The Relationship between Exchange Rates and International Trade: A Literature Review

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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. The second issue involves exchange rate misalignments, which are predicted to have short-run effects in models with price rigidities. However, 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.

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1.   Introduction

How do currencies affect international trade flows? This has been a recurrent question in the trading community. As the WTO Director General Pascal Lamy recently put it: "Exchange rates are, and have always been, a highly sensitive subject in the WTO." (Lamy, 2012). The sensitivity of this relationship probably has more than one source. First, exchange rates are endogenous variables that result from the complex interaction of macroeconomic, financial, and trade determinants. But from the perspective of individual traders, currency movements are exogenous. The uncertainty and costs associated to exchange rate fluctuations may, therefore, be a reason of frustration for producers. Second, exchange rate volatility and prolonged deviations of currencies from their equilibrium levels often impose costs on the real economy that are asymmetric, between different types of producers and between different economies. These asymmetries may distort international competition and negatively impact the efficient allocation of resources between different activities. Third, as highlighted by Irwin (2011), international trade and monetary relations have certainly undergone more than one period of tension in the course of history, a reflection of their intertwined nature. After the recent financial crisis, as in previous periods of distress for the world economy, exchange rates are perceived to be a transmission belt of financial shocks to the real economy and a vector of "monetary dumping".

Revisiting the question of the trade impact of exchange rates is, therefore, a useful exercise to help policymakers distinguish perceptions or prejudices from more systematic effects embed in the theory and the empirical evidence. In order to separate the "is" from the "ought", as David Hume would have said. This is particularly important to avoid ill-designed policy responses by frustrated countries - such as trade protectionism - based on (more or less justified) accusations of beggar-thy-neighbour behaviour of trading partners.

In the last decades, the economic literature on the relationship between exchange rates and trade has followed the evolution of the policy debate. From the perspective of the trade policy community, two key issues stand out: exchange rate volatility and currency misalignments (i.e. an exchange rate that is above or below the equilibrium exchange rate). A first batch of literature has emerged after the end of the gold exchange standard, during the 1970's through the 1990's, focusing on the impact of exchange rates volatility on the incentives to trade - a logical outcome of the increased levels of currency volatility caused by the end of the fixed (but adjustable) system of exchange rates. Secondly, the effects of currency misalignments gained more prominence in the 2000s and onwards, when sustained deviations of exchange rates were suspected, rightly or wrongly, to be at the origin of global current account imbalances. Still, during this period, the discussion on volatility continued and somewhat expanded, in parallel.

A regular stock-taking of the economic literature is needed in this domain because of the rapidly evolving nature of the world economy in general, and of the trading environment in particular (e.g. the emergence of new trading powers, the increasing importance of regional monetary areas, new production processes such as supply chains). Moreover, trade theory (e.g. New new trade theory), estimation techniques and statistics (in particular firm-level customs data) are making steady progress, most lately in analysing the trade impact of exchange rates on heterogeneous firms. Hence, this paper aims at taking stock of the most recent work, roughly one decade since the last major review was conducted (the classic survey by the IMF was published in early 2004). In a rapidly evolving field such as international economics, a decade can arguably be regarded as a long time. Proof is the fact that the review by the IMF focused on the trade impact of exchange rate volatility and gave little space to the effects of currency misalignments, clearly the major concern in today's policy debate.

In reviewing the literature, we focus first on the trade impact of exchange rate volatility and then turn to currency misalignments (Sections 2 and 3, respectively). This approach helps the non-academic reader to organize his/her thoughts according to the policy problem of interest, rather than along the lines of some modelling features or a simple historical account of the evolution of the literature. In each section, we begin with a discussion of the theoretical arguments that underpin the relationship

between exchange rates and trade, before turning to the review of the empirical evidence. Section 2 emphasizes the cost of uncertainty to traders generated by high volatility, while Section 3 mostly focuses on the potential of misalignments to create short-run and lasting effects on resource allocation and export growth. In both sections, we depart from the basic "theory/evidence" structure to allow for an in-depth discussion of certain specific areas of on-going research (e.g. currency unions, the impact of exchange rates on heterogeneous firms and sectors, global value chains, and trade policy). While inevitably subjective and non-encompassing, these discussions provide insights from the academic literatures on issues that are at the forefront of policy concerns.

In writing this survey, we had to make some choices and leave out certain topics. The issue of rebalancing the global economy has been one of the key policy objectives of the international community in recent years. Adjustment of real exchange rates is unquestionably a component of global rebalancing (as the theory predicts, real exchange rates will adjust, whether through nominal rates or prices). But this debate is clearly much broader than the effect of exchange rates on trade: the distortions that are at the origin of global imbalances are primarily macroeconomic and structural. A narrow trade view would therefore be inappropriate given the complexity of the underlying factors (Blanchard and Milesi-Ferretti, 2009). For this reason, we abstract from the broader debate on the impact of exchange rates adjustments and the reduction of global current account imbalances. In some sense, by focusing on the impact of exchange rate volatility and misalignments on trade, the paper makes the point that this relationship is a topic in its own right in the trade economics literature, rather than a side-issue of the wider open-economy macroeconomics literature on exchange rate adjustment and the current account.

The paper is organized as follows. Section 2 focuses on the effect of exchange rate volatility on trade flows. Section 3 studies the impact of currency misalignments on trade. Concluding remarks that summarize the main messages follow.

2.   Exchange rates volatility and trade

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.

After a period of thirty years of relatively stable 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, the IMF examined the effects of greater exchange rate volatility on global trade. While arguing that there are several channels through which exchange rates could affect trade, the IMF (1984) highlighted the role of exchange rate risk. This was in line with the early (1970s and 1980s) theoretical analyses of the relationship between exchange rates and international trade. These studies focused primarily on the commercial risk involved in conducting international transactions and the uncertainty generated by short-term or longer-term volatility. The question of 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.

Below, we review the literature on exchange rate uncertainty and trade, starting from the earlier contributions and following the evolution of the academic debate. We first analyze the theoretical

arguments on how currency risks may affect trade flows in Subsection (a) and then focus on the empirical evidence in Subsection (b). Lastly, Subsection (c) is dedicated to two recent debates in the policy and academic communities: the sectoral effects of exchange rate volatility and the trade impact of currency unions.

(a)   Theoretical work: exchange rate risks and trade

One simple but relatively well known example of how exchange rates affect trading firms is provided in a seminal paper by Clark (1973). The author describes the hypothetical case of a firm operating under perfect competition that produces a single product, which contains no imported input, for sale in 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 is risk averse, 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 where the variability of the firm's profits depends only on the exchange rate, the greater volatility of the 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 the works of Clark, Hooper and Kohlagen, see also, inter alia, Baron, 1976; Cushman, 1983; Gros, 1987; De Grauwe and Verfaille, 1988; Giovannini, 1988; Bini-Smaghi, 1991). 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 leads the way to more sophisticated models, 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), as well as the risk aversion of firms towards price uncertainty, also matters. These factors suggest that the link between greater exchange rate volatility and reduced trade flows is less robust than initially presumed. However, the notion that exchange rate volatility affects trade cannot be entirely dismissed. Rather, this relationship appeared to be more significant in certain specific cases and less relevant in others, leading to more nuanced results.

In the first set of 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-averse ones will, albeit in different degrees. Paradoxically, for very risk-averse traders, exporting more to compensate for the

expected fall in revenue per exported unit could be a reasonable response to increased volatility. 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, De Grauwe stresses that the dominance of income effects over substitution effects results in a positive relationship between exchange rate fluctuations and the volume of trade.[2] The existence of a positive relationship between exchange rate volatility and exports is 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. 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." A more volatile exchange rate, however, also implies a higher risk of exposure for international firms - with this effect working in the opposite direction. In this context, the authors find that the net effect of exchange rate uncertainty on production and exports depends on the degree of relative risk aversion of the firm.[3]

A second set of studies accounts for the possibility of firms hedging against exchange rate risks. The availability of financial hedging, for instance through forward exchange markets, helps reduce the uncertainty generated by fluctuations of nominal exchange rates. Firms, however, have unequal access to hedging facilities and may display different behaviours according to which side of the hedging position they stand. While Baron (1976) argues 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) nuance this conclusion by suggesting that forward markets create "losers" and "winners" among exporters and importers which are on the 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. In addition, 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-averse firms hedge against exchange rate movements, but hedging costs translate into higher export prices, which will have a negative impact on (world) output and trade.

A third extension of the literature focuses on adjustment costs. 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 the prices are low. However, this depends on risk aversion towards profit uncertainty. The more risk averse the firms are, the less likely they will export more in light of higher profit variance from exchange rate volatility. On the other hand, the less risk averse

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[2] In De Grauwe's model, exchange rate variability has two effects on risk-averse firms: an income effect, whereby the expected reduced utility derived from higher uncertainty of profits leads the firm 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.

[3] Broll et al. (2006) show that an increase in exchange rate risk could have ambiguous effects on trade in using a portfolio theory approach.

firms will sell more even with profit uncertainty because the opportunity from price variability can offset the uncertainty.

A fourth set of studies analyses the effect of exchange rate volatility on the composition of trade rather than on the gross volume of trade. Some models focus on the extensive rather than the intensive margin of trade (i.e. the number of products traded, rather than the volume of trade of a given number of products). Specifically, 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 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 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 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 the incentive to stay in for firms having already entered the market. The other group of studies emphasizes the effects of exchange rate variability on inter- and intra-industry trade. In particular, 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.

Finally, the last group of works removes the assumption that exchange rate uncertainty is exogenous and takes instead a general equilibrium approach. 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. In particular, Bacchetta and Van Wincoop (2000) use a general equilibrium model, in which exchange rate 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. This is because the depreciation of the exchange rate reduces imports but 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.

(b)   Empirical work: does exchange rate volatility hinder trade?

Reflecting the relatively mixed state of theoretical models regarding the effects of exchange rate variability on trade, the vast empirical works conducted by academics and policy-oriented economists in support of theoretical considerations leave no less ambiguous evidence. This point is made in a series of overviews of the empirical literature. 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". Similarly, Coric and Pugh (2010) conclude that: "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." 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.[4]

These mixed conclusions are perhaps best illustrated by a key IMF study on exchange rate volatility and trade flows (IMF, 2004). The study allows for an exploration of the effects of exchange rate volatility on trade along several new dimensions such as by type of volatility (e.g. short- and long-run, real and nominal), 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 looked first at the time paths of the exchange rate volatility and trade and finds 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 in Eastern Europe in 1990-94 and of the Asian crisis in 1997-98. As indicated in the study, 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. In order to estimate the specific impact of exchange rates on trade flows, the IMF used a gravity model which controls for the determinants of trade patterns other than exchange rates, such as distance/geographical positions, GDP (or demand), and many other factors that may affect transaction costs relevant to bilateral trade.[5] IMF estimates suggest that if exchange rates were to rise by one standard deviation, trade would fall by 7 per cent. However, the authors do not find the relationship to be robust.[6] IMF (2004) also finds little evidence to show that exchange rate variability affects differentiated or homogeneous products differently, thus providing little support to earlier theoretical findings. Finally, the proposition that the trade impact of exchange rate variability differs across country groups (i.e. developed versus developing) is also not supported by the IMF analysis.

Results of recent studies confirm on aggregate those of the IMF (2004) (i.e.volatility decreases trade, although the effect is small and the results are not entirely robust to changes in specifications), even if there are some differences depending on the periods and countries of interest. Rahman and Serletis (2009) found that exchange rate uncertainty has had a generally negative and significant effect on recent US exports, but that exports respond asymmetrically to positive and negative exchange rate shocks. In a gravity model using 25 years of quarterly data and co-integration techniques, Chit et al. (2010) examine 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 test the impact of exchange rate volatility from third countries to establish whether a rise in exchange rate volatility between the importing country and other exporting countries encourage 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) apply similar techniques to other six countries, and find that, over the period 1980-2005, exchange rate uncertainty exerts 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) focus on the impact

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[4] A third review is by Ozturk (2006), which contains a fairly comprehensive account of the empirical studies of the impact of exchange rate variability published between the 1970s and the early 2000s. Similar to the other surveys, it argues that the overall evidence is mixed.

[5] 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 are significant.

[6] 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.

of exchange rate volatility on export demand to least developed countries, and find 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. Using data on 1,000 country pairs, Wei (1998) empirically tests the hypothesis according to which the difficulty in finding large and negative effects of exchange rate volatility on trade is due to the availability of hedging instruments. He finds that there is 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 deters 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).

On the other hand, other authors have failed to find any robust, negative relationship between exchange rates and aggregate trade. This is, for instance, the case with Hondroyiannis et al. (2008). They use a sample of 12 industrialized countries, for which they fail 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) find no evidence suggesting that export performance of Norwegian firms has been significantly affected by exchange rate uncertainty. Tenreyro (2007) uses an estimation approach to address the reverse causality problem in estimating the effect of nominal exchange rate volatility on trade flows, finding no significant impact. Some recent studies incorporating exchange rate volatility in a gravity equation setting do not find a robust impact of exchange rate volatility (e.g. 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.

(c)   Recent debates: sectoral effects and currency unions

Even though the literature on the trade effects of exchange rate volatility is quite broad, two issues seem to stand out in recent debates. The first concerns sectoral effects and the second relates to currency unions. On the first issue, the literature on the effects of exchange rate volatility is taking into account the progress in sectoral analysis, with a view to eliminating the aggregation biases deriving from the use of total exports data. The literature on currency unions acknowledges that a permanent commitment to a fixed exchange rate, by eliminating uncertainty, may have a large impact on trade. The extent to which this can be shown to be empirically true, however, depends on the ability of the empirical analyses of solving a complex reverse causality problem.

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 particularly the case in Peridy (2003), who shows 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 finds 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 find 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 find 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. Bahmani-Oskooee and Hanafiah (2011) have conducted similar work for

all the largest US trading partners, arriving at similar results (strong suspicion of short-term effects, more ambiguous results in the long-run). Caglayan and Di (2010) examine 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. Finally, a series of studies focuses specifically on agricultural trade. Wang et al. (2002) have noted that "temporal aggregation necessarily dampens exchange rate variability, which may make identifying any true trade-risk relationship more difficult". This problem may be particularly severe when one estimates the effect of exchange rate volatility on agricultural trade. Correcting for these weaknesses, Wang and Barrett (2007) look 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 find 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) who use a panel of ten OECD countries over the period 1974-1995.

A second topic where the recent academic and policy debate has been particularly lively is the trade effects of currency unions. Early studies find that adopting a single currency has rather strong and positive effects on trade flows. Dell'Ariccia (1999) 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 finds 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's (2000) seminal paper on the effects of monetary unions on trade finds that sharing a currency increases bilateral trade between countries by over 200 per cent.[7] Rose (2000) and Rose's subsequent work with co-authors provide extensive sensitivity analysis, including different specifications of the gravity model, changes in the sample, and use of instrumental variables to control for reverse causality. However, as concluded in Rose and van Wincoop (2001), while smaller than initially found, the effect of currency unions on trade remains large and significant throughout. This suggests that, as noted in the IMF (2004) study, the trade-enhancing benefits of currency unions far exceed gains from a reduction in exchange rate volatility.[8]

A large number of other studies, surveyed in Baldwin (2006), Eicher and Henn (2009) and Santos Silva and Tenreyro (2010), further qualify this initial result. The key empirical issue consists precisely in isolating the impact of currency unions on trade. Mundell's (1961) optimal currency hypothesis itself suggests a reverse causality, whereby trade flows stabilize real exchange rate fluctuations, thus reducing the cost of forming a currency union. More broadly, the question is whether there are some omitted factors that drive countries to participate in a currency union and to trade. Broda and Romalis (2010) present the problem most clearly: "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."[9] The authors argue that ignoring the causal effect of trade on volatility results in overestimates of the true impact of exchange rate volatility on trade. Their evidence confirms that deeper bilateral trading relations dampen real exchange rate volatility and are

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

[8] Klein and Shambaugh (2006) focus on the gap in the literature between the trade effects of currency unions and of a decrease in exchange rate volatility, providing support to the view that the introduction of a common currency is something more than the simple reduction of exchange rate risk.

[9] Broda and Romalis (2010) 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 a greater distance between countries significantly increases bilateral exchange rate volatility through the effect of distance on the intensity of commercial relationships.

more likely to lead to a currency union. Controlling for that reverse causality, they conclude that currency unions enhance trade by 10 to 25 per cent. Santos Silva and Tenreyro (2010) have a more pessimistic view of this relationship. In particular, their analysis (as a substantial part of the literature on currency unions) focuses on the trade effects of the euro, finding that the single currency in Europe had a trade impact close to zero. Intuitively, they argue that the discrepancy between their results and previous findings lies in the fact that members of the euro-area historically traded intensively with each other and the introduction of the euro had a small differential effect on trade when compared with other developed countries outside the euro-area.[10] While not conclusive, this provides a word of caution on the trade effects of currency unions.

3. Exchange rate misalignments and trade

A harsh debate about exchange rates and their impact on trade re-opened with the build-up of large external imbalances in the first decade of the 21st century and, even more forcefully, in the aftermath of the Great Recession. Concerns about unemployment and slow recovery strengthened the sensitivity and vigilance towards those countries suspected of "exporting" their way out of the crisis at the expense of their trading partners. 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 depreciations/appreciations and currency misalignments.[11] This means that the emphasis falls less on the effects of variability and more on the level of the real exchange rate.

How do currency misalignments affect international trade? Two broad "direct" channels can be at work. The first, and more direct, effect is through price signals that may have an immediate impact on trade patterns. The second effect may materialize if a currency misalignment changes investment decisions and causes shifts in resources between the non-tradable and the tradable sector in the economy. As we review in the first subsection below, these direct effects depend on a number of circumstances that economic theory has helped spell out. The second subsection reviews the recent empirical evidence on the impact of exchange rate depreciations on export growth and the trade balance. Finally, the third subsection evaluates three areas of recent academic debate on the trade impact of currency misalignments: when firms are heterogeneous and face sunk export costs, when production chains span different countries and monetary areas, and when a misalignment generates pressure for compensating trade restrictions in the trading partners' economy.

(a)   Theoretical work: transitory or permanent effects?

Exchange rates can depart from their equilibrium level for two reasons. First, it can be 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 can be a result of distortions in the international financial architecture or in domestic structural conditions.

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[10] Santos Silva and Tenreyro (2010) acknowledge that the trade impact of the participation to a currency union is larger for small developing economies, as the ones in the original historical dataset of Rose (2000).

[11] As it is common in economics, a depreciation (appreciation) refers to a fall (rise) in the value of a country's currency on the exchange market, relative either to a particular other currency or to a weighted average of other currencies. Note that we will use the terms devaluation and revaluation as synonymous of depreciation and appreciation respectively, even if these terms generally indicate only the change in the value of a currency that has been pegged.

The academic and policy debate on currency misalignments revolves around two important points. The first is whether the real exchange rate is a variable that authorities can influence (see, for instance, Eichengreen, 2007, and Rodrik, 2008). The consensus is that the real exchange rate, being the relative price of non-traded goods, is not under the direct control of policy-makers. However, its level can be influenced by policy in the short or medium term. Eichengreen (2007) illustrates this point with the historical experience of Korea in the 1960s, where a nominal devaluation was associated to a fiscal consolidation in order to maintain an undervalued level of the real exchange rate. The second point concerns the measurement of the equilibrium real exchange rate. To ascertain the equilibrium exchange rate and, hence, the root cause of a currency misalignment is often a difficult matter in practice. This is because the exchange rate is an endogenous variable, which is determined by a complex set of macroeconomic, financial and trade factors. [12] Not surprisingly, assessment of misalignments may vary by a substantial degree. The ensuing discussion will abstract from the cause (policy or not) and the proper measurement of misalignments and will, instead, focus on their 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 the undervaluation of the currency, has no long-run effect on trade flows or on real economic activity because 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.

Textbook open-economy macroeconomic models embed these short-term effects of exchange rate misalignments (e.g. Krugman and Obstfeld, 2003; Feenstra and Taylor, 2008). Specifically, when prices are sticky a nominal depreciation of the home currency causes a real depreciation of the exchange rate which signifies that foreign goods become more expensive than domestic goods. The result of this short-run change in relative prices is expenditure switching: the home economy will import less, as home consumers switch to buying domestic products, and export more, as foreign consumers switch to less expensive home goods. This implies that in standard macroeconomic models, the trade balance (i.e. exports minus imports) is predicted to be an increasing function of the exchange rate in the short-run.[13] This implication assumes that two mechanisms are at play. First, nominal exchange rate depreciation causes a real depreciation, thus raising the price of foreign imports relative to home exports. The second mechanism at play is that such a change in relative prices has an immediate impact on imports and exports, and therefore on the trade balance. The short-run trade effects of exchange rate misalignments, however, are more complex as each of these mechanisms may be subject to questions, depending on the circumstances.

On the first mechanism, recent macroeconomic literature shows that the short-run impact of exchange rates devaluations on trade depends, among other things, on the currency in which domestic producers invoice their products. This is because the currency of denomination affects the extent to which a nominal depreciation causes a real depreciation. For instance, if producers set their price in the home currency (as implicitly assumed in standard trade models), there is perfect "pass-through" from

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[12] Under the mandate of the "Consultative Group on Exchange Rates" (CGER), the IMF has developed several methodologies to provide exchange rate assessment for advanced and developing economies. For a recent survey of these approaches, see Lee *et al.* (2008).

[13] The trade balance has a number of other macroeconomic determinants, such as the income of the home economy and of the rest of the world. These determinants, in turn, feed back into the equilibrium level of the exchange rate. This is because, as we argued earlier, the exchange rate is eminently an endogenous variable. Understanding how these direct and indirect effects interact is central to the discussion of global imbalances and the role of exchange rates in this context. These issues, however, are beyond the scope of the present survey. For a recent policy perspective on exchange rates and global imbalances, see Blanchard and Milesi-Ferretti (2009).

changes in the nominal exchange rate to the real, and an unanticipated devaluation lowers the price of domestic goods relative to foreign goods, as discussed above. This case, which has been much debated in policy circles in recent times, has similarities (even if it is not perfectly equivalent) to the imposition of a combination of export subsidy and import tariff on all goods –an argument first made by Keynes in 1931.[14] 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.[15] This is because the pass-through would be less than perfect in these cases. For instance, when firms set prices in a vehicle currency, 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, as shown in Staiger and Sykes (2010).

The second mechanism assumed in standard macro models (i.e. the immediate impact of a real currency misalignment on exports and imports) is also questionable. Under the J-curve effect, the depreciation of the real exchange rate is often synonymous with a deterioration of the trade balance on impact and a subsequent improvement. This is because at the time of an unexpected devaluation, most import and export orders are fixed as they 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 trade balance. The increase in import prices may be partly or fully offset by the substitution, if available, of imported goods by domestic goods, but this consumption switching may require time and adjustment. When these changes have taken place, a real exchange rate depreciation will improve the trade balance relative to its pre-depreciation level. In brief, understanding the short-run impact of an exchange rate devaluation on trade flows and the trade balance in the short and medium-run is conceptually more difficult than it may appear at first sight.

The above discussion abstracts from the possibility of failures in the domestic market or the presence of entry costs into export markets. 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, 1989; Bagwell, 1992). 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. A number of papers (e.g. Baldwin, 1988; Baldwin and Krugman, 1989) study the trade effects of a currency misalignment when the entry costs into the foreign market are sunk. In this context, the undervaluation of the exchange rate may have long-run effects if it allows exporters to enter foreign markets, and thus overcome the initial information inefficiency or the cost of entry. 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 and entry costs are considered to play a more prominent role in developing economies as opposed to developed economies, one should expect that these long-run effects are weaker for the latter group.

A related literature analyses the relationship between the exchange rate and income growth through its effect on exports. 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). More recently, attention has focused on the "export-led" growth process. The broad question is whether the undervaluation of the currency can

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[14] Several authors make this point, including Bergsten (2007) and Mattoo and Subramanian (2008).

[15] On the use of vehicle currencies in international trade, see Goldberg and Tille (2008). The key point is that the extent to which countries use domestic, foreign or vehicle currencies (trade dollarization) varies largely by country. In the United States 100 per cent of exports are denominated in dollars and so are 93 per cent of imports. In countries like Korea, Malaysia and Thailand, over 75 per cent of exports and imports are invoiced in US dollars.

have benign effects on a country's aggregate performance by improving its export performance. In this regard, an influential argument was first made by Balassa (1964). A series of recent papers by Hausman *et al.* (2005), Eichengreen (2007), Rodrik (1986 and 2008), Korinek and Serven (2010), Di Nino *et al.* (2011) show different mechanisms through which a devaluation can play an important part in the growth process, particularly for developing countries, by promoting exports. In general, 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, poor institutions for contract intensive activities) are more prominent in the tradable sector relative to the non-tradable. As a result, undervaluation has a positive impact on growth precisely because it alleviates the economic costs of market distortions by promoting the expansion of the tradable activities. In other words, it is the growth in exports promoted by the devalued real exchange rate that underpins income growth in these models.

This argument appears to differ dramatically from the so called "Washington Consensus" view (Williamson, 1990). As Berg and Miao (2010) point out, in this view any real exchange rate misalignment implies some sort of macroeconomic disequilibrium that is itself bad for economic growth. Specifically, an economic argument can be made that an exchange rate undervaluation or overvaluation can hamper growth by providing a wrong signal to economic agents, which may lead to factor misallocation. Hence, while the conventional wisdom embedded in the Washington Consensus supports the view that a real exchange rate undervaluation can be an effective instrument to promote the growth of exports, it is its long-run impact on economic growth that is questioned. Differently put, the view expressed by Rodrik (2008) and other economists, and the view of the Washington Consensus seem to differ on the importance of market imperfections in the tradable sector more than on the trade impact of exchange rate misalignments.

Ultimately, whether exchange rates undervaluation can have an effect on trade (and on other variables) in the short- and or the long-run is an empirical question that we address below. 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 three important caveats. First, according to the so called "targeting principle" in economics, policies that 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 a currency undervaluation will likely have a negative spillover effect on other exporters. This is because exchange rate movements in one country will affect its competitors in third markets. Mattoo *et al.* (2012) provide evidence of this effect for developing countries that compete with China in export markets. Finally, and related to the above point, 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).

(b)   Empirical work: devaluations, export growth and the trade balance

The relationship of the exchange rate level with other major economic variables, namely the growth of exports and the trade balance, has been at the center of a great deal of discussion since the beginning of the mid-2000s. Below we review the main recent contributions.

A number of papers have looked at the empirical relationship between exchange rate devaluation and export surges, defined as an acceleration of export growth. 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 are an important determinant of export increases. Most of the increase in exports is on the intensive rather than the extensive margin (i.e. increasing export intensity among existing exporters rather than from new entry into exporting), a finding that is at odds with later papers discussed in the next subsection. 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.

Three recent studies focus on a cross-country analysis. Freund and Pierola (2008) examine the determinants of 92 episodes of export surges, which they define as increases in manufacturing exports of at least 6 per cent that last for a period of seven years or longer. They find that large depreciations of the real exchange rate have been an important determinant of export surges for developing countries. Specifically, an undervalued exchange rate has a positive effect by facilitating entry in new export products and new markets. These new products and markets account 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 find 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 by 50 per cent in real undervaluation is associated with an annual 1.8 per cent increase in exports 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 -a result consistent with the basic prediction of the theory. In another recent study, Nicita (2012) investigates the impact of misalignments on trade estimating fixed effects models on a panel dataset comprising 100 countries for the years 2000-2009. This study finds that a currency undervaluation promotes exports and restricts imports and conversely for an overvaluation. The author argues that misalignments across currencies have a diversion effect quantifiable in about one per cent of world trade.

Finally, the literature on exchange rate misalignments and economic growth has devoted substantial attention to the trade effects of currencies. Several recent studies have found that an undervaluation of the exchange rate boosts economic growth by promoting the export sector, while a real overvaluation of the currency is negatively associated to growth (Razin and Collins, 1999; Johnson et al., 2007; Rajan and Subramanian, 2009; Gala, 2008; Rodrik, 2008; Berg and Miao, 2010).[16] Recent evidence by Di Nino *et al.* (2011) broadly confirms this assessment, but finds that the positive relationship between undervaluation and export growth is strong for developing countries and weak for advanced economies. This supports the view that addressing market failures in the tradable sector, which may well be more relevant for developing economies, is indeed what triggers the export and income growth effects of a currency undervaluation.

Two recent studies by the OECD focus on the impact of exchange rates misalignments on the trade balance. A first paper focuses on the world's three largest economies, namely the United States, the euro-zone and China (OECD, 2011a). The OECD finds that on aggregate, short-run exchange rate movements impact trade but there are some interesting nuances. Specifically, the authors find a more

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[16] Other studies, however, suggest that the relationship between exchange rates and growth is non-linear. For example, Williamson (2008) argues that only a small undervaluation can benefit growth. Haddad and Pancaro (2010) find that a real undervaluation has a positive effect on the economic growth of low income countries in the short and medium-run, but a negative effect in the long-run.

pronounced impact of exchange rates on exports of agricultural goods than on manufactured goods. 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. 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. Based on 2008 trade data, a hypothetical 10 per cent depreciation of the US dollar (or a 10 per cent appreciation of the RMB) 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. This outcome goes in the direction of recent academic papers (Evenett, 2010), which suggests 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. A 10 per cent depreciation of the euro 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. As in most macroeconomic studies, the main driver of trade flows is found to be income/demand levels. This finding is generally robust both at the bilateral and global trade levels, and also at the country and sector levels. The analysis also finds that there is little evidence of the J-curve in the short and medium-run.

In a companion paper, the OECD (2011b) examines the impact of exchange rate shifts on trade in two small open economies - Chile and New Zealand - and find that small economies trade tends to be more impacted by exchange rate changes than larger economies. This finding is consistent with earlier theoretical and empirical literature. The OECD simulates 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 finds 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 a less 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 and positive impact on Chile's exports to China, a large importer of extractive products - an expected result 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 of the factors that influences trade balances.

(c)   Recent debates: Heterogeneous firms, global production, and trade policy

The recent academic and policy debate on exchange rate misalignments and trade has taken three main directions. The first set of studies looks more closely at how sectors and firms react to a devaluation or overvaluation of the exchange rate. The second question is how misalignments affect trade in a world where production chains cross several borders. Finally, recent studies revisit the issue of how exchange rate misalignments may have an indirect effect on trade flows by triggering a trade policy response.

Until the mid-2000s most of the literature looked at the impact of exchange rate changes on aggregate imports and exports. These estimations have problems because aggregate trade flows may have feedback effects on exchange rates. Focusing on firms, rather than aggregate variables, is a way to address this endogeneity problem. This is because individual firms' export choices are likely to be influenced by the level of the exchange rate, but not to directly influence its value. Therefore, this approach provides a better identification of the impact of exchange rate misalignments on trade. In addition, a firm-level analysis has the advantage of disaggregating the impact of exchange rate changes on different firms. Adopting this approach, Berman et al. (2012) examine how high- and low-performance firms react to exchange rate changes. When faced with a change in the exchange rate, exporters (or potential exporters) can react in different ways. First, they can change export volumes, but not their price. This is the case of 100 per cent pass-through of the exchange rate discussed earlier, where the price in destination countries changes one-to-one with the exchange rate. The opposite situation is one of zero pass-through. In this case, exporters' mark-ups fully absorb the change in the exchange rate and there is no impact on trade volumes. Both these situations (and the cases in between) focus on the intensive margin of trade. The third impact of an exchange rate change is to alter the extensive margin of trade. Specifically, a depreciation can lead firms to start exporting or to expand the product scope of their exports, while an appreciation may have the opposite effect. In this setting, the authors show 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. Since the highest performing firms are the largest exporters, the authors conclude that the prices of tradable goods should be relatively insensitive to exchange rate movements. Put differently, exchange rates have only a limited effect on import prices and trade volumes as a result of the "natural" selection process of exporting.

Berman *et al.* (2012) test this theory with detailed data on French firms. Two recent papers follow a similar methodology with exporters from China and Brazil (Chatterjee *et al.*, 2012; Tang and Zhang, 2012). This evidence shows that larger and more productive firms react to a devaluation with an increase in mark-ups, while smaller and less productive exporters react by changing the import price with the exchange rate. Since the group of large exporters account for the dominant share of trade flows, aggregate trade is not very responsive to exchange rate movements, as predicted by the theory. On average, following a 10 per cent depreciation of the currency vis-à-vis a trading partner, firms increase their export quantities to that market by 4 to 7 per cent. The extensive margin of trade is also found to be affected by the exchange rate movement. The probability of entering an export market (or of expanding the product scope in that market) increases by 1-2 per cent in the year following a currency devaluation of 10 percentage points. The overall volume of trade (the sum of old and new products) increases in the short-run by 10 per cent (unit elasticity). The firm-level analysis of Taglioni (2012), however, provides a more pessimistic result of the direct negative link between an exchange rate appreciation and export growth, even in the short-run. She argues that the trade impact of a currency revaluation differs in important ways across the intensive and the extensive margin of trade. In particular, there can be important pro-competitive effects associated to a strong currency that materialize through the extensive margin of trade. This channel is particularly strong for middle-income economies that try to diversify their export base and improve the sophistication of their exports. Importantly, this channel may offset the more traditional negative impact that a currency appreciation has on the intensive margin of trade. The author finds supporting evidence of the offsetting effects of a change in the exchange rate on the different margins of trade using firm-level data from Chile, Macedonia, Pakistan and Turkey. These results seem to suggest that a currency devaluation may promote export volumes but at the expenses of export diversification, at least for middle-income economies.

The second consideration that emerges from the recent academic and policy debate 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 radically changed the structure of international trade. 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. This simple observation suggests that the relationship between exchange rates and trade varies over time, as changes in the world economy materialize.

While the internationalization of production is the focus of a large economic literature, few studies analyse the trade impact of exchange rate movements in this context. One such study is Zhao and Xing (2006) who analyse the effect of exchange rates on the outsourcing decision of multinational enterprises (MNEs). They 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 on which country the currency appreciation takes place. Second, the overall production cost 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. A second study is by Arunachalaramanan and Golait (2011) who 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.

The third question that is at the forefront of recent research is how exchange rate misalignments may affect trade, not directly but through their impact on trade policy. The issue is whether tensions in the domain of exchange rate policy, as the ones created by persistent currency misalignments, may lead to trade policy responses. While we lack definitive evidence on the comparison of exchange rate changes and tariff changes, it is widely perceived by economists that the latter have a stronger and more persistent impact on trade flows.[17] If this argument is correct, one important feedback channel of currencies on trade is precisely through the impact on trade policy changes. This motivates the question: are trade measures responsive to exchange rate developments?

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[17] Two recent studies estimate jointly the trade impact of tariffs and the real exchange rate. Fitzgerald and Haller (2012) use firm-level data from Ireland and find small trade effects of exchange rate movements compared to changes in tariffs. De Sousa *et al.* (2011) find similar results estimating a gravity equation. Specifically, the coefficient on the "relative prices" variable in their regression (a measure of the real exchange rate) is substantially smaller than the one on tariffs.

A first set of studies looks at this question from a historical perspective. Eichengreen and Irwin (2010) and Irwin (2012a) focus on the trade policy choices of the 1930s. Their argument relates to the basic "trilemma" in open economies that stable exchange rates, stable internal prices and open trade are incompatible policy objectives (as they cannot be achieved all at the same time). Specifically, in this view the inability of a country to use the exchange rate as a policy instrument may create an incentive to impose protectionist measures. The authors find that during the Great Depression, those countries that maintained the gold standard resorted to restrictive trade policies to a greater extent than those countries that abandoned the gold standard and let their currencies fluctuate. A second historical example is the 10 per cent import surcharge on all imported goods imposed by President Nixon in 1971. The trade measure was imposed by the US to force other countries to revalue their currency vis-à-vis the dollar, which was seen to be largely overvalued. This historical episode seems to support the view that an overvalued currency may trigger a protectionist reaction. As Irwin (2012b) argues, however, whether the import surcharge was successful in imposing a revaluation of major currencies against the dollar is at best controversial.

A large literature in trade policy studies how protectionism varies with the business cycle. As Bagwell and Staiger (2003) point out, the theory and substantial empirical evidence find that trade barriers are countercyclical.[18] The broad idea is that governments may revert to use trade policy in the face of adverse macroeconomic shocks, such as the rise in unemployment associated to a downturn in economic activity. Recent empirical work has shown that one such macroeconomic shock that may trigger the rise in protectionism is an exchange rate appreciation (Bown and Crowley, 2012). While advanced economies have low applied import tariffs that are bound under the WTO, they may use contingent protection (e.g. antidumping duties, countervailing duties and safeguards) to implement any new barrier when hit by a macroeconomic shock. Using quarterly data for the US, the EU and three other industrialized countries from 1980 to 2010, Bown and Crowley (2012) find that real appreciations in bilateral exchange rates lead to substantial increases in the use of these contingent measures.[19] A second study by Nicita (2012) also looks at the relationship between trade policy and currency misalignments. In a panel of 100 countries between 2000 and 2009, he finds that countries with overvalued exchange rates are less likely to pursue trade liberalization, but the coefficient in the regressions is small and only marginally significant. On the other hand, the results indicate that periods of exchange rate appreciations are strongly related to the number of antidumping investigations, confirming for this larger panel of countries that contingent measures are the main trade policy means of response to exchange rate shocks.[20] Finally, a third study looks at the determinants of protectionist legislation in the United States (Broz and Werfel, 2011). They find that there is a positive association between exchange rate appreciation and the demand for trade protection, where the latter is measured by the initiation of trade restrictive legislation in the US parliament. In brief, while details of these studies differ in a number of dimensions, they all suggest that countries may use trade measures as a form of policy substitute to an appreciating currency.

4.   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 has dealt with the effect of increased variability (volatility) of exchange rates on trade. This was the main issue covered in the well-known survey by the IMF (2004). This genre of the literature has continued until

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[18] For a dissenting view, however, see the recent work by Rose (2012).

[19] Similarly, a study from the World Bank argues that an overvalued exchange rate is often the root cause of protectionism in developing countries (Schatz and Tarr, 2002).

[20] This finding confirms earlier work suggesting that exchange rate appreciations are associated to the use of antidumping (Knetter and Prusa, 2003). As Bown and Crowley (2012) note, expanding the set of trade policy instruments beyond antidumping duties reinforces the impact of an appreciating currency on trade policy.

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, following the build-up of large global imbalances and the outbreak of the financial crisis, 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". 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 neighbors, in particular in the case of very integrated economies.

On the issue of currency misalignments, theoretical and empirical studies over the years show that the relationship between the level of the exchange rate 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 because 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 are 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 and the characteristics of firms). Moreover, an insidious way through which exchange rates may affect trade is an indirect one, as trading partners may react to a misaligned currency with tariff protection. 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. Empirical studies also broadly confirm that contingent trade measures are used in response to trading partners' currency devaluations.

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