IMPACT OF EXCHANGE RATE VOLATILITY ON TRADE:
A LITERATURE SURVEY

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ÖZET
Bu çalışmada, döviz kuru oynaklığının dış ticaret üzerine etkilerini inceleyen çalışmaların literatür taraması amaçlanmaktadır. Çalışmada 1983-2013 yılları arasında yapılan araştırmalar incelenmiştir. Konu öncelikle teorik çerçevede ele alınmış, ikinci aşamada belli bazı çalışmalar veri dönemi, incelediği ülkeler, ekonometrik yöntemler ve elde ettiği bulgular bakımından kronolojik olarak karşılaştırılmıştır. Araştırma sonucunda, döviz kuru oynaklığının dış ticaret akımları üzerindeki etkisinin halen çelişkili olduğu sonucuna varılmıştır.

Anahtar Kelimeler: Döviz kuru, ticaret akımları, döviz kuru oynaklığı.

ABSTRACT
In this study, literature review of effects of exchange rate volatility on trade is aimed. Researches between 1983-2013 are reviewed in the study. The subject is analyzing primarily at the theoretical level; in the second part surveys are compared from the view of sample period, analyzed countries, econometric methods and conclusions. Results revealed that impact of exchange rate volatility on international trade is ambiguous.

Key Words: Exchange rate, trade flows, exchange rate volatility.

Introduction

Throughout much of the twentieth century, governments have pursued a fixed system of exchange rate determination. However, the collapse of Bretton Woods exchange rate system saw a change as many of the major participants in the global trade arena made the transition to a floating regime whereby the rate at which currencies are traded is subject to the forces of supply and demand. With this growing trend toward floating exchange rates, attentions have been directed toward the welfare effects of exchange rate policy. The focus of this debate has largely centered on the issue of exchange rate volatility and its possible impact on the real economy. Volatile currencies following the collapse of Bretton Woods prompted questions about the consequences of exchange rate variability on trade. Central question is "High volatility of exchange rates has hampered the growth in the volume of international trade or not?" This debate is still going on because there is no consensus among economists to date on how exchange rate volatility influences trade volume from either a theoretical or empirical perspective. The issue is relatively more important in developing countries mostly due to a lack of the forward exchange market, which rules out the hedging options in these countries.

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Exchange rate volatility could affect the trade flows in either direction. Risk averse traders may choose to trade less in order to avoid any price uncertainty associated with exchange rate changes. Revenue maximizing traders, on the other hand, may choose to trade more to avoid any decline in their future revenues, again due to price uncertainty. Using the standard tools of analysis models, owing to revenue maximizing traders, have been constructed which show how exchange rate volatility may not act as a hindrance to international trade.

There are several channels through which exchange rate volatility could affect trade flows. First, if traders are risk averse, they could reduce their activities due to exchange rate uncertainty in order to avoid any loss. Second, exchange rate uncertainty could directly affect the trade volume by making prices and profits uncertain. Even if forward markets do exist in some industrial countries, some studies indicate that forward markets are not very effective in completely eliminating exchange rate uncertainty (Akhtar and Hilton, 1984). Third if exchange rate volatility persists over a longer period of time, it could induce domestic producers to switch buying from foreign sources to domestic sources, reducing the volume of trade, especially traded inputs. Finally, exchange rate uncertainty could also affect direct foreign investment decisions which in turn could lower the volume of trade. To reduce the price fluctuation due to exchange rate volatility, production facilities would be located near final markets, leading to change in pattern of trade (Mohammadi et al., 2011).

Brief Review of The Theoretical and Empirical Literature

Following the seminal work of Hooper and Kohlhagen (1976), a large amount of research has been published in an attempt to discover a robust relationship between exchange rate variability and international trade. Early empirical research suggested that there was no statistically significant variability effect. The large majority of empirical studies on the impact of exchange rate variability on the volume of international trade are unable to establish a systematically significant link.

Since the appearance of IMF (1984) study of the effects of exchange rate volatility on trade, two survey papers of the literature on the topic have appeared: Cote (1994) and McKenzie (1999). These two surveys conclude that from a theoretical perspective there is no unambiguous response in the level of trade to an increase in exchange rate volatility, as differing results can arise from plausible alternative assumptions and modelling strategies. The same ambiguity pervades much of the empirical literature, which may reflect the lack of clear cut theoretical results as well as the difficulty in arriving at an appropriate proxy for exchange rate risk (Clark et al., 2004, p. 12).

It is useful to begin with the example of a rudimentary exporting firm to illustrate how real exchange rate volatility can affect the level of the firm's exports. The simplest case described by Clark (1973), for example, considers a competitive firm with no market power producing only one commodity which is sold entirely to one foreign market and does not import any intermediate inputs. The firm is paid in foreign currency and converts the proceeds of its exports at the current exchange rate which varies in an unpredictable fashion, as there are assumed to be no hedging possibilities. Moreover, because of costs in adjusting the scale of production, the firm makes its

production decision in advance of the realization of the exchange rate and therefore cannot alter its output in response to favorable or unfavorable shifts in the profitability of its exports arising from movements in the exchange rate. In this situation the variability in the firm's profits arises solely from the exchange rate and where the managers of the firm are adversely affected by the risk, greater volatility in the exchange rate leads to a reduction in output and hence in exports in order to reduce the exposure to risk (Clark et al., 2004, p. 13).

Hooper and Kohlhagen (1978) utilized a model for traded goods and derived equations for export prices and quantities in terms of the costs of production reflecting both domestic and imported inputs, other domestic prices, domestic income and capacity utilization. Exchange rate risk was measured by the average absolute difference between the current period spot exchange rate and forward rate last period. They examined the impact of exchange rate volatility on aggregate and bilateral trade flow data for all G-7 countries except Italy. In terms of the effect of volatility on trade flows, they found essentially no evidence of any negative effect.

Akhtar and Hilton (1984) examine the influence of exchange rate variability on the prices and volumes of US and West Germany exports and imports, over the sample periods 1974Q1-1981Q4 and 1974Q1-1982Q4. Akhtar and Hilton specify a two equation structural system, modeling export volumes as a function of foreign income; relative prices and a measure of nominal exchange rate variability. For the 1974Q1-1981Q4 period, Akhtar and Hilton found a statistically significant negative variability effect on West German export and import volumes and US export volumes, but no significant effect on US import volumes.

Canzoneri, et al. (1984), De Grauwe (1988) and Gros (1987) has been analyzed why trade may be adversely affected by exchange rate volatility. Their finding indicated to one assumption. Firm cannot alter factor inputs in order to adjust optimally to take account of movements in exchange rates. When this assumption is relaxed and firms can adjust one or more factors of production in response to movements in exchange rate, increased variability can in fact create profit opportunities. The effect of such volatility depends on the interaction of two forces at work (Clark et al., 2004, p. 4).

Broll and Eckwert (1999) study is starting at an example. In the study's example, an international firm decides upon production before the exchange rate uncertainty materializes. However the decision whether to sell in the domestic market or in the world market can be made contingent on the realization of the spot exchange rate. The specification of the firm's decision problem implies an extreme allocation of sales. The whole production will either be sold on domestic market or entirely be shifted to the foreign market. The economic intuition for the mechanism derived in this paper is the following: As the exchange rate volatility increases, so does the value of the option to export to the world market. Higher volatility increases the potential gains from international trade which makes production more profitable. However, a more volatile exchange rate implies a higher risk exposure for international firms. Rose (1999) employs the gravity approach and uses a very large data set involving 186 countries for the five years 1970, 1975, 1980, 1985 and 1990. His main objective in the paper is to measure the effect of currency unions on members' trade. His primary measure of volatility is the standard deviation of the first difference of the monthly logarithm of the bilateral nominal exchange rate. In his benchmark results using the pooled data, he finds

a small but significant negative effect: reducing volatility by one standard deviation around the mean would increase bilateral trade by about 13 percent. Aristotelous (2001) investigated the impact of exchange rate volatility and exchange rate regime on British exports to the United States in the context of a generalized gravity model. In the study gravity model was estimated using annual data for the sample period 1889-1999. The empirical findings support two main conclusions. Firstly, exchange rate volatility did not have an effect on the volume of British export to the U.S. Secondly, there is no evidence that any of the exchange rate regimes of the late 19th and 20th centuries had any impact on the volume of British exports to the U.S.

Byrne et al. (2008) used disaggregated price data as their trade deflator rather than the U.S. consumer price index and construction of new disaggregate sectors to examine the importance of exchange rate uncertainty. The main result is that pooling all industries together provides an evidence of a negative effect on trade from exchange rate volatility. But using econometric criteria in particular they find evidence that this effect may be different across industries. This would seem to suggest that sectoral differences do exist in explaining the different impact of volatility on trade and may be based on the characteristics of the markets in which they trade.

Bahmani and Wang (2009) employ import and export demand models in order to assess the impact of currency depreciation as well as exchange rate risk on the trade flows between the U.S and the Australia. The study use disaggregated data at commodity level from 107 industries that trade between two countries. The empirical results could be best summarized by saying that exchange rate uncertainty has short run effects on imports and exports of majority of the industries for which data was available. However, the short run effects last into long run only in the limited number of industries, though number of U.S importing industries affected in the long run were found to be almost twice as many as U.S exporting industries. Alternatively, exchange rate uncertainty affects Australia's exports to the U.S more than it affects imports.

Up to this point the discussion of the impact of volatility on trade has been within partial equilibrium framework, i.e., the only variable that changes is some measure of the variability of the exchange rate, and all other factors that may have an influence on the level of trade are assumed to remain unchanged. Thus it is important to take account in a general equilibrium framework the interaction of all the major macroeconomic variables to get a more complete picture of the relationship between exchange rate variability and trade. Such an analysis has been provided by Bacchetta and Van Wincoop (2000). They develop a simple, two country, general equilibrium model where uncertainty arises from monetary, fiscal and technology shocks and they compare the level of trade and welfare for fixed and floating exchange rate arrangements. They reach two main conclusions. First, there is no clear relationship between the level of trade and the type of exchange rate arrangement. Second, the level of trade does not provide a good index of the level of welfare in a country, and thus there is no one to one relationship between levels of trade and welfare in compering exchange rate systems.

Doganlar (2002) examines the impact of exchange rate volatility on the exports of five Asian countries; Turkey, S. Korea. Malaysia, Indonesia and Pakistan. The impact of volatility term on exports is examined by using Engle-Granger residual based

cointegrating technique. The results indicate that the exchange rate volatility reduced real exports for these countries.

Arize et al. (2008), Poon et al. (2005), Baak (2008), Hayakawa and Kimura (2009), Zelekha and Efrat (2011), Mohammadi et al. (2011), Mougoue and Aggarwal (2011), Verheyen (2012), Srinivasan and Kalaivani (2012), Grier and Smallwood (2013) and lastly Poon and Hooy (2013) found a significant and negative impact of exchange rate volatility on international trade.

But Tenreyro (2007), Serenis and Serenis (2008), Baum and Caglayan (2010), Serenis and Serenis (2010), Bahmani-Oskooee and Harvey (2011), Nishimura and Hirayama (2013), Baek (2013) and Bahmani-Oskooee et al. (2013) found no effect or intermediate effects of volatility on international trade flows.

Abbott (1999) and Hall et al. (2010) are listed the exchange rate volatility impact on trade literature between 1983-2007 as follows;

Author	Sample Period	Countries	Measure of Volatility	Estimation Technique	Result
Cushman (1983)	1965Q1-1981Q4	UK, US, France, West Germany, Canada, Japan.	Four quarter moving average standard deviation of the percentage changes in the real exchange rate.	OLS	6 out of 16 cases show evidence of a negative relationship between real exchange rate variability and trade volumes.
IMF (1984)	1959Q1-1982Q4	Canada, France, Italy, West Germany, Japan, UK and US.	Standard deviation of a seven country trade weighted average of quarterly real effective exchange rate.	OLS	Insignificant results and positively signed for world trade. 2 out of 42 bilateral trade flows significant and negatively signed.
Chan and Wong (1985)	1977Q1-1984Q4	Hong Kong, US, UK and West Germany	Four quarter moving average standard deviation of percentage changes in the real bilateral rates.	OLS	No significant effect on export volumes for any of the countries analysed.

Table.1 Studies of The Effects of Exchange Rate Volatility on Trade, 1983-2007.

(Table 1 continued) Studies of The Effects of Exchange Rate Volatility on Trade, 1983-2007.

Gotur (1985)	1975Q1-1983Q4	US, West Germany, France, Japan and UK.	Standard deviation of the effective exchange rate index weighted from the IMF multilateral exchange rate model.	OLS	1 out of 10 trade volume equations have significant variability elasticities which are negatively signed.
Bailey, Tavlas and Ulan (1986)	1973Q1-1983Q4	Canada, France, West Germany, Italy, japan, UK, US.	Absolute value of quarter to quarter changes in the nominal effective exchange rate.	Second order polynomial Distributed lag.	No significant effect for any of the countries analysed.
Kenen and Rodrik (1986)	1975Q1-1984Q2	US, Canada, Belgium, France, Germany, Italy, the Netherlands, Sweden, Switzerland and UK.	Standard deviation of percentage changes in the real exchange rate over 12 and 24 month periods.	OLS	4 out of 11 cases are negatively signed and significant.
Bailey, Tavlas and Ulan (1987)	1962Q2-1974Q4 and 1975Q1-1985Q3	Canada, France, Germany, Italy, Japan, UK, US, Australia, the Netherlands and Switzerland.	The absolute quarterly percentage change in the effective exchange rate.	Polynomial distributed lag model.	Overall significant effect but not very strong. Direction of the variability effect inconclusive.

(Table 1 continued) Studies of The Effects of Exchange Rate Volatility on Trade, 1983-2007.

Brada and Mendez (1988)	1973-1977	30 developing and developed countries	Month to month percentage changes in effective rates.	OLS	Significant negative result overall.
De Grauwe (1988)	1960Q1-1969Q4 and 1973Q1-1984Q4	Belgium, Canada, France, West Germany, Italy, Japan, the Netherlands, Switzerland, UK, US.	Variability of the yearly percentage changes in the bilateral nominal and real exchange rates.	SUR Model	Insignificant result during fixed rate period and significant effect during floating period for real exchange rate variability. Nominal exchange rate variability has an insignificant effect.
Lastrapes and Koray (1990)	1973M3 - 1987M12	US	Moving sample standard deviation of the movements of the real exchange rates.	VAR	Significant but weak effect on trade.

(Table 1 continued) Studies of The Effects of Exchange Rate Volatility on Trade, 1983-2007.

Bahmani Oskooee (1991)	1973Q1-1980Q4	Brazil, Greece, South Korea, Pakistan, Philippines, Thailand and Turkey.	Standard deviation of the percentage changes in the real effective exchange rate over the previous eight quarters.	OLS	Significant negative elasticities for Greece and Turkey. Significant positive elasticity for Brazil and Korea.
Chowdhury (1993)	1973Q1-1990Q4	Canada, France, West Germany, Italy, Japan, UK, US	Moving sample monthly standard deviation.	Johansen cointegration Procedure and ECM.	Strong, significant negative effect.
Arize (1995)	1973Q2-1991Q3	US	ARCH	Johansen cointegration Procedure and ECM.	Significant negative effect for all measures of variability.
Arize (1997)	1973Q2-1992Q4	Denmark, Germany, Italy, Japan, Switzerland, UK, US.	ARCH	Johansen cointegration Procedure and ECM	Significant negative influence on export volumes for all countries analyzed.
Doroodian (1999)	Quarterly 1973-1996	India, Malaysia, South Korea	GARCH	Time series estimation for each country.	Significant negative impact.

(Table 1 continued) Studies of The Effects of Exchange Rate Volatility on Trade, 1983-2007.

Arize et al. (2000)	Quarterly 1973-1996	Ecuador, Indonesia, Korea, Malaysia, Malawi, Mauritius, Mexico, Morocco, Philippines, Sri Lanka, Taiwan, Thailand.	Eight quarter moving standard deviation.	Cointegration estimation for each country.	Significant negative impact.
Sauer and Bohara (2001)	Annual 1973-1993	22 developed countries, 25 Latin American LDC, 25 African LDC, 12 Asian LDC, 7 other LDC.	ARCH	Panel estimation	Negative impact for Latin American and African countries.
Esquivel and Larrain (2002)	Annual 1973-1998	Germany, Japan, USA, 40 LDC from Asia, Africa, Europe and Latin America.	Twelve month moving standard deviation.	Panel estimation.	Germany, Japan and USA exchange rate volatility has negative impact on LDC.
Arize, Malindretos and Kasibhatla (2003)	Quarterly 1973-1996	Burkina Faso, Colombia, Costa Rica, Jordan, Kenya, Myanmar, Pakistan, S. Africa, Venezuella.	Eight quarter moving standard deviation.	Cointegration estimation for each country.	Significant negative impact of volatility for all countries.

(Table 1 continued) Studies of The Effects of Exchange Rate Volatility on Trade, 1983-2007.

Poon et al. (2005)	Quarterly 1973-1997	Indonesia, Japan, South Korea, Singapore, Thailand.	Twelve quarter moving standard deviation.	Cointegration for each country.	Volatility has significant negative impact in all countries except Thailand. For Thailand significant positive impact.
Tenreyro (2007)	1970-1997	France, Germany, S. Africa, UK, US.	Instrumental Variable Poisson Pseuda Maximum Likelihood	GMM, OLS	Exchange rate variability has no significant impact on trade.

The literature about effects of exchange rate volatility on trade between 2008-2013 are listed below;

Baak (2008)	1986Q1-2006Q2	US, China	Standard deviation of exchange rate.	Cointegration, Dynamic ECM.	The volatility of exchange rates turned out to negatively influence the Chinese exports to the US, but not to have any influences on the US exports to China.
Serenis and Serenis (2008)	1973Q1-2006Q4	Norway, Poland, Hungry, Switzerland.	Standard deviation of the moving average.	Engle-Granger Cointegration	Exchange rate volatility has no major effects.

Table.2 Studies of The Effects of Exchange Rate Volatility on Trade, 2008-2013.

(Table 2 continued) Studies of The Effects of Exchange Rate Volatility on Trade, 2008-2013.

Hayakawa, Kimura (2009)	1992-2005	60 countries	Standard deviation of the first difference of the monthly natural logarithm of the bilateral real exchange rate.	OLS	Intra East Asian trade is discouraged by exchange rate volatility more seriously than trade in other regions. The negative effect of the volatility is greater than that of tariffs.
Baum, Caglayan (2010)	January 1980-December 1998	USA, UK, Canada, Germany, France, Italy, Japan, Finland, the Netherlands, Norway, Spain, Sweden, Switzerland	M-GARCH BEKK Model.	Engle-Granger Regression.	The impact of exchange rate volatility on trade flows is intermediate. Only a small number of models (30 out of 143) present significant relationship: significant and positive in 23 models and significantly negative in the remaining 7 models.

(Table 2 continued) Studies of The Effects of Exchange Rate Volatility on Trade, 2008-2013.

Serenis, Serenis (2010)	1973-2005	Austria, Belgium, Denmark, France, Finland, Italy, Portugal, Greece, Netherlands UK, Sweden.	Standard deviation of moving average of the logarithm of the real exchange rate.	Engle Granger Cointegration, ECM.	Exchange rate volatility does not have any major effects on the sectoral level of exports.
Zelekha, Efrat (2011)	1997Q1 -2010Q1	Israel, USA.	Instrumental Variable.	2SLS	Uncertainty has a negative and dominant effect on exports in both short run and the long run.
Mohammadi et al. (2011)	1959-2009	Iran.	TARCH.	Johansen Cointegration Test.	Significant and negative impact of exchange rate uncertainty on Iran's imports.

(Table 2 continued) Studies of The Effects of Exchange Rate Volatility on Trade, 2008-2013.

Mougoue, Aggarwal (2011)	British Pound: 1 Nov. 1997-21 Aug. 2009 Japanese Yen: 21 Nov. 1978-21 Aug. 2009 Canadian Dollar: 1 Dec. 1978-2009	UK, Japan, Canada.	EGARCH	Linear and non-linear Granger causality test.	Trading volumes and return volatility are negatively correlated with trading volume.
Bahmani-Oskooee, Harvey (2011)	1971-2006	USA, Malaysia.	Standard deviation of the 12 monthly real bilateral exchange rate.	ECM, Bound Testing Approach, OLS.	The exchange rate volatility has neither short run nor long run effect on trade flows.
Verheyen (2012)	January 1995-August 2010.	Austria, Belgium, Spain, Finland, France, Germany, Greece, Ireland, Italy, the Netherland, Portugal.	Moving standard deviation of the changes in the nominal exchange rate, GARCH.	ARDL Bound Testing.	The results do indicate that it is most likely that exchange rate variability depresses exports.

(Table 2 continued) Studies of The Effects of Exchange Rate Volatility on Trade, 2008-2013.

Srinivasan, Kalaivani (2012)	1970-2011	India	Moving average standard deviation.	ARDL Bound Testing.	The exchange rate volatility has significant negative impact on real exports both in the short run and long run.
Grier, Smallwood (2013)	January 1973-April 2007	Canada, Denmark, Japan, Norway, Sweden, Switzerland, UK, US and 19 LDC.	M-GARCH	VAR	The real exchange rate uncertainty negatively impacts trade for several less developed countries.
Nishimura, Hirayama (2013)	Daily January 2002-December 2011	Japan, China.	ARCH, Standard deviation.	ARDL	The results indicate that Japan's exports to China are not affected by the exchange rate volatility, but China's exports to Japan are negatively influenced.

(Table 2 continued) Studies of The Effects of Exchange Rate Volatility on Trade, 2008-2013.

Baek (2013)	1991Q1-2010Q4	Korea, Japan.	Standard deviation of the three monthly real exchange rate values within each quarter.	ARDL, ECM.	Korea's exports and imports are relatively sensitive to the bilateral exchange rate in the short run but less responsive in the long run.
Bahmani-Oskooee et al. (2013)	Annual 1971-2010	USA, Brazil.	Standard deviation of the 12 monthly real exchange rate values.	Bound Testing Cointegration, ECM.	The majority of the industries are not affected by volatility in the long run, large share of those that are affected responds positively to increased risk.
Poon, Hooy (2013)	1995-2008	Organization of the Islamic Conference Countries	Standard deviation of the monthly nominal exchange rate.	Panel regression.	Exchange rate volatility generally has significant negative effect on trade.

Conclusion

This paper provides an extensive survey of the literature on exchange rate volatility and trade, examining both the theory that underlies the work in this area and the results of empirical studies published between 1983-2013. Results of the studies are contradictory. Studies' sample periods, model specifications, countries and selected econometric methods vary widely. Especially analyses using aggregate data are in contradiction with analyses using disaggregate data. So one cannot argue that exchange rate volatility affect international trade positively or negatively.

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