

The impact of exchange rate volatility on economic growth and international trade

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Abstract: This paper summarizes several research works which deal with the different effects that the volatility of exchanges rates has on the economy. Among those effects, the most studied have been the effects on international trade and economic growth. Over the last five decades, there has been a debate at the theoretical level and different views at the empirical level on whether the gains from flexibility got under flexible exchange rates outweigh the losses from increased uncertainty which often prevails in such environment of flexible exchange rates. In particular, the impact of exchange rate volatility, both on international trade and economic growth, has been often discussed. This paper attempts to summarize some of the main results of these debates, concerning, in particular, the empirical evidence thus collected.

Keywords: volatility of exchange rates; economic growth; exports

El impacto de la volatilidad del tipo de cambio sobre el crecimiento económico y el comercio internacional

Resumen: Este artículo resume una serie de trabajos de investigación que abordan los diferentes efectos que la volatilidad de los tipos de cambio tiene sobre la economía. Entre esos efectos, los más estudiados han sido los efectos sobre el comercio internacional y el crecimiento económico. Durante las últimas cinco décadas ha habido debate a nivel teórico y diferentes puntos de vista a nivel empírico sobre si las ganancias de la flexibilidad obtenidas bajo tipos de cambio flexibles superan las pérdidas de la mayor incertidumbre que a menudo prevalece en dicho entorno de tipos de cambio flexibles. En particular, se ha discutido a menudo el impacto de la volatilidad del tipo de cambio, tanto en el comercio internacional como en el crecimiento económico. Este artículo intenta resumir algunos de los principales resultados de estos debates, en lo que respecta, en particular, a la evidencia empírica así recopilada.

Palabras clave: *volatilidad de tipos de cambio; crecimiento económico; exportaciones*

I. Introduction

A key element in the international financial system is the design of the rules governing the relationship between different currencies. During the twentieth century, this relationship went from the prevailing use of the gold standard during the first decades to the Bretton Woods system in use between 1945 and 1972. The main difference between both systems was that with the gold standard, each holder of one of the main national currencies was entitled to exchange that currency for an amount of gold, while under the Bretton Woods Agreement, only the US dollar had to be directly pegged to a certain amount of gold, stated as 35 dollars for an ounce of gold, while the other currencies of the member countries were tied to the value of the dollar, rather than its own gold value. Nevertheless, the accumulation of current account deficits by the United States during the 1960s eventually led to a large mismatch between the US gold reserves and its liabilities with foreign countries, and eventually in mid-1971 the US administration ended the convertibility of the dollar into gold, transforming the US dollar into fiat currency, and in that manner, setting an end to the Bretton Woods international system. Although there were attempts to continue with the system of fixed exchange rates for every member of the IMF, eventually by mid-1973 each country was free to choose the exchange rate system that it prefers, be it one of floating rates, a fixed peg, a basket of currencies, etc. In the post Bretton Woods world, there are different institutional frameworks, from the Eurozone in which several European countries share their currency, the euro, which floats with respect to the other currencies, to the floating currencies of countries such as the United States, United Kingdom, Japan, Brazil, Mexico, Argentina, Russia, Canada, Chile, India or Australia, or the crawling parity of China. This variety of exchange rate mechanisms in which most of the major currencies of the world float vis-à-vis the other currencies has provided the basis for an enormous increase in volatility of exchange rates, both nominal and real, among different countries.

Since then, there has been interest in understanding the different effects stemming from the uncertainty about exchange rate levels, and whether this uncertainty has negative effects on the economy. There have been two main schools of thought regarding exchange rate regimes, one that

stresses the advantages of flexible exchange rates, and another one which discusses the possible shortcomings of this system. In that respect, we will review the literature on the economic effects of exchange rate volatility, which is broadly understood as the best proxy for uncertainty about future exchange rate levels. The economic effects of exchange rate volatility are a topic relevant per se, but should be of special interest for developing countries, which typically have a real exchange rate volatility much larger than developed countries (Hausmann, Panizza & Rigobon, 2006) and also for those developed countries such as Japan, Australia, Israel or the United Kingdom that also possess significant real exchange rate volatilities.

II. Exchange rate volatility and economic growth

David Dollar wrote in 1992 an influential paper in which he studies outward-oriented economies, i.e., those economies whose policies include real exchange rates that fostered the growth of exports, together with liberalization of import tariffs on inputs in the production of export goods and shows that these economies have a larger rate of GDP growth. By comparing Asian economies to the ones in Latin America and Africa, D. Dollar opened the door for an increase in the relationship's interest between economic policy, foreign exchange rates, and economic growth.

By the early 1990s, there was a broad acceptance among economists of the virtues of export-led growth policies to improve GDP growth, particularly for LDC (less developed countries). Nevertheless, the researchers were far from agreeing on how to measure the degree of export openness of a particular country, in order to compare between different countries (Prichett, 1996; Edwards, 1989). In the early literature, four measures underlie the definitions that were more prevalent to measure outward orientation of an economy: The share of trade to GDP, the largest meaning more outward oriented countries: the average tariff ratio (the lower meaning more outward orientation), a measure of real price distortions and also some measures of the deviation of countries trade patterns from a comparative advantage model (Prichett, 1996).¹ Modern research on the evidence about the connection between trade policy and economic growth includes, among others, the works of Huchet-Bourdon, Le Mouél, and Vijil (2018) as well as Irwin (2019), and Alam and Sumon (2020).

The key value of exchange rate management for economic growth is a well-known fact. In particular, Rodrik (2008) and previously, Dollar (1992) and Sachs (1985) claim that a significant overvaluation of exchange rate is

one of the main mistakes to avoid if a country aims to obtain persistent economic growth. The effects of currency misalignments (i.e., undervaluation or overvaluation) have been extensively documented, among others, by Rodrik (2008)². We are primarily interested in studying the effects of exchange rate volatility, a topic which is related though different from currency misalignments. It is related to currency misalignment because exchange rate volatility also depends (at least partly) on exchange rate policies, and it is clearly a different issue. In particular, we will deal in this section with the effects of exchange rate volatility on growth. The papers which we discuss in this section deal mainly (or deal as one of their main questions) with the effects of volatility in the foreign exchange rate on economic growth. Following the literature, several measures of the exchange rate are used in this paper. The nominal exchange rate, i.e. the number of units of the domestic currency needed to purchase one unit of the foreign currency; the real exchange rate, RER which is the nominal exchange rate multiplied by the ratio of price (indexes) between two countries, While the nominal exchange rate depend directly on the daily movements of currency markets, the real exchange rates are more complex, because they involve both the nominal exchange rates and also the rates of inflation in each of the countries under consideration We also consider the real effective exchange rate REER, or the real exchange rate which results from the basket of exchange rates in relation with each of the main trading partners of a country.

Among the first works to address this topic, Cottani, Cavallo and Khan (1990) show, in a cross section, OLS study a negative relationship between real exchange rate volatility and countries' economic growth. In the same paper quoted before, David Dollar (1992) shows a negative relationship through a cross section regression between rates of growth and exchange rate volatility in a large sample of countries.

After discussing the conflicting arguments about advantages of flexibility provided by flexible exchange rate regimes, versus cost of volatility represented by an increase in uncertainty, Bagella, Becchetti and Hasan (2006) provide a framework to study, simultaneously the effects of exchange rate flexibility with the cost of exchange rate volatility. Their main questions being, what are the effects of real exchange rate volatility on economic growth, and how to compare that cost of exchange rate volatility in terms of growth with the loss of flexibility under more rigid exchange rate regimes. They use real effective exchange rates as opposed to bilateral exchange rates since the former, being multilateral, allows to input externalities from other

trading partners. They work with a growth model based on two factors, physical and human capital, with a sample of 120 countries provided by the World Bank, in a timeframe spanning from 1980 to 2000, and find that the real effective exchange rate volatility has a significant negative effect on economic growth.

Aghion et al. (2009) write an outstanding work in which they have several objectives. First, they construct a model which relates innovation, credit constraints and productivity growth, under sticky wages. Then, they conduct empirical analysis to discover whether real exchange rate volatility has a negative impact on the growth of productivity, and how this effect depends on the financial development of the economies. They present a simplified model in which the labor cost in local currency is sticky, and the growth in productivity stems from investment in innovation by the firms. They assume that firms' borrowing capacity is proportional to their profits. Since nominal wages are sticky, an exchange rate appreciation will reduce firms' earnings, meaning that firms' will face a reduced borrowing limit and therefore be more vulnerable to liquidity shocks, as well as less prone to invest in innovation.³ Therefore, when the nominal exchange rate moves, the exporting firm is unable to pass through completely the change in values to the customers which import his goods or services. In countries with more volatility of exchange rate, we obtain that firms' profits are also more volatile. In this model, the growth in productivity depends on innovation, which is only conducted by firms which survive the liquidity shocks, which (according to the model) take place at regular intervals. Innovation is assumed to be proportional to the productivity level achieved by the firm and the rate at which innovation takes place is affected by the existence of credit constraints. In this model, credit is restricted, and the entrepreneurs can only borrow in proportion to their level of profits, and the likelihood of conducting innovation will be an increasing function of the firm's productivity. Exchange rate volatility will increase the volatility of a firm's profits and therefore the economies with more financial development (meaning economies with less companies restricted by credit constraints, and for which the ratio of available external finance to internal finance is larger) will be less affected by exchange rate volatility in terms of innovation and productivity growth. After showing the theoretical results, the authors go on to conduct empirical work. The main empirical hypothesis that they test is that exchange volatility reduces growth for countries with limited financial development. In testing this hypothesis, they use a generalized method of moments (GMM) dynamic panel data analysis. The authors consider the exchange rate regime as the measure of

flexibility, and the standard deviation of the real exchange rate as the measures of volatility. They estimate the effects that both exchange rate flexibility and volatility have on productivity growth and also they use another term which measures the interaction between exchange rate volatility and the level of financial development. The authors use the ratio of aggregate credit to the private sector to the gross domestic product (GDP) as a measure of financial development. The change in productivity is measured as growth in real GDP per worker. When volatility is measured by changes in the multilateral real exchange rates, they find a relevant effect of volatility. Also, the measure of the interaction between exchange rate volatility and financial development shows that volatility has any important adverse effect for the less financially developed economies while it has a much milder effect on financially developed countries.⁴

On the other hand, Janus and Riera-Crichton (2015) in a panel data study of countries from the Organization for Economic Cooperation and Development (OECD) which comprises the period 1980 to 2011 find that REER volatility has a negative effect on economic growth for the OECD countries which are financially developed or highly developed countries. This result differs from Aghion et al. (2009) for whom only countries which are not financially developed are negatively affected by REER volatility.

Another study which aims to assess the effects of real exchange rate volatility on economic growth is Vieira, Holland, Da Silva & Bottecchia (2013) in which the authors apply GMM analysis with fixed and random effects to a panel of eighty-two countries for the period 1970-2009 and they find that REER volatility has a significant negative impact on GDP growth. Moreover, they establish that the negative effect of real exchange rate volatility on growth is stronger than the effects of currency misalignments.

Also, Rapetti (2020) with a panel data model covering the period 1950-2014, studies the rates of growth of the OECD countries and the developing countries and finds evidence of the negative effect of real exchange rate volatility on growth. This evidence is stronger for developing countries, and he also finds that real exchange rate volatility has been particularly detrimental for developing countries during the period of financial globalization.

III. The impact of exchange rate volatility on international trade

We have discussed in the previous pages the evidence on the volatility of REER and economic growth. When it comes to the channels through which the volatility of REER affects economic growth, perhaps the most studied has been its effect on international trade. This section deals with the empirical evidence on the impact of REER and its volatility on countries' international trade. In particular, we study the empirical evidence collected on this issue.

IV. Exchange rate volatility and international trade, the case of developed countries and international studies

After the breakdown of the Bretton Woods system, the cycles of recurring volatility between major currencies have attracted the interest of researchers. We will start with the theoretical explanation of how this effect may take place.

Auboin and Ruta (2013) present a clear illustration of the effect of exchange rate volatility, following Clark (1973). A firm which operates under perfect competition, and obtains its income only in foreign currency, and has a limited ability to hedge its foreign exchange exposure will find its profit margin dependent on the level of exchange rates. In the presence of costly or limited hedging opportunities for exchange rate risk, this firm's profits in domestic currency will be riskier the more uncertain is the level of future exchange rates. Therefore, a risk averse firm will reduce its output and exports when it faces an increase in foreign exchange risk, even if the mean level of exchange rate doesn't change. On the other hand, this basic theoretical model rests on a certain number of assumptions, such as perfect competition, costly or non-existent hedging opportunities for exchange rate risk, or a reduced share of imported inputs in the production of the export good. Auboin and Ruta (2013) discuss the different assumptions on which these original results rest. Among these assumptions, one can highlight the absence of imported inputs, the high-risk aversion of the producers, and the non-existence of a market to hedge foreign exchange risk. They also summarize several models in which the previous assumptions are relaxed, resulting in more indeterminate results for the relationship between exchange risk and trade.

Although the model of Clark (1973) presents the basic intuition on exchange rate uncertainty shared by most researchers, that more exchange rate risk leads risk averse firms with significant foreign exchange income to

less-than-optimal production and export levels, there is no academic consensus on this issue. In fact, the theoretical results on the effect of exchange rate volatility on international trade are somewhat ambiguous. Several authors have presented models in which exchange rate volatility leads to more international trade, rather than less international trade (Caballero & Corbo, 1989).

Among the early papers in this literature, Diaz-Alejandro (1976) shows a negative relationship between exports and real exchange rate volatility (which he calls instability) for the case in Colombia. Also, De Grauwe (1988) studies the impact of foreign exchange volatility on trade among a group of industrialized countries. He observes that the growth rate of foreign trade between developed countries had fallen by one half in the period 1973-1988, after the world's main currencies moved from fixed to flexible exchange rates. He first shows that from a theoretical point of view, the effect of foreign exchange volatility depends on the degree of risk aversion of producers. He sets up a simple production and consumption model where a firm can produce either for a domestic or for an export market. The author asks, what would be the effect of an increase in the variability of exchange rate on the ratio of exports to domestic production? The answer depends on whether a rise in exchange rate volatility rises or lowers the expected marginal utility of income from exports. The author shows that the critical theoretical condition to derive the effect on exports of an increase in exchange rate and volatility boils down to whether the utility function on export revenues is convex or concave, i.e. and the degree of risk aversion of the producer. In particular (and somewhat paradoxically) if there is constant relative risk aversion, the model yields that for the more risk averse producers, an increase in exchange rate variability will lead to increase rather than decrease their exports. On the other hand, for those producers who are not very risk averse, the more intuitive result obtains that a higher exchange rate variability is associated with less exports. The author summarizes these two results, arguing that an increase in exchange rate risk implies that the total expected utility of exports falls. This decrease leads both to a substitution and an income effect. If the substitution effect is the strongest one, there will be less exports; yet if the income effect is dominant, there will be more exports following an increase in exchange rate risk.

For De Grauwe (1988), while individual firms that exhibit a regular degree of risk aversion will end up with less production for exports, those which exhibit a sufficiently large coefficient of risk aversion will export more,

since in that case, the increase in expected marginal utility of revenue allows them to hedge against a fall in their income.

De Grauwe (1988) also coins the concept of “political economy of exchange rate variability” by which he refers to the issues arising from the misalignment problem (Williamson, 1983) which appear when exchange rates adopt values which differ from their equilibrium PPP⁵ values. If these misalignments are persistent, overvaluation of the exchange rate “leads to a loss of output and employment” while undervaluation may favor them setting protectionist legislation. He also conducts empirical tests in the form of cross-country regression analysis, that consider bilateral trade between Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, the United Kingdom and the United States. He divides the sample between a fixed rates period, from 1960 to 1969, and a flexible rates period from 1973 to 1984. The empirical analysis concludes that there is a negative effect of real exchange rate volatility on the growth rate of trade, but when the two subperiods are studied, this effect is actually relevant in the subperiod of flexible exchange rates, and it is not in the subperiod of fixed exchange rates.

Viaene and De Vries (1992) set up a theoretical model to discuss the inverse relationship between exchange rates volatility and trade flows. In their model, there are merchants and also speculators, and both types have access to the spot exchange rate market and the forward exchange rate market. Traders are assumed to be risk averse, while speculators can be risk lovers. The merchants have to take both a decision on their export level and the level of currency hedge that they choose, in order to maximize an expected utility function. Agents have full access to the forward exchange rate market. In this model, the effect of an increase in exchange rate volatility depends critically on whether there is a well-developed forward market for exchange rate risk, and also on the coefficient of risk aversion and on whether the net foreign currency position is negative or positive.

Kroner and Lastrapes (1993) study the relationship between the variation in multilateral nominal exchange rates (based on the IMF classification) and multilateral export prices and quantities for five industrialized countries, the United States, the United Kingdom, (West) Germany, Japan and France for the period from 1973 until 1990. They work with a multivariate generalized autoregressive conditional heteroscedasticity model (GARCH) and find that the conditional variance of nominal exchange rates has a statistically significant impact on exports for all countries in this study.

Sukar and Hassan (2001) study the effect of exchange rate volatility on aggregate exports from the U.S., for the period from 1975 until 1993. They start by mentioning that the effect of exchange rate volatility “is a controversial issue in international economics”. The authors use the real effective exchange rate REER. They measure exchange rate volatility with a GARCH model, under which the variance of the exchange rate is time dependent and estimate the effects of real exchange rate volatility on US exports volume with a model which also includes real activity on export markets and real effective exchange rates for the US and they find the existence of a negative and significant relationship between export volumes and the volatility of exchange rates.

A study on the effect of exchange rate volatility on bilateral trade flows is carried on by Dell’ Ariccia (1999). He discusses the European Monetary System, which was established with the aim of reducing exchange rate volatility and also to avoid currency misalignment. He uses four different measures of exchange rate volatility to test its impact on trade: The standard deviation of the nominal exchange rate, the standard deviation of the real exchange rate, the sum of the squares of the forward errors (i.e., of the differences between the previous period forward exchange rate and the current spot exchange rate and finally, the percentage difference between the maximum and the minimum of the nominal exchange rate. The sample contains fifteen countries that were members of the European Union in 1999 plus Switzerland. The estimation includes several variables as a gravity model⁶ and the period for these estimates comprises between 1975 to 1994. He finds that the exchange rate volatility coefficient is negative and significant at the 1% level for the different measures considered. Moreover, he concludes that the European monetary union had more impact on the sectors for which large capital expenditures are requested.

An important survey of the early literature can be found in McKenzie (1999). He first reviews an extensive theoretical literature to conclude that there is a fundamental ambiguity as to the likely effect of exchange rate volatility on trade. When it comes to the empirical evidence, he considers several important issues, starting with: is it the nominal rate or the real rate that should be considered? Although conceptually the real exchange rate should be chosen, he shows that many studies have been using the nominal rather than the real exchange rate to measure volatility. Moreover, from the literature in international economics the author brings the argument that volatility can be defined in several ways, starting with the conditional or

unconditional variance of the spot exchange rate, but also including the variance of the error term stemming from the difference between the expected exchange rate level and its current value. He also asks about the different measures of exchange rate volatility. Among the measures of exchange rate volatility which appear in the literature, the variance, the percentage change of the exchange rate, the standard deviation, as well as the autoregressive integrated moving average models (ARIMA) are the ones most frequently used. Another important topic is which trade flows are considered, whether aggregate trade, bilateral trade, or sectoral trade. Although the different manners in which trade flows are studied can influence the results obtained, the author perceives a certain tendency in the sense that the latest papers find a relevant impact of volatility on trade. Nevertheless, the author elaborates that the effects of volatility are different, depending on which market is studied. He presents a table which summarizes several models in the literature, which show the specification of volatility, frequency, tests, significance of coefficients, etc. for those models.

Also, Eichengreen and Gupta (2013), study the exports of services from a panel of 66 countries, of which nine are low income, 22 are middle income and 22 are high-income countries. Their main interest is to find out the impact of the real exchange rate on trade for the period from 1980 to 2009. In the empirical analysis, they find out that real exchange rate volatility decreases exports.

Servén (2003) in a related work, analyzes the connection between real exchange rate uncertainty and private investment in a large sample of sixty-one developing countries, for the period 1970 to 1995. The real exchange rate volatility is modelled with a GARCH model. He finds that exchange rate volatility exerts a strong negative effect on investment, and this effect is stronger in economies with insufficient financial development.

In 2004 there was a study sponsored by the IMF, whose authors are Clark, P., Tamirisa, N., Wei, S.J., who reviewed an extensive literature. They point out that, although volatility is usually described in real terms, in practice the real exchange rate volatility and the nominal exchange rate volatility are similar and therefore, they do not present separate the results for both types of volatility. Nevertheless, the authors argue that there is not necessarily a close relationship between the exchange rate variability and exchange rate regime of the country because, even for a country which pegs its money to a main currency, the real multilateral exchange rate depends critically on the value of inflation in the country and the values of the nominal

exchange rates and the inflation rate in its main trading partners. Therefore, a fixed exchange parity is no complete guarantee of low real exchange rate volatility. “With effective exchange rates, effective volatility is a multidimensional concept”. Nevertheless, they point out that in the short run, in most countries prices are relatively sticky, and therefore, “nominal and real exchange rate tend to move together”. After discussing the geography and history of real exchange rate volatility and pointing out that such volatility is usually larger in developing countries than in advanced economies, they analyze the evidence on exchange rate volatility and trade. They specify that long-run real exchange rate volatility has a negative effect on trade, quoting Rose (2000) and Tenreyro (2007). Nevertheless, they claim that no negative effect is found if country-specific effects are changing. Furthermore, they show that, when the country effect and the time effects are controlled separately, there is a negative effect on the trade of differentiated products, but no effect is visible for the trade in homogeneous goods.

Also, Baak (2004) studies the effect of exchange rate volatility on the international trade of fourteen countries from the Asia Pacific area, including Australia, Canada, Chile, Indonesia, Japan, Republic of Korea, Malaysia, New Zealand, Papua New Guinea, the Philippines, Singapore, Thailand, and the U.S. for the period 1980 to 2002. Baak shares the view of Clark (1973) and others, in the sense that exchange rate volatility is considered a risk factor, and that, if traders are risk averse, more volatility will lead to less international trade. The larger the unpredictability, the less will be traded internationally, and this cannot be completely avoided even if it is possible to hedge foreign exchange risk, because hedging is costly. He approaches the countries in the sample with an empirical test of a gravity model. In such an environment, these models typically study bilateral trade. The volatility of the exchange rates is measured as the standard deviation of the log value of the monthly bilateral real exchange rate. The author also studies a second model, one of a generalized gravity model. In this model, the dependent variable is formed by the exports from one country to another country. Among the variables used to explain the exports from one country, we find the GDP of the importing country, the depreciation rate of the importing country, the bilateral exchange rate, and the distance between those two countries. The impact of real exchange rate volatility turns out to be negative and significant, whether fixed or random effects are incorporated.

Another relevant survey on this literature connecting exchange rate volatility and trade is Ozturk (2006). In this article, the author reviews many

papers, dealing both with nominal and real exchange rates. The studies surveyed differ in both methodology, countries studied, periods and model specification, and hence obtaining a general conclusion is difficult. Nevertheless, the author concludes that “overall a larger number of studies appear to favor the conventional assumption that exchange rate volatility depresses the level of trade” (Ozturk, 2006: 93).

Bahmani-Oskooee and Hegerty (2007) write another interesting survey of the literature, which divides the papers in this area mostly by its econometric testing strategy. They point out, that studies concerning aggregate trade usually conclude that exchange rate volatility is detrimental to trade flows. Moreover, they also discuss, both at the theoretical and the empirical level, articles that analyze this problem in terms of bilateral trade flows between two countries, and also, sectoral trade flows. One of the reasons lying behind some ambiguity in the results is the absence of a broadly accepted optimal measure of exchange rate uncertainty.

A study of exchange rate regimes and exchange rate volatility effects on international trade for ten Eastern European countries, namely Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Slovenia, and Ukraine, for the period 1990 to 2003 was performed by Égert and Morales-Zumaquero (2008). Several of the countries in the sample were transitioning into the European Exchange Rate Mechanism. The authors study the export functions of these countries both in nominal and in real terms. Also, the volatility of exchange rates is taken both in its nominal and its real form. After discussing the different exchange rate regimes applied by these countries, which included crawling pegs, currency pegs, and managed floats, they work with panel cointegration techniques. They find out that for eight countries in the sample (excluding Russia and Ukraine) there is a statistically significant and negative impact of exchange rate volatility, both on nominal and real exports. They also analyze sector exports and find that exchange rate volatility has a negative impact on the exports of manufactured products, but there is no significant effect on primary products. They also find that the negative impact on exports takes place with a certain lag.

An exercise of meta regression analysis on the literature on exchange rate volatility and trade, whose results are important to mention was undertaken by Coric and Pugh (2010). After analyzing fifty-eight published studies, they conclude that the majority, thirty-three of them, document a negative effect of exchange rate variability on trade, while the other twenty-five studies fail to reach that conclusion, with results ranging from a positive

effect of volatility (six studies) to statistically inconclusive (the remaining nineteen studies). The authors interpret these results saying that there seems to be a negative relationship between exchange rate volatility and trade, although that relationship does not look robust.

V. Exchange rate volatility and international trade, the case of developing countries

In this section we focus on those papers that deal with the empirical evidence on the effect of exchange rate volatility on developing countries. While most papers in the literature study exports originating from the more developed countries, in fact volatility of exchange rates is often much larger in developing countries and often attains levels up to three times larger than the volatility in high-income countries, as have shown Hausmann, Panizza and Rigobon (2006), and Clark, Tamirisa and Wei (2004).

Since exchange rate volatility is larger for less developed countries (LDC) and middle-income countries, it is more likely to have relevant effects on its export levels. Besides, there are much less opportunities for hedging exchange rate risk in developing countries, and this hedging of exchange rate risk, when it is available, often comes at a higher cost since financial markets in middle- and lower-income countries are usually much less developed.

An important early contribution is Caballero and Corbo (1989). They study a representative firm with a Cobb-Douglas production function, and the real exchange rate follows a log normal process and both the real exchange rate and the real wage are exogenous to the firm. They derive that, in a two-period model, if capital level is given and agents are risk neutral, “investment is a risk neutral function of uncertainty.” This positive relationship between real exchange rate uncertainty and investment is reversed either by assuming risk averse firms, or by assuming that the firms’ capital stock can be adjusted in the second period. Applying this model in an empirical estimation, Caballero and Corbo use data from six developing countries, Chile, Colombia, Peru, Philippines, Thailand and Turkey, and find that the impact of real exchange rate uncertainty is always negative, and that, except for the cases of Peru and Colombia, this negative effect on exports is very strong. In the short run, they predict that an increase in the volatility of real exchange rate in Chile, Turkey or Thailand would reduce exports by more than two or three times the size of the change in the independent variable. In the long run, they predict that the effects are usually much larger than in the short run.

Servén (2003) in a related work, analyzes the connection between real exchange rate uncertainty and private investment in a large sample of 61 developing countries, for the period 1970 to 1995. The real exchange rate volatility is modelled with a GARCH model. He finds that exchange rate volatility exerts a strong negative effect on investment, and this effect is stronger in economies with insufficient financial development.

Arize, Osang and Slottje (2000) consider the impact of exchange rate volatility on the trade flows of developing countries. Since most of the evidence that had been studied previously concerned developed countries, the authors want to broaden the analysis, having in mind that often, developing countries are in need to increase their export trade flows. They study the volume of exports for thirteen developing countries, including Ecuador, Indonesia, South Korea, Malaysia, Malawi, Mauritius, Mexico, Morocco, the Philippines, Sri Lanka, Taiwan, Thailand, and Tunisia. They use the REER measure of exchange rates. They first test for cointegration of the time series in each of the countries and can reject the hypothesis of no cointegration for all of them. Then they study the relationship between real exports and the independent variables for each country, using an error correction model in which the volume of each country's export goods is a function of world demand conditions, of the relative prices of the country export's goods vis-à-vis the world's export goods, and also a function of the standard deviation of real exchange rates (dependent and independent variables are taken in log form).

With this model, they find evidence of the negative impact of exchange rate volatility on export flows, and also of the existence of a long-term relationship between exports and volatility in each one of the countries in the sample.

Arize et al. (2003) analyze the relationship between real exchange rate volatility and trade flows for a group of ten developing countries, namely Burkina Faso, Colombia, Costa Rica, Jordan, Kenya, Korea, Myanmar, Pakistan, South Africa, and Venezuela. They study whether there is cointegration between the series of real exports, foreign economic activity, relative prices, and exchange-rate volatility for those countries. They also analyze whether the relationship between those series is stable, and finally, they test through Johansen and Dickey and Fuller method the short-run dynamic relationship between export demand, foreign income, relative prices, and exchange-rate volatility. They argue that since the exchange rate is agreed when an export contract is signed, but payment is usually made only

when goods are delivered, exchange rate volatility increases risk and uncertainty about actual cash flows.

In this study, the authors find a stable long-term relationship between exports and economic activity in foreign markets, exchange rates and the volatility of exchange rates for these developing countries. In nine out of ten countries studied, the coefficient for volatility of real exchange rates has a negative sign and is statistically significant.

Arize, Osang and Slottje (2008), using a similar approach to Arize, Osang and Slottje (2000) published a study on the export behavior of Bolivia, Colombia, Costa Rica, The Dominican Republic, Ecuador, Honduras, Peru, and Venezuela. They first construct a measure of exchange rate uncertainty based on the autoregressive conditional heteroskedasticity (ARCH) model. Later, the authors apply cointegration analysis and error correction model. They conclude that exchange rate volatility has a negative impact on the export volume of the countries in the sample, both in the short and the long run.

Pino, Tas and Sharma (2016) look for the effects of exchange rate volatility on the exports of East Asia and find that exchange rate volatility has a significant impact on short-term and long-term exports. This impact is predominantly negative, for almost all countries studied.

VI. Concluding remarks

There are several studies which show the negative impact of real effective exchange volatility on economic growth. This impact is particularly important for countries with insufficient financial development. Also, most studies show a negative effect of real exchange rate volatility on exports, although the effects on international trade may vary depending on the sector under study. Panel data studies which consider different trade sectors may shed more light on the specific effects of REER volatility on trade. The negative effects of REER on growth may be explained by other factors, besides the relation between REER volatility and international trade. Countries with sluggish economic growth or with difficulties to increase its export volumes should be aware of the problems derived from REER volatility, and much more so in the case of developing countries with scarce financial development.

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¹ For a more updated summary and critical view on export led growth, read Rodrik (2010).

² Rapetti (2020) has recently reviewed the literature on exchange rate misalignment and economic growth.

³ Although an exchange rate depreciation has an opposite effect, the authors explain that the existence of credit constraints means that these two effects fail to completely offset each other.

⁴ Although these results are obtained under the Reinhart and Rogoff (2004) classification of exchange rate regimes and while they do not appear to hold significantly under the Levy Yeyati and Sturzenegger (2003) classification, when the authors perform a sensible modification of the latter classification their main results are confirmed.

⁵ Purchasing power parity equilibrium value.

⁶ A gravity model of trade is a model in which it is assumed that international trade between a pair of countries depends both on the size of each country's GDP, and also on the physical distance between these two countries.