EXCHANGE RATE VOLATILITY AND SECTORAL TRADE – AN ECONOMETRIC ANALYSIS WITH RESPECT TO INDIA

THESIS SUBMITTED TO

GOA UNIVERSITY

FOR THE AWARD OF THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

ECONOMICS

BY

DHANEESH KUMAR T.K

UNDER THE SUPERVISION OF

PROFESSOR P.K. SUDARSAN

DEPARTMENT OF ECONOMICS

GOA UNIVERSITY

GOA – 403206

2018

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CERTIFICATE

This is to certify that the thesis titled "**Exchange Rate Volatility And Sectoral Trade – An Econometric Analysis With Respect To India**" for the award of Ph.D degree in Economics, is a bonafide record of the research work done by **Mr. Dhaneesh Kumar T.K** during the period of study under my supervision and that the thesis has not formed the basis for the award of any degree, diploma, associateship, fellowship or similar title to the candidate and also that the thesis represents independent work on the part of the candidate.

Date: 16 / 02 / 2018

Place: Goa

Research Guide:

Dr. P.K. Sudarsan

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DECLARATION

I hereby declare that the thesis titled "**Exchange Rate Volatility And Sectoral Trade – An Econometric Analysis With Respect To India**" submitted to the Goa University, Goa for the award of the degree of Doctor of Philosophy in Economics, is an original and independent research work done by me during the period June 2013 to February 2018 under the supervision and guidance of **Professor P.K. Sudarsan, Head – Department of Economics, Goa University**, Goa and also that it has not formed the basis for award of any degree, diploma, associateship, fellowship or similar title to any candidate of any university.

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Dhaneesh Kumar T.K

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CHAPTER I

INTRODUCTION

1.1 Introduction

The Exchange rate volatility and trade impact is one of the areas where economists and policy makers have shown great interest in recent years. The breakdown of the Brettonwood system of fixed exchange rate in 1973 and the resulting exchange rate variability has introduced lots of uncertainty in trading relationships between nations worldwide. One of the major concerns since the introduction of the flexible exchange rate has been whether the increase in exchange rate variability has adversely affected the international trade flow. In the early 1970s it was argued that moving from a fixed to flexible exchange rates would make exchange rates more stable in the long run, but even after 45 years the volatility of exchange rates has been increasing rather than decreasing.

The exchange rate is considered to be an important macroeconomic variable in determining a countries' economic stability**.** In the recent past the foreign exchange market especially the exchange rate volatility has emerged as a strategic area of concern and of great relevance as it impacts the overall economic conditions of the nations and more specifically trade. The present world characterised by the integration among nations, coupled with the scenario of liberalised trade policy norms have pushed trade among the nations to a substantial level. Subsequently, the trade flows have become more exposed to exchange rate risk. Several studies have come to the conclusion that exchange rate volatility can have a negative impact on trade flows. Equally, several others studies have concluded that the effect is uncertain or positive. Interestingly, one cannot reach a firm conclusion from empirical studies. Results are conflicting and sensitive to various factors.

The exchange rate volatility is the result of the changes in various macroeconomic variables like liquidity conditions, GDP, inflation, supply of foreign exchange reserves, etc. Further the decisions of monetary authority have great influences on the exchange rate by altering interest rate and thereby changing people's expectations of future exchange rate. Researchers and policy makers have shown great interest to study exchange rate volatility and its impact on macroeconomic variables since exchange rate system moved from fixed to flexible exchange rate in the early 1970s. Many economists argued for establishment of flexible exchange rate regime on two grounds. The first argument is related to the competitive position of a country in the international market. The second argument is that the stabilizing behaviour of speculators will make exchange rates relatively stable. Recent global financial crisis, debt crisis, etc. have increased exchange rate volatility. Since then, numerous studies have been exploring these impacts, but their findings are mixed and depend on region, period, data and methodology used. The general argument is that excessive exchange rate fluctuation has detrimental impact on a countries' economic growth. The present globalized era, international trade and investment decisions have become more difficult due to high risk resulting from exchange rate volatility.

1.2 Exchange rate regimes and international monetary system

The international monetary system has gone through many changes over the past 200 years. From 1815 to 1873, international monetary system was operating by Bimetallism (silver and gold). The evolution from bimetallic standard to a pure gold standard was achieved by the end of the 19^{th} century. The gold standard is known as fixed exchange rates system, in which each nation defined its currency in terms of Gold. Under this system the accounts between countries were settled through the exchange of gold.

This system was prevailed until the post-world war 1 period. After the war the industrialised nations were trying to resolve the domestic economic problem through protection and competitive devaluation. Eventually the continuation of gold standard system became impossible. On the other hand, there was a need for everlasting international monetary standard for world prosperity in which gold was no longer suitable because of the limited quantity available. The paper money was first introduced in Britain followed by US. Initially pound sterling controlled the paper standard across the world, later dollar led international system dominated which is still working with the volatile exchange rate regime. From 1915 to 1999, International monetary system adopted Dollar–Gold Standard, Gold Exchange Standard, Dollar Standard, and Flexible Exchange Rates system.

In the year 1944, The Bretton Woods System was signed and became the first international institution to govern monetary relations among independent nations. One of the main features of the Bretton Woods system was an obligation for each country to adopt a monetary policy that maintained the exchange rate which bind its currency to the U.S. dollar. Under the Bretton Woods system each nation agreed to the scheme of fixed but adjustable exchange rates where the currencies were pegged against the dollar and the dollar can be convertible into gold at a fixed price. As per Bretton wood agreement the IMF and the World Bank were established in the year 1945. The main duty of IMF was to bridge the temporary imbalances of payments.

In the year 1971 United States withdrew the commitment to buy and sell gold at fixed rate and thereby Bretton wood par value system came to an end. After the collapse of Bretton wood system there was an emergence of a flexible exchange rate which was adopted by many developed nations. Under this system exchange rate were determined by the market forces of demand and supply.

Further, the common market countries wanted stability of fixed exchange rate among themselves and flexible exchange rate with other countries. This system was called as common margin arrangements or the snake in the tunnel. In 1979 European Monetary System, a new arrangement had come and on January 1st 1999 a common currency the Euro was introduced for the members of European Union. Two major flaws can be observed from international monetary system, one is the Triffin dilemma and the second is exclusion of emerging market. Triffin dilemma refers to the situation where national currencies are used for managing international liquidity and other related issues. Such case was evident from the experience of US BoP deficit and the collapse of Bretton wood system. And the other is excluding emerging market despite their increasing economic weight makes the international monetary system a partial adjustment and possibility of imbalances.

As Salvatore (2011) points out, the main characteristics of the current international monetary system is, that there is a wide variety of exchange rate arrangements, nation is free to choose exchange rate regime, pegging or floating. Unlike previous systems, the pre-war gold standard and the Bretton Woods dollar standard, today's arrangement is characterised by the pronounced tendency of countries to adapt their exchange-rate regime to their own needs. Most importantly, countries decide whether to float or peg their currency, and to what currency or mix of currencies they should peg. They also choose what combination of currencies and gold to use as reserves.

1.3 Exchange rate and trade – A theoretical background

There has been lot of development in the theoretical perspective which stress on the relation between trade and exchange rate namely, (a) Standard Theory of International Trade, (b) Elasticity Approach, (c) Keynesian Absorption Approach, and (d) Monetary Approach

The Mercantilist approach during the sixteenth to eighteenth centuries assumed that the wealth of a nation depends primarily on its ability to hold precious metals such as gold and

silver. Mercantilist on the one hand supported exports and encouraged metal discoveries and on the other hand, discouraged imports through imposing high tariffs. After three centuries, the classical economists with the publications of Adam Smith's Wealth of Nations and David Ricardo's the principles of Political Economy and Taxation, criticised Mercantilism and came out with the standard theory of international trade.

Standard Trade Theory indicate that a fluctuation in exchange rate affects both the value and volume of trade. Theory states that if real exchange rate increases (real depreciation) imports become costlier and exports become cheaper. Foreign household can purchase more domestic good and domestic household buy of less foreign goods. Eventually, the home country can obtain trade surplus. Later, Lerner extended the trade theory by incorporating price elasticities of imports and exports demand in measuring the effect of real exchange rate variations on trade balance. According to Lerner, trade balance is not concerned with the volume of physical goods but with their actual values

The Elasticity Approach

The Elasticity Approach which is commonly known as Bickerdike-Robinson-Metzler Condition implies that the adjustment in trade balance is viewed on the basis of elasticities of demand for imports and exports and the initial volume of trade. Mainly it focuses on volume and value responses to the changes in real exchange rate. If the foreign demand is elastic, lower prices in the domestic country as a result of currency devaluation will normally increase foreign demand for domestic goods. On the other hand, if foreign demand elasticity for domestic goods is fragile, the quantity of domestic goods sold in foreign market will not increase.

Policymakers can use Elasticity Approach in practice when a country experience trade balance deficit. They calculate the responsiveness of imports and exports for a change in exchange rate to identify at what extent devaluation would affect the trade balance. If foreign

and domestic demands for imports and exports are elastic, a small change in the exchange rate would have substantial impact on trade balance.

Marshall-Lerner Condition

Marshall-Lerner Condition is an extension of the elasticities approach. According to this approach, if policymakers depreciate the currency with the purpose of improving trade balance, the demand for the nation's exports and imports should be sufficiently elastic. Marshall-Lerner Condition states that the sum of the absolute values of the two elasticities must exceed unity, if the sum is less than one, trade balance will worsen when a depreciation takes place

J-Curve theory

After three decades of the Marshall-Lerner Condition, the J-Curve theory came into existence. First it was illustrated by Stephen Magee in 1973, the J-Curve phenomenon reflects how a devaluation of a country's exchange rate affects its trade balance over time. To answer the question how long it takes for the trade balance to experience an improvement in relation to devaluation, in the year 1985 Mohsen Bahmani-Oskooee was the first to introduce a method of testing the J-Curve phenomenon.

According to J curve effect, the expansion in exports and deceleration of imports are expected to improve the trade deficit but not immediately. Because of several reasons, initially the trade balance often worsens before improving. The pattern of movement of the trade balance over time due to devaluation look like the letter J, its termed as the J-Curve phenomenon. The main reasons for J curve phenomenon is time delay and adjustment lag, indicating that export volume and import volume will adjust with new exchange rate after a particular time. Secondly a growing economy may require more imports, the increase in import may offset the favourable effect of exchange rate devaluation.

Absorption Approach

The elasticity approach is a partial equilibrium approach, it only takes into account the value and volume responses to price changes. The Absorption Approach combines the elasticities approach with the Keynesian macroeconomics. It was initially modelled by Meade, Alexander and others in early 1950s. According to the absorption approach, a currency devaluation improves trade balance if the economies substitution towards domestic goods in response to the relative price change boosts output more than absorption (domestic consumption). In reality, this is more likely to happen through Keynesian multiplier effect in an economy which has excess capacity. Under the Absorption Approach the trade balance is a function of real income and absorption. Trade balance can improve if there is a growth in output or a decline in domestic consumption or both. Thus a trade balance improvement is happening through currency devaluation with the effect of an increased output.

Monetary Approach

As per monetary approach the effect of devaluation is purely a monetary phenomenon. Devaluation leads to an increase in the prices of traded goods and services and lowers the real value of cash balance. This will result in the reduction of spending in order to restore the real value of money. The drop in consumption results eventually in the reduction of absorption and trade balance improvement. The significant implication of the Monetary Approach is that if the monetary authorities increase money supply after devaluation, the effect of devaluation is believed to be minimal. Some empirical studies argued that excess money supply might increase consumption and lower the trade balance

All above mentioned four approaches have their own importance from time to time. The traditional standard theory has given fundamental knowledge to understand the trade and exchange rate relation. In the modern world the trade relations are more complicated and

the analysis requires additional macroeconomic perspective. So the absorption and monetary approaches can give more light in to the present trade exchange rate relation.

1.4 The Exchange Rate System in India

India being one of the founder member of IMF was obliged to adopt par value system of exchange rate suggested by Brettonwoods. As per this system each country defined their domestic currency in terms of gold or US dollar and peg the market value of domestic currency within ± defined par value. After independence India's exchange rate policy has seen a change from a par value system to a basket-peg and thereafter to a managed float exchange rate system. After breakdown of the Bretton Woods System in 1971, the rupee was linked with pound sterling. Further to overcome the issues of a single currency peg and to ensure stability of the exchange rate, the rupee was pegged to a basket of currencies from 1975 to till the early 1990s. India adopted The Liberalised Exchange Rate Management System (LERMS) in March 1992 which followed the dual exchange rate system in the short-term period. This was replaced by a unified exchange rate system in March 1993. Thereafter, we are following a market determined exchange rate system which is managed by the monetary authority.

One of the important aspects of India's foreign exchange policy is that we adopt the market intervention combined with monetary and administrative measures during volatility to achieve the financial stability. India's exchange rate policy is channelled towards first, reducing exchange rate volatility ensuring market correction; second, to maintain adequate level of forex reserves; third, curtailing speculative activity to stabilise the market and assist in the development of healthy foreign exchange market. Since 1990s India initiated a series of structural reforms in the foreign exchange market to gain investors' confidence and boost domestic competitiveness. It can be observed that the Indian rupee is moving along with the economic fundamentals. However, as India progresses towards full capital account

convertibility by greater integration with the rest of the world it is bound to pose greater challenges for managing the periods of exchange rate volatility. It is to be noted that, though the reforms have been good, it has paved the way for exchange rate volatility and acted as hurdles for India's economic growth. The free floating exchange rate regime in India continued to operate within the framework of RBI's exchange rate control. Under the present day managed float system Reserve Bank of India regularly trade in forex market using USD-INR to make sure that exchange rate remains stable and thereby reduce volatility. When rupee depreciate beyond particular level RBI sells foreign exchange reserves to prevent further depreciation. On the other hand, if rupee appreciates much RBI buy foreign exchange to prevent further rupee appreciation. Preserving stability in the foreign exchange market would require more flexibility and innovations in the exchange rate policy of the RBI.

1.5 Exchange Rate measure used in India

The USD-INR is the widely used single currency pair for RBI's transaction and other related calculation with rest of the world. A bilateral exchange rate in nominal terms is not a good measure for the competitiveness. Also single currency cannot measure the difference in price and cost changes in relation to many other trading partners. To overcome these issues, the effective exchange rate concept is used.

Nominal and Real Effective exchange rate

India used two indices namely Nominal Effective Exchange Rate (NEER) and Real Effective Exchange Rate (REER). These indicators are used for measuring external competitiveness of India. NEER is a weighted average of bilateral nominal exchange rates of the home currency in terms of foreign currencies. REER is a weighted average of nominal exchange rates adjusted for relative price differential between the domestic and foreign countries. Presently Reserve Bank of India provides 6-currency and 36-currency NEER and REER indices. Wholesale price index is used as a proxy for Indian prices and consumer

price index is used as a proxy for foreign partner countries in both 6-currency and 36-currency indices.

When we use single currency pair and an index to represent exchange rates, there is a fundamental difference in understanding its effects on trade flows. When Real effective exchange rate goes up, it indicates the appreciation of Indian rupee. If USD-INR increases, it reflects the depreciation of rupee. The exchange rate depreciation is theoretically expected to have a positive sign effect on exports and negative sign effects on imports. However, when we use Real Effective Exchange Rate (REER) index as a proxy for exchange rate the expected sign differs. When REER increases, a negative sign for exports and positive sign for imports are anticipated. With respect to REER volatility there can be either positive or negative impact for both exports and imports.

1.6 Statement of the Problem

The study titled "Exchange Rate Volatility and sectoral trade– an Econometric Analysis with Respect to India" focus on the relation between exchange rate volatility and sectoral trade. Many of the studies have analysed the impact of exchange rate volatility only on aggregate trade data. There are limited studies especially on Indian context that consider sector wise analysis of trade with respect to exchange rate volatility. It's not very right to say that the impact of exchange rate on all sectors and commodities effect in the similar line, sensitivity may vary from sector to sector and commodity to commodity. It's also true that the effect exchange rate for some commodities are more in the short than the long run. It's also possible that exchange rate does not have any effects on sectors and commoditise in the short run and the effect is substantial in the long run or vice versa.

In order to get clarity on which sector is more vulnerable to the exchange rate volatility, a sector specific and even an item specific study is essential. The present study is an attempt to connect sector wise trade data to exchange rate volatility in the context of Indian economy and her major trading partners and to analyse the impact of exchange rate on commodity wise export-import to get more insight on ground level reality of trade - exchange rate volatility relation.

The study raises the following research questions:

i What is the nature and extent of exchange rate volatility with respect to India and its trading partner?

ii What is the impact of exchange rate volatility on trade in relation to India's trading partner?

iii What is the impact of exchange rate volatility on various export and import sectors of India?

iv What is the magnitude of sensitivity of each commodity under export and import sectors to exchange rate volatility in India?

v Whether the effect of exchange rate on export and import differ in the short and long run?

There are limited studies focusing on exchange rate volatility and its impact on various sectors, especially on Indian context. As such the present study has great relevance and also have policy implication in future.

1.7 Research Aims and Objectives

Research aims to find the impact of Exchange rate volatility on sectoral trade in order to identify the sensitive sectors and commodities in India's export and import. The study adopts different econometric methods and approaches to fulfil the objectives.

The objectives of the study are:

1. To find out India's exchange rate volatility and its magnitude.
2. To assess the impact of exchange rate fluctuation on India's trade in relation to major trading partners.
3. To identify sectors and commodities which are sensitive to exchange rate volatility in India.

1.8 Hypothesis of the Study

Based on the above objectives the following hypothesis has been formulated:

1. India's exchange rate is volatile.
2. Exchange Rate depreciation has a positive effect on India's exports with its trading partners.
3. Exchange Rate depreciation has a negative effect on India's imports with the trading partners.
4. Increase in Real Effective Exchange Rate has a negative effect on exports of different sectors and commodities of India.
5. Increase in Real Effective Exchange Rate has a positive effect on imports of different sectors and commodities of India.
6. Real Effective Exchange Rate volatility has an effect on exports and imports of different sectors and commodities of India.
7. The effect of exchange rate on the sectors and commodities differ in short and long-run.

1.9 Data and Methodology

Data

The study has used different secondary data sources. To achieve the first objective, the study used data from Bloomberg and Reserve Bank of India (RBI). The data of 36 currency REER, 6 currency REER, Rupee against the currencies of USA, China, UAE, UK, Switzerland, Saudi Arabia, Belgium, Japan and Germany has been collected for the period 1991 to 2016. For the second objective, the quarterly data for the period 1991 to 2015 of export, import and trade balance of India with its major trading partners, has been collected from Bloomberg, IMF Direction of Trade Statistics, RBI Handbook, EXIM Bank data source and CMIE Economic Outlook. To fulfil the third objective, the quarterly data from 1993Q1 to 2016Q4 of export & import of major and sub-commodities has been collected from Centre for Monitoring Indian Economy (CMIE) and RBI data source.

Methodology

The present study assesses the impact of exchange rate volatility on trade in three stages. First, it estimates the exchange rate volatility. Second, it analyses the impact of exchange rate volatility on India's trade with major trading partners. Third, it estimates the short-run & long-run impact of exchange rate on export and import commodities. To measure exchange rate volatility, the study uses 36 currency REER, 6 currency REER and nine major trading partner's currencies namely USA, UK, China, UAE, Belgium, Switzerland, Saudi Arabia, Japan, and Germany. The volatility is estimated using GARCH and E GARCH models.

To analyse the elasticity of exchange rate in relation to India's nine trading partners' trade data, the study employs log-lin and Panel Pooled mean group estimation. The study estimates the depreciation trend of currencies and growth rate of export & import using log-lin model. To estimate the aggregate effect of exchange rate on trade the study employs

panel data. To understand the impact of exchange rate volatility on various sectors and commodities the study employs Auto Regressive Distributed Lag model (ARDL). The study identifies the long-run relation between exchange rate and trade using cointegration and the short-run adjustment through error correction term. Further, ARDL estimates the short-run and long-run coefficients of exchange rate volatility.

GARCH and E GARCH

GARCH family of models are widely used in measuring volatility. GARCH model captures heteroscedasticity and volatility clustering. It accommodates high kurtosis in the tails of the time series data that helps in forecasting the covariance of returns in the data. In GARCH model good news and bad news have similar impact. While in case of EGARCH good news and bad news have different impact. In EGARCH, negative news has more volatility than the positive news. As such EGARCH is able to capture asymmetric behaviour in the markets. If the coefficient is negative, then negative news creates more volatility in the markets.

Log-Lin model (growth rate model)

The log-lin model is well known in the calculation of growth rate, depreciation trends etc. In this model the dependent variable is in log form while one or more independent variables are expressed in linear form. This model is used to estimate the growth rate of the dependent variables for a unit change in independent variable over a period of time.

Panel Data Models

Panel data accounts for both cross sectional and time dimensions and addresses the issues of heterogeneity and autocorrelations faced by cross sectional and time series. The study has used panel unit root for testing stationarity of the series. Panel cointegration is used to identify long-run relation among the variables. To estimate long-run and short-run impact

of exchange rate on export & import the study employs Pooled Mean Estimator proposed by Pesaran et. al (1999).

Auto Regressive Distributed Lag Model (ARDL)

The ARDL-Bound testing methodology advocated by Pesaran and Shin (1999) and Pesaran et al. (2001) it is possible to test cointegration and extract long-run and short-run estimates through a single equation model. This model can be used with a mixture of I(0) and I(1) data, i.e the differenced data and level data can be included in the ARDL model to test the possibility of cointegration and error correction among some of the I(1) variables.

1.10 Chapterisation

Chapter 1 **Introduction:** This chapter gives the background of the study. It provides theoretical background, statement of the problem, objectives of the study, overview of methodology and scope of the study

Chapter 2 **Literature Review:** This chapter contains exchange rate and trade related selected review of literature categorised on various themes.

Chapter 3 **Measuring Exchange Rate Volatility in India**: This chapter measures the exchange rate volatility of 36 & 6 Currency REER and Rupee against the currencies of India's major trading partners.

Chapter 4 **Exchange Rate and Trade Relation - India and its major trading partners:** This chapter analyses the impact of exchange rate on India's exports and imports in relation to major trading partners.

Chapter 5 **Exchange Rate Volatility and India' Exports:** This chapter analyses the impact of Exchange Rate volatility on India's exports of major sectors and its commodities.

Chapter 6 **Exchange Rate Volatility and India' Imports:** This chapter analyses the impact of Exchange Rate fluctuations on India's import of major sectors and its commodities.

Chapter 7 **Findings, Conclusions and Policy Implications**: This chapter deals with findings, conclusions, policy implications, limitations and scope for further research.

1.11 Scope of the Study

The study "Exchange Rate Volatility and sectoral trade– an Econometric Analysis with Respect to India" broadly covers measurement of volatility, calculation of elasticities of export and import for the selected trading partner and identifies the short & long-run impact of exchange rate volatility on India's export-import commodities. It's imperative for a country like India to know sector specific relation with exchange rate volatility as India's trade over the years increased substantially with rest of the world. The identification of sectors and product sensitivity towards exchange rate volatility will serve a right channel for smooth trade flow with different countries.

The study is an empirical investigation to assess the relation between exchange rate and trade. Consequently, it has enormous macroeconomic policy implications as exchange rate is affected by GDP, inflation, liquidity condition and money supply. The study also would contribute in understanding the role of international pricing of the export-import commodities taking in to account the fluctuations in the forex market. Further, the export & import oriented industries can assess the gain or loss arising due to fluctuations in exchange rate thereby benefiting the producers and consumers in taking appropriate decisions to cover the risks.

CHAPTER II

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

2.1 Introduction

Exchange rate can be considered as one of the widely used economic indicator which reflects the trade competitiveness. However, exchange rate movements affect many other economic variables such as foreign trade, investment, tourism or even more generally on economic growth. From a long time, economist have given emphasis on the relation between trade and exchange rate. Further in the middle of 20th century with the development of macroeconomic models and econometrics, the empirical results were also presented. Even then the relation between exchange rate and trade have become highly debatable.

As per the theory, exports are positively or negatively affected by exchange rate volatility. The effects of exchange rate volatility on exports will be negative if the traders are risk averse in the forex market (Cushman, 1983 and Koray & Lastrapes, 1989). The negative impact on exports may be attributed to adjustments costs, uncertainty in the market, allocation of resources, changing government policies, etc. (Cote, 1994). Previous empirical studies have proven the existence of both negative and positive relationship (Sercu & Uppal, 2000) and also no relationship (Bacchetta & Van Wincoop, 1998) between exchange rate volatility and exports. These mixed results have led the policy makers and the researchers to examine the nature and extent of relationship between exchange rate, exports and imports. The present chapter classifies and discusses the literature based on three main themes namely, exchange rate volatility, exchange rate & trading partner and exchange rate & sectoral trade.

2.2 Exchange Rate Volatility

There are many empirical studies which tries to measure the extent of volatility over the years. In earlier studies basic statistics were used to understand the magnitude, while in recent literature advanced econometric models like ARCH, GARCH, EGARCH, etc. are used to explore the volatility in detail.

Grossmann, Love, & Orlov (2014) examine the dynamics of overall exchange rate volatility using panel vector autoregressive model. Study used the daily exchange rate of 29 economies for the period 1986 to 2011. Study found dynamic relation between exchange rate volatility and financial variables. The study reveals that the feedback effect from exchange rate volatility to macro-economic and financial variables are found to be lesser for developed economies comparing to developing countries.

Giannellis & Papadopoulos (2011) evaluate the relevance of monetary, financial and real variables to exchange rate volatility in the case of selected European Economic and Monetary Union (EMU) candidates' countries. The study uses VAR, Granger Causality and Multivariate GARCH to analyse monthly exchange rate for the period 1980 to 2012. As per the result volatility in Polish zloty/euro and the Hungarian forint/euro forex market influence monetary side of the economy. But, ex-post analysis reveals forex markets in Spanish, France and Italy are influenced by monetary and real shocks. Further, Irish Pound, had been effected only by real shocks.

Sahoo (2012) examine volatility spill-over volatility spill-overs from the exchange rates of the Brazilian Real, the Russian Ruble, the South Korean Won, the Singapore Dollar, the Japanese Yen, the Swiss Franc, the British Pound Sterling and the Euro to the exchange rate of the Indian Rupee. The study used two step Multi-GARCH and simple pairwise Granger Causality Test for the period 2005-2011. All the currencies demonstrate the

presence of conditional autocorrelation and persistence of volatility in exchange rates. The study identifies that the volatility in the exchange rate of leading currencies can cause volatility in the Indian Rupee.

Francisco & Bleaney (2015) examine REER volatility for 90 countries using monthly data from January 1990 to June 2006. The four measures employed in the study are the mean absolute monthly change (MAC), the standard deviation of monthly changes (SDC), the root mean square monthly change (RMSC) and the standard deviation of the level (SDL). The results showed that volatility decreases with openness to international trade and increases with inflation. After controlling for the effects of macro-economic variables, under free float regime, 45% standard deviation is added to REER volatility.

Wong & Lee (2016) examine exchange rate volatility using threshold generalized autoregressive conditional heteroscedasticity (TGARCH) model, Johansen cointegration method and the dynamic ordinary least squares (DOLS) to understand impact of exchange volatility on bilateral exports of Malaysian manufactured goods to China. There is some evidence of exchange rate volatility to have significant impact on real exports. Moreover, the impact of exchange rate volatility on real export can be negative or positive. The study suggested that exports competitiveness of Malaysia should be improved.

Ozer-Imer & Ozkan (2014) investigated the impact of the 2008–2009 global financial crisis on the co-movement of 16 currencies using Engle's (2002) dynamic conditional correlation (DCCR). The result shows that volatility has increased at least twofold with the outbreak of the crisis and it is found that there is an inverse relationship between volatility and the duration of the crisis.

Bhagwati, Barua, & Khan (2015) examines whether Indian Rupee reasonably valued. Weighted REER has been taken for the study for the period 2006-2015. The study

evaluated Harrod-Balassa-Samuelson effect and Behavioural Equilibrium Exchange Rate (BEER) models to analyse whether the Rupee is fairly valued. The study concluded that, rupee is overvalued under different methodologies.

Sharma (2011) analysed the relation between volatility in the exchange rate in INR–USD spot market and trading activity in the currency futures in the Indian context, using GARCH model and Granger causality. The results show that there is a two-way causality between the volatility in spot exchange rate and the trading activity in currency futures market.

Inci (2005) studied the effects of the exchange rate mechanism (ERM) for the period of 1991–1993 on currency markets in European Union. It was shown that the ERM led to a regime shift from the 1980s to the 1990s. The main contribution of this study is that ERM was found to have reduced currency risk premium volatility, which validated the expectations hypothesis in both spot and futures markets.

Choudhry (2005) examines the effect of exchange volatility on exports of Japan, Canada and US for the period 1974-1998. The study used multivariate cointegration, Error Correction Model and GARCH (1,1). Result indicate that exchange rate volatility affects negatively on real exports.

Another study by Christian & Laura (1998) using SWARCH model indicate that futures volatility does not significantly explain spot market volatility, nor does it increase after the introduction of futures. Their study used contracts for the period from January 1985 to February 1997, taking into consideration Mexican peso, Brazilian real and Hungarian forint.

Nabil, Se-Eun, Jacques, & Jamel (2010) compare the exchange rate misalignments (ERM)of emerging Asian & Latin American countries with that of industrialised

economies. They find that dollar was overvalued against East Asian countries, while ERM reduced at the world level. It is also found that Indian rupee was overvalued while there was a steadiness for Brazilian Real since 2000s. Comparing to East Asian countries, the Latin American countries faced widespread and disseminated ERM.

Sahu (2012) examined the impact of currency futures on exchange rate volatility of EURO after the introduction of currency futures trading in India. The data used in this paper comprises of daily exchange rate of EURO in terms of Indian rupees for the sample period January 02, 2008 to December 31, 2011. The study used Unit Root, ARCH LM and GJR GARCH (1, 1) models to study the impact on underlying volatility. The results indicate that the introduction of currency futures trading has had no impact on the spot exchange rate volatility of the foreign exchange market in India. Further, the results are also indicative of the fact that the importance of recent news on spot market volatility has increased and the persistence effect of old news has declined with the introduction of currency futures trading.

Bleaney & Francisco (2010) examine Real effective exchange rate volatility for 90 countries using monthly data from January 1990 to June 2006. Volatility decreases with openness to international trade and increases with inflation, particularly under a horizontal peg or band, and with terms-of-trade volatility. The study identifies that the choice of exchange rate regime matters. After controlling for these effects, a free float adds at least 45 % to the standard deviation of the real effective exchange rate, relative to a conventional peg, but most other regimes make little difference.

Lee-Lee & Hui-Boon (2007) examine the long-run and short-run relation between macro-economic factors and exchange rate volatility using ARDL and GARCH models. The study considers four ASEAN economies *viz* Thailand, Indonesia, Malaysia, and Singapore.

The study covers the sample period 1983-2003.The study found that Indonesian Rupiah is the most sensitive to the innovations while Singapore is the least; also identifies common factors that influence exchange rate volatility.

Hu & Oxley (2017) examine exchange rate bubbles in BRICS, ASEAN and some G7 Countries from March 1991 to Dec 2014. Study used generalised sup ADF (SADF) and unit root testing of Philips et al. SADF is a bubble detective method. The study finds that the US-Peso crisis was a bubble. Study identifies the bubbly behaviour of emerging countries' shallow financial markets than more matured G10 countries.

Bahmani-Oskooee, Kutan, & Xi (2015) examine the effect of inflation volatility on consumption and savings. The study uses 12 emerging economies data for the period 1995 to 2014. The study finds that in the short-run exchange rate volatility has effect on domestic consumption. The author concludes that the study has policy implications towards the economic growth and business cycle in the emerging economies.

Calderón & Kubota (2018) examines the diving factors of REER volatility and the effect of trade and financial openness to stabilise volatility. Study used REER of 82 countries from 1974-2013. The study finds that financial openness and trade activities matters for REER stabilisation. The study identifies that non-manufacturing trade contributes to higher REER volatility whereas, trade in manufacturing helps to reduce volatility.

Coudert, Couharde, & Mignon (2011) examine the impact of global financial turmoil on exchange rate policies in emerging economies. The authors test the hypothesis whether there is any intensified spill-over from advanced financial markets to the currencies of emerging economies. To assess the spill-over the study employs non-linear smooth transition regressor for 21 emerging countries sample for the period 1994 to 2009. Study

finds regional contagious effects from one emerging currency to other. Also, volatility increase more proportionately with global financial stress for most countries under study.

Ben Rejeb & Boughrara (2015) explore the volatility relation between emerging and developed market in normal times and in times of financial crisis. The study considers seven emerging economies and two developed countries for the period 1976 to 2008 and employs Vector Auto Regressive and Bai & Perron techniques. The study found that there is a spill-over of volatility across all the financial markets; further, geographical proximity is an intensifying factor for the spread of volatility; study also indicate financial liberalisation cause transmission of volatility and risk.

Caporale, Menla Ali, Spagnolo, & Spagnolo (2017) analyse the impact of exchange rate volatility on equity and bond portfolio inflows. Study considers monthly bilateral data for US and seven Asian emerging countries over 1993 to 2015. Study employs Markov switching specifications with time-varying transition probabilities and GARCH model. It is found that except Philippines other Asian countries are associated with the exchange rate volatility and equity bond inflows towards US. Study points out that capital control would be an effective tool to stabilise foreign exchange market in the scenario of exchange rate volatility.

2.3 Exchange Rate and Trading partner

Hayakawa & Kimura (2009) examine the relation between international trade and exchange rate volatility with special reference to East Asia. The study found that exchange rate volatility discouraged intra East Asian trade more severely. The study identified that intermediate goods trade is more susceptible to exchange rate volatility compared to other trade items. The adverse effect of the volatility is greater than tariffs in East Asia and smaller than distance related costs.

Shri & Rekha (2009) examine the impact of exchange rate fluctuation on trade for the period 1990 to 2008. The study found that Indian Rupee has depreciated by 2/3rd during the period. Due to this there is an increase of exports, but imports does not have the effects of depreciation of rupee.

Bahmani-Oskooee, Harvey, & Hegerty (2013) studied bilateral trade flows between US and Brazil from 1971 to 2010. The study employs cointegration analysis. The result indicates that, majority of the industries are least effected by exchange rate volatility in the long run. The study found that the export of agricultural products is negatively affected whereas imports of US machinery are not at all impacted. Further, the products which are small in share are likely to be sensitive to the uncertainty than the major exports.

Nishimura & Hirayama (2013) investigate the effect of RMB on JPY on Japan-China trade for the period 2002 to 2005. Author estimated volatility using ARCH and standard deviation. Also, analysed short and long run volatility effects on exports using ARDL approach. Result indicate that, Japan exports to China are not influenced by exchange rate. Whereas, china's export to japan are negatively affected. Further, the level of exchange rate has no influence on Japan's exports. But there is a significant effect on China's exports.

C. H. Wang, Lin, & Yang (2012) tested the short-run J-Curve hypothesis and long-run trade balance effect of real exchange rate between China and its eighteen major trading partners using a panel data over the period 2005–2009. The study used panel cointegration test and panel error correction model. Results supported the inverted J-curve hypothesis between China and its trading partners. However, it is found that a real appreciation of RMB has a decreasing long-run effect on China's trade balance in only three of the eighteen trading partners, while it has an increasing long-run effect in five of the eighteen

trading partners. These mixed findings, indicate that the real appreciation of RMB has no overall long-run impact on China's trade balance.

Šimáková (2014) analyse the impact of exchange rate on bilateral trade flows between Czech Republic and its major trading partners. The study explores J-curve pattern and relationship between exchange rate volatility and trade flows using quarterly data over the period 1997 – 2012. For analysing the long run relationship, Johansen cointegration test is employed and for short term effects, error correction model and impulse-response functions are used. Study found that J-curve for trade with France and an inverse J-curve for Slovakia and United Kingdom. Overall it is concluded that volatility has no clear impact on trade flows.

Brahmasrene & Jiranyakul (2002) investigate the impact of real exchange rates on the trade balance between Thailand and its major trading partners. The study employs cointegration technique. The results show that the impact of real exchange rates (Thai baht/foreign currency) on trade balances is significant in most cases. Therefore, the generalized Marshall-Lerner condition seems to be valid. It is concluded that the real exchange rates play a major role in the determination of the bilateral trade balances.

Lotfalipour & Bazargan (2014) addresses the issue whether exchange rate volatility has any significant and direct impact on trade balance. The study focuses on the effect of real effective exchange rate volatility on the balance of trade of Iran during the period 1993 to 2011. The study employs GARCH (1, 1) approach and balance Panel data models. Results indicate that the real effective exchange rate has no significant effect on the trade balance. It is also found that trade balance is affected by import, rather than export.

Soleymani, Chua, & Hamat (2015) investigate the effect on trade due to exchange rate volatility among ASEAN-4 countries (Indonesia, Malaysia, Singapore and Thailand) as

well as to their five main trading partners. Import and export data over the period 1980–2012 are used. The study employs cointegration and error-correction model. The result reveal that the real exchange rate volatility does play a significant role in 15 export and four import models in short-run and long run. It is found that the effects of exchange rate volatility on trade flows are negative rather than positive.

Phan & Jeong (2015) examine the effect of real exchange rate, domestic and foreign income on bilateral trade balance for Vietnam and her sixteen trading partners over the period 1999-2012. The study use panel cointegration method to examine the long-run relationship between the real exchange rate and bilateral trade. The result indicates that there is a long-run relationship between trade balance, real exchange rate, domestic income, and foreign income in the case of Vietnam. Further, the real exchange rate and domestic income have negative effect on trade balance. A policy implication of the study is that Vietnam's trade balance can be improved by restructuring the economy rather than devaluating currency in the long run.

Sercan (2014) examines whether depreciation or devalution of Turkish Lira is effective for improving trade deficit. The study used bound test cointegration, ARDL and Error Correction for the period 1987 Q1 to 2013 Q3. According to bound testing there is an evidence of long run relation among trade balacnce, domestic income, foreign income and real exchange rate. Further, study approved the validity of Marshal Lerner condition. Finally, the estimationof ECM indicate there is no J Curve effect for Turkish economy.

Brahmasrene & Jiranyakul (2002) investigate the impact of exchange rate on trade balance between Thailand and its major trading partners. ADF and PP tests and cointegration tests are used for the stationarity. The study found that Marshal Lerner condition is satisfied. The results indicate that exchange rate plays an important role in determining the bilateral

trade. Arize & Shwiff (2017) examine the influence on the imports of G-7 countries by exchange rate volatility, for the period 1973 to 1995. The study employs Johansen Cointegration, Stock and Watson's (1993) Robust Single Equation method. The study found that exchange rate volatility has significant negative impact on the imports of G-7 countries except for Canada which has positive impact.

Lal & Lowinger (2002) examine the short-term and long-term determinants of trade balances of five South Asian countries, using quarterly data from 1985 to 1998. The study confirms the existence of both short run and long run relationship between nominal effective exchange rates (NEER) and trade balances. Result highlights the differences in the duration of structural reforms and the extent of the J-curve phenomena.

Sastre (2012) attempts to analyse how in open economies where the export and import flow/GDP ratio is very high, independence between the GDP and the exchange rate is not a plausible assumption, so the traditional version of the Marshall-Lerner condition is not sustained. The analytical model attempts to explain the potential impact of currency devaluation on the balance of trade, breaking down the total effect according to the degree of simultaneity among export and import flows. The study uses the Maximum Likelihood cointegration procedure to study the long-run equilibrium of exports and imports. The long-run approach supports the notion that devaluation could improve the balance of trade.

Halicioglu (2008) study empirically analyses bilateral J-curve dynamics of Turkey with her 13 trading partners using quarterly time series data over the period 1985-2005. Short- and long-run impacts of the depreciation of Turkish Lira on the trade balance between Turkey and her 13 trading partners are estimated from the bounds cointegration testing approach and error correction modelling. The empirical results indicate that whilst there is

no J-curve effect in the short-run, but in the long-run, the real depreciation of the Turkish lira has positive impact on Turkey's trade balance in couple of countries.

Sukar & Hassan (2001)examine the relationship between exchange rate volatility and US trade volume by employing cointegration and error correction models. The study uses GARCH model to measure volatility in REER. The results indicate a negative relation between exchange rate volatility and US trade volumes. The effect of both exchange rate and real exchange rate volatility are insignificant in the short-run on US trade volume.

Hooy (2016) examines whether exchange rate volatility affect world and bilateral trade flows of SAARC countries? The study used (EGARCH) model and bound testing approach and the results revealed that there exists long-run steady state equilibrium among exports, income, price differential and exchange rate volatility in Bangladesh, India, Pakistan and Sri Lanka. Exchange rate volatility has a significant positive effect on real exports in most, but not all the South Asian countries. The study supports the hypothesis that exchange rate volatility imposes costs on risk-averse market participants and responds by favouring to trade at the margin. Hence, this induces intra-trade flows among South Asian countries.

C. H. Wang et al. (2012) examine the relation between exchange rate volatility and trade between China and its trading partners for the period 2005-2009. The study employs Panel Fully Modified OLS and Panel Error Correction Term to test short-run J curve hypothesis and long-run trade balance effect of real effective exchange rate on trade. The study found that RMB appreciation has decreasing long-run effect on China's trade balance in only three of the eighteen trading partners, while it has an increasing long-run effect in five of the eighteen trading partners. The authors also conclude that the real appreciation of RMB has no overall long-run impact on China's trade balance.

Ekanem (2002) investigate the effect of exchange rate on trade of US with two major and two minor trading partners in Africa for the period ranging from 1987 to 1996. The study employed Johansen Cointegration test, Vector Auto Regression and Variance decomposition. The study comes to two conclusions: First, the countries considered account for a very small share of the US trade, partly because they either lack the ability to export or the inclination to purchase US imports. Second, Exchange rate policy may be effective in Egypt and Ghana, if the constraints are removed, but for Kenya and South Africa, exchange rate policy may not be effective even though such constraints do not appear to exist.

Bahmani-Oskooee & Ardalani (2006) examine the impact of real depreciation of dollar on export and import of 66 US industries for the period 1991 to 2002. The study employs ARDL cointegarting approach and finds that the real depreciation of US dollar in the long-run increases exports earnings while there is no impact on importing industries.

Baum & Caglayan (2010) examine the impact of exchange rate uncertainty on the bilateral trade flows for the periods from 1980 to 1998. The study employs bivariate GARCH model and arrives at the conclusion that exchange rate uncertainty has positive and significant effect on the bilateral trade flows.

Dash (2013) investigate the long-run and short-run impact of real exchange rate volatility on India’s trade with four major trading partners namely US, UK, Japan and Germany for the period 1991 to 2005. The study employs Johansen cointegration technique, Error Correction Model and Impulse Response Function. The study concludes that J-curve effect is visible in India's bilateral trade with both Japan and Germany, but the Marshall-Lerner condition appears to hold in the context of India-Germany trade. On the contrary, we did not get J-curve in India's trade with the US, and the UK, rather we got S-curve effect in India-UK trade.

An & Park (2016) estimates the effect of trading partners' regimes on the speed of the home country's current account adjustment, using a mean-reversion current account model and data of 80 countries from 1980 to 2010. The results show that when a country trades more with countries under non-free-floating regimes, its current account adjustment as a whole becomes slower than under free-floating. The adjustment speed, however, does not increase monotonically with the flexibility of the partners' regimes. There is also an asymmetry in the adjustment, that is, less flexible regimes decelerate the adjustment of a partner in deficit of the current account. These findings are robust even when using other exchange rate regime classifications or employing different samples.

Galagedera & Kitamura (2012) investigates the exchange rate volatility spill-over between the currency pairs of five trading regions namely Asia, Asia-Europe, Europe, Europe-America and America for the period 2008 to 2009. The study found that depreciation of the US dollar against the yen has a greater impact on the US dollar-yen volatility spill-over than appreciation in the subprime crisis period. Appreciation and depreciation of the US dollar against the euro does not appear to have an asymmetric effect on the euro-US dollar volatility spill-over. Our results support the notion that the yen may have been preferred to the euro as a 'safe-haven' currency relative to the US dollar during the subprime crisis period.

Auboin & Ruta (2013) surveys a wide body of economic literature on the relationship between currencies and trade. Specifically, two main issues are investigated: the impact on international trade of exchange rate volatility and of currency misalignments. On an average, exchange rate volatility has a negative (even if not large) impact on trade flows. The extent of this effect depends on a number of factors, including the existence of hedging instruments, the structure of production (e.g. the prevalence of small firms) and the degree of economic integration across countries. Exchange rate misalignments are

predicted to have short-run effects in models with price rigidities, but the exact impact depends on a number of features, such as the pricing strategy of firms engaging in international trade and the importance of global production networks. This effect is predicted to disappear in the long-run, unless some other distortion characterizes the economy. Empirical results confirm that short-run effects can exist, but their size and persistence over time are not consistent across different studies.

2.4 Exchange Rate and Sectoral Trade

Many studies have examined the impact of exchange rate fluctuation on macroeconomic variables. It is believed that the exchange rate depreciation leads to higher exports and lesser imports. However, empirical evidence is not conclusive about this.

Bahmani-Oskooee & Hegerty (2008) examine the effect of increased volatility on Japanese US trade. The study applies cointegration analysis to disaggregated export and import data for 117 Japanese industries from 1973 to 2006. Result indicates that in the long run the trade shares of most industries are relatively unaffected by increased uncertainty, while other industries experience a relative increase or decrease in their proportion of overall trade. In the short run, some industries are influenced by exchange-rate volatility, but this effect is often ambiguous. Japanese exports of certain manufactures seem to improve in the long run relative to overall trade flows.

Bahmani-Oskooee, Harvey, & Hegerty (2014) examine trade between the United States and Spain over the period from 1962 to 2009, for 131 U.S. export industries and 88 import industries. The result indicates that there is short-run and long-run impact of exchange rate volatility only for a fraction of the cases, but that exports respond more to increased uncertainty than imports do. In all, only 35 of the 74 U.S. export industries are affected (11 positive, 24 negative), whilst only three out of 37 import industries have positive coefficients and 11 have negative ones. Further, there is no evidence that durable or

nondurable goods are more likely to respond to volatility, whilst small industries or specialized goods might show more of a positive response.

Jumah & Kunst (2001) employ multivariate autoregressive conditional heteroscedasticity models to investigate the effect of dollar/sterling exchange rate fluctuations on coffee and cocoa futures prices on the London LIFFE and the New York CSCE. For both commodities and in both markets, the exchange rate emerges as a main source of risk for the commodity futures price. Results indicate that the commodities show similarities not only in their long-run features and first-order shock propagation, but also in their characteristics of volatility propagation.

Baek (2014) examines the effect of exchange rate fluctuations on Korea's trade with the U.S. by taking the roles of exchange rate volatility and third country effects into account. An autoregressive distributed lag (ARDL) approach to cointegration is applied to estimate bilateral exports and imports of disaggregating 10 industries between Korea and the U.S. the study find that Korea's major export industries are highly responsive to the bilateral exchange rate, volatility and third country effects in both the long- and short-run, whereas Korea's imports are mostly insensitive to changes in those three factors. It is also found that income in both countries plays an important role in influencing the bilateral trade flows in both the long- and short-run.

Huchet-bourdon & Korinek (2011) investigate the effect on trade flows in China, US and European area due to exchange rate volatility. The study assesses the impact towards agriculture, manufacturing and mining. The study finds that there is only a marginal effect on exchange rate volatility.

Pandey (2013) attempt to empirically verify the Marshall Lerner condition in relation to India's external trade. These conditions ensure that a devaluation of the exchange rate

causes an improvement in the trade balance. The study also produces estimates of equilibrium export and import elasticities using a multivariate cointegration approach.

Umaru & Musa (2013) investigates the impact of exchange rate volatility on export in Nigeria. The paper employed three models, viz: Ordinary Least Square (OLS), Granger causality test and ARCH and GARCH techniques. Causality test revealed that there is causation between export and exchange rate in the country. The study further showed that exchange rate is impacting positively on export. The elasticity results revealed that, the demand for Nigerian products in the World market is fairly elastic.

Varela (2007) examine impact of REER volatility on sectoral output among Mercosur countries. Volatility is estimated using GARCH model and rolling variance. The results show through Instrumental-Variable technique estimation, that a negative and non-negligible effect of volatility on output. Further, result indicate that high volatility affects the output most. Also, there is a heterogeneous effect of volatility on output across sectors. Finally, it is also observed that, trade within Mercosur are effected by REER volatility.

Bahmani-Oskooee & Hajilee (2013b) examine the sensitivity of 131 industries that trade between U.S. and Germany. Results indicate that exports and imports of a majority of the industries react to the real dollar–euro volatility in the short run. The short-run effects, however, last into the long run only in almost 50 % of the industries. Among these industries, while almost all U.S. exporting industries are affected favourably by exchange rate volatility, a majority of the U.S. importing industries are affected adversely.

Appuhamilage & Alhayky (2010) examines the effect of exchange rate movements on trade between Srilanka and China. The study used quarterly data from 1993 to 2007. The study used Panel regression model. The results indicate that exchange rate volatility play

an active role for the trade between Srilanka and China. The study reveals the effects of exchange rate on total trade as well as sectoral trade between Srilanka and China.

Al-Abri (2013) Using a panel of 53 primary-commodity exporting countries, show that greater international financial integration reduces the impact of terms-of-trade shocks on real exchange rate volatility. This reduction is larger when financial integration is defined as foreign direct investment.

Muhammad Aftab (2012) explore the impact of exchange rate volatility on sectoral exports of Pakistan. Quarterly data has been collected for the period 2003-2010. Study used bound testing approach and GARCH models. Result indicate that exports are negatively influenced by exchange rate volatility. And also as per the results, there is a long run relationship between sectoral exports and exchange rate.

Soleymani & Chua (2014) investigate the impact of currency depreciation on trade between Malaysia and China. Study used quarterly data from 1993 Q1 to 2012 Q4. The study considered import and export of 52 industries over the period. The result from bound testing approach of cointegration and Error Correction reveal that exchange rate has short and long run impact on industries. Study also found that depreciation improves Malaysia's trade balance with China for the industries under study.

Cheung & Sengupta (2013) examine the effect of REER on the share of Indian non-financial sector firms from 2000 to 2010. The result indicates that there is a significant negative impact of currency appreciation and the volatility on Indian firm's export shares. Further, effect of REER changes is driven by negative appreciation but not by depreciation. Finally, compared with other exporting goods, the firm that exports services are highly influenced by exchange rate fluctuations.

Vieira & MacDonald (2016) examines role of REER volatility on export volume for the period 2000 to 2011. The study used GMM estimation for a set of 106 countries. The study found that any increase in REER volatility reduces the export volume. Further, the export volume is inelastic to REER and income before crisis period (2008).

M. Aftab, Syed, & Katper (2017) examine exchange rate volatility and bilateral industry trade between Malaysia and Thailand for the period 2000-2013. The study used GARCH (1,1) and ARDL model. The study finds that exchange rate volatility has limited influence for certain industries. Industries like instruments and apparatus have negative influence due to exchange rate volatility.

Byrne, Darby, & MacDonald (2008) examine the effect on the bilateral US sectoral trade exports and imports volume by exchange rate volatility. The study finds that there is a significant negative effect of exchange rate volatility across sectors.

Jain & Ghosh (2013) examine cointegration and Granger causality among global oil prices, precious metal (Gold, Platinum and Silver) prices and Indian Rupee–US Dollar exchange rate using daily data spanning from 2nd January 2009 to 30th December 2011. The result of ARDL bound test indicate that series are cointegrated. Further, Toda- Yamamoto version of Granger causality establish the causation amongst the variables.

Awokuse & Yuan (2003) evaluates the effects of exchange rate volatility on U.S. poultry exports using the gravity model on panel data. The study identified the negative effect of exchange rate volatility on the U.S. poultry export for the model in which they use the variance of spot exchange rate as the measurements. Consistent with previous studies, foreign incomes are also a very important determinant of poultry trade.

Nishimura & Hirayama (2013) investigate the effect of RMB on JPY on Japan-China trade for the period 2002 to 2005. Author estimated volatility using ARCH and standard deviation. It also, analysed short and long run volatility effects on exports using ARDL

approach. Results indicate that Japan exports to China are not influenced by exchange rate. Whereas, china's export to Japan are negatively affected. Further, the level of exchange rate has no influence on Japan's exports. But there is a significant effect on China's exports.

Dhasmana (2012) studies the relationship between India's trade balance and real exchange rate with her major trading partners. The study considered quarterly trade data for 15 countries over the period 1975Q1 to 2011Q1. The author use Pooled Mean Group estimator of Pesaran and Smith (1995) to get direct estimates of long term income and real exchange rate elasticities and find that real exchange rate depreciation is positively associated with the trade balance in the long run. At the same time India's trade balance is negatively correlated with real exchange rate volatility in the long run.

Hooper & Kohlhagen (1978) recognized a negative relationship between international trade and exchange rate volatility. An empirical study by Ćorić & Pugh (2010)conclude that on an average, exchange rate variability exerts a negative effect on international trade. Baum & Caglayan (2010)found that exchange rate volatility does not have any impact on the level of trade. Usman & Aliyu (2009)showed that appreciation of exchange rate results in increased import and reduced export while depreciation would expand export and discourage import.

Razazadehkarsalari, Haghir, & Behrooznia (2011) showed that exchange rate deprecation has a negative effect in developing countries. Nicita (2013) investigated the importance of exchange rates on international trade and found that short-term exchange rate volatility is generally not a serious concern.

Ihnatov & Căpraru (2012) used Ordinary Least Squares (OLS) and Generalized Methods of Moments (GMM) to estimate the growth model with dummy variables that isolate the effect of exchange rate regimes on economic growth. The findings suggest superior effect

of the floating and intermediate regimes on economic growth as compared to the fixed arrangements. Further, exchange rate stability is viewed as a simulation for economic growth.

According to Sen (2013) depreciation of currency is actually good for growth. It helps exports, but not immediately. In short run, it can have negative effects. A study by Hafer, (1989) on depreciation of the US dollar and its impact on US inflation showed that depreciation may cause transitory price shocks but may not cause inflationary spiral.

Bahmani-Oskooee & Hajilee (2013a) analyzed the relationship between exchange rate uncertainty and domestic investment. The study assessed the short-run and long-run effects of exchange rate volatility on domestic investment in each of the 36 countries considered in the sample using time series data. The application of the bounds testing approach indicates that exchange rate volatility has significant short-run effects on domestic investment in 27 countries. The short-run effects were translated into the long run only in 12 countries. A study by Takagi and Shi (2011) on Japanese economy found that depreciation of host country's currency promotes FDI inflows.

Volatility of exchange rate induces uncertainty and risk in investment decision with destabilizing impact on the macroeconomic performance (Mahmood and Ali, 2011). Mordi (2006) noted that operators in the private sector are concerned about the volatility of exchange rate because of its effects on their investment which may be capital gains or losses.

Beckmann, Czudaj, & Pilbeam (2015) examine the causality volatility pattern between gold price and exchange rate. The study considered the data period from 1979 to 2013 and employed GARCH-in-mean SVAR models. It is found that there is a negative effect on gold prices in the initial days and turns out to be positive after two days because of

exchange rate depreciation in all currencies. The study identifies the specific role of dollar in gold exchange rate relationship. There is found to be strong hedging function for gold prices in relation to volatility of dollar exchange rate more frequently. Also, the study found that after depreciation of dollar, the gold prices denominated in US dollar tend to increase.

Arezki, Dumitrescu, Freytag, & Quintyn (2014) study the relation between gold price volatility and the South African rand using monthly data for the period 1971 to 2010. The study finds that prior to capital account liberalisation, the direction of volatility flows from South African Rand to gold price, whereas, in the post liberalisation period volatility runs in opposite direction. The study conclude that gold price volatility is playing a key role in explaining exchange rate volatility.

Asteriou, Masatci, & Pilbeam (2016) investigate the effect of exchange rate volatility on trade volumes for Mexico, Indonesia, Nigeria, and Turkey. The study considers the data for the period 1995 to 2012 and employs GARCH models, ARDL Bound Testing and Granger Causality. The study found that there is no association between international trade and exchange rate volatility in the long-run except for turkey. However, there is a significant relationship between volatility and export-import demand in the short-run for Mexico and Indonesia. The study identifies unidirectional causality from export demand to volatility for Nigeria. Whereas no causality between volatility and export-import demand for turkey.

Hammoudeh, Yuan, McAleer, & Thompson (2010) analysed correlation dependency and independency and the conditional volatility for the four major precious metals namely gold, silver, platinum and palladium. The study considered the period from 1999 to 2007 and employed GARCH and Dynamic conditional correlation models. The result found that

significant long-run and short-run dependency and interdependencies of four metal system to the news and past volatility. Results also indicate monetary policy has differential impact on exchange rate volatilities and precious metals.

Dhasmana (2015) examine the impact of exchange rate changes on Indian manufacturing firms. The study considers the period 2000 to 2012 and employed panel VAR model. the results indicate that; Real Exchange Rate moments has significant impact on firm's performance. Further, it is identified that the impacts differ according to industry and firm characteristics. And the impact depends upon foreign ownership, degree of market power, access to domestic finance etc. it is also evident that depreciation & appreciation affect firms' performance differently.

Tunaer Vural (2016) examine the relation between balance of trade and real exchange rate in Turkish economy with its major trading partner Germany. The author had collected data of 96 commodities traded with Germany for the period 2002 to 2014. The author employs cointegration and error correction model and tests for the presence of J-Curve phenomenon. The study finds the presence of J-curve phenomenon and concludes that no single pattern of exchange rate - trade balance relationship is found to exist.

Nicita (2013) examine the impact of exchange rate volatility on trade and also tests whether the government's decisions on trade policies are effected by exchange rate misalignments. The author collects the data for the period from 2000 to 2009 for about 100 countries. The author employs fixed effects models. The study finds that in the short-run exchange rate fluctuation is not a serious concern and argues that trade policy is used to compensate for some of the consequences of an overvalued currency, especially with regard to antidumping interventions.

Bahmani-Oskooee & Gelan (2018) investigate the effects on trade flows due to exchange rate volatility in the long-run and short-run of twelve African countries for the period ranging from 1970 to 2015 by employing ARDL bound testing approach. The study find that long-run effects were confined to only on the exports of five countries (Ethiopia, Kenya, Lesotho, Sierra Leone, and Tanzania), while on the imports of only one country (South Africa). In the short-run exchange rate volatility affected almost all the countries. The level of economic activity in the world and at home were identified to be major determinants of exports and imports, respectively.

Bahmani-Oskooee, Iqbal, & Salam (2016) examine the effect on bilateral trade flows in relation to exchange rate volatility between Pakistan and Japan for the period ranging from 1980 to 2014 for 44 export commodities from Pakistan to Japan and for 60 import commodities from Japan to Pakistan. The authors employ the most popular ARDL bound testing approach to estimate the long-run and short-run impact. The study found that not many of the export and import industries were found to be having impact of exchange rate volatility either in short-run or long-run.

Bahmani-Oskooee, Bolhassani, & Hegerty (2010) investigate the impact of exchange rate volatility on bilateral trade flows of Canada with Mexico for 62 Canadian export commodities to Mexico and 45 import commodities from Mexico for the period from 1973 to 2006 by employing ARDL bound testing approach of cointegration. The study found that Canada's largest export industries are less responsive compared to Mexico's largest industry to exchange rate depreciation. Also, the trade between the countries are greatly influenced by trade integration as there is evidence of intraday trading between the economies.

Bahmani-Oskooee et al. (2014) investigate the impact of exchange rate on trade relation between Spain and United States for 131 export and 88 import industries of US for the period 1962 to 2009 using ARDL bound testing approach. The study finds that exchange rate volatility has short-run and long-run impact on only few industries altogether. However, export industries are comparatively more affected than import industries. 11 export and 37 import industries have positive impact while 24 export and 11 import industries have negative impact.

Péridy (2003) investigates the impact of exchange rate volatility on exports of G-7 countries (21 partner countries) in 20 industries for a period ranging from 1975-2000. The author employs Dynamic Panel Model and two volatility measurements namely moving sample standard deviation &GARCH approach to achieve the objective. The main finding shows that the impact of exchange rate volatility on exports varies considerably, depending on the industry covered and the export destination markets. As a consequence, there is both a sectoral and geographical aggregation bias when estimating the effects of exchange rate variations.

K. Wang & Barrett (2002) examine the effect of exchange rate volatility on trade flows between Taiwan and United States for the period 1989 to 1998. The study identified that real exchange rate risk has minor effects in most sectors. The agricultural trade volumes are highly receptive to real exchange rate volatility.

Vita & Abbott (2004) aims at assessing the impact on US exports to rest of the world due exchange rate volatility for the period ranging from 1987 to 2001. The author employs ARDL bound testing approach and find that export volumes are significantly affected by exchange rate fluctuations.

Oskooee, Ardalani, & Bolhasani (2017) argue that exchange rate volatility has both positive and negative effect on the trade flows. The authors empirically examine the effect of exchange rate on trade for 66 American industries with the rest of the world for the period 1991 to 2007. The study uses ARDL bound approach and GARCH model. The study conclude that GARCH-based volatility real effective exchange rate of dollar does not have any impact on trade flows.

2.5 Summary and Research Gap

The review of literature has been done mainly on three themes namely, exchange rate volatility, exchange rate and trading partners and the exchange rate and sectoral trade. The objective of the review was to identify the importance of the exchange rate as a crucial variable that affect the macroeconomic fundamental of a country in general and trade in specific. The review was also intended to find the gap in the existing literature with respect to the methodology, data and findings with respect to exchange rate–trade relation in India. From the first theme it can be observed that there are many techniques the researchers are using to analyse exchange rate volatility in different perspective. Starting from the standard deviation and variance approach, the other advanced models like the dynamic ordinary least squares, two-way Granger Causality, Co-integration and GARCH family of models, etc. are extensively employed in volatility analysis. The studies on exchange rate volatility are associated with wide range of areas focusing the effects on countries openness to exchange rate, extent of volatility in emerging and developed economies markets and their spill-over effects. In recent years many studies assess the impact of global financial crisis on exchange rate volatility. There are studies which concentrate on the effects of inflation and financial stability on exchange rate. Further the studies also explore the spot and future volatility and its magnitude to understand which market is more volatile and to recognize the meaningful existence of future market.

With respect to the second theme, exchange rate and trading partner, the reviews throws light on how trading partners' trade are affected by exchange rate fluctuation. It gives the insight whether partners' trade is encouraged or discouraged by exchange rate volatility. In these area few studies concentrate on theoretical justification of J curve hypothesis, Marshal learner condition etc. On the other side, many studies are clustered to verify the impact of exchange rate appreciation and deprecation on trading partner's trade. Further, reviews disclose that many advanced econometric techniques like GARCH, panel co-integration, panel ECM etc. are employed to assess the relation among exchange rate and trading partners' trade.

Under third theme, exchange rate and sector wise trade, reviews focus on the impact of exchange rate on different industries, commodities, major category items, specific products, etc. The wide range of advanced econometrics models like ARDL bound testing, granger causality, GMM estimation; panel VAR, etc. are used to assess short-run and long-run impact of exchange rate volatility on different segments and item wise trade. Largely, studies reveal effect of exchange rate volatility on trade cannot be generalised.

The empirical results vary from one to another and it depends on countries & period selected and the methodology adopted. Nevertheless, the empirical studies on exchange rate and trade will serve for appropriate policy decisions for individual countries.

There are limited studies especially on Indian context that consider sector wise analysis of trade with respect to exchange rate volatility. In order to get clarity on which sector and which commodity is more exposed to the exchange rate volatility, a sector specific and commodity wise study is essential. The present study is an attempt to connect export and import sectors and commodities to exchange rate volatility in the Indian context. Through the review it has been noticed that there are less number of studies which focus on

exchange rate influence on specific sector and commodity trade in India. Also, there are very limited studies employing ARDL bound testing approach to assess the long-run and short-run impact of exchange rate volatility on the sectors and commodities trade in India. From the literature it can be observed that, the period of study is maximum up to 2012 for assessing exchange rate-trade relations. So the current study extends the data till 2015-16. As such, the present study broadly tries to bridge these gaps.

CHAPTER III

MEASURING EXCHNAGE RATE VOLATILITY

CHAPTER III

MEASURING EXCHANGE RATE VOLATILITY IN INDIA

3.1 Introduction

In the recent years there has been a substantial increase in the cross border movement of goods and services and capital flows between the developed and developing countries. This has resulted in the increasing interlinkages and integration between the nations. This integration has resulted in search for higher returns, risk diversification, and anticipation of global dominance in the international market etc. The exchange rate is certainly an important determinant for all cross border transactions. Over the years especially after 90s there has been enormous fluctuations in the forex market. The domestic as well as the international factors are responsible for the volatility in the exchange rate. Measuring and understanding the magnitude of exchange rate fluctuations is of utmost importance as it influences general macro-economic performance of a nation. Exchange rate risk arising out of volatility always has potential money loss for traders and investors. Measuring exchange rate volatility from the policy perspective, is important as it would help to understand how it affects other macroeconomic variables and the economic growth.

Volatility indicate the degree and magnitude of changes in exchange rate overtime. The floating exchange rates are more likely to be volatile. However, it is not necessary that floating exchange rate are to be always volatile, it can be stable also. Exchange rate volatility hampers international trade and investment decisions. In general, floating exchange rates are riskier than fixed exchange rates. In recent years, it is observed that exchange rates are highly volatile and it is a source for uncertainty and risk. Nevertheless, the risk can be minimised if one could measure and forecast volatility somewhat accurately. It is possible to avoid the negative affect of volatility on trade by using appropriate hedging tools.

3.2 Methodology

The policy makers and researchers over the years have used different methods to measure exchange rate volatility. The earlier approaches have used mainly the standard deviation of the moving averages of the logarithms to measure volatility. In recent times, more advanced econometric tools like ARCH-GARCH, ECM and VAR models have been used. The present study employs Standard deviation, variance, GARCH and E-GARCH models for measuring volatility.

To measure exchange rate volatility and to make the series amenable to GARCH estimation, the exchange rate data are converted into logarithm form using the following formula:

$$R = \ln\left(\frac{r_t}{r_{t-1}}\right)$$

Where R is the returns, R_t is present day closing prices of particular currency and R_{t-1} is the previous day closing prices of the same currency.

3.2.1 Coefficient of Variation and Volatility

Coefficient of Variation (CV) and volatility are used interchangeably. CV is a relative measure of assessing variability. It is the ratio of standard deviation to mean. Standard deviation and CV are basic measure of volatility. In general, volatility measures the degree of variation or dispersion of series over a period of time. Further, volatility is a subjective term which don't have any fixed mathematical definition. There are so many advanced techniques which are available to measuring volatility. The present study, consider GARCH coefficients (response to market shocks) as a measure of volatility. At the same time, the standard deviation and coefficient of variation are also used in the study.

3.2.2 Unit Root Test

The stationarity test is a pre-condition for the application of GARCH models. The study conducts unit root test by employing ADF test. The following null hypothesis is tested at 1% significance level.

H_0: The Currency series has a unit root.

The unit root test is used to know whether the time series is stationary or non-stationary. Further, unit root test indicates the order of integration of series. The variable Y_t may be tested for the presence of unit root.

$$Y_t = \rho Y_{t-1} + u_t$$

Where u_t is the white noise error term. If $\rho = 1$: there is unit root. In the first differenced equation, $\Delta Y_t = \delta Y_{t-1} + u_t$ if $\delta < 0$ there is no unit root problem.

3.2.3 GARCH (1,1)

As per the symmetric normal GARCH, the conditional variance is assumed to be dynamic in behaviour. Following is the mean and *conditional variance equation*:

Mean Equation : $lER_t = \boldsymbol{\alpha} + \boldsymbol{l}ER_{t-1} + \varepsilon_t$

Variance Equation : $\sigma_t^2 = \omega + \propto \varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \qquad \varepsilon_t|I_{t-1}| \sim N(0, \sigma_t^2)$

Where ER_t is the exchange rate of the currency. The GARCH *conditional volatility* is the annualized square root of conditional variance. The conditional variance and volatility are conditional on the information set. ε_t denotes the market shock or unexpected return (Alexander, 2012). The squared residuals of ε_{t-1}^2 of the previous estimated models are used as regressors in the variance equation.

The long term volatility

The long term or unconditional variance (also called long term volatility) is found by substituting $\sigma_t^2 = \sigma_{t-1}^2 = \overline{\sigma^2}$ into the GARCH conditional variance equation. For instance, for the symmetric normal GARCH we use $E(\varepsilon_{t-1}^2) = \sigma_{t-1}^2$ and then put $\sigma_t^2 = \sigma_{t-1}^2 = \bar{\sigma}^2$ to obtain

$$\bar{\sigma}^2 = \frac{\omega}{1 - (\propto + \beta)}$$

GARCH model captures heteroscedasticity and volatility clustering. It accommodates high kurtosis in the tails of the time series data that helps in forecasting the covariance of returns in the data. There are two important parameters in the GARCH model alpha and beta. Alpha measures the reaction of conditional volatility to market shocks. If α is above 0.1 it is understood that volatility responds to market events within a short period. The parameter β measures the persistence of the conditional volatility. If the value of β is above 0.1 it implies that the volatility in the markets takes a long time to die out. The sum of α & β determines the rate of convergence of conditional volatility to the long term average level. EGARCH model has additional parameter γ to capture leverage effect (Alexander, 2012).

3.2.4 E-GARCH

The exponential or E-GARCH model formulate the conditional variance equation in terms of the log of the variance rather than the variance itself. The log may indeed be negative, but the variance will always be positive. The standard E-GARCH conditional variance specification is defined in terms of an i.i.d. normal variable Z_t and an asymmetric response function defined by

$$g(z_t) = \theta z_t + \gamma \left(|z_t| - \sqrt{\frac{2}{\pi}} \right)$$

where Z_t is a realization of Z_t . Since Zt is a standard normal variable,

$$E|z_t| = \sqrt{\frac{2}{\pi}}$$

The γ parameter measures the asymmetry or the leverage effect. If γ is 0, the model is symmetry. If $\gamma < 0$, it indicates that good news generate less volatility and vice versa. The term θ, determines the sign effect. For instance if $\theta = \gamma$, it indicate that the response is due to only positive shocks. If $\theta = -\gamma$, there would be response because of negative shocks.

Following two differences can be attributed for GARCH and EGARCH models. In GARCH model good news and bad news have similar impact. While in case of EGARCH model good news and bad news have different impact. In EGARCH, negative news has more volatility than the positive news. As such EGARCH is able to capture asymmetric behaviour in the markets. If the coefficient is negative, then negative news creates more volatility in the markets.

3.3 Empirical Analysis

This chapter tries to measure exchange rate volatility in three different approaches.

i. Volatility analysis of 6, 36 Currency REER and USD-INR.
ii. A period wise analysis of USD-INR volatility.
iii. Volatility analysis of currencies of India's major trading partners with respect to rupee.

3.3.1 Volatility Analysis of 6, 36 Currency REER and USD-INR

The Effective exchange rates are summary indicators of movements in the exchange rates of home currency against a basket of currencies of trade partner countries and are considered to be an indicator of international competitiveness. Real Effective Exchange Rate (REER)

is an index comprising of different currencies, the volatility in the currency index may have significant impact on trade flows. Further, US Dollar being one of the major currency, the study tries to compare the volatility of Currency Index with a key individual currency.

For calculating volatility in India the study used three series namely 36 currency REER, 6 Currency REER and USD-INR. The study compares REER Index with USD-INR to know how volatile is the broad index series (REER) in comparison to individual exchange rate (USD-INR). Data has been collected from Reserve Bank of India online source for a period from April 1993 to March 2016. All series are converted into lognormal forms for reliable econometric analysis. The study employs GARCH (1,1) and E-GARCH models for measuring volatility of the given series.

Table No 3.1

Descriptive Statistics of 6, 36 REER and USD-INR

Variable	REER_6	REER_36	USD-INR
Mean	109.054	102.164	46.1134
Minimum	95.9388	88.7804	31.3105
Maximum	128.307	116.06	68.2377
Std. Dev.	8.5365	6.28079	9.43797
C.V.	0.07828	0.0614776	0.20467
Skewness	0.66467	0.399143	0.53059
Ex. kurtosis	-0.7867	-0.662612	-0.1271
Observations	285	285	285
Jarque-Bera	28.334	12.78124	13.56426
Probability	0.000	0.001677	0.001134

Note: CV: Coefficient of Variation

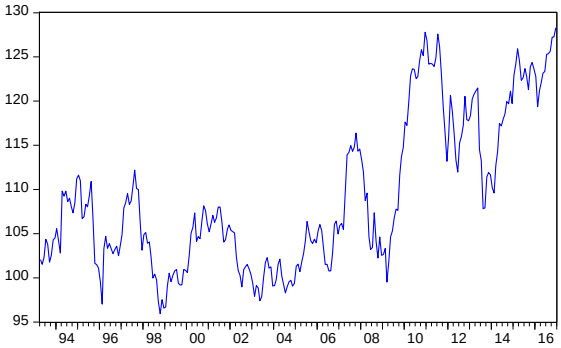
The Table (3.1) reports the descriptive statistics of 36 currency REER, 6 currency REER and USD-INR exchange rate. The average exchange rate for the period is 109.05, 102.16 and 46.11 for 6 currency REER, 36 currency REER and USD-INR respectively.

Further, it can be seen that higher level of volatility given by standard deviation and CV is high for USD-INR (20%) followed by 6 currency REER (7%) and 36 currency REER (6%). The value of the kurtosis indicate that all the data series are platykurtic compared to the normal distribution. As per Jarque-Bera Test statistics it is evident that series are not normally distributed.

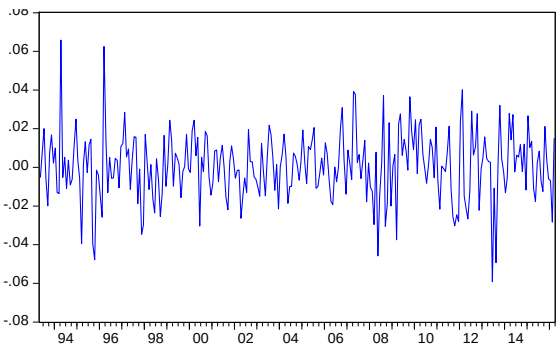
Figure 3.1

Actual and Lognormal Series Graph of 6, 36 currency REER & USD-INR

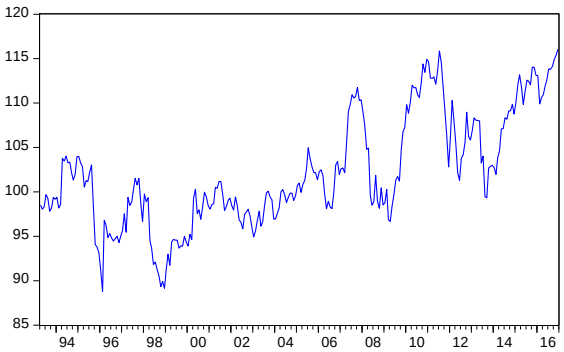
3.1 (a) 6 REER



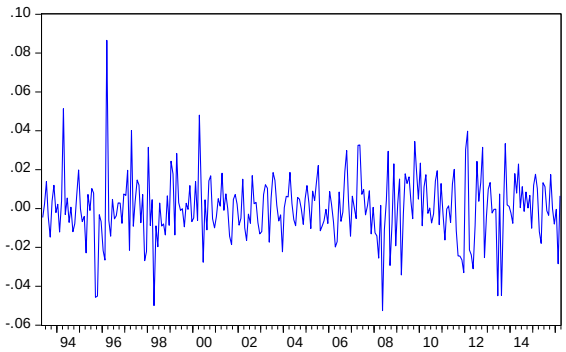
3.1 (b) 6 REER Lognormal Series



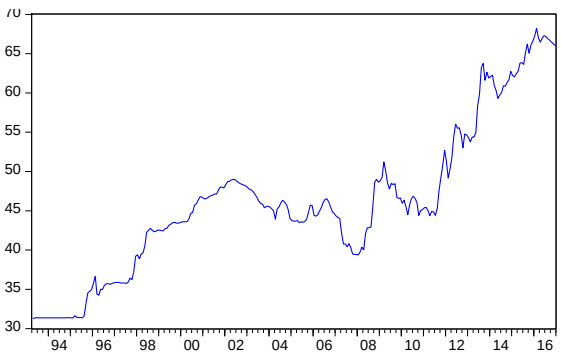
3.1 (c) 36 REER



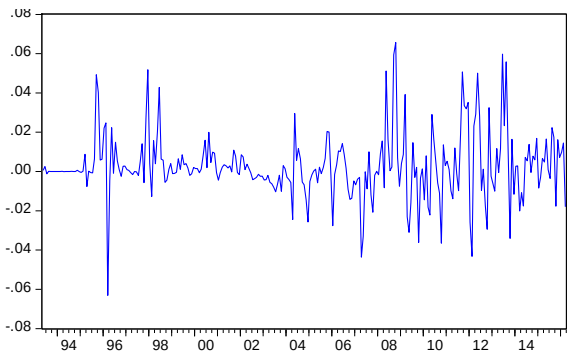
3.1 (d) 36 REER Lognormal Series



3.1 (e) USD-INR



3.1 (f) USD-INR Lognormal Series



The actual and lognormal series of 6, 36 currency real effective exchange rate and USD-INR are shown in Figure (3.1). It is evident from the upward sloping line of USD-INR that rupee depreciated gradually over the years (Figure 3.1(e)). Whereas, no depreciation trend is seen in terms of real effective exchange rate. Over the period, real effective exchange rate has appreciated showing India's international competitiveness. However, REER witnessed ups and downs during the study period.

The results of unit root test of 36 currency REER, 6 currency REER and USD-INR are given in Table (3.2). It is observed that there is no unit root problem at first difference. Which means that series are stationary at 1% significance level at first difference and non-stationary at level. Based on the model selection criteria of log likelihood and AIC the results of EGARCH are considered for interpretation of 36 & 6 Currency REER and USD-INR. The output of GARCH for 36 & 6 Currency REER and USD-INR are given in Table (3.3). As per the results shown in the Table (3.4) reaction to market shocks is less for 6 Currency REER compared to 36 currency REER and USD-INR as given by the values of α. The coefficient of γ is found negative in case of 36 REER indicating that negative news create more volatility in the market. Whereas γ is positive for USD-INR indicating that it responds to only to the positive news.

Table 3.2

Augmented Dickey Fuller Unit Root Testing

of 6, 36 REER and USD-INR

Null Hypothesis	At level	At First Difference
	***t*-statistic**	***t*-statistic**
36REER has a unit root	-2.19	-15.844***
6 REER has a unit root	-2.16	-14.365***
USD-INR has a unit root	0.105	-12.234***

*Note: *** significant at 1%; ** at 5%; * at 10%*

Table 3.3

GARCH Results of 6, 36 REER and USD-INR

	36 REER	6 REER	USD-INR
Mean Equation			
β_0	0.001331	0.000764	0.000830
β_1	0.015542	0.1408	0.261724
Variance Equation			
ω	6.56E-05***	1.66E-05	2.85E-06***
α	0.134***	0.047	1.135***
β	0.641***	0.896***	0.508***
Log likelihood	736.650	728.544	793.945
Akaike info criterion	-5.340	-5.281	-5.758
ARCH LM	0.20	0.04	0.09

*Note: *** significant at 1%; ** at 5%; * at 10%; # indicate model selection based on Log likelihood and Akaike Information Criterion*

Table 3.4

E GARCH Results of 6, 36 REER and USD-INR

	36 REER	6 REER	USD-INR
Mean Equation			
β_0	0.0001	0.0004	0.0003
β_1	0.0279	0.1289	0.2754
Variance Equation			
ω	-1.0209	-1.6463***	-1.3985***
α	0.0349*	0.0057*	0.7307***
γ	-0.229***	-0.1741***	0.0647***
β	0.8794***	0.7992***	0.8926***
Log likelihood	747.879#	732.911#	808.0726#
Akaike info criterion	-5.415#	-5.3059#	-5.854#
ARCH LM	0.12	0.00	0.05

*Note: *** significant at 1%; ** at 5%; * at 10%; # indicate model selection based on Log likelihood and Akaike Information Criterion*

Also, the long term volatility is calculated using the formula stated in the methodology in this chapter (Sec 3.2.2). The long term volatility of 36 currency REER and 6 currency REER is 10% and 2.74% respectively. This indicates that 36 currency REER is more volatile than 6 currency REER. However, the long term volatility of 36 currency REER is less than USD-INR of 23.65%.

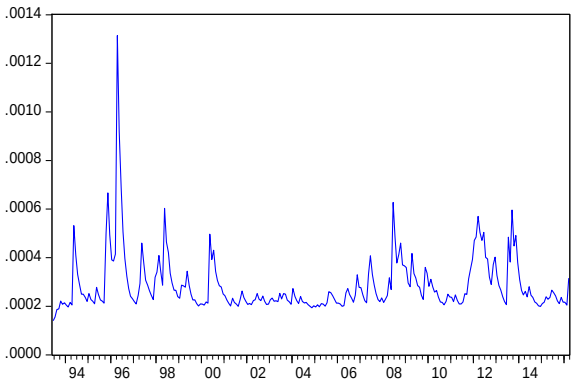
Conditional Variance Graph

A conditional variance is a variance of random variable given the values of one or more other variables. Conditional variance is an important part of ARCH model. The one interpretation of variance is that it gives the smallest possible expected squared prediction error. If we have the knowledge of another random variable X that we can use to predict Y, we can potentially use this knowledge to reduce the expected squared error. The best prediction of Y given X is the conditional expectation. Conditional Variance graphs shows the periods of high or low volatility.

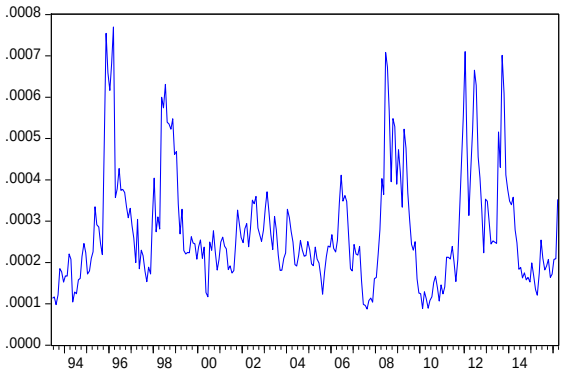
Figure 3.2

GARCH Conditional Variance – E GARCH Conditional Variance of 36 & 6 Currency REER and USD-INR

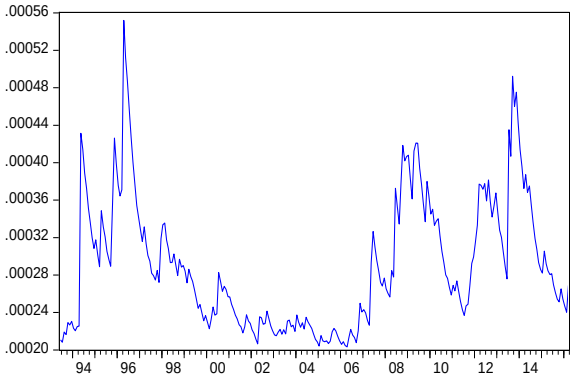
3.2 (a) GARCH Conditional Variance: 36 REER



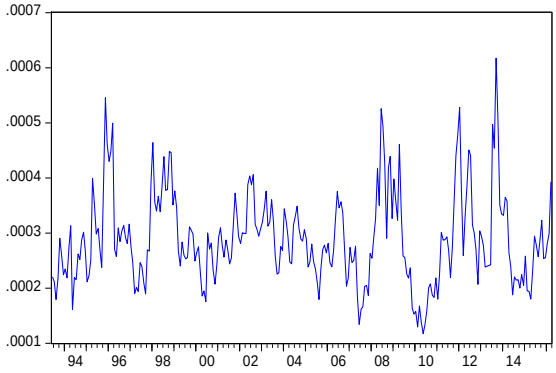
3.2 (b) E-GARCH Conditional Variance: 36 REER



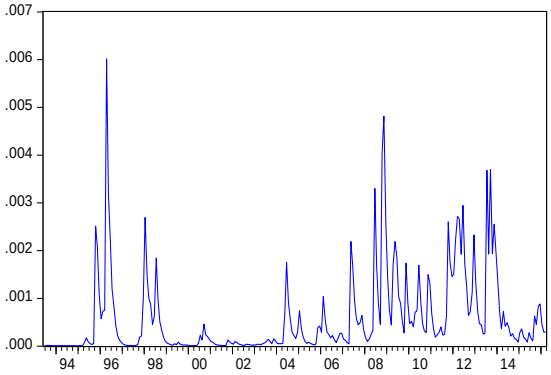
3.2 (c) GARCH Conditional Variance: 6 REER



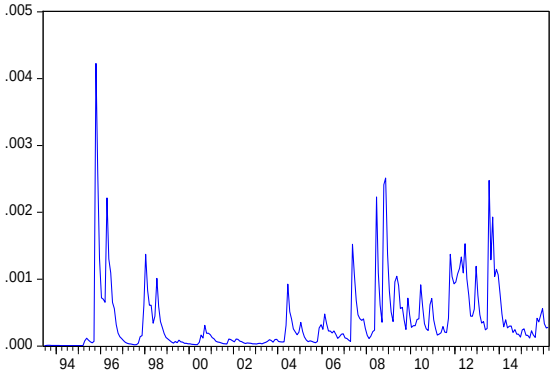
3.2 (d) E-GARCH Conditional Variance: 6 REER



3.2 (e) GARCH Conditional Variance: USD-INR



3.2 (f) E-GARCH Conditional Variance: USD-INR



3.3.2 Periodical Analysis of USD-INR volatility

Most commonly INR is compared with USD because it is an international currency. Many countries hold reserves of the USD as it is considered to be the strongest and reliable currency. So India also considers USD. Even though India exports to many underdeveloped economies it prefers receipts in terms of US dollars, because India cannot use other countries local currencies for the payment of its imports. It makes more sense to analyse the variations in the exchange rate in relation to US dollar. The study does a periodical analysis by dividing the entire data into 3 periods, i.e., (1) 1991-1999 (reform period) (2) 2000-2007 (pre-crisis period) and (3) 2008-2015 (post crisis period).

As per the descriptive statistics in Table (3.5), the mean value of exchange rate during 1991-1999 is Rs.33.55 per dollar. It depreciated to Rs.45.41 in 2000-2007 and to Rs.52.70 during 2008-2015. During the period 1991-1999 rupee depreciated to the maximum level of Rs.43.62 per dollar, Rs.49.05 in 2000-2007 and Rs.68.83 per dollar during 2008-2015. The

deviation as given by standard deviation during reform period is 6.11, pre-crisis period is 2.26 and post-crisis period is 7.65. However, the relative fluctuation as given by CV among the three period is high during reform period (18%) followed by post-crisis period (14%) and least during pre-crisis period (4%).

During 1991-1999 and 2008-2007 there is negative skewness and during 2000-2007 there is positive skewness. Leptokurtic is observed during the period 2000-2007 with low standard deviation. A clear platykurtic is observed during the period 1991-1999 and 2008-2015 with high standard deviation. Jarque-Bera test is used for testing normality of the data series. The null hypothesis of JB test is that the data series are normally distributed. As the probability value of Jarque-Bera statistics the study rejects the null hypothesis at 5% significance level and accept the alternative that data series are not normally distributed.

Table 3.5
Periodical Descriptive Statistics of USD-INR

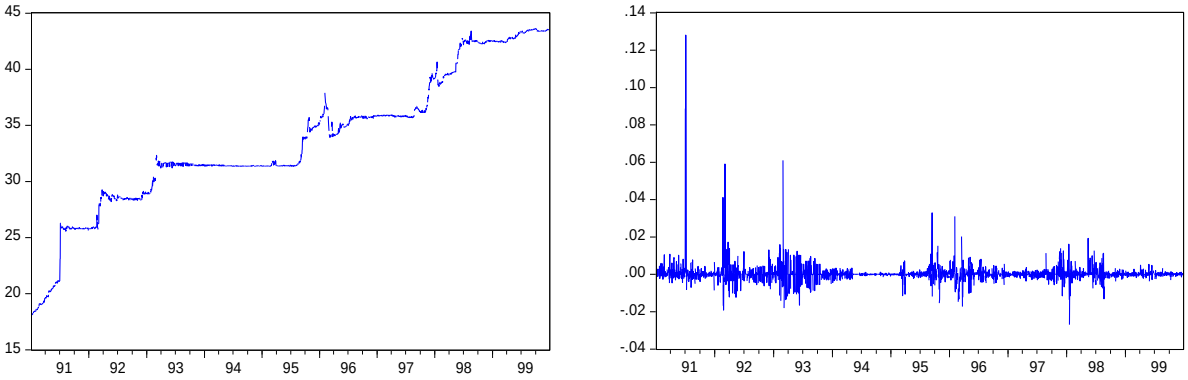
	1991-1999	**2000-2007**	**2008-2015**
Mean	33.557	45.414	52.705
Median	31.670	45.650	50.747
Maximum	43.620	49.050	68.825
Minimum	18.100	39.277	39.265
Std. Dev.	6.108	2.263	7.6590
CV	0.18	0.04	0.145
Skewness	-0.183	-0.697	0.227
Kurtosis	2.765	3.328	1.743
Jarque-Bera	18.578	178.595	155.235
Probability	0.000	0.000	0.000
Observations	2346	2085	2086

Note: CV: Coefficient of variation

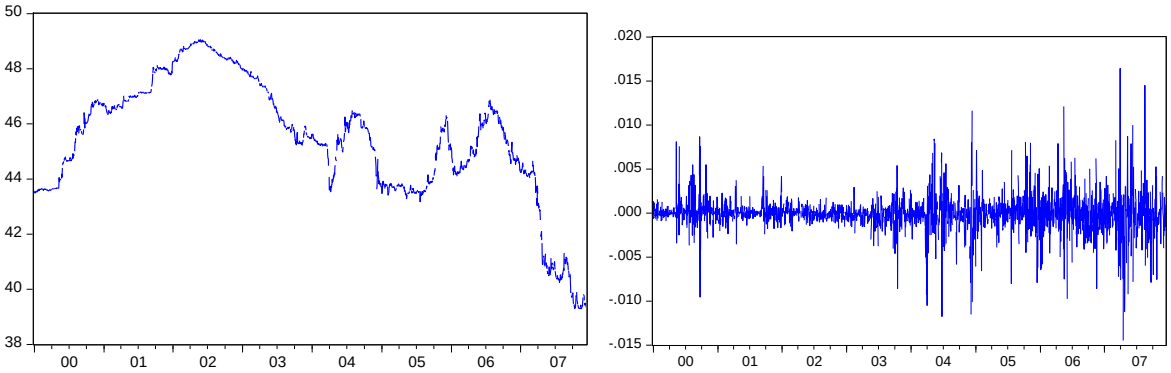
Figure 3.3

Actual and Lognormal Series Graph of USD-INR (period wise)

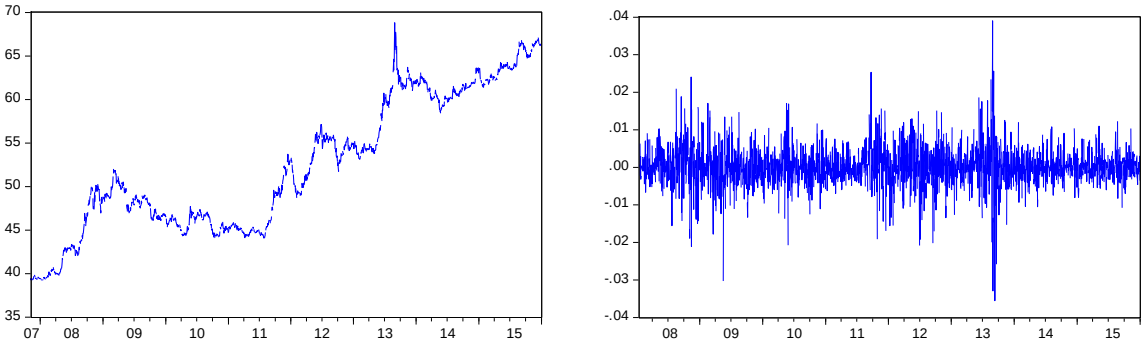
3.3 (a) USD-INR ***(1991 to 1999)*** *3.3 (b) USD-INR Lognormal*



3.3 (c) USD-INR ***(2000 to 2007)*** *3.3 (d) USD-INR Lognormal*



3.3 (e) USD-INR ***(2008 to 2015)*** *3.3 (f) USD-INR Lognormal Series*



Unit Root Testing

It is necessary to test the presence of stationarity in time series data before applying the econometric models. The study uses Augmented Dickey Fuller Test to detect the unit root problem for the three different period since 1991. The null hypothesis of ADF is 'there is unit root in USD-INR'. The ADF results are presented in the Table No (3.6). The result

indicates non-existence of unit root in USD-INR, which means USD-INR is stationary in all three periods under study.

Table 3.6

ADF Unit Root Test Results

Null Hypothesis	1991-1999 (t statistics)	2000-2007 (t statistics)	2008-2015 (t statistics)
USD-INR has a unit root	-28.53***	-45.15***	-46.65***

*Note: *** significant at 1%, ** at 5%, * at 10%*

GARCH Analysis

Based on model section criteria of log-likelihood and AIC the study has chosen the results of E GARCH Model. Where it's found that log-likelihood is higher and AIC is lower for E GARCH results. All coefficients of E GARCH variance equation is found to be significant at 1%.

Table 3.7

Periodical GARCH Effect of USD-INR

Variables	1991-1999	2000-2007	2008-2015
Mean Equation			
β_0	0.0000	0.0004	0.0001
β_1	-0.314***	0.02	-0.0361
Variance Equation			
ω	0.000***	0.0000***	0.0000***
α	0.1588***	0.2864***	0.0806***
β	0.9206***	0.7451***	0.9048***
Log likelihood	10218.1	10448	8158.88
Akaike info criterion	-8.8142	-10.017	-7.8177

*Note: *** significant at 1%; ** at 5%; * at 10%; # indicate model selection based on Log likelihood and Akaike Information Criterion*

Table 3.8

Periodical E-GARCH Effect of USD-INR

	1991-1999	2000-2007	2008-2015
Mean Equation			
β_0	0.00012***	2.09E-05	0.00028
β_1	-0.3143***	0.0318	-0.039
Variance Equation			
ω	-0.2110***	-1.2199***	-0.3618***
α	0.1301***	0.4983***	0.1504***
γ	0.179***	0.0661***	0.0485***
β	0.988***	0.9310***	0.9764***
Log likelihood	10433.82#	10463.77#	8165.092#
Akaike info criterion	-8.8974#	-10.03143#	-7.8227#

*Note: *** significant at 1%; ** at 5%; * at 10%; # indicate model selection based on Log likelihood and Akaike Information Criterion*

α indicates reaction of the conditional volatility to market shocks. As per the above Table (3.7) and (3.8) during 2000 to 2007 volatility is very sensitive to market shocks (α is greater than 0.1). During the period 1991-1999 the reaction is slightly less as compared to 2008-2015. The value of β measures persistence in the conditional volatility. As per the Table (3.8) for 1991-1999, the volatility persists relatively for a long time compared to 2008-2015. Persistence of volatility is low during 2000-2007. As per the leverage effect positive news create more volatility during all the period but its seen that there is more leverage effect during 1991-1999.

3.3.3 Volatility analysis of INR with respect to the currencies of major trading partners of India.

Data Description

The present study considers India and her 9 major trading partners namely USA, China, UAE, UK, Switzerland, Saudi Arabia, Belgium, Japan and Germany. The exchange rate is defined as units of domestic currency per unit of foreign currency. The countries which have appeared five times consecutively in top five in the total trade during the study period are selected as major trade partners. Daily frequency data is used for all the currencies except AED-INR in Table (3.9).

Table 3.9

Currencies of Trading Partners

Country	Abbreviations	Currencies	Data Frequency	Data Period
USA	(USD-INR)	US Dollar	Daily	1991-2016
China	(CNY-INR)	Yuan	Daily	1999-2016
UK	(GBP-INR)	Pound Sterling	Daily	1991-2016
Japan	(JPY-INR)	Yen	Daily	1992-2016
Saudi Arabia	(SAR-INR)	Riyal	Daily	1991-2016
UAE	(AED-INR)	Dirham	Monthly	1994-2016
Belgium	(EUR-INR)	Euro	Daily	1991-2016
Germany	(DM-INR)	Euro	Daily	1991-2016
Switzerland	(CHF-INR)	Swiss Franc	Daily	1991-2016

The study used spliced series of Euro for both Belgium and Germany because Belgium Franc and Deustch Mark series were not continuous. The data has been collected from Bloomberg data source.

Descriptive Statistics

As per the Table (3.10) CV is high for CHF-INR (42%) followed by EUR-INR (29%) and JPY-INR (27%) and the C.V is low for AED-INR. With respect to the asymmetry of the series USD-INR, SAR-INR and GBP-INR are negatively skewed. The negative values imply the leverage effect. All currencies except AED-INR are playtkurtic in nature. As per Jarque-Bera test statistics except USD-INR and SAR-INR, other currency series are not normally distributed. This nature of non-normal distribution demonstrates volatility clustering meaning that large changes tend to be followed by large changes, but with random sign, whereas small changes tend to be followed by small changes.

Table 3.10

Descriptive Statistics of Rupee against currencies of trading partners

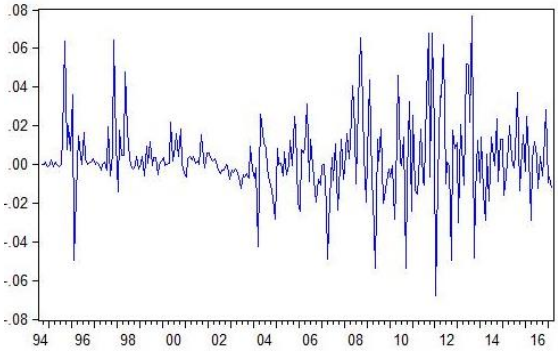
Variable	USD-INR	SAR-INR	JPY-INR	GBP-INR	EUR-INR	CNY-INR	CHF-INR	AED-INR
Mean	43.35	11.55	0.42	70.41	52.42	6.95	36.86	12.84
Minimum	16.89	4.50	0.19	27.23	19.95	5.12	10.74	8.54
Maximum	68.82	18.34	0.72	106.38	91.81	11.24	74.72	18.68
Std. Dev.	11.69	3.11	0.11	17.74	15.21	1.81	15.78	2.51
C.V.	0.27	0.27	0.27	0.25	0.29	0.26	0.42	0.19
Skewness	-0.04	-0.04	0.49	-0.33	0.12	0.83	0.72	0.64
Ex. kurtosis	-0.04	-0.04	-0.61	-0.47	-0.67	-0.88	-0.46	2.93
Jarque-Bera	2.68	2.82	360.30	196.85	691.38	672.67	18.81	18.81
Probability	0.261	0.24	0.000	0.000	0.000	0.000	0.000	0.000
Observations	7011	7011	6523	7011	7011	4662	7011	271

Note: CV: Coefficient of variation

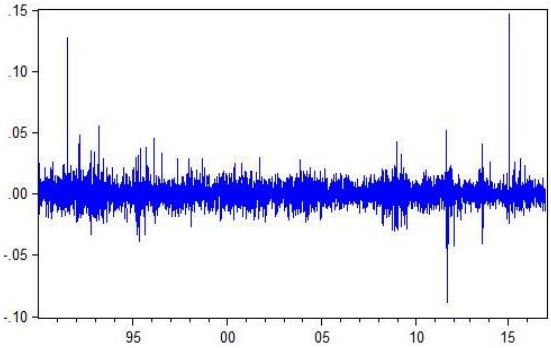
Figure 3.4

Lognormal Series Graph of major trading partners' currencies

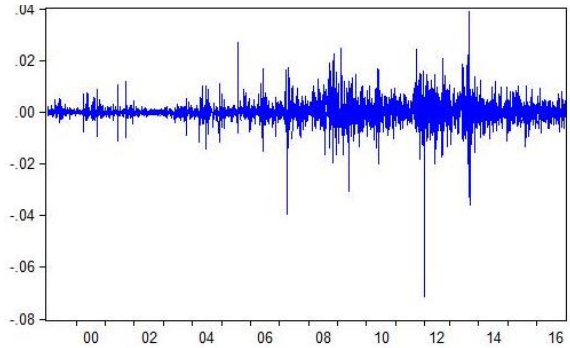
3.4 (a) AED-INR



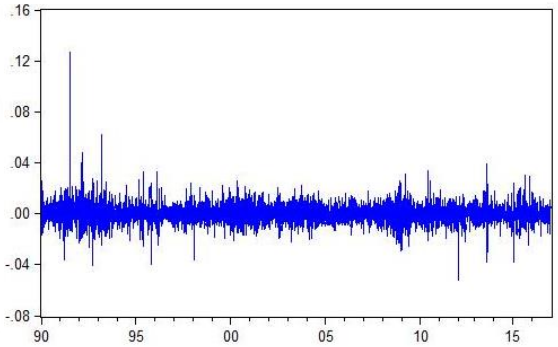
3.3 (b) CHF-INR Lognormal Series



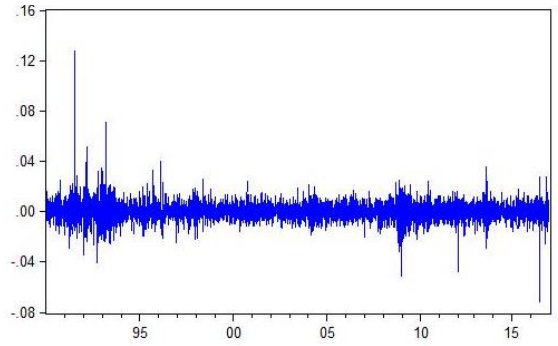
3.4 (c) CNY-INR



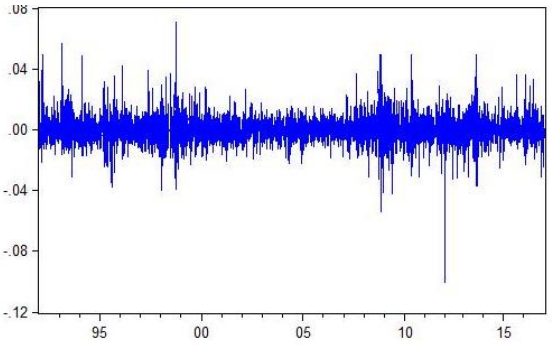
3.4 (d) EUR-INR Lognormal Series



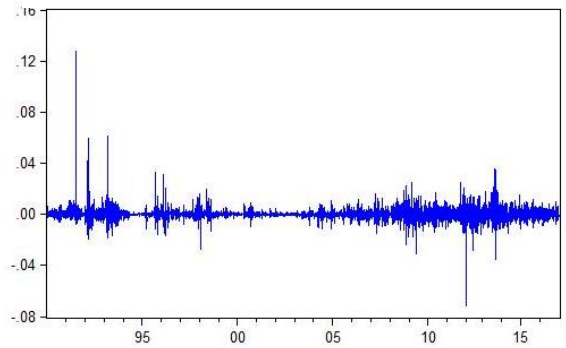
3.4 (e) GBP-INR



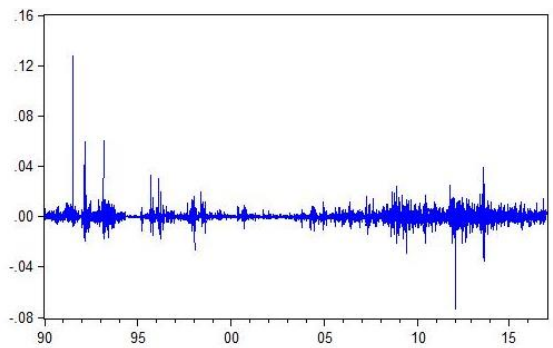
3.4 (f) JPY-INR Lognormal Series



3.4 (g) SAR-INR



3.4 (h) USD-INR Lognormal Series



Unit Root Testing

The Table (3.11) reports the Augmented Dickey Fuller Test of Unit Root for currencies of India's trading partners. The following null hypothesis is tested at 1% significance level.

H_0: The Currencies has unit Root.

Table (3.11) shows that all currency series have unit root problem at the level. However, the null hypothesis of presence of unit root is rejected for the currencies at first difference.

Table 3.11

ADF Unit Root Testing

Null Hypothesis	At level t-Statistic	At First Difference t-Statistic
USD-INR has a unit root	-7.07	-56.114***
SAR-INR has a unit root	-1.08	-55.745***
JPY-INR has a unit root	-1.54	-85.189***
GBP-INR has a unit root	-2.32	-83.970***
EUR-INR has a unit root	-1.74	-86.947***
CNY-INR has a unit root	-0.13	-69.994***
CHF-INR has a unit root	-0.58	-87.289***
AED-INR has a unit root	-0.44	-14.699***

*Note: *** significant at 1%, ** at 5%, * at 10%*

Figure (3.4) shows the lognormal series graphs of the India's major currencies quoted against Rupees. All the data series demonstrate the presence of volatility clustering. Fluctuations in the exchange rates can be observed for all currencies in the post 2008 financial period. The exchange rates remained relatively stable between period 2000 to 2008 in case of GBP-INR, JPY-INR, SAR-INR and USD-INR.

Volatility Analysis

The study employs GARCH (1,1) and E-GARCH models to estimate the volatility patterns in various currency pairs. The GARCH and E GARCH estimates are reported in Table (3.12) and Table (3.13) respectively. To choose between the models the Log Likelihood (LL) and Akaike Infromation Criterion (AIC) are used. The model with higher LL and model with lower AIC are chosen. As per the model selection criteria based on Log likelihood and AIC the GARCH results are applicable for GBP-INR, CNY-INR and CHF-INR. E GRACH results are valid for USD-INR, SAR-INR, JPY-INR, EUR-INR and AED-INR.

The reaction to market shocks as given by α (by GARCH and EGARCH results) is low for CHF-INR and GBP-INR. Whereas, other currency reactions are above 0.1. The reaction to market shock is relatively very high for AED-INR and USD-INR. In case of persistence volatility given by β, it is high for SAR-INR and CNY-INR. As per the sign effect of leverage coefficient (γ), the currencies respond to positive shocks.

The conditional variance graphs of GARCH and E-GARCH are shown in Figure (3.5) and Figure (3.6) respectively. The conditional variance graph depicts the periods of low volatility and high volatility.

Table 3.12 : GARCH Results

	USD-INR	SAR-INR	JPY-INR	GBP-INR	EUR-INR	CNY-INR	CHF-INR	AED-INR
Mean Equation								
β_0	0.0000	0.0000	0.0000	0.0002***	0.0001***	0.0000	0.0003***	0.0016
β_1	-0.0782***	-0.0669***	-0.0587***	-0.0277***	-0.0357***	-0.0833***	-0.0679***	0.2177***
Variance Equation								
ω	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
α	0.0944***	0.0901***	0.0533***	0.0810***	0.0636***	0.1194***	0.0663***	0.3571***
β	0.9309***	0.9328***	0.9335***	0.9010***	0.9177***	0.8955***	0.9157***	0.6494***
LL	30837.59	30681.54	22359.82	25685.12#	25212.01	20545.37#	24174.25#	697.47
AIC	-8.7967	-8.7535	-6.8933	-7.3278#	-7.1928	-8.8156	-6.8966#	-5.1870
ARCH LM	0.02	0.03	0.62	0.21	0.03	30.98***	0.07	0.13

*Note: (a) ***significant at 1%, ** at 5%, * at 10% (b) # indicates the model selection based on Log Likelihood (LL) and Akaike Infiramtion Crietrion (AIC)*

Table 3.13 : E-GARCH Results

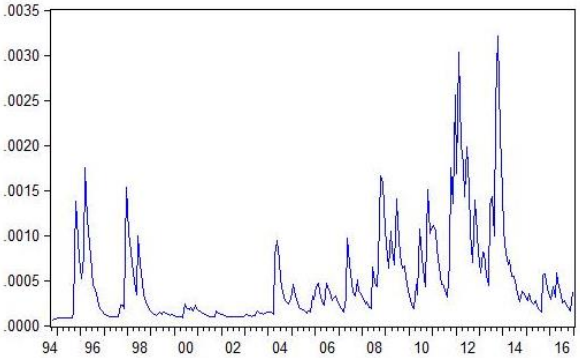
	USD-INR	SAR-INR	JPY-INR	GBP-INR	EUR-INR	CNY-INR	CHF-INR	AED-INR
Mean Equation								
β_0	0.0000***	0.0001***	0.0002***	0.0002***	0.0002***	-0.0001***	0.0003***	0.0020
β_1	-0.2608***	-0.0926***	-0.0540***	-0.0284***	-0.0354***	-0.0653***	-0.0722***	0.1754***
Variance Equation								
ω	-0.7519***	-0.2288***	-0.2948***	-0.3385***	-0.3329***	-0.3703***	-0.3679***	-1.7097***
α	0.5693***	0.1691***	0.1094***	0.1808***	0.1523***	0.2745***	0.1627***	0.5822***
γ	0.0589***	0.0683***	0.0606***	0.0144***	0.0139***	0.0080***	-0.0078***	0.1480***
β	0.9707***	0.9896***	0.9780***	0.9800***	0.9782***	0.9839***	0.9745***	0.8371***
LL	31913.030#	30841.950#	22399.440#	25682.550	25221.710#	20516.530	24174.400	708.714#
AIC	-9.102#	-8.799#	-6.905#	-7.327	-7.195#	-8.803	-6.896	-5.225#
ARCH LM	0.10	0.12	1.09	0.001	0.002	25.58***	0.03	0.07

*Note: (a) ***significant at 1%, ** at 5%, * at 10% (b) # indicates the model selection based on Log Likelihood (LL) and Akaike Infiramtion Crietrion (AIC)*

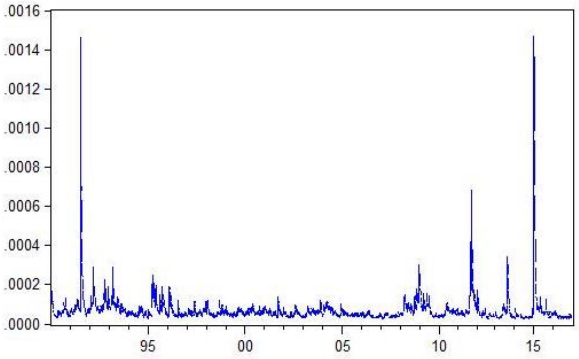
Figure 3.5

GARCH Conditional Variance Graphs of major trading partners' currencies

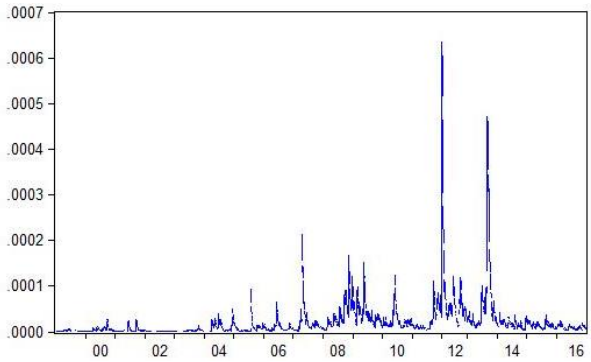
3.5 (a) AED-INR



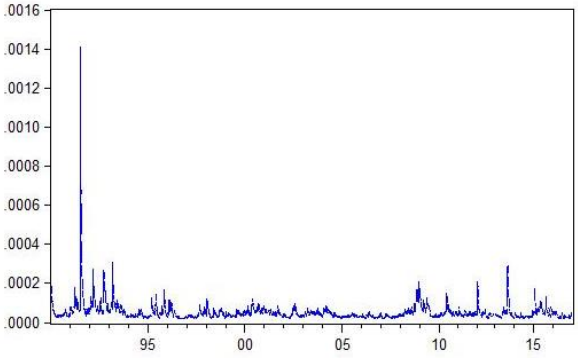
3.5 (b) CHF-INR



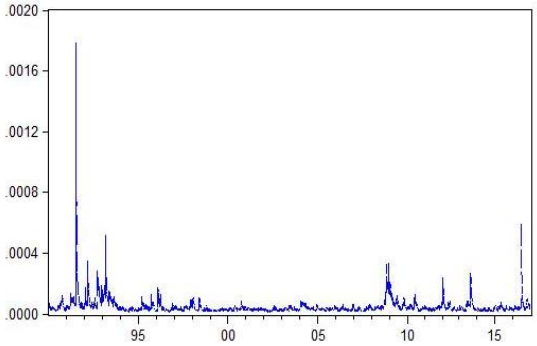
3.5 (c) CNY-INR



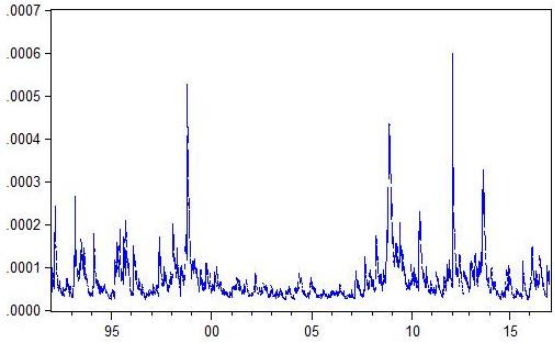
3.5 (d) EUR-INR



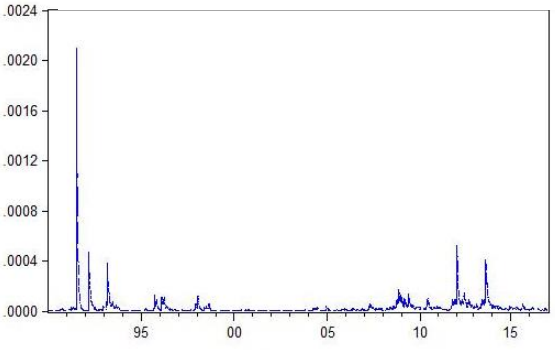
3.5 (e) GBP-INR



3.5 (f) USD-INR



3.5 (g) SAR-INR



3.5 (h) JPY-INR

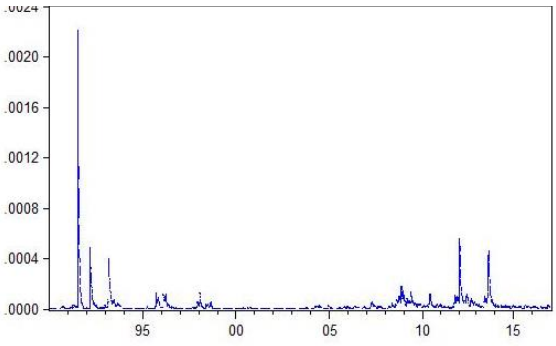
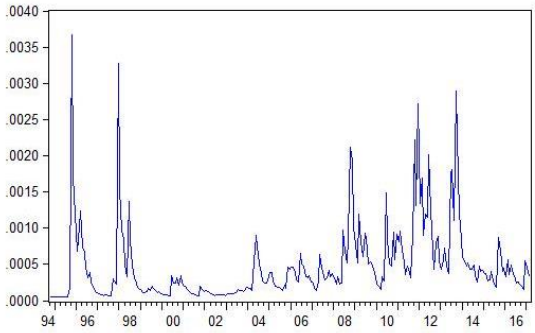


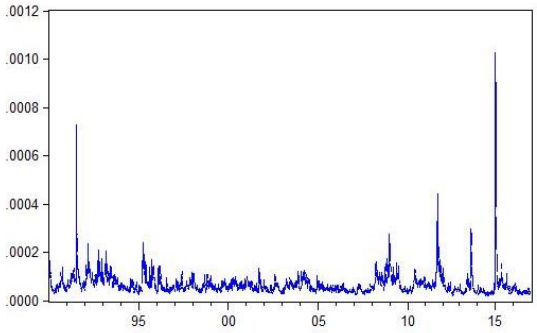
Figure 3.6

E-GARCH Conditional Variance Graphs of major trading partners' currencies

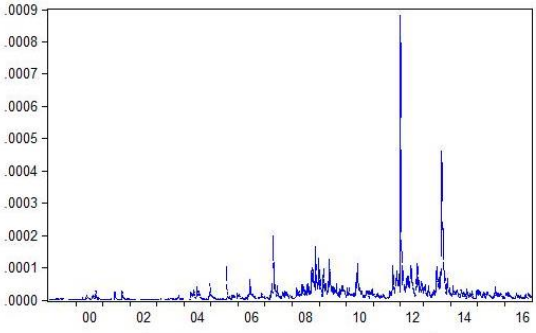
3.5 (a) AED-INR



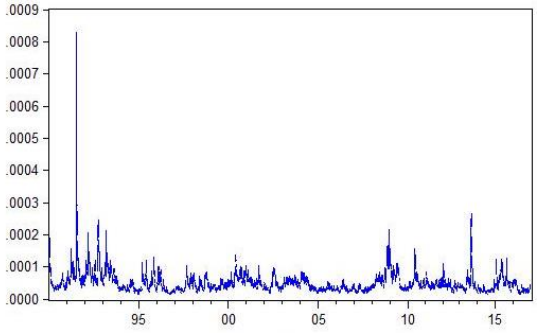
3.5 (b) CHF-INR



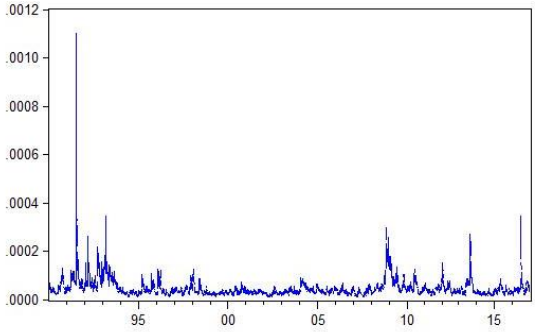
3.5 (c) CNY-INR



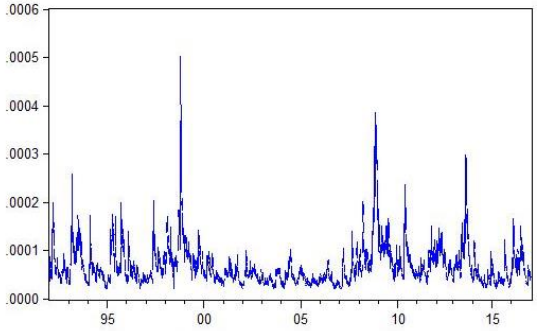
3.5 (d) EUR-INR



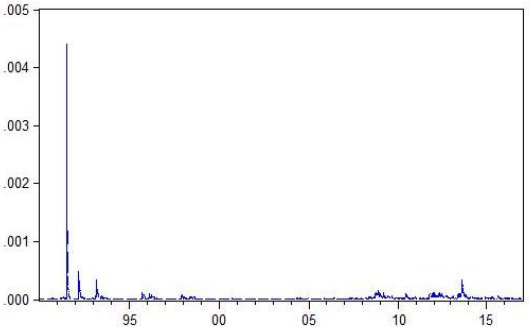
3.5 (e) GBP-INR



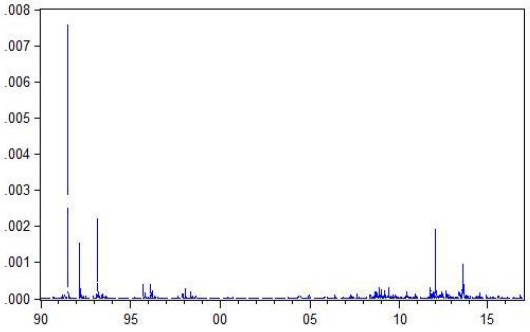
3.5 (f) USD-INR



3.5 (g) SAR-INR



3.5 (h) JPY-INR



Long term Volatility

The following Table (3.14) reports the long term volatility of the currencies:

Table 3.14

Long term Volatility of Currency Pair

Currency Pair	Long Term Volatility	Currency Pair	Long Term Volatility
USD-INR	18.63%	AED-INR	31.81%
SAR-INR	18.95%	GBP-INR	1.17%
JPY-INR	29.018%	CNY-INR	0.02%
EUR-INR	25.252%	CHF-INR	1.18%

The long term volatility is high for AED-INR, JPY-INR and EUR-INR whereas it is low for CNY-INR, GBP-INR and CHF-INR.

3.4 Chapter Summary

Firstly, the study compared the volatility among 6, 36 REER and USD-INR. The study finds that the exchange rate variation is high for USD-INR followed by 6 currency REER and least for 36 currency REER. The 36 Currency REER index volatility shocks were less than the USD-INR. Further, REER index responded to negative and USD-INR responded to positive news in the market. It is also found that volatility persists for a long duration for USD-INR compared to REER index. Secondly, from the periodical analysis of USD-INR, it is found that the exchange rate variation is high during reforms period (1991-1999) and low in pre-crisis period (2000-2007). During reforms period, market responded to the positive shocks. Even though, volatility was low, it took a long time to die out from the market during reforms period. Throughout 2000 to 2007 volatility was very sensitive to market shocks. Thirdly, the analysis of trading partners' currencies indicate that the variation is high for CHF-INR and low for AED-INR but the reaction to market shocks is high for AED-INR and USD-INR and is low for CHF-INR and GBP-INR. The long term volatility is highest for AED-INR and lowest for GBP-INR & CHF-INR. All currencies of the trading partners under study responded to positive news.

CHAPTER IV

EXHANGE RATE AND TRADE RELATION –

INDIA &ITS MAJOR TRADING PARTNERS

CHAPTER IV

EXCHANGE RATE AND TRADE RELATION - INDIA AND ITS MAJOR TRADING PARTNERS

4.1 Introduction

Historical experience in emerging market and developing economies suggests that exchange rate movements typically have sizable effects on export and import volumes. Many studies focussed on the exchange rate trade relation on account of the international dynamism and sudden shocks which have been happening in the world economy in the recent years. Exchange rate instabilities among major currencies and substantial slowdown in world trade make the study on the relation between exchange rate and trade always relevant. Emerging markets witnessed currency crisis in recent years due to exchange rate volatility which has become a major concern for trading activities of developing economies. Change in volatility itself over the years and the degree of trade sensitivity to this volatility are the matters of extreme concern.

International trade greatly depends upon domestic currency price variation than exchange rate variation. Studies found that, exchange rate inconsistency does not necessarily imply greater real domestic currency price variation. Real domestic price may vary because of foreign currency price (world price) of the traded goods (Smith, 1999). The increase in exchange rate volatility since 1973 has had uncertain effects on international export and import flows (Bahmani-Oskooee & Hegerty, 2007). Even, Depreciation may worsen country's trade balance in short run, but in the long run trade balance may improve (J Curve phenomenon) (Wang et al., 2012). Grier & Smallwood (2013) state that exchange rate volatility has significant and negative impact on developing countries trade and there is no such effect is found for advanced economies. Even several researchers also reported the same findings.

The chapter analyses the impact of exchange rate fluctuation on trade flows of India and its major trading partners. Many studies arrived at the conclusion that exchange rate fluctuation can have a negative impact on trade flows. Exchange rate fluctuation may reduce import and export among countries and possible reallocation of resources towards domestic activity. There are theoretical models that support positive and negative relation between exchange rate and trade. Whereas empirical studies do not have clear cut results. Empirical results vary, depending upon the model framework, form one study to another (McKenzie, 1999). It is not possible to reach a firm conclusion from the existing empirical studies about possible impact of exchange rate fluctuation. The results are conflicting and sensitive to various factors. In the context of India, the trade over the years has increased substantially with rest of the world and it is contributing to the growth process. As such it is important to test the existence of theoretical relation between trade and exchange rate variations in India with its major selected trading partners.

4.2 Data and methodology

The study used data on export, import, trade balance and exchange rate of Indian rupee against the currencies of trading partners for the period 1993 to 2015. The quarterly data has been collected from Bloomberg data base, CMIE Economic Outlook, Reserve Bank of India (RBI) and Ministry of Commerce and Industry, Government of India.

The exchange rate - trade relation of India with its major trading partner has been analysed through Simple regression framework (Log-Lin Model) and Panel Data Analysis. The study tried to explore the relation between exchange rate and trade in two dimensions: First, to assess the growth of India's export and import and the rate of currency depreciation during the period using log-lin model. Second, to evaluate the aggregate effect of exchange rate across selected trading partners using panel data analysis.

4.2.1 Log-Lin Model

The Currency depreciation, growth rate of export and import are estimated using semi log (log-lin) model.

Log-Lin Model: $lnY_t = \alpha + \beta t + u_t$

Where, lnYt is Export of India, Import of India, Exchange Rate of India to its major trading partners.

t is the time period β shows instantaneous growth rate (β x 100).

4.2.2 Panel Data Methodology

To understand overall effect of exchange rate across all countries panel data analysis is employed. As Panel data analysis accounts for both cross sectional and time dimensions, it addresses the issues of heterogeneity and autocorrelations faced by cross sectional and time series data.

4.2.2.1 Panel Unit Root

To identify whether all variables are integrated with the same order, the study employs, first generation test of unit root proposed by Im, Pesaran and Shin (2003) (IPS) and Levin and Lin (1993) (LL). The following is the basic unit root test model:

$$\Delta Y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p} \emptyset_{ij} \Delta y_{i,t-j} + \varepsilon_{i,t}; I = 1,2, \dots n; T = 1,2, \dots T$$

Where Yit is each variable under consideration (exports, imports, exchange rate, trading partners GDP and India GDP). α_i is the individual effect and p is selected to make residuals uncorrelated over time.

The H0: $\rho = 0$ for all I versus the alternative hypothesis which is $\rho < 0$.

4.2.2.2 Panel Cointegration Tests

After examining the stationarity, the study applies Pedroni's cointegration methodology. This test taken into account heterogeneity by using specific parameters that are allowed to vary across individual members of the sample. Pedroni has proposed seven different statistics to test panel data cointegration. Out of these seven statistics, four are based on pooling, what is referred to as the ''Within'' dimension, and the last three are based on the ''Between'' dimension. Both kinds of tests focus on the null hypothesis of no cointegration. However, the distinction comes from the specification of the alternative hypothesis. The test statistics in the first group (that Pedroni terms the 'within dimension' or 'panel statistics' test) are averages of the cointegration test statistics across cross-sections. The alternative hypothesis for those tests is pi = p < 1 for all i. The test statistics in the second group (referred to as the 'between-dimension' or 'group statistics' test) are based on averaging the individual estimated values of pi for each cross section unit i. The alternative hypothesis for those tests is pi < 1 for all i. The finite sample distribution for the seven statistics has been tabulated by Pedroni via Monte Carlo simulations. The calculated statistical tests must show values that are smaller than the tabulated critical value to reject the null hypothesis of the absence of cointegration (Bidirici & Bohur, 2015).

4.2.2.3 Panel cointegration estimation: Pooled Mean Group (PMG) approach:

Pesaran et al. (1999) proposed an intermediate estimator that allows the short-term parameters to differ between groups while imposing equality of the long-term coefficients between countries. One advantage of the PMG is that it can allow the short-run dynamic specification to differ from country to country while making the long-run coefficients constrained to be the same.

The PMG estimator highlights the adjustment dynamic between the short-run and the long-run. The long-run relationship between export & imports with exchange rate and GDP is expected to be identical from country to country but the short-run coefficients are expected to be country-specific. If variables are in logarithms, then the long-run coefficients can be interpreted as elasticities. The choice of the lag length is confirmed by the Akaike Information Criterion (AIC). As such for the export model the Panel ARDL is (4,1,1) and for import model the ARDL is (4,2,2) is chosen.

Export specification

$$\Delta lnEx_{it} = \alpha_0 + \sum_{j=0}^{n4} \beta_{it} \Delta lnER_{t-1} + \sum_{j=0}^{n4} \gamma_{it} \Delta lnTgdp_{t-j} + \sum_{j=1}^{n4} \Phi_{it} \Delta lnEx_{t-1} + \lambda_{0it} lnER_t + \lambda_{1it} lnTgdp_{t-1} + u_{it}$$

i = 1, 2, ……9; t = 1, 2, … 25

Where, Ex_{it} : Exports of India

ER_{it} : Domestic Exchange Rate with respect to trading partner

$Tgdp_{it}$: Trading partners' Gross Domestic Product

i : Cross section units (USA, China, UK, Japan, Saudi Arabia, UAE, Belgium, Germany, Switzerland)

t : 1991Q1 to 2015Q4

Import specification

$$\Delta lnIm_{it} = \alpha_0 + \sum_{j=0}^{n4} \beta_{it} \Delta lnER_{t-1} + \sum_{j=0}^{n4} \gamma_{it} \Delta lnIgdp_{t-j} + \sum_{j=1}^{n4} \Phi_{it} \Delta lnIm_{t-1} + \lambda_{0it} lnER_{it}$$

$$+ \lambda_{1it} lnIgdp_{t-1} + u_{it}$$

$$i = 1, 2, \ldots\ldots 9; \; t = 1, 2, \ldots 25$$

Where, Im_{it} : Imports of India

ER_{it} : Domestic Exchange Rate with respect to trading partner

$Igdp_{it}$: India's Gross Domestic Product

i : Cross section units (USA, China, UK, Japan, Saudi Arabia, UAE, Belgium, Germany, Switzerland)

t : 1991Q1 to 2015Q4

The pooled mean group estimator of panel cointegration also provide the **Error Correction Term (ECT)** which estimate the speed at which the dependent variable gets adjusted to independent variable or returns to equilibrium from short-run to long-run. The ECT in panel cointegration tests are arrived through the following model:

ECT for Exports $= Ex_{jit-1} + \beta_{ji} ER_{jit} + \gamma_{ji} Tgdp_{it-1}$

ECT for Imports $= Im_{jit-1} + \beta_{ji} ER_{jit} + \gamma_{ji} Igdp_{it-1}$

Hypotheses

In order to study the impact of exchange rate fluctuations on the export, import and trade balance of India and its major trading partners the following hypothesis are tested:

Exports:

H_0: $\beta = 0$ (Exchange Rate depreciation has no effect on export).

H_1: $\beta > 0$ (Exchange Rate depreciation has a positive effect on export).

Imports:

H_0: $\beta = 0$ (Exchange Rate depreciation has no effect on import).

H_1: $\beta < 0$ (Exchange Rate depreciation has a negative effect on import).

4.3 Empirical Analysis

Under this section the study analyses descriptive statistics, graphs, exchange rate variability, depreciation, growth of exports & imports, and short-run & long-run impact of exchange rate on India's export &import of selected trading partners.

4.3.1 Descriptive Statistics

As per the Table (4.1), it is seen that the average exchange rate of rupee to UK Pound Sterling is ₹ 73.15, whereas the average is very low for Japanese Yen (₹ 0.427). In case of coefficient of variation Switz Franc is high (0.364) and is low for UAE (0.193). As per the results only UK pound sterling is negatively skewed. All kurtosis values are negative indicating they are platykurtic in nature. Among the selected trading partners, the average exports of India were highest towards USA followed by UAE and the least was Switzerland. In case of CV, Saudi Arabia (1.28) was highest followed by UAE (1.09) and least for Japan (0.74). Exports series showed positive skewness for all countries. Export to Switz show leptokurtic while exports to China and Saudi are mesokurtic and other series exhibit platykurtic.

Table 4.1

Descriptive Statistics of Exchange Rate, Exports, Imports and GDP

Variable	Mean	Minimum	Maximum	Std. Dev.	C.V.	Skewness	Ex. kurtosis
Exports (in ₹. Billion)							
USA_EXP	218939.000	28062.400	687730.000	191577.000	0.875	1.175	0.163
UAE_EXP	170438.000	7644.000	544956.000	186753.000	1.096	0.833	-0.927
China_EXP	78026.900	1082.100	348578.000	84114.000	1.078	1.022	0.296
UK_EXP	56922.800	8335.500	161672.000	44485.000	0.781	0.875	-0.450
Germany_EXP	47658.500	10964.900	127492.000	35944.700	0.754	0.794	-0.833
Belgium_EXP	36952.000	5560.400	109722.000	29387.600	0.795	0.831	-0.594
Saudi_Arabia_EX	42554.400	2831.300	223627.000	54563.100	1.282	1.739	2.136
Japan_EXP	37209.600	12104.100	109891.000	27683.000	0.744	1.296	0.433
Switzerland_EXP	7219.920	1339.000	38580.000	6250.150	0.866	2.405	7.559
Imports (in ₹. Billion)							
China_IMP	257362.000	1057.800	1070290.000	320959.000	1.247	1.081	-0.199
UAE_IMP	145847.000	924.200	562088.000	177043.000	1.214	0.956	-0.639
Switzerland_IMP	124362.000	3203.200	566401.000	147528.000	1.186	1.400	0.981
USA_IMP	129819.000	13375.300	385355.000	119838.000	0.923	0.821	-0.860
Saudi_Arabia_IM	140563.000	1671.300	597028.000	175468.000	1.248	1.080	-0.125
Germany_IMP	80940.400	9149.200	211963.000	70359.900	0.869	0.694	-1.091
Belgium_IMP	61456.400	7080.000	192037.000	47882.100	0.779	1.012	-0.193
UK_IMP	45234.700	9884.700	120538.000	26861.700	0.594	0.703	-0.386
Japan_IMP	61634.000	9402.700	191769.000	53372.900	0.866	0.963	-0.532

Table 4.1 (Continued)

GDP

Variable	Mean	Minimum	Maximum	Std. Dev.	C.V.	Skewness	Ex. kurtosis
JAPAN_GDP	514668.000	480976.000	536602.000	14917.500	0.029	-0.602	-0.778
SWITZERLAND_GDP	128.428	95.510	162.055	22.336	0.174	0.142	-1.511
UK_GDP	315.650	173.871	471.095	90.253	0.286	0.058	-1.278
US_GDP	12274.000	6748.200	18222.800	3398.650	0.277	0.001	-1.249
BELGIUM_GDP	84.239	58.592	108.529	12.300	0.146	-0.292	-0.877
CHINA_GDP	6348.110	736.892	18486.900	5213.470	0.821	0.867	-0.620
SAUDI_GDP	334.825	92.312	913.651	219.259	0.655	0.802	-0.708
UAE_GDP	169.984	31.739	439.876	125.284	0.737	0.445	-1.260
GERMANY_GDP	482.149	84.541	766.906	240.119	0.498	-0.860	-0.934
GDP_INDIA	10273.100	1853.000	27902.800	5982.640	0.582	1.091	1.457
Exchange Rate							
UAE_ER	12.270	7.619	17.950	2.372	0.192	0.359	-0.037
SWITZ_ER	38.182	18.582	69.183	13.894	0.364	0.929	-0.299
SAUDI_ER	12.017	7.461	17.579	2.323	0.193	0.358	-0.037
UK_ER	73.152	41.266	102.224	14.512	0.198	-0.077	-0.334
JAPAN_ER	0.427	0.232	0.703	0.109	0.256	0.689	-0.488
CHINA_ER	6.273	3.605	10.327	1.909	0.304	0.887	-0.202
USA_ER	45.068	27.974	65.924	8.712	0.194	0.360	-0.038
GERMANY_ER	66.209	40.536	101.885	16.041	0.242	0.266	-0.823
BELGIUM_ER	66.291	40.536	101.799	16.210	0.245	0.294	-0.810

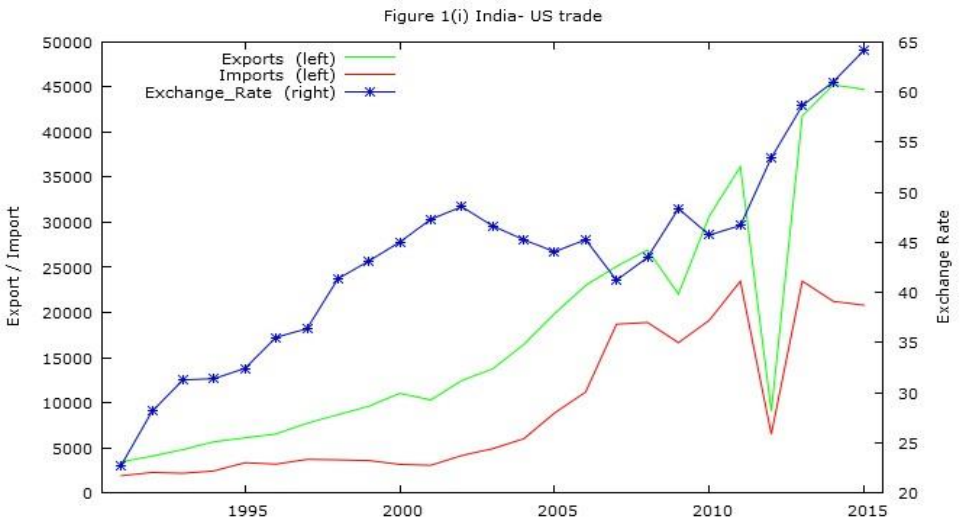
The average import among the trading partners was highest for China followed by UAE and the least was from UK. The CV was high for China followed by UAE and least for UK. all import series show positive skewness. All import series are platykurtic. The CV of GDP was highest for China (0.82) followed by UAE (0.73) and least for Japan (0.029). the GDP series of Japan, Belgium and Germany exhibit negatively skewed distribution, while other GDP series show positive skewness. Further, the GDP series of all countries show platykuric. The average export price index is 1034.29 and import price index is 851.23. Also, the CV of import price index (0.689) is higher than export price index (0.574).

4.3.2 Graph Analysis

From the Figure (4.1) it is evident that, the exchange rate line is sloping upward direction demonstrating the currency depreciation trend for all selected trading partners. Exports and imports of all these countries have also increased over the years with depreciating currencies. In majority of the countries, imports are higher than exports. India has huge gap between import and export with the countries like Switzerland, Saudi Arabia and China in recent years.

Figure 4.1

Exchange Rate, Exports and Imports of India's Trading Partners



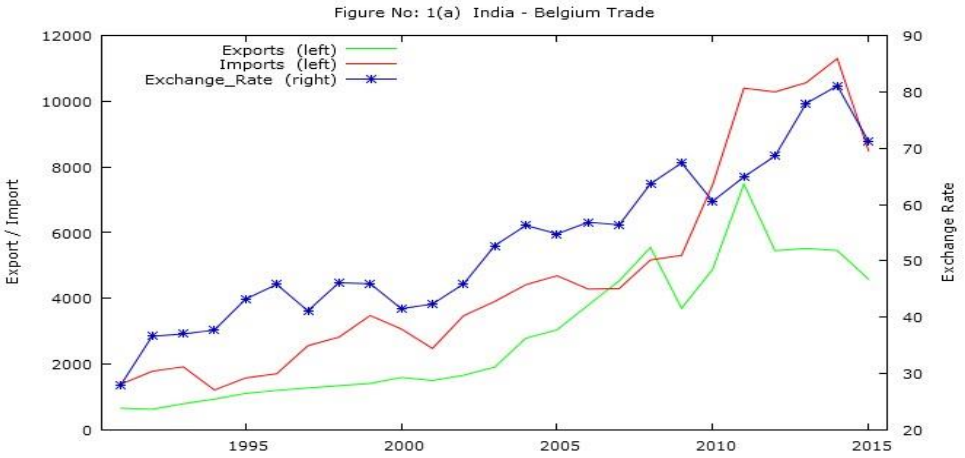


Figure No: 1(a) India - Belgium Trade
Exports (left)
Imports (left)
Exchange_Rate (right)
Export / Import
Exchange Rate
0
2000
4000
6000
8000
10000
12000
20
30
40
50
60
70
80
90
1995
2000
2005
2010
2015

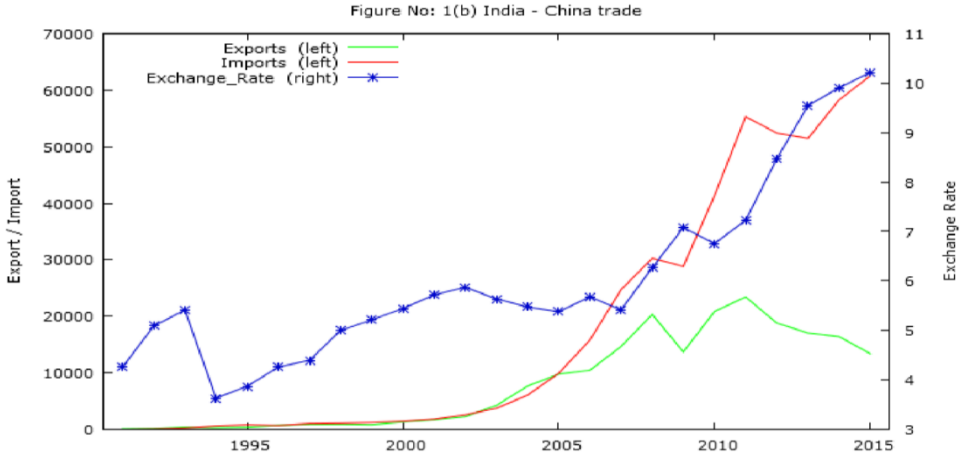


Figure No: 1(b) India - China trade
Exports (left)
Imports (left)
Exchange_Rate (right)
Export / Import
Exchange Rate
0
10000
20000
30000
40000
50000
60000
70000
3
4
5
6
7
8
9
10
11
1995
2000
2005
2010
2015

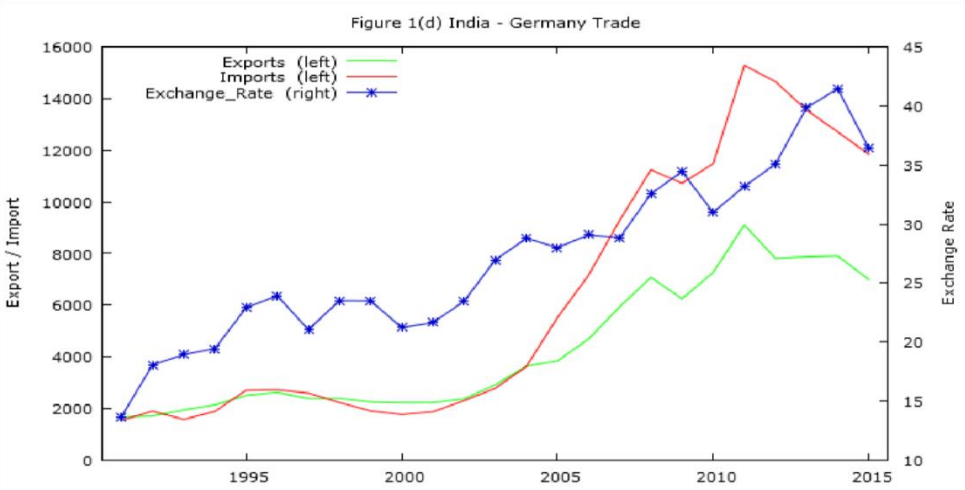


Figure 1(d) India - Germany Trade
Exports (left)
Imports (left)
Exchange_Rate (right)
Export / Import
Exchange Rate
0
2000
4000
6000
8000
10000
12000
14000
16000
10
15
20
25
30
35
40
45
1995
2000
2005
2010
2015

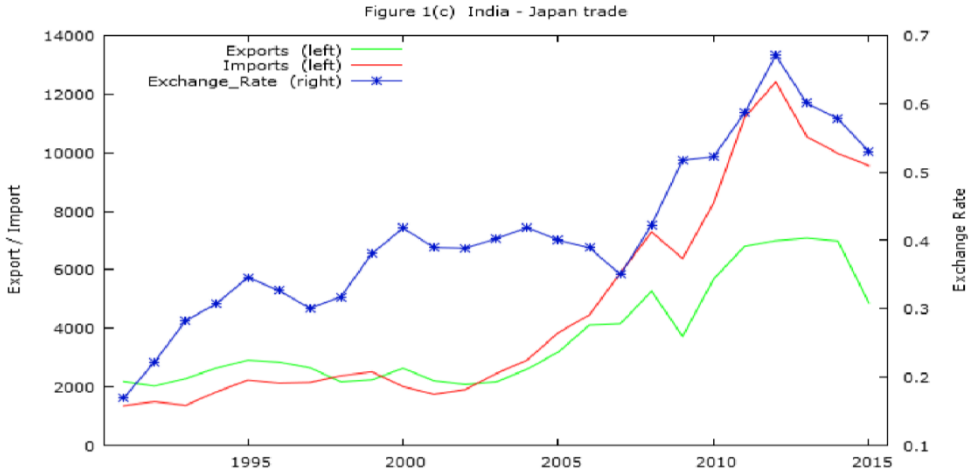


Figure 1(c) India - Japan trade
Exports (left)
Imports (left)
Exchange_Rate (right)
Export / Import
Exchange Rate
0
2000
4000
6000
8000
10000
12000
14000
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1995
2000
2005
2010
2015

Figure 1(e) India - Saudi Trade

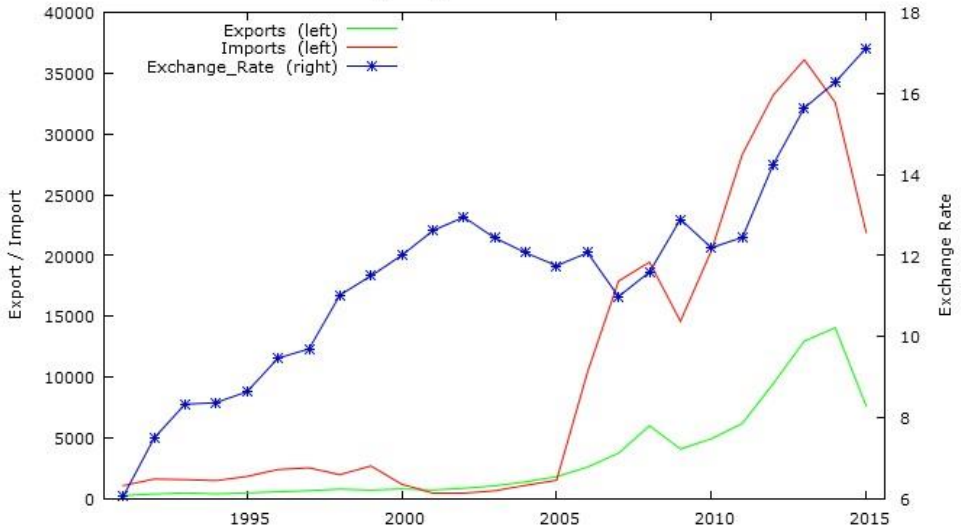


Figure 1(f) India - switzerland

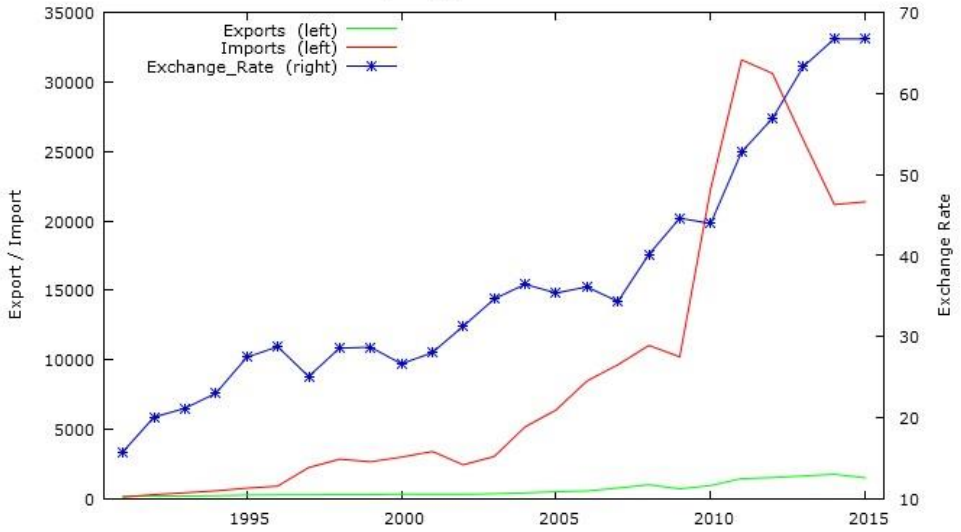


Figure 1(g) India- UAE Trade

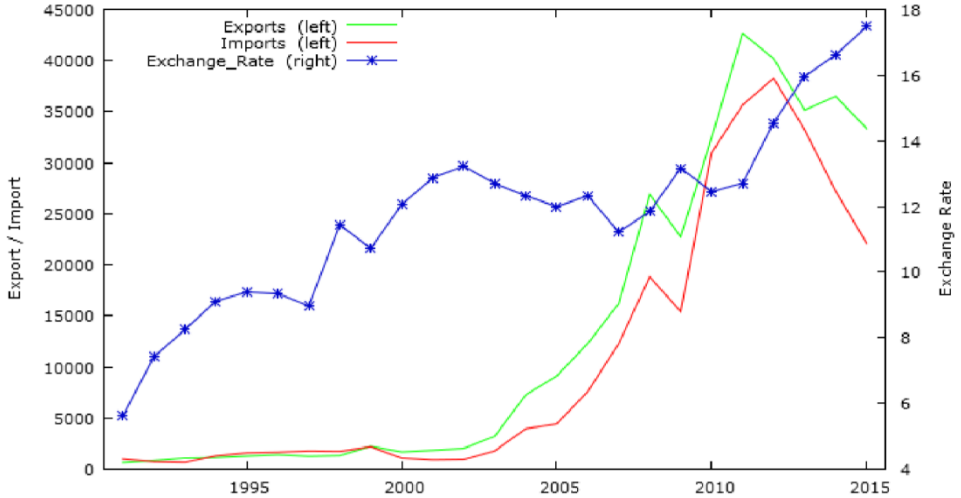
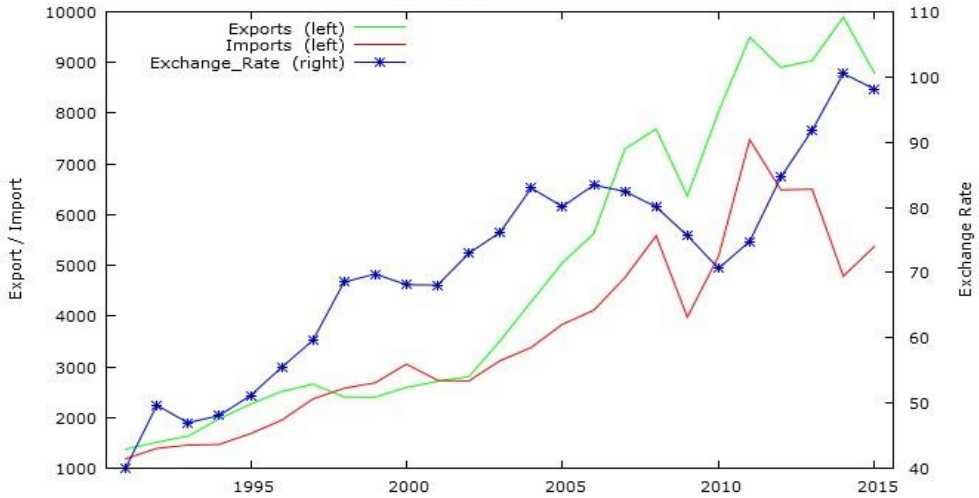


Figure 1(h) India-UK trade



4.3.3 Exchange Rate Variability, Depreciation and Growth of Export and Imports

The study has selected nine countries which have appeared five times consecutively in top five in the total trade during the study period as major trade partners. The study calculated Exchange Rate variability, rate of depreciation and growth of India's Export and Imports. As per the results in Table (4.2) the ranking of exchange rate variation using coefficient of variation (CV) is highest against Swiss Franc, followed by Japanese Yen and Chinese Yuan. While, UK Pound Sterling, US Dollar and Saudi Real exhibit least variation during the period.

Table 4.2

Ranking of Exchange rate variability and Exchange Rate Depreciation

Country and	Currency	Exchange Rate Variability			Exchange Rate Depreciation	
		SD	CV	Ranking	Rate of Depreciation	Ranking
USA	(USD-INR)	9.9360	0.22848	8	2.94	8
China	(CNY-INR)	1.8034	0.29814	3	3.33	5
UK	(GBP-INR)	16.057	0.22554	9	2.99	7
Japan	(JPY-INR)	0.12241	0.29885	2	3.88	2
Saudi Arabia	(SAR-INR)	2.6496	0.22849	7	2.94	8
UAE	(UAE-INR)	2.7900	0.23744	6	3.09	6
Belgium	(EUR-INR)	13.845	0.26146	5	3.46	4
Germany	(DM-INR)	7.1205	0.26293	4	3.49	3
Switzerland	(CHF-INR)	14.534	0.39627	1	5.01	1

Note: *Ranking of exchange rate variability is based on Coefficient of Variation (CV) and the Rate of Currency Depreciation is based on coefficient of log-lin model*

As per the Table (4.2), the rupee depreciation during 1991 to 2015 was highest against Swiss Franc followed by Japanese Yen and German Deustch Mark. The rupee depreciation was least in case of Saudi Real, US dollar and UK Pound Sterling. The ranking of exchange rate variation and the ranking of rate of depreciation show more or less the similar trend implying that exchange rate variation has been in the form of exchange rate depreciation.

4.3.3.1 Growth Rate of Indian Exports and Imports

Table 4.3

Growth Rate of Indian Exports and Imports

Country	Export Growth Rate	Import Growth Rate
USA	9.84	11.10
China	22.33	29.37
UK	8.66	6.91
Japan	5.08	9.53
Saudi Arabia	15.85	15.62
UAE	19.74	18.02
Belgium	9.98	8.79
Germany	7.35	10.66
Switzerland	9.55	19.94

Table (4.3) shows that India's Export growth rate towards china is higher among the trading partners followed by UAE and Saudi Arabia and the same trend is seen in case of import growth rate also. The countries such as Japan, Germany, UK and Belgium exhibit low export and import growth rate during the period. Courtiers like China, Switzerland, USA, Germany and Japan exhibits import growth rate more than export growth rate.

4.3.4 Short and Long-run Estimates through Panel Data

4.3.4.1 Panel Unit Root Tests Results

The results of two panel unit Root tests: Im Pesaran and Shin (2003) and Levin & Lin (1993) are shown in Table (4.4). It can be observed that both the tests fail to reject the null hypothesis that there is unit root in the panel series. It means at level all variables are non-stationary. Further, the study test first difference unit root testing of IPS and LL, and the result is there is no unit-root in the panel series. i.e all variables are stationary at first difference and follow I(1) process.

4.3.4.2 Panel Cointegration Tests Results

As per the results of panel-unit root testing reported in Table (4.5) all variables are stationary at first difference. The study employs Pedroni's (1999) cointegration test to establish the existence of cointegraiton among variables. The study considered four within group tests like v-stat, ρ-stat, PP stat and ADF stat and three between dimension ρ-stat, PP stat and ADF stat and the tests reject the null hypothesis *of no cointegration among* variables at 1% significance level. Table (4.5) suggests that there is a long-run relation between exports, exchange rate and trading partners GDP. And in case of imports there is a long-run relation among imports, exchange rate and India GDP.

4.3.4.3 Analysis of Exports using Pooled Mean Group Estimator (PMG)

The study identifies the cointegration among exports, exchange rate and GDP of India's trading partners. The long-run and short-run impact of exchange rate on exports can be estimated using panel cointegration estimator and for that the study employs pooled mean group estimator. The report of PMG of long-run and short-run is estimated using the specification given by Pesaran et.al (1999).

Table 4.4

Panel Unit Root Tests Results

(a) IPS - Panel Unit Root Test at level

Exchange Rate		**Exports**		**Imports**		**TGDP**		**India GDP**	
Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend
2.17	0.94	5.28	-0.54	3.82	-1.66***	3.68	0.32	10.71	7.56
(0.98)	(0.82)	(1.00)	(0.29)	(0.99)	(0.04)	(0.99)	(0.62)	(1.00)	(1.00)

(b) LLC - Panel Unit Root Test at level

Exchange Rate		**Exports**		**Imports**		**TGDP**		**India GDP**	
Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend
1.15	0.81	4.31	-2.40***	2.82	-2.78***	1.76	-0.14	9.81	6.36
(0.87)	(0.79)	(1.00)	(0.00)	(0.99)	(0.00)	(0.99)	(0.44)	(1.00)	(1.00)

(c) IPS - Panel Unit Root Test at First Difference

Exchange Rate		**Exports**		**Imports**		**TGDP**		**India GDP**	
Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend
-24.98***	-24.61***	-27.06***	-30.08***	-27.56***	-28.82***	-20.45***	-20.44***	-29.42***	-31.19***
(0.000)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Table 4.4 (continued)

(d) LLC - Panel Unit Root Test at First Difference

Exchange Rate		Exports		Imports		TGDP		India GDP	
Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend
-26.98***	-29.56***	-29.07***	-32.58***	-29.91***	-31.97***	-18.57***	-19.85***	-29.46***	-32.86***
(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: Figures in brackets are probability values, *** significant at 1%, ** at 5%, * at 10%

Table 4.5

Panel Cointegration Test

	Within-dimension				Between-dimension		
	v-stat	**ρ-stat**	**PP stat**	**ADF stat**	**ρ-stat**	**PP stat**	**ADF stat**
Among Export ER and Trading Partners GDP	1.499**	-6.109***	-4.93***	1.476	-9.876***	-8.63***	-3.03***
	(0.06)	(0.00)	(0.00)	(0.93)	(0.00)	(0.00)	(0.00)
Among Import ER and India GDP	4.447***	-1.797**	-1.793**	-1.27*	-1.78**	-1.69**	-0.56
	(0.00)	(0.03)	(0.03)	(0.10)	(0.03)	(0.04)	(0.28)

Note: Figures in brackets are probability values, *** significant at 1%, ** at 5%, * at 10%

Table 4.6
Export Results: Pooled Mean Group Estimator

	Short-Run Coefficients							***Long Run Coefficients***	
	ECT	$\Phi_1 \Delta lEx_{t-1}$	$\Phi_2 \Delta lEx_{t-2}$	$\Phi_3 \Delta lEx_{t-3}$	$\beta_1 \Delta lER_t$	$\gamma_1 \Delta lnTG_t$	α_0	$\lambda_0 lER$	$\lambda_1 TG$
Pooled	-0.075***	-0.379**	-0.298***	-0.235***	0.557***	1.040*	-0.162	0.959***	1.722***
	(0.037)	(0.037)	(0.068)	(0.053)	(0.098)	(0.611)	(0.114)	(0.268)	(0.144)
Belgium	-0.018***	-0.400***	-0.402***	-0.397***	0.660***	-1.268***	0.043***		
	(0.000)	(-0.008)	(-0.009)	(-0.009)	(-0.055)	(-0.126)	(-0.001)		
China	0.022***	-0.386***	-0.651***	-0.138***	0.645	-0.129	0.233		
	(-0.004)	(-0.017)	(-0.01)	(-0.012)	(-0.335)	(-0.092)	(-0.158)		
Japan	-0.028***	-0.515***	-0.413***	-0.228***	0.257	2.247	-0.286		
	(-0.001)	(0.013)	(0.012)	(0.012)	(0.11)	(2.856)	(0.19)		
Germany	-0.015***	-0.438***	-0.318***	-0.430***	0.801***	0.387***	-0.010		
	(0.000)	(0.009)	(0.01)	(0.009)	(0.062)	(0.017)	(0.003)		
Saudi	-0.239***	-0.174***	-0.145***	-0.215***	-0.079	-0.239***	-0.454***		
	(-0.006)	(0.013)	(0.011)	(0.01)	(0.414)	(0.011)	(0.055)		
Switz	-0.287***	-0.416***	-0.250***	-0.137***	0.598	2.448	-0.888***		
	(-0.013)	(0.017)	(0.016)	(0.011)	(0.302)	(11.962)	(0.23)		
UAE	-0.048***	-0.214***	-0.442***	-0.210***	0.544	0.007	0.104***		
	(-0.002)	(0.012)	(0.01)	(0.011)	(0.249)	(0.005)	(0.002)		
US	-0.003***	-0.430***	-0.014	-0.418***	0.846***	4.727**	-0.017***		
	(-0.001)	(0.01)	(0.009)	(0.008)	(0.08)	(1.776)	(0.063)		
UK	-0.061***	-0.439***	-0.052**	0.059***	0.743***	1.181	-0.180***		
	(-0.002)	(0.011)	(0.013)	(0.01)	(0.065)	(1.389)	(0.027)		

*Note: (a) Figures in brackets are standard errors (b) *** significant at 1%, ** at 5%, * at 10% (c) Long-run coefficients are applicable only for pooled estimates*

The results reported in Table (4.6) shows that the average elasticity of export to trading partners in relation to exchange rate is 0.959 which is significant at 1% with the expected positive sign. This indicates that 1% change (depreciation) in exchange rate leads to increase of exports by 0.95% across all the countries in the panel. The results also reveal long-run significant impact on exports in relation to trading partners GDP. The estimated long-run coefficient of trading partners GDP is 1.72 indicating that 1% increase in GDP of trading partners leads to 1.72% increase in exports of India across all the countries in the long-run. The average adjustment coefficient given by error correction term (ECT) (-0.075) is negative and significant at 1% implying that speed of adjustment from short-run to long-run is 7.5%.

Table (4.6) also provides the short-run and adjustment coefficient of trading partners. ECT is found to be negative and significant for all countries except China. The adjustment speed given by ECT is high for Switzerland (28.7%) followed by Saudi Arabia (23.9%). While the adjustment speed is least for US (0.3%). The result exhibits the significant impact of exchange rate on India's exports for the countries like Belgium, Germany, US and UK. While the countries like China, Saudi, Switz and UAE does not show any influence of exchange rate on exports. Further, there is a significant impact of trading partners GDP for India's exports to countries like Belgium, Germany, Saudi and US. This implies higher the GDP higher will be the exports to those countries.

4.3.4.4 Analysis of Imports using Pooled Mean Group Estimator (PMG)

The long-run and short-run estimates of imports and exchange rate are reported in table (4.7). As per the results, imports do not have any impact of exchange rate in the long-run. The study also reveals long-run significant impact on imports in relation to India's GDP.

Table 4.7

Import Results: Pooled Mean Group Estimator

	Short-run Coefficient									*Long Run Coefficients*	
	ECT	$\Phi_1 \Delta lIm_{t-1}$	$\Phi_2 \Delta lIm_{t-1}$	$\Phi_3 \Delta lIm_{t-1}$	$\beta_1 \Delta lER_t$	$\beta_2 \Delta lER_{t-1}$	$\gamma_1 \Delta lIGt$	$\gamma_2 \Delta lIGt\text{-}1$	α_0	$\lambda_0 lER$	$\lambda_1 IG$
Pooled	-0.078***	-0.249***	-0.158***	-0.132***	0.536***	-0.337	0.022	-0.067	0.237***	-0.375	1.087***
	(0.032)	(0.037)	(0.046)	(0.028)	(0.21)	(0.456)	(0.05)	(0.053)	(0.069)	(0.438)	(0.142)
Belgium	-0.160***	-0.461***	-0.329***	-0.234***	-0.11	0.213*	0.245***	0.088*	0.425		
	(0.007)	(0.015)	(0.014)	(0.011)	(0.087)	(0.085)	(0.038)	(0.037)	(0.068)		
China	-0.013***	-0.134***	-0.022	-0.134***	0.246**	-0.615***	0.083***	0.118***	0.112***		
	(0.000)	(0.011)	(0.011)	(0.009)	(0.064)	(0.063)	(0.008)	(0.008)	(0.001)		
Japan	-0.021***	-0.245***	-0.178***	-0.069***	0.397***	0.257**	-0.019*	-0.085***	0.053***		
	(0.001)	(0.011)	(0.012)	(0.012)	(0.069)	(0.065)	(0.008)	(0.008)	(0.002)		
Germany	-0.027***	-0.295***	-0.22***	0.021	0.042	0.498***	-0.016*	-0.069***	0.117***		
	(0.000)	(0.01)	(0.011)	(0.01)	(0.019)	(0.019)	(0.006)	(0.006)	(0.004)		
Saudi	-0.032***	-0.103***	0.025***	-0.092***	1.799	-2.663	-0.263**	-0.074	0.135***		
	(0.001)	(0.011)	(0.011)	(0.011)	(1.874)	(1.897)	(0.075)	(0.074)	(0.005)		
Switz	-0.084***	-0.238***	-0.251***	-0.246***	-0.126	1.321	0.21*	-0.063	0.272***		
	(0.002)	(0.011)	(0.01)	(0.01)	(0.869)	(0.879)	(0.074)	(0.073)	(0.017)		
UAE	-0.042***	-0.153***	0.005	-0.107***	0.732	-2.304	-0.022	-0.397***	0.178***		
	(0.001)	(0.01)	(0.01)	(0.01)	(1.198)	(1.209)	(0.047)	(0.047)	(0.005)		
US	-0.027***	-0.346***	-0.338***	-0.181***	1.065***	-0.605*	-0.003	0.077***	0.135***		
	(0.001)	(0.011)	(0.011)	(0.01)	(0.204)	(0.215)	(0.009)	(0.009)	(0.006)		
UK	-0.299***	-0.262***	-0.116***	-0.148***	0.782*	0.867*	-0.021	-0.196***	0.705***		
	(0.008)	(0.013)	(0.013)	(0.01)	(0.282)	(0.286)	(0.018)	(0.018)	(0.157)		

*Note: (a) Figures in brackets are standard errors (b) *** significant at 1%, ** at 5%, * at 10% (c) Long-run coefficients are applicable only for pooled estimates*

The estimated long-run coefficient of India's GDP is 1.087 indicating that 1% increase in GDP of India leads to 1.08% increase in imports from the selected trading partners in the long-run. The average adjustment coefficient given by ECT (-0.078) is negative and significant at 1% implying that speed of adjustment from short-run to long-run is 7.8%.

Table (4.7) also provides the short-run and adjustment coefficients of imports for selected trading partners. ECT is found to be negative and significant for all countries. The adjustment speed given by ECT is high for UK (29.9%) followed by Belgium (16%). While the adjustment speed is least for China (1.3%). The result indicates that there is not much impact of exchange rate on import from majority of the trading partners. Study can only trace the impact of exchange rate on imports only for China and US with expected negative sign.

Further, there is a significant impact of India's GDP for its imports from countries like Belgium, China, Switz and US. This implies higher the GDP of India higher will be the imports to India. India's GDP has negative relation with imports from Japan, Saudi, UAE and UK.

4.4 Chapter Summary

The study found the depreciation trend of rupee against all currencies of the selected trading partners. India's export and import grew substantially over the years. However, the study ascertains high import growth rate than export growth rate in majority cases. The results establish the presence of long-run relationship among exports, imports, exchange rate, GDP of India and its trading partners. Further, in the long-run the exchange rate has impact on exports and not for imports of India. The average impact of exchange rate in the short-run is significant for exports and not for imports.

The result identifies that there is a significant impact of exchange rate for India's export with the countries like Belgium, Germany, US and UK. However, the exchange rate depreciation has significant effects on the imports from China and US. One interesting fact about the result is that the exchange rate has significant impact on India's exports to US and imports from US. Study reveals the significant positive impact of GDP of trading partners like Germany and US to India's exports. Whereas GDP of Belgium and Saudi shows negative impact on India's exports. Further, there is a significant positive impact of India GDP on imports from the Belgium, China, Switz and US. The study also indicates the negative relation between India's GDP and imports in the case of Japan, Germany, Saudi, UAE and UK, which means that as the GDP increases there is a decrease in imports.

CHAPTER V

EXCHANGE RATE VOLATILITY AND INDIA'S EXPORTS

CHAPTER V

EXCHANGE RATE VOLATILITY AND INDIA'S EXPORTS

5.1 Introduction

Theoretically depreciation of real exchange rate is likely to result in increase of exports due to the relative price effect. However, the relationship between real exchange rate volatility and exports are not very straight forward. There are number of studies which focus on the impact of exchange rate volatility on trade with varying results. Hooper and Kohlhagen (1978) after examining the effect of exchange rate uncertainty on the volume of trade among developed economies, arrived at the conclusion that exchange rate volatility does not have any significant impact on trade volume. There are studies even in Indian context by Viramani (1991), Joshi & Little (1994) and Srinivasan (1998) reached the conclusion that there is negative and significant relation between REER and merchandise aggregate exports. Both the theoretical and empirical studies have given inconclusive results indicating that the impact may be positive or negative. The standard theoretical argument is that exchange rate volatility may hinder the trade flow, some theoretical literature provides justification for positive or insignificant effect as well. Further, different modelling techniques were developed over time to incorporate new dynamics in econometric analysis to assess the impact of exchange rate volatility on trade.

Exports have been playing a significant role in India's substantial and sustained economic growth over the decades. India's contribution to the world export share since economic reforms has improved from 0.56% in 1991 to 2% in 2015 as per WTO data. However, uncertainty in the total volume of export for many commodities is the matter of great concern. Specifically, the performance of manufactured goods which occupies a major portion (72.75%) of India's total export has been disappointing. Many argue that the

exchange rate volatility is one of the key variables which determines the total volume of trade in India.

This chapter examines the relation between exchange rate and India's export with rest of the world. The study analyse the effect of REER and REER volatility on various export commodities. It is assumed that exchange rate volatility can have substantial effect on commodity trade. To assess the impact of exchange rate volatility on export, the study considers the major and sub-categories of Petroleum crude and products, Non-Petroleum Total, Agricultural and allied products, Ores & minerals, Total Manufactured goods, Leather Manufactured goods, Chemicals & related products, Manufactured goods, Engineering Manufactured goods, Electronic Manufactured goods, Textiles (excluding readymade garments) Manufactured goods and Readymade Garments Manufactured goods.

5.2 Methodology

The study employs the widely used ARDL model to analyse the impact of exchange rate volatility on trade. ARDL stands for Auto Regressive Distributed Lag models. This model is used to test the cointegration among the variables and estimating the long-run and short-run dynamics between the variables. This model has been extensively used in recent studies as they can accommodate stationary and non-stationary time-series together in the model. The following is the basic construct of an ARDL model

$$y_t = \beta_0 + \beta_1 y_{t-1} + \cdots \beta_\rho y_{t-\rho} + \alpha_0 x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \cdots \alpha_q x_{t-q} + \varepsilon_t \qquad (1)$$

The above model is autoregressive as y_t is explained by the lagged values of itself. The above model has a distributed lag component as the X explanatory variables expressed through successive lags. ε_t is a random disturbance term.

This model can be used with a mixture of I(0) and I(1) data, the differenced data and level data can be included in the ARDL model to test the possibility of cointegration among some

of the I(1) variables. Through ARDL / Bound testing methodology advocated by Pesaran and Shin (1999) and Pesaran et al. (2001) it is possible to test cointegration and extract long-run and short-run estimates through a single equation model. Consider the following equation (2) and equation (3):

$$\Delta y_t = \beta_0 + \sum \beta_i \Delta y_{t-i} + \sum y_j \Delta x_{1t-j} + \sum \delta_k \Delta x_{2t-k} + \emptyset z_{t-1} + e_t \quad (2)$$

$$\Delta y_t = \beta_0 + \sum \beta_i \Delta y_{t-i} + \sum y_j \Delta x_{1t-j} + \sum \delta_k \Delta x_{2t-k} + \theta_0 y_{t-1} + \theta_1 x_{1t-1} + \theta_2 x_{2t-1} + e_t \quad (3)$$

Notice that equation (2) and (3) look alike except the difference is that the error-correction term $\emptyset z_{t-1}$is replaced by y_{t-1}, x_{1t-1} and x_{2t-1}.

Bound Testing is performed for the hypothesis H_0: $\theta_0 = \theta_1 = \theta_2 = 0$ against the alternative that H_0 is not true. Bound testing helps in testing for the absence of a long-run equilibrium relationship between the variables. A rejection of null hypothesis implies that variables have long-run relationship. Pesaran *et al*. (2001) has given *limits* on the critical values for the *asymptotic* distribution of the F-statistic. They provided lower and upper bounds on the critical values for different number of variables. In each case, the lower bound is based on the assumption that all of the variables are I(0), and the upper bound is based on the assumption that all of the variables are I(1). If the computed F-statistic falls below the lower bound we would conclude that the variables are I(0), so no cointegration is possible. If the F-statistic exceeds the upper bound, it is concluded there is cointegration. Further, if the F-statistic falls between the bounds, the test is inconclusive. One can "extract" long-run effects from the unrestricted ECM. Looking back at equation (3), and noting that at a long-run equilibrium, $\Delta y_t = 0$, $\Delta x_{1t} = \Delta x_{2t} = 0$, the long-run coefficients for x_1 and x_2 are $-(\theta_1/\theta_0)$ and $-(\theta_2/\theta_0)$ respectively.

Following is the model specification of export commodities using Auto Regressive Distributed Lag (ARDL) Bound testing approach in the study:

$$\Delta lnEx_t = \alpha_0 + \sum_{j=1}^{n4} \gamma_j \Delta lnEx_{t-1} + \sum_{j=0}^{n4} \beta_j \Delta lnR_{t-j} + \sum_{j=0}^{n4} \delta_j \Delta lnRV_{t-j} \sum_{j=0}^{n4} k_j \Delta lnWgdp_{t-j}$$
$$+ \theta_1 lnEx_{t-1} + \theta_2 lnR_{t-1} + \theta_3 lnRV_{t-1} + \theta_4 lnWgdp_{t-1} + \varepsilon_t$$

Where, Ex = export value of commodity of India

R = Real Effective Exchange Rate of India

RV = REER Volatility

Wgdp = World Gross Domestic Product

REER Volatility is the moving average standard deviation of the log values of 36 Currency REER. The optimum lags of various variables in the ARDL model is determined by using Akaike Information Criterion (AIC).

Hypotheses

In the above ARDL export model specification θ_1, θ_2, θ_3 and θ_4 are the long run coefficients. While β_j, γ_j, δ_j and k_j are the short-run coefficients. The Cointegration (CI) among the variables is tested through the following hypothesis:

H_0: $\theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ (There is no long-run relation among Ex, R, RV and Wgdp)

H_1: $\theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq 0$ (There is a long-run relation among Ex, R, RV and Wgdp)

In order to assess the impact of exchange rate fluctuations on the India's export the study used 36 Currency REER index as one of the independent variables. The following hypothesis are tested:

H_0: $\beta = 0$ (Increase in REER has no effect on export).

H_1: $\beta < 0$ (Increase in REER has a negative effect on export).

H_0: $\delta = 0$ (REER Volatility has no effect on export).

H_1: $\delta \neq 0$ (REER Volatility has an effect on export).

5.3 Empirical Analysis

The study follows CMIE (Centre for monitoring Indian Economy) categorisation of exports as major-category and sub-category exports and are indicated in different tables in this chapter. Further, the study has not considered all sub-categories of export due to less number of observations and non-availability of data. As such, the study is limited to select commodities. The gems and jewellery being one of the sub-category of other manufactured goods is shown along with the major-category as the percentage share of export of the same is high. It is to be noted that the coefficients of only relevant parameter are estimated by the software output based on model selection criteria. Therefore, there are blank spaces in the result table.

5.3.1 Analysis of Export of Major Categories

To analyse the relation between exchange rate and exports major-category, the study performs the cointegration test through ARDL approach. The results are shown in the Table (5.1) for main export commodities. The cointegration results are arrived on the basis of F Statistics Upper Bound critical value of 3.2 and lower bound critical value of 2.37 at 10% significance level. The study chose 10% significance level in order to ascertain maximum number of cointegration with least upper and lower bound F critical values. If the F statistics is exceeding the upper bound critical value the study rejects the null hypothesis of "*no long run relationship",* and conclude that variables are cointegrated or have long run relationship. While if the F statistics is lesser than the lower bound critical value, variables are not cointegrated.

Table 5.1

Cointegration and Error Correction Results of Major-Category of India's Exports

Export Categories	Share (%)	F Statistics	ECT_{t-1}	CI	ARDL	AIC
Total Export	**100**	12.21	-0.02*** (-7.99)	Yes	4,2,0,0	-2.36
1. Petroleum crude and products	**12.12**	2.64	-0.17*** (-3.72)	No	4,0,1,3	2.89
2. Non-POL : Total	**87.88**	14.55	-0.008*** (-8.74)	Yes	4,2,3,0	-2.42
2A. Agricultural and allied products	**12.65**	9.06	-0.06*** (-6.89)	Yes	4,3,0,1	-1.42
2B. Ores & minerals	**1.25**	2.31	-0.005*** (-3.48)	No	4,0,2,0	-0.2
2C. Manufactured goods Total	**72.75**	13.38	0.001*** (8.38)	Yes	4,2,3,0	-2.55
2C(i) Leather & leather manufactures	1.19	5.97	0.007*** (5.59)	Yes	4,1,0,0	-1.89
2C(ii) Chemicals & related products	12.72	20.24	-0.02*** (-10.29)	Yes	4,2,1,0	-2.68
2C(iii) Engineering goods	22.38	9.94	0.0009*** (7.21)	Yes	2,2,0,0	-1.71
2C(iv) Electronic goods	2.55	2.66	-0.03*** (-3.74)	No	1,1,4,4	-1.16
2C(v) Textiles (excluding readymade garments)	6.02	4.69	-0.02*** (-4.95)	Yes	2,1,1,1	-2.2
2C(vi) Readymade garments	5.88	2.33	-0.02*** (-3.49)	No	2,0,0,2	-1.05
2C(vii) Other Manufactured Goods	21.29	9.00	0.00*** (6.87)	Yes	4, 1, 3, 0	-1.71
2C(vii)a. Gems & jewelry	14.89	7.532	0.01*** (6.28)	Yes	4, 1, 3, 0	-1.28
2D Other Commodities	**1.23**	1.68	-0.02*** (-2.97)	No	4, 0, 3, 0	0.52

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios(d) CI : Cointegration*

As per the results given in Table (5.1), India's total exports is found to be cointegrated i.e having long-run relation with respect to REER and REER volatility. Further, categories like

non-petroleum total, agriculture and allied products, manufactured goods total, leather manufactures, chemical related products, engineering products, textiles (excluding readymade garments) and other manufactured goods have cointegration with REER and REER volatility.

Error correction term(ECT_{t-1}) indicates the short term adjustment in the variable. If the coefficients are negative and significant we can say that there is a short run adjustment among variables. ECT_{t-1} directly estimates the speed at which a dependant variable returns to equilibrium after a change in other variable in a short period and hence the long run relationship is established. The long run estimates of the coefficients are meaning full if F or ECT_{t-1} is found significant. Desirable range of ECT_{t-1} is -1 to 0. As per the results in Table (5.1), the study found negative and significant coefficient of ECT_{t-1} for Total Export (-0.02), non-petroleum total (-0.008), agriculture and allied products (-0.06), chemical related product (-0.02), electronic goods (-0.03), textiles (-0.02) and readymade garments (-0.02). The speed of adjustment to equilibrium is high in case of agriculture and allied products (6%) and least for non-petroleum total (0.8%).

The results in Table (5.2) provides short run as well as long-run estimates of REER and REER volatility. The results are shown up to two lags though the models are estimated up to a maximum of four lags. The model focus mainly on the impact of REER and REER volatility. As such short run GDP and lagged values of the dependent variables are not shown in the results table. In order to assess the impact of exchange rate fluctuations on the India's export the null hypothesis of '*change in REER has no effect on export'* are tested using the ARDL model. As per the Table (5.2), majority of the export major-category are found significant impact in short-run with the expected negative sign and we reject the null hypothesis and conclude that increase in REER has an impact on India's exports. Whereas, there is minimal impact of REER in the long run.

Table 5.2
Short and Long Run Coefficient Estimates of India's Exports

	Short Run Coefficients						*Long Run Coefficients*		
	ΔlnR_t	ΔlnR_{t-1}	$\beta\Delta lnR_{t-2}$	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$	*lnREER*	*lnRV*	*lnWGDP*
A - Cointegrated									
Total	-0.96***	-0.69***					8.46	1.17	1.75
	(-3.18)	(-2.16)					(0.78)	(0.59)	(1.19)
2. Non-POL : Total	-1.00***	-0.76***		0.01	0.07***	0.06***	10.84	-5.93	2.29
	(-3.32)	(-2.39)		(-0.57)	(3.29)	2.79	(0.64)	(-0.42)	(0.61)
2B. Agricultural and allied products	-1.19***	-1.89***	-1.56***				21.77***	0.61	0.55***
	(-2.36)	(-3.28)	(-2.75)				(4.59)	(0.84)	(-4.04)
2C. Manufactured goods Total	-0.96***	-0.68***		0.01	0.1***	0.07***	41.02	77.63	-13.69
	(-3.40)	(-2.29)		(-0.62)	(4.52)	(3.58)	(-0.11)	(-0.08)	(-0.08)
2C(i) Leather & leather	-1.007***						14.65	0.27	-1.62
	(-2.61)						(-0.53)	(-0.94)	(-0.36)
2C(ii) Chemicals & related products	-0.44***	-0.414		0.016			10.2***	2.34	0.78***
	(-1.71)	(-1.579)		(-1.14)			(1.99)	(-1.6)	(2.14)
2C(iii) Engineering goods	-0.96***	-1.03***					188.7	2.97	-41.17
	(-2.27)	(-2.37)					(-0.08)	(-0.05)	(-0.07)
2C(v) Textiles	-0.72***			-0.03***			9.84	0.13	0.14
	(-2.11)			(-2.02)			(-1.83)	(-0.09)	(-0.53)
2C(vii) Other Manufactured Goods	-1.27***			0.04	0.18***	0.13***	17.3	19.38	-0.47
	(-2.93)			(1.42)	(5.09)	(4.25)	(-0.41)	(-0.28)	(-0.18)
2C(vii)a. Gems & jewellery	-1.46***			0.06	0.22***	0.16***	13.08	24.02	0.28
	(-2.72)			(1.61)	(5.005)	(4.19)	(-0.29)	(-0.24)	(-0.11)
B - Not Cointegrated									
1. Petroleum crude and products	12.72***			0.25					
	(2.56)			(-0.92)					
2B. Ores & minerals	-0.72	-2.09***		-0.06	0.15***				
	(-0.69)	(-2.01)		(-1.02)	(2.58)				
2C(iv). MG Electronic goods	-1.25***			0.02	-0.01	-0.07***			
	(-2.09)			(-0.47)	(-0.26)	(-1.74)			
2D. Other Commodities	-0.97			0.03	0.24***	0.25***			
	(-0.67)			(0.42)	(2.12)	(2.70)			

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significance at 1%, ** at 5%, * at 10%*

The export categories like non-petroleum, agriculture & allied, manufactured goods total, leather, chemicals related, engineering, electronic, ores and minerals and textiles are found to be significant in the short run. It is evident from table that, agriculture & allied and chemical related products are significant in long run in relation to REER but not with expected sign. As per the results in Table (5.2), petroleum crude and product, readymade garments do not show any short and long run significant coefficients. The result also reveals significant short run volatility impact for few major export categories. REER volatility has negative impact on exports of electronics and textiles in the short run. Whereas, non-petroleum total, ores and minerals, manufactured goods total and other manufactured goods show positive effect for REER volatility in short-run. Further, there is no effect of REER volatility on any of the export categories in the long-run.

Table 5.3: Diagnostic Statistics of India's Exports

Diagnostic Checking	LM	RS	C	CS	$\bar{R}^2$
Total Exports	5.95	2.84	S	S	0.35
Petroleum crude and products	0.57	1.03	S	S	0.30
Non-POL : Total	1.05	1.27	S	S	0.44
Agricultural and allied products	2.87	0.75	S	S	0.48
Ores & minerals	7.21	3.1	S	US	0.24
MG Total	8.01	0.15	S	S	0.53
MG Leather & leather	23.10***	0.07	S	S	0.48
MG Chemicals & related products	5.74	0.14	S	S	0.42
MG Engineering goods	2.75	0.51	S	S	0.30
MG Electronic goods	0.42	0.26	S	S	0.25
MG Textiles	1.02	0.34	S	S	0.26
MG Readymade garments	14.05***	0.01	S	S	0.28
Other Manufactured Goods	0.28	1.02	S	S	0.67
Gems and Jewellery	0.20	1.99	S	S	0.69
Other Commodities	0.20	2.41	S	S	0.21

*Note: (a) LM=Lagrange Multiplier test of residual serial correlation. (b) RS = Ramsey RESET test for functional form. (c) C=Cusum sum of residuals; S="stable"; US="unstable" (d) CS= Cumulative sum of squared residuals; S="stable"; US="unstable" (e) *** significance at 1%, ** at 5%, * at 10% (f)* $\bar{R}^2$ *= Adjusted R Square*

The diagnostic results of ARDL for India's main export categories are provided in Table (5.3). For autocorrelation, the study has tested null hypothesis of *no autocorrelation* using LM statistics. In majority of the cases, the null hypothesis is not rejected indicating the absence of autocorrelation. In case of the commodities like leather and readymade garments has autocorrelation problem.

Further, the model employs Ramsey RESET test for identifying model specification problem. The model also tested the null hypothesis of *no specification error.* The Ramsey RESET test statistics does not reject the null hypothesis and conclude that all the models are correctly specified. In order to test the stability of the parameters Cusum and Cusum Squared tests are used. Most export categories are indeed stable. The results in Table (5.3) shows that models have good explanatory power as given by adjusted R square.

5.3.2 Analysis of Export of Agriculture and Allied Products

For agriculture and allied products, the study found that a total of 20 export commodities are cointegrated as reported in Table (5.4) The export commodities like cashew, cashewnut shell liquid, fresh vegetables, gurgaun meal, miscellaneous processed items, poultry and dairy products, dairy products, pulses, shellac, alcoholic beverages, tea, tobacco unmanufactured and wheat are not cointegrated. The ECT_{t-1} is found negative and significant for majority of the agriculture and allied products category indicating the short run adjustment with REER and REER volatility leading to a long-run relation. The speed of adjustment is high for coffee (30%) followed by cashwenut shell liquid (27%), Cotton raw (25%) and Groundnut (25%). The speed of adjustment to equilibrium is least in case of marine products (2%), meat preparations (3%) processed vegetables (3%) and spices (4%). Further, the products like fresh fruits, processed fruits & juice, basmati rice, tobacco manufactured and unmanufactured commodities ECT_{t-1} have been found positive indicating that these commodities do not have short run adjustment.

Table 5.4
Cointegration and error correction Results of India's Exports
(Agricultural & allied products)

Export Commodities	Export Share (%)	F Statistics	ECT_{t-1}	CI	ARDL	AIC
2A. Agricultural & allied products	12.65	9.06	-0.06*** (-6.89)	Yes	4, 3, 0, 1	-1.42
Cashew	0.36	2.37	-0.11*** (-3.53)	No	3, 3, 0, 0	-0.95
Cashewnut shell liquid	0	3.01	-0.27*** (-3.97)	No	3, 0, 1, 3	2.12
Castor Oil	0.24	3.67	-0.14*** (-4.38)	Yes	4, 0, 0, 0	0.16
Coffee	0.27	8.86	-0.30*** (-6.81)	Yes	4, 3, 0, 0	-0.08
Cotton raw including waste	0.78	4.30	-0.25*** (-4.75)	Yes	4, 0, 4, 0	3.05
Floriculture products	0.03	8.74	-0.13*** (-6.77)	Yes	4, 3, 0, 0	-0.32
Fresh fruits	0.19	4.61	0.04*** (4.92)	Yes	4, 0, 0, 0	0.25
Fresh vegetables	0.4	2.20	0.07*** (-3.38)	No	4, 0, 0, 0	0.05
Fruits & Vegetable Seeds	0.02	3.35	-0.16*** (-4.21)	Yes	4, 2, 0, 0	0.62
Groundnuts	0.38	3.55	-0.25*** (-4.31)	Yes	4, 0, 0, 0	2.04
Guargum meal	0.19	2.241	-0.06*** (-3.42)	No	4, 1, 0, 0	0.37
Marine products	2.65	6.39	-0.02*** (-5.78)	Yes	4, 0, 0, 1	-0.74
Meat & preparations	1.67	9.19	-0.03*** (-6.94)	Yes	4, 1, 3, 0	-0.75
Misc Processed Items	0.16	2.04	-0.08*** (-3.27)	No	1, 1, 1, 0	0.20
Oil meals	0.35	3.79	-0.16*** (-4.45)	Yes	4, 0, 3, 0	1.19
Oilseeds	0.59	4.23	-0.08*** (-4.71)	Yes	4, 1, 0, 0	0.90
Sesame & Niger Seeds	0.15	4.21	-0.07*** (-4.69)	Yes	4, 1, 1, 0	0.58

Table 5.4 (continued)

Export Commodities	Export Share (%)	F Statistics	ECT_{t-1}	CI	ARDL	AIC
Poultry and dairy products	0.12	1.85	-0.05*** (-3.11)	No	3, 0, 0, 0	0.54
Pultry Products	0.03	4.47	-0.18*** (-4.90)	Yes	4, 0, 2, 3	-0.09
Dairy Products	0.09	2.58	-0.15*** (-3.71)	No	4, 1, 0, 0	1.09
Processed fruits and juices	0.22	5.59	0.00*** (5.41)	Yes	4, 1, 0, 3	-0.22
Processed vegetables	0.09	3.53	-0.03*** (-4.30)	Yes	4, 0, 0, 0	-0.50
Pulses	0.04	2.67	-0.13*** (-3.73)	No	4, 0, 0, 0	1.03
Rice	1.62	3.30	-0.08*** (-4.15)	Yes	3, 2, 0, 0	0.08
Basmati rice	0.98	4.57	0.02*** (4.89)	Yes	4, 0, 0, 2	-0.15
Shellac	0.01	1.46	-0.16*** (-2.77)	No	4, 3, 0, 0	1.28
Spices	0.93	5.51	-0.04*** (-5.38)	Yes	4, 3, 2, 0	-0.91
Alcoholic beverages	0.12	2.05	-0.09*** (-3.27)	No	1, 0, 3, 0	0.66
Sugar	0.49	4.55	-0.18*** (-4.87)	Yes	2, 2, 0, 0	2.45
Tea	0.3	2.73	-0.05*** (-3.78)	No	4, 3, 0, 0	-0.50
Tobacco manufactured	0.13	3.57	0.04*** (4.32)	Yes	4, 4, 1, 0	-0.65
Tobacco unmanufactured	0.23	1.07	0.01*** (2.36)	No	4, 3, 2, 0	0.63
Wheat	0.01	1.65	-0.14*** (-2.97)	No	3,3,1,0	3.98

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

The short run and long run coefficient estimates of the export of agriculture and allied products which are cointegrated are shown in Table (5.5). The results indicate that REER has only short run impact for the export under this category with the expected sign. Whereas in the long run, none of the commodities coefficients have found with expected sign. The commodities like coffee, floriculture, fruits & vegetable seeds, processed fruits & juice, rice, spices, sugar, tobacco manufactured show short run impact with the negative sign in relation to the changes in REER. The commodities like castor oil, cotton raw, fresh fruits, groundnuts, marine products, oil seeds, processed vegetables and basmati rice do not show any significant impact in the short run. The Table (5.5) shows that REER volatility has negative effect for few commodities like, cotton raw, meat preparations, oil meal, poultry products and spices. In the long run REER volatility has shown positive effects for raw cotton and oil meals. The study finds that World GDP has long-run relation with agriculture and allied products exports in general and raw cotton in specific.

The short run coefficient estimates of the export commodities which are not cointegrated are shown in Table (5.6). The commodities like shellac, alcoholic beverages, cashew, miscellaneous processed items, tea, tobacco manufactured and wheat show significant result with expected sign in relation to changes in REER. Alcoholic beverages and tobacco unmanufactured are negatively affected by REER Volatility. It is also evident that REER volatility has very minimal impact with respect to the commodities which are not cointegrated.

Table 5.5

Short and Long Run Coefficient Estimates of India's Exports

(Agricultural & allied products) (Cointegrated)

	Short Run Coefficients						*Long Run Coefficients*		
	ΔlnR_t	ΔlnR_{t-1}	ΔlnR_{t-2}	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$	*lnREER*	*lnRV*	*lnWGDP*
2A. Agricultural and allied products	-1.19**	-1.89***	-1.56***				21.77***	0.61	0.55*
	(-2.36)	(-3.28)	(-2.75)				(4.59)	(0.84)	(1.94)
Castor Oil	0.05						10.68***	0.89	0.13
	(0.04)						(3.16)	(1.35)	(0.80)
Coffee	1.03	-2.34**	-3.38***				11.69***	0.32	0.02
	(1.045)	(-2.31)	(-3.25)				(7.09)	(1.12)	(0.29)
Cotton raw including waste	7.91			0.34	-2.84***	-1.87***	18.74**	15.04***	1.46**
	(1.44)			(1.05)	(-4.06)	(-3.40)	(2.36)	(2.77)	(2.09)
Floriculture products	-0.09	-1.66**	-2.04**				5.86*	0.39	0.12
	(-0.108)	(-1.98)	(-2.32)				(1.87)	(0.71)	(0.96)
Fresh fruits	-1.01						27.49	-0.2	-0.23
	(-1.25)						(1.45)	(-0.09)	(-0.46)
Fruits & Vegetable Seeds	-1.01	-3.24***					15.68***	-0.54	-0.11
	(-0.71)	(-2.26)					(3.74)	(-0.71)	(-3.42)
Groundnuts	-2.21						14.89***	0.33	0.06
	(-0.82)						(3.26)	(0.39)	(0.3)
Marine products	0.31						20.5	0.18	-0.66
	(0.38)						(1.04)	(0.08)	(-0.68)
Meat & preparations	-0.67			0.7	-0.22***	-0.08*	16.78*	15.49	1.79
	(-0.96)			(1.38)	(-3.29)	(-1.61)	(1.72)	(10.35)	(1.23)
Oil meals	0.35			0.29**	-0.57***	-0.21	2.79	7.12**	0.83
	(0.17)			(2.21)	(-2.8)	(-1.46)	(0.51)	(2.13)	(1.57)

Table 5.5 (Continued)

	Short Run Coefficients						*Long Run Coefficients*		
	ΔlnR_t	ΔlnR_{t-1}	ΔlnR_{t-2}	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$	*lnREER*	*lnRV*	*lnWGDP*
Oilseeds	-1.61						16.92***	0.2	0.87
	(-1.02)						(2.09)	(0.13)	(1.32)
Sesame & Niger Seeds	-2.01			-0.05			13.11***	1.52	0.98
	(-1.49)			(-0.69)			(1.69)	(0.72)	(1.38)
Poultry Products	1.59			0.16	-0.23***		3.58	1.72	0.23
	(1.17)			(1.39)	(-2.92)		(1.14)	(1.76)	(1.24)
Processed fruits and juices	-2.87***						-192.52	84.22	-17.97
	(-3.01)						(-0.03)	(0.03)	(-0.03)
Processed vegetables	-1.02						-3.17	5.27	-0.02
	(-1.14)						(-0.11)	(0.59)	(-0.03)
Rice	-2.24***	-3.40***					21.01***	0.78	0.15
	(-2.12)	(-3.01)					(-3.22)	(0.69)	(0.57)
Basmati rice	-0.38						35.99	-8.23	-2.03
	(-0.37)						(0.96)	(-0.60)	(-0.71)
Spices	-0.66	-1.21***	-1.91***	-0.08***	0.10***		29.88***	-3.09	0.66
	(-1.02)	(-1.76)	(-2.68)	(-1.82)	(2.49)		(2.23)	(-0.74)	(1.05)
Sugar & mollases	-3.78	-6.49***					31.40***	-2.00	0.72
	(-1.12)	(-1.74)					(3.38)	(-1.06)	(1.50)
Tobacco manufactured	-2.30***	-0.83	0.13	-0.01			8.13	2.63	-0.43
	(-3.11)	(-1.10)	(0.17)	(-0.29			(0.75)	(0.85)	(-0.93)

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significance at 1%, ** at 5%, * at 10%*

Table 5.6

Short Run Coefficient Estimates of India's Exports (Not Cointegrated)

(Agricultural & allied products)

	ΔlnR_t	ΔlnR_{t-1}	ΔlnR_{t-2}	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$
Cashew	-0.18	0.40	-1.45**			
	(-0.27)	(-0.61)	(-2.23)			
Cashewnut shell liquid	5.19*			0.13		
	(1.72)			(0.76))		
Guargum meal	-1.41					
	(-1.15)					
Misc. Processed Items	-2.28***			-0.03		
	(-1.97)			(-0.44)		
Dairy Products	-3.17					
	(-1.51)					
Shellac	-2.03	-2.93	-4.01***			
	(-1.06)	(-1.45)	(-2.00)			
Alcoholic beverages	1.75	-2.68***		0.13	-0.43***	-0.22***
	(1.06)	(-1.70)		(1.30)	(-2.71)	(-1.96)
Tea	-1.87***	-1.58***	-1.85***			
	(-2.39)	(-1.93)	(-2.31)			
Tobacco unmanufactured	-2.33***	-2.32***	2.95***	-0.25***		
	(-1.66)	(-1.65)	(2.02)	(-2.71)		
Wheat	-12.12	4.83	-21.28***			
	(-1.34)	(0.56)	(-2.44)			

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

5.3.3 Ores and Minerals

Under this category majority of the commodities are not cointegrated. However, the Table (5.7), indicate that other Ores and Minerals category is cointegrated. Further, the table also reveals negative and significant ECT_{t-1} for majority of the commodities like iron ore, coal, processed minerals and other ores & minerals indicating that commodities have short run adjustment with exchange rate.

Table 5.7:
Cointegration and error correction Results of India's Exports
(Ores and Minerals)

Export Commodities	Export Share (%)	F Statistics	ECT_{t-1}	CI	ARDL	AIC
2B. Ores & minerals	1.25	2.31	-0.01*** (-3.48)	No	4, 0, 2, 0	-0.20
Iron ore	0.69	1.19	-0.10*** (-2.49)	No	1, 0, 0, 4	1.28
Mica	0.02	1.18	0.00*** (2.48)	No	3, 1, 0, 3	0.63
Coal	0.03	1.35	-0.10*** (-2.67)	No	4, 0, 3, 4	1.57
Processed minerals	0.33	2.09	-0.06*** (-3.32)	No	4, 2, 0, 4	-0.23
Other ores & minerals	0.01	5.31	-0.02*** (-5.32)	Yes	4, 4, 2, 0	-0.38

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Table (5.8) reports the short and long-run estimates of cointegrated and not cointegrated commodities. The category other ores and minerals has a significant impact with expected sign in relation to REER in the short run. Also, REER volatility has mixed effects i.e present REER volatility has negative effect and lagged volatility has positive effect. It is found that ores & minerals, mica, processed minerals are effected by REER which is evident through negative and significant coefficient. REER volatility has positive effect on the export of ores and minerals and coal. Under this category none of the long run coefficient estimates are significant.

Table 5.8:

Short and Long Run Coefficient Estimates of India's Exports

(Ores & Minerals)

	Short Run Coefficients						***Long Run Coefficients***		
	ΔlnR_t	ΔlnR_{t-1}	ΔlnR_{t-2}	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$	***lnREER***	***lnRV***	***lnWGDP***
A Cointegrated									
Other ores & minerals	0.07	-2.11***	-2.7***	-0.18***	0.3***		62.26	-32.25	2.42
	(0.08)	(-2.13)	(-2.59)	(-2.57)	(4.21)		(0.55)	(-0.44)	(0.45)
B Not-Cointegrated									
2B. Ores & minerals	-0.72	-2.09***		-0.06	0.15***				
	(-0.69)	(-2.01)		(-1.02)	(2.58)				
Mica	-3.53***								
	(-2.35)								
Coal	2.90			0.08	0.59***	0.30***			
	(11.14)			(0.44)	(2.84)	(1.72)			
Processed minerals	0.49	-2.17***							
	(0.52)	(-2.33)							

Note: (a) *The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

5.3.4 Manufactured Goods – Leather Manufactures

Under this category, majority of the sub commodities are not cointegrated. The result as shown in Table (5.9) indicate that leather garments and leather footwear are cointegrated with other variables. But, these two variables do not have expected sign for error correction term. so, the long rung equilibrium is doubtful. The commodities like finished leather and leather goods show negative and significant error correction term even though they are not cointegrated. Table (5.10) reports the short and long run coefficient estimates of leather and leather manufactured goods. The result found that REER has a significant effect on leather and leather manufacture in general with expected sign. Also, REER has significant effect on leather footwear in specific.

Table 5.9

Cointegration and error correction Results of India's Exports

(Leather Manufactures)

Export Commodities	Export Share (%)	F Statistics	ECT_{t-1}	CI	ARDL	AIC
2C(i)leather manufactures	1.91	5.97	0.01*** (5.59)	Yes	4, 1, 0, 0	-1.90
Finished leather	0.33	2.45	-0.03*** (-3.59)	No	4, 0, 0, 0	-1.44
Leather goods	0.49	0.91	-0.04*** (-2.18)	No	1, 0, 1, 0	-0.51
Leather garments	0.18	3.61	0.04*** (4.36)	Yes	4, 0, 2, 3	-0.61
Leather Footwear	0.18	4.99	0.09*** (5.11)	Yes	4, 0, 0, 0	-1.08
Leather footwear component	0.11	3.26	0.05*** (4.152)	No	4, 0, 0, 3	-1.30
Saddlery & Harness	0.05	2.93	0.01*** (3.92)	No	4, 0, 0, 0	-1.11

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

The study finds that the present REER volatility has positive impact on export of leather garments and negative effect of lagged REER volatility.

Table 5.10

Short and Long Run Coefficient Estimates of India's Exports (Leather Manufactures)

	Short Run Coefficients						*Long Run Coefficients*		
Export Commodities	ΔlnR_t	ΔlnR_{t-1}	$\beta\Delta lnR_{t-2}$	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$	***lnREER***	***lnRV***	***lnWGDP***
2C(i) Leather manufactures	-1.01***						14.66	0.27	-1.62
	(-2.61)						(0.54)	(0.07)	(-0.37)
Leather garments	0.13	0.28		0.12***	-0.12***		3.59	-8.11	-1.47
	(0.14)	(0.31)		(2.17)	(-2.32)		(0.45)	(-0.47)	(-0.53)
Leather footwear	-1.42***	-0.07					14.05***	0.60	-0.09
	(-1.90)	(-0.09)					(5.02)	(1.17)	(-0.76)
Leather footwear component	-0.63	-0.07					0.94	-0.98	-1.11
	(-0.94)	(-0.11)					(0.16)	(-0.57)	(-0.75)
Saddlery & Harness	-0.44	-0.38							
	(-0.58)	(-0.51)							

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

5.3.5 Manufactured Goods – Chemical Manufactures

Table (5.11) shows that for chemical and related products, all the sub-category products considered under study are cointegrated. Also, all the commodities have significant coefficient for ECT_{t-1} indicating short-run adjustment with exchange rate. The speed of adjustment for the category paints and varnish (6%) is highest among the commodities and the least is dyes intermediaries and coal tar products (1%). As per the results inorganic/organic/agro chemicals does not have significant coefficient for ECT_{t-1}. Further, cosmetics and toiletries does not have negative sign for ECT_{t-1}.

Table 5.11

Cointegration and error correction Results

(Chemical & Related Products)

Export Commodities	Export Share (%)	F Statistics	ECT_{t-1}	CI	ARDL	AIC
2C(ii) Chemicals & related products	12.72	20.24	-0.02*** (-10.29)	Yes	4, 2, 1, 0	-2.69
Drugs, pharmaceuticals & fine chemicals	6.45	26.46	-0.03*** (-11.79)	Yes	4, 2, 1, 4	-2.57
Dyes intermediates & coal tar chemicals	0.75	6.47	-0.01*** (-5.86)	Yes	4, 2, 0, 4	-1.15
Paints varnishes and allied products	0.25	5.48	-0.06*** (-5.35)	Yes	4, 0, 0, 0	-1.38
Inorganic/organic/agro chemicals	3.14	7.22	-0.03 (-5.35)	Yes	4, 2, 0, 0	-1.35
Cosmetics/toiletries	0.53	6.91	0.01*** (6.03)	Yes	3, 3, 4, 4	-1.51
Residual Chemicals	1.51	3.47	-0.03*** (-4.26)	Yes	4, 0, 0, 0	-0.35

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Table 5.12

Short and Long Run Coefficient Estimates of India's Exports (Chemicals)

	Short Run Coefficients						*Long Run Coefficients*		
	ΔlnR_t	ΔlnR_{t-1}	ΔlnR_{t-2}	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$	*lnREER*	*lnRV*	*lnWGDP*
2C(ii) Chemicals & related products	-0.45***	-0.41		0.02			10.20***	2.35	0.79***
	(-1.72)	(-1.58)		(1.14)			(1.99)	(1.60)	(2.15)
Drugs, pharmaceuticals & fine chemicals	-0.90***	-0.57***		0.01			7.63	2.12	0.67***
	(-3.12)	(-1.93)		(0.41)			(1.43)	(1.54)	(1.85)
Dyes intermediates & coal tar chemicals	0.90	-1.88***					30.87	6.11	3.18
	(1.46)	(-3.01)					(0.68)	(0.48)	(0.50)
Paints varnishes and allied products	0.47	0.54					9.83***	-0.28	0.32
	(0.82)	(0.95)					(2.58)	(-0.36)	(1.45)
Inorganic/organic/agro chemicals	-0.62	-0.98***					16.69***	-0.12	0.67
	(-1.22)	(-1.88)					(1.87)	(-0.07)	(1.13)
Cosmetics/toiletries	-0.40	-0.08	-1.23***	0.04	0.26***	0.19***	-20.92	27.61	-3.45
	(-0.80)	(-0.15)	(-2.38)	(1.23)	(5.26)	(3.97)	(-0.17)	(0.32)	(-0.30)
Residual Chemicals	-0.02						18.35***	-0.01	0.35
	(-0.02)						(1.80)	(-0.01)	(0.63)

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

Table (5.12) reports short & long-run coefficient estimates of export of chemicals manufactures. The results show that chemical and related products have short-run effects in relation to REER and the sub-category drug and pharmaceuticals also has significant impact with respect to REER. REER volatility does not have short and long-run impact on export of chemical and related products except cosmetics and toiletries. Further, study also found significant effect of few of chemical related products with exchange rate in the long-run but not with expected sign.

5.3.6 Manufactured Goods – Engineering Goods

Under this category, the study has mixed results with respect to cointegration. The commodities like export of ferrous & non-ferrous metals, manufactures of metals, machine tools, machinery and instruments, transport equipment and engineering goods in general are cointegrated. Few of the commodities do not have negative and significant ECT_{t-1}. The speed of adjustment is high for machine tools (6%) and least for machinery instruments (1%) as per the Table (5.13).

As per the Table (5.14), engineering goods in general, and the sub commodities like, iron & steel, manufactures of metals, iron & steel / rods, primary & semi-finished iron & steel, have significant effect with expected sign in relation to REER.

Table 5.13:

Cointegration and error correction Results of India's Exports

(Engineering Goods)

Export Commodities	Export Share (%)	F Statistics	ECT_{t-1}	CI	ARDL	AIC
2C(iii) Engineering goods	22.38	9.57	0.00^{***} (7.08)	Yes	4, 2, 0, 0	-1.73
Iron and steel	3.04	2.22	-0.02^{***} (-3.41)	No	4, 2, 0, 4	-0.02
Iron & Steel Bars/rods		2.27	0.05^{***} (3.47)	No	3, 0, 4, 2	-0.21
Primary & Semi finished Iron a& Steel		2.17	-0.06^{***} (-3.38)	No	4, 0, 0, 0	0.24
Ferro alloys		2.64	-0.04^{***} (-3.73)	No	2, 0, 0, 0	0.81
Ferrous and non-ferrous metals	5.12	7.40	0.02^{***} (6.23)	Yes	4, 0, 0, 4	-0.96
Manufactures of metals		7.97	0.00^{***} (6.49)	Yes	4, 2, 0, 0	-1.63
Machine tools	0.14	8.13	-0.06^{***} (-6.53)	Yes	4, 0, 1, 4	-1.01
Machinery & instruments	5.99	13.30	-0.01^{***} (-8.35)	Yes	4, 0, 1, 4	-2.29
Transport equipment	7.12	6.49	0.00^{***} (5.83)	Yes	4, 0, 0, 1	-0.43
Project goods		1.27	-0.26^{***} (-3.14)	No	4, 0, 1, 0	-0.43

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

The export share of few commodities under engineering goods categories in Table (5.13) are not available.

Table 5.14
Short and Long Run Coefficient Estimates of India's Exports
(Engineering Goods)

	Short Run Coefficients							*Long Run Coefficients*		
	ΔlnR_t	ΔlnR_{t-1}	ΔlnR_{t-2}	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$	$\Delta ln\ RV_{t-3}$	*lnREER*	*lnRV*	*lnWGDP*
Cointegrated										
2C(iii) Engineering goods	-0.92***	-1.03***						91.74	-1.22	-14.45
	(-2.18)	(-2.39)						(0.29)	(-0.09)	(-0.24)
Manufactures of metals	-1.21***	-0.98***						45.83	2.27	-2.13
	(-2.55)	(-1.99)						(1.65)	(0.83)	(-1.10)
Machine tools	0.97			0.12***	0.10***	0.09***		12.21***	1.70	1.01***
	(1.41)			(1.84)	(1.66)	(1.82)		(-2.84)	(1.39)	(1.98)
Machinery & instruments	-0.54							-45.53	10.11	8.55
	(-1.53)							(-0.44)	(0.65)	(0.61)
Transport equipment	-1.27							96.14	-21.28	-12.39
	(-1.35)							(0.17)	(-0.13)	(-0.14)
Not Cointegrated										
Iron and steel	-1.07	-2.38***								
	(-1.21)	(-2.61)								
Iron & Steel Bars/rods	-0.08	-2.04***		0.08	0.53***	0.46***	0.27***			
	(-0.08)	(-1.78)		(1.02)	(1.02)	(4.32)	(3.54)			
Primary & Semi finished Iron a& Steel	-2.01	-2.49***			0.41***	0.24***				
	(-1.56)	(-1.84)			(2.40)	(1.69)				
Ferro alloys	0.26				-0.41***					
	(0.14)				(-1.69)					
Project goods	0.11***									
	(0.48)									

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

The study also found only one category, i.e. machine tools having long run effect in relation to REER but with positive sign. Further, the study found that, few commodities like exports of Machine tools, iron & steel bars, primary & semi-finished iron & steel have positive effect with respect to volatility in the short-run. However, ferro alloy product has negative effect with respect to REER volatility in short-run.

5.3.7 Manufactured Goods – Textiles

Table (5.15) provides the results of cointegration and error correction of textiles goods. Under this category, yarn fabrics made-up, coir and coir manufactures, are found to be cointegrated. Further, these categories ECT_{t-1} is negative and significant. The speed of adjustment is very high for coir and coir manufactures (16%) and least for manmade staple fibre (1%).

Table 5.15
Cointegration and error correction Results of India's Exports (Textiles Goods)

Export Commodities	Export Share (%)	F Statistics	ECT_{t-1}	CI	ARDL	AIC
2C(v) Textiles (excluding readymade garments)	6.02	4.69	-0.03*** (0.01)	Yes	2, 1, 1, 1	-2.20
Yarns, fabrics, madeups	4.97	5.30	-0.04*** (-5.26)	Yes	2, 1, 1, 1	-2.13
Jute manufacture including floor coverings	0.12	2.91	-0.12*** (-3.90)	No	4, 2, 0, 0	0.40
Carpets	0.01	1.92	0.06*** (3.16)	No	4, 0, 0, 1	-0.96
Other textiles excl. RMG	0.35	2.97	-0.02*** (-3.94)	No	4, 0, 0, 0	-0.52
Coir & coir manufactures	0.11	4.35	-0.16*** (-4.79)	Yes	4, 2, 4, 4	-0.19
Manmade staple fibre	0.23	1.29	-0.01*** (-2.59)	No	3, 0, 0, 0	0.58

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Table 5.16

Short and Long Run Coefficient Estimates of India's Exports

(Textiles Goods)

	Short Run Coefficients						*Long Run Coefficients*		
	ΔlnR_t	ΔlnR_{t-1}	ΔlnR_{t-2}	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$	*lnREER*	*lnRV*	*lnWGDP*
Cointegrated									
2C(v) Textiles (excluding readymade garments)	-0.72***			-0.04***			9.84***	0.14	0.14
	(-2.11)			(-2.02)			(1.84)	(0.10)	(0.53)
Coir & coir manufactures	-0.16	-1.60		-0.19***	-0.36***	-0.36***	13.27***	1.25	0.25
	(-0.16)	(-1.53)		(-2.74)	(-3.45)	(-3.67)	(4.75)	(1.14)	(1.31)
Not Cointegrated									
Yarns, fabrics, madeups (cotton/natural silk/manmade/wollen	-0.57	-0.03***							
	(-1.61)	(-1.71)							
Jute manufacture including floor coverings	-1.00	-3.74***							
	(-0.83)	(-2.88)							
Carpets	-0.96	-1.00	-1.41***						
	(-1.35)	(-1.37)	(-1.92)						
Other textiles (excluding garments)	0.14			-0.13***					
	(0.15)			(-2.19)					
manmade staple fibre	0.40								
	(0.25)								

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

The table (5.16) provides the long and short run coefficient estimates of textiles goods. Under this category, yarn fabrics madeups, jute manufactures and carpets have significant effect in relation to REER. Further, coir and coir manufactures, other textiles excluding garments, have negative effect in relation to REER volatility in short run.

5.3.8 Manufactured Goods – Readymade Garments

Table (5.17) reports the results of cointegration and error correction estimates of readymade garments exports. Under this category majority of the readymade garments components are cointegrated except RMG of silk. Results also indicate negative and significant ECT_{t-1} for majority of the items. The speed of adjustment is high for RMG of silk and least for RMG of other textiles materials.

Table 5.17
Cointegration and error correction Results of India's Exports
(Readymade Garments Goods)

Export Commodities	Export Share (%)	F Statistics	ECT_{t-1}	CI	ARDL	AIC
2C(vi) Readymade garments	5.88	8.62	-0.01*** (-6.72)	Yes	4, 1, 0, 0	-1.52
RMG of cotton incl. accessories	2.85	7.91	-0.03*** (-6.43)	Yes	4, 0, 0, 1	-1.38
RMG of silk	0.07	1.44	-0.08*** (2.74)	No	4, 0, 0, 0	-0.05
RMG of manmade fibres	1.77	5.24	0.00*** (5.24)	Yes	4, 1, 0, 0	-0.98
RMG of wool	0.07	3.72	-0.06*** (-4.41)	Yes	4, 0, 0, 0	0.24
RMG of other textile materials	1.11	6.01	-0.01*** (-5.61)	Yes	4, 1, 1, 0	-0.87

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Table (5.18) provide the results of short and long run estimates of export of RMG. From the results RMG in general, RMG of silk, RMG of other textile materials found significant effect in relation to REER. Also, RMG of silk and RMG of other textile materials has effect of REER volatility in the short run. In long run none of the coefficients are significant.

Table 5.18

Short and Long Run Coefficient Estimates of India's Exports

(Readymade Garments Goods)

	Short Run Coefficients						*Long Run Coefficients*		
	ΔlnR_t	ΔlnR_{t-1}	ΔlnR_{t-2}	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$	*lnREER*	*lnRV*	*lnWGDP*
Cointegrated									
2C(vi) Readymade garments	-1.13***						-11.73	3.57	-0.74
	(-2.44)						(-0.24)	(0.43)	(-0.45)
RMG of cotton incl. accessories							-13.15	1.39	-0.17
							(-0.61)	(0.75)	(-0.44)
RMG of manmade fibres	-1.01						-46.48	-13.98	2.61
	(-1.65)						(-0.16)	(-0.19)	-0.19
RMG of wool							-18.23	0.29	0.38
							(-0.86)	(-0.18)	(0.81)
RMG of other textile materials	-1.16***			0.07***			110.43	74.61	4.93
	(-1.79)			(2.03)			(0.15)	(0.13)	(0.12)
Not Cointegrated									
RMG of Silk	-0.25	2.03***	2.06***	0.15***					
	(-0.22)	(1.74)	(1.79)	(1.93)					

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

5.3.9 Other Manufactured Goods

The cointegration and ECT_{t-1} estimates of other manufactured goods are provided in the table (5.19). Majority of the commodities under this category are cointegrated with REER, REER Volatility and World GDP. The commodities like handicrafts, footwear of rubber do not show cointegration among variables. The ECT_{t-1} of majority of the commodities are negative and significant. The speed of adjustment is high for computer software in physical form (45%) and least for glass/glass ware & ceramic products (1%).

Table 5.19

Cointegration and error correction Results of India's Exports

(Other Manufactured Goods)

Export Commodities	Export Share (%)	F Statistics	ECT_{t-1}	CI	ARDL	AIC
2(vii) Other manufactured goods	21.29	9.00	0.00*** (6.87)	Yes	4, 1, 3, 0	-1.71
Handicrafts	0.58	0.85	-0.02*** (-2.11)	No	4, 0, 2, 1	0.69
Sports goods	0.07	5.103	-0.08*** (-5.16)	Yes	4, 0, 1, 0	-1.03
Rubber manufactured products	0.91	6.67	-0.02*** (-5.92)	Yes	4, 3, 1, 0	-1.63
Footwear of rubber/canvas etc.	0.11	2.946	0.05*** (3.93)	No	4, 0, 4, 1	0.46
2C(vii)a. Gems & jewellery	14.89	7.532	0.01*** (6.28)	Yes	4, 1, 3, 0	-1.28
Glass/glassware/ceramics/refractories/cement	0.79	4.83	-0.01*** (-5.02)	Yes	4, 0, 0, 0	-1.42
Paper/wood products	0.73	4.65	-0.03*** (-4.93)	Yes	4, 0, 0, 0	
Plastic & linoleum products	1.62	3.25	-0.04*** (-4.12)	Yes	3, 0, 1, 0	-1.03
Computer software in physical form		10.03	-0.45*** (-7.28)	Yes	2, 0, 1, 4	1.71

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Table 5.20

Short and Long Run Coefficient Estimates of India's Exports

(Other Manufactured Goods)

	Short Run Coefficients							*Long Run Coefficients*		
	ΔlnR_t	ΔlnR_{t-1}	ΔlnR_{t-2}	$\Delta lnRV_t$	$\Delta lnRV_{t-1}$	$\Delta ln\ RV_{t-2}$	$\Delta ln\ RV_{t-3}$	*lnREER*	*lnRV*	*lnWGDP*
Cointegrated										
2C(vii) Other manufactured goods	-1.27***			0.04	0.18***	0.13***		17.30	19.38	-0.47
	(-2.93)			(1.42)	(5.09)	(4.25)		(-0.41)	(-0.28)	(-0.18)
Sports goods	0.05							6.91**	1.48*	-0.10
	(1.29)							(2.27)	(1.69)	(-0.71)
Rubber manufactured products	-0.48	-0.27	-1.19***	0.01				22.64**	2.78	1.03
	(-1.08)	(-0.61)	(-2.52)	(0.48)				(2.16)	(0.93)	(1.12)
2C(vii)a. Gems & jewellery	-1.46***			0.06	0.22***	0.16***		13.08	24.02	0.28
	(-2.72)			(1.61)	(5.005)	(4.19)		(-0.29)	(-0.24)	(-0.11)
Glass/glassware/ceramics/refractories/cement								-7.45	8.78	0.76
								(-0.16)	(0.54)	(0.41)
Paper/wood products	0.23			0.00				6.93	0.09	0.17
	(0.69)			(0.07)				(-0.88)	(-0.07)	(-0.52)
Plastic & linoleum products				-0.06*				5.54	0.85	0.36
				(-1.69)				(0.73)	(0.47)	(1.03)
Computer software in physical form				0.36**				5.37*	3.11***	0.35*
				(2.12)				(1.93)	(4.08)	(2.12)
Not Cointegrated										
Handicrafts	-0.69			0.13	-0.22**					
	(-0.42)			(1.33)	(-2.22)					
Footwear of rubber/canvas etc.	-1.31			0.14	-0.47***	-0.34***	-0.30***			
	(-0.89)			(1.48)	(-2.82)	(-2.45)	(-3.13)			

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

The results of short and long run estimates of other manufactured goods are stated in Table (5.20). The study found that other manufactured goods in general and gems and jewellery in particular found significant effect in relation to REER. Further, REER volatility has positive impact with respect to gems and jewellery and other manufactured goods in general. It is also evident from the Table (5.20) that REER volatility has negative effect towards handicrafts, footwear of rubber/canvas.

5.3.10 Diagnostic Analysis

The diagnostic results of export sub-categories are reported in Table (5.21). The autocorrelation for export of agriculture and allied products is tested through Lagrange Multiplier (LM) statistics which follows Chi-square distribution with 2 degrees of freedom having a critical value of 5.99. The result indicate that majority of the model do not have autocorrelation problem except marine products, processed fruits & juice and Basmati Rice, these products' LM statistics exceeds the Chi-Square critical value. Table (5.21) also reports Ramsey RESET statistics. This test is used for evaluating the specification of the model. The results indicate that all the models are correctly specified. The parameter stability given by Cusum and Cusum Square indicate that majority of the models are stable. Further, all the models have good explanatory power as revealed by reasonably good adjusted R Square value.

The results of export of ores and minerals are reported in Table (5.21). It is found that except ores and minerals rest all the models are free from autocorrelation problem as the LM statistics do not exceed the chi-square critical value of 5.99. Model is adequately specified as reported by Ramsey RESET Test statistic. The parameters are stable as given by Cusum and Cusum Square Test. The explanatory power of the model is good as given by adjusted R Square. The diagnostic results of chemical products are shown in Table (5.21). The autocorrelation results indicated by LM statistics reveals that the models do not have auto

correlation problem. Also, the results of Ramsey RESET indicate that all the models are adequately specified. The parameters are stable as reported by Cusum and Cusum Square. Finally, all the models have good explanatory power as given by adjusted R Square.

The diagnostic results of exports of engineering goods are given in Table (5.21). Except transport equipment, rest of all the commodities are free from autocorrelation problem as given by LM statistics. Results pertaining to Ramsey RESET shows that model is correctly specified. Parameters are stable as given by Cusum and Cusum Square. The models have reported moderate adjusted R Square.

Further, diagnostic results of exports of textiles goods are given in Table (5.21). All the commodities are free from autocorrelation problem as given by LM statistics. The result of Ramsey RESET reveals that model is correctly specified. Majority of the parameter are stable as given by Cusum and Cusum Square. The models have reported moderate adjusted R Square.

The diagnostic results of exports of RMG goods are given in Table (5.21). Most of the commodities are not free from autocorrelation problem as given by LM statistics. Ramsey RESET shows that model is correctly specified. Majority of the parameters are stable as given by Cusum and Cusum Square. The models have reported moderate adjusted R Square.

The diagnostic results of exports of other manufactured goods are given in Table (5.21). All the commodities are free from autocorrelation problem as given by LM statistics. As per the Ramsey RESET model is correctly specified. Majority of the parameter are stable as given by Cusum and Cusum Square. The models have reported moderate adjusted R Square.

Table 5.21

Diagnostic Analysis of India's Exports

Export Commodities	LM	RS	C	CS	$\bar{R}^2$	Export Commodities	LM	RS	C	CS	$\bar{R}^2$
Agricultural & allied products	2.87	0.75	S	S	0.48	Pulses	0.41	1.30	S	S	0.26
Cashew	1.19	0.22	S	S	0.19	Rice	3.03	0.35	S	S	0.24
Cashewnut shell liquid	1.33	0.85	S	S	0.33	Basmati rice	11.46	0.92	S	S	0.44
Castor Oil	3.29	1.45	S	S	0.41	Shellac	0.00	0.18	S	S	0.23
Coffee	2.29	1.75	S	S	0.72	Spices	0.11	1.18	S	S	0.31
Cotton raw including waste	0.74	9.72	S	S	0.41	Alcoholic beverages	1.52	1.19	S	S	0.07
Floriculture products	0.73	0.07	S	S	0.53	Sugar & molasses	0.30	0.31	S	S	0.22
Fresh fruits	1.18	0.01	S	S	0.83	Tea	5.43	0.70	S	S	0.70
Fresh vegetables	0.49	0.63	S	S	0.39	Tobacco manufactured	0.50	0.15	S	S	0.30
Fruits & Vegetable Seeds	0.41	0.02	S	US	0.62	Tobacco unmanufactured	4.78	0.27	S	S	0.32
Groundnuts	0.22	11.16	US	S	0.30	Wheat	5.59	0.04	US	S	0.23
Guargum meal	2.41	0.02	S	S	0.17	**Ores & minerals**	7.21	3.11	S	S	0.25
Marine products	28.21	1.87	S	S	0.66	Iron ore	3.05	0.50	S	S	0.12
Meat & preparations	0.61	0.003	S	S	0.38	Mica	0.71	0.54	S	S	0.38
Misc processed items	0.04	3.13	S	US	0.18	Coal	0.49	0.71	S	S	0.78
Oil meals	5.22	0.63	S	S	0.63	Processed minerals	0.03	2.32	S	S	0.29
Oil seeds	0.82	0.48	S	S	0.50	Other ores & minerals	0.23	0.06	S	S	0.34
Sesame and Niger Seeds	0.08	0.71	S	S	0.51	**Manufactured goods**	8.01	3.68	S	S	0.54
Poultry and dairy products	2.97	0.17	S	S	0.20	**Leather & leather manufactures**	23.10***	0.07	S	S	0.49
Poultry Products	1.13	1.04	S	S	0.32	Finished leather	1.61	0.05	S	S	0.16
Dairy Products	2.03	0.75	S	S	0.34	Leather goods	1.14	0.42	S	S	0.04
Processed fruits and juices	22.49	0.49	S	S	0.62	Leather garments	23.79***	0.01	S	S	0.73
Processed vegetables	4.06	1.90	S	S	0.35						

*Note: (a) LM=Lagrange Multiplier test of residual serial correlation. (b) RS = Ramsey RESET test for functional form. (c) C=Cusum sum of residuals; S= "stable"; US= "unstable" (d) CS= Cumulative sum of squared residuals; S="stable"; US="unstable" (e) *** significant at 1%, ** at 5%, * at 10% (f)* $\bar{R}^2$ = Adjusted R Square

Table 5.21 (Continued)

Diagnostic Analysis of India's Exports

Export Commodities	LM	RS	C	CS	$\bar{R}^2$	Export Commodities	LM	RS	C	CS	$\bar{R}^2$
Leather footwear	22.66***	1.16	S	US	0.64	**Textiles (excluding RMG)**	1.02	0.35	US	S	0.26
Leather footwear component	9.11	0.56	S	S	0.32	Yarns, fabrics, made-up	0.25	0.58	S	S	0.27
Saddlery & Harness	4.55	0.52	S	S	0.13	Jute manufacture	0.21	0.87	S	US	0.30
Chemicals & related products	5.74	0.14	S	S	0.43	Carpets	1.17	0.59	S	S	0.29
Drugs & pharmaceuticals	1.45	0.07	S	S	0.54	Other textiles excl. RMG	7.59	0.28	S	US	0.59
Dyes intermediates & coal tar	0.52	0.59	S	US	0.42	Coir & coir manufactures	0.18	0.05	S	S	0.30
Paints varnishes and allied	1.70	0.79	S	S	0.29	Manmade staple fibre	2.20	0.01	S	S	0.17
Inorganic/organic/agro	1.83	0.15	S	S	0.18	**Readymade garments**	15.51***	0.78	S	S	0.55
Cosmetics/toiletries	1.94	2.22	S	S	0.34	RMG of cotton incl. accessories	21.53***	0.70	S	S	0.61
Residual Chemicals	1.19	0.80	S	S	0.08	RMG of silk	1.12	0.02	S	US	0.30
Engineering goods	0.09	0.64	S	S	0.32	RMG of manmade fibres	13.54***	0.58	S	S	0.31
Iron and steel	4.06	0.77	S	S	0.23	RMG of wool	14.45***	0.87	US	S	0.68
Iron & steel bar/rods	1.85	1.16	S	S	0.21	Other Readymade garments	0.15	0.04	S	S	0.35
Primary & semi-finished I&S	7.05	1.52	S	S	0.16	**Other manufactured goods**	0.28	1.00	S	S	0.68
Ferro alloys	1.26	3.01	S	S	0.16	Handicrafts	2.73	4.22	S	US	0.32
Ferrous and non-ferrous metals	2.17	0.04	S	US	0.36	Sports goods	4.59	1.63	S	S	0.35
Manufactures of metals	5.23	0.01	S	S	0.25	Rubber manufactured products	0.02	2.54	S	S	0.23
Machine tools	2.93	1.16	S	S	0.43	Footwear of rubber/canvas etc.	6.85	0.49	US	US	0.24
Machinery & instruments	3.16	0.0003	S	S	0.35	Glass/glassware/ceramics	2.81	1.66	US	US	0.12
Transport equipment	9.25***	2.45	S	S	0.36	Paper/wood products	5.64	0.52	S	US	0.13
Project goods	0.30	0.29	S	S	0.50	Plastic & linoleum products	1.12	0.01	S	S	0.14
Electronic goods	0.17	0.26	S	S	0.25	Computer software in physical form	3.75	0.05	S	US	0.46

*Note: (a) LM=Lagrange Multiplier test of residual serial correlation. (b) RS = Ramsey RESET test for functional form. (c) C=Cusum sum of residuals; S="stable"; US="unstable" (d) CS= Cumulative sum of squared residuals; S="stable"; US="unstable" (e) *** significant at 1%, ** at 5%, * at 10% (f)* $\bar{R}^2$ = Adjusted R Square

List of exports commodities effected by REER having expected negative sign in short-run is reported below. Whereas, REER does not have impact in the long-run. The changes in real effective exchange rate have desired results on the following export commodities in short-run:

- Agricultural & allied products
- Cashew
- Coffee
- Floriculture products
- Fruits/vegetable seeds
- Misc. processed items
- Processed fruits and juices
- Rice
- Shellac
- Spices
- Alcoholic beverages
- Tea
- Tobacco manufactured
- Tobacco unmanufactured
- Wheat
- Ores & minerals
- Processed minerals
- Other ores & minerals
- Leather & leather manufactures
- Footwear of leather
- Chemicals & related products
- Drugs, pharmaceuticals & fine chemicals
- Dyes intermediates & coal tar chemicals
- Inorganic/organic/agro chemicals
- Cosmetics/toiletries
- Engineering goods
- Iron and steel
- Iron & steel bar/rods
- Primary & semi-finished iron & steel
- Manufactures of metals
- Textiles (excluding readymade garments)
- Readymade garments
- Other manufactured goods
- Rubber manufactured products
- Gems & jewellery

The positive and negative effect of REER volatility on export commodities in short-run is listed below:

Positive

- Oil meals
- Spices
- Ores & minerals
- Leather garments
- Cosmetics/toiletries
- Iron & steel bar/rods
- Primary & semi-finished iron & steel
- Machine tools
- RMG of silk
- RMG of other textile materials
- Other manufactured goods
- Gems & jewellery
- Computer software in physical form

Negative

- Cotton raw including waste
- Meat & preparations
- Oil meals
- Poultry products
- Spices
- Alcoholic beverages
- Tobacco unmanufactured
- Other ores & minerals
- Leather garments
- Ferro alloys
- Textiles (excluding readymade garments)
- Coir & coir manufactures
- Handicrafts excluding handmade carpets
- Footwear of rubber/canvas etc.
- Plastic & linoleum products

In the long-run REER volatility has positive effect on cotton raw, oil meals and computer software in physical form. There is no long-run negative effect of REER volatility.

5.4 Chapter Summary

From the analysis study establishes that most of the major export categories have long-run relation with REER and REER volatility. The results of sub-category reveals that majority of the export commodities in agriculture & allied, chemical, engineering goods, readymade goods and other manufactured goods categories have long-run relation with REER and REER volatility. Further, REER and REER volatility have significant short-run impact on many of the major export categories but the short run volatility effect is positive. REER volatility do not show any long-run effect. The study found that majority of the sub-category commodities are effected by REER in the short run. Most of the commodities under agriculture & allied and textile categories are negatively affected by REER volatility. However, mixed results of positive and negative effect of REER volatility are witnessed in case of leather garments and other manufactured goods. Approximately 40% of the sub-commodities are affected by REER volatility in the short-run. The long-run impact of REER and REER volatility on export of sub-commodities are negligible.

CHAPTER VI

EXCHANGE RATE VOLATILITY AND INDIA'S IMPORTS

CHAPTER VI

EXCHANGE RATE VOLATILITY AND INDIA'S IMPORTS

6.1 Introduction

In today's globalised world, consumers are getting all kinds of products which is produced in any corner of the world in their local market. Currently, the basket of goods contains large quantity of imports which provide numerous choices to the consumers within the limited budget. However, too many imports coming to a country in relation to export can distort balance of trade. It is a fact that positive net export will contribute to the growth. In practice, more exports indicate additional output from industries with high employment leading to the inflow of funds into the economy which contribute to economic growth. On the other hand, excessive imports are a hindrance to economic progress. In reality, import leads to outflow of funds from a country and drain of forex reserves. Nevertheless, imports per se not necessarily detrimental to economic growth. In fact, it is avital component. Large imports are an indication of increasing domestic demand for a growing economy. If the imports are in the nature of capital assets it will contribute to the productive capacity of the economy in the long run. In general, for a healthy economy it can be observed that both exports and imports are important.

Theoretically, excessive imports are adjusted either through depreciation or devaluation. When currency depreciates, import becomes costlier thereby reducing the volume of imports. Though over the years' Indian rupee has depreciated against major currencies, imports have surged. At the international level many studies already analysed the contradictory nature of imports in relation to exchange rate. However, there is no unanimous opinion for the undue increase in imports even after depreciation. The general notion is that; the macroeconomic fundamentals by and large influences the flow of imports. India being a fastest growing economy has excessive imports from the rest of the world.

The present study in this chapter, examines the influence of exchange rate volatility on the aggregate and disaggregated imports of commodities of India with rest of the world.

6.2 Methodology

To estimate the impact of REER and REER volatility on the imports of India, the study employs ARDL approach to cointegration. In ARDL approach pre-testing of unit root is not essential as the model can test the existence of cointegration between a set of variables of order I(0) and I(1) or a combination of both. The following is the specification of the model to achieve the said objective.

$$\Delta lnIm_t = \alpha_0 + \sum_{j=1}^{n4} \beta_j \Delta lnIm_{t-1} + \sum_{j=0}^{n4} \gamma_j \Delta lnR_{t-j} + \sum_{j=0}^{n4} \delta_j \Delta lnRV_{t-j} \sum_{j=0}^{n4} k_j \Delta lnIgdp_{t-j}$$
$$+ \theta_1 lnIm_{t-1} + \theta_2 lnR_{t-1} + \theta_3 lnRV_{t-1} + \theta_4 lnIgdp_{t-1} + \varepsilon_t$$

Where,

Im = Import value of commodity of India

R = Real Effective Exchange Rate of India

RV = REER Volatility

Igdp = India Gross Domestic Product

The optimum lags of various variables in the ARDL model is determined by using Akaike Information Criterion (AIC).

Hypotheses

In the above ARDL import model specification θ_1, θ_2, θ_3 and θ_4 are the long run coefficients. While β_j, γ_j, δ_j and k_j are the short-run coefficients. The cointegration among the variables is tested through the following hypothesis:

H_0: $\theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ (There is no long-run relation among Im, R, RV and Igdp)

H_1: $\theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq 0$ (There is a long-run relation among Im, R, RV and Igdp)

In order to assess the impact of exchange rate fluctuations on the India's export the study used 36 Currency REER index as one of the independent variable. The following hypothesis are tested:

Imports:

H_0: $\beta = 0$ (Increase in REER has no effect on Import).

H_1: $\beta > 0$ (Increase in REER has a positive effect on Import).

H_0: $\delta = 0$ (REER Volatility has no effect on Import).

H_1: $\delta \neq 0$ (REER Volatility has an effect on Import).

To ensure the robustness of the results the study employs structural stability tests on the parameters of the long-run results based on the cumulative sum of recursive residuals (CUSUM) and cumulative sum of recursive residuals of squares. They are the graphical representation to assess the stability of the parameter coefficient at a given significant level of percentage. If the plots of the CUSUM and CUSUMSQ remain with the given percentage of significance level, it would signify the parameter consistency and the model stability, which in turn means that there is no systematic change identified in the coefficients at given significance level over the study period.

6.3 Empirical Analysis

The study follows CMIE (Centre for monitoring Indian Economy) categorisation of major and sub-category imports as indicated in different tables in this chapter. Further, the study has not considered the sub-category of all major-categories of import due to less number of observations and non-availability of data. As such the study is limited to certain commodities. The gold & silver being one of the major import has been taken out from the

sub-category and shown in the major category. It is to be noted that the coefficients of only relevant parameter are estimated by the software output based on model selection criteria. Therefore, there are blank spaces in the result table.

6.3.1 Analysis of Import of Major Categories

To analyse the relation between imports and its sub category commodities with REER and REER volatility, the study employs ARDL Bound Testing procedure. The results of cointegration and Error Correction are shown in the Table (6.1) for main import commodities.

As per the results given in Table (6.1), India's total imports and most of the major import categories are having long-run relation with REER and REER volatility, i.e., cointegrated. The categories like petroleum crude & product, ores & minerals and leather manufactures having total share of 21.5%, 5.74% and 0.24% in total imports respectively, are not cointegrated, i.e., do not have long-run relation with respect to REER and REER volatility.

The model output exhibit ECT_{t-1} is negative and significant indicating that there is a short-run adjustment among the variables except other manufactured goods. Speed of adjustment is high for gold & silver (28%) and least for petroleum & crude products (2%). According to the Table (6.2) REER do not have significant result with expected sign in short-run. At the same time few commodities have shown significant but negative sign. Volatility has a negligible impact on import commodities in the short-run. In case of agriculture & allied changes in present REER is impacting positively while past REER has negative impact. Petroleum crude & products, ores & minerals and other manufactured goods are having positive effect of REER volatility. In the long-run, study reveals that changes in REER has significant effect for few commodities with expected sign like agriculture & allied,

manufactured goods total, chemical, engineering, electronic, textiles and readymade garments. However, the REER volatility has minimal effect in the long-run.

Table 6.1

Cointegration and Error Correction Results of India's Imports

Import Commodities	Share (%)	F Statistics	ECT	CI	ARDL	AIC
Total	100	4.89	-0.01*** (-5.07)	Yes	4,3,0,1	-2.14
1. Petroluem : crude and products	21.5	1.85	-0.02*** (-3.11)	No	3,0,0,3	-0.95
2. Non-POL : Total	78.5	10.66	-0.05*** (-7.47)	Yes	4,2,0,0	-2.18
2A. Agricultural and allied products	6.98	6.04	-0.23*** (-5.64)	Yes	3,4,4,2	-0.51
2B. Ores & minerals	5.74	2.31	-0.05*** (-3.48)	No	3,0,0,1	-0.62
2C. Manufactured goods : Total	62.2	17.02	-0.08*** (-9.45)	Yes	4,2,0,1	-1.73
2C(i). Leather manufactures	0.24	3.04	-0.17*** (-3.99)	No	2,1,0,3	-0.76
2C(ii). Chemicals & related products	8.24	6.17	-0.07*** (-5.69)	Yes	4,2,0,3	-0.95
2C(iii). Engineering goods	19	17.24	-0.06*** (-9.51)	Yes	4,2,0,0	-1.47
2C(iv). Electronic goods	11.8	30.74	-0.08*** (-12.71)	Yes	4,2,0,1	-1.71
2C(v). Textiles (excluding RMG)	0.89	9.04	-0.08*** (-6.89)	Yes	4,1,0,4	-1.47
2C(vi). Readymade garments (RMG)	0.14	4.96	-0.03*** (-5.15)	Yes	4,2,0,2	0.09
2C(vii). Other manufactured goods	21.9	5.33	-0.09*** (-5.29)	Yes	4,0,0,1	-0.62
2C(vii)(a). Gold & silver	10.3	4.26	-0.28*** (-4.72)	Yes	1,0,0,3	0.84
2D. Other commodities	3.63	4.23	-0.13*** (-4.71)	Yes	4,1,2,0	-0.55

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Table 6.2

Short and Long Run Coefficient Estimates of India's Imports

	Short-run Coefficients								*Long Run Coefficients*		
	ΔlnR_T	ΔlnR_{T-1}	ΔlnR_{T-2}	ΔlnR_{T-3}	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	$\Delta lnRV_{T-2}$	$\Delta lnRV_{T-3}$	*lnR*	*lnRV*	*lnIGDP*
Cointegrated Total	-0.65***	-0.5	0.79***						12.77	3.18	-0.85
	(-1.88)	(-1.47)	(2.24)						(0.65)	(0.56)	(-0.21)
2. Non-POL : Total	-0.31	-0.7***							10***	0.96***	0.82***
	-0.92	(-2.08)							(2.65)	(1.61)	(2.30)
2A. Agricultural and allied products	0.18	-1.17	-2.05***	-1.21	0.03	-0.31***	-0.32***	-0.19***	8.18***	0.95	1.03***
	(0.22)	(-1.41)	(-2.51)	(-1.46)	(0.55)	(-3.77)	(-3.93)	(-3.07)	(3.13)	(1.38)	(4.59)
2C. Manufactured goods : Total	0.313	-1.01***							18.11***	0.68	-0.27
	(0.71)	(-2.32)							(3.21)	(1.45)	(-0.4)
2C(ii) Chemicals & related products	-0.82	-1.77***							20.03***	0.45	-0.34
	(-1.21)	(-2.67)							(2.09)	(0.66)	(-0.33)
2C(iii) Engineering goods	0.01	-1.27***							28.67***	0.74	-1.34
	(0.01)	(-2.50)							(2.85)	(1.16)	(-1.19)
2C(iv) Electronic goods	-0.68	-0.84***							12.96***	0.26	0.36
	(-1.55)	(-1.91)							(3.14)	(0.62)	(0.62)

Table 6.2 (continued)

	ΔlnR_T	ΔlnR_{T-1}	ΔlnR_{T-2}	ΔlnR_{T-3}	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	$\Delta lnRV_{T-2}$	$\Delta lnRV_{T-3}$	lnR	lnRV	lnIGDP
2C(v) Textiles (excluding RMG)	-0.23								11.13	0.28	0.02
	(-0.46)								(2.09)***	(0.59)	(0.03)
2C(vi) Readymade garments	-0.33	-3.43***							92.44	-5.86	-6.89
	(-0.26)	(-2.58)							(0.4)	(-0.37)	(-0.27)
2C(viii) Other manufactured goods	0.97				0.11***				7.68	1.4***	0.59
	(1.13)				(2.01)				(1.43)	(1.72)	(0.78)
2D.Non-POL : Other commodities	-1.53***				0.03				5.39	1.33	1.15***
	(-2.02)				(0.70)				(1.61)	(1.63)	(3.68)
2C(viii) Gold & silver	2.19								2.12	0.36	2.14***
	(1.23)								(0.65)	(0.83)	(6.33)
Not Cointegrated											
1. Petroleum : crude and products	-0.69				-0.01	0.15***					
	(-0.98)				(-0.12)	(2.05)					
2B. Ores & minerals	0.11				0.02	0.14***					
	(0.15)				(0.33)	(1.89)					
2C(i) Leather manufactures	-1.41***										
	(-1.99)										

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

The diagnostic results are reported in Table (6.3). The LM statistics show that except the categories of leather manufacture and electronic goods, other major imports do not have autocorrelation problem. Ramsey RESET statistics show that all the import model are correctly specified. In case of Cusum and Cusum Square except few, all commodities parameters are found to be stable. Models have good explanatory power as given by adjusted R square.

Table 6.3

Diagnostic Checking: India's Major-Category Imports

Import Commodities	LM	RS	C	CS	$\bar{R}^2$
Total	2.65	11.08	S	US	0.24
Petroluem : crude and products	1.06	1.81	S	S	0.15
Non-POL : Total	5.46	7.17	S	S	0.26
Agricultural and allied products	1.5	0.46	S	S	0.47
Ores & minerals	3.72	2.03	S	S	0.14
Manufactured goods : Total	16.22	0.12	US	S	0.5
Leather & leather manufactures	5.94	0.46	S	S	0.39
Chemicals & related products	14*	0.23	US	S	0.5
Engineering goods	22.77	3.08	S	S	0.53
Electronic goods	11.73*	0.17	S	S	0.6
Textiles (excluding readymade garments)	9.99	0.01	US	US	0.51
Readymade garments	0.87	0.01	S	S	0.5
Other manufactured goods	0.16	0.14	S	S	0.34
Other commodities	3.38	0.28	S	S	0.33

*Note: (a) LM=Lagrange Multiplier test of residual serial correlation. (b) RS = Ramsey RESET test for functional form. (c) C=Cusum sum of residuals; S="stable"; US="unstable" (d) CS= Cumulative sum of squared residuals; S="stable"; US="unstable" (e) ***indicates significance at 1% (f)* $\bar{R}^2$= Adjusted R Square

6.3.2 Analysis of Import of Sub-Categories: Agriculture & Allied

In Table (6.4), majority of the agriculture & allied commodities are cointegrated with REER and REER volatility. The commodities like cashew, cereal preparation, silk raw and natural rubber are not cointegrated.

Table 6.4
Cointegration and error correction Results of India's Imports (Agriculture & Allied)

Import Commodities	Share (%)	F Statistics	ECT	CI	ARDL	AIC
2A. Agricultural and allied products	6.98	6.04	-0.23*** (-5.64)	Yes	3,4,4,2	-0.5
Cashew	0.2	2.67	-0.18*** (-3.73)	No	4,0,1,0	1.13
Cereal preparations	0.02	2.17	-0.22*** (-3.36)	No	4,0,0,0	1.02
Cotton raw including waste	0.22	3.83	-0.32*** (-4.47)	Yes	2,0,0,2	2.31
Silk, raw	0.04	2.21	-0.14*** (-3.39)	No	3,0,0,1	-0.54
Wool, raw	0.07	3.88	-0.15*** (-4.51)	Yes	4,1,0,4	-0.77
Jute, raw	0.02	11.36	-0.7*** (-7.72)	Yes	1,0,0,0	2.48
Fresh fruits	0.51	4.21	0.03*** (4.699)*	Yes	4,0,0,0	-0.09
Milk & cream	0.01	5.17	-0.41*** (-5.23)	Yes	1,0,0,0	2.89
Natural rubber	0.17	1.42	-0.15*** (-2.73)	No	4,0,0,0	1.93
Pulses	1.45	4.81	-0.312*** (-5.02)	Yes	1,0,3,1	0.71
Rice, other than basmati	0.01	1.69	-0.28*** (-3.05)	No	2,2,0,1	3.66
Oilseeds	0.04	3.28	-0.33*** (-4.14)	Yes	2,1,0,2	2.91
Spices	0.2	5.27	-0.17*** (-5.25)	yes	3,1,1,0	-0.18
Sugar and mollases	0.46	3.29	-0.26*** (-4.16)	Yes	2,0,4,1	4.14
Vegetable & animal fats	0.01	9.05	-0.73*** (-6.92)	Yes	1,0,3,2	0.93
Vegetable oils (edible)	2.8	9.87	-0.23*** (-7.20)	Yes	4,4,0,0,	0.27
Wheat	0.29	4.81	-0.2 (-6.33)	Yes	4,3,4,2	2.63

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Further, results indicate that all the commodities ECT_{t-1} is negative and significant except fresh fruit. The speed of adjustment is high for vegetable & animal fat (73%) followed by milk & cream (41%) and adjustment speed is least for raw jute (7%).

The short and long-run coefficient estimates of import of agriculture and allied categories are reported in Table (6.5). As per the table, very few commodities have significant effect of REER in short-run. The commodities like raw jute, pulses, wheat and cereal preparation have significant effect of REER with expected sign. Whereas, the commodities like oil seeds, spices, vegetable oil and rice are significant with negative sign. It is evident from the results, the REER volatility has negative effect for the commodities like pulses, sugar & molasses, vegetable animal fat & wheat. The study reveals the existence of long-run effect of REER for raw wool, raw jute, milk cream, pulses & vegetable oil. REER volatility does not show long-run impact except pulses. The agriculture and allied product in total has long-run impact of REER with appropriate sign. The commodities like raw cotton, milk cream, pulses, oil seeds, spices, vegetable animal fat and vegetable oil have long-run effect of GDP under agriculture & allied category.

Table 6.5

Short and Long Run Estimates of India's Imports

(Agriculture & Allied)

	Short-run Coefficients								*Long-run Coefficients*		
	ΔlnR_T	ΔlnR_{T-1}	ΔlnR_{T-2}	ΔlnR_{T-3}	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	$\Delta lnRV_{T-2}$	$\Delta lnRV_{T-3}$	*lnR*	*lnRV*	*lnIGDP*
Cointegrated											
2A. Agricultural and allied products	0.18	-1.17	-2.05***	-1.21	0.03	-0.31***	-0.33***	-0.19***	8.18***	0.95	1.03***
	(0.22)	(-1.41)	(-2.51)	(-4.46)	(0.55)	(-3.77)	(-3.93)	(-3.07)	(3.13)	(1.38)	(4.59)
Cotton raw including waste	-0.06								-0.61	-0.36	1.66***
	(-0.01)								(-0.11)	(-0.46)	(3.45)
Wool, raw	-0.15								7.82***	-0.21	0.16
	(-0.23)								(1.92)	(-0.52)	(0.43)
Jute, raw	8.87***								6.39***	-0.002	0.49***
	(2.09)								(2.26)	(-0.01)	(1.92)
Fresh fruits	-0.61								1.71	-0.89	1.73
	(-0.56)								(0.12	(-0.33)	(1.33)
Milk & cream	2.01				-0.45	0.87***			13.95***	-0.74	1.41***
	(0.38)				(-1.08)	(1.68)			(2.26)	(-0.76)	(2.16)
Pulses	2.93***				0.09	-0.46***	-0.36***		9.38***	2.03***	1.16***
	(1.81)				(0.93)	(-3.57)	(-3.44)		(3.61)	(2.93)	(4.54)
Oilseeds	-8.08***								9.71	-1.03	2.33***
	(-1.87)								(1.31)	(-0.9)	(3.33)

Table 6.5 (Continued)

	Short-run Coefficients								*Long-run Coefficients*		
	ΔlnR_T	ΔlnR_{T-1}	ΔlnR_{T-2}	ΔlnR_{T-3}	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	$\Delta lnRV_{T-2}$	$\Delta lnRV_{T-3}$	*lnR*	*lnRV*	*lnIGDP*
Spices	-3.45***				0.13***				-0.53	0.11	2.34***
	(-3.64)				(2.66)				(-0.16)	(0.18)	(7.40)
Sugar and mollases	8.4				-0.59	-3.39***	-3.7***	-1.74***	10.84	7.89	1.25
	(0.88)				(-0.99)	(-3.94)	(-4.62)	(-2.61)	(0.59)	(1.32)	(0.61)
Vegetable & animal fats	1.54				0.009	-0.29***	-0.33***		0.08	0.39	1.26***
	(0.84)				(0.07)	(-1.96)	(-2.62)		(0.06)	(1.08)	(9.23)
Vegetable oils (edible)	1.15	-1.26	-4.78***						9.11***	0.48	0.86***
	(0.97)	(-1.08)	(-3.99)						2.22	1.09	(1.93)
Wheat	5.25***	123.41***	71.25***		5.29***	-16.75***	-7.81***	-2.49***	-65.05	125.34	-20.96
	(4.37)	(5.94)	(5.29)		(0.4.37)	(-7.81)	(-5.91)	(-2.84)	(-1.21)	(1.46)	(-1.32)
Not Cointegrated											
Cashew	-0.53				0.19***						
	(-0.27)				(1.74)						
Cereal preparations	3.67***										
	(1.89)										
Silk, raw	1.28										
	(1.49)										
Natural rubber	2.14										
	(0.68)										
Rice, other than basmati	-22.01***	10.56									
	(-2.51)	(1.27)									

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

6.3.3 Analysis of Import of Sub-Categories: Ores & Minerals

From results of Table (6.6), it can be seen that sulphur & unroasted iron and coal /coke/briquettes are cointegrated with REER and REER volatility. Whereas, metalliferous ores & metal scrap and other crude minerals are not cointegrated. Also, ores & minerals in total are not cointegrated. ECT_{t-1} of all commodities under this category are negative and significant indicating shot-run adjustment among variables. Speed of adjustment is high for sulphur unroasted (38%) and least for metalliferous ores (1%).

Table 6.6

Cointegration and error correction Results of India's Imports

(Ores & Minerals)

Import Commodities	Share (%)	F Statistics	ECT	CI	ARDL	AIC
2C. Ores and minerals	5.74	2.31	-0.05***	No	3,0,0,1	-0.62
			(-3.48)			
Metaliferrous ores & metal scrap	1.24	1.01	-0.018***	No	3,0,0,1	-0.12
			(-2.29)			
Sulphur & unroasted iron pyrites	0.03	7.01	-0.38***	Yes	2,0,0,0	0.68
			(-6.05)			
Other crude minerals	0.07	3.12	-0.14***	No	1,0,0,4	-0.63
			(-4.04)			
Coal, coke & briquettes	4.2	3.94	-0.04***	Yes	4,0,0,0	-0.67
			(-4.54)			

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

As per the results reported in Table (6.7), REER do not have any short-run impact on any of the import commodities of ores & minerals category. REER and REER volatility has short-run and long-run impact on sulphur & unroasted iron.

Table 6.7

Short and Long Run Estimates of India's Imports

(Ores & Minerals)

	Short-run Coefficients				*Long-run Coefficients*		
	ΔlnR_T	ΔlnR_{T-1}	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	*lnR*	*lnRV*	*lnIGDP*
Cointegrated							
Sulphur & unroasted iron pyrites	1.67		0.29***		7.44***	0.92***	0.27
	(0.99)		(2.34)		(3.45)	(3.16)	(1.45)
Coal, coke & briquettes	-0.16				18.04	2.99	0.05
	(-0.21)				(1.19)	(1.07)	(0.03)
Not-Cointegrated							
2C. Ores and minerals	0.11						
	(0.15)						
Metaliferrous ores & metal scrap	0.12	-2.37***					
	(0.12)	(-2.16)					
Other crude minerals	0.59						
	(0.78)						

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

6.3.4 Analysis of Import of Sub-Categories: Leather manufactures

The Table (6.8) indicate that there is no long-run relation of import of leather & leather manufactures in total and leather products with REER and REER volatility. The import of raw hides & skins, have long-run relation with respect to REER and REER volatility. The speed of adjustment as given by ECT_{t-1} is high for raw hides & skins (38%) and is least for leather products (8%). REER and REER volatility do not have neither short-run or long-run impact on the import of leather manufactures as given by the results in Table (6.9).

Table 6.8

Cointegration and error correction Results of India's Imports

(Leather Manufactures)

Import Commodities	Share (%)	F Statistics	ECT	CI	ARDL	AIC
2C(i) Leather and leather manufactures	0.24	3.04	-0.177***	No	2,1,0,3	-0.76
			(-3.99)			
Raw hides & skins	0.01	5.31	-0.38***	Yes	2,0,0,4	-0.44
			(-5.27)			
Leather and leather products	0.22	3.08	-0.06***	No	4,0,0,3	-0.85
			(-4.51)			

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Table 6.9

Short and Long Run Estimates of India's Imports

(Leather Manufactures)

	Short-run Coefficients			***Long-run Coefficients***		
	ΔlnR_T	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	***lnR***	***lnRV***	***lnIGDP***
Cointegrated						
Raw hides & skins	0.44			1.59	0.17	0.41***
	(0.5)			(1.34)	(1.09)	(3.49)
Not Cointegrated						
Leather and leather products	-0.81					
	(-1.09)					
Leather manufactures	-1.41***					
	(-1.99)					

***Note: (a)** The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

6.3.5 Analysis of Import of Sub-Categories: Chemical manufactures

Table (6.10) reports the cointegration results of chemical manufactures category. Majority of the import commodities except fertilisers are cointegrated with REER and REER volatility. The commodities like chemical material & product and dyeing/tanning & colouring material are having significant and positive sign for ECT_{t-1} indicating that series are explosive while other commodities are having short-run adjustment. The speed of adjustment is high for inorganic chemicals (17%) and least for organic chemicals (3%).

Table 6.10

Cointegration and error correction Results of India's Imports

(Chemical Manufactures)

Import Commodities	Share (%)	F Statistics	ECT	CI	ARDL	AIC
2C(ii) Chemicals and related products	8.24	6.17	-0.07*** (-5.69)	Yes	4,2,0,3	-0.95
Chemical material & products	1.55	10.5	0.01*** (7.43)	Yes	4,2,0,2	-1.14
Organic chemicals	2.4	4.58	-0.03*** (-4.90)	Yes	4,0,0,1	-1.28
Inorganic chemicals	0.93	5.21	-0.17*** (-5.22)	Yes	4,2,0,2	-0.75
Medicinal & pharmaceutical products	1.22	7.76	-0.05*** (-6.38)	Yes	4,1,0,0	-0.97
Dyeing tanning & colouring materials	0.56	8.12	0.01*** (6.54)	Yes	4,4,0,4	-1.4
Fertilisers	1.17	1.72	-0.13*** (-3.01)	No	4,2,0,3	0.97

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

As per the results of Table (6.11) there is no short-run impact of REER on import of chemical manufactures as the coefficients have negative sign. REER has long-run impact on the import of chemical & related products and inorganic chemicals. However, REER volatility do not have any short-run and long-run effect on the import of commodities under this category.

Table 6.11

Short and Long Run Estimates of India's Imports

(Chemicals Manufactures)

	Short-run Coefficients						*Long-run Coefficients*		
	ΔlnR_T	ΔlnR_{T-1}	ΔlnR_{T-2}	ΔlnR_{T-3}	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	*lnR*	*lnRV*	*lnIGDP*
Cointegrated									
Chemicals and related products	-0.82	-1.77***					20.03***	0.45	-0.34
	(-1.21)	(-2.67)					(2.09)	(0.66)	(-0.33)
Chemical material & products	-1.38***	-1.38***					-113.07	3.53	15.62
	(-2.37)	(-2.30)					(-0.19)	(0.19)	(0.22)
Organic chemicals	-0.27						17.31	2.02	-0.97
	(-0.43)						(1.28)	(1.12)	(-0.48)
Inorganic chemicals	-606	-2.1***					6.88***	0.2	0.65***
	(-0.88)	(-2.99)					(2.34)	(0.61)	(2.42)
Medicinal & pharmaceutical products	-0.67						16.98	2.04	0.14
	(-1.06)						(1.52)	(1.27)	(0.11)
Dyeing tanning & colouring materials	-0.78	-0.46	0.42	1.3***			-48.27	-2.4	9.2
	(-1.47)	(-0.85)	(0.78)	(2.42)			(-0.32)	(-0.32)	(0.43)
Not Cointegrated									
Fertilisers	-1.49	-3.76							
	(-0.83)	(-2.21)							

Note: (a) *The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

6.3.6 Analysis of Import of Sub-Categories: Engineering Goods

Table (6.12) reports the cointegration and error correction results of commodities under Engineering Goods. Under this category transport equipment, manufactures of metals machine tools and non-electrical machinery are cointegrated with REER and REER volatility. Iron & steel, ferrous & non-ferrous metals, primary steel pig iron based items are not cointegrated. Majority of ECTt-1 is found negative and significant except manufacture of metal. Speed of adjustment with respect to REER is high for ferrous & non-ferrous (12%) and low for iron & steel (2%). The import share for few commodities under Engineering Goods category is not available.

Table 6.12

Cointegration and error correction Results of India's Imports

(Engineering Goods)

Import Commodities	Share (%)	F Statistics	ECT	CI	ARDL	AIC
2C(iii) Engineering goods	19	17.24	-0.06*** (-9.51)	Yes	4,2,0,0	-1.47
Transport equipment	4.57	4.39	-0.03*** (-4.80)	Yes	4,1,0,3	0.28
Iron & steel	2.13	1.91	-0.02*** (-3.16)	No	3,0,0,1	-0.84
Ferrous and non-ferrous metal products	3.37	3.01	-0.12*** (-3.97)	No	2,1,4,1	-0.46
Manufactures of metals		7.07	0.01*** (6.13)	Yes	4,3,3,0	-1.21
Primary steel pig iron based items		1.16	-0.05*** (-2.48)	No	2,4,0,0	0.2
Machine tools including hand tools and cutting tools	0.81	3.85	-0.07*** (-4.49)	Yes	2,2,0,3	-0.09
Non-electrical machinery	4.79	17.74	-0.08*** (-9.65)	Yes	4,2,0,0	-1.39

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Table 6.13

Short and Long Run Estimates of India's Imports (Chemicals Manufactures Enginerring Goods)

	Short-run Coefficients								*Long-run Coefficients*		
	ΔlnR_T	**ΔlnR_{T-1}**	**ΔlnR_{T-2}**	**ΔlnR_{T-3}**	**$\Delta lnRV_T$**	**$\Delta lnRV_{T-1}$**	**$\Delta lnRV_{T-2}$**	**$\Delta lnRV_{T-3}$**	**lnR**	**lnRV**	**lnIGDP**
Cointegrated											
2C(iii) Engineering goods	0.01	-1.27***							28.67***	0.74	-1.34
	(0.01)	(-2.50)							(2.85)	(1.16)	(-1.19)
Transport equipment	-1.57								36.28	3.9	-2.31
	(-1.26)								(0.86)	(0.73)	(-0.42)
Manufactures of metals	-1.31***	-1.62***	-1.07						-120.17	49.19	2.53
	(-2.21)	(-2.47)	(-1.66)						-0.12	0.13	0.79
Machine tools including hand tools & cutting tools	-1.66***	-1.44							26.64***	-0.43	-0.49
	(-1.68)	(-1.44)							(1.73)	(-0.37)	(-0.35)
Non-electrical machinery	0.64	-1.17***							25.64***	0.8	-1.23
	(1.22)	(-2.25)							(3.39)	(1.5)	(-1.39)
Not Cointegrated											
Iron & steel	-0.22										
	(-0.29)										
Ferrous and non-ferrous metal products	-2.08***				-0.08	-0.09	-0.19***				
	(-2.54)				(-1.11)	(-1.18)	(-3.33)				
Primary steel pig iron based items	-0.63	-0.72	-0.67	4.04***							
	(-0.54)	(-0.58)	(-0.56)	(0.00)							

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

The Table (6.13) show the model estimates of short-run and long-run of engineering goods category. Under this category change in REER do not have significant result in the short-run. However, Engineering goods in general, machine tools and non-electrical machinery have long run REER impact. Further, REER volatility does not have any effect in the long-run.

6.3.7 Analysis of Import of Sub-Categories: Electrical / Project / Electronic goods category.

From the Table (6.14), it is observed that electrical machinery, professional instruments, computer software in physical form and electronic good are cointegrated with REER and REER volatility. Whereas project good is not cointegrated. As per the table coefficient of ECTt-1 of all commodities are negative and significant. The speed of adjustment is high for professional instrument and computer software (19%) and least for electrical machinery (5%). The import share for few commodities under Electrical /Project / Electronic Goods category is not available.

Table 6.14

Cointegration and error correction Results of India's Imports

(Electrical /Project / Electronic Goods)

Import Commodities	Share (%)	F Statistics	ECT	CI	ARDL	AIC
Electrical machinery	1.88	15.17	-0.05*** (-8.94)	Yes	4,2,3,3	-1.41
Project goods	0.64	1.65	-0.11*** (-2.94)	No	2,3,0,4	0.51
Professional instruments, optical goods etc.		11.85	-0.19*** (-7.93)	Yes	4,3,0,2	-2.09
Computer software in physical form		3.97	-0.19*** (-4.58)	Yes	2,0,0,1	0.53
2C(iv) Electronic goods	11.8	30.74	-0.08*** (-12.71)	Yes	4,2,0,1	0.61

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Table 6.15

Short and Long Run Estimates of India's Imports

(Electrical /Project / Electronic Goods)

	Short-run Coefficients								***Long-run Coefficients***		
	ΔlnR_T	ΔlnR_{T-1}	ΔlnR_{T-2}	ΔlnR_{T-3}	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	$\Delta lnRV_{T-2}$	$\Delta lnRV_{T-3}$	***lnREER***	***lnRV***	***lnIGDP***
Cointegrated											
Electrical machinery	-1.64***	-1.47***			-0.03	0.03	0.08***		32.63	-2.62	-1.14
	(-3.21)	(-2.63)			(-0.98)	0.89	(2.24)		(1.48)	(-0.78)	(-0.5)
Professional instruments, optical goods etc.	-0.82***	-1.58***	-0.73***						7.05***	0.27	1.31***
	(-2.18)	(-3.56)	(-1.64)						(5.82)	(1.46)	(12.73)
Computer software in physical form	-2.04				-0.01	0.4***			-0.71	0.55	1.58***
	(-1.37)				(-0.05)	(2.44)			(-0.18)	(0.91)	(3.27)
2C(iv) Electronic goods	-0.68	-0.84							12.96***	0.26	0.36
	(-1.55)	(-1.91)							(3.14)	(0.62)	(0.53)
Not Cointegrated											
Project goods	-3.21***	-2.91***	-2.01								
	(-2.38)	(-1.95)	-1.42								

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

The short and long-run estimates are provided in Table (6.15). Change in REER do not have any short-run impact on Electrical / Project / Electronic goods category. While, REER volatility has positive impact on electrical machinery and computer software in physical form. It is also observed that, there is a long-run impact of change in REER for professional instruments and electronic goods. Whereas, REER volatility has no long-run impact.

6.3.8 Analysis of Import of Sub-Categories: Textiles

As per the results in Table (6.16), textiles and yarns/fabrics/madeups are cointegrated with REER and REER volatility. Woollen and cotton rags are not cointegrated. ECTt-1 is high and significant for woollen cotton rags (25%) and low for yarns/fabrics/madeups (9%). The short-run and long-run estimates under this category are given in Table (6.17). Change in REER and REER volatility do not have any impact in the short-run for textiles imports. However, there is long-run impact for yarns/fabrics/madeups in relation to change in REER.

Table 6.16

Cointegration and error correction Results of India's Imports

(Textile Goods)

Import Commodities	Share (%)	F Statistics	ECT	CI?	ARDL	AIC
2C(v) Textiles (excl.rmg)	0.89	9.04	-0.08*** (-6.89)	Yes	4,1,0,4	0.51
Yarns, fabrics, madeups	0.74	8.51***	-0.09*** (-6.969)	Yes	4,1,0,4	-1.41
Woollen & cotton rags	0.01	2.25	-0.25*** (-3.44)	No	1,0,0,1	0.13

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

Table 6.17

Short and Long Run Estimates of India's Imports

(Textile Goods)

	Short-run Estimates					*Long-run estimates*		
	ΔlnR_T	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	$\Delta lnRV_{T-2}$	$\Delta lnRV_{T-3}$	*lnR*	*lnRV*	*lnIGDP*
Cointegrated								
2C(v) Textiles	-0.23					11.13***	0.28	0.02
	(-0.46)					(2.09)	(0.59)	(0.03)
Yarns, fabrics, madeups	-0.13					10.42***	0.21	0.02
	(-0.25)					(2.18)	(0.45)	(0.02)
Not Cointegrated								
Woollen & cotton rags	0.81	-0.01	0.17	0.30***	0.19***			
	(0.64)	(-0.11)	(1.28)	(2.39)	(1.91)			

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

6.3.9 Analysis of Import of Sub-Categories: Gold / Silver / Precious Stones.

The results of cointegration and error correction are given in Table (6.18) of import of gold, silver and precious stones. It is observed that gold & silver in general and silver in specific are cointegrated with REER and REER volatility. Gold and precious stones are not cointegrated i.e do not have long-run relationship with REER and REER volatility.

Table 6.18

Cointegration and Error Correction Results of India's Imports

(Gold / Silver / Precious Stones)

Import Commodities	**Share (%)**	**F Statistics**	**ECT**	**CI**	**ARDL**	**AIC**
2C(viii) Gold & silver	10.3	4.26	-0.28***	Yes	1,0,0,3	0.84
			(-4.72)			
Gold	9.76	1.47	-0.19***	No	4,1,0,0	0.93
			(-2.81)			
Silver	0.51	3.94	-0.43***	Yes	1,0,1,2	2.47
			(-4.58)			
Pearls precious & semiprecious stones	5.09	3.07	-0.29***	No	3,0,4,0	0.99
			(-4.01)			

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

The speed of adjustment indicated through ECTt-1 is high for precious stones (29%) and least for gold (19%). The short-run and long-run estimates under this category are given in Table (6.19). There is a short-run impact of change in REER with the expected sign on the imports of gold and silver. REER volatility have long-run impact on import of silver.

Table 6.19:

Short and Long Run Estimates of India's Imports

(Gold / Silver / Precious Stones)

	Short-run Coefficients			***Long-run Coefficients***		
	ΔlnR_T	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	***lnR***	***lnRV***	***lnIGDP***
Cointegrated						
2C(viii) Gold & silver	2.19			2.12	0.36	2.14***
	(1.23)			(0.65)	(0.83)	(6.33)
Silver	8.77***			7.85	1.63***	1.2
	(1.46)			(1.11)	(1.65)	(1.2)
Not Cointegrated						
Pearls & semi precious stones	0.71	0.16	-0.16			
	(0.39)	(1.33)	(-1.04)			
Gold	5.68***					
	(2.85)					

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

6.3.10 Analysis of Import of Sub-Categories: Other Manufactured Goods.

The results of cointegration and error correction are given in Table (6.20) of import of other manufactured goods. Wood & wood products, pulp & waste paper, news print and synthetic regenerated fibres are cointegrated with REER and REER volatility. While, books/publication/printing, artificial resins and synthetic rubber are not cointegrated. The speed of adjustment is high for news print (26%), synthetic regenerated fibres (25%) and low for pulp & waste paper (2%).

The short-run and long-run estimates under this category are given in Table (6.21). In short-run change in REER do not have impact on the import of any commodity under this category. While REER volatility has impact on import of books/publication/printing. REER have long-run impact on the import of Wood & wood products, pulp & waste paper, news print and synthetic regenerated fibres. While REER volatility has long-run impact on the import of pulp & waste paper and synthetic regenerated fibres.

Table 6.20

Cointegration and error correction Results of India's Imports

(Other Manufactured Goods)

Import Commodities	Share (%)	F Statistics	ECT	CI	ARDL	AIC
Wood & wood products	0.62	6.3	-0.12*** (-5.74)	Yes	4,1,0,0,	-0.53
Pulp & waste paper	0.23	5.9	-0.2*** (-5.56)	Yes	4,0,1,0	-0.97
Newsprint	0.22	4.5	-0.26*** (-4.85)	Yes	4,3,0,0	-0.28
Books, publications and printing	0.07	2.92	-0.11*** (-3.92)	No	4,4,4,1	0.25
Artificial resins, plastic materials etc.	2.75	2.84	-0.03*** (-3.86)	No	3,1,0,4	-0.53
Synthetic & reclaimed rubber		2.38	-0.04*** (-3.56)	No	4,4,0,4	-0.71
Synthetic & regenerated fibres		7.72	-0.25*** (-6.38)	Yes	3,1,0,2	-0.02

*Note: (a) *** significance at 1%, ** at 5%, * at 10% (b) the export share is as per the 2016Q4 provided by CMIE Economic Outlook database. (c) The values in the parenthesis are the absolute values of t-ratios (d) CI : Cointegration*

The import share for few commodities under other manufactured goods category is not available.

Table 6.21

Short and Long Run Estimates of India's Imports

(Other Manufactured Goods)

	Short-run Coefficients							***Long-run Coefficients***		
	ΔlnR_T	ΔlnR_{T-1}	ΔlnR_{T-2}	ΔlnR_{T-3}	$\Delta lnRV_T$	$\Delta lnRV_{T-1}$	$\Delta lnRV_{T-2}$	***lnR***	***lnRV***	***lnIGDP***
Cointegrated										
Wood & wood products	-0.12							10.58^{***}	0.22	0.29
	(-0.15)							$(1.89)^{*}$	(0.41)	(0.41)
Pulp & waste paper	0.45				0.03			6.05^{***}	0.75^{***}	0.59^{***}
	(0.67)				0.99			(3.15)	(2.26)	(3.14)
Newsprint	-0.74	-2.24^{***}	-1.44					7.69^{***}	-0.01	0.52^{***}
	(-0.84)	(-2.24)	(-1.53)					(2.89)	(-0.06)	(2.37)
Synthetic & regenerated fibres	0.56							12.27^{***}	0.72^{***}	-0.12
	(0.53)							(3.91)	(1.92)	(-0.47)
Not Cointegrated										
Books, publications and printing	0.39	-0.59	4.44^{***}	4.24^{***}	0.18^{***}	-0.28^{***}				
	(0.32)	(-0.49)	(3.69)	(3.34)	(2.08)	(-2.30)				
Artificial resins, plastic materials etc.	$(-1.28^{***}$									
	(-1.62)									
Synthetic & reclaimed rubber	-0.11	-0.80	0.09	2.80^{***}						
	(0.50)	(-1.09)	(0.12)	(3.70)						

*Note: (a) The values in the parenthesis are the absolute values of t-ratios. (b) *** significant at 1%, ** at 5%, * at 10%*

6.3.11 Diagnostic Results

The diagnostic results of import sub-categories are reported in Table (6.22). The result indicate that import of commodities under agriculture and allied products category do not have autocorrelation problem as LM statistics do not exceeds the Chi-Square critical value. Table (6.22) also reports Ramsey RESET statistics for evaluating the specification of the model. As per the results all the models are correctly specified. The parameter stability given by Cusum and Cusum Square indicate that majority of the models are stable. Further, all the models have good explanatory power indicated by moderate adjusted R Square. As per the results of import of ores and minerals category in Table (6.22) it is evident that all the models are free from autocorrelation problem as the LM statistics do not exceed the chi-square critical value of 5.99. Model is adequately specified as reported by Ramsey RESET Test statistic. The parameters are stable as given by Cusum and Cusum Square Test. The explanatory power of the model is good as given by adjusted R Square.

The diagnostic analysis of import of leather manufactures category is reported in Table (6.22). All the models are free from autocorrelation problem as the LM statistics do not exceed the chi-square critical value of 5.99. Model is adequately specified as reported by Ramsey RESET Test statistic. The parameters are stable as given by Cusum and Cusum Square Test. The explanatory power of the model is good as given by adjusted R Square. The results of diagnostic analysis of import of chemical products are shown in Table (6.22). As per the autocorrelation results indicated by LM statistics majority of the import commodities do not have autocorrelation problem. However, the commodities like dyeing/tanning/colouring and fertilizer have auto correlation problem. Also, the results of Ramsey RESET indicate that all the models are adequately specified. The parameters are stable as reported by Cusum and Cusum Square. Finally, all the models have good explanatory power as given by adjusted R Square.

Table 6.22

Diagnostic Checking: India's Imports

Import Commodities	LM	RS	C	CS	$\bar{R}^2$	Import Commodities	LM	RS	C	CS	$\bar{R}^2$
Petroleum crude & products (POL)	0.47	1.81	S	S	0.15	Sugar and mollases	0.42	0.01	S	S	0.23
Agricultural and allied products	0.61	0.46	S	S	0.47	Vegetable & animal fats	0.52	2.44	S	US	0.39
Cashew	3.93	6.58	US	S	0.52	Vegetable oils (edible)	2.76	0.34	S	S	0.47
Cereal preparations	0.77	0.07	S	US	0.35	Wheat	4.11	0	S	US	0.83
Cotton raw including waste	1.92	2.83	S	US	0.23	Ores and minerals	3.72	2.03	S	S	0.14
Silk, raw	1.22	1.48	S	S	0.31	Metaliferrous ores & metal scrap	0.31	2.14	S	US	0.07
Wool, raw	2.42	0.23	S	S	0.31	Sulphur & unroasted iron pyrites	0.36	1.37	S	S	0.27
Jute, raw	0.2	2.16	S	US	0.41	Other crude minerals	1.06	2.02	S	US	-0.63
Fresh fruits	0.91	2.78	S	US	0.7	Coal, coke & briquettes	3.3	1.68	S	US	0.11
Milk & cream	0.87	1.69	S	US	0.26	Manufactured goods	8.46***	0.35	S	US	-1.73
Natural rubber	2.45	0.27	S	US	0.24	Leather and leather manufactures	2.76	0.46	S	S	0.39
Pulses	0.51	0.59	S	S	0.21	Raw hides & skins	1.14	0.24	S	S	0.38
Rice, other than basmati	0.29	1.41	S	US	0.43	Leather and leather products	5.81	2.82	S	S	0.37
Oilseeds	1.54	1.8	S	US	0.28	Chemicals and related products	6.90***	0.23	US	S	0.5
Spices	0.12	0.18	US	US	0.42	Chemical material & products	1.04	0.05	S	S	0.48

*Note: (a) LM=Lagrange Multiplier test of residual serial correlation. (b) RS = Ramsey RESET test for functional form. (c) C=Cusum sum of residuals; S="stable"; US="unstable" (d) CS= Cumulative sum of squared residuals; S="stable"; US="unstable" (e) ***indicates significance at 1% (f)* $\bar{R}^2$ = Adjusted R Square

Table 6.22 (continued)

Diagnostic Checking: India's Imports

Import Commodities	LM	RS	C	CS	$\bar{R}^2$	Import Commodities	LM	RS	C	CS	$\bar{R}^2$
Organic chemicals	1.17	1.25	S	S	0.27	Computer software in physical form	2.36		S	S	0.32
Inorganic chemicals	0.01	0.05	S	S	0.42	Electronic goods	11.73***	0.17	S	S	0.6
Medicinal & pharmaceutical products	2.71	0.34	S	S	0.29	Textiles (excl.rmg)	9.99***	0.01	S	S	0.51
Dyeing tanning & colouring materials	16.34***	1.06	S	US	0.49	Yarns, fabrics, madeups	9.07***	0.09	S	US	0.5
Fertilisers	10.62***	0	S	S	0.54	Woollen & cotton rags	4.5	6.81	S	S	0.17
Engineering goods	22.77***	3.08	S	S	0.53	Gold & silver	0.95	2.05	S	S	0.19
Transport equipment	8.36	0.48	US	S	0.58	Gold	2.11	0.41	S	S	0.26
Iron & steel	0.2	1.87	S	S	0.07	Silver	0.12	0.39	S	S	0.28
Ferrous and non-ferrous metal products	2.45	0.93	S	US	336	Pearls precious & semiprecious stones	0.61	0.05	S	US	0.43
Manufactures of metals	0.54	2.06	S	S	0.3	Wood & wood products	1.36	1.01	S	S	0.31
Primary steel pig iron based items	3.98	1.96	S	S	0.23	Pulp & waste paper	3.11	0.53	S	S	0.33
Machine tools including hand tools / cutting tools	3.95	1.23	S	US	0.39	Newsprint	4.88	0.58	S	S	0.31
Non-electrical machinery	17.87***	6.08	S	US	0.51	Books, publications and printing	1.69	0.15	S	S	0.52
Electrical machinery	17.11***	0.29	S	US	0.57	Artificial resins, plastic materials etc.	10.64***	0.34	S	S	0.29
Project goods	0.04	0.15	S	S	0.32	Synthetic & reclaimed rubber	4.02	0.11	S	US	0.33
Professional instruments, optical goods etc.	0.14	0.02	S	S	0.41	Synthetic & regenerated fibres	10.16***	0.12	S	S	0.41

*Note: (a) LM=Lagrange Multiplier test of residual serial correlation. (b) RS = Ramsey RESET test for functional form. (c) C=Cusum sum of residuals; S="stable"; US="unstable" (d) CS= Cumulative sum of squared residuals; S="stable"; US="unstable" (e) ***indicates significance at 1% (f)* $\bar{R}^2$ = Adjusted R Square

As per the results of imports of engineering goods given in Table (6.22) except non-electrical machinery, rest of all the commodities are free from autocorrelation problem as given by LM statistics. The result of Ramsey RESET, the study found that model is correctly specified. Parameters are stable as given by Cusum and Cusum Square. The models have reported moderate adjusted R Square.

The diagnostic results of Electrical / Project / Electronic goods category in Table (6.22) indicate that the import of electrical and electronic goods have autocorrelation problem as given by LM statistics. As per the result of Ramsey RESET, the study found that model is correctly specified. Majority of the parameters are stable as given by Cusum and Cusum Square. The models have reported moderate adjusted R Square.

The diagnostic results of imports of textiles goods are given in Table (6.22). The import of commodities like textiles in general and yarn fabric made-ups have autocorrelation problem as given by LM statistics. As per the result of Ramsey RESET, the study found that model is correctly specified. Majority of the parameter are stable as given by Cusum and Cusum Square. The models have reported moderate adjusted R Square. As per the results of imports of Gold / Silver / Precious Stones are given in Table (6.22). All the commodities are free from autocorrelation problem as given by LM statistics. As per the result of Ramsey RESET, the study found that model is correctly specified. Majority of the parameters are stable as given by Cusum and Cusum Square. The models have reported moderate adjusted R Square.

The diagnostic results of imports of other manufactured goods are given in Table (6.22). The import of commodities like Artificial resins, plastic materials and Synthetic & regenerated fibres have autocorrelation problem as given by LM statistics. As per the result of Ramsey RESET, the study found that model is correctly specified. Majority of the

parameter are stable as given by Cusum and Cusum Square. The models have reported moderate adjusted R Square.

List of import commodities affected by REER having expected positive sign in short-run and long-run is reported below. The changes in real effective exchange rate has desired results on the following import commodities in short-run:

Effect in Short-Run	Effect in Long-run
• Cereal preparations	• Wool, raw
• Jute, raw	• Jute, raw
• Pulses	• Milk & cream
• Wheat	• Pulses
• Dyeing tanning & colouring materials	• Vegetable oils (edible)
• Primary steel pig iron based items	• Sulphur & unroasted iron pyrites
• Silver	• Chemicals and related products
• Pearls precious & semiprecious stones	• Inorganic chemicals
• Books, publications and printing	• Professional instruments, optical goods
• Synthetic & reclaimed rubber	• Textiles (excl. rmg)
	• Yarns, fabrics, madeups
	• Wood & wood products
	• Pulp & waste paper
	• Newsprint
	• Synthetic & reclaimed rubber

The positive and negative effect of REER volatility on import commodities in short-run is listed below:

Positive	Negative
• Cashew	• Pulses
• Milk & cream	• Sugar and mollases
• Spices	• Vegetable & animal fats
• Wheat	• Wheat
• Sulphur & unroasted iron pyrites	• Ferrous and non-ferrous metal products
• Electric machinery and equipment	• Woollen & cotton rags
• Computer software in physical form	• Books, publications and printing

The effect of REER volatility in the long-run is found on the import of Pulses, Electronic goods and Silver. There is no negative effect of REER volatility in the long-run on the imports.

6.4 Chapter Summary

From the analysis it can be ascertained that the most of the import major-category are having long-run relation with REER and REER volatility. Further, change in REER do not show impact on many of the import major-categories in the short-run. Whereas, REER has long-run effect on the import of non-petroleum total, agriculture & allied, manufactured goods total, chemical & related products, engineering goods, electronic goods and textiles (excluding RMG) goods. Any of the import commodities under ores & minerals, leather manufactures, electrical, project, electronic and textiles goods categories are not affected by changes in REER. The impact of REER volatility is negligible as many commodities are not affected either in the short-run nor in the long-run. Even though few commodities are impacted by REER volatility in the short-run the effects are mixed in nature i.e. positive & negative.

CHAPTER VII

FINDINGS, CONCLUSIONS,

POLICY IMPLICATIONS

CHAPTER VII

FINDINGS, CONCLUSIONS AND POLICY IMPLICATIONS

7.1 Introduction

The exchange rate is a key economic variable that influences the decisions of investors, exporters, importers, financial institutions, and tourists in the developed as well as developing world. Exchange rate fluctuations affect the volume of international investment, competitiveness of exports and imports, volume of international reserves, currency value of debt payments, and the cost to tourists in terms of the value of their currency. Movements in exchange rates thus have important implications for the economy's growth, trade and capital flows. Therefore, exchange rate movement and its implication is crucial for understanding the growth trajectory of a country.

There is enough literature to show that exchange rate fluctuations have reduced international trade volume (Caballero and Corbo 1989, Cushman 1986, Kenen and Rodrik 1986, Bahmani-Oskooee and Payesteh 1993, Chowdhury 1993, Kumar and Dhawan 1991). While literature have also provided evidence that exchange rate volatility stimulates trade flows (Giovannini 1988, Sercu and Vanhulle 1992, Franke 1992, Dellas and Zilberfarb 1993). Also, many studies have failed to prove any significant relation between exchange rate volatility and international trade volume (Hooper and Kohlhagen 1978, IMF 1984, Bailey et al. 1987, Assery and Peel 1991, Bahmani-Oskooee 1991). Therefore, the relationship between exchange rate and trade is not very clear both theoretically and empirically.

The present study analyses exchange rate-trade relation with respect to India. After analysing the objectives like measuring exchange rate volatility in India, impact of exchange rate fluctuation on India's trade with trading partners and assessing the sector specific and

commodity specific impact in relation to exchange rate volatility, the study arrived at the following findings.

7.2 Major findings of the study

Objective 1: To find out India's exchange rate volatility and its magnitude

i. Through the comparative study of volatility between REER index and USD-INR, study found that USD-INR is more volatile and also its volatility persists for a long time in comparison to REER index. One interesting finding is that REER index responded to negative shocks and USD-INR responded to positive shocks in the market.

ii. From the periodical analysis of USD-INR, it is found that the exchange rate variation is high during reforms period (1991-1999) and low in pre-crisis period (2000-2007). During reforms period, market responded to the positive shocks. Even though, volatility was low, it took a long time to die out from the market during reforms period. Throughout 2000 to 2007 volatility was very sensitive to market shocks.

iii. It is observed that, all selected currencies of India's trading partners exhibit volatility in the short and long run. Further, currency variation is high for CHF-INR and low for AED-INR. The reaction to market shocks is high for AED-INR and USD-INR and is low for CHF-INR & GBP-INR. In case of persistence volatility, it is high for SAR-INR and CNY-INR. The long term volatility is highest for AED-INR and lowest for GBP-INR. All currencies of the trading partners under study responded to positive innovations.

Objective 2: To assess the impact of Exchange rate fluctuation on India's trade in relation to trading partners

iv. The study reveals the depreciation trend of rupee against all currencies of the selected trading partners. The rupee depreciation was highest against Swiss Franc followed by Japanese Yen and German Deustch Mark. The rupee depreciation was least in case of Saudi Real, US dollar and UK Pound Sterling. The ranking of currencies with respect to exchange rate variation and depreciation show more or less the similar trend implying that the exchange rate variation has been in the form of exchange rate depreciation.

v. Study also found the growth of exports and imports during the study period. However, the study ascertains high import growth rate than export growth rate for most of the trading partners. India's Export growth rate towards china is higher among the trading partner followed by UAE and Saudi Arabia and the same trend is seen in case of import growth rate also. The countries such as Japan, Germany, UK and Belgium exhibit low export and import growth rate during the period. Countries like China, Switzerland, USA, Germany, and Japan exhibit import growth rate more than export growth rate.

vi. The study also examined whether there exists any long-run relationship (cointegration) among the variables. The results establish the presence of long-run relationship among exports, imports, exchange rate, GDP of trading partners and GDP of India. Exchange rate has impact on exports in the short-run and long-run. However, exchange rate does not show impact on imports not only in the short-run but in the long-run also.

vii. The study found that there is a significant impact of exchange rate on India's exports to the countries like Belgium, Japan, Germany, US and UK. Study could trace the impact of exchange rate on India's imports only from China and US. One interesting fact about the result is that, US is the only country where the exchange rate has significant impact on India's exports and imports.

viii. Study reveals significant positive impact of GDP of trading partners like Germany and US for India's exports. Whereas GDP of Belgium and Saudi show negative impact on India's exports. Further, there is a significant positive impact of India's GDP on imports from the Belgium, China, Switz and US. The Study also indicate the negative relation between India's GDP and imports, which point out that as the GDP increases there is a decrease in imports. Such cases are reported for countries like Japan, Germany, Saudi, UAE and UK.

Objective 3: To identify sectors and commodities which are sensitive to exchange rate volatility in India.

ix. The study found that India's total exports is having long-run relation with REER and REER volatility. Most of the major export categories like non-petroleum total, agriculture and allied products, manufactured goods total, leather manufactures, chemical related products, engineering products, textiles (excluding readymade garments) and other manufactured goods have long-run relation with REER and REER volatility. The results of sub-category reveals that many of the export commodities under agriculture & allied, chemical, engineering goods, readymade goods and other manufactured goods have long-run relation with REER and REER volatility.

x. The study reveals that there is a significant impact of REER in short run for most of the major export category with expected negative sign indicating that increase in REER has an impact on India's exports categories. Whereas, there is minimal impact of REER in the long run. The study also reveals significant short run REER volatility impact for few major export categories. REER volatility has negative impact on exports of electronics and textiles in the short run. Whereas, non-petroleum total, ores and minerals, manufactured goods total and other manufactured goods show positive effect for REER volatility in short-run. Further, REER volatility does not have any long-run effect on the major export categories.

xi. The study found that majority of the commodities are effected by REER in the short run. Most of the commodities under agriculture & allied and textile categories are negatively affected by REER volatility. However, mixed results of positive and negative effect of REER volatility are witnessed in case of leather garments and other manufactured goods category. Approximately 40% of the sub-commodities are effected by REER volatility in the short-run. The long-run impact of REER and REER volatility on export of sub-commodities are negligible.

xii. After assessing the long-run relation (cointegration) the study found that India's total imports and most of the major import categories are having long-run relation with REER and REER volatility. Further study identifies that petroleum crude & product, having total share of 21.5% in total imports do not have long-run relation with respect to REER and REER volatility.

xiii. Study found that REER do not have significant effect on any of the import commodities under ores & minerals, leather manufactures, electrical, project, electronic and textiles goods for both short-run and long-run. Exception is that, in the long-run, changes in REER has significant effect for few commodities like

agriculture & allied, manufactured goods total, chemical, engineering, electronic, textiles and readymade garments with expected sign.

xiv. The impact of REER volatility is negligible as many commodities are not effected either in the short-run nor in the long-run. The categories like Petroleum crude & products, ores & minerals and other manufactured goods are having positive effect of REER volatility. While the REER volatility has minimal effect in the long-run. Very few commodities are impacted by REER volatility in the short-run and their effects are mixed in nature i.e. positive & negative.

7.3 Conclusion

The present study has investigated one of the key subject matter in international trade i.e. the relation between trade and exchange rate. From the above findings the following conclusions are drawn.

Since 1991, the volatility of rupee with respect to dollar was high compared to real effective exchange rate. During the reforms period, it is observed that rupee against dollar, had low volatility which persisted for a long time. In comparison to the trading partners' currencies, the rupee volatility was high with respect to UAE Dirham and US Dollar and low for Switz Franc and UK Pound Sterling.

In last two decades' Indian rupee has depreciated against the currencies of all trading partners. At the same time there has been an increase in exports and imports. However, the growth rate of imports has been significantly high compared to exports. Further, there is a long-run relationship among exports, imports, exchange rate, GDP of India and its trading partners. Notably the exchange rate had significant impact for exports and not for imports in short and long-run. There is an impact of exchange rate on exports to the countries like Belgium, Japan, Germany, US and UK. Whereas China and US shown notable impact of

depreciation on imports. Interestingly, exchange rate has substantial effect on exports to US and imports from US. There is a positive impact of trading partners' GDP on Indian exports and India's GDP on imports of India. Remarkably, negative relation between GDP of India and imports is identified for countries like Japan, Germany, Saudi, UAE and UK. This specify that India is able to reduce imports from these countries because of increased domestic production.

The long-run relation exists between real effective exchange rate volatility with majority of the export items under agriculture & allied, chemical, engineering goods, readymade goods and other manufactured goods. Real effective exchange rate volatility has short-run impact for major exports whereas the long-run effect is least. Many of the commodities under agriculture & allied and textiles are negatively affected by real effective exchange rate volatility. Mixed results of positive and negative effect on exports are perceived for items under leather, garments and manufactured goods categories. There is a minimal impact of real effective exchange rate volatility on India's export of sub-commodities. Altogether, 13 commodities are positively and 15 commodities are negatively affected by real effective exchange rate volatility in the short-run. Only 3 export commodities have long-run positive effect of real effective exchange rate volatility.

Changes in real effective exchange rate does not show impact on many of the import categories in the short-run. Whereas, non-petroleum total, agriculture & allied, manufactured goods total, chemical & related products, engineering goods, electronic goods and textiles (excluding RMG) goods has long-run effects. There is no impact for the import of commodities under ores & minerals, leather manufactures, electrical, project, electronic and textiles goods categories. Real effective exchange rate volatility has positive and negative effect on the import of seven commodities each in the short-run. Whereas, only five commodities, negatively and three commodities, positively are effected in the long-run.

To conclude, it is only few sectors and commodities are influenced by exchange rate volatility. So, the effect of exchange on trade is not uniform in India. There are many other important macro-economic variables that can affect India's international trade. In order to minimise the negative effect of exchange rate volatility on India's trade a systematic and efficient micro-level domestic policy needs to be in place.

7.4 Policy Implications

Exchange rate primarily determines the amount of price paid or received for goods and services in the international market. Any variation in exchange rate directly or indirectly effects producers, consumers and overall economic health of a nation. The present study analysed three important aspects of exchange rate in India and the results of the study has few policy implications.

i. Having analysed exchange rate volatility, it's very clear that Indian Rupee exhibited volatility in short and long-run. Moreover, volatility has negative effect on trade for few sectors and commodities in India. Therefore, India need a systematic policy in place to mitigate foreign exchange fluctuations to control its negative effects. From the policy point of view, trader should be encouraged to use hedging instruments to adjust uncertainty.

ii. From the trading partner's analysis, it is clear that Indian rupee has depreciated against all trading countries and in majority cases exports increased substantially. Therefore, there is a reason to believe that depreciation of rupee has had desired result for India's exports. As such the policy makers need not bother much on depreciation trend of Indian rupee. The policy implication is that, the policy makers should be more concerned about the appreciation of rupee and the rupee should not be allowed to appreciate beyond a limit.

iii. Similar to earlier studies, the present study also indicate that Indian imports are inelastic to exchange rate. Imports are very important for a country like India and it is essential in its growth process. It is not advisable for India to control the imports because we import many essential commodities. Also, our consumption and production activities are closely associated with the imports. The findings of the study have lot of implications in this context. The government can continue with suitable exchange rate and monetary policies which would boost exports without reducing the imports of essential commodities. However, the study implies that government may resort to long term strategies to bring down India's imports to improve balance of payment situation. Government of India's policies of 100% FDI, make in India etc. are in right direction in this context.

iv. The Finding of the study on impact of exchange rate volatility on sectoral trade is mixed in nature. In other words, trade is not hampered much with flexible exchange rate system. So, exchange rate volatility is not a powerful factor that affect trade. The implication of the study is that; India can continue with the present day managed floating system. At the same time, policies should be concentrated on increasing competitiveness of India's exports through productivity enhancement that should supplement monetary and exchange rate policies. So controlling and managing exchange rate alone cannot resolve exchange rate-trade issues.

v. The effectiveness of broad exchange rate-trade policies are questionable in Indian context as the study finds that only few sectors and commodities are influenced by exchange rate volatility. Which means exchange rate policy may not affect all the sectors uniformly. Hence, it is suggested that, the monetary and fiscal policies specific to certain sectors should complement exchange rate policy.

7.5 Limitation of the study

The present study has great relevance and policy implications. However, it is not free from limitations. The study considers the effect of only Real Effective Exchange Rate (REER) and not the Nominal Effective Exchange Rate (NEER). India have many trading partners; yet, the study considers only 9 major trading partners. Another important limitation is that the study takes into account value effect and not the volume of trade. Finally, study analysed few selected commodities from India's trade basket due to non-availability of data.

7.6 Scope for Further Research

The present study has tried to fill the research gap in establishing the relation between exchange rate and different sector & commodities trade in Indian context. Even though the study has lot of policy implications, there is a possibility of extending the present research in future.

The present study in general perspective gives a macro outlook. For analysing trade relations with major trading partners' future research can include different sectors and commodities rather than aggregate export and imports. The study connects India's Exchange rate, export and import sectors with rest of the world, not any particular region or country. In this line further research can concentrate on bilateral or region specific relations with respect to SAARC, ASEAN, NAFTA etc. The study has considered bilateral trade relations with only nine major trading partners of India. This can be extended by adding more trading partners. Finally, the study has tried to analyse the impact of exchange rate on trade value. Further research can take into account the trade volume.

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