EXCHANGE RATE VOLATILITY AND INTERNATIONAL TRADE

By
Orkhan Najafov

Submitted to
Central European University
Department of Economics

In partial fulfillment of the requirements for the degree of Master of Arts

Supervisor: Professor Miklós Koren

Budapest, Hungary

2010

CEU eTD Collection

Abstract

Main objective of this thesis is to analyze the effect of exchange rate volatility and different exchange rate regimes on international trade. Through use of a panel data including US trade with large number of countries and fixed effects estimation methods significant negative effect of exchange rate volatility on trade is found, but this effect is not unambiguous. I find larger effect of exchange rate regimes on US imports compared to exports.

CEU eTD Collection

Acknowledgments

I am very thankful to my academic supervisor, Professor Miklós Koren, for his valuable comments and recommendations which helped me in developing my approach to the topic. I want to thank Yulia for her patience, support, help and love throughout the thesis process. Special thanks to Mammad Babayev for entertaining me during the sleepless nights and providing insights that guided and challenged my thinking.

CEU eTD Collection

Contents

CEU eTD Collection

Introduction

The collapse of Bretton-Woods posed a vexed question in the world economic research: the impact of exchange rate volatility on the international trade. As the exchange rates have been highly volatile since then, a lot of research was done to find out what was the effect of such volatility on foreign trade. Most scholars thought that the exchange rate volatility was the main source of economic instability in the world economy, and they were able to find significant relationships between the exchange rate volatility and international trade. A lot of research papers were devoted to looking for negative relationship between the volatility and trade, but this was not always the case. To sum up, although sometimes the results of empirical studies confirmed positive relationship, in a number of cases these relationships were not proven to be strong.

There are several reasons why economists had certain difficulties with finding strong relationships between the exchange rate volatility and international trade. The given study will attempt to enumerate and analyze these difficulties, while simultaneously it will search for the answer to the main question under consideration - what is the impact of exchange rate volatility on the international trade. As some of the economic models built by different economists in order to explain the impact of exchange rate volatility on the firm level and globally will be helpful for the research, they will also be included in the study.

Although a lot of articles were written on the topic of exchange rate volatility, different economists still have different ideas about the effect of exchange rate variability on international trade and most of the results of empirical studies are inconclusive. Since the exchange rates during the last decades have been highly volatile which caused a lot of changes in capital markets, this question is still very relevant. Moreover, the development of forward markets makes us look at this problem from

CEU eTD Collection

different point of view now. As the exchange rate variability has a great influence on the welfare of the nation as it directly affects its trade, it is very important to research this problem to find ways to avoid the negative consequences of it. Therefore, the topics of exchange rate volatility and international trade have been the main subjects of a number of articles that have been written during the last four decades

CEU eTD Collection

1 Literature Review

One of the early articles written on this topic is Hooper and Kohlhagen (1978). In this article Hooper and Kohlhagen develop a model to analyze the impact of exchange risk on trade prices and quantities. Besides, they test this model empirically for U.S. and German trade flow cases for the period of 1965-1975, considering both importers' and exporters' attitudes toward exchange risk. In their theoretical model they find out that if traders are risk averse, an increase in exchange risk will reduce the volume of trade no matter the importers or exporters bear the risk. They also found out that the price of traded goods can change in either direction depending on who faces the risk.

In order to focus only on the issue of exchange rate volatility Hooper and Kohlhagen assume that the exchange rates are the only source of uncertainty. Three methods of measuring the exchange rate variability were used for estimation.[1] Other sources of uncertainty, such as expectations about exchange or capital controls and trade barriers are not easily quantifiable. Using the data from 1965 to 1975 they test for the impacts of exchange rate volatility in sixteen cases involving U.S. and Germany. They test this model both for multilateral and bilateral trade flows. As in previous studies they did not find statistically significant relationship between the exchange rate volatility and international trade. Although they use different functional forms, models and measures of exchange rate volatility they do not get significant results, except for the case with United Kingdom. They find out that exchange rate volatility has had a relatively significant negative effect on U.S. - U.K trade.

CEU eTD Collection

[1] Measuring the exchange rate volatility is discussed in the next section.

The similar model is used by Cushman (1983). Cushman uses larger sample size and real exchange rates instead of nominal exchange rates. The following model was used to estimate the effect of uncertainty.

$$Q = \beta_0 + \beta_1 Y + \beta_2 CU + \beta_3 UC + \beta_4 UC^{*} + \beta_5 R + \beta_6 M + \beta_7 S + \beta_8 D$$

Where Q is export, Y is nominal GNP, UC and UC^{*} are unit cost of production of home and foreign countries respectively, R is the real exchange rate, S is uncertainty, M is percentage change in real exchange rates and D is dummy for trade disruptions. Cushman tests this model for fourteen cases of bilateral trade between developed countries using quarterly data for 1965-1977, but only in six cases he finds significant negative effect. In Cushman (1986) and Cushman (1988), he uses similar methodology and data with a few modifications to volatility measure and additional variables to study the effect of exchange rate uncertainty on US trade. New results suggest better results in terms of significance.

One of the interesting papers about exchange rate volatility and international trade is De Grauwe (1988). He develops a model which explains the decline in the growth of international trade. He focuses mainly on developed countries and looks at the period 1973-1984. The international trade growth among industrial countries has declined since 1973 and De Grauwe tries to find the amount of contribution of exchange rate volatility to this decline. He uses the following model:

$$X_{ij} = f\,(Y_j, P_{ij}, T_{ij}, S_{ij}, a)$$

Where the X_{ij} is the growth of exports of country j, Y_j is the growth rate of real income of country j and P_{ij} is the rate of change of the price of country i's goods relative to country j's goods. In this

CEU eTD Collection

model T_{ij} is the dummy variable which will be one if the trade arrangements between the two countries exist or it will be zero otherwise. S_{ij} is the exchange rate volatility measure of which will be discussed later. Finally, a is the disturbance term. It includes other disturbances that may affect the growth rate of trade flows between two countries. Here is the equation:

$$X_{ij} = b_t T_{ijt} + c_t Y_{jt} + e_t S_{ijt} + g_t P_{ijt} + a_t + u_{ijt} \qquad i, j = 1,\ldots,n; \; t = 1,2$$

t is the period and u_{ijt} is the error term. De Grauwe estimates the equation for two periods: 1960-1969 and 1973-1984. 1960-1069 represents the fixed exchange rate period and 1973-1984 represents the flexible exchange rate period. The transitional period of 1970-1972 is not taken into account.

The equation is estimated for 10 developed countries: Belgium, Canada, France, the Federal Republic of Germany, Italy, Japan, the Netherlands, Switzerland, the United Kingdom and the United States. I will not discuss the all coefficients and look at only exchange rate volatility. The result shows that the coefficient of exchange rate volatility is negatively significant in the second period. However it occurs only when real exchange rate volatility is used. De Grauwe does not find significant relationship for fixed period, because the exchange rate variability is small during that period. Thus, De Grauwe concludes that the high volatility of exchange rates has a significant negative effect on the growth rates of trade among the main developed countries.

Unlike the other studies De Grauwe uses cross-section evidence, such as integration variable. Besides, De Grauwe focuses on the long-run effect of exchange rate variability. In conclusion, using cross-section evidence pooled with data of two periods De Grauwe shows that the long-run volatility of real exchange rates affected the growth of international trade significantly. He shows that almost

CEU eTD Collection

20 percent of the observed reduction in the growth rate of international trade among the advanced courtiers can be explained by the increase in the long-run volatility of real exchange rates.

Koray and Lastrapes (1989) also investigate the impact of real exchange rate volatility on U.S bilateral imports from developed countries. They use vector autoregression (VAR) model to estimate the equation for imports from United Kingdom, Germany, Canada, France and Japan separately. Their article has a few advantageous points, as compared to previous studies. First, they do not impose theoretical restrictions, such as exogeneity, on the variables. Second, the vector autoregression model accommodates general dynamic relationships among variables in the system. They estimate the systems separately for fixed exchange rate period and the floating rate period. Since they estimate the equation for U.S. imports they included the following variables: the US money supply, output level, price and real exchange rate volatility. All variables are transformed into natural logarithms, except interest rates and volatility.

However, overall the estimation results were not significant. These results make us say that the relationship between exchange rate volatility and international trade is weak. Still Koray and Lastrapes find out that effect of exchange rate volatility on U.S. imports was greater during the flexible rate regime than during the fixed exchange rate regime. They also conclude that shocks to volatility tend to depress imports.

Dell'Ariccia (1999) studies the effect of exchange rate volatility on bilateral trade flows using a gravity model and panel data from western European countries. Other explanatory variables include log product of GDPs and log product of populations of two trading countries, log distance between trading country pairs, dummy for common border and language, dummy for EU membership and measure of exchange rate volatility. They use different proxies for exchange rate volatility including

CEU eTD Collection

standard deviation of nominal and real exchange rates. The main advantage of this paper is that in this study the simultaneity bias is taken into account and Instrumental Variable method is used to eliminate the issue. This paper suggests that Central banks are likely to stabilize the exchange rates with their main trade partners in which case there would be a negative feedback from bilateral trade to exchange rate volatility. In order to avoid this problem they used forward error as an instrument for exchange rate volatility. Forward rates are not controlled by central banks and have positive correlation with exchange rate volatility. All the results for different exchange rate volatility measures are similar. Overall most of the results are significant, but small.

Most empirical studies are based on the data for developed countries, and only a few papers have been written to examine the impact of exchange rate volatility on trade flows of developing countries. One of them is Arize *et al.* (2000) where he focuses on the effects of real exchange rate volatility on the export flows of 13 less developed courtiers (LDSs). Arize estimates the following equation using the data over the quarterly period 1973-1996:

$$Q_t^d = b + b_1 W_t + b_2 P_t + b_3 S_t + EC_t$$

Where Q_t denotes the logarithm of desired volume of a country's exports, W_t is the logarithm of a scale variable that represents the world demand; P_t is the logarithm of relative prices and is defined as the ratio of that country's export price in US dollars to the world export price in US dollars. S_t is the measure of exchange rate volatility and EC_t is a disturbance term. It is expected that b_1 is positive and b_2 is negative. Arize finds negative and statistically significant long-run relationships between export flows and exchange rate volatility in each of the 13 LDC's. In most countries Arize also finds significant relationship in a short-run period.

CEU eTD Collection

Arize and Shwiff (1998), Arize *et al.* (2005) use time series Granger method of cointegration to estimate the effect of exchange rate uncertainty on international trade between G-7 and Latin American countries. They use quarterly data and find significant negative effect for most of the countries. Unlike Arize, Bahmani-Oskooee (1996) and Bahmani-Oskooee (2002) apply time series Johansen method of cointegration to quarterly data to estimate the same effect. They also find significant negative effect.

The study by International Monetary Fund (IMF)[2] uses the model similar to Cushman's. They estimate the model for bilateral exports between seven developed countries. They use the data from 1969 to 1982. Four variables are used: real GNP, the real exchange rate, relative capacity utilization and exchange rate volatility. As a measure of volatility they use the standard deviation of the percentage changes in the exchange rate. In only two cases volatility has significant negative coefficients. Some coefficients are significantly positive. One of the reasons is that the sample period in which exchange rates are highly volatile is short.

Most of the studies use OLS and time series analysis to estimate the effect of exchange rate volatility. However, there is a number of papers that use other estimation methods like GARCH-in-mean (Kroner and Lastrapes (1993)), Instrumental variable (Tenreyro (2004)), Fixed and Random effects (Sauer and Bohara (2001)), ARMA (Doroodian (1999)) and others.

In conclusion it can be said that most of the empirical research that has been done on the topic proves the fact that the effect of exchange rate volatility on international trade is significant. However, there are a number of studies that do not support the hypothesis that exchange rate volatility does have negative effect on international trade. Moreover, what makes the research on the topic more

[2] Clark, Tamirisa, Wei, Sadikov and Zeng (2004)

CEU eTD Collection

problematic is the fact that the effect of exchange rate volatility on international trade is different for different countries and estimation methods. Thus it is quite evident that better estimation methods and data should be used to find the results that are reliable.

CEU eTD Collection

2 Measuring the Exchange Rate Volatility

One of the initial questions that must be discussed before the actual research is the way of measuring the exchange rate volatility. In most of the research devoted to exchange rate volatility and trade, there is no generally accepted method to measure volatility. Because there is no consensus on the model of firm behavior facing risk arising from fluctuations in exchange rates, different economists use different models to measure the exchange rate volatility. Different measures of volatility are introduced in Table 1.

There are several issues concerning measuring the exchange rate variability. Before measuring the volatility we have to decide whether short-term or long term volatility matters. Most of economists believe that short-term volatility in exchange rates is not appropriate for this kind of analysis, because they can be self canceling and long-run variability would affect decisions more. According to this theory change in exchange rates from one period to the next is not important and within period standard deviation and absolute percentage change of the exchange rate are not good measures for exchange rate volatility. The important factor that affects decisions is departure from the trend or equilibrium value. In this case variance of the spot exchange rate around its trend would be a better proxy for exchange rate volatility.

One of the exchange rate measures that were used in number of studies is average absolute difference between the previous forward rate and current spot rate. Supporters of this measure of volatility argue that exchange rate volatility can be anticipated by market. Therefore they use forward rate which incorporates these anticipations.

CEU eTD Collection

Table 1

Measure of Exchange Rate Volatility	*Papers*	*Results*
Absolute percentage change of the exchange rate $V_t = \frac{\lvert E_t - E_{t-1} \rvert}{E_{t-1}}$ where E_t is the spot exchange rate and t refers to time	Thursby and Thursby (1985)	Insignificant at aggregate level Significant at bilateral level
	Bailey, Talvas and Ulan (1986)	Significant negative effect in a few regressions
Average absolute difference between the previous forward rate and the current spot rate $V_t = \sum \frac{\lvert F_{t-1} - E_t \rvert}{n}$ where F is the forward rate	Hooper and Kohlhagen (1978)	Relatively significant effect for US-UK case and insignificant effect for the rest
	Maskus (1986)	Significant negative effect in machinery, chemicals and transport industries
Variance of the spot exchange rate around its trend which is predicted from $\ln e_t = \varphi_o + \varphi_{1t} + \varphi_{2t}^2 + e$	Thursby and Thursby (1987)	Significant negative effect for most of countries
	De Grauwe and De Bellefroid (1987)	Relatively significant negative effect
Moving average of the standard deviation of the exchange rate $V_t = \left[\frac{1}{m} \sum \left(Z_{t+i-1} - Z_{t+i-2} \right)^2 \right]^{\frac{1}{2}}$ Where Z is the log relative price of foreign consumer goods in terms of US consumer goods and m=12	Cushman (1983), (1986), (1988a, b)	Significant negative and positive effects in the first two papers; negative effects for the last
	Thursby and Thursby (1985)	Insignificant at aggregate level, significant at bilateral level
	Koray and Lastreps(1989)	Insignificant negative effect
	Bahmani and Oskooee (1996)	Significant negative effect
	Arize *et al.* (2000)	Significant negative effect
	Sauer and Bohara (2001)	Significant negative effect
	Bahmani and Oskooee (2002)	Significant negative effect
Within period standard deviation $V_t = \sqrt{\frac{1}{n-1} \sum \left(E_i - \bar{E} \right)^2}$ Where n is the number of period	Hooper and Kohlhagen (1978)	Relatively significant effect for US-UK case and insignificant effect for the rest
	Akhtar Hilton (1984)	Significant negative effect
	Gotur (1985)	Insignificant for most of the countries
ARCH model: $\sigma^2(\varepsilon_t) = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \ldots + \alpha_p \varepsilon_{t-p}^2$	Cushman (1983)	Positive and negative effects

CEU eTD Collection

Where p is the number of lags in ARCH(p) model	Arize *et al.* (2005)	Significant negative effect

Another widely used measure of exchange rate volatility is moving average of the standard deviation of exchange rate. This measure of volatility has done a better job compared to other volatility measures. However, it has been criticized, because of its skewed distribution and volatility clustering which makes successive price changes correlated. In order to avoid these disadvantages ARCH and GARCH models were proposed.

CEU eTD Collection

3 Theoretical Background

All the previous research on exchange rate volatility and international trade has been done in order to find negative relationship between them. The common belief is that if traders are risk averse and when there is an uncertainty about future exchange rates the volume of trade should decrease. When traders are uncertain about how exchange rates in the future will affect their revenues they reduce trade in order to minimize exchange rate risk and loss. Consider a firm producing commodities for export and being paid in foreign currency. Usually firms determine the volume of production before the exchange rate realization and they cannot adjust to moving exchange rates immediately. When the firms observe high volatility in exchange rates, they reduce the volume of trade to avoid loss from foreign exchange transaction. However, if a firm can adjust its production to moving exchange rates, there can be good opportunity from exchange rate variability. So, if a firm is paid in foreign currency and foreign currency is depreciating, the firm will decrease exports reducing loss, and if foreign currency is appreciating the firm will increase exports by increasing profits.

Some of the previous research tries to show that existence of developed forward markets can considerably decrease exchange rate volatility increasing international trade. However, not all countries have perfect forward markets and even in countries with developed forward market traders still can be uncertain about future exchange rates.

Hooper and Kohlhagen (1978) suggest that there can be feedback from international trade levels to exchange rate variability, i.e. exchange rate volatility can be viewed as endogenous variable. When there is a high level of trade between two trade partners, governments can adopt policies to

CEU eTD Collection

reduce exchange rate volatility. Exchange rate volatility even can be reduced to zero by adopting common currency or entering currency unions. Currency unions and other exchange rate regimes will be discussed later in this chapter.

Besides numerous papers that show that exchange rate variability does not have any effect on international trade, there are few articles that suggest positive effect of exchange rate volatility on international trade. Viaene and de Vries (1992) argue that since two trade partners are on the opposite sides of trade transactions exchange rate volatility should have a positive effect on one of the traders. Other scholars think that exchange rate uncertainty can have benefits. Exchange rate volatility increases the level of risk on one hand, but on the other hand it creates an opportunity to earn additional revenue. Other studies find negative, positive or no effect at all of exchange rate variability in specific industries.

It is also useful to look at this issue taking into account other macroeconomic variables that affect exchange rate volatility and trade. Depending on the movements of other macroeconomic variables exchange rate effect can have different effect on trade. For instance, if government is increasing money supply, local currency can depreciate leading to reduction in imports. On the other hand monetary expansion triggers increase in demand increasing imports. So, exchange rate effect can be offset by movements in demand leaving imports unaffected.

CEU eTD Collection

4 Model Specification

Exchange rate volatility is the main concern of most traders and according to common belief if the exchange rate is very volatile the risk-averse traders will reduce the trade volume. However, the research has shown that it is not so straightforward and this issue is still an object of argument in academic world. Different methods of estimation, data and volatility measures were used to find empirical evidence by followers of different theories. However, in this work I will look at this issue from different point of view using high frequency data and large sample. Most of the previous research was done using quarterly data and Ordinary Least Squares (OLS) and Fixed Effects method to estimate the effect of exchange rate volatility on trade. In my research I will apply Panel Least Squares method to large sample and up-to-date data to estimate the effect of exchange rate volatility on US imports and exports. Also I will look at the effect of different exchange rate regimes including currency boards on trade. In the basic model I assume that exchange rate volatility is exogenous. However, trade volume itself can affect the exchange rate volatility causing reverse causality. In order to avoid simultaneity bias I will focus on the effect of uncertainty on trade using Instrumental Variables method. Different exchange rate regimes are used as instruments for volatility. Besides, it seems relevant to look at the effect of different currency arrangements after exchange rate volatility was taken into account.

CEU eTD Collection

4.1 Basic Model

This section presents the basic model for estimating effect of uncertainty on US imports and exports. Main assumption I make here is that exchange rate volatility is exogenous, i.e. there is no causal relationship between trade and exchange rate volatility. Here I include several specifications for comparison that will be estimated with and without fixed effects.

Most of the previous research uses different gravity models to estimate bilateral trade that include number of variables. Here I include few control variables and volatility measure to estimate their effect on US imports and exports separately. Basic specifications for imports and exports are following:

$$Exp_{it} = \alpha + \beta \ln(GDP)_{it} + \gamma Vol_{it} + \delta_t + \eta_i + \varepsilon_{it} \quad \textbf{(4.1.3)}$$

$$Imp_{it} = \alpha + \beta \ln(GDP)_{it} + \gamma Vol_{it} + \delta_t + \eta_i + \varepsilon_{it} \quad \textbf{(4.1.4)}$$

Here Expit is US export to country *i* at time *t*, Imp_{it} is US import from country *i* at time *t*, $\ln(GDP)_{it}$ is the GDP of country *i* at time *t* and Vol_{it} is real exchange rate volatility measured as moving average of standard deviation of log real exchange rates. Since I am using monthly data, moving average of the standard deviation of real exchange rates was calculated using seven months including three months before and after the time period *t*. Measure of exchange rate volatility is similar to the one used by Cushman (1983). This measure of exchange rate is used in most of the empirical research involving exchange rates. δ_{it} is a year fixed effect, η_{it} is a country fixed effect and ε_{it} is the error term. In these equations log of GDP is included as an explanatory variable in order to capture the recessions and booms in the country[3].

In the majority of previous research real exchange rates was also used as an explanatory variable and as a major factor that affects the imports and exports. Therefore it is useful to include it as an explanatory variable for further comparison.

CEU eTD Collection

[3] Since, monthly data for GDP was not available, following formula was used to generate monthly GDP series from yearly data: $GDP_t = \left(\left[\frac{GDP_{year_n}}{GDP_{year_{n-1}}} \right]^{\frac{1}{12}} \right)^t GDP_{year_{n-1}}$

n is the yearly observations and *t*=1,2….12 within each year

$$Exp_{it} = \alpha + \beta \ln(GDP)_{it} + \gamma Vol_{it} + \lambda \ln reer_{it} + \delta_t + \eta_i + \varepsilon_{it} \qquad \textbf{(4.1.3)}$$

$$Imp_{it} = \alpha + \beta \ln(GDP)_{it} + \gamma Vol_{it} + \lambda \ln reer_{it} + \delta_t + \eta_i + \varepsilon_{it} \qquad \textbf{(4.1.4)}$$

Here $reer_{it}$ is the real exchange rates in terms of US dollars. I expect the coefficient for this variable to be negative for exports. Since, real exchange rate is equal to per US dollar foreign currency, when it increases US goods become expensive for importing countries which in turn reduces the trade volume. Real exchange rate is expected to be positive for imports. When exchange rate increases, foreign goods become cheaper increasing the imports. Estimating these equations I will look at the effect of exchange rate volatility on exports and imports.

Main advantage of panel data is that fixed effects method can be employed to estimate time and country fixed effects. Time specific variables include mainly US data as US GDP, population and etc. that do not vary across countries in a given time period. Time fixed effect method takes care of these variables and there is no need to include them as explanatory variables. Country effects include distance between US and trading partners, common border, common language, other historical and cultural relationships and etc. that affect US imports and exports. Employing cross-section fixed effects methods these variables can be eliminated.

4.2 The Effect of Exchange Rate Regimes on US Trade

One of the interesting issues in international trade is the effect of exchange rate regimes on trade. Do fixing exchange rates or entering a currency union increase the international trade? Rose (2000) tries to answer this question using large panel data including most of world countries. He finds statistically significant positive effect of currency unions on international trade. According to his research countries that have common currency trade three times as much as they would

CEU eTD Collection

with different currencies. Other paper, Glick and Rose (2001), looks at the effect of leaving the currency union on trade and shows that countries that leave the currency union observe huge decline in trade. One of the most recent researches that study the effect of exchange rate regimes on trade is IMF Working Paper by Qureshi and Tsangarides (2010). Using large data set and different estimation methods they find out that effect of currency unions on bilateral trade is not different from that of common currency pegs.

In this section I will focus on the effect of exchange rate regimes on trade and discuss the specifications I use to estimate this effect. One of the main issues in estimating the effect of regimes is the classification of different exchange rate regimes. Here I use reduced version of exchange rate regime classification used by Reinhart and Rogoff (2004). These regimes include four exchange rate arrangements classified as currency board, pegged, crawling and floating.

First of all, it would be interesting to look at the relationship between the exchange rate volatility and exchange rate regime. First I regress the exchange rate volatility on dummies for tree exchange rate regimes. The fourth floating regime is used as reference group.

$$Vol_{it} = d_0 + d_1 Board_{it} + d_2 Peg + d_3 Crawling + \delta_t + \eta_i + \varepsilon_{it} \quad \textbf{(4.2.1)}$$

I expect negative coefficients for all the dummy variables. However, for countries in currency union coefficients should be larger in absolute value. Constant term should have the smallest absolute value if negative. However, constant can have positive coefficient, because floating exchange rate regimes have higher volatility.

CEU eTD Collection

Next I will look at the effect of the exchange rate arrangement of partner countries on US imports and exports. Along with exchange rate regimes partner countries' GDP and real exchange rate are included as explanatory variables. I will also estimate these equations using fixed effects method separately for exports and imports.

$$Exp_{it} = \alpha + \beta \ln(GDP)_{it} + \lambda \ln reer_{it} + d_1 Board_{it} + d_2 Peg + d_3 Crawling + \delta_t + \eta_i + \varepsilon_{it} \quad \textbf{(4.2.2)}$$

$$Imp_{it} = \alpha + \beta \ln(GDP)_{it} + \lambda \ln reer_{it} + d_1 Board_{it} + d_2 Peg + d_3 Crawling + \delta_t + \eta_i + \varepsilon_{it} \quad \textbf{(4.2.3)}$$

As I already noted it is interesting to see what the effect of regimes on trade is after controlling for exchange rate volatility. Including the exchange rate volatility in the above equation will show us if the movements in trade occur because of volatility or some other effects of exchange rate regimes.

$$Exp_{it} = \alpha + \beta \ln(GDP)_{it} + \gamma Vol_{it} + \lambda \ln reer_{it} + d_1 Board_{it} + d_2 Peg + d_3 Crawling + \delta_t + \eta_i + \varepsilon_{it} \quad \textbf{(4.2.4)}$$

$$Imp_{it} = \alpha + \beta \ln(GDP)_{it} + \gamma Vol_{it} + \lambda \ln reer_{it} + d_1 Board_{it} + d_2 Peg + d_3 Crawling + \delta_t + \eta_i + \varepsilon_{it} \quad \textbf{(4.2.5)}$$

Rose (2000) reveals that common currency has much more effect on trade than it should have. He argues that exchange rate regimes as currency board has other effects besides reduction in exchange rate volatility. These effects include stronger financial integration which in turn increases the level of trade. Currency unions also can have negative effect on trade volume of a country. Country entering a currency union can divert its trade from cheaper countries to less efficient European countries reducing the trade volume.

CEU eTD Collection

One last point that should be discussed is the endogeneity issue of exchange rate volatility. As I have already mentioned, there can be reversed causality from trade to exchange rate volatility. This can occur when two close trade partners adopt policy arrangements to reduce exchange volatility. This creates simultaneity bias and estimations give biased results. This can be avoided using Instrumental Variables method which gives unbiased results in the presence of endogeneity. I will estimate the basic equation using exchange rate regimes as instruments.

CEU eTD Collection

5 Data and empirical results

In this section I give a brief description of the data and discuss the estimation results of above mentioned equations. Unlike previous studies of exchange rate volatility, I use large high frequency panel data including 79 countries and 276 months covering time period from 1985 to 2007. List of all the countries are given in Table 7 in the Appendix. Equations include monthly US trade, including imports and exports, monthly GDP of US trade partners, real exchange rates, exchange rate volatility calculated as moving average of the standard deviation of log real exchange rates. All the variables are seasonally adjusted except for GDP. However, some observations are missing, especially for CIS countries that became independent after 1992.

US foreign trade data comes from Foreign Trade database of U.S. Census Bureau.[4] Real exchange rate data was retrieved from International Financial Statistics (IFS) database of International Monetary Fund (IMF).[5] Natural logarithm of real exchange rate is used for estimation and calculation of exchange rate volatility. Since, monthly GDP data is not available in monthly frequency, yearly series are used to generate monthly data. This data is not precise, but it will capture the size of the countries and main booms and recessions. GDP data comes from World Development Indicators database of The World Bank.[6]

I use monthly fine classification by Reinhart and Rogoff (2004) for time period from 1985 to 2007.[7] Original classification includes 15 types of exchange rate regimes. I reduced the number of types of regimes to 4 including currency board, pegged, crawling and floating based on the

[4] Available at : http://www.census.gov/foreign-trade/statistics/historical/
[5] Available at: http://www.imfstatistics.org/imf/
[6] Available at: http://data.worldbank.org/data-catalog
[7] Available at: http://terpconnect.umd.edu/~creinhar/Papers.html

CEU eTD Collection

flexibility of regimes, where currency board is the least flexible and floating is the most flexible. Original classification and reduced classification is presented in Table 8 in Appendix. In the equations I included dummies for each exchange rate regime excluding the floating one. Floating exchange rate regime will be used as a reference group. Dummies take value of one if the country has the indicated exchange rate regime in a given month and zero otherwise. Summary statistics of all the variables are given in Table 9 in the Appendix.

5.1 Estimation of the Basic Model

This section provides empirical evidence on the effect of exchange rate volatility using basic equations shown earlier employing OLS estimation method with panel data. First I estimate the effect of exchange rate volatility on US exports controlling for trade partner's GDP and real exchange rates. I estimate all the equations with and without fixed effects in order to see how fixed effects influence the results. Observations for some regressions may differ, because I use unbalanced panel data where series may not overlap.

Estimation results showing the relationship between the exchange rate volatility and US exports are presented in Table 2. First three columns were estimated without real exchange rates and include the regression results from equations (4.1.1) obtained using simple OLS, time fixed effects and two-way fixed effects method. All the remaining tables present the results in the same fashion.

In order to capture the size of the country and the economy log of trading partner's GDP is included. Real exchange rate s also included as one of the main factors affecting international trade. As we can see from the results coefficients of log of GDP has the expected sign and has a significant effect on US exports. Coefficient of log GDP is significant at any level of significance

CEU eTD Collection

in all the regressions. Compared to simple OLS, GDP has a lower coefficient when fixed effects were taken into account. When two-way fixed effect method is used coefficient of log of GDP shows that 1 percent increase in country's GDP increases the US export to that country by almost 0.7 percent. This is expected result, because GDP captures the size and the development of the economy and have a large impact on demand for international goods. Same regressions with and without time fixed effect show larger effect of GDP on US exports. Exchange rate volatility is the variable of main interest here. First three regressions suggest that exchange rate volatility is not significant at all. The last three columns show regression results from equation (4.1.3). Including the real exchange rate do not change the coefficient of GDP variable. However, now coefficient of exchange rate volatility becomes significant at 5 percent significance level and has the expected sign with only time fixed effect. Two-way fixed effect method still shows that effect of exchange rate volatility is statistically insignificant and small. Coefficient of log real exchange rates is very significant and has the expected sign in first two columns with and without time fixed effects. These results suggest that 1 percent increase in real exchange rates of trading partner increases the US exports by about 0.21 percent. Taking into account the fact that appreciation of dollar stimulates US firms to export more this result is not unexpected. However, when US dollar appreciates US goods become more expensive for foreign importers. I expect the coefficient of real exchange rates to be negative in the equations for US exports. R-squared from two-way fixed effects model suggest that with this method explanatory variables better explains the variation in US exports.

CEU eTD Collection

Table 2: Estimation results of basic equations for US exports

	Dependent Variable:		Ln (US Exports in mln. USD)			
	(1)	(2)	(3)	(4)	(5)	(6)
Ln (GDP in mln. USD)	0.856 (0.004)***	0.848 (0.004)***	0.685 (0.016)***	0.857 (0.004)***	0.849 (0.004)***	0.693 (0.017)***
Exchange Rate Volatility	0.046 (0.155)	-0.145 (0.160)	0.073 (0.065)	-0.187 (0.162)	-0.366 (0.168)**	0.101 (0.067)
Ln (Real Exchange Rate Index)				0.223 (0.047)***	0.209 (0.048)***	-0.034 (0.021)
Country fixed effects	No	No	Yes	No	No	Yes
Time fixed effects	No	Yes	Yes	No	Yes	Yes
F-statistic	24534	178	1196	16384	177	1193
Observations	17793	17793	17793	17793	17793	17793
R-squared	0,73	0,74	0,96	0,73	0,74	0,96

Notes: Standard Errors presented in parentheses. ***, **, * indicate 1%, 5%, and 10% statistical significance level respectively.

Estimation results for equations (4.1.2) and (4.1.4) are presented in Table 3. Here I estimate the same equations with same explanatory variables for US imports. Presented results suggest that exchange rate volatility has larger and more significant effect on US imports compared to exports. Coefficient of exchange rate volatility is very significant and has the expected sign in all the regressions. Most of the regressions suggest that 1 percent increase in exchange rate volatility decreases the imports by about 1.1 percent. Coefficient of partner country's GDP is very significant as in the regressions for exports. However, now estimated results are relatively higher. Most of regressions suggest one to one increase in US imports as GDP increases. Real exchange rate also have very significant coefficient in the regression estimated with two way fixed effects. Regression in the last column with time and country fixed effects show that 1 percent increase in real exchange rates decreases the imports by 1 percent. This can be considered expected result if US importers make payments in foreign currency. However, most of the transactions in international trade involve US dollar. Negative coefficient for real exchange rate is not intuitive.

CEU eTD Collection

Table 3: Estimation results for basic equations for US imports

Dependent Variable:	Ln (US Imports in mln. USD)					
	(1)	(2)	(3)	(4)	(5)	(6)
Ln (GDP in mln. USD)	0.992 (0.004)***	0.986 (0.005)***	0.983 (0.022)***	0.992 (0.004)***	0.987 (0.005)***	1.144 (0.024)***
Exchange Rate Volatility	-1.123 (0.353)***	-1.403 (0.382)***	-1.121 (0.170)***	-1.100 (0.354)***	-1.393 (0.382)***	-1.154 (0.169)***
Ln (Real Exchange Rate Index)				-0.000 (0.000)	0.233 (0.106)**	-0.989 (0.064)***
Country fixed effects	No	No	Yes	No	No	Yes
Time fixed effects	No	Yes	Yes	No	Yes	Yes
F-statistic	24997	181	989	16665	181	1001
Observations	17658	17658	17658	17658	17658	17658
R-squared	0,74	0,74	0,95	0,74	0,74	0,95

Notes: Standard Errors presented in parentheses. ***, **, * indicate 1%, 5%, and 10% statistical significance level respectively.

5.2 Estimation of Effect of Exchange Rate Regimes on US Trade

Most of the research studying the effect of exchange rate regimes on international trade suggests that countries with fixed or hard peg exchange rate regimes trade more, because these regimes reduce level of exchange rate volatility decreasing the level of uncertainty. Trade can increase because of the reduction in hedging costs when such a regime exists. In this section I will focus on the effect of different exchange rate regimes on the trade volume. First I estimate equation (4.2.1) to look at the relationship between exchange rate regime and volatility. Estimation results including three regressions obtained using simple OLS, time-fixed and two-way fixed effects methods are presented in Table 4. Explanatory variables include four exchange rate regimes classified as floating, crawling, pegged and board (currency union).[8]

[8] Exchange rate regime classified as currency board includes countries sharing common currency with any country, not necessarily with United States. So, I will not be able to look at the effect of common currency, instead I use the dummy variable "Board" as reference group in the estimations .

CEU eTD Collection

Different regressions estimated with different methods give conflicting results. However, relative effects of exchange rate regimes within regression are intuitive. As the most flexible regime floating regimes have the largest effect on volatility. Other regimes have less effect on volatility as expected. Estimation results presented in the last column using time and country fixed effects are the most intuitive. Here floating exchange rate regimes have a positive effect on volatility as expected. Other two regimes are less flexible and have negative coefficients.

Table 4: Exchange rate volatility and exchange rate regimes

	Dependent Variable:	Exchange Rate Volatility	
	(1)	(2)	(3)
Floating	0.025 (0.002)***	0.022 (0.002)***	0.017 (0.003)***
Crawling	0.004 (0.002)**	0.002 (0.001)	-0.013 (0.002)***
Pegged	0.003 (0.002)*	0.002 (0.002)	-0.004 (0.002)*
Constant	0.006 (0.002)***	0.007 (0.002)***	0.016 (0.002)***
Country fixed effects	No	No	Yes
Time fixed effects	No	Yes	Yes
F-statistic	174	6	10
Observations	19409	19409	19409
R-squared	0,03	0,08	0,15

Notes: Standard Errors presented in parentheses. ***, **, * indicate 1%, 5%, and 10% statistical significance level respectively.

Regression results for equations (4.2.2) and (4.2.3) are presented in Table 5. First three columns include regressions for export equation, and last three columns include regressions ran for import equations. Coefficients for exchange rate regimes in the second column with only time fixed effects are more significant and intuitive. Indeed floating exchange rate regime is more flexible and has higher exchange rate volatility leading to reduction in exports. This result suggests that if

CEU eTD Collection

US trade partner switches from other exchange rate regimes to floating one exports to that country decreases by 12 percent. However, if partner country moves to crawling regime US exports to that country increase by 18 percent. It is hard to interpret these results, because it is hard to determine the direction of the change. Here I can look at only two extreme exchange rate regimes. If we compare floating to other two exchange rate regimes the relative effects are intuitive.

Positive coefficient of real exchange rates does not have the expected sign again. In case of exports, appreciation of US dollar should decrease the US exports, because US goods become more expensive for other countries as the per US dollar foreign currency increase.

Last three columns of Table 5 include regression results for import equations. Three regression results obtained using simple OLS, time fixed and country fixed effects are different in terms of signs of the coefficients for regimes. However, if look at the direction of change in the effect of regimes from the most flexible to least flexible coefficients become more positive in all cases. Floating regime seems to have large negative effect on imports. According to regression results obtained using country and time fixed effects, if country allows its currency to float freely US imports from that country decreases by 28 percent.

CEU eTD Collection

Table 5: Exchange rate regimes and trade

	Dependent Variable:					
	Ln (US Exports in mln. USD)			Ln (US Imports in mln. USD)		
	(1)	(2)	(3)	(1)	(2)	(3)
Ln (GDP in mln. USD)	0.870 (0.004)***	0.861 (0.004)***	0.682 (0.017)***	1.012 (0.005)***	1.011 (0.005)***	1.171 (0.024)***
Ln (Real Exchange Rate Index)	0.285 (0.045)***	0.263 (0.046)***	0.007 (0.021)	0.445 (0.112)***	0.467 (0.113)***	-1.104 (0.071)***
Floating	-0.032724 (0.038)	-0.122 (0.041)***	-0.025 (0.024)	0.171 (0.042)***	0.225 (0.046)***	-0.283 (0.030)***
Crawling	0.262 (0.037)***	0.184 (0.039)***	-0.008 (0.021)	0.369 (0.042)***	0.419 (0.044)***	-0.186 (0.026)***
Pegged	0.163 (0.040)***	0.096 (0.042)**	-0.015 (0.019)	0.250 (0.045)***	0.326 (0.047)***	-0.125 (0.024)***
Constant	-5.518 (0.113)***	-5.320 (0.116)***	-2.864 (0.163)***	-7.340 (0.236)***	-7.433 (0.240)***	-5.449 (0.223)***
Country fixed effects	No	No	Yes	No	No	Yes
Time fixed effects	No	Yes	Yes	No	Yes	Yes
F-statistic	9719	174	1190	10009	180	1005
Observations	17597	17597	17597	17466	17466	17466
R-squared	0,73	0,74	0,96	0,74	0,75	0,95

Notes: Standard Errors presented in parentheses. ***, **, * indicate 1%, 5%, and 10% statistical significance level respectively.

It is also worth looking at the effect of exchange rate regimes on trade after taking account for exchange rate volatility. In order to see the effects of regimes over exchange rate volatility I estimate the equations (4.2.4) and (4.2.5) for imports and exports separately. Table 6 contains all the regression results for export and import equations obtained using simple OLS, time and country fixed effects methods.

CEU eTD Collection

Equations estimated using only time fixed effects methods give more significant results than two-way fixed effects method for export equations. After controlling for exchange rate volatility export regression results do not change much for exports. Coefficients for exchange rate regimes are still significant. It is possible that there are some other characteristics of exchange rate regimes that may affect exports of the country.

Table 6: Exchange rate volatility and trade

	Dependent Variable:					
	Ln (US Exports in mln. USD)			Ln (US Imports in mln. USD)		
	(1)	(2)	(3)	(1)	(2)	(3)
Ln (GDP in mln. USD)	0.863 (0.004)***	0.854 (0.004)***	0.697 (0.017)***	1.003 (0.004)***	1.002 (0.005)***	1.180 (0.024)***
Ln (Real Exchange Rate Index)	0.258 (0.047)***	0.245 (0.048)***	-0.010 (0.021)	0.430 (0.111)***	0.455 (0.112)***	-1.166 (0.071)***
Exchange Rate Volatility	0.120 (0.164)	0.004 (0.170)	0.096 (0.066)	-0.496 (0.367)	-0.488 (0.400)***	-1.179 (0.173)***
Floating	-0.050 (0.039)	-0.151 (0.042)***	-0.017 (0.023)	0.163 (0.044)***	0.217 (0.047)***	-0.262 (0.030)***
Crawling	0.244 (0.037)***	0.156 (0.039)***	-0.009 (0.021)	0.361 (0.042)***	0.412 (0.044)***	-0.174 (0.026)***
Pegged	0.151 (0.040)***	0.075 (0.042)*	-0.0123 (0.019)	0.229 (0.045)***	0.309 (0.047)***	-0.136 (0.024)***
Constant	-5.387 (0.115)***	-5.191 (0.119)***	-2.864 (0.163)***	-7.202 (0.235)***	-7.299 (0.240)***	-5.404 (0.223)***
Country fixed effects	No	No	Yes	No	No	Yes
Time fixed effects	No	Yes	Yes	No	Yes	Yes
F-statistic	7850.916	167.9630	1170.770	8122.094	174.3404	974.3704
Observations	17192	17192	17192	17066	17066	17066
R-squared	0.732698	0.736225	0.961389	0.740711	0.744822	0.954294

Notes: Standard Errors presented in parentheses. ***, **, * indicate 1%, 5%, and 10% statistical significance level respectively.

CEU eTD Collection

As I already mentioned exchange rate volatility can be endogenous and there can be reversed causality between exchange rate volatility and international trade. If this is the case exogeneity assumption does not hold and obtained results are biased. I use IV method to estimate the effect of volatility on trade and as instruments I use dummies for exchange rate regimes.

Results of the estimations are presented in Table 7. As we can see results are not satisfying. Coefficient of exchange rate volatility is too high in all the regressions and it has different signs for imports and exports, except the two-way fixed effect estimation results, all the regressions give very significant coefficients. In two regressions R-squared is negative. It is possible that dummies for exchange rate regimes are not good instruments for exchange rate volatility. We can not rely on these results.

Table 7: Exchange rate volatility and trade (Instrumental Variables)

	Dependent Variable:					
	Ln (US Exports in mln. USD)			Ln (US Imports in mln. USD)		
	(1)	(2)	(3)	(1)	(2)	(3)
Ln (GDP in mln. USD)	0.870 (0.020)***	0.875 (0.025)***	0.565 (0.239)**	1.009 (0.016)***	0.979 (0.017)***	1,545 (43.18)
Ln (Real Exchange Rate Index)	9.239 (2.077)***	11.125 (4.177)***	0.132 (0.677)	10.993 (1.470)***	11.682 (1.7425)***	49.04 (173.65)
Exchange Rate Volatility	-12.313 (2.095)***	-12.409 (2.399)***	-0.538 (1.164)	11.606 (03.219)***	16.556 (4.002)***	150.50 (596.78)
Country fixed effects	No	No	Yes	No	No	Yes
Time fixed effects	No	Yes	Yes	No	Yes	Yes
F-statistic	681	10	1053	732	10	853
Observations	17192	17192	17192	17066	17066	17066
R-squared	0,16	-0,07	0,96	0,59	0,57	-4,34

Notes: Standard Errors presented in parentheses. ***, **, * indicate 1%, 5%, and 10% statistical significance level respectively.

CEU eTD Collection

CONCLUSION

In this research I try to find the effect of exchange rate volatility on international trade using large data set including exchange rate regime data. Looking at relationship between different exchange rate regimes and trade volume I conclude that more flexible exchange rate regimes have negative effect on trade by increasing volatility. However, I get different results for imports and exports. In case of imports all the results are more significant and intuitive. As we can see from these results, regressions estimated with country fixed effects method do not change coefficients much for US export equations, but for imports fixed effects change coefficients completely. Country fixed effects in this case include distance between US and other trade partners, common language, other cultural and historical properties of trading partner countries. It seems that country effects have much more impact on imports than exports. For example, distance between countries can have greater impact on imports than exports, because major US exporters are transnational corporations that can reach any country in the world. For less developed distant countries it is much more expensive to export their goods to US because of high transaction costs.

Also I estimated the effect of volatility using IV method, but results do not seem to be satisfying. Some specification problems can cause this kind of results. I do not believe that exchange rate volatility can have such a large effect on international trade.

This research suggests that exchange rate volatility reduces international trade, but its effect is larger on imports than on exports. This may be due to the fact that major US trade transaction involve only US dollar.

CEU eTD Collection

Appendix

Table 7: List of Countries

Algeria	**France**	**Norway**
Armenia	**Gabon**	**Pakistan**
Australia	**Gambia**	**Paraguay**
Austria	**Georgia**	**Philippines**
Bahamas	**Germany**	**Poland**
Bahrain	**Ghana**	**Portugal**
Belgium	**Greece**	**Romania**
Belize	**Grenada**	**Sierra Leone**
Bolivia	**Guyana**	**Singapore**
Bulgaria	**Hungary**	**South Africa**
Burundi	**Iceland**	**Spain**
Cameroon	**Ireland**	**St Kitts and Nevis**
Canada	**Israel**	**St Lucia**
Central African Republic	**Italy**	**St Vincent and the Grenadines**
Chile	**Japan**	**Sweden**
China	**Lesotho**	**Switzerland**
Colombia	**Luxembourg**	**Togo**
Costa Rica	**Macedonia**	**Trinidad and Tobago**
Croatia	**Malawi**	**Tunisia**
Cyprus	**Malaysia**	**Uganda**
Denmark	**Malta**	**UK**
Dominica	**Morocco**	**Ukraine**
Dominican Republic	**Netherlands**	**Uruguay**
Ecuador	**Netherlands Antilles**	**Venezuela**
Equatorial Guinea	**New Zealand**	**Zambia**
Fiji	**Nigeria**	
Finland	**Norway**	

CEU eTD Collection

Table 8: Summary Statistics

Variable	Observations	Mean	Standard Deviation
US Exports in mln. USD	18948	505,84	1600,73
Ln (US Exports in mln.USD)	18809	4,07	2,36
US Imports in mln. USD	18948	799	2537
Ln (US Imports in mln. USD)	18647	4,19	2,70
GDP of partner country in mln. USD	21152	207549	574744
Ln (GDP of partner country in mln. USD)	21152	9,87	2,47
Real Exchange Rate Index	20916	3590	160322
Ln (Real Exchange Rate Index)	20916	2,02	0,20
Moving average of the Standard Deviation of log Real Exchange Rates	20490	0,01	0,06

Table 9: Correlation Matrix

	LnExp	***LnImp***	***LnGDP***	***Lnreer***	***Vol***	***Floating***	***Crawling***	***Pegged***
LnImp	0,887							
LnGDP	0,852	0,860						
Lnreer	-0,060	-0,052	-0,089					
Vol	-0,047	-0,027	-0,021	-0,024				
Floating	0,094	0,128	0,169	-0,121	0,197			
Crawling	0,035	0,029	-0,012	0,112	-0,066	-0,470		
Pegged	-0,262	-0,281	-0,313	0,024	-0,080	-0,328	-0,523	
Board	0,223	0,212	0,277	-0,059	-0,055	-0,156	-0,249	-0,174

CEU eTD Collection

Table 10. Exchange Rate Regimes classified by Reinhart and Rogoff (2004)

Exchange Rate Regime	Original fine classification codes	Reduced Form Classification
No separate legal tender	1	Board
Pre announced peg or currency board arrangement	2	Pegged
Pre announced horizontal band that is narrower than or equal to +/-2%	3	
De facto peg	4	
Pre announced crawling peg	5	Crawling
Pre announced crawling band that is narrower than or equal to +/-2%	6	
De factor crawling peg	7	
De facto crawling band that is narrower than or equal to +/-2%	8	
Pre announced crawling band that is wider than or equal to +/-2%	9	
De facto crawling band that is narrower than or equal to +/-5%	10	
Moving band that is narrower than or equal to +/-2% (i.e., allows for both appreciation and depreciation over time)	11	
Managed floating	12	Floating
Freely floating	13	
Freely falling	14	
Dual market in which parallel market data is missing.	15	N/A

CEU eTD Collection

REFENRENCES

Agathe Cote 1994. "Exchange Rate Volatility and Trade." A survey. International Department of Canada.

Thursby, J.G. and Thursby, M. (1985), "The uncertainty effects of floating exchange rates: empirical evidence on international trade flows", in Arndt, S.W., Sweeney, R.J. and Willett, T.D. (Eds), Exchange Rates, Trade and the US Economy, Ballinger, Cambridge, MA.

Thursby, J.G. and Thursby, M.C. (1987), "Bilateral trade flows, the Linder hypothesis, and exchange risk", *The Review of Economics and Statistics*, Vol. 69, pp. 488-95.

Akhtar, M.A. and Hilton, R.S. (1984), "Effects of uncertainty on German and US trade", *Federal Reserve Bank of New York Quarterly Review*, pp. 7-16.

Arize, A.C. (1995), "Trade flows and real exchange-rate volatility: an application of cointegration and error-correction modeling", *North American Journal of Economics & Finance*, Vol. 6 No. 1, pp. 37-51.

Arize, A.C. (1996), "A reexamination of the demand for UK exports: evidence from an error correction model", *International Trade Journal*, Vol. 10 No. 4, pp. 501-25.

Arize, A.C., Osang, T. and Slottje, D.J. (2000), "Exchange-rate volatility and foreign trade: evidence from thirteen LDCs", *Journal of Business & Economics Statistics*, Vol. 18, pp. 10-17.

Bahmani-Oskooee, M. (1996), "Exchange rate uncertainty and trade flows of LDCs: evidence from Johansen's cointegration analysis", *Journal of Economic Development*, Vol. 21 No. 1, pp. 23-35.

Bahmani-Oskooee, M. (2002), "Does black-market exchange rate volatility deter the trade flows?",*Applied Economics*, Vol. 34, pp. 2249-555.

Arize, A.C. (1997), "Foreign trade and exchange-rate risk in the G-7 countries: cointegration and error-correction models", *Review of Financial Economics*, Vol. 6 No. 1, pp. 95-112.

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

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

CEU eTD Collection

Cushman, David O. 1986. “Has Exchange Risk Depressed International Trade? The Impact of Third-Country Exchange Risk.” *Journal of International Economics* 5 (September): 361-79.

De Grauwe, P. (1987), “Exchange rate variability and the slowdown in growth of international trade”, International Monetary Fund Staff Papers, Vol. 35 No. 1, pp. 63-84.

Dell’Ariccia, G. (1999), “Exchange rate fluctuations and trade flows: evidence from the European Union”, IMF Staff Papers, Vol. 46 No. 3, p. 5.

De Grauwe, Paul. 1988. “Exchange Rate Variability and the Slowdown in Growth of International Trade.” International Monetary Fund Staff Papers 35 (March): 63-84.

Ethier, Wilfrid. 1973. “International Trade and the Forward Exchange Market.” American Economic Review 63 (June): 494-503.

Gotur, P. (1985), “Effects of exchange rate volatility on trade: some further evidence”, International Monetary Fund Staff Papers, Vol. 32 No. 3, pp. 475-512.

Hooper, Peter and Steven W. Kohlhagen. 1978. “The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade.” *Journal of International Economics* 8 (November): 483-511.

International Monetary Fund. 1984. “Exchange Rate Volatility and World Trade.” Occasional Paper no. 28.

Koray, Faik and William D. Lastrapes. 1989. “Real Exchange Rate Volatility and U.S. Bilateral Trade: A VAR Approach.” *Review of Economics and Statistics* 71 (November): 708-12.

Kroner, K.F. and Lastrapes, W.D. (1993), “The impact of exchange rate volatility on international trade: reduced form estimates using the GARCH-in-mean model”, *Journal of International Money and Finance,* Vol. 12 No. 3, pp. 298-318.

Maskus, K.E. (1986), “Exchange rate risk and US trade: a sectoral analysis”, *Economic Review,* Vol. 71 No. 3, pp. 16-28.

Michael D. McKenzie 1999. “The Impact of Exchange Rate Volatility on International Trade Flows.” *Journal of Economic Surveys* 13, No. 1 R.M.I.T., Melbourne.

CEU eTD Collection