NEXUS BETWEEN EXCHANGE RATE VOLATILITY AND ECONOMIC GROWTH: A CROSS COUNTRY COMPARISON OF SELECTED SOUTH ASIAN COUNTRIES

BY

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QUAID-I-AZAM UNIVERSITY, ISLAMABAD

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بسم الله الرحمن الرحيم

DEDICATED

TO

THE LOVING MEMORIES OF MY PARENTS

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I would like to acknowledge my mother, her hope and encouragement enable me to get education up to this level, without her hope it is not possible for me to even take the metric certificates. In every moment of my life I miss my mother, may ALLAH give her Jannatul Firdus AMEEN.

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Table of Contents

List of Tables

List of Figures

Abstract

The present study is an attempt to examine the impact of exchange rate volatility on economic growth rate of selected South Asian Countries. A cross country comparative analysis is being conducted for Pakistan, Bangladesh, India, Bhutan, Maldives, Nepal and Sri Lanka using annual data from the year 1970 to 2013. The exchange rate volatility is captured through EGARCH model. The OLS regression and ARDL approach of co-integration is employed to find out the empirical evidence. The results of the study are different with respect to countries, for most of the countries the results show the negative impact of exchange rate volatility on economic growth rate, while economic growth rate of few countries is not affected by exchange rate volatility. Moreover, the Nepal economic growth rate is positively affected through exchange rate volatility. In comparative analysis, the study indicates that the Bhutan economic growth rate suffers more from the instability of exchange rate.

Chapter 1

Introduction

Economic performance of a country can be affected by exchange rate volatility. The possibility is there, that the exchange rate fluctuation will have a negative or positive impact on economic growth rate. After the breakdown of the Bretton wood system, volatility of both nominal exchange rate and real exchange rate are increased. With the free mobility of capital if the economy is disturb by foreign and domestic monetary shocked, then it will cause fluctuation in output, prices and in the exchange rate, if the exchange rate are flexible (Demir F. , 2013).

The exchange rate volatility will have negative effect the economic growth rate because the increase in the exchange rate volatility results more fluctuation in price level, which creates uncertainty in domestic investors and slow down the domestic investment level, the low domestic investment causes low capital accumulation which slow economic growth rate (Dorantes & Pozo, 2001). On the other hand (Ghosh & Ostry, 1994) claimed that there is a positive effect of exchange rate fluctuation on economic growth rate because the volatility in exchange rate, create variations in prices that encourage the nation to engage in precautionary savings, the higher saving rate will boost up domestic investment and results in a positive impact on growth rate.

Exchange rate volatility affects the economic growth rate through the domestic investment level. To further discuss that how exchange rate volatility affects the domestic investment level

(Bahmani-Oskooee & Hajilee, 2013) claim that the exchange rate fluctuation create price volatility and the price volatility is negatively or positively related with the domestic investment. In the case of risk averse investors, they invest more in order to escape from future price fluctuation. Conversely, an increase in price volatility will have a negative impact on the investment level of risk neutral investors.

In South Asia, the majority of the countries have a low economic growth rate. The countries in South Asia are trying to achieve the consistently increasing economic growth rate. Therefore, in what way the exchange rate volatility effect economic performance in South Asian countries are essential to clarify. Also for the South Asian countries, there is a need to explain the relative importance of the impact of exchange rate volatility on economic growth. Because in South Asia most of the countries are competing against each other in economic activities.

To find out the effect of exchange rate volatility on economic growth rate in each South Asian country, the null and alternative hypothesis can be stated as.

H_0: There is no impact of exchange rate fluctuation on economic growth of South Asian countries.

H_1: The economic growth of each South Asian country is affected by exchange rate volatility.

Moreover, we can also test whether there is same impact of exchange rate volatility in the economic performance of South Asian countries or the impact of exchange rate volatility on economic growth are varied with respect to countries in South Asia.

The main objectives of our study is

- ❖ to find out the impact of exchange rate fluctuation on economic growth in selected South Asian country Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.
- ❖ to compare the effect of exchange rate volatility on economic growth of South Asian countries and explain the relative importance of exchange rate stability.

The study employed Exponential Generalized Auto Regressive Conditional Heteroscedastic (EGARCH) model to estimate the exchange rate volatility. To discover the impact of exchange rate volatility on economic growth rate, we apply Ordinary Least Square (OLS) method on sample regression. Furthermore, for Short run and long run impact of exchange rate fluctuation on economic growth rate, we use Auto Regressive Distributive Lagged (ARDL) approach of co-integration analysis.

The remaining thesis is organized as: chapter 2 contained the extensive review of present literature on the effect of exchange rate fluctuation on economic growth; chapter 3 deal with the methodology of the study; chapter 4 discusses the type of data, sources of data and descriptive statistics of the data; chapter 5 presents the results of study; the last chapter of the study is the conclusion of the study.

Chapter 2

Review of Literature

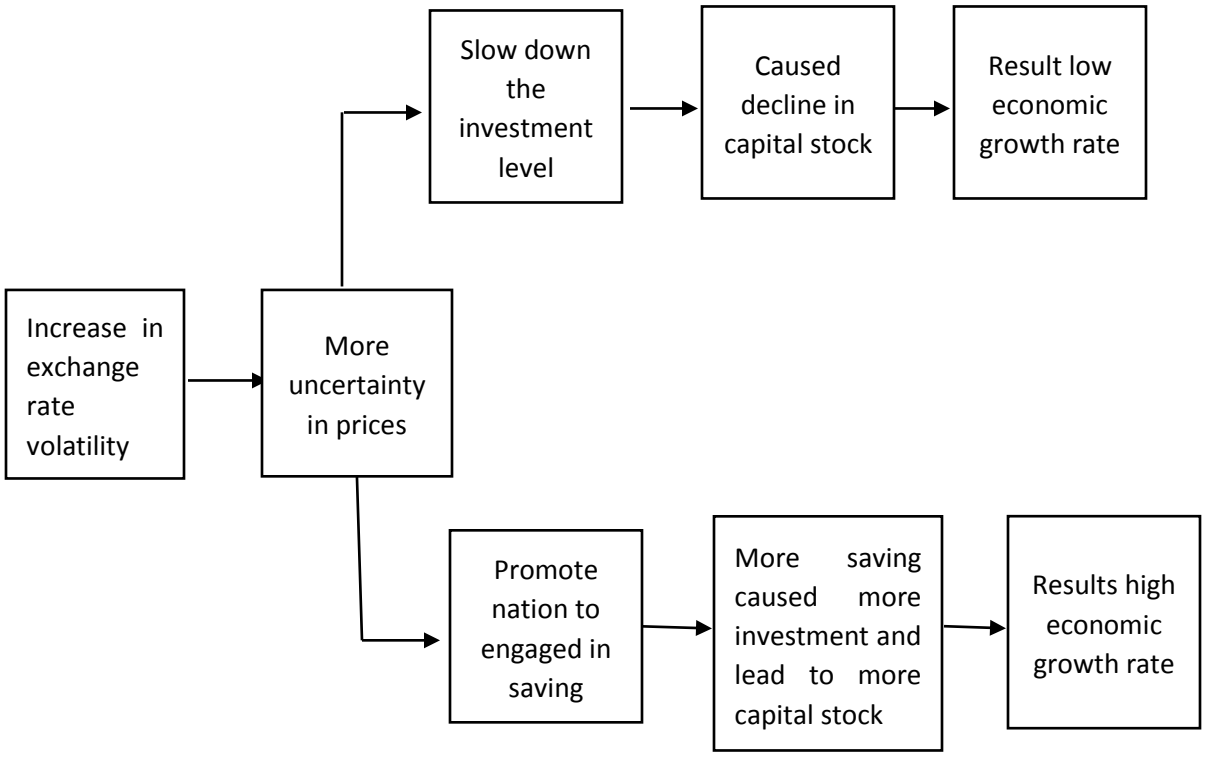
2.1. Introduction

In this chapter, we give a brief discussion of previous studies that related to the impact of exchange rate volatility on economic growth. In this chapter, we focused on those empirical and theoretical works which are related to the effect of exchange rate volatility and economic growth. However, we also examined some articles that show the impact of exchange rate fluctuation on other economic variables which are closely related to the economic growth rate such as exports, trade openness, investment and employment.

2.2. Theoretical Literature Review

Theoretically, volatility in economic variables like exchange rate cause uncertainty in prices, the uncertainty of price results to decrease in domestic investment, decrease in investment level slow the capital accumulation which in turn transfer to low economic growth (Dorantes & Pozo, 2001). On the other hand, (Ghosh & Ostry, 1994) argue that the uncertainty in exchange rate creates price volatility that encourage nations to engage in precautionary saving. This increase in saving will cause more investment and more investment will lead to more capital and resulting high economic growth.

Figure 2.1: Channel for the effect of exchange rate fluctuation on growth



Source: (Dorantes & Pozo, 2001) *and* (Ghosh & Ostry, 1994)

How the exchange rate volatility can affect the investment level (Bahmani-Oskooee & Hajilee, 2013) argued that exchange rate volatility is the of cause price fluctuation, the price fluctuation have negative or positive impact on domestic investment level depend upon the degree of risk of investors, risk averse investors invest more in order to avoid from future price fluctuation, while in case of risk neutral investors they slowdown their investment process with increase in price volatility.

2.3. Empirical Literature Review

In this section, review of empirical studies on the effect of exchange rate fluctuation on economic growth is presented. A number of researchers tried to find the impact of exchange rate volatility on economic growth.

(Demir F. , 2013) conducted an empirical study on the impact of exchange rate fluctuation and the growth rate of manufacturing firms in Turkey. The results of this study based on panel data from 1993 to 2005 taking for 500 private firms. The Arellano Bounds model was employed to get the results. The results show that there is a negative effect of exchange rate volatility in the growth rate of manufacturing firms.

(Bahmani-Oskooee & Hajilee, 2013) examined the effect of exchange rate fluctuation on domestic investment of 75 different countries. Annual data from 1975 to 2010 were used to obtain the results. The results were obtained through ARDL model. The results show that in case of fourteen countries the exchange rate volatility has a positive impact on domestic investment, while in case of thirteen countries the exchange rate volatility have a negative impact on domestic investment. Furthermore, in the case of nine countries, insignificant impact of exchange rate fluctuation was founded.

(Hassan, 2013) estimated the effect of exchange rate fluctuation on the trade growth rate of Pakistan with its three major trading partners. The study was based on time period from 1998:8 to 2011:6. The volatility was computed through Generalized Auto Regressive Conditional Heteroscedasticity (GARCH) model and the results were obtained through Johansen Juselius

(JJ) approach of co-integration. In the short run they found different results, while in the long run exchange rate fluctuation have a positive impact on the import for UK and UAE and have a negative impact on the imports of Russia. The same results are derived in export regression.

(Umaru, Musa, & Saidu, 2013) regressed the exports on exchange rate volatility for Nigeria, they used the ARCH and GARCH model to measure the volatility. The order of integration was founded by ADF and PP test. The results were obtained by using the OLS method and Granger causality test. The results of the Granger causality test show that the exchange rate volatility causes the growth rate of exports in a negative direction because the exchange rate volatility results fluctuation in price that cause the low domestic investment and low output, with low output there is low exports.

(Mpofu, 2013) find the effect of exchange rate volatility on the employment rate of the manufacturing sector and other important variables. The study was based on quarterly data for the time period from 1995 to 2010. The volatility was measured with simple moving standard deviation. While the results are obtained through ARDL model. The main results of the study indicate that the exchange rate variability has negative impact on the manufacturing employment rate.

(Yusoff & Sabit, 2013) empirically examined the effect of exchange rate volatility on the exports of the selected Association of Southeast Asian Nations (ASEAN) countries. This study used panel data over the period from 1992 to 2011. The average moving standard deviation was used to capture the volatility of exchange rate. The GMM was used to obtain the results. The

results show the negative effect of exchange rate fluctuation on exports because exchange rate variability creates price variability, and that results to fall the investment, output and exports.

(Ahmad, Ahmad, & Ali, 2013) find out the relationship between the nominal exchange rate and economic growth rate in case of Pakistan. Annual data from 1975 to 2011used for the study. The Augmented Dickey-Fuller (ADF) test was used to check the order of integration of variables. The results were obtained by Ordinary Least Square (OLS) method. The main findings of the study show that there is an adverse and significant effect of nominal exchange rate of economic growth rate.

(Sanginabadi & Heidari, 2012) explored the relationships between the exchange rate fluctuation and economic growth rate for Iran. The estimation was based on quarterly data from 1980:1 to 2007:4. In order to find out the volatility in real exchange rate, the GARCH (1, 1) model was employed. The ARDL approach of co-integration was adopted to find long run and short run results. The results show that the exchange rate fluctuation has a negative influence on the economic growth rate of Iran.

(Musyoki, Pokhariyal, & Pundo, 2012) empirically inspected the relationship between economic growth and exchange rate uncertainty for Kenya. The study was based on the time period from 1991:1 to 2009:12. The data on volatility was computed using the GARCH model. The results were obtained by using Generalized Method of Moment (GMM). The results of this empirical work show the negative, but insignificant effect of exchange rate uncertainty on the economic growth rate of Kenya.

(Dickson, 2012) discovered the effect of exchange rate volatility on economic growth in Nigeria. The study was based on annual data from 1970 to 2009. The GARCH model was used to capture the volatility of real exchange rate. The results were obtained by applying JJ approach of co-integration. The results of the study show that the exchange rate volatility positively affects economic growth in the short run, while in the long run there is a negative and significant effect of exchange rate volatility in the economic growth rate of Nigeria.

(Saqib & Sana, 2012) analyzed empirically the effect of real exchange rate uncertainty on exports of Pakistan. In the study, they used annual data from 1981 to 2010.The stationarity of the variables were checked through Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) test. To obtain the results sample OLS method was used. The results show that the real exchange rate uncertainty has a negative effect on the volume of exports.

(Jantarakolica & Chalermsookb, 2012) examined the effect of exchange rate variability on textile and garments exports Thailand. For the analysis, they used quarterly data over the period from 2000:1 to 2011:2 of nine products. For exchange rate volatility GARCH model was used. The panel data with fixed effect and random effect are employed to obtain the results. The results show that the exchange rate variability has a negative effect on Thailand textile and garment exports.

(Renani, Hosein, & Mirfatah, 2012) inspected the empirical linked between exchange rate uncertainty and Foreign Direct Investment (FDI). In the study, the quarterly was used based on the time period from 1980:2 to 2006:3. The average moving standard deviation was used to

capture volatility in the exchange rate. The results were obtained by JJ co-integration approach. The study shows there is negative impact of exchange rate uncertainty on FDI.

(Selmi, Bouoiyour, & Ayachi, 2012) explored the empirical relationships between exchange rate fluctuation and oil price volatility for two small open economies. In the study Morocco is oil importing country and Tunisia is an oil exporting country. The GARCH family model was employed to measure volatility. The results show that whether the exporting or importing country the real oil price volatility have a negative effect on exchange rate fluctuation.

(Boar, 2010) observed the empirical relationship between exchange rate volatility and growth rate of selected countries of Europe. The volatility was measured by symmetric and asymmetric ARCH model and also by sample moving standard deviation of exchange rate. The results were obtained by Arellano Bounds model. For individual country, the co-integration analysis was done through JJ approach. The results show that there exists negative impact of both nominal and real effective exchange rate volatility on economic growth.

(Tarawalie, 2010) explored the effect of the real effective exchange rate on economic growth for Sierra Leone. The study was based on the time period from 1990:1 to 2006:4. The JJ co-integration approach were used to obtain the results. The results of the study suggest that there is a positive and significant impact of the real effective exchange rate on economic growth.

(Mukhtar & Malik, 2010) examined the relationships between exchange rate uncertainty and export growth for Pakistan, India and Sri Lanka over the period 1960-2007. The GARCH model

was employed to estimate the volatility. The results of the JJ co-integration approach suggest that there is negative and significant influence of exchange rate volatility on export growth in all countries.

(Hooy & Choong, 2010) analyzed the effect of exchange rate variability in export demand function of selected SAARC countries. In this study monthly data were used based on the time period from 1980:1 to 2008:1. The volatility in the exchange rate was measured with GARCH model and Conditional Constant Correlation (CCC) model. The co-integration analysis are done by ARDL model. The results declared that there is negative significant effect of exchange rate variability in export demand function.

(Alam & Ahmad, 2010) examined the effect of exchange rate uncertainty on Pakistan's bilateral import. The study was conducted for the trading partners Japan, Saudi Arabia, USA, UK, Germany, UAE and Kuwait during 1982:1 to 2008:2 using quarterly data. The volatility was measured through GARCH model. The order of integration was checked by ADF and PP test, while the results were obtained through ARDL model. The study finds out that the impact of exchange rate uncertainty on bilateral import is negative and significant for UK only.

(Demir F. , 2010) claimed that the exchange rate volatility is negatively related with the employment growth rate. The claimed was based on annual data on the firm's level from 1983 to 2005. The volatility in the exchange rate was computed by GARCH (1, 1) model and the results were obtained through GMM and OLS.

(Javed & Farooq, 2009) examined the impact of exchange rate uncertainty on economic growth of Pakistan for the period 1982 to 2007. Auto Regressive Lagged Distributive (ARDL) model was employed to obtain the results. The results of the study show that in the long run and short run, the exchange rate uncertainty has negative impact on economic growth rate of Pakistan.

(Aqeel & Nishat, 2006) find the relationships between exchange rate fluctuation and exports in the case of Pakistan. They used quarterly data in a study based on the period 1982:1 to 2000:4. The volatility of the exchange rate was estimated by simple moving standard deviation. The results of the study were derived through JJ co-integration approach. The main findings of the study show that there is a negative and significant effect of exchange rate fluctuation on exports.

(Azid, Jamil, & Aneela, 2005) examined the effect of exchange rate volatility on economic growth of Pakistan. The study used quarterly data based on time period from 1973:1 to 2003:4. The Generalize Auto Regressive Conditional Heteroscedastic (GARCH) model was employed to find out volatility in the real exchange rate. The results were obtained by using Engle and Granger approach of co-integration and Impulse Response Function. The results show that there is the negative and insignificant impact of exchange rate variability on economic growth.

(Bagella, Becchetti, & Hasan, 2004) examined the effect of real effective exchange rate volatility, the quality of governance and macroeconomics performance of the Eurozone countries. The study was based on the time period from 1980 to 2001. The results were obtained by fixed effect model. The results of the study show that the real effective exchange rate fluctuation has negative impact on growth rate.

(Mustafa & Nishat, 2004) analyzed the influence of exchange rate uncertainty on export growth rate of Pakistan. The results of the study were based on quarterly data from 1991:3 to 2004:2. The volatility was measured through simple moving standard deviation. The results were obtained through JJ co-integration approach. The results of the study show the negative impact of exchange rate uncertainty on export growth for the countries USA, UK, Australia, Bangladesh, Singapore and India because these countries are the major trading partner of Pakistan. The study also shows that there is an insignificant impact of exchange rate volatility on export growth rate for the countries like New Zealand and Malaysia.

(Dorantes & Pozo, 2001) explored the effect of exchange rate uncertainty on the economic growth in Chili, Korea, Mexico and Singapore. They used quarterly data from 1971:3 to 1994:2. The Auto Regressive Conditional Heteroscedasticity (ARCH) model was employed for volatility in exchange rate, while the results were obtained through the JJ approach of co-integration. The results of the study show that there is no significant evidence for the effect of exchange rate volatility on economic performance.

(Kumar & Dhawan, 1991) examined the relationship between exchange rate uncertainty and Pakistan's exports with its major partner countries. They used quarterly data based on time period 1974:1 to 1985:4. The volatility was measured by average moving of standard deviation, coefficient of variation and Gini mean difference of exchange rate. The OLS method was used to find out the results. The results of the study show the effect of exchange rate uncertainty on Pakistan's exports varies with the partner countries.

Table 2.1: Summary of Review of Literature

Reference	Time Period of Analysis	Countries	Methodology	Conclusion
(Demir F. , 2013)	1993 to 2005	Turkey	Arellano Bounds model	Exchange rate uncertainty has negative significant impact on the growth rate of each firm
(Bahmani-Oskooee & Hajilee, 2013)	1975 to 2010	Analysis for 36 countries.	ARDL model	In most countries the exchange rate fluctuation has negative impact on domestic investment
(Hassan, 2013)	1998:8 to 2011:6	Pakistan, USA, UK, UAE	JJ approach of co-integration	The results vary from country to country ambiguity in the results
(Umaru, Musa, & Saidu, 2013)		Nigeria	OLS and Granger Causality test	Exchange rate volatility has a negative effect on the growth rate of exports.
(Mpofu, 2013)	1995 to 2010	South Africa	ARDL model	The results find negative effect of exchange rate uncertainty on manufacturing firm's employment growth rate
(Yusoff & Sabit, 2013)	1992 to 2011	Indonesia, Malaysia, Philippine, Singapore and Thailand	GMM	Exchange rate volatility has a negative impact on export
(Ahmad, Ahmad, & Ali, 2013)	1975 to 2011	Pakistan	OLS	The nominal exchange rate has negative impact on growth
(Sanginabadi & Heidari, 2012)	1980:1 to 2007:4	Iran	ARDL model	Exchange rate volatility has negative impact on economic growth
(Musyoki, Pokhariyal, & Pundo, 2012)	1991:1 to 2009:12	Kenya	GMM	Exchange rate volatility has a negative insignificant impact on economic growth
(Dickson, 2012)	1970 to 2009	Nigeria	JJ approach of co-integration	The exchange rate volatility has negative impact on growth in the long run, while in the short run the impact is positive
(Saqib & Sana, 2012)	1981 to 2010	Pakistan	OLS	The real exchange rate has negative impact on exports

(Jantarakolica & Chalermsookb, 2012)	2000 to 2011	Thailand	Fixed effect model	Exchange rate volatility has negative impact on Thai
(Renani, Hosein, & Mirfatah, 2012)	1980:2 to 2006:3	Iran	JJ approach of co-integration	Exchange rate volatility has negative impact on FDI
(Boar, 2010)		Romania, Hungry, Turkey, Poland, Czech Republic and Latvia	Arellano Bounds model	Exchange rate volatility has negative impact on growth
(Tarawalie, 2010)	1991:1 to 2004:4	Sierra Leone	JJ approach of co-integration	The real exchange rate has a positive impact on growth rate.
(Mukhtar & Malik, 2010)	1960 to 2007	Pakistan, Sri Lanka and India	JJ approach of co-integration	Exchange rate volatility has negative impact on the growth of exports
(Hooy & Choong, 2010)	1975 to 2010	Analysis for 36 countries.	ARDL	Exchange rate volatility has negative impact on exports
(Alam & Ahmad, 2010)	1982:1 to 2008:3	Pakistan	ARDL	The results of real exchange rate fluctuation are ambiguous and are varied from country to country
(Demir F. , 2010)	1983 to 2005	Turkey	GMM and OLS	The exchange rate volatility has a negative effect on the employment growth rate.
(Javed & Farooq, 2009)	1982 to 2007	Pakistan	ARDL	The exchange rate uncertainty has negative impact on growth
(Aqeel & Nishat, 2006)	1982:1 to 2000:4	Pakistan	JJ approach of co-integration	Exchange rate volatility has negative impact on exports
(Bagella, Becchetti, & Hasan, 2004)	1980 to 2001	Eurozone countries	Fixed Effect Model	Real effective exchange rate volatility has negative impact on growth rate
(Mustafa & Nishat, 2004)	1991:3 to 2004:2	Pakistan	JJ approach of co-integration	Exchange rate volatility negatively affects the growth of exports
(Azid, Jamil, & Aneela, 2005)	1971:1 to 2003:4	Pakistan	Engle and Granger co-integration approach	Exchange rate volatility has an insignificant negative impact on Manufacturing Production Index (MPI)
(Dorantes & Pozo, 2001)	1971:4 to 1994:4	Chile, Korea, Mexico and Singapore	JJ approach of co-integration	There is an insignificant negative impact of exchange rate uncertainty on MPI
(Kumar & Dhawan, 1991)	1974 to 1985	Pakistan	OLS	The impact of exchange rate variability varies with respect to partner countries

Overall, the literature shows ambiguous results about the impact of exchange rate fluctuation on economic growth. In many studies, insignificant effect of exchange rate volatility on economic growth rate were found, however, some studies show that there is negative impact of exchange rate uncertainty on economic growth rate, while few studies also reported the positive impact of exchange rate volatility on economic growth. So there are inconclusive results in the literature about the impact of exchange rate volatility on economic growth rate.

From the above literature, it is justified that there is no study conducted which analyzed the impact of exchange rate uncertainty on economic growth rate of South Asian countries. Also in the above literature we find no study that shows the comparison of the effect of exchange rate fluctuation on the economic growth rates of different countries. So the present study is an attempt to find out the impact of exchange rate fluctuation on the growth rate of South Asian countries and then compare the results across countries to find out the relative importance of exchange rate stability in South Asia.

Chapter 3

Methodology

3.1. Introduction

In this chapter, we provide an overview of the model and variables used in the analysis to analyze the hypothesis mentioned in chapter 2. In the second section model to link exchange rate volatility and economic growth is presented. In the third section, we will discuss the econometric methodology to estimate the model.

3.2. Model Specification

As we have mentioned above that the present study intends to examine the impact of exchange rate fluctuation on economic growth. For this purpose, the augmented version of the Solow growth model. Following the idea of (Bagella, Becchetti, & Hasan, 2004) we have augmented the standard growth model in a number of ways. The basic version of the Solow growth model is given as follows:

$$Y_t = f(K_t, H_t, A_t L_t) = K_t^{\alpha_1} H_t^{\alpha_2} (A_t L_t)^{1-\alpha_1-\alpha_2} \qquad 0 < \alpha_1 + \alpha_2 < 1 \qquad 3.1$$

In the above specification 'H_t' is the 'human capital stock at time t' while K_t and L_t are the physical capital and human capital which are the traditional inputs of Solow growth model at time period t, while A_t show the impact of other variables on output at time period t, A_t is also called the augmented factor for labor. The reason to use the Cobb-Douglus form of production is that it's satisfying most of the assumption of the Solow growth model such as

constant returns to scale with respect to inputs and Inada condition[1]. The equations of motion of the inputs are given as follows.

$$\dot{K}_t = s_K Y_t - \delta_K K_t \quad 3.2$$

$$\dot{H}_t = s_H Y_t - \delta_H K_t \quad 3.3$$

In the above equations $\dot{K}_t$ and $\dot{H}_t$ show the change with respect to time in physical capital and human capital, respectively. Also s_K and s_H are the fraction of output that are devoted to physical capital and human capital, respectively. While δ_K and δ_H show the rate at which physical capital and human capital are depreciated. The labor inputs are determined exogenously as under.

$$L_t = L_0 e^{nt} \quad 3.4$$

Where is n is the population growth and are assumed to be exogenously determined from outside the model. As this study aims to examine the impact of exchange rate volatility on economic growth, so for this purpose, we extend the Solow growth model by incorporating the exchange rate volatility variable along with other variables. To incorporate the additional variables in the model, it is assumed that these variables affect the technological growth rate and then in turn economic growth. These variables are modeled as follows

$$A_t = A_0 e^{v(To_t, Ervol_t, \dots)} \left(v_{To_0} e^{gr_{To} t}\right)^{\gamma_1} \left(v_{Ervol_0} e^{gr_{Ervol} t}\right)^{\gamma_2} (A_{R_o} e^{gr_{A_R} t}) \quad 3.5$$

Where, To_t Show, the trade openness, while $Ervol_t$ show the real exchange rate volatility, γ_1 and γ_2 shows their impact respectively on labor augmented factor, v_{To_0} and v_{Ervol_0} show the initial value of trade openness and exchange rate volatility, gr_{To} and gr_{Ervol} show the growth rate of trade openness and growth rate exchange rate volatility that are also assumed to be exogenously determined. 'A_R' shows the contribution of other factors to the technology,

[1] $\lim_{k \to o} F'(k) = \infty$ and $\lim_{k \to \infty} F'(k) = 0$, $\lim_{H \to 0} F'(H) = \infty$ and $\lim_{k \to \infty} F'(H) = 0$

A_{R_o} show its initial value and $gr_{A_R t}$ are its growth rate. Equation 3.1 is the output equation which can be written in per worker form as follows.

$$y_t = {A_t}^{1-\alpha_1-\alpha_2} k_t^{\alpha_1} h_t^{\alpha_2} \quad 3.6$$

Here $y_t = \frac{Y_t}{L_t}$, $k_t = \frac{K_t}{L_t}$ and $h_t = \frac{H_t}{L_t}$

Where as y_t show the output per worker, k_t and h_t show the physical capital per worker and human capital per worker, respectively. To determine the rate of change we take the time derivatives of k_t and h_t. We get the following two standard equations for physical capital and human capital:

$$\dot{k}_t = s_K y_t - k_t(n + \delta_K) \quad 3.7$$

$$\dot{h}_t = s_H y_t - h_t(n + \delta_H) \quad 3.8$$

From equations 3.6, 3.7 and 3.8 we show the growth rate of h_t, k_t and y_t along the balanced growth path as

$$gr_k = \frac{\dot{k}_t}{k_t} = s_K {A_t}^{1-\alpha_1-\alpha_2} k_t^{\alpha_1-1} h_t^{\alpha_2} - (n + \delta_K) \quad 3.9$$

$$gr_h = \frac{\dot{h}_t}{h_t} = s_H {A_t}^{1-\alpha_1-\alpha_2} k_t^{\alpha_1} h_t^{\alpha_2-1} - (n + \delta_H) \quad 3.10$$

$$gr_y = \frac{\dot{y}_t}{y_t} = (1 - \alpha_1 - \alpha_2) gr_A + \alpha_1 gr_k + \alpha_2 gr_h \quad 3.11$$

Where,

$$gr_A = gr_{To} t + gr_{Ervol} t + gr_{A_R} t$$

In the above equations gr_k, gr_h and gr_y indicate the growth rate of physical capital per worker growth rate of human capital per worker and growth rate of output per worker, respectively. In equation 3.9, the first term on the right hand side equal to $\frac{s_K Y_t}{K_t}$. Since both gr_k and $n + \delta_K$ are constant along the balanced growth path, then the Y_t and K_t also grow at

a constant rate along the balanced growth path (Bernanke & Gurkaynak, 2001) . Similar arguments can apply to equation 3.10. Hence, Y, H and K grow at a constant rate that is $gr_K = gr_H = gr_Y = g$.

In equations 3.9 and 3.10, we put $\dot{k}_t$ and $\dot{h}_t$ equal to zero to derive the steady state growth rate of h and k_t .

$$\frac{k_t}{h_t} = \frac{s_K(n+\delta_K)}{s_H(n+\delta_H)} = \mu \qquad 3.12$$

To make algebra simple we assume $\delta_K = \delta_H = \delta$ so that $\mu = \frac{s_K}{s_H}$ and from the simultaneous solution of equations 3.9 and 3.10 we obtain the steady state value of physical capital per worker and human capital per worker that is k_t^* and h_t^*

$$k_t^* = A_t\left(\frac{s_K^{1-\alpha_2} s_H^{\alpha_2}}{n+\delta}\right)^{\frac{1}{1-\alpha_1-\alpha_2}} \qquad 3.13$$

$$h_t^* = A_t\left(\frac{s_H^{1-\alpha_1} s_K^{\alpha_1}}{n+\delta}\right)^{\frac{1}{1-\alpha_1-\alpha_2}} \qquad 3.14$$

As we have converted all the variables in growth form and then we derived the steady state level for k_t and h_t , now from equation 3.6, we derived steady state growth rate level of output using equations 3.13 and 3.14 that is lny_t^*

$$lny_t^* = lnA_t + \frac{\alpha_1}{1-\alpha_1-\alpha_2} lns_K + \frac{\alpha_2}{1-\alpha_1-\alpha_2} lns_H - \frac{(\alpha_1+\alpha_2)}{1-\alpha_1-\alpha_2} \ln(n+\delta) \quad 3.15$$

Taking logarithm of equation 3.5 and then put the value of lnA_t in equation 3.15 we get

$$lny_t^* = ln(A_{R_0} + gr_{A_R} t) + \gamma_1[lnTo_0 + gr_{To} t] + \gamma_2[lnRERV_0 + gr_{RERV} t] +$$

$$\frac{\alpha_1}{1-\alpha_1-\alpha_2} lns_K + \frac{\alpha_2}{1-\alpha_1-\alpha_2} lns_H - \frac{(\alpha_1+\alpha_2)}{1-\alpha_1-\alpha_2} \ln(n+\delta) \qquad 3.16$$

Equation 3.16 is showing the balance growth path of output per worker. Any deviation from the balance growth path will be shown by ε_t. So the above equation is written in final form as

$$lny_t = \gamma_0 + \gamma_1\, lnTo_t + \gamma_2 lnErvol_t + \gamma_3 lns_k + \gamma_4 lns_H + \gamma_5 ln(n+\delta) + \varepsilon_t \quad 3.17$$

In the above equation we take the impact of other variables on labor augmented factor is fixed and represent by the intercept γ_0 in equation 3.17. In the above equation 3.17, ε_t show the deviation of output per worker from the balance growth path that is $\varepsilon_t = lny_t^* - lny_t$.

3.3. Variables Description and Measurement

In the above section we specified all the variables, use in this study. This section discusses the variables description and its measurement. Further, in this section we defined the expected effect of exogenous variables on the dependent variable.

Gross Domestic Product per worker (y_t) this is an attempt to examine the impact of exchange rate volatility on economic growth. In the equation 3.17 the GDP per worker is our dependent variable. In this study, we measured it by GDP per working age population.

Trade openness ($\boldsymbol{To_t}$) is used as an exogenous variable in our empirical model. The trade openness is the ratio of the sum of exports and imports to GDP. The purpose of the inclusion of this variable in our growth equation is to highlight its impact on economic growth. This variable is expected to have a positive and significant impact on economic growth because surplus in trade causes the earning of precious foreign exchange reserve, which can help to enhance the economic performance of a country in the future. In this study, we have used the ratio of trade openness computed from the merchandised exports plus the merchandised imports and GDP.

Exchange Rate Volatility ($\boldsymbol{Ervol_t}$) as the main objective of this study is to evaluate the impact of exchange rate volatility on economic growth, so this is a core exogenous variable in our growth equation. Exchange rate volatility cause fluctuations in prices, which leads to uncertain environment for domestic investment, hence with the increase in volatility in exchange rate the neutral domestic investors hesitate to invest more and lead a negative impact on economic growth rate, so it is expected that the coefficient of exchange rate volatility has negative significance. On the other hand more, exchange rate volatility causes uncertainty in prices, the uncertainty in price promotes people to save more, increased in saving lead positive impact on growth, so the positive sign about exchange rate volatility also expected. To calculate exchange rate volatility, the ARCH family models are used.

Physical capital ($\boldsymbol{S_K}$) is the main variable in the Solow growth model, physical capital have a direct positive impact on growth rate. The physical capital is the direct input used in the production function, with the increased in physical capital the output also increased. We use the physical capital to GDP in this study. The data on physical capital are generated by the perpetual inventory method followed by (Barro & Lee, 2010)[2].

Human capital ($\boldsymbol{S_H}$) is taken as independent variable. The direct data on Human capital is not available, different proxies are used for human capital in literature that is average year of schooling, literacy rate, school enrollment, etc. In this study, we used the school enrollment in primary percentage of gross as a proxy for human capital follow the literature (Bagella, Becchetti, & Hasan, 2004).

[2] In perpetual inventories method the initial $K_0 = I_1/(gr_1 + \delta)$ Where gr_1 is the gdp growth rate at $t = 1$and I_1 is the investment level in time '1' and δ is the rate of depreciation which are assumed (0.06) across the countries. Then $K_t = K_{t-1}(1 - \delta) + I_t$

Population growth rate ($\boldsymbol{n}$) is another exogenous variable in our regression equation. The expected sign for the population growth rate is negative. This is because with high population growth rate the human resources are not properly utilized. In our study, we used the population growth plus the rate of depreciation allowance of physical capital and human capital as an exogenous variable.

3.4. The Econometric Methodology

This section provides a brief overview of the methodology that we have used to estimate the growth model for the South Asian economies. This includes the procedure which we used to estimate the exchange rate volatility, unit root test to find out order of integration and ARDL co-integration approach.

3.4.1. Measurement of Exchange Rate Volatility

In literature, most of the time to estimate the volatility in exchange rate series, the simple moving standard deviation of exchange rate or the average moving standard deviation of exchange rate, are mostly used. However, in this study, we used Autoregressive Conditional Hetroskedasticity (ARCH) family model. In the ARCH family model we used Exponential Generalized Autoregressive Conditional Hetroskedasticity (EGARCH) model present by (Nelson, 1991). The EGARCH model of exchange rate are formulated as

$$Er_t = \propto_0 + \sum_{i=1}^{p} \propto_i Er_{t-1} + \varepsilon_t \qquad 3.17$$

$$\log h_t = \gamma_0 + \sum_{i=1}^{r} \gamma_i log\ h_{t-r} + \sum_{\substack{i=1 \\ i \neq j}}^{q} \theta_i \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \theta_j \left| \frac{\varepsilon_{t-j}}{\sqrt{h_{t-j}}} \right| + \varphi_j \frac{\varepsilon_{t-j}}{\sqrt{h_{t-j}}} + \eta_t \qquad 3.18$$

Equation 3.17 represents the mean equation of EGARCH model. In mean equation, we can add trends also, while for lagged selection we used Schwraz Bayesian Criteria (SBC). The

equation 3.18 presents the variance equation of EGARCH model. In equation, h_t showing the variance of ε_t and γ_i show the impact of the lagged value of the variance of mean equation residuals. In equation 3.18, φ_j show the impact of bad news. If its value are negative and significant then it show that the bad news have significant impact.

3.4.2. Unit root test

In time series data before the estimation it is important to check, whether the series is stationary or not. For this purpose, different test, has been used by econometrician, among which the Dickey and Fuller (1979) is the well-known test to check the unit root of a series

$$y_t = \alpha y_{t-1} + \varepsilon_t \quad 3.19$$

$$\Delta y_t = \delta y_{t-1} + \varepsilon_t \quad 3.20$$

Whereas, in equation 3.20, $\delta = \propto -1$ to check the unit root we test $H_0: \delta \geq 0$ versus $H_1: \delta < 0$, the null hypothesis show that the variable is not stationary while the alternative hypothesis show that the variable is stationary. The DF test, based on the assumption that the error term is white noise, however, if the error term is not white noise then DF test is not valid. To set this problem Dickey and Fuller suggest the Augmented Dickey and Fuller test of a unit root.

$$\Delta y_t = \delta y_{t-1} + \sum_{i=1}^{p} \propto_i \Delta y_{t-1} + \varepsilon_t \quad 3.21$$

The equation 3.21 is the final equation for estimation in ADF test. In above equation $\delta = \sum_{i=1}^{p} \propto_i - 1$. During test procedure, when can add intercept and trend variable for time impact. For lagged selection we used Akiak Information Criteria (AIC).

3.4.3. Autoregressive Distributive Lag (ARDL) Model of Co-Integration

Autoregressive Distributive Lag (ARDL) is the co-integration approach developed be (Pesaran & Shin , 1995) is used in the present study. ARDL model is used to estimate the

long run and the short run relationships. The ARDL procedure is applied because the other co-integration approach such as Engel Granger and JJ approach of co-integration requires that all the variable should be integrated of the same order. While in ARDL approach such restriction has not been required while estimating the equation.

As our study is concerned to find out the comparative effect of the exchange rate volatility on economic growth rate in South Asian countries. Therefore, we need to run the ARDL model for each South Asian country. The ARDL for each country is formulated as in our study.

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 To_{t-1} + \alpha_3 Ervol_{t-1} + \alpha_4 S_{K\,t-1} + \alpha_5 S_{H\,t-1} + \alpha_6 (n+\delta)_{t-1} + \sum_{i=0}^{p_1-1} \theta_{1i} \Delta y_{t-i} + \sum_{i=0}^{p_2-1} \theta_{2i} \Delta To_{t-i} + \sum_{i=0}^{p_3-1} \theta_{3i} \Delta Ervol_{t-i} + \sum_{i=0}^{p_4-1} \theta_{4i} \Delta S_{K\,t-i} + \sum_{i=0}^{p_5-1} \theta_{5i} \Delta S_{H\,t-i} + \sum_{i=0}^{p_3-1} \theta_{6i} \Delta (n+\delta)_{t-i} + \varepsilon_t \qquad 3.23$$

In the above equation α_i are the composite parameters containing the long run coefficients, θ_{ji} shows the short run coefficients in the model. For the large selection of the model we used Schwraz Bayesian Criteria (SBC). After the estimation of ARDL equation, we apply co-integration test that is a Bounds test of co-integration (Pesaran, Shin, & Smith, 2001). The null hypothesis and alternative hypothesis in this test are.

$$H_0: \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 0$$
$$H_A: \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq 0$$

The acceptance of alternative hypothesis shows there exist co-integration between GDP per worker and exogenous variables. The (Pesaran, Shin, & Smith, 2001) point out that the critical value of F test be biased and they computed the true critical values of the test which depends on the number of I (0) and I (1) variables.

After the co-integration test we estimated the long run coefficients from the ARDL equation. In the next step after the estimation of long run coefficients, we compute the lagged of residual that is ε_{t-1} . Next the estimation of lagged residual we estimate the Error Correction Model to obtain the short run coefficients.

3.4.4. Error Correction Model (ECM)

The Error Correction Model can be written

$$\Delta y_t = \alpha_0 + \sum_{i=0}^{p_1-1} \theta_{1i}\Delta y_{t-i} + \sum_{i=1}^{p_2} \theta_{2i}\Delta To_{t-i} + \sum_{i=1}^{p_3} \theta_{3i}\Delta Ervol_{t-i} +$$

$$\sum_{i=1}^{p_4} \theta_{4i}\Delta S_{K\,t-i} + \sum_{i=1}^{p_5} \theta_{5i}\Delta S_{H\,t-i} + \sum_{i=1}^{p_3} \theta_{6i}\Delta(n+\delta)_{t-i} - \pi\varepsilon_{t-1} + \varepsilon_t \quad 3.24$$

In the above equation θ_{ji} show the short run coefficients and ε_{t-1} is the error correction term and its coefficient π show the adjustment towards equilibrium level if we have disequilibrium in the economy. For co-integration relationships the π should negative and significant.

In this chapter we have a detailed discussion of all the variables that are used in this study. Also, we discuss the methodology of our study in this chapter. In the next chapter of the study, we have a discussion on the data that are used to obtain the results. Also in the next chapter we have a descriptive discussion of the data.

Chapter 4

Data

4.1. Introduction

In this chapter, the issues related to data. In the second section of the chapter, we will discuss the sources and types of data. In next two sections of the chapter, we discuss the trend and descriptive statistics of dependent variables GDP per worker and the key exogenous variable exchange rate volatility.

4.2. Data

In the present section, we will discuss the types of data and their sources. To compute the exchange rate volatility series, we used quarterly data of exchange rate from International Financial Statistics (IFS-CD 2013) from 1972:1 to 2012:4. As in this study, we find the impact of exchange rate volatility on growth rate in Bangladesh, Bhutan, India, Maldives, Nepal, in most of these countries the data on GDP per worker is available from 1972 and onward. While to estimate the exchange rate volatility by EGARCH model we need more observation. So we used quarterly data to estimate exchange rate volatility. Then we convert the quarterly exchange rate volatility data into annual exchange rate volatility data by formulating two models.

1) Model-1:

In Model-1 we used the exchange rate volatility series, which are obtained by taking the last observation of quarterly data in each year.

2) Model-2:

In Model-2 we used the exchange rate volatility series, which is obtained by taking an average of quarterly exchange rate volatility series.

To obtain the results, of OLS regression and ARDL approach of co-integration, we used annual data from 1972 to 2013. Table 4.1 gives information about the description of data for each variable along with the data source and symbols used in this study. We used quarterly exchange rate data, which are collected from International Financial Statistics. While the remaining data that is Gross Domestic Product GDP, the working age population, population growth rate, Gross Capital Formation, School enrollment and trade openness data are collected from the World Development Indicator WDI.

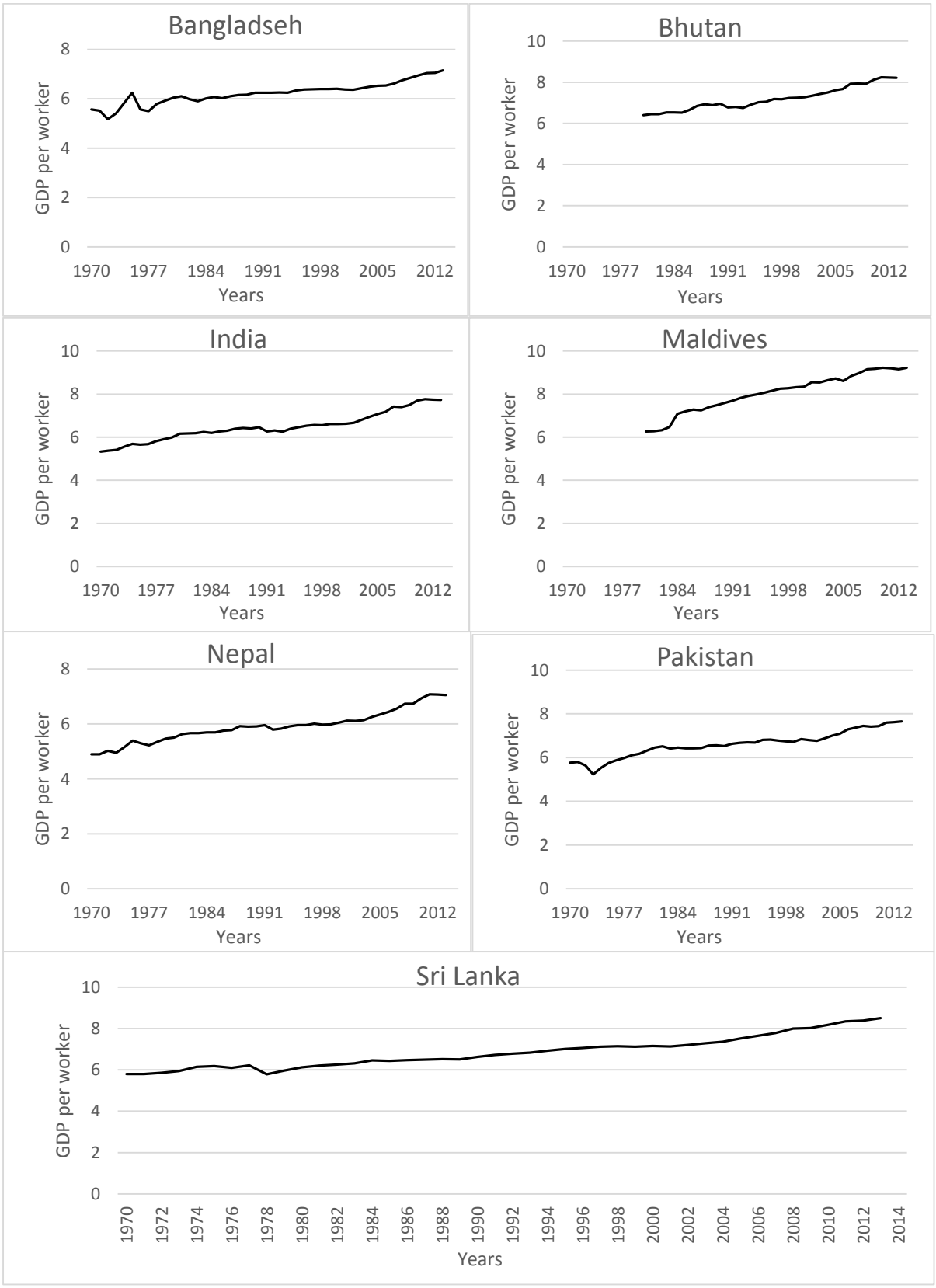
Table 4.1: Variables and their symbols

Variables	Definition	Source	Symbols
Exchange Rate	National Currency per US Dollar for each country	IFS	Er
GDP	Gross Domestic Product in current US dollars	WDI	Y
Labor	The working age population age 15-64	WDI	L
Output per capita	Ratio of GDP to working age population $\frac{Y}{L}$	Author's own calculation	y
Investment	Gross Capital Formation in current US dollar	WDI	I
Population growth rate	Population growth in annual percent	WDI	n
Physical capital	Generate using an equation $K_t = I_t + K_{t-1}(1-\delta)$	Author's own calculation	K
Percentage share of Physical Capital out of GDP	The ratio of physical and GDP per worker $\frac{K}{Y}$	Author's own calculation	S_K
Percentage share of Human Capital out of GDP	Proxy variable (gross school enrollment)	WDI	S_H
Exchange rate volatility	Estimated by EGARCH Model	Author's own calculation	$Ervol$
Trade Openness	The sum of exports and imports to GDP per worker $\frac{X+M}{Y}$	WDI	To_t

4.3. Trend and descriptive statistics of GDP per worker

Here in this study, we used the log of GDP per working age population is our dependent variable. The trends and descriptive statistics of GDP per worker of South Asian countries are discussed in figure 4.1. While the descriptive statistics of GDP per working age population are presented in Table 4.2.

Figure 4.1: Trend and descriptive statistics of GDP per worker of South Asian countries



Source: World Development Indicators

Table 4.2: Descriptive statistics of GDP per worker

Countries	Min – Max	Mean	SD
Bangladesh	5.1732 – 7.1479	6.2213	0.4390
Bhutan	1.1511 – 2.9313	1.8235	0.5568
India	5.3274 – 7.7689	6.4707	0.6467
Maldives	6.2631 – 9.2181	8.0422	0.8903
Nepal	4.8947 – 7.0767	5.9039	0.5659
Pakistan	5.2263 – 7.6507	6.6068	0.5776
Sri Lanka	5.7840 – 8.5057	6.8516	0.7565

Source: Author's own calculations.

From the Figure 4.1, we observed that in case of Bangladesh during the 1972 to 1980 the ups and down has been seen in the log of GDP per worker and thereafter a steady growth rate was observed in GDP per worker. Bhutan is showing instability in GDP per worker from 1980 to 1993 and then the GDP per worker increased steadily. From the Figure 4.1, it is observed that the GDP per worker in case of Maldives increased sharply from 1980 to 1987 and then the steady growth rate was seen in the GDP per worker of Maldives. Nepal shows the smooth growth rate in GDP per worker in the entire period from 1972 to 2012. In the starting period of 1972, GDP per worker of Pakistan show decline and then after the 1974 there is a smooth increase in the GDP per capita. GDP per worker of Sri Lanka show up and down during in 1972 to 1987 and after that increased occur.

In Table 4.2 of descriptive statistics presents the minimum, maximum, mean and standard deviation of GDP per worker of each country. From the minimum and maximum value of GDP per worker we can observe that Maldives economy GDP per worker grow highly during the 1980 to 2013, while the Bhutan's economy is relatively weak as compare to other South Asian countries. The mean value of GDP per worker also indicates the high mean GDP per

worker for Maldives and low mean value of GDP per worker in Bhutan. In the Table 4.2 of descriptive the standard deviation values show that there is low variation occurring in the GDP per worker of Bangladesh as compare to other South Asian countries.

4.4. Trend and descriptive statistics of exchange rate volatility

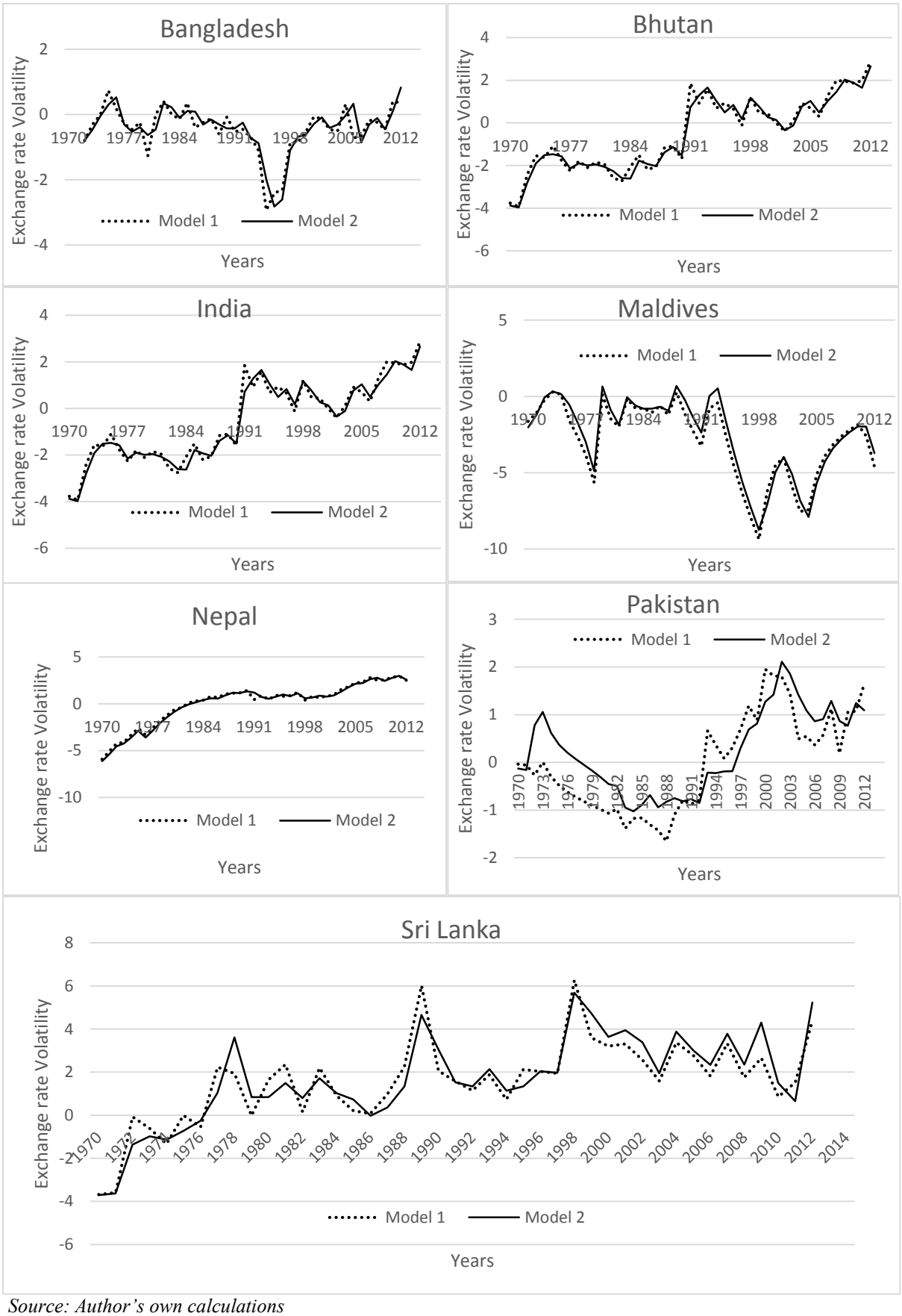
The main objective of our study is to examine the impact of exchange rate volatility on economic growth rate, so the key independent variable in our regression is the exchange rate volatility. This section of the chapter provides a brief discussion on the trend and descriptive statistics of exchange rate volatility of South Asian countries.

The volatility in the exchange rate is measured by ARCH family model. To estimate volatility series quarterly data from 1972:1 to 2012:4 is used. In most of the countries we estimate the volatility by EGARCH model except Nepal, where the GARCH model well used[3]. The quarterly data of exchange rate volatility are then changed into annual data by either taking the volatility of last quarter or, by taking the average of the volatility of quarters within the year or by taking a simple standard deviation of quarters within the year.

After the estimation of exchange rate volatility we have a discussion on trends and descriptive statistics of exchange rate volatility. In Figure 4.2 we present trends in exchange rate volatility and in Table 4.3 descriptive statistics of the exchange rate volatility are presented.

[3] EGARCH model for each South Asian countries are given in Appendix A

Figure 4.2: Trend in exchange rate volatility of South Asian countries



Source: Author's own calculations

Table 4.3: Descriptive statistics of exchange rate volatility

Countries	Model	Min – Max	Mean	SD
Bangladesh	Model 1	-2.9296 – 0.7397	-0.442	0.7292
	Model 2	-2.8209 – 0.8274	-0.413	0.7156
Bhutan	Model 1	-3.9337 – 2.8878	-0.488	1.7181
	Model 2	-3.9740 – 2.6655	-0.543	1.7165
India	Model 1	-3.9401 – 2.8871	-0.491	1.7187
	Model 2	-3.9783 – 2.6523	-0.548	1.7184
Maldives	Model 1	-9.3636 – 0.3049	-2.890	2.4807
	Model 2	-8.7467 – 0.6851	-2.571	2.5493
Nepal	Model 1	-6.8573 – 4.5033	0.2997	2.5102
	Model 2	-6.1274 – 2.9775	0.036	2.3252
Pakistan	Model 1	-1.6512 – 1.9496	-0.015	1.0025
	Model 2	-1.0253 – 2.1090	0.231	0.8638
Sri Lanka	Model 1	-3.6822 – 6.2707	1.570	1.9311
	Model 2	-3.0770 – 5.6793	1.661	2.0969

Source: Author's own calculations.

From Figure 4.2 we see the ups and down in the exchange rate volatility of Bangladesh and Maldives. While persistent increased were observed in the exchange rate volatility of Bhutan, India, Nepal and Sri Lanka. In case of Pakistan, there is a decline in the exchange rate volatility during 1970 to 1990 and then increased in exchange rate volatility occur up to 2000.

In Table 4.3 of descriptive statistics we observed the Sri Lanka have high values of exchange rate volatility. On the other hand Maldives has lower values of the exchange rate volatility in South Asia. Similarly, the mean value of exchange rate volatility shows the lower mean value of exchange rate volatility for Maldives and the highest mean value of the exchange rate in Sri Lanka. The variance of exchange rate indicates the high degree of variation in the exchange rate volatility of Nepal and lower degree of variation in the exchange rate volatility of Bangladesh.

In this chapter, we discussed to sourced and the typed of data used in the study. Also in this chapter, we discussed the trend and descriptive statistics variables. In the next chapter, we are going to discuss the results of unit root tests, OLS regression and ARDL approach of co-integration.

Chapter 5

Results and Results Discussion

5.1. Introduction

This chapter includes the results and discussion. In the second section of the chapter, we give the results of unit root test. After the results of unit root tests we will discuss the results of OLS regression and then the last section of the chapter based on the short run and long run results of ARDL model

5.2. Results of Unit Root tests

To check the unit root, we apply ADF test on data. In this study, we report the results with constant and no trend and with constant and trend. For lag selection we use Sheward Bayesian criteria. The results of ADF test are tabulated in Table 5.1. The results show that for Bangladesh with intercept and trend GDP per worker and exchange rate volatility and share of physical capital are integrated of order zero. While the remaining all other variables are integrated of order one.

In Bhutan, the results of the ADF test show that population growth rate, GDP per worker and school enrollment are stationary at first difference, while remaining all variables are stationary at level. For India, the share of physical capital is integrated of order zero, while the remaining all other variables are stationary at first difference.

Table 5.1: Results of ADF test

Variables	With intercept				I( )	With intercept and trend				I( )
	Level	P value	1st diff	P value		Level	P value	1st diff	P value	
Bangladesh										
lny_t	0.4361	0.9821	-5.998	0.0000	I(1)	-1.28	0.8763	-4.89	0.0013	I(1)
$lnTo_t$	-0.662	0.8457	-8.817	0.0000	I(1)	-3.48	0.3866	-8.81	0.0000	I(1)
$lnvol_t$ **1**	-2.761	0.0719	-7.471	0.0000	I(0)	-2.73	0.0078	-7.40	0.0000	I(0)
$lnvol_t$ **2**	-3.08	0.0078	-8.90	0.0000	I(0)	-2.80	0.0013	-7.89	0.0000	I(0)
lns_{K_t}	-8.192	0.0000	-3.007	0.0431	I(0)	-5.84	0.0001	-5.67	0.0002	I(0)
lns_{H_t}	-0.180	0.9408	-19.54	0.0001	I(1)	-1.79	0.7087	-20.8	0.0000	I(1)
$\ln(n+\delta)_t$	-0.672	0.8407	-2.388	0.1511	I(2)	-1.08	0.9318	-9.88	0.0000	I(1)
Bhutan										
lny_t	0.876	0.9939	-4.693	0.0007	I(1)	-1.09	0.9154	-4.89	0.0021	I(1)
$lnTo_t$	-2.023	0.2761	-6.096	0.0000	I(1)	-3.92	0.0226	-5.98	0.0001	I(0)
$lnvol_t$ **1**	-1.393	0.5762	-8.505	0.0000	I(1)	-3.35	0.0718	-8.39	0.0000	I(0)
$lnvol_t$ **2**	-0.78	0.8976	-7.98	0.0000	I(1)	-2.78	0.0623	-4.34	0.0001	I(0)
lns_{K_t}	-15.52	0.0000	-21.73	0.0000	I(0)	-16.9	0.0000	-20.7	0.0000	I(0)
lns_{H_t}	-1.812	0.3680	-3.522	0.0123	I(1)	-1.71	0.8246	-8.67	0.0000	I(1)
$\ln(n+\delta)_t$	-2.384	0.1510	-3.907	0.0044	I(1)	-2.54	0.3070	-3.86	0.0231	I(1)
India										
lny_t	0.042	0.9572	-5.817	0.0000	I(1)	-1.18	0.9020	-5.75	0.0001	I(1)
$lnTo_t$	-0.32	0.9120	-5.745	0.0000	I(1)	-1.58	0.7808	-5.65	0.0002	I(1)
$lnvol_t$ **1**	-1.52	0.5095	-8.409	0.0000	I(1)	-3.29	0.1807	-8.30	0.0000	I(1)
$lnvol_t$ **2**	-0.89	0.9876	-3.40	0.0765	I(1)	-0.45	0.9765	-3.34	0.0876	I(1)
lns_{K_t}	-11.48	0.0000	-17.83	0.0000	I(0)	-13.7	0.0000	-17.7	0.0000	I(0)
lns_{H_t}	0.077	0.9602	-6.151	0.0000	I(1)	-2.09	0.5341	-6.12	0.0000	I(1)
$\ln(n+\delta)_t$	-1.20	0.6606	-3.600	0.0112	I(1)	-2.43	0.5495	-6.45	0.0000	I(1)
Maldives										
lny_t	2.004	0.2835	-5.156	0.0002	I(1)	-1.88	0.6383	-5.66	0.0003	I(1)
$lnTo_t$	-2.542	0.1153	-3.829	0.0068	I(1)	-1.94	0.6069	-4.83	0.0072	I(1)
$lnvol_t$ **1**	-1.150	0.2268	-5.856	0.0000	I(1)	-2.58	0.2880	-5.77	0.0001	I(1)
$lnvol_t$ **2**	-1.45	0.3567	-4.89	0.0056	I(1)	-0.89	0.7563	-4.05	0.0045	I(1)
lns_{H_t}	-1.944	03093	-2.681	0.0859	I(1)	-2.47	0.3369	-4.42	0.0007	I(1)
$\ln(n+\delta)_t$	-1.287	0.6245	-2.168	0.2208	I(2)	-3.26	0.1886	-5.62	0.0002	I(1)
Nepal										
lny_t	0.0091	0.9542	-6.454	0.0000	I(1)	-1.47	0.8215	-6.40	0.0000	I(1)
$lnTo_t$	-2.70	0.0807	-6.247	0.0000	I(0)	-1.73	0.7167	-6.73	0.0000	I(1)
$lnvol_t$ **1**	-2.78	0.0691	-9.213	0.0000	I(0)	-4.75	0.0022	-9.24	0.0000	I(0)
$lnvol_t$ **2**	-2.56	0.0785	-6.45	0.0000	I(0)	-3.65	0.0045	-7.34	0.0000	I(0)
lns_{K_t}	-11.14	0.0000	-11.25	0.0000	I(0)	-10.7	0.0000	-11.7	0.0000	I(0)
lns_{H_t}	-2.87	0.0566	-4.612	0.0006	I(0)	-1.87	0.6507	-5.07	0.0009	I(1)
$\ln(n+\delta)_t$	-3.27	0.1228	-8.35	0.0000	I(1)	-3.19	0.1468	-8.23	0.0000	I(1)
Pakistan										
lny_t	-0.186	0.9324	-5.52	0.0000	I(1)	-2.21	0.4718	-5.47	0.0003	I(1)
$lnTo_t$	-3.720	0.0071	-7.75	0.0000	I(0)	-3.42	0.0611	-8.20	0.0000	I(0)
$lnvol_t$ **1**	-0.951	0.9511	-7.58	0.0000	I(1)	-2.21	0.4699	-7.70	0.0000	I(1)
$lnvol_t$ **2**	-0.456	0.8967	-3.56	0.0878	I(1)	-1.04	0.5643	-7.67	0.0000	I(1)
lns_{K_t}	-14.51	0.0000	-18.9	0.0000	I(0)	-14.8	0.0000	-18.7	0.0000	I(0)
lns_{H_t}	0.432	0.9821	-6.20	0.0000	I(1)	-1.44	0.8313	-6.29	0.0000	I(1)
$\ln(n+\delta)_t$	-3.24	0.1328	-5.89	0.0003	I(1)	-3.55	0.1464	-8.99	0.0000	I(1)
Sri Lanka										
lny_t	1.283	0.9982	-7.124	0.0000	I(1)	-1.14	0.9093	-7.50	0.0000	I(1)
$lnTo_t$	-1.710	0.4191	-5.165	0.0001	I(1)	-1.37	0.8548	-5.41	0.0003	I(1)
$lnvol_t$ **1**	-3.92	0.0041	-8.912	0.0000	I(0)	-4.87	0.0016	-8.88	0.0000	I(0)
$lnvol_t$ **2**	-4.67	0.0014	-9.67	0.0000	I(0)	-5.89	0.0010	-8.34	0.0000	I(0)
lns_{K_t}	-11.53	0.0000	-10.98	0.0000	I(0)	-9.91	0.0000	-11.3	0.0000	I(0)
lns_{H_t}	-1.37	0.5857	-4.103	0.0026	I(1)	-0.96	0.9387	-4.12	0.0119	I(1)
$\ln(n+\delta)_t$	-4.654	0.0005	-8.45	0.0000	I(0)	-5.38	0.0004	-8.33	0.0000	I(0)

Source: Author's own calculations.

For the Maldives, the results of the ADF test show that all variables are integrated of order one. For Nepal, the exchange rate uncertainty and the share of physical capita are integrated of order zero, while GDP per worker, trade openness, school enrollment and population growth rate are integrated of order one. For Pakistan the trade openness and share of physical capital are integrated of order zero and the remaining all other variables are integrated of order one. For Sri Lanka, GDP per worker, trade openness and school enrollment are integrated of order one and the rest of the variables are integrated of order zero.

5.3. Results based on OLS-Regression

To investigate the effect of exchange rate fluctuation on economic growth rate, we apply Ordinary Least Square (OLS) method on sample regression. To run the OLS regression, it required that the variables should be stationary. If the variables are non-stationary, then we will have a spurious regression whose coefficients are not valid. To avoid the problem of spurious regression, we used stationary variables in OLS regression. As the results of the ADF test show that some variables are I (1), so we take the first difference of I (1) variables to make it stationary before using them in the regression.

The results of OLS regression are presented in Table 5.2. The results show that the exchange rate volatility has insignificant effect on the GDP per worker of Bangladesh. Because, from the trend of exchange rate volatility of Bangladesh, we observed that in Bangladesh exchange rate volatility, there is no considerable change occurring during the period of the present study that results low fluctuation in prices and weak the channel of the impact of exchange rate volatility on economic growth rate. (Dorantes & Pozo, 2001) Also find that there is an insignificant effect of exchange rate volatility on economic growth rate.

Table 5.2: OLS results

	γ_0	$lnTo$	$lnErvol$	lns_k	lns_H	$ln(n+\delta)$	DW statistics	R square
Model-1								
Bangladesh	0.0413 (1.66)	-0.79*** (-5.95)	-0.02522 (-0.87)	0.0106 (0.34)	0.8044 (1.71)	0.4371 (1.34)	1.9315	0.5177
Bhutan	-1.263*** (-2.52)	0.290*** (2.55)	-0.0509*** (0.012)	0.0518 (1.25)	0.4283 (1.06)	0.0044 (0.07)	2.3112	0.2526
India	0.0452*** (2.28)	0.0145 (0.09)	-0.0397*** (-2.68)	0.0745** (1.97)	0.041 (0.07)	-3.2316* (-1.71)	1.8820	0.2226
Maldives	0.0779*** (3.88)	-0.43*** (-3.98)	-0.0027 (-0.21)	….. …..	-0.8041 (-1.23)	0.1206 (0.22)	2.0773	0.3739
Nepal	0.057*** (3.66)	0.0112 (0.08)	0.04707*** (3.05)	0.138*** (3.35)	-0.1249 (-0.65)	-0.4225 (-1.12)	2.1362	0.2657
Pakistan	-0.4019 (-0.48)	0.1335 (0.56)	-0.0303 (-0.72)	0.0020 (0.03)	-0.8418 (-1.41)	0.5034 (0.63)	1.9076	0.1014
Sri Lanka	0.0932*** (3.14)	-0.3402 (-0.16)	-0.0151 (-1.18)	0.0268 (0.63)	-0.6557 (-1.05)	-0.0512 (-0.99)	2.4091	0.0909
Model-2								
Bangladesh	0.0393 (1.61)	-0.77*** (-5.93)	-0.03181 (-1.09)	0.0115 (0.37)	0.7909 (1.70)	0.4475 (1.39)	1.8906	0.5236
Bhutan	-1.1556** (-2.05)	0.2661** (2.09)	-0.0462** (-2.00)	0.4731 (1.01)	0.4422 (1.01)	0.0148 (0.21)	2.4262	0.1703
India	0.0482*** (2.36)	-0.0325 (-0.20)	-0.0459** (-2.24)	0.0761** (1.96)	0.0113 (0.02)	-3.301* (-1.70)	1.8965	0.1821
Maldives	0.0774*** (3.86)	-0.44*** (-4.01)	-0.0055 (-0.40)	…. ….	-0.8425 (-1.28)	0.1316 (0.24)	2.0725	0.3766
Nepal	0.0598*** (3.88)	0.0065 (0.05)	0.04889*** (3.24)	0.149*** (3.53)	-0.906 (-0.48)	-0.4803 (-1.29)	1.8445	0.2844
Pakistan	-0.4522 (-0.59)	0.1482 (0.68)	-0.0452 (-0.53)	-0.0181 (-0.29)	-1.002* (-1.79)	-0.0607 (-0.08)	2.1889	0.2259
Sri Lanka	0.1096*** (3.92)	-0.0584 (-0.31)	-0.0299*** (-2.41)	0.0707 (1.61)	-0.7601 (-1.29)	-0.063 (-1.30)	2.2777	0.1867

Source: Author's own calculations.

Note: The values in parenthesis are the t-values. Moreover, ***, **, and * indicate significance at 1%, 5%, and 10% level of significance, respectively.

For Bhutan the results of OLS regression show that in both models there is negative impact of exchange rate fluctuation on GDP per worker. The negative impact of exchange rate fluctuation on economic growth of Bhutan is due to that because there is more volatility in the exchange rate of Bhutan throughout the study period that cause more fluctuation in price and hence the domestic investor hesitate to invest more which results low economic growth rate in Bhutan. In the study of (Musyoki, Pokhariyal, & Pundo, 2012) also find that there is negative impact of exchange rate fluctuation on the economic growth rate.

For India the results of OLS regression, indicates that according to all two models there is the negative effect of exchange rate volatility on economic performance. The negative effect, that is due to the exchange rate volatility creates price volatility, this uncertainty of prices falls the domestic investment and have a contractionary effect on the economic growth of India. The same results were obtained by (Javed & Farooq, 2009) in which they obtained negative impact of exchange rate volatility in the economic growth rate of Pakistan.

The results of Model-1 and Model-2 show insignificant impact of exchange rate uncertainty on the GDP per worker of Maldives. The exchange rate volatility in Maldives causes no more fluctuation in prices and break down the channel that show the effect of exchange rate uncertainty on the economic growth rate. Thus, according to the results of OLS regression, we have insignificant effect of exchange rate uncertainty on the economic growth rate of Maldives. The results of the study (Musyoki, Pokhariyal, & Pundo, 2012) also find an insignificant effect of exchange rate uncertainty on economic growth rate.

The results of OLS regression show that the economic growth rate of Nepal is positively affected by exchange rate fluctuation, because in Nepal the exchange rate uncertainty creates

uncertainty in prices that fall the domestic consumption and increase the saving rate. High saving rate cause high domestic investment and then more domestic investment results high economic growth rate. The study conducted by (Dickson, 2012) also finds that there is a positive influence of exchange rate fluctuation in the economic growth rate of Nigeria.

For Pakistan the results of OLS regressions show that in both models there is an insignificant effect of exchange rate fluctuation on economic growth rate. In Pakistan there is an insignificant effect of exchange rate fluctuation on the economic growth rate because in Pakistan there is no rule of exchange rate fluctuation in the fluctuation of prices that creates a weak channel for the effect of exchange rate fluctuation of economic growth rate of Pakistan. In Pakistan (Azid, Jamil, & Aneela, 2005) also find out that there is an insignificant effect of exchange rate fluctuation on economic growth.

How the economic growth rate of Sri Lanka is affected through exchange rate volatility. The results of OLS regression indicate that in Model-2 show the negative effect of exchange rate uncertainty on the economic growth rate of Sri Lanka. While in Model-1 show insignificant influenced of exchange rate uncertainty on the economic growth. The negative effect of exchange rate uncertainty on the GDP per worker of Sri Lanka is due to that the exchange rate volatility in Sri Lanka creates price volatility that discourage the domestic investors to invest more and thus leave a negative impact on GDP per worker of Sri Lanka. In literature (Sanginabadi & Heidari, 2012) find out the negative impact of exchange rate fluctuation on economic performance.

To discuss the effect of other explanatory variables on economic growth rate. The results of OLS regression show that there is a negative effect of trade openness on the GDP per worker

of Bangladesh and Maldives, while in the Bhutan positive impact of trade openness on economic growth rate are shown. The study of (Bernanke & Gurkaynak, 2001) finds the positive effect of trade openness in most of the countries.

The share of physical capital have a positive effect on the GDP per worker of India and Nepal and have an insignificant impact on GDP per worker of remaining South Asian countries. The gross school enrollment proxy of human capital, showing insignificant impact on GDP per worker in most South Asian countries. The school enrollment values are over estimated in developing countries, therefore, not a good proxy for human capital, that's why it causes an insignificant impact on the economic performance of South Asian countries. Moreover, the effect of population growth rate is negative on India's economic growth rate and insignificant in case of the remaining countries.

The study of (Bagella, Becchetti, & Hasan, 2004), the authors show the positive effect of physical capital, school enrollment and whereas the negative effect of population growth rate in most of the countries. In the Results of OLS regression, the values of Durbin Watson statistics close to 2 indicated that in the estimated regressions we have no problem of serial autocorrelation.

The summary of OLS regression results is that in South Asia, there is the negative effect of exchange rate volatility on the economic growth of Bhutan, India and Sri Lanka. While in Pakistan, Bangladesh and Maldives there is an insignificant effect of exchange rate volatility in the economic growth rate. Moreover, the results also show positive influenced of exchange rate volatility on the GDP per worker of Nepal. In the next section we will discuss the short

run and the long run effect of exchange rate fluctuation on the economic performance of South Asian economies.

5.4. Results of ARDL model

The results of the ADF test show that the variables are integrated of order zero or integrated of order one. So in the OLS results we run the regressions at the first difference of I (1) variables in order to avoid spurious regression. If the variables are integrated of order one or more than one, then it is better to have co-integration analysis to find out the long run relationships among variables. Here for co-integration analysis, we are estimating the ARDL model.

5.4.1. Results of Bounds test

In the ARDL approach of co-integration, first we estimate the ARDL model and then, to check co-integration among the variables we apply the Bounds test of co-integration. The results of Bounds test are tabulated in Table 5.3. For the Bounds test of co-integration, we estimate two models for each country. For lag selection we used Schwarz Bayesian Criteria (SBC).

The results of the Bounds test of co-integration reject the null hypothesis that state, there exist no long run relationships and accept the alternative hypothesis of long run relationships. Thus the results of the Bounds test of co-integration conclude that there exist long run relationships among the GDP per worker and the explanatory variables in all cases. After the confirmation of co-integration, in the next step of ARDL, we estimate the long run coefficients.

Table 5.3: Results of Bounds test of Co-Integration

$lny_t = \gamma_0 + \gamma_1\, lnTo_t + \gamma_2 lnErvol_t + \gamma_3 lns_k + \gamma_4 lns_H + \gamma_5 ln(n+\delta) + \varepsilon_t$				
Countries	**Model-1**		**Model-2**	
	ARDL equation	F-value	ARDL equation	F-value
Bangladesh	ARDL(1,1,0,1,1,1)	2541.1	ARDL(1,1,0,1,1,1)	2568.9
Bhutan	ARDL(1,0,0,0,1,0)	294.36	ARDL(1,0,0,0,1,0)	281.8134
India	ARDL(1,0,0,0,1,0)	538.934	ARDL(1,0,1,0,1,1)	573.68
Maldives	ARDL(1,0,0,0,1)	383.14	ARDL(1,1,0,0,0)	391.55
Nepal	ARDL(1,0,0,0,0,1)	508.75	ARDL(1,0,1,0,0,1)	517.68
Pakistan	ARDL(1,0,0,1,0,0)	177.19	ARDL(1,0,0,1,0,0)	179.81
Sri Lanka	ARDL(1,1,0,0,1,1)	808.81	ARDL(1,1,0,0,1,1)	844.676

Source: Author's own calculations

Note: the probability value P (0.0000) are same in the above all tests

5.4.2. Long run coefficients of ARDL model

In the ARDL approach of co-integration, we estimate the long run coefficients and short run coefficients. After the confirmation of co-integration relationships we can move to the next step of the ARDL approach of co-integration where we derive the long run coefficients for the impact of exchange rate volatility on economic growth rate of South Asian countries from the estimated ARDL model. The long run coefficients of ARDL model are presented in Table 5.4.

For Bangladesh the results of ARDL show that in the long run there is an insignificant effect of exchange rate fluctuation on GDP per worker. The same results were obtained when we apply the OLS on sample regression. There is an insignificant impact of exchange rate volatility on the GDP per worker of Bangladesh. Because the exchange rate volatility does not create price uncertainty in Bangladesh. So in the long run, we have a weak channel that

explains the effect of exchange rate fluctuation of economic growth rate of Bangladesh. The insignificant results of the effect of exchange rate volatility are also derived by (Musyoki, Pokhariyal, & Pundo, 2012) and (Dorantes & Pozo, 2001).

The results of ARDL show that in long there exists a negative impact of exchange rate uncertainty on the GDP per worker in Bhutan. In Bhutan there is negative impact of exchange rate volatility on the GDP per worker because the exchange rate volatility creates price volatility that negatively affect the domestic investment level that are the cause of low economic growth rate in Bhutan. In the study of (Javed & Farooq, 2009) also find that there is negative impact of exchange rate volatility on the growth rate in the long run.

According to the results of ARDL there is insignificant impact of exchange rate volatility on the economic growth rate of India. So on the basis of two models we can decide that in the long run the Indian economic growth rate is not affected through exchange rate volatility. In India the exchange rate volatility can cause price fluctuation but in the long run it does not affect the economic growth rate. In past studies (Azid, Jamil, & Aneela, 2005) also find that in the long run there is irrelevant impact of exchange rate volatility on the economic performance.

For Maldives the long run coefficients of ARDL model results show that there is an insignificant impact of exchange rate volatility on GDP per worker of Maldives. For theoretical justification of the results we can say that in the long the exchange rate volatility effect on price fluctuation does not remain that cause insignificant impact on domestic investment and output. The same results were also derived by (Musyoki, Pokhariyal, & Pundo, 2012).

Table 5.4: Long run coefficients of ARDL

Model-1						
	γ_0	$lnTo$	$lnErvol$	lns_k	lns_H	$ln(n+\delta)$
Bangladesh	16.53*** (3.01)	1.05 (1.53)	-0.0483 (-0.67)	3.07*** (2.65)	-3.33** (-2.15)	-0.0564 (-0.78)
Bhutan	3.344 (0.90)	0.3754 (0.852)	-0.1771* (-1.70)	1.169*** (3.89)	1.425 (-1.46)	-0.0483 (-0.32)
India	-18.71 (-0.97)	-0.068 (-0.08)	-0.228 (-1.47)	1.479 (1.31)	6.36 (1.45)	-3.45 (-1.08)
Maldives	35.06*** (5.45)	-1.006*** (-3.03)	-0.006 (-0.12)	…. ….	-4.33*** (-3.41)	-0.611 (-0.73)
Nepal	7.856 (1.28)	0.317*** (2.42)	0.003 (0.23)	0.264*** (8.53)	-0.194 (-0.97)	-1.03*** (-11.02)
Pakistan	-12.57 (-1.28)	2.669 (1.41)	-0.210 (1.16)	0.3138 (0.66)	2.664 (1.59)	-0.8069 (-0.47)
Sri Lanka	-4.13 (-0.59)	0.252 (0.58)	-0.082** (-1.86)	1.301*** (2.42)	1.91 (1.51)	0.215 (1.14)
Model-2						
Bangladesh	16.54*** (3.05)	1.03 (1.53)	-0.052 (-0.72)	-3.04*** (-2.70)	-3.33** (-2.18)	-0.0785 (-1.23)
Bhutan	3.413 (1.12)	0.403 (1.10)	-0.169** (-2.08)	-1.091*** (-4.33)	-1.471** (-1.83)	-0.042 (-0.35)
India	-24.63 (-0.16)	-6.041 (-0.18)	-0.158 (-0.093)	-15.97 (-0.19)	16.83 (0.22)	-26.63 (1.45)
Maldives	35.76*** (5.41)	-1.02*** (-3.10)	-0.015 (-0.32)	…. ….	-4.49*** (-3.43)	-0.476 (-0.53)
Nepal	6.41 (0.60)	0.332** (2.21)	0.042*** (2.47)	0.312*** (8.32)	-0.477** (-1.94)	-1.02*** (-9.48)
Pakistan	13.41 (0.69)	-2.859 (-0.96)	-0.404 (-1.45)	-0.982 (-0.84)	1.837 (0.77)	-3.626 (-1.00)
Sri Lanka	-0.285 (-0.05)	0.209 (0.58)	-0.103*** (-2.40)	1.343*** (2.63)	1.107 (1.25)	0.121 (0.82)

Source: Author's own calculations.

Note: The values in parenthesis are the t-values. Moreover, ***, **, and * indicate significance at 1%, 5%, and 10% level of significance, respectively.

For Nepal the results show that economic growth rate is positively affected by exchange rate volatility in the long run. In Nepal there is the positive effect of exchange rate volatility on the growth rate because exchange rate fluctuations caused fluctuations in prices that decline the domestic consumption level and engaged the people in precautionary saving. The increased in the saving rate caused increases in domestic investment that results high economic growth rate. The (Dickson, 2012) also finds out the positive impact of exchange rate volatility on the growth rate.

For Pakistan the long run results of ARDL indicate that in both models there is insignificant impact of exchange rate volatility on GDP per worker of Pakistan. The Pakistan economic growth rate is not affected through exchange rate volatility, because in Pakistan the exchange rate fluctuation and its influence on the price does not exist in the long run. Thus that break down the channel through which the exchange rate volatility affects the economic growth rate. In the literature (Azid, Jamil, & Aneela, 2005) also the long run that for Pakistan in long run there is insignificant impact of exchange rate volatility on economic growth rate.

For Sri Lanka the results of ARDL in both models show that there is negative impact of exchange rate volatility on GDP per worker of Sri Lanka. The Sri Lankan economy is adversely affected by exchange rate volatility. Because in Sri Lanka in exchange rate uncertainty creates uncertainty in the price that creates uncertainty for the domestic investors to invest more. The low investment level in the country results the low economic growth rate. In past studies (Dorantes & Pozo, 2001) also indicate irrelevant impact of exchange rate volatility on growth rate.

The results also show in the long run there is positive effect of trade openness on GDP per worker of Nepal. While for Maldives there is the negative effect of trade openness on GDP per worker. In remaining countries the effect of trade openness on GDP per worker is insignificant. The results also indicated that in most of the South Asian countries in the long run there exists positive impact of the share of physical capital on GDP per worker.

In the long run, we have different results about the effect of school enrollment on GDP per worker. For most South Asian countries, there is insignificant impact of school enrollment on GDP per worker while in few of the countries the school enrollment negatively affect the GDP per worker. In Nepal, The long run results also show that, there is a negative impact of population growth rate, GDP per worker, while for remaining South Asian countries the results show insignificant impact of population growth rate.

For South Asia, the results of ARDL model indicate that in the long run the exchange rate volatility has negative impact on GDP per worker of Bhutan and Sri Lanka. While for Pakistan, India, Maldives and Bangladesh in the long run there is an irrelevant effect of exchange rate volatility GDP per worker. Moreover, the results of ARDL also show that in the long run, we have the positive impact of exchange rate volatility in the economic growth rate of Nepal.

5.4.3. Error Correction Model (ECM)

In the ARDL approach of co-integration for the short run relationships we examined the coefficients of Error Correction Model (ECM). The ECM is estimated after the estimation of long run coefficients. After the estimation of long run coefficients we make the series of lag residual series that are incorporated in ECM to examine the convergence of the model.

The results of ECM are presented in Table 5.5. The results of ECM indicate for Bangladesh there is insignificant impact of exchange rate volatility on the GDP per worker. The same results were obtained in OLS regressions and in long run coefficients of ARDL model. The insignificant impact of exchange rate volatility on the GDP per worker of Bangladesh is due to that in Bangladesh the exchange rate volatility does not cause uncertainty in prices that collapse the channels that show the impact of exchange rate volatility on the economic growth rate. The same results also derived by (Dickson, 2012)

The short run results of ARDL model show that for Bhutan in both models there is negative impact of exchange rate volatility on GDP per worker. The same results were obtained in OLS and long run coefficients of ARDL. In Bhutan there is the negative effect of exchange rate volatility on economic growth rate because in Bhutan the exchange rate volatility results fluctuation in price levels, then neutral risk investors are reluctant to invest more. The fall in the domestic investment level caused the low economic growth rate. In a study of (Javed & Farooq, 2009) also indicate that in the short run there is negative impact of exchange rate volatility on growth rate.

Table 5.5: Short run coefficients of ARDL

	γ_0	$\Delta lnTo_t$	$\Delta lnErvol_t$	Δlns_{k_t}	Δlns_{H_t}	$\Delta ln(n+\delta)_t$	ε_{t-1}	DW
Model-1								
Bangladesh	1.108*** (2.74)	-0.0205 (-0.65)	-0.0032 (-0.72)	-1.095*** (-32.46)	0.038 (0.37)	-0.296*** (-4.40)	-0.067*** (-2.52)	1.74
Bhutan	0.95 (0.87)	0.1066 (0.88)	-0.0503** (-2.28)	-0.49** (-2.07)	-0.405 (-1.49)	-0.013 (-0.32)	-0.281*** (-3.34)	1.67
India	-1.77 (-1.11)	-0.0065 (-0.08)	-0.045*** (-3.71)	-0.358*** (-4.86)	0.602* (1.77)	-0.327 (-1.27)	-0.094* (-1.68)	2.04
Maldives	8.11** (2.26)	-0.494*** (-3.85)	-0.0014 (-0.12)	…. ….	-1.004** (-2.00)	-0.141 (-0.67)	-0.231** (-2.33)	2.01
Nepal	… ...	0.208** (2.17)	0.002 (0.23)	0.174*** (4.68)	-0.127*** (-0.98)	-1.216*** (-2.59)	-0.657*** (-4.79)	2.09
Pakistan	-2.224 (-1.43)	0.0315 (0.14)	-0.0371 (-1.18)	-0.0555 (-0.78)	-0.9254 (-1.47)	-0.1427 (-0.48)	-0.176** (-2.33)	2.10
Sri Lanka	-1.001 (-0.72)	-0.167 (-1.47)	-0.019*** (-2.83)	-0.757*** (-8.19)	0.463*** (2.50)	-0.018 (-0.72)	-0.242*** (-2.72)	1.82
Model-2								
Bangladesh	1.118*** (2.76)	-0.020 (-0.64)	-0.0035 (-0.76)	-1.093*** (-32.36)	0.034 (0.32)	-0.26*** (-4.43)	-0.067*** (-2.55)	1.71
Bhutan	1.175 (1.10)	0.14 (1.11)	-0.058** (-2.33)	-0.552*** (-3.58)	0.506** (-1.84)	-0.014 (-0.35)	-0.344* (-4.24)	1.61
India	-0.359 (-0.19)	-0.0933 (-1.04)	-0.049*** (-3.03)	-0.492*** (-5.01)	0.245 (0.59)	-0.359** (-1..93)	-0.014* (-1.76)	2.26
Maldives	8.45** (2.30)	-0.500*** (-3.90)	-0.0037 (-0.31)	…. ….	-1.062** (-2.05)	-0.112 (-0.50)	-0.323*** (-2.38)	2.01
Nepal	…. ….	0.18** (2.22)	0.0101*** (2.71)	0.169*** (3.73)	-0.259** (-2.19)	-1.23*** (-2.88)	-0.543*** (-3.36)	2.15
Pakistan	1.616 (0.87)	-0.3447 (-1.40)	-0.074** (-2.68)	-0.382*** (-2.96)	0.221 (0.64)	-0.4371 (-1.40)	-0.120** (-1.98)	1.74
Sri Lanka	-0.075 (-0.05)	-0.152 (-1.43)	-0.026*** (-3.69)	-0.662*** (-7.25)	0.293* (1.65)	-0.025 (-1.42)	-0.264*** (-3.20)	1.79

Source: Author's own calculations.

Note: The values in parenthesis are the t-values. Moreover, ***, **, and * indicate significance at 1%, 5%, and 10% level of significance, respectively.

For India the results of ECM show that in both models there is negative impact of exchange rate volatility on GDP per worker in the short run. In the short run the Indian economy is negatively affected by exchange rate volatility, because in short the exchange rate uncertainty is the source of price uncertainty in India. The more uncertainty in prices results to fall the domestic investment level that cause the lowest economic growth rate. Similar results were also derived by (Boar, 2010).

The short run results of ECM presents that for Maldives in Model-1 and Model-2 we have insignificant impact of exchange rate volatility on the GDP per worker. So on the basis of these two model results we can say that there is an insignificant effect of exchange rate volatility on the GDP per worker of Maldives. The same results were obtained through OLS regression and long run coefficients of ARDL.

For Nepal, The results of ECM declared that in Model-2 we have the positive impact of exchange rate volatility on the GDP per worker. While in Model-1 show irrelevant impact of exchange rate volatility on the GDP per worker of Nepal were observed. So overall we can say, that in most cases in Nepal there is positive impact of exchange rate volatility on GDP per worker. Similar results obtain in OLS regression and for the long run coefficients of ARDL.

The results of ECM show that in Pakistan in the short run in Model-1 there is an insignificant effect of exchange rate volatility on GDP per worker. While in Model-2 showing there exist negative effect of exchange rate volatility on GDP per worker of Pakistan. In OLS regression and long run coefficients of ARDL model indicate insignificant effect of exchange rate fluctuation on the GDP per worker of Pakistan, but in the short run on the basis of Model-2

result, we can conclude that there is a negative impact of exchange rate volatility on GDP per worker of Pakistan. The similar results were also derived by (Javed & Farooq, 2009) in which they show the negative effect of exchange rate volatility on the economy of Pakistan.

The Sri Lanka economy is negatively affected by exchange rate volatility in short run according to the results of ECM. The results of the ECM model in two models show that there is negative impact of exchange rate uncertainty on the GDP per worker of Sri Lanka. The similar results were derived from OLS regression and in the long run coefficients of ARDL model.

The ECM model indicates that for South Asia there is negative impact of exchange rate volatility on the GDP per worker of Bhutan, India, Pakistan and Sri Lanka in the short run. The results of ECM also show that, there in the short run there is positive impact of exchange rate volatility on GDP per worker of Nepal. Moreover, for Bangladesh and Maldives short run results of ARDL presents an irrelevant effect of exchange rate volatility GDP per worker.

For the impact of other control variables on the growth rate the results of ECM show that in the short run there is a negative impact of trade openness on GDP per worker of Maldives and positive impact on GDP per worker of Nepal. While in the remaining countries of South Asia there is insignificant impact of trade openness occur on GDP per worker.

The results of ECM also show that in the short run the share of physical capital have a negative effect on GDP per worker of South Asian countries. Generally, according to economic theory, there is a positive impact on physical capital on the growth rate because capital is direct inputs that are used in the production function. Since the physical capital is

direct inputs in production, so its real effect can observe after at the end of production, therefore, there is a negative impact of physical capital on GDP per worker in short run and will have a positive impact on GDP per worker in the long run. In long run results, in most of the cases we obtained the positive effect of physical capital GDP per worker.

In the short run the gross school enrollment has a negative influence on GDP per worker of Maldives and Nepal while for Sri Lanka the gross school enrollment positively affects the GDP per worker. Moreover, in the remaining south Asian countries results of ECM show irrelevant effect of gross school enrollment on GDP per worker.

In ECM results we see that the coefficients of lag residual term are negative and significant in all cases indicates the convergence in all models if we have disequilibrium and also confirm the co-integration relationships among variables. In the results of ECM the values of Durbin Watson statistics close to 2 showing in the ECM we have no problem of serial correlation.

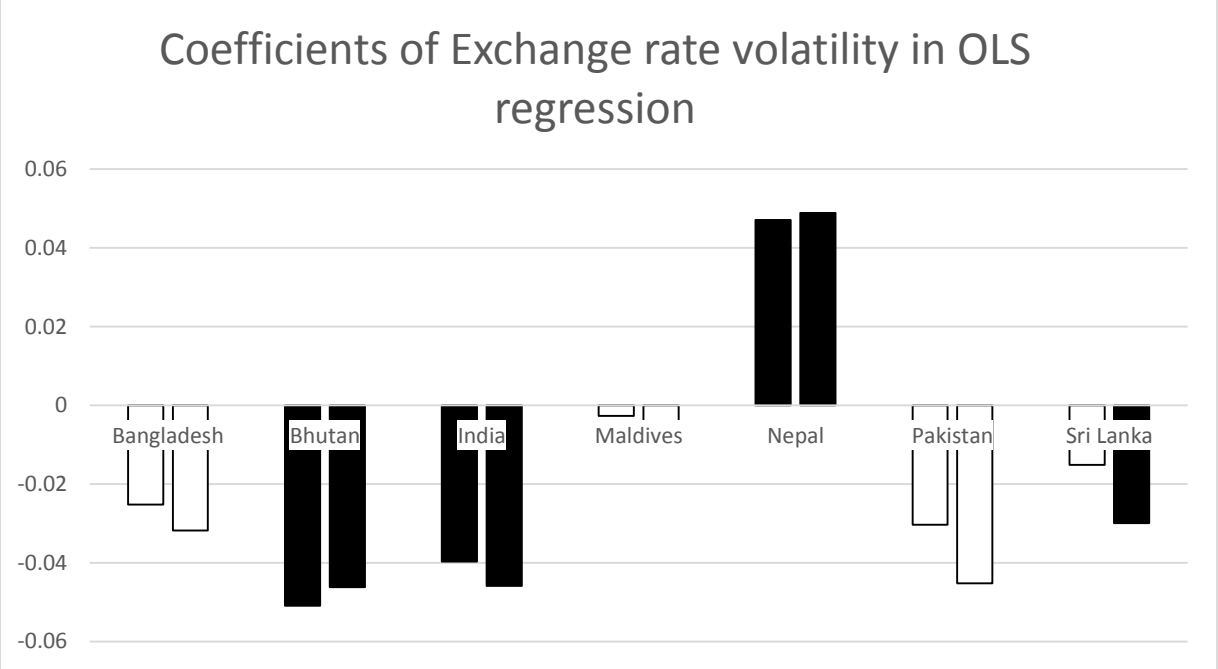
For Nepal and Bangladesh the short run results show that the population growth rate have negatively affected GDP per worker. The results of the ECM model also show that in most South Asian countries, there is an insignificant effect of population growth rate occur on GDP per worker like in Bhutan, India, Maldives, Pakistan and Sri Lanka.

5.5. Comparative impact of exchange rate volatility on the economic growth of South Asian countries

After discussing the results of OLS regression, long run and short run results of ARDL, now in the section of the chapter, we compare the results of the effect of exchange rate fluctuation on economic growth rate of South Asian countries. For the cross country comparison of the

impact of exchange rate volatility on economics growth rates we make the bar chart of the coefficients of the exchange rate volatility.

Figure 5.1: OLS coefficients of exchange rate volatility



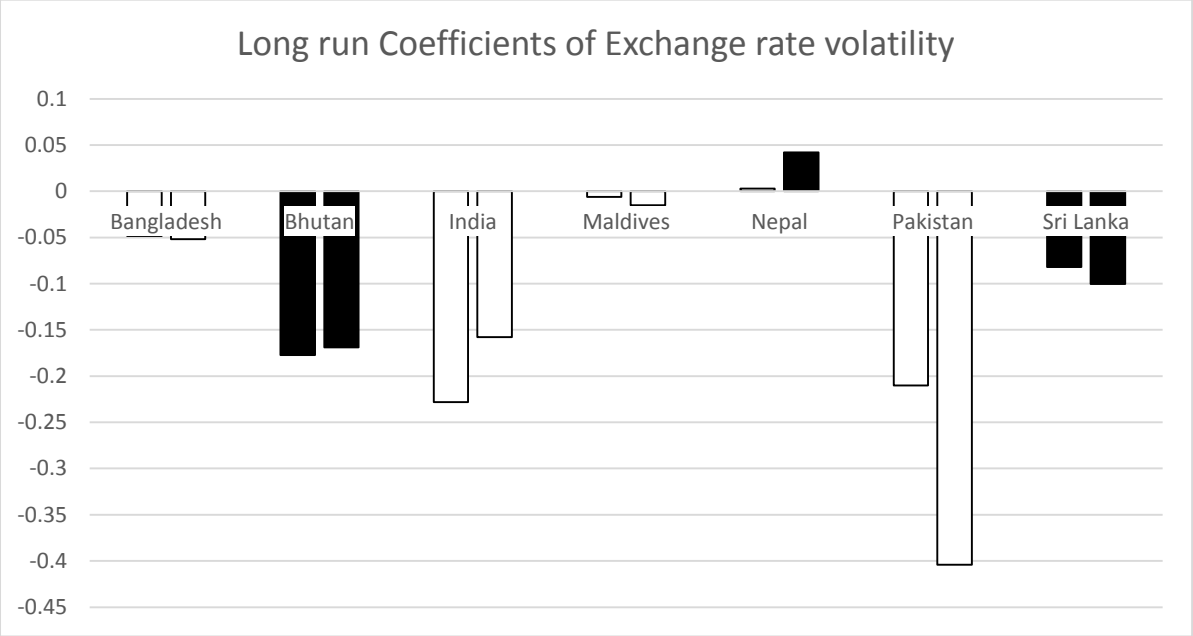
Source: Author's own calculations.
Note: The black bars and white bars show significant and insignificant coefficients respectively. Also the first bar and the second of each country represents the coefficient of Model-1and Model-2 respectively.

In Figure 5.1 we plot the sample OLS regression coefficients of exchange rate volatility. The results of the OLS regression show the negative impact of exchange rate fluctuation on GDP per worker of Bhutan, India and Sri Lanka. On the other hand, the results of OLS regression also indicate the positive effect of exchange rate volatility on the growth rate of Nepal and insignificant impact of exchange rate fluctuation on the growth rate of Pakistan, Maldives and Bangladesh. On the basis of above results we can conclude that in South Asia economies of Bhutan, India and Sri Lanka economies are suffering from the instability of exchange rate.

On the comparison of adverse effect of the exchange rate volatility on the growth rates of selected South Asian countries, we can conclude that in both models the Bhutan economic

growth rate more adversely affected through exchange rate volatility in South Asia and then, the Indian economic growth rate more suffer from the uncertainty of exchange rate. While in last the Sri Lankan economic growth rate more suffer from the uncertainty of exchange rate. Comparison of the long run coefficients of exchange rate volatility can be conducted on the basis of Figure 5.2.

Figure 5.2: Long run coefficients of exchange rate volatility



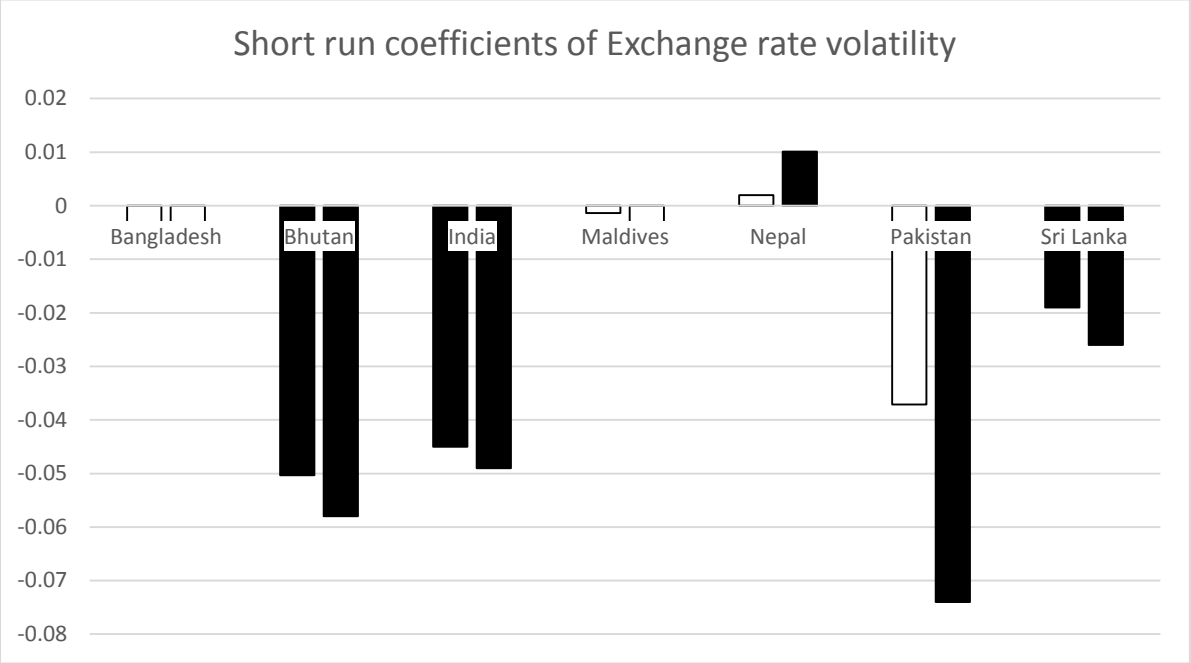
Source: Author's own calculations.
Note: The black bars and white bars show significant and insignificant coefficients respectively. Also the first bar and the second of each country represents the coefficient of Model-1and Model-2 respectively.

The results of the ARDL approach of co-integration suggest that in the long run there is the negative effect of exchange rate uncertainty on the growth rate of Bhutan and Sri Lanka. On the other hand, the results also show the positive influence of exchange rate volatility on the growth rate of Nepal. Moreover, the results of ARDL indicate insignificant long run impact of exchange rate volatility on the growth rate of India, Maldives, Pakistan and Bangladesh.

Therefore, we conclude that in the long run economic growth rate of Bhutan and Sri Lanka economic growth rate are adversely affected through exchange rate fluctuation. From the

figure 5.2 we can say that according to the results of all two models in the long run the economic growth rate of Bhutan is hurt more by the variability of exchange rate.

Figure 5.3: Short run coefficients of exchange rate volatility



Source: Author's own calculations.
Note: The black bars and white bars show significant and insignificant coefficients respectively. Also the first bar and the second of each country represents the coefficient of Model-1and Model-2 respectively.

Comparison of the short run coefficients of exchange rate volatility can be conducted on the basis of Figure 5.3. The short run results of ECM reveal that in the short run, the exchange rate volatility has negative impact on the economic performance of Pakistan, Bhutan, India and Sri Lanka. Furthermore, the results of the ECM model also indicated that the Nepal economic growth rate is positively affected through exchange rate volatility. While in the short run, there is insignificant impact of exchange rate volatility on the economic growth rate of Bangladesh and Maldives. The Figure 5.3 shows that in the short run Pakistan economic growth rate suffers more from the instability of the exchange rate in South Asia.

In this chapter, we discuss the results of OLS regression and the ARDL approach of co-integration. The main findings of the OLS regression reveal that in South Asia the exchange rate volatility adversely affects the economic growth rate of Bhutan, India and Sri Lanka. The results of OLS regression also conclude the direct impact of exchange rate volatility on the growth rate of Nepal. Results of ARDL model declare that in the long run the Bhutan and Sri Lanka economic growth are adversely affected through exchange rate volatility. While in short run for Pakistan, India, Bhutan, Sri Lanka economic growth rates are negatively affected by exchange rate uncertainty. In the next chapter of the study, we draw the conclusion of our study.

Chapter 6

Conclusion

The aim of our study is to examine the impact of exchange rate fluctuation on the economic growth of selected South Asian countries. Furthermore, in this study, we are trying to have cross comparison analysis on the impact of exchange rate fluctuation on the economic growth. So the present study tries to examine out the effect of conditional and unconditional exchange volatility on the economic performance of selected South Asian countries.

The study is based on the time period from 1970 to 2013. To estimate the exchange rate volatility we used quarterly data based on time period 1970:1 to 2013:4 from International Financial Statistics (IFS). The exchange rate volatility is estimated through Exponential Generalized Autoregressive Conditional Hetroskedasticity (EGARCH model) using quarter series of exchange rate. The quarterly series of exchange rate volatility is converted into annual by taking either the last observation of exchange rate volatility series in each year or taking an average of quarterly exchange rate volatility series in each year. Study use the annual data (1970 to 2013) from World Development Indicators (WDI) to obtain the results.

To check stationarity, the study used Augmented Dicky Fuller (ADF) test. Moreover, for analysis, study employed OLS regression and ARDL approach of co-integration. The results of OLS regression indicate that the exchange rate volatility has a negative effect on GDP per worker of Bhutan, India and Sri Lanka. On the other hand, the results of OLS regression also show that the exchange rate volatility also have a positive effect on GDP per worker of Nepal and having an insignificant impact on GDP per worker of Pakistan, Bangladesh and

Maldives. By comparing the negative results of the effect of exchange rate volatility it has been concluded that the Bhutan economic growth rate affected more by exchange rate volatility in selected South Asia.

The results of ARDL model state that GDP per worker in the long run for Bhutan and Sri Lanka are negatively affected through exchange rate volatility and again here the Bhutan's GDP per worker suffer more from the instability of exchange rate. In the long run the results also show the positive influence of exchange rate volatility on GDP per worker of Nepal and insignificant impact on the GDP per worker of Pakistan, India, Bangladesh and Maldives.

The short run results of the Error Correction Model (ECM) show that in the short run there is negative impact of exchange rate volatility on the GDP per worker of Pakistan, Bhutan, India and Sri Lanka. Moreover, the results also indicate positive effects of exchange rate volatility on the GDP per worker of Nepal and insignificant effect on the GDP per worker of Bangladesh and Maldives. Furthermore, the results show that in the short run the Pakistan GDP per worker suffer more from the instability of the exchange rate in South Asia.

Comparing the results to past literatures (Azid, Jamil, & Aneela, 2005), (Dorantes & Pozo, 2001) and (Musyoki, Pokhariyal, & Pundo, 2012) find out that the economic performance is not affected through exchange rate volatility on the other hand (Bagella, Becchetti, & Hasan, 2004), (Boar, 2010), (Demir F. , 2013), (Javed & Farooq, 2009) and (Sanginabadi & Heidari, 2012) shows that the exchange rate volatility are negatively related to economic growth rate. While (Dickson, 2012) find out the positive impact of exchange rate volatility on the economic growth rate of Nigeria.

On the basis of above results we conclude that in South Asia the economies of Bhutan, India, Pakistan and Sri Lanka are negatively affected by exchange rate volatility. While on the other hand, the Nepal economic performance is positively affected by exchange rate fluctuation. The study also concludes insignificant effect of exchange rate fluctuation on the economic performance of Bangladesh and Maldives. So in this study, we find out mixed results for the impact of exchange rate volatility on the economic growth of South Asian countries.

From the results of our study we can say that there is a need of exchange rate stability in Pakistan, India, Bhutan and Sri Lanka to sustain the high economic growth rate. So the exchange rate stability has much importance for the economic policy makers in Pakistan, India, Bhutan and Sri Lanka.

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Appendices

Appendix A: Specification of Exchange rate volatility

Country	Model	Mean equation	Variance equation
Bangladesh	EGARCH	AR(1,3,4), constant, trend	ARCH(1), GARCH(2), Asymmetric order (1)
Bhutan	EGARCH	AR(1), trend	ARCH(1), GARCH(1), Asymmetric order (1)
India	EGARCH	AR(1), constant	ARCH(1),GARCH(1),Asymmetric order (1)
Maldives	EGARCH	AR(1), trend, constant	ARCH(1),GARCH(1),Asymmetric order (1)
Nepal	GARCH	AR(1), trend	ARCH(1),GARCH(1)
Pakistan	EGARCH	AR(1), trend	ARCH(1),GARCH(2),Asymmetric order (1)
Sri Lanka	EGARCH	AR(1), constant	ARCH(1),GARCH(2),Asymmetric order (1)

Source: Author's own calculations.