LUND UNIVERSITY
School of Economics and Management

Consequence of Interactive Effect of Exchange Rate Volatility and Trade on GDP Growth

Department of Economics
Lund University
Master's Program in Economics
NEKN01 Master Essay I (15 Credits)

Submitted By:
S M Abdullah
Salina Siddiqua

Supervised By:
Professor Joakim Westerlund

Seminar Date: 16th October, 2015

Acknowledgement

We would like to express our sincere gratitude to our supervisor **Professor Joakim Westerlund** for the insightful comments and guidance throughout the process. It would have been impossible for us to complete the work and learning process without his proper support. We would also like to acknowledge the burden our family and friends have went through during the thesis work. Last but not the least we are grateful to **Swedish Institute (SI)** for covering one of our study expenses and made the journey of learning easier.

Abstract

Exchange rate volatility has been regarded as a vital macroeconomic concern for the policy makers and its impact on economic growth has gained much attention from the researchers in recent years. Existing studies tried to analyze the impact focusing on financial development. In contrast, we have given effort to examine it taking into account the trade dependence of the country. A panel of seven developing Asian countries has been studied for a total of 29 years (from 1985 to 2013). In order to generate the variable "exchange rate volatility" GARCH (1, 1) model is used with the monthly exchange rate of the countries for the period 1985 to 2013. By using cross sectional dependence test and panel unit root test the variable properties has been diagnosed and Pooled OLS, Panel Least Squares with Single Fixed Effects as well as Both way Fixed Effects and Panel EGLS with Mixed Effects has been used as the estimation technique. The findings suggest that exchange rate volatility has significant negative impact on economic growth and the impact becomes even more negative whenever Trade – GDP ratio is considered. In particular the negative impact of exchange rate volatility becomes more negative the higher the Trade – GDP ratio of the country. The finding is found to be robust against the definition of exchange rate volatility.

Key Words: Exchange Rate Volatility, Trade – GDP ratio, Cross Sectional Dependence, Panel Unit Root, GDP Growth, Fixed Effect.

Contents

List of Tables

List of Figures

1. Introduction

In the literature, Gross Domestic Product (GDP) refers to the total value of goods and services produced in an economy during a particular time period generally for one year. Whereas Economic growth is basically the growth of potential output that is obviously inflation adjusted. Hence we can define economic growth as the increase of total value of goods and services (inflation adjusted) produced in an economy for a particular time period. The evolution of different growth models (both exogenous and endogenous)[1] reveals several determinants of economic growth. Nevertheless, international trade, investment, labor forces, employment growth, inflation etc. could be considered as the most influential factors to economic growth of a country. An important macroeconomic policy variable is the exchange rate (it is conventionally defined as the rate at which one currency is traded for the other). Thus it is some kind of price which is regarded as the fastest moving in the economy (Jamil, Streissler & Kunst, 2012). Previously exchange rate has never been a main focus variable in analyzing economic growth. As per the international economics as a discipline suggests, it is actually good to have international engagement for all countries. Because they can have comparative advantage in particular sector that may help them to recover the needs of other products and to be efficient in case of production, growth, wage, employment etc. Whenever any country has such kind of involvement, exchange rate and its volatility must be under consideration as an important issue. It is an important determinant of competitiveness of the country thus its volatility may change the whole scenario if it is not predicted. Following particular channel, a country's economic growth might also be affected by this movement. Therefore, exchange rate volatility has been regarded as a vital macroeconomic concern for the policy makers and its impact has gained much attention from the researchers earlier.

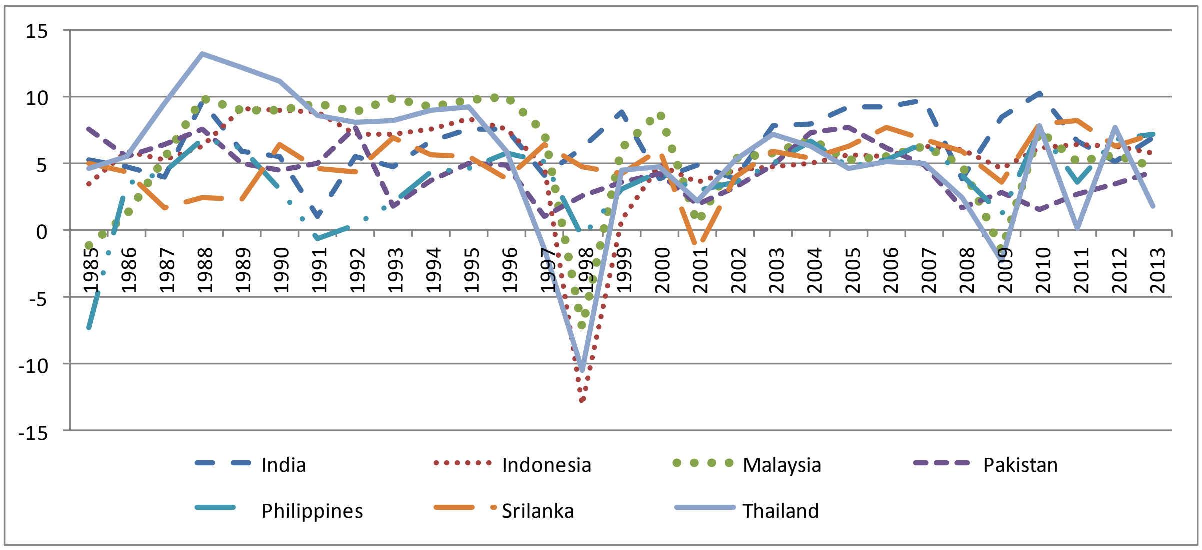
As real terms are more accepted regardless of any circumstances, Real Exchange Rate (RER) and its volatility is the main concern variable for the current study. It can be argued as the inflation adjusted rate at which one currency is traded with the other. On the other hand, the

[1] Exogenous growth models have tried to explain long run economic growth preliminary with the help of capital accumulation, labor force growth and technological progress. In contrast according to endogenous growth models the main exogenous growth variable i.e. technological progress is substituted and investment in human capital, innovation and knowledge has been regarded as the main driver of growth.

volatility of exchange rate can be defined as the amount of uncertainty associated with the magnitude of change in a currency conversion rate. According to Azeez, Kolapo & Ajayi (2012) the deviation of the exchange rate from the equilibrium level for over a period of time is usually referred to as the volatility of exchange rate. When the conversion rate of one currency in terms of other has surprising fluctuations in each direction within a very short time span, it is said to exhibit high volatility. As the convention suggests, volatility is measured using standard deviation which is a measure of dispersion and hence risk. Thus, the higher the volatility the higher is the risk in currency trade and more uncertain is the future conversion rate. On the other hand, if the conversion rate demonstrates moderate changes over a time horizon then it is characterized as less volatile. Following Stanèík (2007) and Insah & Chiaraah (2013), sources of exchange rate volatility might be domestic and foreign money supply, inflation, level of output, the exchange rate regime, openness of the economy, central bank independence, govt. expenditure and domestic and external debt.

Despite the sources, impact of exchange rate volatility is not that much predicted. There is no clear consensus in the findings of existing literature about the impact. It could bring either positive or negative effect for the growth of the economy. It might also affect directly or indirectly through different channels like investment, trade, financial development etc. Most of the available studies used financial development as an important channel and allowed volatility of exchange rate to interact with it while measuring the impact of exchange rate volatility on economic growth (for example Aghion *et. al.,2009)*. Some other studies have used trade as an indicator while defining it as trade volume (export plus import). Our focus is to use Trade - GDP ratio in this regard. So the current study will be estimating the impact of exchange rate volatility on economic growth considering the level of Trade – GDP ratio of the country. Here we would like to examine whether depending on Trade - GDP ratio, effect of exchange rate volatility on economic growth varies or not. In particular, our hypothesis can be stated as, the more dependency on trade could result in worse impact of exchange rate volatility on economic growth. It would be a panel estimation using seven countries (India, Indonesia, Malaysia, Philippines, Pakistan, Srilanka and Thailand) for 29 years (from 1985 to 2013). All these countries are recognized as developing Asian countries with open economy, involved in international trade. As mentioned earlier, when a country is involved in international trade, exchange rate and its volatility is very important to consider. Historical trend of concerned variables support the aforementioned hypothesis. For example Malaysia, Indonesia and Thailand have experienced negative economic growth during late 90's due to some external shocks. During that time most of the developing Asian countries went through a volatile exchange rate but the aforementioned countries found to be most severely affected perhaps due to over dependency on trade (Figure 1, 2 and 3).

Figure 1: Historical Trend of GDP Growth in Developing Asian Countries



Source: World Development Indicators (WDI), 2015

Along with growing trade developing nations from Asia have also been witnessing a change in their exchange rate regimes. Empirical data suggests that exchange rates have become more flexible in the past few decades for most of the Asian countries (Kaur & Vikram, 2013). Therefore it is imperative to study the impact of volatility of exchange rate allowed by such flexible exchange rate regime for this particular area in the world.

2. Literature Review

2.1 Existing Studies in the arena of Exchange Rate Volatility and Growth Nexus:

Exchange rate is not only an important macroeconomic variable but also an important determinant for the volume of international trade. In recent years, when the countries around the world were switching from fixed to pegged or managed pegged or completely flexible exchange rate system, studying the economic impact of exchange rate volatility earned a lot of attention. Researchers have already given endeavor to measure the impact from several perspectives. Surprisingly, the existing empirical studies have not been able to draw any concrete conclusion about the influence of exchange rate volatility on growth. The so called findings are rather "mixed" and "ambiguous". Some suggests that exchange rate volatility may positively affect economic growth of a country while others deny. It may also affect directly or indirectly through investment, trade or financial development of a country. However, some other literatures have remained inconclusive in this regard.

Bailliu, Lafrance & Perrault (2003) have used dynamic Generalized Method of Moments (GMM) estimation procedure to examine the influence of exchange rate regime on economic growth. They constructed a panel with 60 countries where time series was ranged from 1973 to 1998. Along with weak exogeneity they made assumptions for the consistency of the estimates. In order to deal with the endogenity problem they used lagged explanatory variables as the instruments. However, they failed to provide any specific conclusion regarding the issue. The study concluded saying that any kind of exchange rate regime (pegged, intermediate or flexible) characterized by monetary policy anchor exert a positive influence on growth. They have emphasized on the importance of monetary policy framework. Using almost similar methodology and informal growth equation Chen (2012) concluded that real exchange rate appreciation affects economic growth positively. The study has particularly used data from 28 Chinese provinces for the period 1992 to 2008 and thereby remained unique in the literature for this research field. On the other hand, Omojimite & Akrokodje (2010) performed a comparative study of the effect of exchange rate volatility on exports in the Communaute Financiere Africaine (CFA) and Non CFA countries in Africa. By following fixed effect and GMM estimation technique, they found that exchange rate volatility has negative impact on economic growth for both countries but larger effects for non CFA countries.

There are also some studies based on pure time series analysis. For instance, Insah & Bangnyel (2014) investigated the marginal effects of real exchange rate volatility on economic growth by using dynamic ordinary least square (DOLS) and a level - level specification for Ghana. The study found a positive impact of real exchange rate volatility on economic growth. In particular, it argued that the responsiveness of GDP growth in Ghana is close to 50 per cent with respect to an increase or decrease of real exchange rate volatility. However, the study can strongly be criticized as the growth model ignored all other important determinants but real exchange rate volatility. Similarly, Danmola (2013) tried to examine the impact of exchange rate volatility on GDP, FDI, Trade Openness and Inflation in Nigeria for the period 1980 to 2010. The study has used Pair wise Correlation, Granger Causality Test and Ordinary Least Square (OLS) technique for estimating simple linear regressions. The findings outlined that volatility exhibits a positive influence on GDP, FDI and Trade openness while it is negative on inflation rate of the country. The study has some drawbacks as the integration level of the variables was not the same. Also, relying on simple linear regression without controlling other important variables can cause endogeneity problem leading to biased estimation of the parameters. However, Azeez, Kolapo & Ajayi (2012) came up with the same conclusion for Nigeria too. They used data from 1986 to 2010 and OLS for short run and Johansen cointegration for long run estimation of the parameters. For both cases, there were significant positive impacts of nominal effective exchange rate volatility on GDP growth.

In contrast, Carranza, Cayo & Galdon – Sanchez (2003) did a time series analysis for Peru with 163 non-financial listed firms. They found evidence that firms investment decisions are negatively affected by real exchange rate depreciation. Meanwhile, for Kenya, Musyoki, Pokharlyal & Pundo (2012) performed a time series analysis with data from January 1993 to December 2009 and also found a negative impact of exchange rate volatility on economic growth. In order to measure volatility they used GARCH model and unconditional standard deviation and for estimating the model they relied on GMM technique. However, the study did not state any proper diagnostic test for the appropriateness of the estimated parameters and how it deals with the endogeneity of the instruments. On the other hand, Akpan & Atan (2012) did not find any evidence of a strong direct relationship between changes in exchange rate and GDP growth in Nigeria. There economic growth has been directly affected by monetary variables. GMM estimation technique was also used for the quarterly series from 1986 to 2010. It draws attention that they did not use volatility of exchange rate rather only nominal exchange rate had been the variable of interest. Another recent time series study was Sanginabadi & Heidari (2012) which used Autoregressive Distributed Lag (ARDL) bound test approach to level relationship and found significant negativity between Iranian economic growth and exchange rate volatility.

In the recent past, there has been some studies based on panel data analysis identifying that exchange rate volatility has negative impact on economic growth. For instance in OECD countries Janus & Crichton (2015) found that one standard deviation volatility decrease can account for two percentage point growth increase. They argued that real effective exchange rate stability can be growth enhancing in OECD countries. For the Central and Eastern European (CEE) countries Arratibel, Furceri, Martin & Zdzienicka (2011) reached an identical conclusion. However, they used a *"z – score"* measure for volatility of nominal exchange rate which is quite unorthodox.

In emerging Europe and East Asian countries Schnabl (2007) found inverse relation between exchange rate volatility and economic growth by using GLS and GMM technique. In contrast, Huchet-Bourdon & Korinek (2011) argued that exchange rate volatility have little impact on trade. They studied in particular Agriculture, Manufacturing and Mining sector of China, the Euro Asia and the United States.

Nevertheless the most general study was perhaps by Aghion, Bacchetta, Ranciere & Rogoff (2009) who used a panel of 83 countries from 1960 to 2000 to show the impact of exchange rate volatility on productivity growth. GMM dynamic panel estimation came up with the conclusion that exchange rate volatility has impact on productivity growth depending on country's financial development. Negative relation was found for financially less developed countries while effect is insignificant for financially advanced countries.

It is therefore evident that there is not enough studies on the issue concerning Asian countries. However, recently using 2SLS and fixed effect estimation technique Kaur & Vikram (2013) explored economic impact of trade openness and exchange rate regimes for 18 Asian countries during 1961 to 2006. Their target was to examine whether a country's degree of openness matters in choosing how flexible an exchange rate system should be if the objective is to improve per capita GDP or its growth. Evidence showed that both trade openness and exchange rate flexibility impact GDP favorably. It also revealed that though exchange rate volatility independently has a positive (though generally non – significant) impact on output per capita, for more open Asian countries economic impact of greater volatility is significantly negative.

2.2 Motivation for the current study and the Limitations:

The above discussion infers that there is a very small number of works on the volatility of exchange rate and growth nexus that targets Asian countries. The number becomes even smaller when we try to analyze the nexus taking into account the trade dependence of the country. The last study mentioned above could possibly be the sole one in the recent times. Thus, targeting the Asian countries, a study in the area of volatility of exchange rate and growth nexus considering trade involvement would be a valuable contribution to the literature.

Our work involves a panel of seven developing Asian countries for the period 1985 to 2013. The set of countries includes India, Indonesia, Malaysia, Philippines, Pakistan, Srilanka and Thailand, which are actually conditioned upon the availability of data on the required variables. By using the most updated available data, i.e. till the year 2013, we wanted to examine the impact of exchange rate volatility on economic growth depending on trade involvement. Here we have defined the trade involvement by the trade as percentage of GDP. Our main variable Real Exchange Rate (RER) is constructed from monthly data, whereas the above study used yearly data for RER. While the last study mentioned above used unconditional standard deviation to extract volatility, we have used conditional standard deviation estimated using GARCH (1, 1) model as well as unconditional standard deviation for extracting the volatility. One major difference and self - evident motivation for our work in relation to the existing one is the growth model. Along with the concerned variables, we have tried to control investment, labor and inflation that are usually treated as the first and foremost important variables for the growth accounting despite the type of growth theory. Depending on the data characteristics, we also have used different estimation and data diagnostic techniques.

Nevertheless, the current study also has some limitations from several points of views. First of all, in terms of data structure, the set of cross section units that has been considered is not large and diversified enough that could make us cautious before coming to any general conclusion from the study. Secondly, regarding variables, we have used some proxies where availability of the original variable would obviously have made the findings stronger. We have used Real Exchange Rate (RER) instead of trade weighted Real Effective Exchange Rate (REER) while perhaps the later one would have been able to show more important insights regarding the issue. The study has not been able to provide any concrete monetary policy recommendation (for example, which exchange rate regime, namely flexible, fixed or pegged is better or how much flexible a country's exchange rate should be) as it did not consider the actual exchange rate regime of the countries during the study period.

The current paper has six sections. Section 1 provides a brief introduction about the study. Section 2 includes review of literatures with the existing studies and their findings and provides motivation for the current study. It is followed by methodological framework and data in Section 3 where the main model is discussed and eventually the hypothesis has been established. This section also includes discussion about the data diagnostic techniques. Data and description of variables including summary statistics and historical trend is presented in section 4. Consequently, section 5 includes empirical results and discussion. It includes data diagnostic test results, estimation results for static and dynamic model, test results for model appropriateness and finally estimation results for robustness checking of the findings. This section is followed by section 6 that provides the concluding remarks.

3. Methodological Framework and Data

3.1 Methodology and Establishment of Hypothesis:

There is quite a handful of literature establishing the impact (either positive or negative) of Trade on GDP growth or output growth (e.g. Barro, 1991, Edwards, 1993, Dollar & Kraay 2001, Yanikkaya, 2003, Andersen & Babula, 2008, Yucel, 2009, Ali & Abdullah, 2015, Musila & Yiheyis, 2015). It has also been already established by now that trade is condition upon "exchange rate volatility" which is an important macroeconomic stability parameter (e.g. Kenen & Rodrik, 1986, Ghura & Greenes, 1993, Coric & Pugh, 2010, Omojimite & Akpokodje, 2010, Huchet – Bourdon & Korinek, 2011). So, it is possible that exchange rate volatility contains a significant impact on economic growth through its impact on the trade of the region. The general hypothesis that we would like to emphasize and empirically test here can be postulated by saying that the exchange rate volatility has negative impact on GDP growth and which would become even more negative if we allow trade to interact with volatility of exchange rate.

The theoretical framework and the idea for the study were originally developed by Aghion *et. al.* (2009). They were the pioneer who gave effort to empirically test the relationship between exchange rate volatility and productivity growth conditioning upon financial development. Ndambendia & Ahmed (2011) applied the same idea to test the impact of exchange rate volatility on economic growth conditioning on domestic credit to GDP ratio in Sub – Saharan Africa. Nevertheless the process of identifying the threshold level was found to be different for each of the study.

Taking their method as benchmark in the current study we would try to empirically test the impact of exchange rate volatility on economic growth conditioning on trade dependence of the country. Following Aghion *et. al* (2009) the panel data model that we would be estimating can be expressed as below:

$$RGDP_{i,t} = \eta_i + \mu_t + \alpha_1 LVOL_{i,t} + \alpha_2 (LVOL_{i,t} * TGDP_{i,t}) + \beta\, TGDP_{i,t} + \psi' X_{i,t} + \varepsilon_{i,t} \qquad (1)$$

where, i = 1, 2, ------ N and t = 1, 2, ------ T. $RGDP_{i,t}$ is the real GDP growth rate of country i at time t, $LVOL_{i,t}$ denotes the log of volatility of real exchange rate (RER), $TGDP_{i,t}$ stands for Trade – GDP ratio, $(LVOL_{i,t} * TGDP_{i,t})$ is the interaction term between log of volatility of RER and Trade – GDP ratio and $X_{i,t}$ is the set of other control variables which includes gross fixed capital formation as percentage of GDP, employment growth, rate of inflation and sometimes lag of dependent and other independent variables. Here we have used the gross fixed capital formation as a substitute of capital or investment and employment growth as a substitute of labor. Finally, η_i and μ_t represent the country specific and time specific effect respectively while $\varepsilon_{i,t}$ is the error term with all unobserved factors.

As the theory and existing literature suggests in the above model α_1 could be less than zero (< 0) and α_2 could be either less than zero (<0) or greater than zero (>0). However, depending on the sign of the coefficients of log of volatility and interaction term, we could possibly have three alternative scenarios and findings.

Scenario 1: $\boldsymbol{\alpha_1} < 0$ ***and*** $\boldsymbol{\alpha_2} < 0$[2]

In equation (1) the derivative of GDP growth rate (*RGDP*) with respect to log of volatility of RER (*LVOL*) would become as follows:

$$\frac{\delta RGDP_{i,t}}{\delta LVOL_{i,t}} = \alpha_1 + \alpha_2 TGDP_{i,t} < 0 \qquad (2)$$

It argues that the responsiveness of GDP growth rate *(RGDP*) or it's elasticity with respect to log of volatility of RER (*LVOL*) is negative and this negative responsiveness becomes even more negative as Trade – GDP ratio (*TGDP*) becomes higher. Thus, the higher the Trade – GDP ratio (*TGDP*) of a country or in other words the higher the trade openness the more will be the harsh impact of volatility of RER (*LVOL*).

Scenario 2: $\boldsymbol{\alpha_1} < 0$ ***and*** $\boldsymbol{\alpha_2} > 0$ [3]

Following Aghion *et. al* (2009) the sign of above coefficients argues that the impact of volatility of RER (*LVOL*) would be more negative when Trade – GDP ratio (*TGDP*) is at a lower level. In particular, a threshold effect may present there postulating that volatility of RER (*LVOL*) would become growth enhancing when the Trade – GDP ratio exceeds that threshold ($\overline{TGDP}$). In order

[2] Ndambendia & Ahmed (2011) worked with this hypothesis for measuring the impact of exchange rate volatility on growth taking into account the domestic credit to GDP ratio of the economy.
[3] Aghion *et. al* (2009) worked with this hypothesis while estimating the impact of exchange rate volatility on productivity growth in relation to financial development of the economy.

to determine the threshold we can consider the derivative of GDP growth rate (*RGDP*) with respect to log of volatility of RER (*LVOL*). In equation (1) the derivative results in the following expression:

$$\frac{\delta RGDP_{i,t}}{\delta LVOL_{i,t}} = \alpha_1 + \alpha_2 TGDP_{i,t} > 0 \qquad (3)$$

$$\Leftrightarrow \alpha_2 TGDP_{i,t} > \alpha_1 \; (as\; \alpha_1 < 0)$$

$$\Leftrightarrow TGDP_{i,t} > \frac{\alpha_1}{\alpha_2} = \overline{TGDP_{\iota,t}}$$

Scenario 3: $\alpha_1 > 0$ and $\alpha_2 < 0$[4]

The above scenario is just the opposite of scenario 2. It argues that volatility of RER (*LVOL*) has positive impact on growth when the Trade – GDP ratio (*TGDP*) is lower. However, at higher level of Trade – GDP ratio (*TGDP*) the overall impact of volatility of RER becomes negative. Here again we can find a threshold level saying that the impact of volatility of RER (*LVOL*) would become negative if the Trade – GDP ratio (*TGDP*) is higher than that level. Consider the derivative of GDP growth rate (*RGDP*) with respect to log of volatility of RER (*LVOL*):

$$\frac{\delta RGDP_{i,t}}{\delta LVOL_{i,t}} = \alpha_1 + \alpha_2 TGDP_{i,t} < 0 \qquad (4)$$

$$\Leftrightarrow -\alpha_2 TGDP_{i,t} < -\alpha_1 \;\; (as\; \alpha_1 > 0\; and\; \alpha_2 < 0\,)$$

$$\Leftrightarrow \alpha_2 TGDP_{i,t} > \alpha_1$$

$$\Leftrightarrow TGDP_{i,t} > \frac{\alpha_1}{\alpha_2} = \overline{TGDP_{\iota,t}}$$

[4] Insah & Bangnyel (2014), Danmola (2013), Bailliu, Lafrance & Perrault (2003) and Chen (2002) found positive impact of exchange rate volatility on growth.

3.2 Cross Sectional Dependence Test:

Since the countries around the world are gradually becoming more and more integrated through trade and investment, macroeconomic variables of different countries could possibly become simultaneously affected because of common shocks (Hasan, Hoque & Koku, 2015). When such common shock exists, it eventually could result in creating dependency among the different cross section units in the panel (Munir & Kok, 2015). Thus, in order to avoid size distortion, we need to perform the panel unit root test in such a way that becomes robust against cross sectional dependence. Therefore, it is of sheer importance to detect the presence of cross sectional dependence in fitting panel data models (De Hoyos & Sarafidis, 2006). In particular, we would be focusing on four different cross sectional dependence tests[5] namely Breuch – Pagan Lagrange Multiplier (LM) (1980), Pesaran Cross Sectional Dependence (CD) (2004), Pesaran Scaled LM (2004) and Baltagi, Feng and Kao Bias Corrected Sclaed LM (2012). Each of the tests has its own pros and cons. For instance Breuch – Pagan Lagrange Multiplier (LM) (1980) is particularly applicable in the context when N (cross section units) remains fixed and T (time series) tends to infinite ($T \rightarrow \infty$). On the other hand though Pesaran Scaled LM (2004) is appropriate when $T \rightarrow \infty$ and $N \rightarrow \infty$ it probably could face substantial size distortion for large N and small T. However, Pesaran CD (2004) is regarded as the most general one as it is suitable for stationary and as well as non – stationary panels. It also consists of reasonable small sample properties. The null hypothesis that would be tested in all the tests can be stated as the residuals from the standard panel regression should be contemporaneously uncorrelated. Therefore, they would basically test whether the pair - wise covariance among residuals are zero or not. Symbolically:

$$H_0: \rho_{ij} = \rho_{ji} = Cov(\varepsilon_{it}, \varepsilon_{jt}) = 0, for\ all\ t, i \neq j$$

$$H_1: \rho_{ij} = \rho_{ji} = Cov(\varepsilon_{it}, \varepsilon_{jt}) \neq 0, for\ all\ t, i \neq j$$

[5] A brief description of these tests is given in Appendix A.

3.3 Panel Unit Root Test:

It is established in the literature that none of the panel unit root test have been successful to overcome convincingly the statistical pitfalls on the basis of size and power properties. However, it is conventional that the panel based unit root tests are better than the individual unit root test in terms of the power properties. Cross – sectional independence is a crucial assumption for all the readily available panel unit root tests, namely Maddala & Wu, 1999; Breitung, 2000; Hadri, 2000; Levin *et al.*, 2002, and Im *et al.*, 2003. Here, Levin, Breitung and Hadri all three are based on the assumption of common unit root process while Im and Maddala are based on individual unit root process. Among all most commonly used tests are Maddala & Wu, 1999; Levin *et al.*, 2002 and Im *et al.*, 2003 (Hasan, Hoque & Koku, 2015, Aslan & Korap, 2009). Nevertheless Im, Pesaran and Shin (IPS) panel unit root test (Im *et al.*, 2003) is the one which relax the restrictive assumptions of no serial correlation and panel homogeneity. Im, Pesaran and Shin (1995) proposed demeaning procedure (subtracting group mean from the data) in order to denounce the contemporaneous correlation of the data. Therefore, we have used IPS panel unit root test to detect the stationarity of the variables[6]. In order to perform the test at first for each variable, an AR(1) process is estimated and then for each cross section unit an Augmented Dickey Fuller (ADF) test regression is fitted. The IPS panel unit root test in particular, examines the significance of the autoregressive coefficient attached with lagged level dependent variable in ADF regression to detect the stationarity of the variables. Therefore, if the ADF test regression takes the following form:

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij}\, \Delta y_{it-j} + x_{it}^{'}\delta + \varepsilon_{it} \qquad (5)$$

then the appropriate null hypothesis would be $H_0: \alpha_i = 0,\ for\ all\ i$. In the above regression y_{it} denotes the variable of concern for which stationary would be tested and x_{it} stands for other control variables.

[6] A brief description of the tests is given in Appendix A.

3.4 Data and Statistical Software:

We have mainly used two secondary data sources to prepare the whole panel data set, namely International Financial Statistics (IFS) database from IMF and World Development Indicators (WDI) database from World Bank. A total of seven developing countries from Asia namely India, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka and Thailand have been observed from 1985 to 2013. The choice of the countries was confined into the availability of data on required variables for the study period. The yearly observations for variables Growth Rate of Real GDP, Trade – GDP ratio, Gross Fixed Capital Formation (as % of GDP), rate of Inflation has been taken from WDI database. IFS database was used to collect data on employment growth. To have a continuous series on employment growth for some countries, we had to interpolate data for few years. Monthly observations on nominal exchange rate defined as the "national currency per USD" and consumer price index have been collected using IFS database. We have used EVIEWS 9 and STATA 13 to perform the statistical analysis of the study.

4. Variable Descriptions and Summary Statistics

4.1 Real Exchange Rate (RER) and Estimation of its Volatility:

The exchange rate of a currency would be called "real" when changes in the price levels are considered while measuring the value for it in terms of other currencies. It is considered as a measure of international competitiveness that assists to measure the inflation and currency effects (Azid, Jamil & Kousar, 2005). For instance, an increase in the Real Exchange Rate (RER) for a country would imply that relative to the competitors in the international market, the products that it has been exporting are becoming more expensive than before. As a result the country is likely to face a fall in export earnings while having a rise in import payments. Thus, as per the law of international finance, current account deficit would be widened and at the same time there could be shrinkage in the domestic aggregate demand which eventually would curb the inflation. It is beyond debating that an increase in the RER will decrease the international competitiveness and vice versa.

It is imperative in this stage to state how did we measure the real exchange rate (RER) and estimate its volatility. As this is the main variable of concern in this study, we would also check the robustness of findings using different definition of this variable. Assume that $RER_{i,t}$ denotes the real exchange rate of country " i " at time " t ". It is defined here as the relative inflation adjusted exchange rate and constructed as the product of nominal exchange rate (NER) and the ratio of consumer price index (Adler & Lehman, 1983, Jamil, Streissler & Kunset, 2012). Since we have considered USD as the base currency, nominal exchange rate and ratio of consumer price index of a country is expressed in relation to USD and US consumer price index (CPI) respectively. In particular RER of country " i " at time " t " is measured in the following way:

$$RER_{i,t} = \left(\frac{Currency\ of\ Country\ i_t}{USD_t}\right) * \left(\frac{US\ CPI_t}{CPI\ of\ Country\ i_t}\right)$$

$$= NER_{it} * \left(\frac{US\ CPI_t}{CPI\ of\ Country\ i_t}\right) \qquad (6)$$

The volatility of exchange rate indicates the uncertainty associated with the changes in exchange rate. The way we have constructed the RER above argues that volatility of RER of a country can take place either due to the volatility of NER or relative CPI or due to the volatility of both variables. Whatever the case higher volatility of RER would mean that exchange rate can possibly move over a large set of values while lower volatility would indicate that exchange rate changes steadily over a period of time (Yusoff & Sabit, 2015). Figure B1 (Appendix B) contains the trend of the variable RER of the sample countries for the study period.

The term volatility of RER measures the degree to which RER of a country changes over the time. The RER of a country would be more volatile whenever the changes or fluctuations of RER becomes more often. As the name suggests, the fixed exchange rate is not supposed to change and hence there would be no volatility of RER in the country that follow such exchange rate regime. However, it should be mentioned here that throughout the world, fixed exchange rate is subject to change due to devaluation or reevaluation of currencies which results in volatility or fluctuation even in the exchange rate regime mentioned earlier. In contrast, as the floating exchange rate is allowed to fluctuate they are usually more volatile than the fixed one[7]. In our study, we have estimated the volatility of RER in two different ways. As a first case we

[7] The idea of "Exchange rate Volatility and Risk" is explained by Steven M. Suranovic in the book "International Finance Theory and Policy". **http://internationalecon.com/Finance/Fch110/F110-1.php**

have estimated the RER volatility using the Generalized Autoregressive Conditional Heteroscedasticity[8], GARCH (1, 1) model with monthly observations of natural logarithm of RER. Such model has already been established as the successful one to estimate or predict volatility changes. As they are proven to be more capable of capturing stylized facts of volatility, these models are widely accepted (Jamil, Streissler & Kunset, 2012). For Instance, Insah & Bangnyel (2014), Heidari & Hashemi Pourvaladani (2011), Azid, Jamil & Kousar (2005), and Huchet – Bourdon & Korinek (2011) have particularly used GARCH model for estimating volatility. It is also possible to estimate the volatility using Autoregressive Conditional Heteroscedasticity (ARCH) model. The required lag length in ARCH model remains usually large which means we need to estimate a large number of parameters if we would like to predict volatility using this model. In contrast to this, the conditional variance is allowed to depend upon its own lags in GARCH model. This typically reduces the number of required ARCH lags when we are predicting the volatility. In the second case, with a view to checking the robustness of the findings, we have changed the definition of volatility of RER from conditional to unconditional and measured it using the regular unconditional formula of standard deviation.

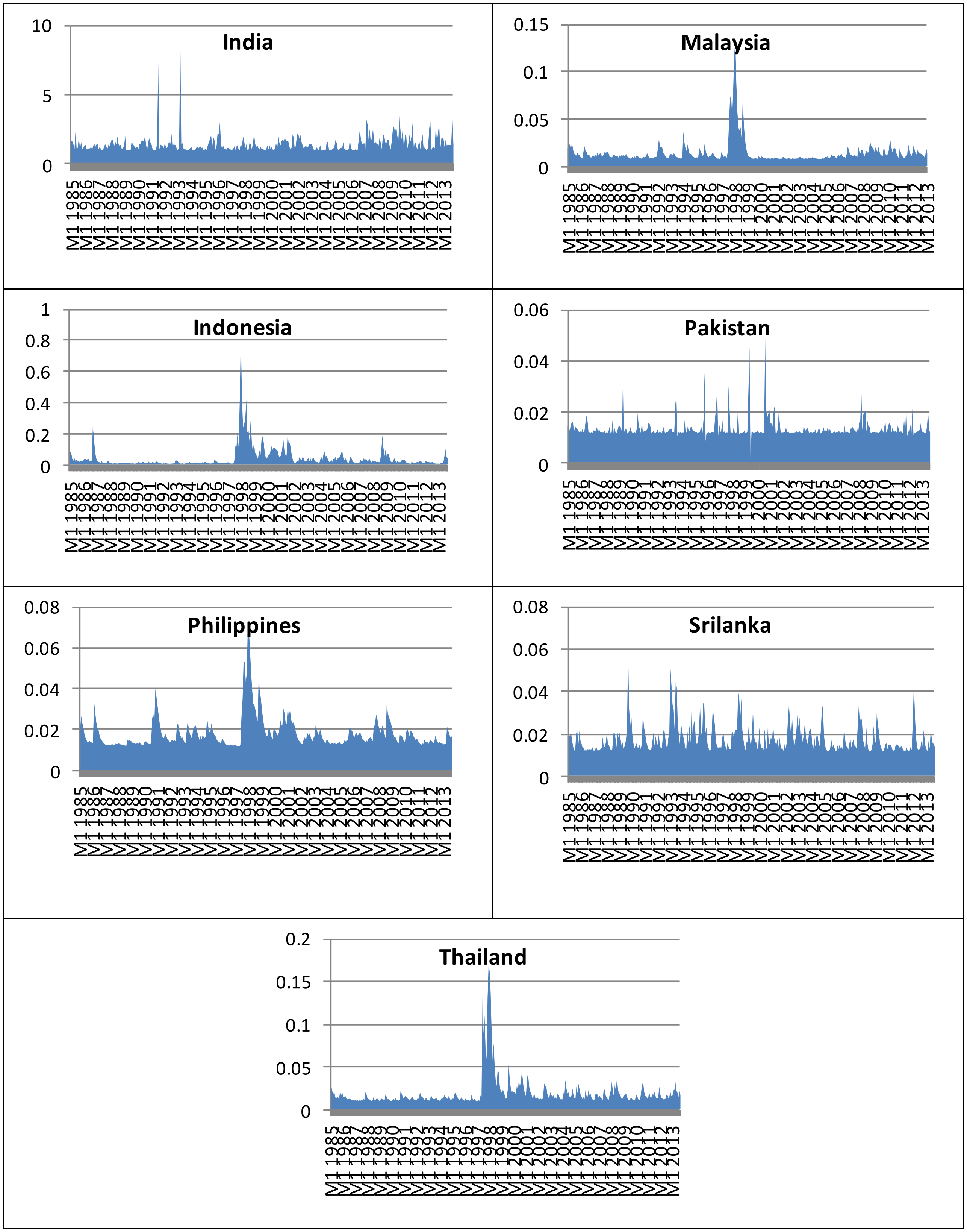
Figure 2 contains the RER volatility over time for all the sample countries which is estimated using GARCH (1, 1) model and Table C1 (Appendix C) contains their summary statistics. It is evident that among all countries, India has the highest value of RER volatility. The average value of volatility of RER was found to be 1.48 with a maximum of 9.15 and a minimum of 1.02. In terms of average volatility of RER, India is followed by Indonesia, Thailand, Philippines, Sri Lanka, Malaysia and Pakistan. A common feature in the time trend of volatility of RER in Malaysia, Indonesia, Philippines and Thailand is that during late 90's all of them experienced hugely volatile RER compared to what they had in past. This is because of Asian Financial Crisis when all the aforementioned countries have been affected badly and followed a series of own currency devaluation. On the other hand a close look on the time trend of volatility of RER for India, Pakistan and Sri Lanka will reveal the fact that there exist some spikes in all countries in regular intervals. When exchange rate becomes more volatile due to increase in *exchange rate risk*[9] trade and investment decision also becomes more difficult to make.

---

[8] GARCH model for estimating the volatility was pioneered by Engel (1982) and Bollerslev (1986).

[9] Exchange rate risk refers to the potential to lose money because of a change in the exchange rate, "International Finance Theory and Policy" by Steven M. Suranovic

Figure 2: RER Volatility in Developing Asian Countries



Source: Author's estimation using GARCH (1, 1) model.

4.2 GDP Growth:

GDP growth is defined here as the annual percentage growth of Gross Domestic Product (GDP) at market prices based on constant local currency (WDI Database, World Bank). Figure 1 presents the historical trend of GDP growth of the countries. Table C1 (Appendix C) contains the summary statistics of the GDP growth for all the countries during the period 1985 to 2013. It has been observed that India has the highest average GDP growth with 6.38 per cent while Philippines has the lowest with a value of 3.81 per cent. The rest of the countries have their average growth rate around 5 per cent per annum. Except India and Pakistan, all other countries had experienced negative growth rate in some years during the study period. In particular, during the year of 1998, most of the countries have experienced negative GDP growth. Perhaps they had been hardly hit by the Asian Financial Crisis during that time[10]. Thailand has achieved its maximum GDP growth of 13.28 per cent as far back in the year of 1988. The reason that could explain the recent down turn of growth rate of that country is the political instability. In 2010, India achieved the highest growth rate of 10.26 per cent. In contrast, Malaysia achieved its highest growth rate of 10 per cent during 1996.

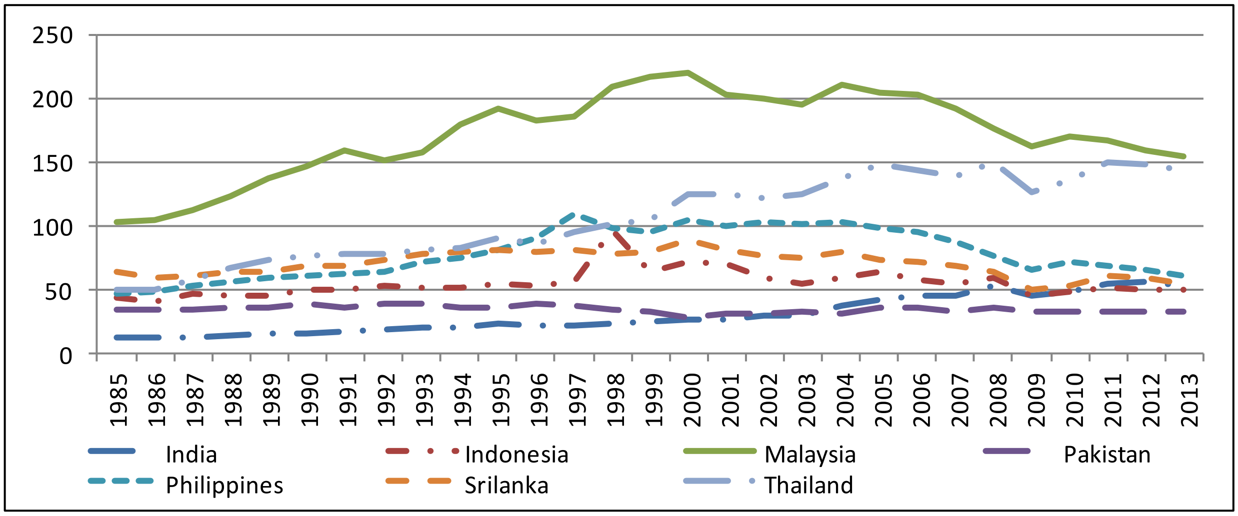
4.3 Trade – GDP Ratio:

Trade – GDP ratio is defined here as the sum of exports and imports of goods and services measured as the share of GDP (WDI Database, World Bank). The ratio can be argued as a measure of trade dependence of a country. The higher the contribution from trade in the GDP of a country, the more the country's economy would be vulnerable in terms of export or import shock. However, as the countries over the world have been becoming more and more open since long ago the volume of trade and also its share in their GDP is increasing over the years.

---

[10] Asian Financial Crisis which is recorded to come out in the picture during July 1997 clutched most of the East Asian countries. The crisis was originated in Thailand when the particular govt. float the currency (Thai Baht) facing the adequate foreign currency supply to support it's the then exchange rate regime. Facing tremendous market pressure Malaysia, Indonesia and Philippines also had weakened their respective currencies. All these countries observed to be the most affected for the crisis.

Figure 3: Historical Trend of Trade - GDP ratio in Developing Asian Countries



Source: World Development Indicators (WDI), 2015

Figure 3 presents the time series trend of Trade – GDP ratio of the countries from 1985 to 2009. As the figure suggests in our sample, Malaysia is the country which has the highest Trade – GDP ratio among all countries throughout the study period. The trade dependency of this country was observed to be tremendously high with a minimum of 103.16 per cent in the year of 1985 and a maximum of 220.40 percent during the year of 2000. The average trade dependency has found to be as high as 171.57 per cent for this country with a standard deviation of 33.40 (Table C1, Appendix C). This could be explained by saying that Malaysia perhaps was domestically producing way little amount compared to what they used to export and import.

4.4 Inflation:

Here, inflation (annual percentage) refers to the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specific intervals, such as yearly (WDI Database, World Bank). Increasing inflation is a threat for the value of money and by that way a threat as well for the purchasing power of the people in the economy. Although the issue of an exact relationship between inflation and GDP growth has been debatable since long ago, the fact that the former one does contain impact (either positive or negative) on the later one is well established. Stockman (1981), Fischer (1993), Judson & Orphanides (1999), Mallick & Chowdhury (2001), Munir, Mansur & Furuoka (2009) and Sethi (2015) are the worth mentioning literatures in the recent past who argued about the impact of inflation on GDP or output growth. Figure B2 in Appendix B presents the historical trend in the rate of inflation for different countries during the study period. It is established that the highest average rate of annual inflation was in Sri Lanka with a value of 9.99 per cent followed by Indonesia, Pakistan and India with values of 9.84, 8.63 and 7.85 per cent respectively. In terms of average annual percentage change in prices of goods and services Malaysia performed tremendously well by just conceiving a rate of only 2.54 per cent which is the lowest among all sample countries. Thailand was found to be the other country which had experienced an average annual rate of inflation of 3.52 per cent during the study period. In terms of dispersion of rate of inflation, Malaysia and Thailand have been doing well also with a value of only 1.40 and 2.10 respectively Thus, these two countries actually have consistently been maintaining a low rate of inflation. In contrast, Pakistan and India had standard deviation of 3.97 and 3.11 respectively with a high average annual rate (Table C1, Appendix C).

4.5 Gross Fixed Capital Formation:

Share of gross fixed capital formation in GDP has been used as a substitute of investment share of GDP for a country. Gross Fixed Capital Formation (GFCF) includes land improvements, plant, machinery and equipment purchases and the construction of infrastructure including schools, offices, hospitals, private residential dwellings and commercial as well as industrial buildings (WDI Database, World Bank). Figure B3 (Appendix B) contains the time series trend on gross fixed capital formation while Table C1 (Appendix C) contains the summary statistics for it over the period 1985 to 2013. As the figure suggests, India, Indonesia, Philippines and Sri Lanka have been increasing their share of GFCF in GDP over the years while that have remained almost constant in Thailand. In contrast, Pakistan has actually received a down fall in GFCF in terms of her GDP percentage. During the early 90's, Thailand and Malaysia both had a high and handsome share of GFCF in their GDP. In particular, sometimes they had the share as close as 40 per cent. Nevertheless it came down in the late 90's and started picking up slowly again in the early years of last decade.

4.6 Employment Growth:

Employment growth is measured as the percentage change in employment from current year to next year. It has been used as a substitute of labor force in our current study. Figure B4 and Table C1 (Appendix B and C) respectively contains the historical trend and summary statistics of employment growth in different countries from 1985 to 2013. The left hand side vertical axis is used to measure the employment growth of India only. It can be observed that the employment growth in India has been moving around zero with an exception during the year of 2003. It should be worth mentioning here that the data on employment growth during 2003 and 2004 was missing in the original source which we had to interpolate to complete the series. Thus, the unexpectedly high value in those years can be ignored. This also stimulated the average employment growth in India (19.20 per cent) during the study period (Figure B4, Appendix B).

5. Results and Discussion

5.1 Testing the presence of ARCH effect and Estimating Volatility of RER:

As the name of the study suggests, main concerned variable here is the "Real Exchange Rate (RER)". The whole study concentrates on identifying the impact of volatility of RER on GDP growth of a country considering the Trade – GDP ratio of the country concerned. Thus, as a first task, we have collected monthly observations of national currency per US $ i.e. exchange rate for each of the countries for the period 1985 to 2013. The RER exchange rate is defined here as the relative Consumer Price Index (CPI) weighted. To convert the exchange rate of each country, we have actually multiplied it with the ratio of US CPI to the CPI of respective country. Therefore it could be argued that the US $ and CPI has been used as the benchmark currency and index respectively for this study. We have tested for the presence of ARCH effect[11] for each country using Lagrangian Multiplier test for Autoregressive Conditional Heteroscedasticity (ARCH) before identifying the predicted volatility of RER. STATA 13 has been used to carry out the test. In order to perform the test for each of the country, we have transferred the RER into log of RER and regressed the later one upon its lag and have predicted the residuals from there. Then we have plotted the residuals against time for each of the country to have a visual inspection of the

[11] A brief description of how the test was implemented is given in Appendix A.

existence of volatility. Test for ARCH effects in the residuals have been performed form post estimation time series specification tests. Table C2 (Appendix C) contains the result. A keen look on the table establishes the fact that the null hypothesis of *"no ARCH effect"* can convincingly be rejected at 1 per cent level for all the countries except India as the Chi – Square statistic is found to be significantly high. Thus we have estimated widely accepted "Generalized Autoregressive Conditional Heteroscedasticity" GARCH (1, 1) model for each of the countries and predicted the conditional variance which is used as a measure of conditional volatility of RER[12]. In order to check for the robustness of the results we have also used another definition of volatility of RER where we have calculated the unconditional standard deviation of the monthly RER and took a yearly average of that. It is also considered as the most common way of volatility measurement. Although it might have some limitations regarding the distributional assumptions of the variable it is calculated for, it could be considered as a measure of "long – term" volatility (Kalra, 2008).

5.2 Cross Sectional Dependence and Panel Unit Root Test:

With a view to determining the appropriate estimation method, we need to check the stationary of the variables and also their order of integration. But cross sectional dependence or cross sectional correlation of the variables is a fact that we should detect for the variables to decide which panel unit root test should be applied[13].

Table C4 (Appendix C) contains the test results for Cross Sectional Dependence test of different variables. For testing the null hypothesis of *"no cross – section dependence"* for each of the concerned variables, we have four different test results namely, Breusch – Pagan LM (1980), Pesaran Scaled LM (2004), Bias Corrected Scaled LM (2012) and Pesaran CD (2004). From the table, it can be observed that except for the variable employment growth, the hypothesis is possible to reject for all the other variables. However, it should be mentioned that the Interaction Term which is defined as the product of Log of Volatility of RER and Trade – GDP ratio is significant at 5 per cent level in terms of Pesaran CD test while the variable Interaction Term 1

---

[12] See Appendix A for detail analysis of how GARCH model was implemented.

[13] According to Munir & Kok (2015) "second generation" panel unit root tests namely Chang (2002), Moon & Perron (2004), Breitung & Das (2005), Harris *et. al.* (2005), Choi (2006) and Pesaran (2007) are constructed to account for cross section dependence and hence more appropriate then the first generation ones in case of presence of cross sectional dependence.

which is on the other hand defined as the product of Log of Volatility of RER 1 and Trade – GDP ratio is found to be insignificant in terms of Pesaran CD. However, the later one is significant in terms of the other three tests.

We have used EVIEWS 9 for performing the Cross – Section Dependence test and it did not contain the second generation panel unit root test in its built in options. Thus, the best available alternative was Im – Pesaran – Shin (IPS) test for Panel Unit Root. We have demeaned each variable from cross – sectional average before performing the test for the purpose of addressing cross sectional dependence problem (Im, Pesaran and Shin, 1995).

Table C3 (Appendix C) contains the panel unit root test results for each of the variables. The test is concerned with the null hypothesis of *"Panels Contain Unit Root"*. The test has been carried out with two different test regression specifications; one with constant and the other with constant and trend. It is evident from the table that both level and first difference of the variables GDP growth, Log of Volatility of RER, Log of Volatility of RER1, Interaction Term, Interaction Term 1 and Inflation does not contain any unit root. The result establishes that they are stationary and I(0) i.e. integrated of order zero variables. Gross Fixed Capital Formation (GFCF) and Trade contains unit root at level but they are stationary at first difference. Thus these two variables are non-stationary in nature and they should be I(1)[14]. Since the integration order of all the variables is not the same, we have not been able to estimate the model using Fully Modified OLS (FMOLS), or Dynamic OLS (DOLS) and perform any sort of cointegration analysis. Thus the best option would be to estimate the model using stationary variables and use Panel Least Square as the estimation method with cross – section and period fixed effects.

5.3 Test for Model Appropriateness:

In panel data models, if the individual effects happened to be correlated with the other independent variables in the model, then fixed effect estimators would be consistent while the random effect estimators would be inconsistent. In contrast, if the individual effects are found to be uncorrelated, then though both estimators would be consistent, estimators from random effect would be the one with lower variance i.e. more efficient. Thus with a view to figuring out which

[14] According to Damodar N. Gujarati (2003), "Basic Econometrics", pp. 805, if a (nonstationary) series has to be differenced *d* times to make it stationary then it would be characterized as integrated of order *d*.

estimators are more appropriate in our current study, we have employed Hausman (1978) test for correlated random effects which compares fixed and random effect estimates of coefficient. Table 1 contains the test results. According to the test results, it can be convincingly postulated that there is not enough evidence in favor of the null hypothesis saying that *"random effect model is more appropriate"*. Both the test statistic of cross section random effect and period

Table 1: Hausman Model Specification Test

Correlated Random Effects - Hausman Test		
H_0: Random Effect Model is Appropriate		
Model Specification	**Chi - Sq. Stat.**	**Prob.**
Cross Section Random	59.849*	0.000
Period Random	28.035*	0.000

Note: * Indicates 1 per cent level of significance.

random effect is found to be significant at 1 per cent level. Therefore, it can be concluded that if we assume the individual effect as fixed then the resulting estimator would be consistent. We have also employed "Redundant Fixed Effect – Likelihood Ratio Test" for testing the joint significance of the fixed effect estimates in panel least square specifications. Table 2 contains the test results. As the table shows there are three set of test results. The first and second set tests the individual significance of cross section and period fixed effects respectively while the final set tests the joint significance of the aforementioned two fixed effects. It is evident from the table that individual significance of cross section and period fixed effects as well as their joint significance are statistically established.

Table 2: Redundant Fixed Effects Tests

Effects Test	**Statistic**	**Prob.**
H_0: Cross Section Effects are Redundant		
Cross-section F	5.731*	0.000
Cross-section Chi-square	39.042*	0.000
H_0: Period Effects are Redundant		
Period F	1.693**	0.025
Period Chi-square	50.381*	0.004
H_0: Cross Section and Period Effects are Jointly Redundant		
Cross-Section/Period F	3.385*	0.000
Cross-Section/Period Chi-square	105.840*	0.000

Note: * Indicates 1 per cent level of significance and ** indicates 5 per cent level of significance.

5.4 Regression Results from Static Model:

Table 3: Estimation Results of the Benchmark Regression

	Pooled OLS	Panel Least Squares			Panel EGLS	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-	6.523*	6.406*	6.696*	6.623*	6.614*
	-	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
First Difference of Trade (% of GDP)	-0.022	0.006	-0.022	-0.016	-0.004	-0.018
	(0.610)	(0.852)	(0.441)	(0.526)	(0.896)	(0.476)
First Difference of GFCF (% of GDP)	1.061*	0.802*	0.661*	0.635*	0.715*	0.642*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.021**	0.001	0.005*	0.001	0.001	0.002
	(0.049)	(0.755)	(0.000)	(0.490)	(0.588)	(0.154)
Inflation (Annual %)	0.391*	-0.191**	-0.171*	-0.210*	-0.202*	-0.199*
	(0.000)	(0.013)	(0.000)	(0.000)	(0.003)	(0.000)
Observation	196	196	196	196	196	196
Adjusted R - Square	-0.919	0.479	0.552	0.595	0.454	0.580
Cross Section Effect	None	Fixed	None	Fixed	Fixed	Random
Period Effect	None	None	Fixed	Fixed	Random	Fixed

Note: * Indicates 1 per cent level of significance and ** indicates 5 per cent level of significance. Probabilities are given in the parenthesis.

Table 3 contains the estimation results of our benchmark regression where GDP growth has been regressed upon First Difference of Trade (% of GDP), First Difference of Gross Fixed Capital Information (% of GDP), Employment Growth (%) and Inflation (Annual %). For the variable Trade and Gross Fixed Capital Formation, first difference is used instead of level as they are I(0) in the difference. Here, employment growth is actually substituting labor force growth while gross fixed capital formation is substituting investment. Thus it is just a regular Cobb – Douglas (Cobb & Douglas, 1928) type production function that we have been estimating with two more exogenous variables namely Trade and Inflation. As all the variables have been expressed in terms of percentage, the coefficient here is a measure of elasticity of dependent variable with respect to the variable attached with holding everything else constant. We have estimated the benchmark regression using three different estimation methods i.e. Pooled OLS, Panel Least Square and Panel EGLS (Estimated Generalized Least Square). In the table, models have been separated with respect to the estimation method and on the basis of fixed effect specification. Model 1 contains the estimation of benchmark regression using pooled OLS and ordinary formula for variance covariance matrix. Thus the estimated parameters are the regular least square estimators. It can be observed from this model that gross fixed capital formation and employment growth has significant positive impact on GDP growth. More specifically, the elasticity of GDP growth with respect to gross fixed capital formation is 1.061 and with respect to employment growth is 0.021. However, inflation and trade has found to have unorthodox sign for their coefficients. The value of adjusted R – square is found to be negative and as high as 0.919. By definition, R – square is the amount of variance proportion that is explained by the fit. When the regression equation happens to ignore the constant term which is what we have in Model 1 the R – square can become negative. It emphasizes on that, a constant term should be present in the model.

In model 2, we have tried to address the cross sectional dependence problem by using cross section fixed effect only. Thus it estimates the benchmark regression with cross section fixed effect only and the estimators could be characterized as fixed effect estimators or within estimators. As a method, panel least square has been used to estimate the model and White diagonal robust variance covariance has been used which is robust to observation specific heteroscedasticity in the disturbances. Here, gross fixed capital formation and inflation has found to have expected sign with significant impact on GDP growth. However, though employment growth and trade has expected sign but they are insignificant. In model 3, we have just tried to control serial correlation by using period fixed effect only. Thus it estimates the benchmark regression with period fixed effect only and provides within estimators. Along with gross fixed capital formation, inflation and employment growth has found to have expected significant impact on GDP growth. The adjusted R square is measured to be 0.552. Nevertheless trade has found to have contradictory sign and insignificant impact as before. Although unconventional there are some recent studies which have used updated econometric methodology and also found negative impact of trade on growth e. g. Clemens & Wiliamson (2001), Musila & Yiheyis (2015), Ali & Abdulah (2015) and Irwin (2002). While Permani (2011) has found no robust evidence of the positive impacts of a tariff cut on economic growth rates by using Meta Regression Analysis.

In Model 4, the benchmark regression has been estimated using panel least square with both cross section and period fixed effect. Therefore, this model in comparison to the earlier ones is capable of addressing cross sectional dependence as well as serial correlation problem. The estimators here could be characterized as both way fixed effect estimator where the model transformation is made from within unit as well as within period variation. The elasticity of GDP growth with gross fixed capital formation is found to be 0.635 while that with inflation is negative with a value of 0.210. Although trade and employment growth contains expected sign, they are not significant. Model 5 and 6 estimated the benchmark regression using Panel EGLS with White diagonal robust variance covariance estimate. In model 5, we have cross section effect as fixed and period effects as random while in model 6, we have the effects as the other way around. Thus these two models provide random effect estimators or between estimators. The results and conclusions are almost same as model 4 though the magnitude of the coefficients are slightly different.

With a view to checking how volatility of RER affects GDP growth, we have included log of volatility of RER along with other variables in the system. In particular, as a first case we have taken out the variable trade and included the new variable log of volatility of RER in the benchmark regression. Table 4 contains the estimation results. Similarly as before, three different estimation techniques have been applied. Model 1 is estimated with pooled OLS and ordinary formula for variance covariance while model 3, 4 and 5 is estimated with panel least squares with White diagonal robust variance covariance but they are different because of the fixed effect specification. Panel EGLS is employed to estimate model 5 and 6 with White diagonal robust variance covariance. The coefficient of the variable log of volatility of RER has found to be negative and significant for all the models except for model 6 where it is negative but insignificant and for model 3 where it is found to be positive and significant. Gross fixed capital formation has significant positive impact while inflation has got the opposite in all models except model 1. Impact of employment growth is found to be very low and insignificant in most of the cases. It can be worth mentioning that adjusted R square is well above 0.50 for almost all the models.

Table 4: Estimation Results with Log of Volatility of RER ignoring Trade - GDP Ratio

	Pooled OLS	Panel Least Squares			Panel EGLS	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-	-2.841***	7.313*	0.882	-1.773	6.487*
	-	(0.059)	(0.000)	(0.623)	(0.240)	(0.000)
Log of Volatility of RER	-1.081*	-2.557*	0.232**	-1.585*	-2.280*	-0.042
	(0.000)	(0.000)	(0.035)	(0.001)	(0.000)	(0.855)
First Difference of GFCF (% of GDP)	0.870*	0.655*	0.654*	0.587*	0.638*	0.635*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.021*	0.001	0.002	0.001	0.001	0.002
	(0.008)	(0.719)	(0.218)	(0.626)	(0.708)	(0.271)
Inflation (Annual %)	0.083**	-0.107***	-0.188*	-0.160*	-0.123**	-0.203*
	(0.021)	(0.056)	(0.000)	(0.001)	(0.029)	(0.000)
Observation	196	196	196	196	196	196
Adjusted R - Square	-0.038	0.566	0.565	0.621	0.536	0.580
Cross Section Effect	None	Fixed	None	Fixed	Fixed	Random
Period Effect	None	None	Fixed	Fixed	Random	Fixed

Note: * Indicates 1 per cent level of significance, ** indicates 5 per cent level of significance and *** indicates 10 per cent level of significance. Probabilities are given in the parenthesis.

Therefore, volatility of RER is an important component of GDP growth. The higher the volatility, the worse will be the impact on GDP growth. In model 4 where cross section and period effects both are assumed to be fixed, the elasticity of GDP growth with log of volatility of RER is measured to be – 1.585 while in model 5 where cross section effect is fixed but period effect is random, the GDP growth is found to be more negatively responsive with respect to volatility of RER.

For the purpose of checking how does volatility of RER effects growth when we consider trade as a first step, we have inserted the variable Trade (as % of GDP) in the system and in the next step we have inserted another new variable named "Interaction Term" which has been defined as the product of log of volatility of RER and Trade. It measures the interactive effect of the variables on GDP growth. Table 5 contains the estimation results for the models where we have inserted the variable trade along with log of volatility of RER. It can be deduced from the table that the impact of volatility of RER on GDP growth have remained almost same. The trade has found to have insignificant impact on GDP growth.

Table 5: Estimation Results with Log of Volatility of RER and Trade - GDP Ratio

	Pooled OLS	Panel Least Squares			Panel EGLS	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-	-2.964***	7.334*	0.911	-1.908	7.334*
	-	(0.051)	(0.000)	(0.611)	(0.212)	(0.000)
Log Volatility of RER	-1.081*	-2.603*	0.236**	-1.576*	-2.324*	0.236**
	(0.000)	(0.000)	(0.034)	(0.001)	(0.000)	(0.034)
First Difference of Trade (% of GDP)	0.001	0.021	-0.024	-0.003	0.015	-0.024
	(0.979)	(0.537)	(0.372)	(0.900)	(0.655)	(0.372)
First Difference of GFCF (% of GDP)	0.870*	0.643*	0.660*	0.588*	0.631*	0.660*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.021*	0.000	0.002	0.001	0.001	0.002
	(0.009)	(0.780)	(0.203)	(0.621)	(0.753)	(0.203)
Inflation (Annual %)	0.083**	-0.114**	-0.185*	-0.159*	-0.127**	-0.185*
	(0.024)	(0.047)	(0.000)	(0.001)	(0.027)	(0.000)
Observation	196	196	196	196	196	196
Adjusted R - Square	-0.044	0.566	0.564	0.619	0.536	0.564
Cross Section Effect	None	Fixed	None	Fixed	Fixed	Random
Period Effect	None	None	Fixed	Fixed	Random	Fixed

Note: * Indicates 1 per cent level of significance, ** indicates 5 per cent level of significance and *** indicates 10 per cent level of significance. Probabilities are given in the parenthesis.

However, for measuring the interactive effect of log of volatility of RER and Trade – GDP ratio on GDP growth, we have augmented the regression specification further with the variable "interaction term". Table 6 contains the estimation results. The coefficient of the interactive variable is found to be negative and significant in all the models. Also the log of volatility of RER has remained negative and significant as before. Therefore, the impact of volatility on GDP growth is more negative when we consider the trade. The finding is in line with our hypothesis explained under scenario 1 in the methodology. The effect of trade on GDP growth this time is found to be negative and significant for all the models which does not conform the theory. Gross fixed capital formation has positive impact while inflation has negative impact on growth and employment which is found to have very small and insignificant impact on growth as before. The adjusted R square is observed to be well above 0.50 for all models except model 1.

Table 6: Regression Results with Log of Volatility of RER and Interaction Term

	Pooled OLS	Panel Least Squares			Panel EGLS	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-	-2.644***	7.312*	0.314	-1.859	7.312*
	-	(0.060)	(0.000)	(0.852)	(0.194)	(0.000)
Log Volatility of RER	-0.986*	-2.398*	0.299*	-1.639*	-2.198*	0.299*
	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)	(0.004)
Interaction Term	-0.089*	-0.086*	-0.065*	-0.070*	-0.082*	-0.065*
	(0.001)	(0.000)	(0.002)	(0.000)	(0.000)	(0.002)
First Difference of Trade (% of GDP)	-0.302*	-0.275*	-0.241*	-0.241*	-0.266*	-0.241*
	(0.002)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
First Difference of GFCF (% of GDP)	0.818*	0.607*	0.641*	0.570*	0.600*	0.641*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.022*	0.002	0.003	0.001	0.002	0.003
	(0.004)	(0.262)	(0.117)	(0.386)	(0.297)	(0.117)
Inflation (Annual %)	0.138*	-0.052***	-0.146*	-0.099*	-0.065**	-0.146*
	(0.001)	(0.082)	(0.000)	(0.009)	(0.033)	(0.000)
Observation	196	196	196	196	196	196
Adjusted R - Square	0.009	0.619	0.594	0.654	0.588	0.594
Cross Section Effect	None	Fixed	None	Fixed	Fixed	Random
Period Effect	None	None	Fixed	Fixed	Random	Fixed

Note: * Indicates 1 per cent level of significance, ** indicates 5 per cent level of significance and *** indicates 10 per cent level of significance.

5.5 Regression Results from the Dynamic Model:

In order to examine the findings with a dynamic model, we have augmented the regression specification given in Table 6 with lagged values of all the variables including the dependent one. Table C6 (Appendix C) contains the estimation results. For all the models except model 3, the short run coefficients of the volatility of RER and interaction term have been observed to be significant and negative. Thus the conclusion that was established in static model is further strengthened from this finding. Nevertheless, the long run coefficients of these two variables are found to be insignificant with unexpected sign. Thus, it was not possible for us to reach any strict conclusion about the long run impact of volatility of RER on growth considering the Trade – GDP ratio. All other long run coefficients except that attached with lag of GDP growth have observed to contain insignificant impact on current GDP growth in most of the models.

As all the lagged variables have found to be insignificant except the lagged dependent one, we have decided to drop others but keep the later one in our final specification of the model. Table 7 contains the estimation results. It is evident from the estimation results that volatility of RER and its interaction with Trade – GDP ratio has significant negative impact on GDP growth. The elasticity of GDP growth with respect to volatility of RER and interaction term has been measured to be – 0.498 when none of the cross section and period effect is considered. When only cross section effect is considered the elasticity is measured to be - 2.110. On the other hand, when only period effect is taken into consideration the elasticity is found to be positive which is the only exception.

Table 7: Regression Results with Log of Volatility of RER and Interaction Term in Dynamic Model

	Pooled OLS	Panel Least Squares			Panel EGLS
	(1)	(2)	(3)	(4)	(5)
Constant	-	-2.402***	5.232*	0.011	-1.562
	-	(0.091)	(0.000)	(0.995)	(0.287)
Log Volatility of RER	-0.498*	-2.110*	0.241*	-1.334*	-1.841*
	(0.000)	(0.000)	(0.010)	(0.004)	(0.000)
Interaction Term	-0.134*	-0.099*	-0.090*	-0.088*	-0.095*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
First Difference of Trade (% of GDP)	-0.485*	-0.329*	-0.338*	-0.315*	-0.324*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
First Difference of GFCF (% of GDP)	0.523*	0.546*	0.528*	0.500*	0.532*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.018*	0.003***	0.005*	0.003***	0.003***
	(0.005)	(0.091)	(0.015)	(0.094)	(0.073)
Inflation (Annual %)	0.065**	-0.050***	-0.099*	-0.069***	-0.058***
	(0.048)	(0.091)	(0.003)	(0.075)	(0.063)
Lag of GDP Growth	0.512*	0.147*	0.306*	0.226*	0.176*
	(0.000)	(0.009)	(0.000)	(0.001)	(0.004)
Observation	196	196	196	196	196
Adjusted R – Square	0.340	0.635	0.653	0.683	0.606
Cross Section Effect	None	Fixed	None	Fixed	Fixed
Period Effect	None	None	Fixed	Fixed	Random

Note: * Indicates 1 per cent level of significance, ** indicates 5 per cent level of significance and *** indicates 10 per cent level of significance. Probabilities are given in the parenthesis.

However, this exceptional measure can possibly be ignored as we have already seen that the variables have been suffering from cross sectional dependence and to control that we are not allowed to ignore the cross section fixed effect. In model 4 where both cross section and period fixed effect have been employed, the elasticity coefficient is measured to be – 1.334. In the last specification where Panel EGLS method with cross – section effect as fixed and period effect as random has been applied, the elasticity coefficient is again observed to be negative with a value of 1.841. As mentioned earlier, the elasticity coefficient of interaction term has remained consistently negative. Therefore, the impact of volatility of RER on GDP growth, itself is negative and this has become even more negative when we allow Trade – GDP ratio to interact with the volatility of RER.

The elasticity of GDP growth with respect to investment which is substituted by gross fixed capital formation is observed to be positive and less than one with a value ranging from 0.500 to 0.546. Thus 1 per cent increase in investment or gross fixed capital formation will bring approximately a 0.500 percentage point positive change in GDP growth. Similarly, employment growth which has been used as a proxy of labor in the regression model is also containing a significant positive elasticity coefficient for GDP growth, although the size of the coefficient is notably small. The responsiveness of GDP growth rate with respect to inflation is found to be negative with only exception in model 1. More specifically, according to model 4 and 5, one per cent increase in inflation will lead to respectively 0.069 and 0.058 percentage point decrease in GDP growth. The effect of last year's GDP growth on current year is measured to be positive and significant. According to the estimation results, if last year's GDP growth would be 1 per cent higher than the GDP growth of current year, it would possibly be 0.226 and 0.176 percentage point higher respectively in model 4 and 5. The coefficients of variable Trade – GDP ratio in different models are significant but do not have any proper sign.

5.6 Robustness of the Findings: Changing the Definition of Volatility of RER:

Robustness with Static Model:

In order to check the robustness of the results, we have performed the same regression exercise using a different definition of our main variable of interest i.e. the volatility of RER. As we have monthly data on RER of each country, for the study period we followed the regular statistical formula of calculating monthly standard deviation of RER which is obviously unconditional. Twelve months average value of monthly standard deviation of RER was taken into account to get the yearly unconditional volatility of RER for each country.

As we did before, at first we have taken out the variable Trade – GDP ratio from the regression equation and added unconditional volatility of RER. The reason behind this effort was to check if it is important to have trade in the system in order to check the importance of RER volatility for GDP growth. Table C7 (Appendix C) presents the regression estimates. The conclusion is same as before when we have used conditional volatility of RER. All the models have found significant negative impact of unconditional volatility of RER on GDP growth except Model 3 where though the sign is negative for the coefficient, it is not significant. The elasticity of GDP growth with respect to inflation is found to be negative while that with respect to gross fixed capital formation is positive. This conform the theory and the previous findings. Employment growth is found to have insignificant impact in most of the cases and has a very low impact when it is significant in one or two exceptions. The size of the other coefficients except volatility of RER has remained almost same as before.

Table C8 (Appendix C) contains the regression results when we have inserted the variable Trade – GDP ratio along with volatility of RER. The coefficient attached with volatility of RER is observed to be more or less same as Table C7 (Appendix C). There is no denying of the fact that trade is an important channel through which RER volatility can have impact on growth. But here it is observed that regardless of trade, RER volatility could have significant negative impact on GDP growth. Nonetheless, Trade – GDP ratio does not have any significant impact on GDP growth and in some of the models, the sign was found to be contradictory. The statistical significance of the coefficients of other variables in different models has remained same as before.

In Table 8 we have added an interaction term in the regression models which is defined as the product of log of unconditional volatility of RER and Trade – GDP ratio. Thus here we allowed the unconditional volatility of RER to interact with Trade – GDP ratio. The elasticity coefficients of unconditional volatility of RER and interaction term in different models are observed to be negative. So, the effect of unconditional volatility of RER on GDP growth has also become more negative once we consider its interaction with trade. In particular, when we did not consider the interactive effect, one per cent increase in unconditional volatility would lead to a 0.967 percentage point decrease in GDP growth on an average in Model 4 while if we consider the interactive effect the reduction would be 1.094 percentage points. Trade – GDP ratio has found to have insignificant impact on the GDP growth as before in all kinds of models. In contrast to this, gross fixed capital formation has contained a significant positive impact on GDP growth while inflation rate turned out to contain the opposite. Like as before, the impact of employment growth has again observed to be occasionally significant with very small magnitude.

Table 8: Robust Regression Results with Log of Volatility of RER and Interaction Term

	Pooled OLS	Panel Least Squares			Panel EGLS	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-	6.492*	6.092*	6.664*	6.576*	6.092*
	-	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log of Volatility of RER1	-0.414*	-1.100*	-0.030	-1.004*	-1.075*	-0.030
	(0.001)	(0.000)	(0.646)	(0.000)	(0.000)	(0.646)
Interaction1	-0.058*	-0.021*	-0.016*	-0.015*	-0.019*	-0.016*
	(0.000)	(0.001)	(0.006)	(0.004)	(0.002)	(0.006)
First Difference of Trade (% of GDP)	0.043	0.038	0.001	0.014	0.029	0.001
	(0.294)	(0.210)	(0.961)	(0.597)	(0.338)	(0.961)
First Difference of GFCF (% of GDP)	1.037*	0.717*	0.682*	0.607*	0.670*	0.682*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.019**	0.002	0.005*	0.002	0.002	0.005*
	(0.045)	(0.199)	(0.000)	(0.314)	(0.232)	(0.000)
Inflation (Annual %)	0.488*	-0.093*	-0.128*	-0.121*	-0.105*	-0.128*
	(0.000)	(0.009)	(0.003)	(0.001)	(0.004)	(0.003)
Observation	196	196	196	196	196	196
Adjusted R - Square	-0.513	0.589	0.569	0.655	0.558	0.569
Cross Section Effect	None	Fixed	None	Fixed	Fixed	Random
Period Effect	None	None	Fixed	Fixed	Random	Fixed

Note: * Indicates 1 per cent level of significance and ** indicates 5 per cent level of significance. Probabilities are given in the parenthesis.

Robustness with Dynamic Model:

In order to check the robustness of the results in the dynamic model, we have augmented the model using lag value of all the independent variable as well as the dependent variable. Table C9 (Appendix C) contains the result. In the both way fixed effect model, elasticity of GDP growth with respect to unconditional volatility of RER is found to be 0.804 with a negative sign and that with interaction term is 0.025 with a negative sign. The measure of coefficient have remained almost same in the model estimated using Panel EGLS. Specifically, when the model is estimated using Panel EGLS, the size of the aforementioned elasticity coefficients is measured to be - 0.844 and – 0.031 respectively. The lagged values for all the variables except that for GDP growth have remained insignificant in most of the cases. Thus, we have decided to augment the model using only the lag of dependent variable. Table 9 contains the estimation results. As the estimation result shows the elasticity coefficient in the both way fixed effect model, which is estimated using panel least square is, – 0.887 and – 0.017 respectively for unconditional volatility of RER and interaction term. The elasticity measure of gross fixed capital formation has been varying in between 0.56 to 0.66 with a positive sign. The elasticity of GDP growth with respect to inflation is observed to be negative while that with last year GDP growth is found to be positive.

Table 9: Robust Regression Results with Log of Volatility of RER and Interaction Term in Dynamic Model

	Pooled OLS	Panel Least Squares			Panel EGLS
Variables	(1)	(2)	(3)	(4)	(5)
Constant	-	5.772*	4.458*	5.597*	5.707*
	-	(0.000)	(0.000)	(0.000)	(0.000)
Log of Volatility of RER1	-0.150	-0.998*	-0.026	-0.887*	-0.960*
	(0.113)	(0.000)	(0.683)	(0.000)	(0.000)
Interaction1	-0.048*	-0.023*	-0.019*	-0.017*	-0.020*
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
First Difference of Trade (% of GDP)	0.011	0.033	-0.007	0.008	0.022
	(0.710)	(0.284)	(0.792)	(0.772)	(0.472)
First Difference of GFCF (% of GDP)	0.614*	0.666*	0.589*	0.561*	0.617*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.013***	0.003***	0.005*	0.003	0.003***
	(0.059)	(0.082)	(0.000)	(0.140)	(0.090)
Inflation (Annual %)	0.167*	-0.092*	-0.096**	-0.101*	-0.097*
	(0.000)	(0.005)	(0.019)	(0.007)	(0.005)
Lag of GDP Growth	0.630*	0.126**	0.276*	0.167*	0.144**
	(0.000)	(0.026)	(0.000)	(0.007)	(0.014)
Observation	196	196	196	196	196
Adjusted R - Square	0.190	0.601	0.621	0.670	0.572
Cross Section Effect	None	Fixed	None	Fixed	Fixed
Period Effect	None	None	Fixed	Fixed	Random

Note: * Indicates 1 per cent level of significance and ** indicates 5 per cent level of significance. Probabilities are given in the parenthesis.

Therefore, it is established that the volatility of RER will contain a negative impact on GDP growth of a region and this impact would become more negative once trade of the region is considered by allowing it to interact with RER volatility. The finding is robust against the definition of RER volatility; conditional or unconditional. The central bank authorities around the world or the relevant policy institutes responsible for controlling the behavior of macroeconomic variables should remain cautious and concern before making any tiny policy change that would result in appreciation or depreciation of the domestic currency.

6. Concluding Remarks

Flexible exchange rate regime allows for more volatile currency rate compared to its counterpart namely fixed exchange rate regime. One major concern is that the uncertainty associated with the exchange rate volatility could also create ambiguity about the trade return and thus conceive an amplified negative impact on the income or output growth of the economy. The current study gave effort to investigate the empirical relationship between the volatility of real exchange rate and GDP growth considering the Trade – GDP ratio for seven developing Asian countries. It has used different panel data models and estimation techniques for the observations spanning 1985 to 2013. The main concerned variable, volatility of RER has been constructed using GARCH (1, 1) model and data on monthly exchange rate of the currencies against US $ for the aforementioned period. Almost all the models reveal that real GDP growth is negatively elastic with respect to volatility of RER. Most importantly, the elasticity becomes even more negative if we allow volatility of RER to interact with trade. The findings infer that whenever the trade dependence measured by Trade – GDP ratio of the country becomes higher the monetary policy makers responsible for determining the exchange rate regime should remain more cautious. Nonetheless, the current study is not free from limitations. One of the major limitations of this study is that it could not address the structural break which if present, can cause instability of parameters and consequently the findings may also change. Thus, it could also remain as a further area of research.

References

Adler, M., & Lehmann, B. (1983). Deviations from Purchasing Power Parity in the Long Run. *Journal of Finance*, *38*(5), 1471-1487.

Aghion, P., Bacchetta, P., Ranciere, R., & Rogoff, K. (2009). Exchange rate volatility and productivity growth: The role of financial development. *Journal of Monetary Economics*, *56*(4), 494-513.

Akpan, E. O., & Atan, J. A. (2012). Effects of exchange rate movements on economic growth in Nigeria. *CBN Journal of Applied Statistics*, *2*(2), 1-14.

Ali, W., & Abdullah, A. (2015). The Impact of Trade Openness on the Economic Growth of Pakistan: 1980-2010. *Global Business & Management Research*, *7*(2).

Andersen, L., & Babula, R. (2008). The link between openness and long-run economic growth. *Journal of International Commerce and Economics*, *2*, 31-50.

Arratibel, O., Furceri, D., Martin, R., & Zdzienicka, A. (2011). The effect of nominal exchange rate volatility on real macroeconomic performance in the CEE countries. *Economic Systems*, *35*(2), 261-277.

Aslan, Ö., & Korap, L. (2009). Are real exchange rates mean reverting? Evidence from a panel of OECD countries. *Applied Economics Letters*, *16*(1), 23-27.

Azeez, B. A., Kolapo, F. T., & Ajayi, L. B. (2012). Effect of exchange rate volatility on macroeconomic performance in Nigeria. *Interdisciplinary Journal of Contemporary Research in Business*, *4*(1), 149.

Azid, T., Jamil, M., & Kousar, A. (2005). Impact of Exchange Rate Volatility on Growth and Economic Performance: A Case Study of Pakistan, 1973-2003. *Pakistan Development Review*, *44*(4), 749-772.

Baltagi, B. H., Feng, Q., & Kao, C. (2012). A Lagrange Multiplier test for cross-sectional dependence in a fixed effects panel data model. *Journal of Econometrics*, *170*(1), 164-177.

Barro, R. J. (1991). Economic Growth in a Cross Section of Countries. *The Quarterly Journal of Economics*, *106*. 407-443.

Bailliu, J., Lafrance, R., & Perrault, J. (2003). Does Exchange Rate Policy Matter for Growth?. *International Finance*, *6*(3), 381-414.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of econometrics*, *31*(3), 307-327.

Breitung, J. (2000). The Local Power of Some Unit Root Tests for Panel Data. In *Advances in Econometrics, Vol. 15: Nonstationary Panels, Panel Cointegration, and Dynamic Panels, JAI*.

Breitung, J., & Das, S. (2005). Panel unit root tests under cross-sectional dependence. *Statistica Neerlandica*, *59*(4), 414-433.

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange Multiplier Test and Its Applications to Model Specification in Econometrics. *Review of Economic Studies*, *47*(1), 239-53.

Carranza, L. J., Cayo, J. M., & Galdón-Sánchez, J. E. (2003). Exchange rate volatility and economic performance in Peru: a firm level analysis. *Emerging Markets Review*, *4*(4), 472-496.

Chang, Y. (2002). Nonlinear IV unit root tests in panels with cross-sectional dependency. *Journal of Econometrics*, *110*(2), 261-292.

Choi, I. (2006). *Combination unit root tests for cross-sectionally correlated panels* (pp. 311-333). Econometric Theory and Practice: Frontiers of Analysis and Applied Research: Essays in Honor of Peter CB Phillips. Cambridge University Press.

Chen, J. (2012). Real exchange rate and economic growth: evidence from Chinese provincial data (1992-2008). *PSE Working Papers* n2012-05.

Clemens, M. A., & Williamson, J. G. (2001). *A tariff-growth paradox? Protection's impact the world around 1875-1997* (No. w8459). National bureau of economic research.

Cobb, C. W., & Douglas, P. H. (1928). A theory of production. *The American Economic Review*, 139-165.

Ćorić, B., & Pugh, G. (2010). The effects of exchange rate variability on international trade: a meta-regression analysis. *Applied Economics*, *42*(20), 2631-2644.

Danmola, R. A. (2013). The impact of exchange rate volatility on the macro economic variables in Nigeria. *European Scientific Journal*, *9*(7).

De Hoyos, R. E., & Sarafidis, V. (2006). Testing for cross-sectional dependence in panel-data models. *Stata Journal*, *6*(4), 482.

Dollar, D., & Kraay, A. (2001). *Trade, growth, and poverty*. World Bank, Development Research Group, Macroeconomics and Growth.

Edwards, S. (1993). Openness, Trade Liberalization, and Growth in Developing Countries. *Journal Of Economic Literature*, *31*(3), 1358-1393.

Enders, W. (2010). *Applied econometric time series*. Hoboken, N.J. : John Wiley & Sons.

Engle, R. F. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*, *50*(4), 987-1008.

Fischer, S. (1993). The role of macroeconomic factors in growth. *Journal of monetary economics*, *32*(3), 485-512.

Ghura, D., & Grennes, T. J. (1993). The real exchange rate and macroeconomic performance in Sub-Saharan Africa. *Journal of development Economics*, *42*(1), 155-174.

Gujarati, D. N. (2003). *Basic Econometrics*, Tata McGraw-Hill Education.

Huchet-Bourdon, M., & Korinek, J. (2011). To What Extent Do Exchange Rates and their Volatility Affect Trade? *OECD Trade Policy Papers*, No. 119, OECD Publishing.

Heidari, H., & Hashemi Pourvaladi, S. (2011). Reinvestigating the relationship between exchange rate uncertainty and private investment in Iran: An application of bounds test approach to level. *African Journal of Business Management*, *5*(15), 6186-6194.

Hassan, K. & Hoque, A. & Koku, P. S.(2015). Purchasing Power Parity in the SAARC Region: Evidence from Unit Root Test with Cross-Sectional Dependence. *The Journal of Developing Areas* 49(5), 129-137.

Hadri, K. (2000). Testing for stationarity in heterogeneous panel data. *Econometrics Journal*, *3*(2), 148-161.

Harris, D., Leybourne, S., & McCabe, B. (2005). Panel stationarity tests for purchasing power parity with cross-sectional dependence. *Journal of Business & Economic Statistics*, *23*(4), 395-409.

Insah, B., & Bangnyel, P. (2014). The Dynamics of Real Exchange Rate Volatility And Economic Growth In A Small Open Economy, *Journal of Finance, 2*(8), (Available at: www.researchjournali.com/pdf/910.pdf)

Insah, B., & Chiaraah, A. (2013). Sources of real exchange rate volatility in the Ghanaian economy. *Journal of Economics and International Finance*, *5*(6), 232-238.

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of econometrics*, *115*(1), 53-74.

Irwin, D. A. (2002). *Did Import Substitution Promote Growth in the Late Nineteenth Century?* (No. w8751). National Bureau of Economic Research.

Jamil, M., Streissler, E. W., & Kunst, R. M. (2012). Exchange rate volatility and its impact on industrial production, before and after the introduction of common currency in Europe. *International Journal of Economics and Financial Issues*, *2*(2), 85-109.

Janus, T., & Riera-Crichton, D. (2015). Real Exchange Rate Volatility, Economic Growth and the Euro. *Journal of Economic Integration*, *30*(1), 148-171.

Judson, R., & Orphanides, A. (1999). Inflation, volatility and growth. *International Finance*, *2*(1), 117-138.

Kalra, S. (2008). Global Volatility and Forex Returns in East Asia. *IMF Working Papers*, 1-31.

Kaur, S., & Vikram, A. (2013). Economic Impact of Trade Openness and Exchange Rate Regimes: Evidence from Developing Asia. *International Journal Of Business And Emerging Markets*, *5*(4), 341-370.

Kenen, P. B., & Rodrik, D. (1986). Measuring and Analyzing the Effects of Short-term Volatility in Real Exchange Rates. *The Review of Economics and Statistics*, *68*(2), 311-15.

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of econometrics*, *108*(1), 1-24.

Maddala, G. S., & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and statistics*, *61*(S1), 631-652.

Mallik, G., & Chowdhury, A. (2001). Inflation and economic growth: evidence from four south Asian countries. *Asia-Pacific Development Journal*, *8*(1), 123-135.

Moon, H. R., & Perron, B. (2004). Testing for a unit root in panels with dynamic factors. *Journal of econometrics*, *122*(1), 81-126.

Musyoki, D., Pokhariyal, G. P., & Pundo, M. (2012). The impact of real exchange rate volatility on economic growth: Kenyan evidence. *Business & Economic Horizons*, *7*(1), 59-75.

Musila, J. W., & Yiheyis, Z. (2015). The impact of trade openness on growth: The case of Kenya. *Journal of Policy Modeling*, *37*(2), 342-354.

Munir, Q., & Kok, S. C. (2015). Purchasing Power Parity of ASEAN-5 Countries Revisited: Heterogeneity, Structural Breaks and Cross-sectional Dependence. *Global Economic Review*, *44*(1), 116-149.

Munir, Q., Mansur, K., & Furuoka, F. (2009). Inflation and economic growth in Malaysia: a threshold regression approach. *ASEAN Economic Bulletin*, *26*(2), 180-193.

Ndambendia, H., & Ahmed, A. H. (2011). Effective Real Exchange Rate Volatility and Economic Growth in Sub-Saharan Africa: Evidence from Panel Unit Root and Cointegration Tests. *IUP Journal of Applied Finance*, *17*(1), 85.

Omojimite, B. U., & Akpokodje, G. (2010). A comparative analysis of the effect of exchange rate volatility on exports in the CFA and Non-CFA countries of Africa. *J Soc Sci*, *24*(1), 23-31.

Pesaran, M. H. H. M. (2004). General diagnostic tests for cross section dependence in panels. *CESifo Working Papers* No. 1233, 255-60

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, *22*(2), 265-312.

Permani, R. (2011). The impacts of trade liberalisation and technological change on GDP growth in Indonesia: A meta regression analysis. *Global Economy Journal*, *11*(4).

Schnabl, G. (2007). Exchange Rate Volatility and Growth in Emerging Europe and East Asia, CESifo working paper, No. 2023

Sanginabadi, B., & Heidari, H. (2012). *The Effects of Exchange Rate Volatility on Economic Growth in Iran* (No. 52406). University Library of Munich, Germany.

Stanèík, J. (2007). Determinants of Exchange-Rate Volatility: The Case of the New EU Members. *Czech Journal of Economics and Finance (Finance a uver)*, *57*(9-10), 414-432.

Stockman, A. C. (1981). Anticipated inflation and the capital stock in a cash in-advance economy. *Journal of Monetary Economics*, *8*(3), 387-393.

Sethi, S. (2015). Inflation, Inflation Volatility and Economic Growth: The Case of India. *IUP Journal Of Applied Economics*, *14*(3), 25-44.

Suranovic, S. M. (2010). *International Finance: Theory and Policy*.

Yusoff, M., & Sabit, A. H. (2015). The effects of exchange rate volatility on ASEAN-China bilateral exports. *Journal of Economics, Business and Management*, *3*(5), 479-482.

Yanikkaya, H. (2003). Trade openness and economic growth: a cross-country empirical investigation. *Journal of Development economics*, *72*(1), 57-89.

Yucel, F. (2009). Causal relationships between financial development, trade openness and economic growth: the case of Turkey. *Journal of Social sciences*, *5*(1), 33-42.

Appendix A: Brief Description of Different Tests

A.1 Testing for ARCH effect

The volatility of many economic and financial time series does not remain constant over time which could be characterized as *conditionally heteroscedastic*[15] (Enders, 2010, pp. 123). Following Engle (1982) very often Autoregressive Conditional Heteroscedasticity (ARCH) models are used to model the variable containing time varying *volatility clustering*[16]. Engle (1982) in his seminal work proposed a Lagrangian Multiplier (LM) test for finding the presence of ARCH effect in the concerned time series. In order to perform the test for the presence of ARCH effect in RER, the model is confirmed in the following way:

$$Mean\ Equation: RER_{i,t} = \mu_i + \delta_1 RER_{i,t-1} + \varepsilon_{i,t} \qquad (6)$$

$$Variance\ Equation: \varepsilon_{i,t} = v_{i,t}\sqrt{\alpha_0 + \alpha_1 \varepsilon_{i,t-1}^2} \qquad (7)$$

Where, $v_{i,t} \sim iid(0,1)$. As variance by definition cannot be negative in variance equation we have to have $\alpha_0 > 0$ and $0 < \alpha_1 < 1$ so that variance remains well behaved. In order to perform the test we followed the Engle two step procedure in the following way:

Step 1: We have estimated the equation (6) by Ordinary Least Square (OLS) method and predicted the residuals i.e. $\widehat{\varepsilon_{i,t}}$.

Step 2: We have tested the following hypothesis:

$$H_0: \beta_1 = 0 (Conditional\ Homoscedastic\ Errors\ i.e. no\ ARCH\ Effect)$$

by using the estimated regression of the form:

$$\hat{\varepsilon}_{i,t}^2 = \beta_0 + \beta_1 \hat{\varepsilon}_{i,t-1}^2 + \zeta_{i,t} \qquad (8)$$

The test statistics is $TR^2 \sim \chi_{(1)}^2$ when null is true. T denotes the number of observations in the auxiliary regression.

---

[15] A series is conditionally heteroscedastic if the unconditional (or long – run) variance is constant, but there are periods in which the variance is relatively high, Walter Enders, "Applied Econometric Time Series", 2010, PP. 123

[16] Volatility clustering implies that the variance of the series is dependent on its past shocks. In particular ARCH model is based on this observation.

A.2 GARCH Model for the Estimation of Volatility

We have used the following form of the GARCH (1, 1) model to measure the volatility of RER:

$$GARCH\ (1,1){:}\ \varepsilon_{i,t} = V_{i,t}\sqrt{h_{i,t}} \qquad (9)$$

$$Where, h_{i,t} = \gamma_0 + \gamma_1 \varepsilon_{i,t-1}^2 + \varphi_1 h_{i,t-1}$$

In the above expression $V_{i,t} \sim iid\ (0,1)$. The restrictions that would require to impose for proper behavior of the above regression model can be written as $\gamma_0 > 0$, $\gamma_1 \geq 0, \varphi_1 \geq 0$ and $(\gamma_1 + \varphi_1) < 1$. The volatility of RER that would be predicted using the above regression model can be interpreted as the conditional volatility of RER. More precisely, the volatility is measured in terms of average value of conditional standard deviation for every month. By taking the twelve month average, finally we have derived to the yearly average value of conditional standard deviation of RER.

With a view to checking the robustness of the findings, we have changed the definition of volatility of RER from conditional to unconditional. Here the volatility of RER is measured using the regular unconditional formula of standard deviation. More specifically, we have used the following formula for measuring the yearly standard deviation of RER:

$$Yearly\ Standard\ Deviation\ \ of\ RER = \sqrt{\frac{\sum_{t=1}^{12}(RER_t - \overline{RER})^2}{12}}$$

A.3 Cross Sectional Dependence Tests

Breusch – Pagan Lagrange Multiplier (LM) Test (1980):

As pointed by Pesaran (2004) the lagrange multiplier test of Breusch – Pagan (1980) is based on the average of squared pair - wise correlation of the residuals and particularly applicable in the context when N (cross section units) remains fixed and T (time series) tends to be infinite ($T \to \infty$). In order to explain the main idea behind the test, it considers the following panel data model:

$$y_{it} = \gamma_i + \alpha_i^{'} x_{it} + \varepsilon_{it} \qquad (10)$$

Here, $i = 1,2,---,N$ and $t = 1,2,---T$. The null hypothesis of *"no cross section dependence"* in Breusch – Pagan LM test procedure could be presented in the following way:

$$H_0: \rho_{ij} = \rho_{ji} = Cov(\varepsilon_{it}, \varepsilon_{jt}) = 0, for\ all\ t, i \neq j$$

$$H_1: \rho_{ij} = \rho_{ji} = Cov(\varepsilon_{it}, \varepsilon_{jt}) \neq 0, for\ all\ t, i \neq j$$

Here, ρ_{ij} measures the pair – wise correlation of the residuals. The sample counterpart of ρ_{ij} is calculated as follows:

$$\widehat{\rho_{ij}} = \widehat{\rho_{ji}} = \left(\sum_{t=1}^{T} \hat{\varepsilon}_{it}^2\right)^{-1/2} \left(\sum_{t=1}^{T} \hat{\varepsilon}_{jt}^2\right)^{-1/2} \sum_{t=1}^{T} \hat{\varepsilon}_{it}\hat{\varepsilon}_{jt}$$

In the above expression $\hat{\varepsilon}_{it}$ is the OLS estimate of the residuals from the previously considered panel data model. The test statistic is defined in the following way:

$$BP_{LM} = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N} \hat{\rho}_{ij}^2$$

Under the null hypothesis here, BP_{LM} asymptotically distributed as $\chi^2_{N(N-1)/2}$.

Pesaran Scaled LM (2004) and Pesaran CD (2004):

The problem with the aforementioned Breusch – Pagan LM test is that it becomes inappropriate and cannot be applied whenever $N \rightarrow \infty$ (Pesaran, 2004, Baltagi, Feng & Kao, 2012). Therefore, Pesaran (2004) proposed a scaled version of LM test. The test statistic is defined in the following way:

$$CD_{Scaled\ LM} = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(T\hat{\rho}_{ij}^2 - 1\right)$$

According to Pesaran (2004) the above test statistic is asymptotically distributed as standard normal distribution with zero mean and unit variance under the null hypothesis when $T \rightarrow \infty$ and $\rightarrow \infty$.

Nonetheless as pointed out in Pesaran (2004) the above test probably could face substantial size distortion for large N and small T. It is because of the fact that small T would result in incorrect centering of $E\left(T\hat{\rho}_{ij}^2-1\right)$ around zero. Similarly, incorrect centering of LM statistics will be accentuated with large N. Thus, based on pair – wise correlation coefficients rather than their squares, Pesaran (2004) suggested a cross sectional dependence (CD) test with reasonable small sample properties. The test statistic is as follows:

$$CD=\sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right)$$

The above test statistic would have exact mean of zero for fixed values of N and T for wide range of panel data models.

Baltagi, Feng & Kao Bias Corrected Scaled LM (2012):

By assuming a fixed effect homogeneous panel data model Baltagi, Feng & Kao (2012) developed a bias corrected scaled LM test for cross sectional dependence. Following Baltagi, Feng & Kao (2012) consider the following fixed effect homogeneous panel data model:

$$y_{it}=\alpha+x_{it}^{'}\beta+\eta_i+\varepsilon_{it} \qquad (11)$$

Here, $i=1,2,---,N$ and $t=1,2,---T$, η_i denotes time invariant cross section effect . The $(k*1)$ vector of regressors x_{it} could be correlated with η_i but are uncorrelated with the idiosyncratic errors ε_{it} . The bias corrected LM statistic is calculated as follows:

$$LM_{BC}=\sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(T\hat{\rho}_{ij}^2-1\right)-\frac{N}{2(T-1)}$$

According to Baltagi, Feng and Kao (2012) under the null hypothesis the limiting distribution of the above test statistic would be standard normal.

A.4 Panel Unit Root Test

In particular following Eviews 8 User's Guide we begin with an AR(1) process for each of the variables containing panel data:

$$y_{it}=\ \rho_i y_{it-1}+x_{it}\delta_i+\varepsilon_{it} \qquad (12)$$

Where $i=1,2,---,N$ are the cross section units that has been observed for the periods $t=1,2,---T$, x_{it} represents the exogeneous variables in the model and ρ_i are the autoregressive coefficients. For each cross section units IPS test begin with the following form of Augmented Dickey Fuller (ADF) regression:

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \, \Delta y_{it-j} + x_{it}^{'} \delta + \varepsilon_{it}$$

The null hypothesis that would be tested in the above ADF regression can be written as,

$$H_0 : \alpha_i = 0, for \ all \ i$$

The above null hypothesis would be tested against the following alternative hypothesis:

$$H_1 : \begin{cases} \alpha_i = 0, for \ i = 1, 2, - - -, N_1 \\ \alpha_i < 0, for \ i = N+1, N+2, - - -, N \end{cases}$$

The IPS test statistic is defined as the following way:

$$W_{\overline{t_{NT}}} = \frac{\sqrt{N}(\overline{t_{NT}} - N^{-1} \sum_{i=1}^{N} E(\bar{t}_{iT}(p_i)))}{\sqrt{N^{-1} \sum_{i=1}^{N} Var(\bar{t}_{iT}(p_i))}} \rightarrow N(0, 1)$$

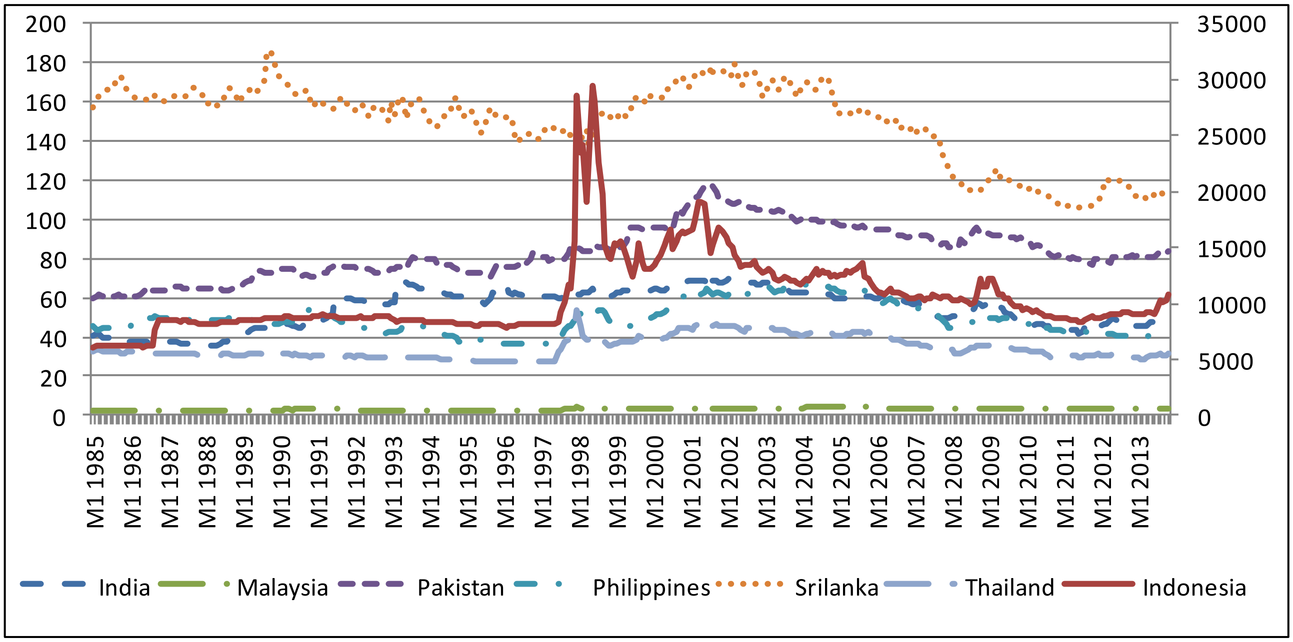
Here, $\overline{t_{NT}}$ denotes the average of the t – statistics for α_i from the individual ADF regressions, $t_{iT_i}(p_i)$. Thus,

$$\overline{t_{NT}} = \frac{\left(\sum_{i=1}^{N} t_{iT_i}(p_i)\right)}{N}$$

$E(\bar{t}_{iT}(p_i))$ and $Var(\bar{t}_{iT}(p_i))$ are the expected value and variance of the ADF regression t – statistics respectively.

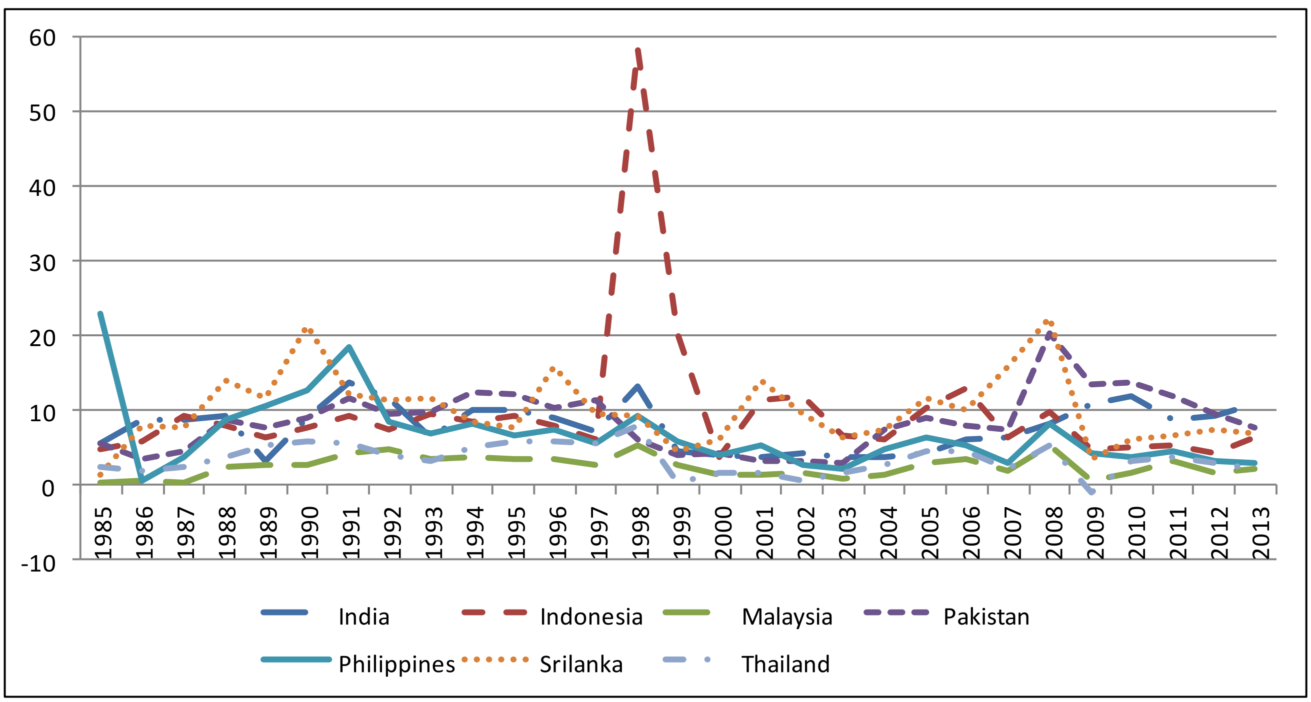
Appendix B: Historical Trend of Variables

Figure B 1: Real Exchange Rate Movement over Time in Developing Asian Countries



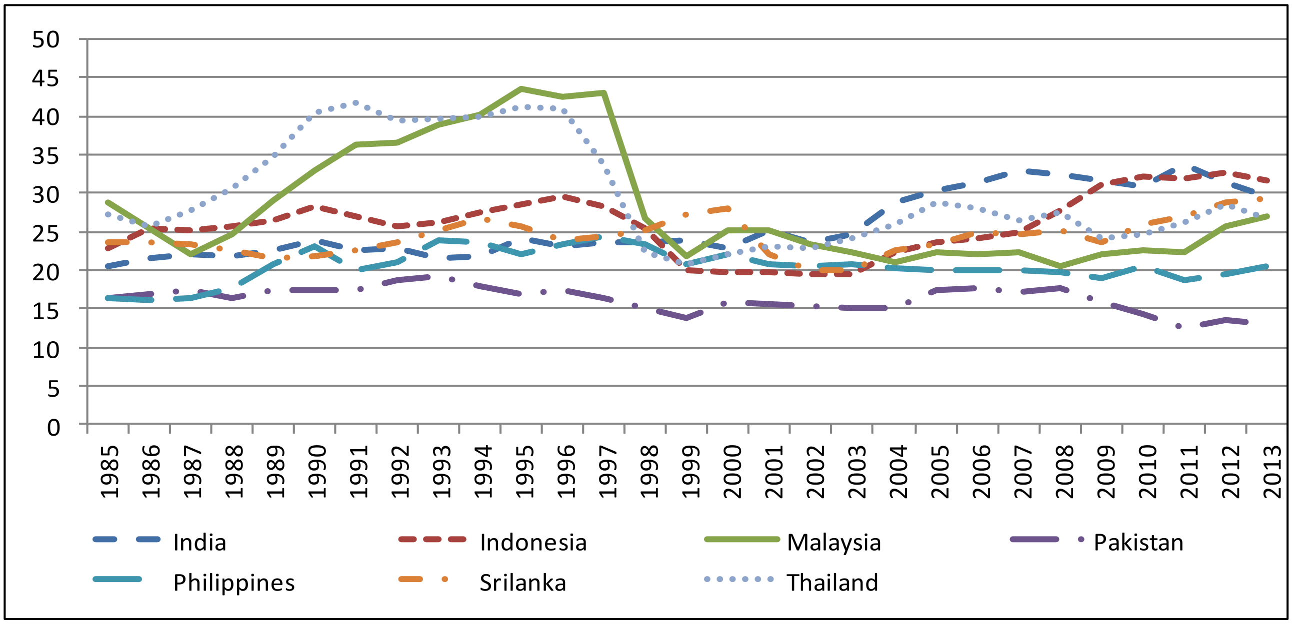
Source: International Financial Statistics (IFS), 2015

Figure B 2: Inflation Trend of Developing Asian Countries



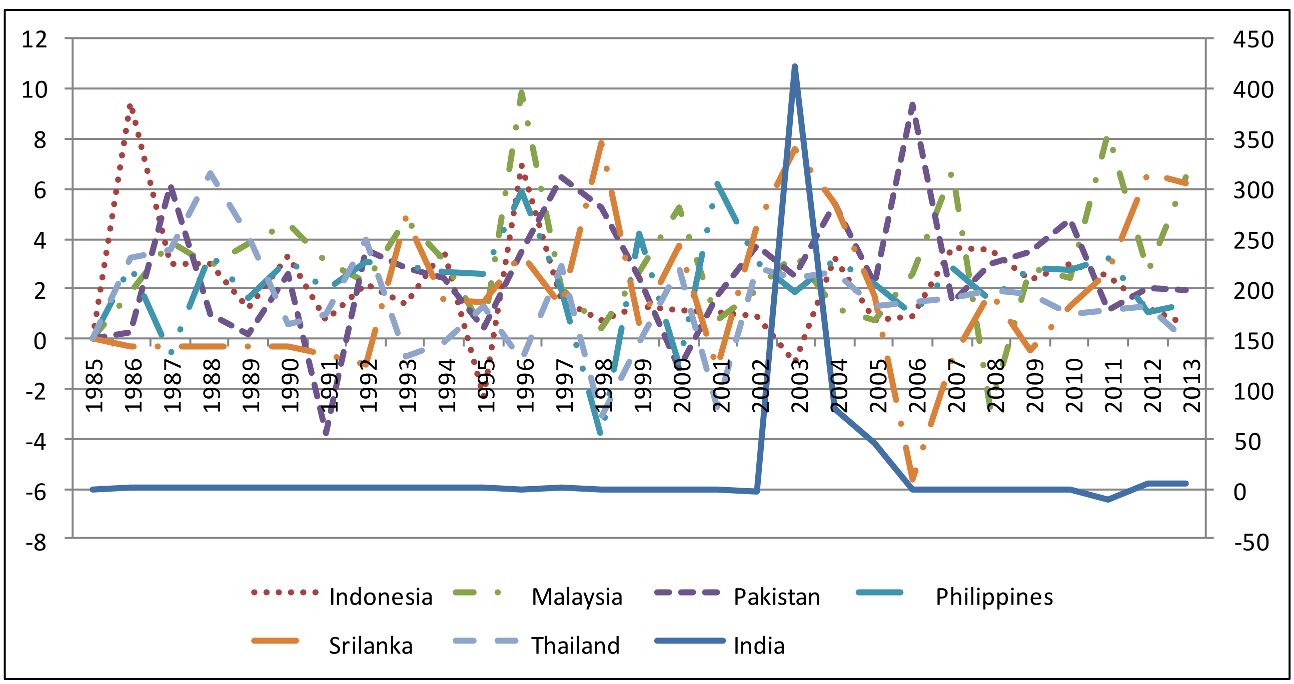
Source: World Development Indicators (WDI), 2015

Figure B 3: Historical Trend of Gross Fixed Capital Formation (% of GDP) in Developing Asian Countries



Source: World Development Indicators (WDI), 2015

Figure B 4: Historical Trend of Employment Growth in Developing Asian Countries



Source: International Financial Statistics (IFS), 2015

Appendix C: Statistical Results

Table C 1: Summary Statistics of the Variables for Different Countries

	Mean	Std. Dev	Maximum	Minimum
GDP Growth (%)				
India	6.3831	2.2643	10.2600	1.0568
Indonesia	5.3221	3.9795	9.0847	- 13.1267
Malaysia	5.7848	4.0826	10.0027	- 7.3594
Pakistan	4.4500	2.0031	7.7059	1.0144
Philippines	3.8182	3.0705	7.6323	- 7.3066
Srilanka	5.1142	2.0921	8.2459	- 1.5454
Thailand	5.3747	4.8127	13.2881	- 10.5100
Trade – GDP Ratio (%)				
India	29.5702	14.6546	55.5450	12.0087
Indonesia	54.7151	10.9310	96.1862	39.9739
Malaysia	171.5774	33.4061	220.4074	103.1654
Pakistan	34.2255	2.6375	38.9095	28.1296
Philippines	77.9366	19.3789	108.2503	45.9090
Srilanka	69.9369	9.9935	88.6365	49.1491
Thailand	106.3158	33.1972	150.3261	49.1552
Inflation (%)				
India	7.8594	3.1158	13.8703	3.2626
Indonesia	9.8425	9.9225	58.3871	3.7200
Malaysia	2.5492	1.4050	5.4408	0.2900
Pakistan	8.6378	3.9757	20.2861	2.9141
Philippines	6.8328	4.7567	23.1031	0.7515
Srilanka	9.9976	4.7943	22.5645	1.4812
Thailand	3.5297	2.0251	7.9947	- 0.8457
Gross Fixed Capital Formation (% of GDP)				
India	25.8263	4.2333	33.6418	20.5993
Indonesia	25.9733	3.9796	32.6740	19.4292
Malaysia	28.1621	7.5363	43.5862	20.5704
Pakistan	16.2473	1.6884	19.2354	12.5206
Philippines	20.5435	2.1804	24.4185	16.0473
Srilanka	24.3646	2.3626	29.2447	20.0384
Thailand	29.8209	6.8226	41.6316	20.8299
Employment Growth (%)				
India	19.2078	79.3923	422.4357	-11.2977
Indonesia	2.0702	2.2231	9.4161	-2.3489
Malaysia	3.0388	2.5780	9.8666	-2.7688
Pakistan	2.5839	2.5556	9.4044	-3.7453
Philippines	2.2099	1.9540	6.2072	-3.9112
Srilanka	1.7665	3.0952	7.8703	-5.6223
Thailand	1.4408	2.0293	6.6030	-3.0879
Real Exchange Rate (Local Currency Per US $ after Inflation adjustment)				
India	54.5024	10.0947	70.0301	35.2496
Indonesia	10,536.5900	3,492.9840	29,489.0600	6,057.0070
Malaysia	3.1501	0.5232	4.3575	2.3260
Pakistan	83.4123	13.4966	117.7831	59.7985
Philippines	49.1918	8.1755	67.1739	35.6677
Srilanka	149.8938	20.3191	186.2416	105.6485
Thailand	34.3857	5.6843	54.0197	27.1880
Volatility of RER (Estimated using GARCH (1, 1) model)				
India	1.4843	0.6985	9.1533	1.0242
Indonesia	0.0423	0.0724	0.8177	0.0062
Malaysia	0.0146	0.0132	0.1328	0.0076
Pakistan	0.0138	0.0043	0.0497	0.0020
Philippines	0.0182	0.0081	0.0748	0.0116
Srilanka	0.0179	0.0068	0.0592	0.0115
Thailand	0.0193	0.0192	0.1681	0.0094

Table C 2: Testing for Existence of ARCH effects in RER for the Countries

LM Test for Autoregressive Conditional Heteroscedasticity (ARCH)		
H_0: No ARCH Effects		
Country	**Chi – Sq. Stat.**	**Prob.**
India	0.102	0.749
Indonesia	34.927*	0.000
Malaysia	136.229*	0.000
Pakistan	12.342*	0.000
Philippines	49.057*	0.000
Srilanka	22.287*	0.000
Thailand	133.145*	0.000

Note: * Indicates 1 per cent level of significance.

Table C 3: Panel Unit Root Test Results of the Variables

Variables	**Im – Pesaran – Shin (IPS) Test for Panel Unit Root**			
	Null: Panels Contain Unit Roots			
	Intercept		**Intercept and Trend**	
	IPS W - Stat	**Prob.**	**IPS W - Stat**	**Prob.**
Employment Growth	-11.928*	0.000	-11.006*	0.000
D(Employment Growth)	-17.178*	0.000	-15.959*	0.000
GDP Growth	-7.485*	0.000	-6.863*	0.000
D(GDP Growth)	-13.277*	0.000	-11.690*	0.000
GFCF (% of GDP)	-0.697	0.242	-0.759	0.223
D(GFCF (% of GDP))	-6.871*	0.000	-4.937*	0.000
Trade(% of GDP)	0.562	0.713	1.052	0.853
D(Trade(% of GDP))	-12.664*	0.000	-11.325*	0.000
Log of Volatility of RER	-5.682*	0.000	-4.207*	0.000
D(Log of Volatility of RER)	-11.699*	0.000	-10.229*	0.000
Log of Volatility of RER 1	-6.337*	0.000	-6.353*	0.000
D(Log of Volatility of RER1)	-17.373*	0.000	-14.239*	0.000
Interaction Term	-10.805*	0.000	-10.903*	0.000
D(Interaction Term)	-17.769*	0.000	-14.900*	0.000
Interaction Term1	-11.951*	0.000	-11.426*	0.000
D(Interaction Term1)	-15.764*	0.000	-13.022*	0.000
Inflation (Annual %)	-7.346*	0.000	-6.137*	0.000
D(Inflation)	-14.033*	0.000	-12.581*	0.000

Note: * Indicates 1 per cent level of significance.

Table C 4: Test Results for Cross Sectional Dependence of the Variables

Variables and Test Names		Breusch - Pagan LM	Pesaran - Scaled LM	Bias Corrected Scaled LM	Pesarn CD
H_0: No Cross - Section Dependence					
GDP growth (annual %)	Statistic	81.401*	8.240*	8.115*	6.018*
	Prob.	0.000	0.000	0.000	0.000
Trade (% of GDP)	Statistic	168.724*	21.714*	21.589*	6.102*
	Prob.	0.000	0.000	0.000	0.000
GFCF (% of GDP)	Statistic	98.347*	10.855*	10.73*	3.644*
	Prob.	0.000	0.000	0.000	0.000
Employment Growth (%)	Statistic	20.207	-1.202	-1.327	0.432
	Prob.	0.508	0.229	0.184	0.666
Log of Volatility of RER	Statistic	87.618*	9.199*	9.074*	5.995*
	Prob.	0.000	0.000	0.000	0.000
Log of Volatility of RER1	Statistic	63.144*	5.422*	5.297*	4.348*
	Prob.	0.000	0.000	0.000	0.000
Interaction Term	Statistic	92.608*	9.969*	9.839*	2.091**
	Prob.	0.000	0.000	0.000	0.036
Interaction Term1	Statistic	43.685*	2.420**	2.290**	-0.181
	Prob.	0.002	0.015	0.022	0.855
Inflation (Annual %)	Statistic	84.997*	8.794*	8.669*	7.658*
	Prob.	0.000	0.000	0.000	0.000

Note: * Indicates 1 per cent level of significance and ** indicates 5 per cent level of significance

Table C 5: Estimation Results with Log of Volatility of RER and Trade - GDP Ratio

	Pooled OLS	Panel Least Squares			Panel EGLS	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-	-2.964***	7.334*	0.911	-1.908	7.334*
	-	(0.051)	(0.000)	(0.611)	(0.212)	(0.000)
Log Volatility of RER	-1.081*	-2.603*	0.236**	-1.576*	-2.324*	0.236**
	(0.000)	(0.000)	(0.034)	(0.001)	(0.000)	(0.034)
First Difference of Trade (% of GDP)	0.001	0.021	-0.024	-0.003	0.015	-0.024
	(0.979)	(0.537)	(0.372)	(0.900)	(0.655)	(0.372)
First Difference of GFCF (% of GDP)	0.870*	0.643*	0.660*	0.588*	0.631*	0.660*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.021*	0.000	0.002	0.001	0.001	0.002
	(0.009)	(0.780)	(0.203)	(0.621)	(0.753)	(0.203)
Inflation (Annual %)	0.083**	-0.114**	-0.185*	-0.159*	-0.127**	-0.185*
	(0.024)	(0.047)	(0.000)	(0.001)	(0.027)	(0.000)
Observation	196	196	196	196	196	196
Adjusted R - Square	-0.044	0.566	0.564	0.619	0.536	0.564
Cross Section Effect	None	Fixed	None	Fixed	Fixed	Random
Period Effect	None	None	Fixed	Fixed	Random	Fixed

Note: * Indicates 1 per cent level of significance, ** indicates 5 per cent level of significance and *** indicates 10 per cent level of significance. Probabilities are given in the parenthesis.

Table C 6: Estimation Results of Dynamic Model

	Pooled OLS	Panel Least Squares			Panel EGLS
Variables	(1)	(2)	(3)	(4)	(5)
Constant	-	-2.580***	4.579*	-0.017	-1.528
	-	(0.095)	(0.000)	(0.994)	(0.357)
Log Volatility of RER	-2.256*	-2.344*	-0.590	-1.299**	-1.963*
	(0.000)	(0.000)	(0.260)	(0.042)	(0.000)
Interaction Term	-0.106*	-0.106*	-0.097*	-0.097*	-0.103*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
First Difference of Trade (% of GDP)	-0.355*	-0.360*	-0.372*	-0.355*	-0.359*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
First Difference of GFCF (% of GDP)	0.549*	0.535*	0.528*	0.497*	0.522*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.009***	0.003***	0.003**	0.003	0.003***
	(0.098)	(0.090)	(0.036)	(0.122)	(0.075)
Inflation (Annual %)	-0.009	-0.029	-0.064	-0.049	-0.038
	(0.840)	(0.422)	(0.133)	(0.270)	(0.304)
Lag of GDP Growth	0.713*	0.225*	0.427*	0.301*	0.254*
	(0.000)	(0.004)	(0.000)	(0.001)	(0.001)
Lag of Log Volatility of RER	1.991	0.335	0.830	0.069	0.271
	(0.000)	(0.438)	(0.112)	(0.893)	(0.520)
Lag of Interaction Term	0.051*	0.008	0.014	0.005	0.006
	(0.017)	(0.744)	(0.483)	(0.835)	(0.793)
Lag of First Difference of Trade (% of GDP)	0.136***	0.002	0.038	0.012	0.003
	(0.079)	(0.986)	(0.586)	(0.890)	(0.971)
Lag of First Difference of GFCF (% of GDP)	-0.323*	-0.094	-0.176***	-0.117	-0.100
	(0.001)	(0.289)	(0.079)	(0.221)	(0.273)
Lag of Employment Growth (%)	0.006	0.002	0.003	0.002	0.003
	(0.311)	(0.335)	(0.333)	(0.433)	(0.318)
Lag of Inflation (%)	0.065	0.003	-0.027	-0.015	-0.004
	(0.122)	(0.927)	(0.545)	(0.759)	(0.918)
Observation	189	189	189	189	189
Adjusted R - Square	0.496	0.633	0.660	0.679	0.598
Cross Section Effect	None	Fixed	None	Fixed	Fixed
Period Effect	None	None	Fixed	Fixed	Random

Note: * Indicates 1 per cent level of significance, ** indicates 5 per cent level of significance and *** indicates 10 per cent level of significance. Probabilities are given in the parenthesis.

Table C 7: Robust Regression Results with Log of Volatility of RER ignoring Trade - GDP Ratio

	Pooled OLS	Panel Least Squares			Panel EGLS	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-	6.902*	6.399*	7.001*	6.964*	6.638*
	-	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Volatility of RER 1	-0.420*	-1.124*	-0.003	-0.972*	-1.058*	-0.249**
	(0.003)	(0.000)	(0.961)	(0.000)	(0.000)	(0.034)
First Difference of GFCF (% of GDP)	1.050*	0.710*	0.656*	0.584*	0.646*	0.629*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.020*	0.002	0.005*	0.002	0.002	0.002
	(0.050)	(0.367)	(0.000)	(0.350)	(0.321)	(0.181)
Inflation (Annual %)	0.443*	-0.143**	-0.173*	-0.168*	-0.156**	-0.182*
	(0.000)	(0.042)	(0.003)	(0.001)	(0.016)	(0.001)
Observation	196	196	196	196	196	196
Adjusted R - Square	-0.832	0.552	0.550	0.639	0.523	0.589
Cross Section Effect	None	Fixed	None	Fixed	Fixed	Random
Period Effect	None	None	Fixed	Fixed	Random	Fixed

Note: * Indicates 1 per cent level of significance and ** indicates 5 per cent level of significance. Probabilities are given in the parenthesis.

Table C 8: Robust Regression Results with Log of Volatility of RER and Trade - GDP Ratio

	Pooled OLS	Panel Least Squares			Panel EGLS	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-	6.934*	6.395*	6.990*	6.973*	6.699*
	-	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log Volatility of RER1	-0.433*	-1.132*	-0.010	-0.967*	-1.060*	-0.394*
	(0.002)	(0.000)	(0.876)	(0.000)	(0.000)	(0.006)
First Difference of Trade (% of GDP)	-0.037	0.014	-0.022	-0.006	0.004	-0.016
	(0.391)	(0.674)	(0.436)	(0.800)	(0.890)	(0.519)
First Difference of GFCF (% of GDP)	1.062*	0.704*	0.662*	0.587*	0.643*	0.624*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.020**	0.002	0.005*	0.002	0.002	0.002
	(0.049)	(0.391)	(0.000)	(0.343)	(0.324)	(0.232)
Inflation (Annual %)	0.451*	-0.148**	-0.168*	-0.166*	-0.158**	-0.176*
	(0.000)	(0.031)	(0.001)	(0.001)	(0.012)	(0.000)
Observation	196	196	196	196	196	196
Adjusted R - Square	-0.835	0.551	0.550	0.636	0.520	0.598
Cross Section Effect	None	Fixed	None	Fixed	Fixed	Random
Period Effect	None	None	Fixed	Fixed	Random	Fixed

Note: * Indicates 1 per cent level of significance and ** indicates 5 per cent level of significance. Probabilities are given in the parenthesis.

Table C 9: Robust Regression Results of Dynamic Model

	Pooled OLS	Panel Least Squares			Panel EGLS
Variables	(1)	(2)	(3)	(4)	(5)
Constant	-	6.061^{*}	3.915^{*}	5.670^{*}	5.943^{*}
	-	(0.000)	(0.000)	(0.000)	(0.000)
Log of Volatility of RER1	-0.424^{**}	-0.862^{*}	-0.295	-0.804^{*}	-0.844^{*}
	(0.065)	(0.000)	(0.168)	(0.002)	(0.000)
Interaction1	-0.038^{*}	-0.034^{*}	-0.023^{*}	-0.025^{*}	-0.031^{*}
	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)
First Difference of Trade (% of GDP)	0.013	0.010	-0.019	-0.012	0.003
	(0.663)	(0.744)	(0.502)	(0.648)	(0.926)
First Difference of GFCF (% of GDP)	0.700^{*}	0.646^{*}	0.604^{*}	0.569^{*}	0.623^{*}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employment Growth (%)	0.011^{***}	0.003^{***}	0.006^{*}	0.003	0.003^{***}
	(0.084)	(0.063)	(0.000)	(0.138)	(0.062)
Inflation (Annual %)	0.032	-0.007	-0.068	-0.035	-0.017
	(0.557)	(0.869)	(0.234)	(0.498)	(0.701)
Lag of GDP Growth	0.729^{*}	0.080	0.375^{*}	0.169^{**}	0.109
	(0.000)	(0.306)	(0.000)	(0.046)	(0.171)
Lag of Log Volatility of RER1	0.273	-0.697^{*}	0.297	-0.311	-0.568^{**}
	(0.234)	(0.005)	(0.165)	(0.248)	(0.021)
Lag of Interaction Term1	-0.005	-0.009	-0.003	-0.006	-0.008
	(0.470)	(0.103)	(0.564)	(0.314)	(0.150)
Lag of First Difference of Trade (% of GDP)	-0.051^{***}	-0.031	-0.007	-0.003	-0.022
	(0.072)	(0.266)	(0.831)	(0.907)	(0.434)
Lag of First Difference of GFCF (% of GDP)	-0.481^{*}	-0.096	-0.186^{***}	-0.091	-0.092
	(0.000)	(0.307)	(0.071)	(0.312)	(0.322)
Lag of Employment Growth (%)	-0.002	-0.003	-0.002	-0.004	-0.003^{***}
	(0.722)	(0.121)	(0.347)	(0.129)	(0.090)
Lag of Inflation (%)	0.130^{*}	-0.027	-0.019	-0.048	-0.034
	(0.009)	(0.487)	(0.706)	(0.343)	(0.384)
Observation	189	189	189	189	189
Adjusted R - Square	0.389	0.630	0.624	0.672	0.597
Cross Section Effect	None	Fixed	None	Fixed	Fixed
Period Effect	None	None	Fixed	Fixed	Random

Note: * Indicates 1 per cent level of significance, ** indicates 5 per cent level of significance and *** indicates 10 per cent level of significance. Probabilities are given in the parenthesis.