"The Effects of Exchange Rate Volatility on International Trade"

Department of Economics, University of Essex

Flavius Nuta

BSc Economics Undergraduate

Registration Number: 1300605

Abstract

This paper provides an empirical analysis of the relationship between bilateral exchange rate volatility and international trade using a gravity model. The panel data set employed in this study includes bilateral observations for 73 countries spanning a period of 22 years from 1990 until 2011. The standard deviation of the difference of the log of exchange rate is used as a measure for volatility. The results are robust across different estimation techniques and identify a small, yet significant negative effect of bilateral exchange rate volatility on bilateral trade, in line with most studies conducted on the matter.

Table of Contents

1. Motivation

The impact of exchange rate volatility on international trade has been addressed in numerous studies conducted after the fall of the Bretton Woods system and the implementation of a new floating exchange rate system. One of the main arguments made against the new exchange rate regime implemented in 1973 was that the lack of predictability posed by variable exchange rates will negatively impact the volume of international trade[1]. The issue that has been of great concern to economists for decades is that increasing exchange rate volatility is perceived as a risk factor for international trade, leading risk averse traders to reduce their export activities and to reallocate their resources toward domestic markets. Exchange rate volatility is defined as the risk associated with large fluctuations in exchange rates. Despite high volatility in economic fundamentals during the 1970s and 1980s, namely balance of payments, interest rates and inflation rates, neither the empirical nor the theoretical academic studies could conclude whether the persistent fluctuations of exchange rate negatively or positively impact international trade.

To analyse the issue at hand, this paper examines bilateral trade among 73 countries spanning a period of 22 years under a gravity model; I aim to contribute the existing literature on the subject by assessing a more detailed set of panel data using a gravity equation approach in order to observe exports under the influence of exchange rate volatility in recent years. Given the gravity model's property of being flexible in supporting different models, the analysis conducted throughout this paper can be extended later on to address other issues regarding the relationship between international trade and exchange rate volatility. This paper extends on previous literature in two points. Firstly, to the best of my knowledge, only two studies have

[1] Frömmel and Menkhoff (2003) find evidence of increased volatility over a period of 25 years (1973-1998) for most of the currencies considered in their empirical study.

conducted unit root tests to address the issue of stationarity in long panel data sets so far (Chit, 2008; Chit et al. 2010). Secondly, apart from providing new insights into the relationship between exchange rate volatility and trade, I analyse international trade in the context of regional trade agreements and colonial relationships between countries.

The paper continues as following. Section 2 gives an overview of existing literature on the matter, Section 3 will provide a description of the panel data used and the empirical model, will Section 4 will comment on the results. The following sections will comment on the limitations of the model, possible future research based on this study as well as a conclusion.

2. Literature Review

2.1. Theoretical works on the relationship between exchange rate volatility and trade

Clark (1973) created a basic model to address the issue of how real exchange rate volatility impacts the level of a firm's exports within a partial equilibrium framework. The author based his research on the hypothetical case of a competitive firm which produces exactly one commodity and then proceeds to sell it in one foreign market without importing any intermediate inputs necessary for production. Payment is made entirely in foreign currency and the firm converts its earnings from exports at the current exchange rate which varies unpredictably under the assumption that no hedging possibilities are plausible. Adjustments in the scale of production incur costs which cannot be borne at short notice. The firm makes a decision regarding production in advance, unable to alter its output in response to positive or negative shifts in the profitability of its exports created by exchange rate fluctuations. Under the model described by Clark (1973), uncertainty about future exchange rates directly affects any future revenue in domestic currency. Thus, the firm must incorporate the risk posed by this

uncertainty when determining the optimal level of exports. This model, as described by Clark (1973) and later refined by Hooper and Kohlhagen (1978), establishes the existence of a negative relationship between exchange rate volatility and the volume of international trade. In other words, when the firm's revenue depends strictly on exchange rates, a greater level of volatility in the latter translates into a decrease in output, as the firm aims to reduce its exposure to risk.

In addition to the works of Clark (1973) and Hooper and Kohlhagen (1978), numerous other studies (Ethier, 1973; Baron, 1976; Cushman, 1983; Peree and Steinherr, 1989) have reached the same end results – increased exchange rate volatility will negatively impact international trade. However, these conclusions are based on a series of simplifying suppositions: perfect competition, the absence of imported production inputs, the payment currency's importance, high risk aversion and the lack of hedging possibilities. Nonetheless, the limitations of these simple models can easily be pointed out: in economies with highly developed forward markets, hedging is available for certain transactions to help reduce exposure to large fluctuations in exchange rates. Furthermore, the effect of volatility on exports volume is diminished when the assumption restricting imported production inputs is removed. When the invoicing currency depreciates and the firm described by Clark (1973) incorporates imported inputs in its production process, the negative effect of exchange rate volatility on exports is counteracted by the lower input costs. These early studies have formed a solid foundation for more complex models depicting the ambiguous relationship between exchange rate volatility and international trade. The models presented in the following subsections, (2.1 – 2.5) analyse each of the assumptions presented above individually, while holding everything else constant.

2.2. Models focusing on the risk-aversion of exporters

De Grauwe (1988) constructed a model to help understand the inconclusive relationship between exchange rate volatility and trade by focusing on the risk-aversion of the exporter. Risk-neutral individuals are less likely to be concerned with possible outcomes caused by large fluctuations in exchange rates, unlike risk-averse exporters who view "the return on export activity now as less attractive given the increase in risk and decide to export less" (De Grauwe, 1988). Surprisingly, the study has found that very risk-averse individuals export more to offset the negative effects of exchange rate volatility on their revenues. Broll and Eckwert (1999), focused their attention on a hypothetical risk-averse firm, flexible enough to react to fluctuations in forward markets by relocating their output from one market to another. Higher exchange rate volatility can lead to increased exports revenue, which in turn, makes production more profitable. Broll and Eckwert (1999) indicate that a volatile exchange rate increases the risk exposure for exporting firms and therefore, those that are risk-averse, tend to decrease their export volumes. Their study has found that the effect of large exchange rate fluctuations on exports depends on the firm's risk aversion level. The conclusion of their paper is more radical than what previous existing literature on the matter offers: "a positive link between exchange rate volatility and international trade has a theoretical basis" (Broll and Eckwert, 1999), given a more risk-neutral exporting firm.

2.3. Models focusing on adjustment costs

Another set of studies focuses on the effect of exchange rate volatility on international trade under the assumption that firms can adjust production according to variations in exchange rates. In theory, when one or more production factors is adjustable, firms can benefit from increased volatility, subject to their level of risk-aversion. According to Gros (1987) and De Grauwe (1992), if an exporter can adjust production during both positive and negative exchange rate

fluctuations, their average revenue will be larger, as they sell more when prices in foreign currency are high, and less when prices in foreign currency are low, thus spreading the risk associated with the latter. However, this depends on the firm's risk aversion towards uncertainty. High risk aversion allows the large variability in profit to deter the firm from exporting more, while a low risk aversion incentivises firms to increase production as a response to the possibility of larger profits.

2.4. Models focusing on hedging possibilities

Certain studies conducted on the issue of exchange rate volatility effects on international trade account for situations when firms can call upon financial hedging through forward exchange markets to protect themselves against considerable exchange rate fluctuations. Under the assumption that exchange rate volatility is the only source of uncertainty, Baron (1976) argues that forward markets are a perfect neutralising tool against the effects of exchange rate volatility on international trade. In a more complex study, Viaene and De Vries (1992) take Baron's (1976) study one step further and state that importers and exporters are on opposite sides of the forward market and so is their exposure to uncertainty posed by exchange rate volatility. In addition, hedging opportunities are available to specific categories of firms operating only in advanced economies. However, these options only cover a limited number of possible fluctuations as it is difficult to assess the impact of such variations on trade. Large exporters engaged in numerous contracts across several countries are presented with numerous opportunities to exploit volatile fluctuations in exchange rate to expand their profits. A study conducted by Caporale and Doroodian (1994) confirms hedging as a difficult to implement and cost-generating instrument for offsetting exchange rate volatility. Cushman (1983) acknowledges that if exports are priced in a depreciating currency, the exporter is capable of offsetting lower profits generated by the declining foreign currency through higher invoice

currency prices. According to Makin (1978), multinational companies which trade in a large number of countries protect their profits in front of offsetting currency movements by holding a portfolio of assets and liabilities invoiced in different currencies. A similar study by Obstfeld and Rogoff (1998) evaluates the hedging behaviour of firms operating in developed economies and concludes that risk-averse firms hedge against exchange rate fluctuations. However, the costs of implementing such a decision are reflected in the overall prices of exports and ultimately they will show up as a negative effect on international trade.

2.5. Models focusing on the composition of trade

This fourth aspect addresses the implication of "sunk costs" on the relationship between exchange rate volatility and international trade. In other words, rather than focusing on volume, this final aspect focuses on the composition of trade. With the sheer amount of different goods available, firms must invest considerably in production, marketing and distribution centres to support their exporting operations and remain competitive. The firm will be less responsive to short-run exchange rate fluctuations, as an implication of these "sunk costs". Models proposed by Dixit (1989), and in particular Franke (1991) and Sercu and Vanhulle (1992) measure the influence exchange rate volatility and associated risk have on a firm's decision to enter or exit a foreign market, based on "sunk costs". Franke (1991) and Sercu and Vanhulle (1992) deeply embed in their models the idea of firms currently not exporting to foreign markets having the option to enter, while firms already trading in these markets having the option to exit. Under the model's assumptions, their decision is based on two factors: the cost of their decision to enter or exit the export market and the "sunk" and variable costs related to that decision.

2.6. Models using a general equilibrium framework

Unlike the partial equilibrium models discussed so far, where the only variable is a measurement of exchange rate variability, ceteris paribus, general equilibrium models, in particular the one proposed by Bacchetta and Van Wincoop (2000) take into account the relationship between all variables to help determine the interaction between exchange rate volatility and international trade. Bacchetta and Van Wincoop (2000) devised a general equilibrium model with two countries where uncertainty arises from technological, fiscal and monetary shocks. The authors find two outcomes after measuring the level of international trade for both floating and fixed exchange rates: "adopting a fixed exchange rate regime does not necessarily lead to more trade" (Bacchetta and Van Wincoop, 2000) and increased international trade conducted by an economy does not always correspond to a higher welfare value.

2.7. Empirical works on the relationship between exchange rate volatility and trade

The various empirical studies conducted in support of the existing theoretical literature on the relationship between exchange rate volatility and international trade lack decisive findings in support of a negative interaction. IMF (2004) explores the issue of exchange rate volatility negatively affecting international trade alongside several points such as country group, differentiated products, short- and long-run volatility. The study also considers nominal and real exchange rates in its analysis. According to IMF (2004), the level of world trade has constantly grown from 1970 until 2000, despite large inflation shocks throughout the 1970s. The findings demonstrate that no obvious negative association between trade and exchange rate volatility exists, or where a significant effect exists, it lacks a "systematic effect in one direction or the other" (IMF, 2004). By using a gravity model, the study allows control over many variables which might affect trade patterns. The authors of the study find little evidence that

exchange rate variability is different in developing and developed countries together with no conclusive results to demonstrate differentiated results on various types of goods.

However, more recent studies, which made use of panel data, have found that in general, there is a negative implication of exchange rate volatility on trade. Rose (2000) and Tenreyro (2004) employ panel data sets with observations for over 100 countries. Tenreyro (2004) finds a small effect of 2% increase in trade if exchange rate volatility would be reduced to zero. On the other hand, Rose (2000), determines the impact of exchange rate volatility on trade to be significantly negative, in the sense that bilateral trade would increase by approximately 13 % if exchange rate volatility were to be reduced by one standard deviation around the mean. Clark, Tamirisa, and Wei (2004) used a panel data set, covering more than 170 International Monetary Fund (IMF) member countries over a period of 25 years. Using fixed effect estimation, the authors found a significant negative impact of volatility on trade, with a 7% increase in trade if volatility was reduced by one standard deviation.

3. Model Background

3.1. Sample description

In order to analyse the impact of exchange rate volatility on trade, a panel data set with *91,456* observations of bilateral trade between 73 countries[2] over a period of 22 years (1990 – 2011) has been used to estimate the equation. For some countries included in this analysis (i.e. Azerbaijan, Kazakhstan), data on bilateral trade, GDP and exchange rate is not available prior to 1993 most probably due to the political and economic uncertainty after the collapse of the USSR. Empirically, this affects the data set, rendering it unbalanced.

[2] See "A1. Countries list" in the Appendix

The source of real GDP has been extracted from the *Penn World Table 8.0* for the period spanning 1990 – 2011. Data on bilateral trade has been compiled from the IMF Direction of Trade Statistics (DOTS), while information regarding distance between countries (contiguity), colonial relationships, regional trade agreements and official language has been sourced from the CEPII website. Quarterly data on nominal exchange rates between national currencies and the US Dollars has been extracted from the IMF International Financial Statistics (IFS) for a period of 27 years in order to better construct the bilateral exchange rate volatility variable. After carefully building the exchange rate between countries *i* and *j* at time *t*, I have moved on to estimate exchange rate volatility as the standard deviation of the first difference of the quarterly natural logarithm of the nominal exchange rate between all combinations of countries *i* and *j* over a five-year period prior to *t*. In other words, the exchange rate volatility for the Brazil – Spain pairing for the year 1990 is estimated using quarterly data from 1985 until 1989. In existing literature, there is no general consensus on how to calculate exchange rate volatility. Using the equation proposed by Nicita (2013), with a few minor changes, the exchange rate volatility can be expressed as:

$$ERVol_{ijt} = \text{sd}[\ln(NER_{ijt,q}) - \ln(NER_{ijt,q-1})]$$

where *sd* represents standard deviation, *NER* is the bilateral nominal exchange rate and *q* represents quarters. In this case, the empirical analysis is not affected by the use of nominal exchange rate instead of real exchange rate, as they are strongly correlated in the short run. According to Baltagi (2001), the use of pane data allows for the control of unobserved individual heterogeneity; in a situation where such effects are correlated with independent variable and are omitted, the OLS estimates would be biased.

In the employed data set there are 13,652 (14,93%) observations of regional trade agreements in effect between two trading countries, 2,879 (3,15%) observations of countries sharing a

common border which engaged in trade, 13,198 (14,43%) observations of countries sharing the same official language and 2,693 (2,94%) observations of countries sharing any type of colonial relationship (coloniser, ex-colony, part of the same empire, same country during the colonial period). The summary statistics for the regression model variables are presented in Table 1.

Table 1. Summary statistics of regression variables

VARIABLES	(1) mean	(2) sd	(3) min	(4) max
Contingency	0.0315	0.175	0	1
Common Language	0.144	0.351	0	1
Bilateral Exports (log)	17.22	3.405	0.378	26.59
Distance (log)	8.709	0.818	4.710	9.892
GDP Exporter (log)	12.21	1.708	7.882	16.41
ER Volatility	0.248	0.392	0	4.967
Colonial	0.0294	0.169	0	1
RTA	0.149	0.356	0	1
GDP Importer (log)	12.08	1.789	7.882	16.41

3.2. Empirical Model

According to Chit et al. (2010), using bilateral rather than aggregate multilateral trade flows allows control of not only exchange rate volatility, but also for other factors such as cultural relationships (i.e. colonial past, common language) and geographical properties (i.e. common border, distance between the two trading countries). The model dates back to Tinbergen (1962) and it establishes the trade volume between two countries as being directly proportional to their national income and inversely proportional to the distance between the two. Rose (2000) argues that the elasticities of trade with respect to income and distance are generally large from an economic point of view and statistically significant. Taking advantage of the model's ability to accommodate various kinds of theoretical models, I make full use of a gravity equation approach:

$$\ln Trade_{ijt} = \beta_1 + \beta_2 \ln GDP_{it} + \beta_3 \ln GDP_{jt} + \beta_3 \ln Dist_{ij} + \beta_4 ERVol_{ijt}$$

$$+ \beta_5 Contig + \beta_6 Language + \beta_7 RTA + \varepsilon_{ijt} \qquad (1)$$

where ***t*** represents time in years, and ***i*** and ***j*** denote countries.

The eight variables have been modelled to help estimate the effects of exchange rate volatility on bilateral trade and to account for as many other factors that might affect exports among countries. The model uses the logarithmic form of four variables to minimise the possible impact of collinearity and model misspecification.

A single dependant variable: $\ln Trade_{ijt}$

To ensure goodness of fit, the dependant variable which describes the value of bilateral trade between countries *i* and *j* at time *t* has been logartihmised.

Four independent, non-dummy, **variables**: $\ln GDP_{it}$, $\ln GDP_{jt}$, $\ln Dist_{ij}$, $ERVol_{ijt}$

$\ln GDP_{it}$ refers to the natural logarithm of the exporting country's GDP at time *t*, $\ln GDP_{jt}$ is the natural logarithm of the importing country at time *t,* $\ln Dist_{ij}$ is the natural logarithm of the distance between the two trading countries and $ERVol_{ijt}$ is the exchange rate volatility between the currencies of countries *i* and *j* at time *t.*

Two dummy variables: *Contig, Language*

The variable *Contig* indicates whether the two countries share a common border or not.

Language is a dummy variable which takes the value "1" if both countries share the same official language.

4. Empirical Results

The main results outlining the effects of bilateral exchange rate volatility on bilateral trade are presented in Table 2 and adjusted for robustness in both fixed-effect and random-effect estimations. Significant negative impact of exchange rate volatility is observed and the results are consistent with those of previous studies on the matter (Chit et al. 2010; Hayakawa and Kimura, 2008; Tenreyro, 2004).

Table 2. The Effects of Exchange Rate Volatility on Bilateral Trade

VARIABLES	(1) Random Effects	(2) Fixed Effects
Distance (log)	-1.216***	-
	(0.0355)	
GDP Importer (log)	0.967***	0.989***
	(0.0102)	(0.0162)
GDP Exporter (log)	1.205***	1.091***
	(0.0104)	(0.0165)
Contingency	0.481***	-
	(0.172)	
Common Language	0.884***	-
	(0.0777)	
ER Volatility	-0.178***	-0.191***
	(0.0103)	(0.0104)
Constant	1.183***	-7.930***
	(0.343)	(0.175)
R-squared (within)		0.219

Notes: Robust standard errors in parentheses. *, ** and *** in the table denote statistically significant coefficients at 10%, 5% and 1% level, respectively.

All coefficients are statistically significant at 1% level for both methods of estimation and all signs are as expected while the coefficients are economically reasonable. Given a greater distance between two countries, the level of trade seems to suffer as firms face increased

logistics costs to export their products. Shared land borders and common languages also show extensive bilateral trade between countries. As expected, large GDPs of both importers and exporters increase the overall bilateral trade.

In accordance with a large number of empirical studies on the matter, the negative effect of exchange rate volatility on trade is obvious from the analysis. The negative coefficients are significant at 1% for both methods of estimation and imply that uncertainty regarding the exchange rate discourages exports.

4.1. Introducing Regional Trade Agreements

In existing literature on trade, another variable which impacts bilateral trade between two countries is the presence of regional trade agreements. Therefore, I introduce the dummy variable *RTA* which takes the value "1" if both countries *i* and *j* are enforcing the same regional trade agreement and "0" otherwise. After running both a fixed effects estimation and a random effects estimation, the results are shown in Table 3.

Regional trade agreements impact bilateral trade significantly in a positive manner and some economic explanations for this situation could be low, or even the absence of tariffs, as well as trade diversion (Freund and Ornelas, 2010); some countries might prefer to divert trade from a third-party to a country which has engaged in a regional trade agreement with the exporter. Another observation is that since the introduction of the RTA dummy variable in the gravity model, the exchange rate volatility coefficient has slightly increased when using both fixed and random effects estimation methods. Countries engaged in regional trade agreements tend to exchange more goods more between each other and once a volatility shock occurs, the exporters could start rethinking their strategy regarding trade. Another mention-worthy observation is that the estimated coefficient for common border is larger than that of the participation in an

RTA. Chit (2008) suspects the benefit of reduction in tariff "may not be large enough to compensate for the transportation costs. This could be a confirmation that most of the bilateral exports among these countries are intermediate goods, which are bulky and already have lower tariff rates."

Table 3. The Introduction of Regional Trade Agreements as a Variable

VARIABLES	(1) Fixed Effects	(2) Random Effects
GDP Importer (log)	0.964***	0.947***
	(0.0162)	(0.0102)
GDP Exporter (log)	1.065***	1.187***
	(0.0166)	(0.0104)
ER Volatility	-0.194***	-0.180***
	(0.0104)	(0.0103)
Regional Trade Agreement	0.322***	0.337***
	(0.0219)	(0.0215)
Distance (log)		-1.125***
		(0.0352)
Contingency		0.511***
		(0.168)
Common Language		0.880***
		(0.0762)
Constant	-7.353***	0.791**
	(0.179)	(0.337)
R-squared (within)	0.221	

Notes: Robust standard errors in parentheses. *, ** and *** in the table denote statistically significant coefficients at 10%, 5% and 1% level, respectively.

4.2. Colonial Relationships as Part of the Model

Colonial relationships play an important role in the political and economic interactions between two countries. Therefore, I have added a dummy variable, *Colonial*, which takes the value "1" if the countries have had any type of role in the colonial relationship between the them (i.e. coloniser, ex-colony, both countries had the same coloniser, both countries were part of the same country) and "0" otherwise.

Table 4. The Introduction of Colonial Relationships as a Variable

VARIABLES	(1) No RTA	(2) RTA
GDP Exporter (log)	1.203***	1.185***
	(0.0105)	(0.0104)
GDP Importer (log)	0.964***	0.945***
	(0.0102)	(0.0102)
Contingency	0.416**	0.443***
	(0.172)	(0.168)
Common Language	0.782***	0.773***
	(0.0803)	(0.0787)
Colony	0.852***	0.890***
	(0.171)	(0.167)
Distance (log)	-1.216***	-1.124***
	(0.0354)	(0.0352)
ER Volatility	-0.179***	-0.180***
	(0.0103)	(0.0103)
Regional Trade Agreement		0.339***
		(0.0215)
Constant	1.229***	0.838**
	(0.342)	(0.337)

Notes: Robust standard errors in parentheses. *, ** and *** in the table denote statistically significant coefficients at 10%, 5% and 1% level, respectively.

Brysk et all. (2002) find a "surprising convergence" in the establishment and development of post-colonial economic preferences and diplomatic structures between colonial powers and their former subjects which could help explain the positively significant coefficient associated with the dummy variable *Colonial*. Furthermore, a colonial relationship between two countries seems to impact bilateral trade more than a regional agreement or a common border would. Colonisers, ex-colonies and countries with the same coloniser, all seem to trade intensely, when compared to countries with no such relationship

4.4. Unit root tests

Previous studies which engaged in analysing the effects of exchange rate volatility on trade using panel data have not particularly addressed the issue of non-stationarity. Dell'Ariccia (1999) notes that long time measure of panel data may in fact lead to non-stationarity while only two of the studies I have researched, Chit (2008) and Chit, Rizov and Willenbockel (2010), have conducted unit root tests to check for non-stationarity. Therefore, previous studies employing panel data to analyse the relationship between international trade and exchange rate volatility are subject to the possibility of spurious regression.

In order to establish if the data set might lead to such issues, I conduct a test in search for unit roots in the panel. However, as I mentioned before, the unavailability of data for some countries included in this data set has lead to an unbalanced panel. This situation causes unit root tests such as IPS (Im, Pesaran and Shin, 2003), Hadri LM (Hadri 2000) and Harris-Tzavalis (Harris and Tzavalis, 1999) to be impossible to conduct in order to check for stationarity. The only viable option left to check for unit roots in the panel data set was a Fisher-type test (Choi, 2001)

based on both augmented Dickey-Fuller tests (ADF) as well as Philips-Perron tests (the latter is robust to serial correlation). The null hypothesis is that all panels contain unit-roots, with the alternative being that there are no unit roots in the panels. Under the given model conditions (time trend and panel mean included), all test statistics render a p-value<0.01 (for both ADF and Philips-Perron), thus rejecting the null hypothesis at a 1% statistical significance level.

Critical Discussion and Future Research

This study is not based on a specific theory on trade and it provides a general overview of a few important factors which impact bilateral trade.

While the gravity model is widely used throughout existing literature to analyse the effects of exchange rate volatility, there are certain limitations which could be addressed in a further research paper on the matter. Dell' Ariccia (1999) makes a strong case for the gravity model to be used in the estimation intra-industry trade between developed countries. Bayoumi and Eichengreen (1995) argue that the use of the gravity model in studies analysing a sample of both developed and developing countries could result in some questionable results due to different trade patterns of developing countries.

The model employed in this paper calculates the exchange rate volatility as the standard deviation of the first difference of the quarterly natural logarithm of the nominal exchange rate between all combinations of countries *i* and *j* over a five-year period prior to *t*. While there is no consensus on the optimal measurement for this variable, the method implemented in this paper "gives large weight to extreme volatility" (Rose, 2000). Moreover, the majority of countries included in this dataset tend to focus on exporting goods as their internal markets cannot consume the entire productions. This leads to their exports being less prone to exchange

rate volatility risk. Other methods which could be used to calculate volatility are based on a GARCH model which allows for volatility clustering; if the exchange rate presented large variances in past periods, it would generate large variances in the future (Clark, Tamirisa and Wei, 2004).

References

Bacchetta, P. and Van Wincoop, E., (2000), "Does Exchange-Rate Stability Increase Trade and Welfare?", *The American Economic Review 90 (5)*, December.

Baltagi, B. H. (2001), *Econometric Analysis of Panel Data:* 2nd ed., Wiley.

Baron, D., (1976), "Fluctuating Exchange Rates and the Pricing of Exports", *Economic Inquiry*, 14: 425-38.

Bayoumi, T., and Eichengreen, B., (1995), "Is Regionalism Simply a Diversion? Evidence from the Evolution of the EC and EFTA", *CEPR Discussion Paper* No. 1294.

Broll, U., and Eckwert, B., (1999), "Exchange Rate Volatility and International Trade", *Southern Economic Journal 66*: 178-185

Brysk, A., Parsons, C., and Sandholtz, W., (2002), "After Empire: National Identity and Post-Colonial Families of Nations", *European Journal of International Relations*, Vol. 8(2): 267–305

Caporale, T., and Doroodian, K., (1994), "Exchange Rate Variability and the Flow of International Trade", *Economic Letters 46-1* (September): 49-54.

Chit, M. M., (2008), "Exchange Rate Volatility and Exports: Evidence from the ASEAN–China Free Trade Area", *Journal of Chinese Economic and Business Studies 6(3):261-277*

Chit, M. M., Rizov, M. and Willenbockel, D., (2010), "Exchange Rate Volatility and Exports: New Empirical Evidence from the Emerging East Asian Economies", *World Economy, 33*: 239-263.

Choi, I., (2001). "Unit root tests for panel data", *Journal of International Money and Finance* 20: 249–272.

Clark, P. B., (1973), "Uncertainty, Exchange Risk, and the Level of International Trade", *Western Economic Journal,* 11 (September): 302-13

Clark, P.B., Tamirisa, N., and Wei., S., (2004) "A new look at exchange rate volatility and trade flows" *IMF Occasional Paper*, No. 235.

Cushman, D., (1983), "The Effects of Real Exchange Rate Risk on International Trade", *Journal of International Economics, 15:* 45-63.

De Grauwe, P., (1988), "Exchange Rate Variability and the Slowdown in Growth of International Trade", *IMF Staff Papers*, 35: 63-84.

De Grauwe, P., (1992), "The Benefits of a Common Currency", *The Economics of Monetary Integration*, edited by Paul De Grauwe. New York: Oxford University Press.

Dell'Ariccia, G., (1999), "Exchange Rate Fluctuations and Trade Flows: Evidence from the European Union", *IMF Staff Papers,* 46, 3, 315-34.

Dixit, A., (1987), "Entry and Exit Decisions of a Firm under Fluctuating Exchange Rates," Mimeo, (New Jersey: Princeton University).

Ethier, W., (1973), "International Trade and the Forward Exchange Market", *American Economic Review 63 (3)*: 494–503.

Franke, G., (1991), "Exchange Rate Volatility and International Trading Strategy," *Journal of International Money and Finance 10*: 292-307

Freund, C., Ornelas, E., (2010) "Regional Trade Agreements", *The Annual Review of Economics* 2010. 2:139–66

Frömmel, M. and Menkhoff L., (2003), 'Increasing Exchange Rate Volatility during the Recent Float', *Applied Financial Economics*, 13, 12: 877–83

Gros, D., (1987), "Exchange Rate Variability and Foreign Trade in the Presence of Adjustment Costs", *Working Paper no. 8704*, Department de Sciences Economiques, Universite Catholique de Louvain.

Hadri, K., (2000), "Testing for stationarity in heterogeneous panel data" *Econometrics Journal* 3: 148–161.

Harris, R. D. F., and Tzavalis, E., (1999), "Inference for unit roots in dynamic panels where the time dimension is fixed", *Journal of Econometrics* 91: 201–226

Hayakawa, K., and Kimura, F., (2008), "The Effect of Exchange Rate Volatility on

International Trade: The Implications for Production Networks in East Asia", IDE Discussion Paper No. 156.

Hooper, P., and Kohlhagen, S. W., (1978), “The effect of exchange rate uncertainty on the prices and volume of international trade”, *Journal of International Economics, 8:* 483-511.

Im, K. S., M. H. Pesaran, and Y. Shin, (2003), "Testing for unit roots in heterogeneous panels", *Journal of Econometrics* 115: 53–74.

IMF, (2004), “Exchange Rate Volatility and Trade Flows - Some New Evidences”, *IMF Occasional Paper 235*.

Makin, J. H., (1978), “Portfolio Theory and the Problem of Foreign Exchange Risk,” *Journal of Finance 33*, May: 517-34.

Nicita, A., (2013), Exchange Rates, International Trade and Trade Policies", *Policy Issues in International Trade and Commodities Study Series No 56*

Obstfeld, M., and Rogoff, K., (1998), “Risk and Exchange Rates,” *NBER Working Papers Series, WP 6694*, (Cambridge, Massachusetts: National Bureau of Economic Research).

Peree, E., and Steinherr, A., (1989), “Exchange rate uncertainty and foreign trade”, *European Economic Review, 33:* 1241-1264.

Rose, A. K., (2000). "One money, One Market: The Effect of Common Currencies on Trade", *Economic Policy 15*, no. 30: 7–46

Sercu, P., and Vanhulle, C., (1992), “Exchange Rate Volatility, International Trade, and the Value of Exporting Firms”, *Journal of Banking and Finance 16*: 155-82

Taglioni, D., (2002), “Exchange Rate Volatility as a Barrier to Trade: New Methodologies and Recent Evidences”, *Economie Internationale (CEPII), Quarter 1-2*: 227-259.

Tenreyro, S., (2004). "On the trade impact of nominal exchange rate volatility", *Federal Reserve Bank of Boston Working Paper*, No. 03-2.

Tinbergen, J., (1962), "Shaping the World Economy: Suggestions for an International Economic Policy" (New York).

Viaene, J.M., and de Vries, C. G., (1992), “International Trade and Exchange Rate Volatility, *European Economic Review* 36: 1311- 21.

Argentina ARG	Iceland ISL	Panama PAN
Australia AUS	India IND	Paraguay PRY
Austria AUT	Indonesia IDN	Peru PER
Azerbaijan AZE	Iran, Islamic Republic of IRN	Philippines PHL
Bangladesh BGD	Ireland IRL	Poland POL
Belgium BEL	Israel ISR	Portugal PRT
Bolivia BOL	Italy ITA	Russian Federation RUS
Brazil BRA	Jamaica JAM	Senegal SEN
Bulgaria BGR	Japan JPM	Sierra Leone SLE
Canada CAN	Jordan JOR	Singapore SGP
Chile CHL	Kazakhstan KAZ	South Africa ZAF
China, P. R.: Mainland CHN	Kenya KEN	Spain ESP
Colombia COL	Korea, Republic of KOR	Sri Lanka LKA
Congo, Republic of COG	Madagascar MDG	Sweden SWE
Costa Rica CRI	Malaysia MYS	Switzerland CHE
Cote d'Ivoire CIV	Mexico MEX	Thailand THA
Czech Republic CZE	Morocco MAR	Togo TGO
Denmark DNK	Netherlands NLD	Tunisia TUN
Ecuador ECU	New Zealand NZL	Turkey TUR
Egypt EGY	Niger NER	United Kingdom GBR
Finland FIN	Nigeria NGA	United States USA
France FRA	Norway NOR	Uruguay URY
Germany DEU	Pakistan PAK	Venezuela, Bolivarian Republic of VEN
Ghana GHA		Zambia ZMB
Greece GRC		Zimbabwe ZWE

Appendix

A1. Countries List