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# EFFECT OF EXCHANGE RATE VOLATILITY ON EXPORTS: EVIDENCE FROM EIGHT DEVELOPED COUNTRIES

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**A B S T R A C T**

The purpose of this study is to empirically examine the relation between volatility in exchange rate and exports of eight developed countries (Australia, Canada, Japan, Korea, New Zealand, Norway, Sweden, and U.K). This study helps in understanding why developed nations have positive relation between volatility in exchange rate and exports. I have regressed three independent variables that are Gross Domestic Product, Consumer Price Index and volatility in exchange rate on total exports of eight developed nations. I have used three estimation techniques in this study including Pooled Ordinary Least Square, Fixed Effect Model and Random Effect Model. Panel Data has been used from 1991Q3 to 2011 Q4. For measuring the volatility in exchange rate "Moving Average Standard Deviation" technique has been used in this study. The results suggest a significant and positive relation between volatility in exchange rate and exports. The reason of these results highlights the important role played by the financial sector in developed nations. Strong financial sector helps the traders by providing hedging facilities which become the major reason to cope with uncertain situation created by volatile exchange rate. Gross Domestic Product variable also shown significant and positive impact on exports while Consumer Price Index shown significant negative impact on total exports.

**Keywords**: Exchange Rate Volatility, Exports, Pooled Ordinary Least Square, Fixed Effect Model, Random Effect Model, Gross Domestic Products.

## INTRODUCTION

There are many studies in literature which focus on the issue of international trade and factors which can affect the international trade. After the collapse of "Bretton Woods System" researchers started to study the relation of international trade with volatility in exchange rate. There is a constant change in the world; some changes make better while some make worse fluctuations in exchange rate. After the globalization, international financial and trading transactions have been increased that boosted volatility in exchange rate. Currency crisis in the markets of developing nations is one of big examples of volatility in exchange rate. Many strategies were adopted, for example the development of financial markets, strong policies for trade, involvement of central banks in financial markets to stabilize the value of currencies, which helped in lessening exchange rate fluctuations.

When nations adopted "Floating Exchange Rate" system there was a lot of assumptions about this system. One of them was that this system will bring volatility in exchange rate. After increasing volatility in exchange rate, international trade becomes more risky for international businessmen. Some of them left their businesses or reduced production because of risk-averse nature. While some developed new techniques to reduce cost of production and decreased the number of employees in their factories.

There are numbers of empirical and theoretical studies that investigate the relationship of volatility in exchange rate and international trade, but the available literature neither empirically nor theoretically suggests either the volatility in exchange rate have negative or positive relation with international trade. Many theoretical and empirical studies have found negative relation of volatility in exchange rate with trade (Abrams, 1980; D. P. Baron, 1976; Hayakawa & Kimura, 2009; Hooper & Kohlhagen, 1978; Kandilov, 2008; Siregar & Rajan, 2004). Some studies stated positive relation (Baum, Caglayan, & Ozkan, 2004; Bredin, Stilianos, & Murphy, 2003; Mckenzie, 1998; McKenzie & Brooks, 1997).

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(Ozturk, 2006) determines that impact of exchange rate vary according to nature of market, country and data sample.

This study empirically investigates the relation between volatility in exchange rate and exports of eight developed countries (Australia, Canada, Japan, Korea, New Zealand, Norway, Sweden, and U.K).

Exports and its Importance: Every nation in the world wants to become developed country; it's possible with the nurturing economy. There are many elements which play important role for the growth of economy, Exports are one of them. Exports are total sale of goods and services to other countries. If exports increase then it will surge the domestic production and enhance the efficiency. If demand for goods and services increases in other country it will increase the production activities and specialization for goods and Governments started to make policies and allocation of resources to facilitate exports (Giles & Williams, 2000; Khalafalla & Webb, 2001; Krueger, 1978). Reynolds (1983), indicate the performance of economic growth of those countries who achieved their high exports targets with the help of proper planning, suitable policies, make assure the implementation of policies, improvement in quality, identify demand in the world and make allocation of resources according to demand.

The Role of Financial Sector for Exports: Globalization enforced nations to bring reforms in their financial sector. Financial sector play essential role in the growth of country's exports. A strong financial sector can lessen the vulnerability of volatility in exchange rate by providing effective techniques to manage risk because main role of financial sector is to help in trading activities and managing risk with risk portfolio approach. A strong financial sector also facilitates the exporters, in getting loan if volatility in exchange rate badly hit the international transactions. Strong financial sector affect the exports in direct and indirect both way.

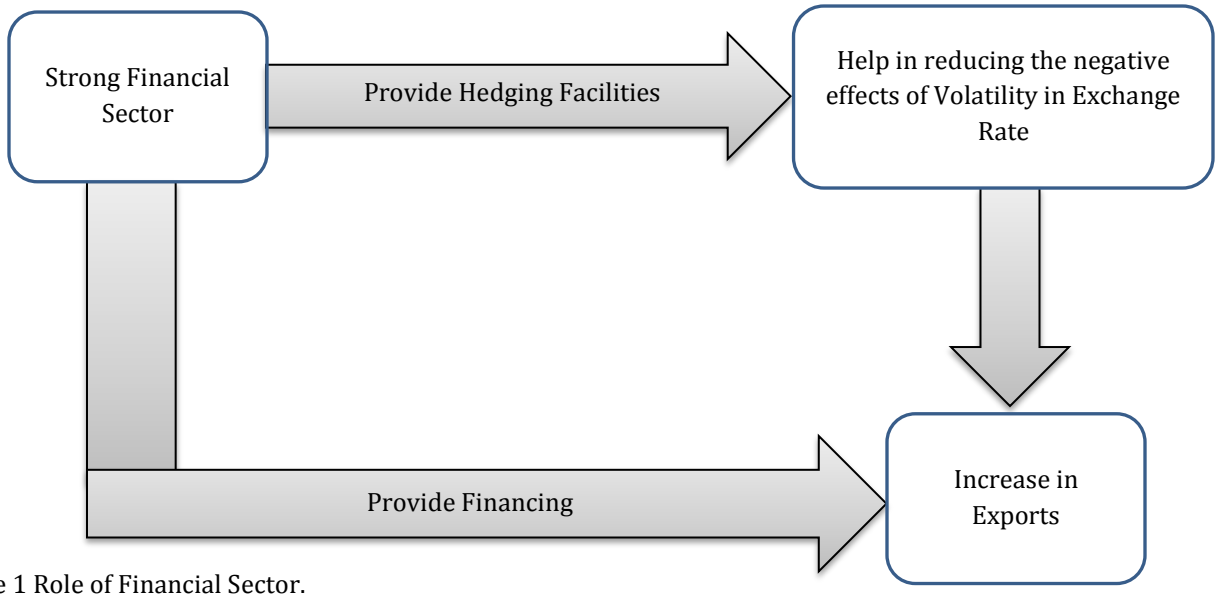


Figure 1 Role of Financial Sector.

**LITERATURE REVIEW**

**Theoretical Review:** "Bretton Woods System" faced a downfall in 1973 that made nations inclined toward floating exchange rate system. Floating Exchange Rate system introduced volatility concept that with passage of time turned into focal area of researchers as it imparts great impact on trade. Every year came with new studies and different perspectives, many researches have been conducted theoretically and empirically for analysis of international trade and exchange rate volatility relationships but there is still not a clear picture of the nature of relationship. Relationship of exchange rate volatility and International trade is explained by researchers through following two approaches.

**Risk aversion approach**

**Risk portfolio approach**

**Risk Aversion Approach:** Volatility has been concluded negatively correlated to that of international trade in numerous theoretical studies formerly. From this conceptual background two schools of thought came into existence; one was of the view that Volatile exchange rates do not influence trader's behaviours whereas second school was firmly supporting the concept of changes in trader's behaviour because of capricious instabilities of exchange rate. "Bretton woods

system" collapse in 1973 turned researcher's attention towards floating rate and its flaws. Major point of interest was volatility arouse from floating exchange rate system. Ethier (1973), introduced two concepts of "Separation Theory" and "Full-Hedge". In his study, they included the firms who do not intend to take risk or were risk averters. Main focus was import of those firms and they were supposed to minimize or cover that risk through hedging in forward contracts. He kept all the other risks constant and it was supposition that the only risk to be faced by the firm was related to exchange rate. Firm can enjoy the profit if he is sure about the extent of impact that would happen as a consequence of fluctuated exchange rate. Imports are dependent upon the assurance the firms have about their future spot rate dependent profits. Forward rates must lead the future spot rate to ensure profit and imports of firm.

Clark (1973), proposed a model in which firm was engaged in producing goods of same nature under market of perfect competition and sale the entire production in foreign market. Firm receives export's earnings in foreign currency and it cannot change its production decision according to fluctuations in exchange rate. Then firm consider exchange rate uncertainty and make decision about production. He shows that marginal revenue of firm is more than marginal cost and in perfect competition market price of goods is equivalent to marginal cost. If marginal revenue is more than marginal cost then firm will make reduction in its supply to bear extra risk.

D.P. Baron (1976), analysed the impact of invoice currency on decisions regarding production and prices of exporting firm in exchange rate variability periods. They related price risk and demand risk with the usage of foreign currency and home currency respectively for export invoices. Increase in volatility is expected due to export invoicing in foreign currency that increase prices of goods. Obstfeld and Rogoff (1998) investigate the "hedging strategy" of "risk aversion firms". They conclude that those firms who have risk aversion approach hedging against the fluctuations of exchange rate, but price of hedging and volatility in exchange rate increased the prices of exports and in result of it volatility in exchange rate have negative relation with trade (Obstfeld & Rogoff, 1998). Hooper and Kohlhagen (1978), describe a model which empirically study the effect of volatility in exchange rate on international trade and found negative relation. Their study examines the effect of volatility in exchange rate which create risk for prices and quantities of trade because of differences in preferences of risk between importers and exporters. They assume that some international trade deals make in foreign currency and ratio of this currency hedged in forward market. Hence, when foreign currency is not been hedged then risk arises. Important variables which ascertain the effect of volatility in exchange rate on inter-national trade are relative risk preference, the currency in which trade contract are denominate and ratio of hedging the contract in forward market.

De-Grauwe, (1988) discussed risk aversion approach and concluded that volatility in exchange rate can have negative and positive relation with international trade. He said that exporters can be in better position if they exports more in case of higher volatility in exchange rate because it increase the chances of marginal profits from exports. The reason behind criticism on this approach is lack of proper guidelines for firms to cope with risk. In following approach traders are risk takers.

**Risk-Portfolio Approach:** If financial markets giving the opportunity of hedging to international traders, it can help in compensating the losses generated by the volatility in exchange rate. Franke (1991) discussed trading strategy of a firm which is not risk averse and defend the positive relation between volatility and international trade. The firm establishes its export's tactics by comparing the cost of entering (exit) in overseas market with the revenue (cost) generated by exports. The firm can take advantages from the increase in volatility, if value of cash asset is more than entering (exit) cost of firm in overseas market.

Dellas and Zilberfarb, (1993) discussed risk portfolio approach in their study. They consider the unexpected changes in exchange rate as a risk and used non-hedge trade agreements in their model which have risk factor and done their analysis on an individual who perform the activities of export, import and used the products. They assumed concave and convex function both in model. In the case of convex function exports will increase if risk become higher and in concave function the situation will be opposite.

Broll and Eckwert, (1999) studied exchange rate volatility relationship with export policy in relation to the behaviour of a competitive firm and found some indication of exports stimulation. They found that firm's decisions about production are related to realization of exchange rate risk. It affect firm in choosing sale in local or international markets on realization of spot exchange rates. Study yielded an economic theory of more

Variability in volatile exchange rates leads to more export gains. It ultimately boosts up the production to meet export needs. However, higher volatility in exchange rate intimates greater risk for those firms who trade their goods internationally. According to them timing for allocation of production is exogenous variable and the model used permits to store and explain timing and distribution of production. After the production timing and allocation exports can become the optional activity and volatility in exchange rate would affect the production in positive manner, because inventories can be stored by firms and delay is possible in option of export's time to cancellation which make rise in value of option.

**Empirical Review:** After theoretical analysis of the relationship of volatility in exchange rate and international trade, it's clear that relationship of volatility in exchange rate with international trade is inconclusive. It shows that nature of this relationship is an empirical issue. In literature there are many studies which tried to empirically study the relationship of volatility in exchange rate with international trade but empirical results are also vague as theoretical propositions. Clear consent yet has to be emerged about the nature and significance of this relationship (Sauer & Bohara, 2001).

Econometric technique, proxies used for volatility in exchange rate, time series data, selected nations and most vital problem; how we quantify the volatility in exchange rate are some general factors that restrain empirical studies significance and measurements. In the empirical studies there is no unanimous technique for the estimation of volatility in exchange rate. Bini-Smaghi, (1991) has emphasized econometric methodological problems because all empirical studies use proxies to estimate exchange rate volatility and most of previous studies incorporated "Moving Standard Deviation" for monthly exchange rate, whereas some studies applied the ARCH models.

We will enumerate different methods adopted and extended by various researchers in studies in this section. Mckenzie, (1999) said that economists have consensus that fluctuations in exchange rate is the volatility because there is no generalized technique to measure such risk. There is no consensus in literature on the proxy of exchange rate volatility which clearly demonstrates risk in exchange rate. In Table 1 a review of techniques for measurement of volatility in exchange rate is given that exercised in studies.

**Summary of Techniques to Measure Volatility in Exchange Rate:** According to Akhtar and Hilton (1984), uncertain exchange rates mean that there is a doubtful estimation about the rates upon which currencies will be traded. Timing and extent of exchange rate variability are of major concern because of their ambiguous estimation by economic factors. True picture is yet to be uncovered, failed by the past experience and Models.

It is an essential requirement in the process of volatility measurement to choose between nominal and real exchange rate despite of the "No major difference" by various researchers(Clark, Tamirisa, Wei, Sadikov, & Zeng, 2004). Dell'ariccia, (1999) concluded a strong relation between Nominal and real exchange rates whilst nominal rate was used in most of early researches (Clark, 1973; Ethier, 1973; Hooper & Kohlhagen, 1978). Nominal exchange rate being the change predictor of price level, was related to risk associated to exchange rate and prices of goods(Bini-Smaghi, 1991). Moreover, taking into consideration the short run and long run scenarios, Bini-Smaghi (1991), and Hondroyiannis et al., (2008), proved a streamlined movement trend of the two exchange rates whereas, in long run variance exists because of unpredictable movements in prices of traded goods. So, for long run, real exchange rate was proved appropriate.

**Summary of Empirical Studies:** Hooper and Kohlhagen, (1978) used various estimation techniques for volatility measurement and one of them is absolute average difference between current spot rate and previous forward rate. They found negative relation with international trade. They gave reason of using this proxy instead of standard deviation of forward and spot rate is that it captures the parity change during the transitional time period from flat to moving exchange rate.

In number of empirical studies researchers used standard deviation technique to measure volatility in exchange rate (Bahmani-Oskooee, 1991; De-Grauwe, 1988; Kenen & Rodrik, 1986).Kenen and Rodrik, (1986) employed three types of techniques to measure volatility. In first technique, they used real exchange rate and measure monthly variations through standard deviation and supposed that variation of anticipated exchange rate in any month of that period is known as the average change for that specific period. In second technique, standard deviation of exchange rate found from a "Log Linear Equation" and assumed that level of

exchange rate in any month will considered as trend value of that month and in third technique standard deviation got from first-order-auto-regressive equation, in which assumed that exchange rate anticipated of any month is the one obtained from autoregressive equation.Bini-Smaghi, (1991) analyze the relation of volatility with the manufacturing trade of Germany, France and Italy. He estimates the volatility by using the standard deviation of variations in weekly exchange rate.

This kind of estimations for volatility in exchange rate is used by risk averse-firms because when exchange rates have constant movement this measure will equal to zero and when there are large fluctuations in exchange rate then it shows the volatility in exchange rate.

Table 1 Technique Used For Volatility Measurement.

| Techniques to measure volatility in exchange rate | Used by |
|---|---|
| $V_{t=\sum_{t=1}^{n}} \left[\frac{f_{t-1}-e_t}{n}\right]$<br>"Average absolute difference between the previous forward and current spot rate.$f$ is the forward rate and $e$ is the spot rate". | Ethier (1973) and Hooper and Kohlhagen, (1978) |
| $V_t = \left[\left(\frac{1}{m}\right).\sum_{i=1}^{m}(e_{t+i-1}-e_{t+i-2})^2\right]^{1}/_{2}$<br>"Moving standard deviation of exchange rate, where $e$ is the log exchange rate and $m$ is moving average". | Gotur, (1985); Kenen and Rodrik, (1986); Bahmani-Oskooee, (1991); Kumar and Dhawan, (1991); Savvides, (1992); Chowdhury, (1993); Arize, (1997); Arize, Osang, and Slottje, (2000); Péridy, (2003); Siregar and Rajan, (2003); Poon, Choong, and Habibullah, (2005); Byrne, Darby, and MacDonald, (2008) |
| $V_{i,t} = (E_{i,t} - E_{i,t-1})/E_{i,t-1}$<br>$V_{i,t}$ is the "absolute value of percentage change in nominal exchange rate" ,$E_{i,t}$ is the "spot rate".<br>"Quarter to Quarter" change in spot rate | Bailey, Tavlas, and Ulan, (1986) |
| $V_t = V_t^1 + V_t^2 = \frac{\max X_{t-k}^t - minX_{t-k}^t}{minX_{t-k}^t} + \left[1+\frac{X^t - X_p^t}{X^p}\right]^2$<br>$X^t$ "Nominal exchange rate at time t", $maxX_{t-k}^t$ and $minX_{t-k}^t$ is the "maximum and minimum values of nominal exchange rate", $X_p^t$ is the "equilibrium exchange rate".<br>"Annual data" used | Peree and Steinherr, (1989) |
| "ARCH" and "GARCH" models | Arize, Osang, and Slottje, (2008); Herwartz, (2003); Hondroyiannis, Swamy, Tavlas and Ulan,(2008); Kroner and Lastraps, (1993); Mckenzie,(1998); McKenzie and Brooks, (1997); Péridy, (2003); Pozo,(1992); Siregar and Rajan,(2003); Wang and Barrett, (2007) |
| $r_{it} = Log\left[E_{it} * \frac{CPI_{ft}}{CPI_{it}}\right]$<br>$r_{it}$ is the "real exchange rate" quarterly, $E_{it}$ is the "nominal exchange rate",$CPI_{it}$ and $CPI_{ft}$ is the "consumer price index of Bangladesh and importing country". | Ahmed, (2009) |
| $volatility_{ij,t} = a_0 + a_1 In\ Risk_{i,t-5} + a_2 In\ Risk_{j,t-5} + \in_{jt}$<br>Riski denotes "country risk in countryi" and riskj denotes "country risk in country j". Country risk index used as proxy in the place of "country risk" and absolute value of residuals use as "volatility". | Hayakawa and Kimura, (2009) |

Table. 2 Summary of Empirical Studies.

| Article | Time Period | Nature of exchange rate | Estimation Model | Results |
|---|---|---|---|---|
| Hooper and Kohlhagen, (1978) | 1965-1975 | Nominal exchange rate | OLS | Insignificant |
| Abrams, (1980) | 1973-1976 | Nominal exchange rate | Panel Ordinary Least Square | Negative |
| Akhtar and Hilton, (1984) | 1974-1981 | Real exchange rate | OLS | Negative |
| Gotur, (1985) | 1974-19 | Nominal exchange rate | OLS | Insignificant |
| Cushman, (1986) | 1965-1983 | Real exchange rate | OLS | Negative |
| Kenen and Rodrik, (1986) | 1975-1984 | Real exchange rate | OLS | Negative |
| Bailey and Tavlas, (1988) | 1975-1986 | Real exchange rate | OLS | Insignificant |
| De-Grauwe, (1988) | 1960-1969 & 1973-1984 | Both | Unrelated Regression Estimation | Negative |
| koray and Lastrapes, (1989) | 1959-1985 | Real exchange rate | Vector auto-regressive | Negative |
| Bini-Smaghi, (1991) | 1976-1984 | Nominal exchange rate | OLS | Negative |
| Kumar and Dhawan, (1991) | 1974-1985 | Both | OLS | Negative |
| Pozo, (1992) | 1900-1940 | Real exchange rate | OLS | Negative |
| Chowdhury, (1993) | 1976-1990 | Real exchange rate | Johansen's Cointegration and ECM | Negative |
| McKenzie and Brooks, (1997) | | Nominal exchange rate | OLS | Positive |
| Mckenzie, (1998) | | Nominal exchange rate | OLS | Positive |
| Dell'ariccia, (1999) | 1975-1994 | Both | Panel Ordinary Least Square | Negative |
| Arize et al., (2000) | 1973-1996 | Real exchange rate | Johansen's cointegration and Error Correction Model | Negative |
| Cho, Sheldon, and McCorriston, (2002) | 1974-1985 | Real exchange rate | Fixed Effect Estimation Model | Negative |
| Bredin et al., (2003) | 1978-1998 | Real exchange rate | OLS | Positive |
| Baum et al., (2004) | 1990-1998 | Real exchange rate | Non-linear OLS | Positive |
| Clark et al., (2004) | 1975-2000 | Both | Fixed effect & Random effect model | Insignificant |
| De-Vita and abbott, (2004a) | 1993-2001 | Both | Auto regressive distributed lag model | Negative |
| Tenreyro, (2007a) | 1970-1997 | Nominal exchange rate | pseudo-maximum likelihood model | Insignificant |
| Arize et al., (2008) | 1973-2004 | Real exchange rate | Johansen's cointegration and Error Correction Model | Negative |
| Hayakawa and Kimura, (2009) | 1992-2005 | Real exchange rate | OLS | Negative |

Previous studies used short run exchange rate volatility but De-Grauwe (1988), probe the relation of long run volatility in exchange rate with international trade by extending time horizon because former researchers tested short run exchange rate volatility. He stated that real exchange rate has more impact on trade as compared to nominal exchange rate because it adjusts with the changes in price level of traded goods. His outcomes indicated that only real exchange rate variability negatively affects the trade flow during the flexible exchange rate system. During flat exchange rate system, he couldn't find significant impact on trade flow because variability in exchange rate in this period was very little.

Arize (1977), Bahmani-Oskooee (1991), Bini-Smaghi, (1991), Chowdhury (1993), Gotur (1985) Kenen and Rodrik (1986) and Kumar and Dhawan (1991), switched to "Moving Sample Standard Deviation" for the proxy of exchange rate from "exchange rate risk" for the just measurement of both high and low exchange rate uncertainty. (koray & Lastrapes, 1989) state that "Moving Sample Standard Deviation" measures variations in exchange rate in short run significantly. In spite of this, Bini-Smaghi, (1991) discuss the even transformation of moving average because of which reliability of measurement of volatility is become questionable.

De-Vita & abbott, (2004a) explored short run and long run volatility difference. Risks arises from short run volatility can be hedged in market while it seems impossible in long run scenarios, in turn impact strongly on trade flows. They used ARDL method for estimating short run and long run volatility impact of UK exports to 14 nations. Study concluded no effect in short run volatility at They developed ARDL bound testing procedure and aggregate and sectoral level. In second estimation for long run volatility impact of volatility was proved negative. Generalized Auto-Regressive Conditional Heteroscadascity (GARCH) model has been used in various empirical studies to measure the exchange rate volatility. It is considered as most suitable measuring technique for volatility because it captures unanticipated changes in exchange rates. In GARCH model auxiliary regression used and estimated "squares of lagged value of the error term" consider as exchange rate variance which is used as a proxy for exchange rate volatility. Kroner & Lastraps, (1993); Mckenzie, (1998); McKenzie & Brooks, (1997) are some of the researchers who used ARCH and GARCH models in their studies. Mckenzie, (1998) used ARCH and GARCH model to compute volatility in exchange rate and then computed it's relation on Australian trade. He tested aggregate trade and produced limited evidence that shown negative affect on Australian imports and positive impact on exports.

Ahmed, (2009), investigated volatility relationship with Bangladesh trade quarterly. He formulated his technique for measuring exchange rate volatility in which he used consumer price index for country under his observation i.e. Bangladesh and Consumer price index of importing country. Hayakawa and Kimura, (2009) measured the unanticipated changes in exchange rate volatility in East Asia by regress the equation according to OLS method. They quantified risk of countries as a variable and defined volatility as "absolute value of residuals". Due to shortage of data for all countries' risk country risk index was used as a proxy for unavailability. Results proved that countries with larger index were to face small risk.

**Data and Methodology:** I have used the data of eight developed countries including Australia, Canada, Japan, Korea, New Zealand, Norway, Sweden, and U.K. to examine the relation between volatility in exchange rate and exports by using panel data. Exports are considered to be as dependent variable. The independent variables include "Gross Domestic Product", "Consumer Price Index" and Volatility in Exchange Rate. In this study I tried to find out the relation between volatility in exchange rate and total exports of eight developed countries. Panel data is used in which Pooled Ordinary Least Square estimation technique used and also checked Fixed and Random Effect regression results by using Hausman test decided either fixed or Random Effect provided better results.

**Data Sources and Issues:** For my study I have used panel Data of eight countries (Australia, Canada, Japan, Korea, New Zealand, Norway, Sweden, and U.K) from the period of 1991Q3 to 2011Q4. The variables of my study is Total Exports as dependent Variable and Gross Domestic Product, Consumer Price Index and Volatility in Exchange Rate as independent variable. All data of eight developed countries has been collected from the website of www.sats.oecd.org and all values of data are expressed in current US dollar.

**Measurement of Volatility in Exchange Rate:** After detailed analysis of review of literature, we noticed that measurement of volatility in exchange rate is the main issue in selecting the suitable proxy which denotes

volatility in exchange rate. There are different methods in literature to measure volatility in exchange rate which has been used in empirical studies but there is no unanimity on the selection of suitable measure. Many researchers used different proxies for volatility in exchange rate to identify the relation between volatility and trade (Bini-Smaghi, 1991; Hooper & Kohlhagen, 1978; Kenen & Rodrik, 1986; Mckenzie, 1998; Peree & Steinherr, 1989).

This study used "Moving average Standard Deviation" to measure volatility in exchange rate (Bahmani-Oskooee, 1991; Bini-Smaghi, 1991; Chowdhury, 1993; Gotur, 1985; Kenen & Rodrik, 1986; koray & Lastrapes, 1989, 1990). This technique helps in capturing the changes in exchange rate over a period of time. According to Klaassen, (2004) the important feature of this technique is that it has the capability to seize higher tenacity changes in exchange rate. Koray and Lastrapes, (1989) explained that this technique helps in seizing the temporary changes in total variations of exchange rate. We can measure the "Moving average Standard Deviation" with the help of this following formula.

$$V_t = \left[\left(\frac{1}{m}\right).\sum_{i=1}^{m}(e_{t+i-1} - e_{t+i-2})^2\right]1/2$$

$e_{t+i-1}$is the logarithm of exchange rate in terms of US Dollar, m is the order of "Moving Average" which is equal to 3.

**Models used for Estimation:** In earlier studies researchers used time series data in their empirical studies and results of these studies were inconclusive. In studies of Bailey and Tavlas, (1988); Hooper and Kohlhagen, (1978) they employed time series data to determine the relation between volatility in exchange rate and trade of developed countries and discovered insignificant results. WhileAkhtar and Hilton, (1984), Bini-Smaghi (1991), and Kenen and Rodrik, (1986), discovered negative relation between volatility in exchange rate and trade and they used time series data for the estimation of results. The main issue of time series data is that it does not control the different effects of nations-pair like distance, language etc. between two nations. Panel data has ability to resolve the issues which occur due to the use of time series data. Such as, many nations want to improve their positions of exchange rate against main trading nations. In examination of time series data, it's difficult to capture the effects of improvement in exchange rate while panel data helps in capturing this. In panel data, there are two estimation methods which used to capture the invisible factors.

**Fixed Effects Model**

**Random Effects Model**

In this study three estimation techniques has been used which are Pooled Ordinary Least Square model, Fixed Effects Model and Random Effects Model.

**Econometric Model**

$$\boldsymbol{X_{ij} = \beta_0 + \beta_1 Y_{ij} + \beta_2 CPI_{ij} + \beta_3 V_{ij} + \varepsilon_{ij}}$$

**Interpretation of Pooled Ordinary Least Square:** I have studied the relation of volatility in exchange rate with exports of following eight developed countries which are Australia, Canada, Japan, South Korea, New Zealand, Norway, Sweden, and U.K. Total exports has been taken as dependent variable and all figures are in US Dollar which is effected by GDP, CPI and volatility in exchange rate.

Pooled Ordinary Least Square was used with the help of this following equation.

$$\boldsymbol{X_{ij} = \beta_0 + \beta_1 Y_{ij} + \beta_2 CPI_{ij} + \beta_3 V_{ij} + \varepsilon_{ij}}$$

Table 3 Pooled OLS

| Independent Variable | Ordinary Least Square | P-Value |
|---|---|---|
| Gross Domestic Product | 110.9658 | 0.000*** |
| Consumer Price Index | -848304.4 | 0.003*** |
| Volatility | 3.68e+09 | 0.000*** |
| Constant | 4.81e+07 | 0.072* |
| $R^2$ | 0.7950 | |
| F | 842.93 | |
| Prob > F | 0.0000 | |

***Significant at 1% Level, **Significant at 5% Level, *Significant at 10% Level.

In results volatility shown positive relation with exports and have significant coefficient at the level of 1 per cent. Which means exports has been increased when volatility in exchange rate increase. Baum et al. (2004,) Bredin et al., (2003), Mckenzie (1998), McKenzie and Brooks (1997), and Pickard (2003), also found positive relation between exports and volatility in exchange rate in their empirical studies. Bernard & Jensen (2004),

studied the U.S exports from 1987 to 1992 and found that volatility in exchange rate is the main variable for the increase in exports. Brada & Mendez (1988), investigate the relation between the volatility in exchange rate with trade under both systems "Fixed Exchange Rate" and "Floating Exchange Rate". They observed that trade has positive relation with volatility in exchange rate, and trade has been surged after adopting "Floating Exchange Rate" system. They gave the reason of this positive relation by arguing that although "Floating Exchange Rate" system brings more risk exposure for traders but it can off-set those effects which occur due to "Fixed Exchange Rate" system such as, restriction policies for trade made by government.

According to Krugman and Obstfeld, (2000) this positive relation encourages those results in which researchers argued that volatility in exchange rate does not decrease the trade flow of those countries which have well developed financial sector and facilitate their traders by providing better hedging of foreign currencies. After the downfall of "Bretton woods System" trade has been increased after adopting "Floating Exchange Rate" system in place of "Fixed Exchange Rate". De-Grauwe, (1988) said that firms does not only consider volatility in exchange rate as a risk for them but also a chance for creating more profit margins. He discussed the theory of option. If price of currency is positive then firms can use the option for exporting its goods and if price is negative then firm may not use its option because if asset of option has more fluctuations then price of option will be high. The variable of Gross Domestic product also shows positive relation with exports in this study which means that if domestic production increases then exports also increase. International trade theory support this positive relation and according to findings of this study if one unit of GDP increases then exports will increased by 110.9658 and it is also significant at the level of 1 per cent. Abrams (1980), also found positive relation between exports and GDP. Mckenzie (1998), studied the Australian's trade and used GDP as independent variable, results of their findings showed positive relation of GDP with exports and statistically significant at the level of 1 per cent.

Consumer Price Index found negative relation with exports which means if prices of goods increases then it will reduce the level of exports. After the estimation of Pooled OLS findings show that if 1 unit of CPI increases then exports will decrease by 848304.4 and significant at the level of 1 per cent. If prices of goods are more in international market as compared to other competitors then demand for export will reduce in result of which total exports of that country also reduce. Mckenzie (1998), evaluate the Australian's exports and found negative relation between Australian's exports and Australian's price level. McKenzie and Brooks (1997), before previous one they investigate German-US trade and found negative relation between German's exports and German Price level.

F Test is used to test the relationship between independent and dependent variables. F-value should be greater than 1 and the 842 is larger than one. Probability value supports the F-test result. F-test value is significant at 0.01%. $R^2$ is 0.7950, which means independent variables explained dependent variable by 79%.

**Fixed Effects Model:**

Following is the econometric model which used for the estimation of Fixed Effect.

$$X_{ij} = \beta_0 + \beta_1 Y_{ij} + \beta_2 CPI_{ij} + \beta_3 V_{ij} + \varepsilon_{ij}$$

Fixed Effect Model used for evaluating the relation between dependent variable and independent variable of different groups. Each and every group has its own traits can influence the independent variable. Fixed Effect Model helps in capturing the unobservable effects on model. As already mention that I have used panel data of eight developed nations which include Australia, Canada, Japan, Korea, New Zealand, Norway, Sweden, and U.K.

Total observations are 656 with 8 groups. All data has been taken in quarterly frequency. Each group has 82 observations. After running the Fixed Effect Model in Stata, results shows corr (u_i, Xb) = -0.9798, which means errors of this model are correlated with independent variables. Results are showing that all independent variables (GDP, CPI and Volatility) have expected signs and significant at the level of 1 per cent. F test is used to see that either coefficients of all independent variable are more than to 0, and if Prob > F is less than 0.05 then results of model consider OK, and results showing that 0.0000 which is less than 0.05 which means results are OK. The value of rho in model shows the variations because of inconsistency in all group of panel. The value of rho in this model is 0.97391502 which means 97% variations is exist in model.

**Random Effects Model:**

Following is the econometric model which used for the estimation of Random Effect.

$$X_{ij} = \beta_0 + \beta_1 Y_{ij} + \beta_2 CPI_{ij} + \beta_3 V_{ij} + \varepsilon_{ij}$$

In Random Effects Model variance in all group of panel is consider as random and have no correlation with independent variables.

If variance in all group of panel has impact on independent variable then we apply Random Effect Model. As already mention that I have used panel data of eight developed nations which include Australia, Canada, Japan, Korea, New Zealand, Norway, Sweden, and U.K.

Total observations are 656 with 8 groups. All data has been taken in quarterly frequency. Each group has 82 observations.

Table 4 Fixed Effects Model.

| Independent Variable | Fixed Effects | P-Value |
|---|---|---|
| Gross Domestic Product | 395.8034 | 0.000*** |
| Consumer Price Index | -844049.6 | 0.000*** |
| Volatility | 7.81e+09 | 0.000*** |
| Constant | -3.45e+08 | 0.000*** |
| F | 284.54 | |
| Prob > F | 0.0000*** | |
| corr(u_i, Xb) | -0.9798 | |
| Rho | .97391502 | |

***Significant at 1% Level, **Significant at 5% Level, *Significant at 10% Level.

Table 5 Random Effect Model.

| Independent Variable | Random Effect | P-Value |
|---|---|---|
| Gross Domestic Product | 249.0719 | 0.000*** |
| Consumer Price Index | -786214.1 | 0.004*** |
| Volatility | 4.36e+09 | 0.000*** |
| Constant | -1.20e+08 | 0.001*** |
| Prob > F | 0.0000*** | |
| Rho | .33167032 | |
| Corr (u_i, X) | 0 (assumed) | |
| Prob > chi2 | 0.0000*** | |

***Significant at 1% Level, **Significant at 5% Level, *Significant at 10% Level.

After running Random Effect Model results are showing corr(u_i, X) = 0 (assumed) which means variations in group of panel data are not correlated with independent variables. Results shows that if GDP increased by 1 unit then exports increased by 249.0719 and it is significant at the level of 1 per cent. CPI increased by 1 unit exports decreased by 786214.1 and it also significant at the level of 1 per cent. Volatility increase by 1 unit then exports will increased by 4.36e+09 and it is also significant at the level of 1 per cent. If Prob > chi2 is less 0.05 then model will consider Ok and results are showing Prob > chi2= 0.0000 means Random Effect Model is OK.

**Hausman Test:** Hausman test is used to select preferred model between Fixed Effect Model and Random Effect Model. If Prob>chi2 is less than 0.05 means we will use Fixed Effect Model and results are showing Prob>chi2 = 0.0279 which mean our model will be Fixed Effect Model.

**CONCLUSION:**

After applying estimation techniques results of my study showing significant positive relation between volatility in exchange rate and total exports. The uncertain situation create by the changes in exchange rate can be reduce if a country have providing hedging facilities to its traders in forward market. D. Baron, (1976) said that fluctuations in exchange rate create the uncertain situation which can be handled with the help of a "Perfect Forward Market".De-Grauwe, (1988) described that traders can make increase in sales in foreign markets if they managed its cost of production according to the fluctuations in the international prices of goods. But it depends on the nature of traders either they are Risk averse or risk taker. In this study all selected countries are developed and results convincing

that government of these countries have effective techniques for hedging the risk which occur due to the changes in exchange rate. Policy maker of these countries may have adopted "Liberalization Policy" for trade when fluctuations of exchange rate are high in market. All selected countries are major and stable currencies in the world.

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