoncu (2009) applied similar techniques to another six countries, and found that, over the period 1980-2005, exchange rate uncertainty exerted a significant negative effect on trade for the Republic of Korea, Pakistan, Poland and South Africa, but a positive effect for Turkey and Hungary. Arize et al. (2000) focused on the impact of exchange rate volatility on export demand to least developed countries (thirteen), and found a negative relationship between volatility and exports both in the short- and long-run. Volatility seems to be felt by least-developed countries even more as forward markets are not accessible to many of them, limiting their ability to hedge against the main currency's movements and increasing their traders' risk aversion.

On the other hand, other authors have failed to find any robust, negative relationship between exchange rates and aggregate trade. This is the case with Hondroyiannis et al. (2008). They use a sample of 12 industrialized countries, for which they failed to find a significant effect over the period 1977-2003. They conclude that “the finding of a significant and negative impact of volatility is attributable to specification biases.” Boug and Fagereng (2010) found no "evidence suggesting that export performance (of Norwegian firms) has been significantly affected by exchange rate uncertainty". Tenreyro (2007) used an estimation approach to simultaneously address all biases identified in previous literature, in particular the reverse causality problem. She found no significant impact of nominal exchange rate volatility on trade flows. Some recent studies incorporating exchange rate volatility in a gravity equation setting do not find a robust impact of exchange rate volatility (Eicher and Henn, 2009). Baum and Caglayan (2010) also conclude that exchange rate volatility does not have an impact on the level of trade, but they do find a robust positive link to the volatility of bilateral trade flows.

The literature on the effects of exchange rate volatility is also taking into account the above-mentioned progress on sectoral analysis, with a view to eliminating the aggregation biases deriving from the use of total exports data. Wang and Barrett (2007) state in their study that "due to data limitation, most studies employ low frequency quarterly or annual series to examine the trade and risk relationship". In one of their earlier papers Wang et al. (2002) demonstrated that "temporal

[14] However, for a more pessimistic view of this positive relationship, see Santos Silva and Tenreyro (2010).

aggregation necessarily dampens exchange rate variability, which may make identifying any true trade-risk relationship more difficult. Furthermore, since trade contracts in many sectors include agreement for delivery in less than 90 days, even quarterly frequency data may be aggregating trade flows excessively to identify short-term fluctuations in response to predicted changes in exchange rate levels or volatility". Correcting for these weaknesses, Wang and Barrett (2007) looked at the effects of exchange rate volatility on trade in eight sectors between the United States and Chinese Taipei over the period 1989-1998, and found that volatility affected agricultural flows, but not those in other sectors. The hypothesis under which agricultural trade is more sensitive to (negatively affected by) long-run exchange rate uncertainty than other sectors is confirmed by Cho et al. (2002) using a panel of ten OECD countries over the period 1974-1995.

Generally, studies using disaggregated data tend to find a more robust negative relationship between exchange rate volatility and trade flows, albeit not systemically, neither for all sectors nor for all countries. This is in particular the case in Peridy (2003), who showed that the impact of exchange rate volatility on exports of G-7 countries varies considerably depending on the industry covered and the destination market, partly as a result of both sectoral and geographical aggregation biases in the aggregate data. He found mostly negative effects for exchange rate volatility, but for several countries and sectors these are not statistically significant. Bryne et al. (2008) consider the impact of exchange rate volatility on the volume of bilateral US trade (both exports and imports) using sectoral data. They found that separating trade into differentiated goods and homogeneous goods results in the most appropriate sectoral division. Thus, exchange rate volatility is found to have a robust and significantly negative effect across sectors, although it is strongest for exports of differentiated goods. Bahmani-Oskooee and Hegerty (2008) looked at the impact of increased exchange rate volatility since 1973 on US-Japan bilateral trade. They used disaggregated data for 117 Japanese industries from 1973 to 2006. They found that in the short-run some industries are influenced by exchange rate volatility, although this effect is often ambiguous. In the long-run, trade shares of most industries are relatively unaffected by exchange rate uncertainty, while some industries experience a relative shift in their proportion of overall trade. As indicated in the above section, Bahmani-Oskooee has conducted similar work for all the largest US trading partners, with similar results (strong suspicion of short-term effects, more ambiguous results in the long-run), with the latest study applying to US-Malaysia trade (Bahmani-Oskooee and Hanafiah, 2011). Caglayan and Di (2010) examined the effect of real exchange rate volatility and sectoral trade between the United States and its top thirteen trading partners. Unlike most of the previously mentioned studies, they conclude that exchange rate volatility does not systematically affect sectoral trade flows. Furthermore, any negative effects of exchange rate volatility, where they occur, often tend to be offset by opposite impacts of income volatility.

III. CONCLUSION

Following the end of the Bretton-Woods system of fixed but adjustable exchange rates four decades ago, the bulk of economic literature on the relationship between exchange rates and trade deals with the effect of increased variability (volatility) of exchange rates on trade. This is almost exclusively the case until 2004, when the IMF survey was published. This genre of the literature has continued until the present, incorporating improvements derived from theoretical refinements (the "new-new" trade theory) and new statistical information (firm-level data). However, since the mid-2000s the focus of the academic community has also turned towards the relationship between the level (misalignment) of exchange rates and trade.

On the question of the effects of exchange rate volatility on trade, the considerable array of theoretical and empirical literature remains somewhat ambiguous. As argued by Taglioni (2002), "it is customarily presumed that the adverse effect of exchange rate volatility (on trade flows), if it exists, is certainly not large". This conclusion is generally shared by Ozturk (2006), which reveals a rather wide range of empirical evidence, some in favour and some against the hypothesis of a negative relationship between exchange rate volatility and trade. As aptly summarized by Coric and Pugh (2010): "on average, exchange rate variability exerts a negative effect on international trade. Yet, […]

this result is highly conditional. […] [A]verage trade effects are not sufficiently robust to generalize across countries." Results are conditional for a variety of reasons. While exporting firms might in principle be more sensitive than domestic firms to exchange rate fluctuations, their sensitivity is likely to be reduced by a number of factors such as the existence of hedging instruments, the presence of imported inputs (which offset the effect of exchange rate changes on the pricing of exports), the presence of firms on global markets (where upwards and downwards movements of various exchange rates cancel out), the possibility of invoicing in local currency, and the capacity to absorb losses due to exchange rates changes and other factors in profit margins. The most sensitive firms may not be the large ones, but rather the smaller ones. In addition, empirical studies tend to find a significant effect mainly in the case of trade with close neighbours, in particular in the case of very integrated economies.

On the issue of the level of exchange rates (misalignments), theoretical and empirical studies over the years show that the relationship between the level of a currency and trade is so multi-faceted and complex that it is hard to take a firm line in any particular direction. Economic theory suggests that when markets are free of distortions, an exchange rate misalignment has no long-run effect on trade flows, as it does not change relative prices. But long-run effects are predicted in models that assume market distortions, such as information problems or product market failures. In the short-run, when some prices in the economy can be sticky, movements in nominal exchange rates can alter relative prices and affect international trade flows. These short-run trade effects, however, are not straightforward, as they are likely to depend on specific characteristics of the economy, including the currency in which domestic producers invoice their products and the structure of trade (for example, the prominence of global production networks). On the empirical side, the complexity of the relationship between exchange rate misalignments and trade yields mixed findings. For instance, a currency undervaluation is sometimes found to have a positive impact on exports, but the presence, size and persistence of these effects are not consistent across different studies.

ANNEX I

TABLE 1: 2006 SURVEY OF EMPIRICAL WORK ON THE RELATIONSHIP BETWEEN EXCHANGE RATES AND TRADE

Study	Sample Period	Nominal or Real Exchange Rate Used	Countries and Estimation Technique Used	Main Result
Akhtar and Hilton (1984)	1974-81Q	Nominal	OLS	Negative effect
Gotur (1985)	1974-82Q	Nominal	OLS	Little to no effect
Bailey, Tavlas and Ulan (1986)	1973-84Q	Nominal	OLS	Not significant, mixed effects
Bailey, Tavlas and Ulan (1987)	1962-85Q	Nominal & Real	OLS	Little to no effect
Bailey and Tavlas (1988)	1975-86Q	Nominal	OLS	Not significant
Belenger et al. (1988)	1976-87Q	---	IVE	Significant and negative in 2 sectors
Brada and Mendez (1988)	1973-77A	Real	Cross section	Positive effect
De Grauwe and Verfaille (1988)	1975-85A	Real	Cross section	Level of trade significantly stronger within EMS than outside the EMS
Koray and Lastpares (1989)	1961-85M	Real	VAR	Weak negative relationship
Mann (1989)	1977-87Q	Real	OLS	Few significant results
Peree and Steinherr (1989)	1960-85A	Nominal	OLS	Negative effect
Caballero and Corbo (1989)	--	Real	OLS and IVE	Significant and negative effect
Lastrapes and Koray (1990)	1975-87Q	Real	VAR	Weak relationship
Medhora (1990)	1976-82A	Nominal	OLS	Not significant and positive effect
Asseery and Peel (1991)	1972-87Q	Real	OLS - ECM	Significant and positive except for UK
Bini – Smaghi (1991)	1976-84Q	Nominal	OLS	Significant and negative effect
Feenstra and Kendall (1991)	1975-88Q	---	GARCH	Negative effect

Study	Sample Period	Nominal or Real Exchange Rate Used	Countries and Estimation Technique Used	Main Result
Akhtar and Hilton (1991)	1974-81Q	Nominal	OLS	Not significant, mixed effect
Kumar and Dhawan	1974-85Q	Nominal & Real	OLS	Not significant and negative effect
Belenger et al. (1992)	1975-87Q	Nominal	IVE, GIVE	Significant and negative effect
Kumar (1992)	1962-87A	Real	Standard deviation	Mixed results
Savvides (1992)	1973-86A	Real	Cross section	Negative effect
Gagnon(1993)	Q	Real	Simulation analysis	Not significant
Frankel and Wei (1993)	1980-90A	Nominal & Real	OLS and IVE	Small and negative in 1980, positive in 1990
Kroner and Lastpares(1993)	1973-90M	Nominal	GARCH-M	Significant, varied signs and magnitudes
Chowdhury(1993)	1973-90Q	Real	VAR	Significant negative effect
Caporale and Dorodian (1994)	1974-92M	Real	Joint estimation	Significant negative effect
McKenzie and Brooks (1997)	1973-92M	Nominal	OLS	Positive effect
McKenzie (1998)			GARCH	Generally positive effect
Daly (1998)	1978-92Q	Real		Mixed results
Hook and Boon (2000)	1985-97Q	Both	VAR	Negative effect on export
Aristotelous (2001)	1989-99A	Real	Gravity model	No effect on export
Doganlar (2002)	1980-96Q	Real	EG Co-integration	Negative effect on export
Vergil (2002)	1990-2000Q	Real	Standard deviation	Negative effect on export
Das (2003)	1980-2001Q	Both	ADF, ECM, Co-integration	Significant negative effect on export

Study	Sample Period	Nominal or Real Exchange Rate Used	Countries and Estimation Technique Used	Main Result
Baak (2004)	1980-2002A	Real	OLS	Significant negative effect on export
Tenreyro (2004)	1970-97A	Nominal	Gravity model	Insignificant and no effect on trade
Clark, Tamirisa, and Wei (2004)	1975-2000A	Both	Gravity model	Negative and significant effect
Kasman & Kasman (2005)	1982-2001Q	Real	Co-integration, ECM	Significant positive effect on export
Arize et al. (2005)	1973-	Real	Co-integration,	Significant negative impact
Hwang and Lee (2005)	1990-2000M	Real	GARCH-M	Positive effect on import and insignificant effect on export
Lee and Saucier (2005)	1986-2003Q	Nominal	ARCH-GARCH	Negative effect on trade

Source: Ozturk (2006)

ANNEX II

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