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Impacts of Inflation, Interest, and Exchange Rates on Foreign Direct Investment in Bangladesh: An Econometric Analysis

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Impacts of Inflation, Interest, and Exchange Rates on Foreign Direct Investment in Bangladesh: An Econometric Analysis

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Declaration

I do hereby declare that this dissertation titled **"Impacts of Inflation, Interest, and Exchange Rates on Foreign Direct Investment in Bangladesh: An Econometric Analysis"** submitted to the Institute of Bangladesh Studies, University of Rajshahi, Bangladesh for the degree of Doctor of Philosophy in Economics is my own and original research work under the supervision of Dr. Md. Abdul Wadud, Professor, Department of Economics, University of Rajshahi, Bangladesh. To the best of my knowledge and belief, this thesis does not contain any material previously published or written by any other person without proper reference.

I do also declare that two articles titled "Foreign Direct Investment, External Debt, and Balance of Payment: A Causality Analysis for Bangladesh" and "Impacts of Inflation and Exchange Rate on Foreign Direct Investment in Bangladesh" have been written from this dissertation which have been published in the 27(2) issue of the *Bangladesh Journal of Public Administration*, and 4(11) of the *International Journal of Science and Business* respectively. Apart from this, this thesis or any part of it has not been submitted to any university/ institute/ organization for any degree or any other purposes.

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Certification

This is to certify that this thesis titled **"Impacts of Inflation, Interest, and Exchange Rates on Foreign Direct Investment in Bangladesh: An Econometric Analysis"** is a basic research work by **Muhammad Mahmud Mostafa** as the requirements for the degree of Doctor of Philosophy in Economics. To the best of my knowledge, this is the researcher's own achievement and not a combined work. This thesis or any part of it has not been submitted to any other university/ institute/ organization for any degree.

I also certify that the research work has been carried out under my direct supervision and guidance. I have gone through the draft and final version of the thesis and found it satisfactory. I confidently recommend that the thesis be submitted for the degree of Doctor of Philosophy in Economics.

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Abstract

Foreign direct investment is crucial for the economic development of any country, especially the developing ones. If a country's economy is to be established on a strong foundation, there is no alternative to encouraging investment situation. For this reason, economists and policy makers of almost every developing and emerging country are regularly researching the factors that influence FDI and suggesting various steps to attract more FDI in their countries. Bangladesh is far behind in this regard. This study is conducted on annual time series data over a period of 39 years from 1980 to 2018 of Bangladesh to examine whether the host country's inflation rate, interest rate, exchange rate and some other macroeconomic variables such as external debt, current account balance, gross national expenditure and air transport (proxy of transport facilities) as well as their volatilities have any impacts on the country's FDI inflows. The study investigates the long-run, short-run, and causal relationship between dependent and independent variables.

Firstly we identify the key determinants of FDI by reviewing a handsome amount of literature. Among the variables frequently used in the literature, market size has been found to be the most important determinant of FDI. Almost all researchers have reached a consensus on its positive role on FDI. Economic growth, trade openness, regional trade agreement, infrastructure facilities, past FDI stock, and human capital have also been found to be the most important determinants of FDI, the positive role of which is not much disputed among the researchers. Inflation rate, interest rate, exchange rate, labor cost, corporate tax rate, and external debt have been found as the critical determinants of FDI. Although these variables are found to be significant in different countries, their role is highly controversial.

Secondly, analyze the effects and causalities of our predictor variables on FDI. For estimation purpose we employ various econometric techniques. ADF and PP unit root test show that all the variables are stationary at their first differences. Johansen cointegration test indicate that there exists a long-run relationship between dependent and independent variables. The results of VECM indicate that this long-run relationship is not significant. The results of Wald test reveal that interest rate and gross national expenditure have a significant negative impact on FDI in the short-run. The other variables are found insignificant.

To test the direction of causality between variables, VEC Granger causality test and Pairwise Granger causality test are employed. Results of both tests reveal that there

exists a unidirectional short-run Granger causality running from interest rate to FDI and a bidirectional Granger causality between gross national expenditure and FDI. No test finds any short run causality between air transport and FDI. In the case of other explanatory variables, different causality has been found in both tests.

In the third step, volatilities of explanatory variables are examined. The test for the presence of ARCH effects allows us to estimate volatilities through ARCH models only for two variables namely inflation rate, and exchange rate. Results of GARCH (1,1) model show that volatility of inflation rate is highly influenced by previous period's information about volatility as well as previous period's conditional variance (volatility). After a certain period, the forecast of variance is increasing over time which indicates that volatility is not stable. In the case of exchange rate, neither the previous period's information about volatility nor the previous period's volatility significantly affects the volatility of exchange rate.

Finally, we examine the impacts of volatilities (measured as 3 year moving average standard deviation) of explanatory variables on FDI. Results of ARDL bounds test and ARDL-ECM indicate that there exists a significant long-run and short-run relationship between dependent and independent variables. In the long-run, volatility of inflation rate and volatility of interest rate are found to have significant negative impacts on FDI whereas volatility of air transport has a significant positive impact on it. The coefficient of the error correction term (ECT) indicates that these relationships will be persistent in the long-run. In the short-run, volatility of interest rate and volatility of gross national expenditure has significant negative effects on FDI whereas volatility of exchange rate is found to have a significant positive relationship with FDI. We also apply an alternative approach (OLS) to verify the relationships. The condition for persistent long-run equilibrium is not satisfied here. Volatility of external debt and volatility of gross national expenditure are found to have significant negative relationship with FDI whereas volatility of exchange rate has significant positive impact on FDI in the short-run. In terms of goodness-of-fit, OLS model is superior to ECM.

From the findings of this study, it can be recommended that ensuring a stable price level, keeping the interest rate low, preventing devaluation of foreign currencies against taka, avoiding excessive reliance on external debt, maintaining a favourable current account balance, increasing expenditure on infrastructural development and capital formation, and increasing transportation facilities, foreign investors can be attracted to invest in Bangladesh.

Table of Contents

List of Abbreviations

ACF	Autocorrelation Function
ADF	Augmented Dicky-Fuller
AIC	Akaike Information Criterion
ARCH	Autoregressive Conditional Heteroscedasticity
ARDL	Autoregressive Distributed Lag (ARDL)
ASEAN	Association of Southeast Asian Nations
BOP	Balance Of Payment
BRIC	Brazil, Russia, India, and China
BRICS	Brazil, Russia, India, China, and South Africa
CAB	Current Account Balance
CEE	Central and Eastern Europe
CEEC	Central and Eastern European Countries
CLRM	Classical Linear Regression Model
CPI	Consumer Price Index
CUSUM	Cumulative Sum of Recursive Residuals
DF	Dickey-Fuller
DOLS	Dynamic Ordinary Least Square
EBA	Extreme Bounds Analysis
ECM	Error Correction Model
ECT	Error Correction Term
EU	European Union
FDI	Foreign Direct Investment
FEM	Fixed Effects Model
FM-OLS	Fully Modified Least Squares
FPE	Final Prediction Error
FRI	Foreign Portfolio Investment
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
GDP	Gross Domestic Product
GLM	Generalized Linear Model
GNI	Gross National Income

HQ	Hannan-Quinn Criterion
IATA	International Air Transport Association
IMF	International Monetary Fund
IRF	Impulse Response Function
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
LM	Lagrange Multiplier
LR	Likelihood Ratio
MA	Moving Average
MINT	Mexico, Indonesia, Nigeria, and Turkey
MLE	Maximum Likelihood Estimate
MNEs	Multinational Enterprises
MPT	Modern Portfolio Theory
MSE	Mean Squared Error
MSM	Markov-Regime Model
MZIP	Markov Zero-Inflated Poisson
NAFTA	North American Free Trade Agreement
NGO	Non-Governmental Organizations
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Square
PACF	Partial Autocorrelation Function
PMG	Pooled Mean Group
POLS	Panel Ordinary Least Square
PP	Phillips-Perron
R&D	Research and Development
REM	Random Effects Model
RMB	Renminbi (Official Currency of China)
SAARC	South Asian Association for Regional Cooperation
SACU	Southern Africa Custom Union
SADC	Southern African Development Community
SC	Schwarz Information Criterion
SEEC	Southeast European Countries)
SLR	Sequential Likelihood Ratio

SPSS	Statistical Package for the Social Sciences
SSA	Sub-Saharan Africa
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
US	United States
USD	United States Dollar
VAR	Vector Auto-Regression
VECM	Vector Error Correction Model
VIF	Variance Inflation Factor
VMA	Vector Moving Average
WTO	World Trade Organization

List of Tables

List of Figures

List of Appendices

Chapter 1
Introduction

1.1 Introduction

With the expansion of the global free market economy, the importance of foreign direct investment (FDI) is gradually increasing in developing and emerging countries of the world. There are many reasons lying behind this. It is generally believed that FDI is a vital source of capital that complements local investment, meets a country's capital deficit, generates new jobs opportunities, increases the consumption of unproduced goods in the country, provides new skills and technologies, promotes exports, and above all, stimulates the country's economic development. Like many other developing countries in the world, FDI has become a major source of external finance in Bangladesh. Over the past two decades, it is helping our country in building up infrastructures, creating more employment, developing capacities, enhancing skills of the labor force through transfer of technological knowledge and managerial capability, and helping in integrating domestic economy with the global economy (Islam, 2014).

In the 1970s, official development assistance (ODA) and foreign aid were the two main preferred means of receiving foreign funds in Bangladesh. Because of decreasing trend of ODA or foreign aid in the 1980s, developing countries like Bangladesh were looking for an alternative to substitute ODA or foreign aid. Eventually they find FDI as the best alternative to foreign aid. Since its independence, Bangladesh has been attempting to establish a conducive investment atmosphere by adopting new economic policies, incentives for investors, promotion of privatization, and so forth. Despite these, flows of FDI were very low in the 1970s and were even negative in some years of the 1980s. Since the mid-1990s, FDI flows started to rise due to the development of the domestic market, better infrastructural facilities, and availability of low-cost workers. Though FDI inflows increased substantially in recent years, the yearly average inflows is still far lower in Bangladesh compared with India and Pakistan, two major FDI recipients of South Asia. Therefore, it is essential to identify the factors responsible for low FDI inflow and formulate appropriate policies to increase the flow of FDI in Bangladesh.

In the neoclassical growth model, it is assumed that foreign capital fosters economic growth by expanding the amount of investment and its proficiency. It not only complements domestic investment but also serves as a source of foreign exchange which can loosen balance of payment restrictions on growth. Considering the economic benefits and growing importance of FDI, most of the countries seek to attract foreign capital in forms of both direct and indirect investments. Economists and policy makers have focused on examining its various determinants and their impacts on FDI worldwide. Numerous studies have tried to determine the factors that influence FDI flows into different countries. There are many factors that have been identified and tested either from the microeconomics or macroeconomics perceptive. Recently three macroeconomic variables such as interest rate, inflation rate, and exchange rate have been a source of worldwide debate. As can be seen from the existing literature, these variables have been considered as the crucial determinants of FDI in many countries of the world and the results are contradictory, with some studies showing a positive effect on FDI whilst other showing a negative or insignificant effect.

Interest rate, inflation rate, and exchange rate are all correlated. Low level of inflation is a sign of economic stability in the country which increases the return on FDI. Most Central Banks have an inflation target of around 2%. Therefore, if inflation rises above the target, they may feel the need to raise interest rate. Higher interest rate increases the cost of borrowing and slows down domestic investment. As a result, the foreign firms enjoy a cost advantage over their competitors and promote investment in the host country. Higher interest rate also causes an appreciation of the host country's currency and reduces the wealth of foreign investors, creating a downward trend of FDI flows in the host country. This is because investors often transfer funds to countries with higher interest rates to have the benefit of better returns on their investments. The purpose of this study is to examine the impacts of these three variables on FDI flows in Bangladesh. The reason for the choice of these three variables is that the impacts of these variables on FDI are highly controversial around the world. Although there exists a great deal of literature in this area, there is hardly any evidence of such research in Bangladesh.

1.2 Foreign Direct Investment (FDI)

There are two main categories of international investment — foreign portfolio investment (FPI) and foreign direct investment (FDI). Foreign portfolio investment refers to the investment in financial assets such as stocks or bonds in a foreign country where the investor does not have any control over investment.

On the other hand, FDI is the amount invested in a country by the resident of a foreign country, either directly or through other related enterprises, over which the investor has effective control. World Trade Organization (WTO) defines FDI as any investment where the investor from a country invests in a foreign country in the creation of the asset (property) of the enterprise, with the right to control its business. This can be done either by purchasing an existing company of that country or by purchasing land and then build factory there and start operation onwards. According to the International Monetary Fund (IMF), to considers an investment as FDI, it is necessary that the value of the investment should be at least 10% of the total value of the enterprise assets, or minimum of 10% of the ordinary shares (Hill, 2007).

Foreign direct investment differs from foreign portfolio investment in the sense that foreign direct investment involves establishing a direct business interest in a foreign country, such as buying or establishing a manufacturing business where the investor has the right to control the company and to participate in the decision making process.

1.3 Statement of the Problem

Due to insufficient capital for domestic savings and investment, a developing country like Bangladesh is always looking forward to achieving foreign capital for creating employment opportunities for huge labor force, importing suitable technology and equipment for effective use of domestic raw materials, collecting and processing natural resources and establishing export-oriented industrial enterprises. From World Investment Report 2020, it is obvious that the flow of FDI in Bangladesh is not encouraging at all. After the independence of Bangladesh, the new government adopted the policy of nationalizing all the medium and large scale industries. As a result, there was no new foreign direct investment in the country till 1977. Later in

1980, the Foreign Private Investment (Promotion and Protection) Act and the Bangladesh Export Processing Zones Authority Act were passed. Nevertheless, foreign investment did not come much in the entire eighties. Although different governments were experimenting with new industrial policies, the flow of foreign direct investment remained very limited until 1993 as the political situation was unstable in the country. However, since then, the registration of companies with foreign investment has increased rapidly. The main reasons for the comparative progress in foreign direct investment are the investment potential of Bangladesh and the relatively stable political, social and economic condition of recent times.

Bangladesh's economy is growing fast. GDP has grown well above the average for developing countries in recent years, averaging 6.76% since 2010, with a growth rate of 8.15% in 2019 (World Bank). But foreign investment in Bangladesh is not consistent with the rate at which the growth of the economy is moving forward. Foreign investment is yet to rise to 2% of GDP. FDI to GDP ratio was only 0.5% in 2019, the lowest in Asia. World Bank Data revealed that India, Indonesia, Vietnam, Pakistan, Myanmar, and Sri Lanka - all of these countries have higher FDI to GDP ratio than Bangladesh. According to Bangladesh Bank Survey Report 2019 (July-December), the amount of FDI inflows in Bangladesh from 2015 to 2019 are US$2235.39, US$2332.72, US$2151.56, US$3613.30, and US$2873.95 million, respectively. That is, investment increased by 4.35% in 2016 compared to 2015, decreased by 7.77% in 2017, increased by 67.94% in 2018, and again decreased by 20.46% in 2019 compared to the immediate previous year. The record jump in 2018 was driven by significant investment in power generation and US$1.47 billion acquisition of United Dhaka Tobacco by Japan Tobacco. However, in terms of quantity, this investment is so negligible that we have to go a long way to get closer to the more invested countries.

Bangladesh is a good destination for foreign investment. It is located at the heart of South Asia, a corridor between SAARC and ASEAN countries. The country has taken significant steps to reform and liberalize all its financial policies including FDI. In the late 1980s and the 1990s, it has declared a number of programs and liberalized its FDI policy structure. Now Bangladesh has the most systematic investment regime in South

Asia (Sahoo, 2006) and it is being considered as the most liberal and business friendly economy in this region (Board of Investment Bangladesh, 2010). The country provides a competitive position for doing business in respect of factors, costs, human resources, market access, and facilitation. It is an attractive destination for business and investment. Its investment environment provides investors with liberal and winsome packages of incentives. Policy reviews, amendments and initiations are being conducted on a regular basis. In spite of these, Bangladesh has not yet been able to attract the handsome flow of FDI. The Doing Business Ranking is also degrading every year. The inflows of FDI is still lower in Bangladesh compared with other South Asian countries Huq et al. (2016). Moreover, the recent trend of FDI inflows appears to be very inconsistent.

Extensive research is needed to find out the answer to the question of why the flow of FDI in the country is low despite the huge investment opportunities. Therefore, this study seeks to identify some problems that might be the reason for this slow flow of foreign capital in Bangladesh and to recommend some policy implications to the government of Bangladesh.

1.4 Research Questions

This research proceeds to answer the following questions:

1. What are the key factors affecting FDI inflows in the host countries?
2. How do inflation rate, interest rate, and exchange rate affect FDI in Bangladesh?
3. What are the causal relationships of FDI with inflation rate, interest rate, and exchange rate in Bangladesh?
4. What types of volatilities exist in inflation rate, interest rate, and exchange rate of Bangladesh?
5. What are the impacts of volatilities of inflation rate, interest rate, and exchange rate on FDI in Bangladesh?

1.5 Objectives

The general objective of this research is to examine the impacts of inflation rate, interest rate, exchange rate, and their volatilities on foreign direct investment (FDI) flows in Bangladesh. To attain this objective, following specific objectives have been set:

1. To identify the key determinants of FDI;
2. To investigate the impacts of inflation rate, interest rate, exchange rate on FDI in Bangladesh;
3. To explore the causal relationship of FDI with inflation rate, interest rate, and exchange rate in Bangladesh;
4. To examine the volatilities (if any) of inflation rate, interest rate, and exchange rate and their impacts on FDI in Bangladesh;
5. To recommend some policy implications on how to attract more FDI in Bangladesh.

1.6 Hypotheses

H_1 : Inflation rate is positively related to FDI

H_2 : Volatility of inflation rate is negatively related to FDI

H_3 : Interest rate is positively related to FDI

H_4 : Volatility of interest rate is negatively related to FDI

H_5 : Exchange rate is positively related to FDI

H_6 : Volatility of exchange rate is negatively related to FDI

1.7 Justification of the Research

Extensive research has been conducted around the world to analyze the impacts of various determinants on the flow of FDI in the host countries. But the results of these empirical evidences are mixed depending on the choice of the country, the time period of data, the sources of the collected data, applied methodologies etc. In the context of Bangladesh, there have been some studies showing the impacts of FDI and other factors on economic growth of the country. But very few empirical studies have been conducted investigating the impacts of various macroeconomic variables specially interest rate, inflation rate, and exchange rate on FDI inflows in Bangladesh. To the best of the researcher's knowledge, five studies have been conducted in Bangladesh on the determinants of FDI. Quader (2009) found no significant relationship between exchange rate and FDI in Bangladesh. Shaheena (2014) did not include any of our three variables in her study. Akther & Akter (2016) did not apply any stationarity test that determines which model to use for the research. Moreover, their discussions contradicts their regression results. Hence, the results found in their study are not reliable. Mahmood (2018) reported a positive effect of interest rate on FDI in Bangladesh. The inflation rate has been found insignificant in his study. Hasan and Nishi (2019) used the OLS model directly instead of VECM or ARDL model despite all the variables in their study being stationary at first difference, making their results unreliable. So it turns out, no systematic study has been conducted in the context of Bangladesh incorporating these three variables together, nor has there been any study on the volatility of these three variables and their impact on FDI. Needless to say, the policies of one country cannot be determined by the findings of another country. So there is a scope to work on this specific field in Bangladesh using a long-term (39 years from 1980 to 2018) time series data and an advanced econometric approach which can be of great help to the policy makers.

1.8 Methods of Data Analysis

This study starts with a correlation matrix to check the issue of multicollinearity that can have the model. If there exists any strong correlation between two independent variables, one must be eliminated from the model otherwise the model will give erroneous results. We also check it through variance inflation factor (VIF). Next step is to check the stationarity of the variables. For this purpose, Augmented Dicky-Fuller (ADF) test and Phillips-Perron (PP) test are applied in this study. If all the variables are stationary at their levels, i.e., I(0), we can simply apply Ordinary Least Square (OLS) estimation. If the variables are stationary at different orders, e.g., I(0) and I(1), we adopt Autoregressive Distributed Lag (ARDL) model because this model avoids the problem of variables in stationary tests having mixed results in their orders. But If all the variables are stationary at first difference, i.e., I(1), we examine the cointegration between them using Johansen Cointegration Test. If the two series are found cointegrated, we estimate the time series by using Vector Error Correction Model (VECM). But if the two series are not cointegrated, we apply unrestricted VAR approach. Then we need to conduct Granger causality test to know the direction of causality. Volatilities of the variables have been measured by the widely used ARCH/GARCH techniques. Various diagnostic tests have been applied to measure the goodness-of-fit of the model. EViews 10 software and Microsoft Excel 2013 Program have been used to run the econometric methods. The econometric methodologies applied in this study are discussed in detail in Chapter 5.

1.9 Structure of the Thesis

In order to achieve the objective of the research, the thesis has been organized into 8 Chapters as shown in Figure 1.1.

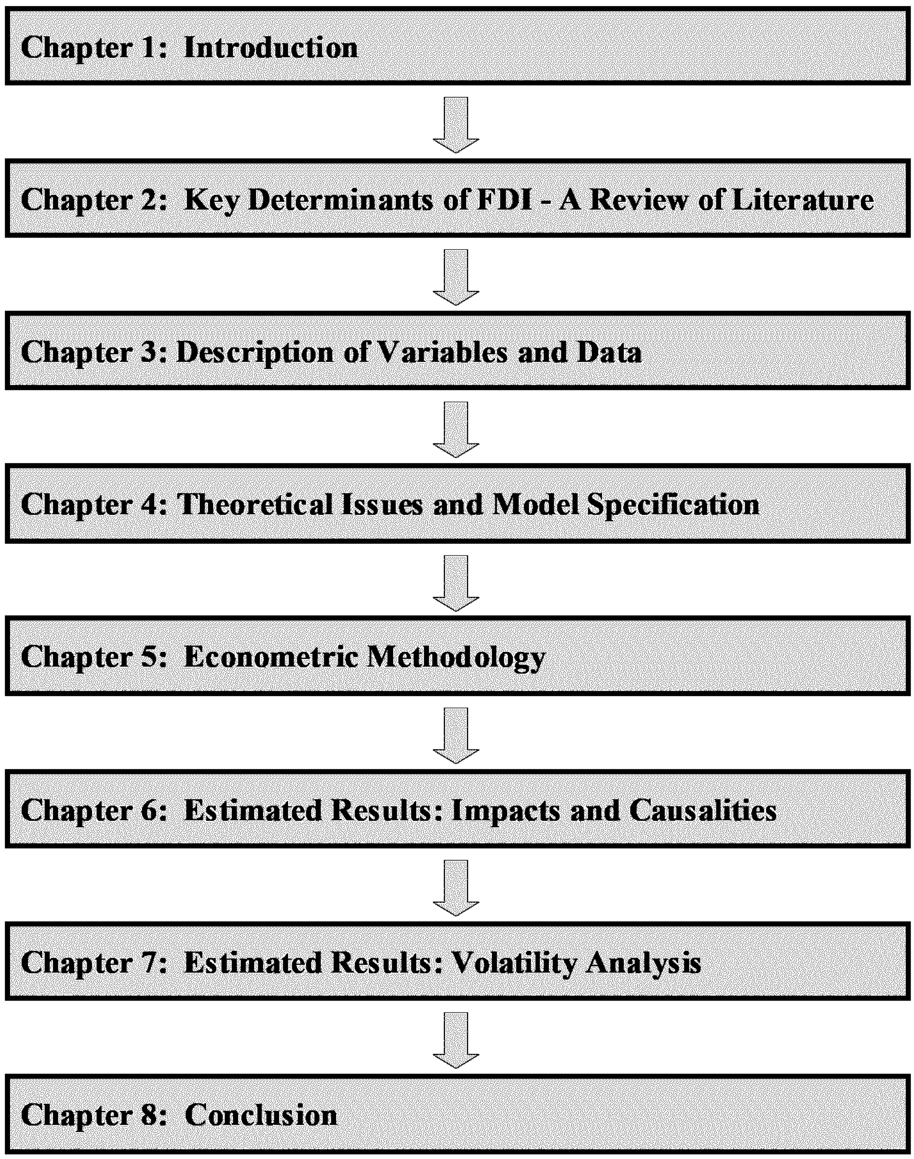
In Chapter 1, we introduce our research topic, familiarize our target variable (FDI), provide an overview of FDI in Bangladesh, define the problem, raise the research questions, specify the general and specific objectives, form hypotheses in terms of the possible relationship of the variables with FDI, outline the rationale for the current research, give a short description of methods of data analysis, and present the structure of the thesis.

In Chapter 2, we review the previous empirical literature on the factors affecting FDI and thereafter identify the key determinants of FDI. We divide literature into high income countries, upper-middle income countries, lower middle-income countries and low-income countries. Moreover, we discuss literature related to Bangladesh separately.

In Chapter 3, we introduce our variables, explain the rationale for selecting variables of interest, and provide tabular and graphical represention of data to get an idea about the nature of the data, and present a summary of descriptive statistics of the variables.

In Chapter 4, we discuss various theories on FDI, its determinants and MNEs, develop a cenceptual framework based on these theories, give a brief description of multiple regression, describe Cobb-Douglas production function based log-linear model and then specify our research model.

Figure 1.1: Structure of the Thesis



In Chapter 5, various econometric methods of data analysis such as multicollinearity test, unit root tests, cointegration test, vector error correction model (VECM), Granger causality test, GARCH (1,1) model, moving average standard deviation, AFDL bounds test, impulse response function, variance decomposition and various residual diagnostic tests are discussed.

In Chapter 6, impacts of inflaton rate, interest rate, exchange rate and other independent variables on FDI are examined and the results are discussed. The causal relationship between dependent and independent variables are also discussed in this Chapter.

In Chapter 7, we analyze the volatility of our explanatory variables through GARCH (1,1) model. We also investigate the impacts of volatility of various explanatory variables on FDI in this Chapter.

Finally, Chapter 8 presents the summary of findings, policy implications, and concludes the thesis.

Chapter 2

Key Determinants of FDI: A Review of Literature

2.1 Introduction

The importance of foreign investment has multiplied today as a result of the massive expansion of the global free market economy. Due to this growing importance, competition has started to attract FDI from all over the world. Policy makers and government officials of various countries are making regular efforts to identify the factors that influence the FDI flows into their countries. That is why, FDI is being widely considered in various economic studies. The purpose of this chapter is to provide a brief overview of the existing empirical literature on the factors affecting foreign investment (including variables of interest) and find out the key determinants of FDI.

The remainder of this Chapter is organized as follows: Section 2.2 provides the review of literature, Section 2.3 discusses the determinants of FDI, Section 2.4 concludes the Chapter identifying the key determinants of FDI and mentioning the research gap.

2.2 Review of Literature

The traditional model regarding the determining factors of FDI starts with the earlier research work by Dunning (1973 and 1981) which yields an extensive investigation based on ownership advantages, location advantages, and internalization advantages (OLI paradigm). The sharp rise in FDI worldwide during the 1980s and 1990s led to an equally prompt increase in the economic literature studying the determinants of FDI. The sharp rise in global FDI in the 1980s and the 1990s gave rise to a promt increase in the literature investigating the determinants of FDI. The following discussion reviews the literature on FDI determinants. The literatures are arranged according to the World Bank Country Classifications by Income Level: 2020-2021.[1]

[1] GNI per capita of $12,536 or more: high-income countries, between $4,046 and $12,535: upper middle-income countries, between $1,036 and $4,045: lower middle-income countries, $1,035 or less: low-income countries. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

2.2.1 Literature on Variables of Interest

2.2.1.1 High Income Countries

Grosse and Trevino (1996) developed a model regarding the determinants of FDI in the United States by country of origin of investment including 23 countries. For this purpose, regressions were run on pooled cross-sectional data over the period 1980-1991. Findings showed the anticipated signs of relationships between FDI into the United States and the causal factors. Bilateral trade (import from U.S. and export to U.S.), exchange rate, and home country GDP were emerged as the most significant factors affecting FDI flows in the United States. The coefficients of exchange rate, import, cultural distance, and geographic distance were negative and significant while the coefficients of GDP and export were significantly positive. Per capita income and political risk were found to be insignificant in this study with positive signs.

Alba et al. (2009) examined the impact of exchange rates on FDI inflows into the United States using Markov Zero-Inflated Poisson (MZIP) regression model. The study used unbalanced industry-level panel data from the US wholesale trade sector for the period of 1982 to 1994. Results indicated that FDI was interdependent over time and under a favorable FDI environment, the exchange rate had a positive and significant effect on the average rate of FDI inflows.

Alshamsi et al. (2015) investigated the effects of inflation rate and GDP per capita on the flows of FDI into the United Arab Emirates on 33-year time series data over the period 1980 - 2013. The auto regressive distributed lag (ARDL) model was applied in this study to examine the long-run relationship between the independent and dependent variables. The results of the study indicated that GDP per capita (which was a proxy for market size) had a significant positive impact on FDI whereas inflation exerted no significant influence on FDI inflows.

Hara and Razafimahefa (2005) empirically investigated the main factors that determine inward FDI into Japan using annual time series data covering the period 1980-2001. Findings revealed that market size, exchange rate volatility, price movements, the cost of setting up greenfield plants, and redemption of the investment environment from regulation were the key determinants of FDI flows into Japan. Market size had a positive correlation with FDI whereas volatility of exchange rates, price movements, and land price had negative impact on FDI. Exchange rate was found to be insignificant in the study.

Pondicherry and Tan (2017) used an autoregressive distributed lag (ARDL) model on 25-year quarterly data of Singapore from 1990 to 2014 to study the relationship between FDI inflows and some of its economic determinants. Findings showed that GDP and trade openness had a positive significant impact on FDI while interest rate had a positive but insignificant impact on FDI inflows in Singapore both in the long-run and short-run.

Gharaibeh (2015) empirically examined the relationships between inward FDI and socio and macroeconomic variables of the host county using annual time series data covering the period 1980-2013. The results provided by OLS regression indicated that country general government consumption expenditure (proxy of economic welfare), inflation rate, interest rate (proxy of economic stability), trade openness, labor force, public education, and population were the significant determinants of FDI flows into Bahrain. On the other hand, market size, export potential, infrastructure development and exchange rates were found to be statistically insignificant.

Hintosova et al. (2018) investigated the determinants of FDI inflows into Visegrad countries (Hungary, Poland, Slovakia, and the Czech Republic). Ordinary least square (OLS) regression and fixed-effect model were employed on the country level data covering the period 1989-2016 for this purpose. In this study, labor cost and the quality of labor were found to be the most significant determinants of FDI with positive signs. On the contrary, trade openness, corporate tax rate, and expenditures on research and development were distinguished as the determinants having negative effect on FDI. The study did not find any significant effect of inflation rate, GDP per capita, and unemployment rate on FDI flows in Visegrad countries.

Banno and Redondi (2014) studied whether air connectivity (proxy of transport infrastructure) has any contribution to the inflows of FDI in Italy. They argued that opening of a new route reduces transportation costs and facilitates implicit and multifaceted knowledge stream which raises the likelihood of FDI between the newly linked regions. The study found that in the two years since the introduction of new routes, FDI increased by 33.7% in general whereas FDI decreased by 16.6% in other alike regions.

Hoare (1975) analyzed the geographical effect of Heathrow Airport on foreign firms expecting that it was somewhat connected to the aspiration of foreign firms to gain access to multinatinal airports. The study found strong evidence on the direct causal relationship between a major international airport and foreign investment in the United Kingdom.

2.2.1.2 Upper Middle Income Countries

Ang (2008) examined the determining factors that affect FDI flows into Malaysia using 46 annual observations from 1960 to 2005. This analysis found a significant positive effect of real GDP and GDP growth rate on FDI. The results also indicated that increase in the magnitude of infrastructural development, financial development, and trade openness stimulated FDI. On the opposite hand, higher statutory corporate tax rate and the appreciation of real exchange rate seemed to debilitate FDI inflows. Surprisingly, the results also seemed to imply that higher macroeconomic uncertainty encourages more FDI inflows.

Aw and Tang (2009) empirically examined the impacts of a bunch of major determinants of FDI flows to Malaysia both in the short-run and long-run. Beside traditional factors, the study incorporated two possible factors - the degree of corruption and China's joining in the WTO. The findings suggested that interest rate, exchange rate, inflation rate, trade openness, the degree of corruption, China's joining in the WTO were the principal determinants of FDI flows into Malaysia in the short-run as well as in the long- run., Inflation rate, interest rate, and trade openness had significant positive correlation with FDI whereas exchange rate, China's joining in the WTO, and corruption had significant negative relationship with FDI. The findings also indicated that infrastructure and market size played a critical role in FDI flows within the short-run, but not within the long-run.

Sharif-Renani and Mirfatah (2012) conducted a study to evaluate the determinants of inward FDI particularly volatility of exchange rate in Iran by using the Johansen and Juselius's cointegration approach covering the period $1980Q_2$-$2006Q_3$. Moving average standard deviation was used for calculating the volatility of exchange rate. The findings of this study revealed that GDP, openness, and exchange rate had significant positive impact but volatility of exchange rate and world crude oil prices had significant negative effect on FDI flows into Iran.

Alavinasab (2013) aimed to find out the determinants that influence FDI in Iran utilizing time series data over the period of 1991 to 2009. Ordinary least squares (OLS) method was applied to find out different economic factors that affect FDI flows into Iran. Results indicated that infrastructure, real GDP growth, return on investment, and imports had significant positive impacts on FDI. While government consumption did not have any significant impact on FDI. The positive efect of import, real GDP growth, and return on investment indicated that FDI in Iran was market-seeking.

Wei (2013) evaluated the relationship between RMB/USD exchange rate and FDI flows in China which was based on the monthly data from July 2005 to December 2010. Regression results demonstrated that appreciation of RMB exchange rate would encourage FDI inflow, and therefore the large amount of FDI would reciprocally bring appreciation strain to the exchange rate of RMB. The results also showed that agglomeration factor (lagged FDI) had a positive impact on FDI inflows in China.

Kalayci and Yanginlar (2016) attempted to examine the impact of economic growth and FDI on airway transportation in Turkey for the period of 1974-2014. Results of Johansen cointegration test and VAR model revealed that a long-run relationship exists among FDI, GDP, and air transportation. Impulse response function and analysis of variance decomposition indicated that the effect of GDP increased air transportation more than the FDI.

2.2.1.3 Lower Middle Income Countries

Akhtar (2001) tried to identify the factors that determine FDI flows in Pakistan by utilizing secondary annual data for the period 1972 to 1996 taking FDI stock as well as FDI inflows as dependent variable. Results of the multivariate regression analyses suggested that economic variables influenced Pakistan's FDI more significantly than political variables. Findings also revealed that the size of the market, exchange rates, and relative interest rates were the most important determining factors of FDI in Pakistan. The growth rate of GDP and political instability were found to be constantly insignificant within the investigation. The other factors like imports of consumer goods and the political regime in Pakistan showed mixed results.

Hakro and Ghumrob (2007) investigated the determining factors of FDI flows to Pakistan economy using data covering the period 1971-2005. Results of the study showed that wage, human capital, and employment were statistically significant both in the short-run and long-run. Openness, savings, and exports were found to be significant in the short-run while output growth and capital formation were significant in the long-run. Inflation and interest rate were found to be insignificant in both the cases.

Khan and Nawaz (2010) explored the determinants of FDI in Pakistan for the years 1970-71 to 2004-05. Regression results confirmed that GDP growth rate, exchange rate, volume of exports, tariff on imports, and wholesale price index were the key determinants of FDI in Pakistan where FDI had a positive relationship with all factors except exchange rate. Volume of exports had been emerged as the most influential determinant of FDI.

Awan et al. (2011) empirically examined the key determinants of FDI in the commodity-producing sector of Pakistan using quarterly data for the period 1996Q1 to 2008Q4. For estimation purpose, vector error correction model (VECM) was employed. Results revealed that GDP, growth rate of real GDP, per capita income, trade openness, foreign exchange reserves, and gross capital formation were the major determinants of FDI in commodity-producing sector of Pakistan. All the variables were statistically significant with positive signs.

Saleem et al. (2013) investigated the impact of inflation and economic growth on foreign direct investment in Pakistan using annual time series data over the period of 1990 to 2011. A multiple regression analysis was used to determine the relationship between the variables. Result reveals that both inflation and economic growth have positive relation with FDI.

Bilawal et al. (2014) attempted to investigate the impact of exchange rate on FDI in Pakistan using annual time series data covering the period of 1982 to 2013. Correlation and regression analysis were employed using SPSS software to identify the relationship between Exchange rate and FDI. The results showed that there was a positive significant relationship between exchange rate and foreign direct investment in Pakistan.

Khan and Zahra (2016) conducted a study to estimate the impact of domestic interest rate on FDI in Pakistan using time series data for the period 1972-2013. The study employed autoregressive distributed lag (ARDL) model for estimation purpose. Findings of the study reveal that domestic interest rate, GDP per capita and unemployment were positively and significantly related with FDI whereas merchandise exports and FDI were significantly and negatively associated.

Azam and Khan (2011) empirically investigated the impact of public debt on FDI in Pakistan using data for the period of 1981-2007. For estimating the impact of public debt on FDI, simple log linear regression and ordinary least squares method were employed. The empirical results were statistically significant and indicated that public debt discouraged FDI inflows into Pakistan.

Amir and Mehmood (2012) analyzed the long-run impact of FDI on real imports and real exports in Pakistan using Johansen cointegration technique and thereby vector error correction model. Results showed that inflows of FDI had a positive impact on imports as well as exports of Pakistan, and net impact of FDI on BOP was positive.

Siddiqui et al. (2013) examined the relationship between FDI and current account (CA) in Pakistan employing Johansen-Juselius cointegration technique and Granger causality test on quarterly time series data covering the period 1976-2005. Results pointed out that FDI and CA were cointegrated and therefore exhibited a plausible long run relationship. The results also indicated that there was a unidirectional long run causality from FDI to CA. However, there was no short run causality running from FDI to CA or vice versa.

Shah and Iqbal (2016) evaluated the effect of government expenditure on FDI in Pakistan by using annual time series data for the period 1972-2013. To identify the relationship, cointegration test, ordinary least square method, and Granger causality test were employed. Results suggested that in the long-run government expenditure on education, health, development activities had a significant positive effect on FDI whereas expenditure on defense had a negative impact on FDI.

Lokesha and Leelavathy (2012) provided an extensive explanation to analyze the determinants of inflows and outflows of FDI. The study concluded that FDI inflows in India is concurrently determined by the market size, economic factors, political factors, economic stability, and policy framework. The significance of particular determinants appeared to be dependent on the type of FDI.

Kaur and Sharma (2013) examined the influential factors of FDI flows into India using quarterly data for the period from 1990-1991 to 2010-2011. Johansen cointegration method was employed to find out the long-run relationship among variables of interest. Empirical findings indicated that openness, foreign exchange reserves, market size and long-term debt had positive impacts on FDI, while negative impacts of inflation and exchange rate on FDI had been observed.

Narayan (2014) explored the determinants of FDI inflows in India covering the period from 1991-92 to 2012-13 by applying correlation and regression analysis. The study found that the size of GDP, growth rate of GDP, and foreign exchange reserves significantly affected FDI flows into India. Real effective exchange rate and long term debt were found insignificant in the study.

Pattayat (2016) explained the determinants of FDI in India by using time series data for the period of 1980-2013. Employing Johnson cointegration test, the study concluded that gross domestic product and exchange rate were the principal determinants having positive influence on FDI flows in India. Trade openness was found to be insignificant in the study.

Mukherjee et al. (2014) attempted to investigate the intrinsic long-run relationship between current account balance and FDI flows in India by analyzing quarterly time series data covering the period from 1990-1991:Q1 to 2010-2011:Q4. Results indicated that a distinctive long-term relationship exists between FDI and current account balance. The study also revealed a unidirectional Granger causality from FDI to current account balance.

Rahman (2016) aimed to assess the influence of inward FDI on the capital account of India's balance of payment for the time period 1991-1992 to 2014-15. Results showed that a bidirectional Granger causality exists between capital account balance and FDI inflows meaning that FDI affects capital account and capital account also affects FDI inflows as well.

Wijeweera and Mounter (2008) examined the response of FDI inflows to Sri Lanka from changes in various macroeconomic variables. The findings indicated that GDP, previous levels of FDI, and external trade were positively correlated with FDI whereas interest rate, exchange rate, and wage rate had negative correlation with FDI flows in Sri Lanka.

Jayasekara (2014) examined the determinants of FDI in Sri Lanka and evaluated the attractiveness of FDI in Sri Lanka, India, Pakistan, and Bangladesh during the period from 1975 to 2012. The study employed fully modified least squares (FM-OLS) method to distinguish the determinants of FDI and utilized proposed FDI index to assess the attractiveness of FDI. Empirical results revealed that inflation rate, official exchange rate, GDP growth rate, infrastructure quality, corporate income tax, labor force, and population growth rate were the significant determinants of FDI in Sri Lanka. FDI had been found to have a positive correlation with all other factors except exchange rate. Trade openness, trade balance, lending interest rates, government consumption expenditure, taxes on international trade, and literacy rate of labor force were found insignificant in his study.

Wanjiru (2014) conducted a study on the impact of inflation volatility and economic growth on FDI in Kenya using the data for the period 1980-2012. A linear regression analysis was used to estimate the relationship among FDI, GDP and inflation. Results indicated that economic growth negatively affected FDI inflows while no significant relationship was found between inflation and FDI. The other independent variables (foreign exchange rate, interest rate, and trade balance) were also found to be insignificant in this study.

Ogono et al. (2017) investigated the determinants of FDI inflows in Kenya. For this purpose, the study employed least square estimation method on annual time series data for the period 1970-2015. Results showed that annual growth rate of GDP (positive), inflation rate (positive), and external debt service (positive) were the significant determinants of FDI inflows in Kenya. The other three determinants namely trade account balance, current account balance, and the growth rate of real exports were found insignificant in the study.

Kiprotich (2015) attempted to estimate the relationship between public debt and FDI flows in Kenya using 15 year data from 2000 to 2014. Multiple regression analysis revealed that a positive relationship existed between foreign debt and FDI. In this study, domestic debt also had a positive impact on FDI. The study also found a positive correlation between domestic debt and FDI.

Udoh and Egwaikhide (2008) examined the impact of exchange rate volatility and inflation uncertainty on FDI flows in Nigeria using GARCH model on annual data for the period 1970-2005. Results showed that exchange rate volatility and inflation uncertainty had significant negative impact on FDI during the period. The results also showed that the size of the potential market, the size of the government, and infrastructural development were the critical determinants of FDI inflows to the country.

Omankhanlen (2011) investigated the impact of inflation and exchange rate on FDI flows in Nigeria and its correlation with economic growth using data covering the period 1980-2009. An OLS regression analysis was carried out to identify the relationship between variables. Results of the study showed that exchange rate had a significant positive effect on FDI. The effect of inflation on FDI was insignificant. The study also revealed that FDI had a positive, though not statistically significant, effect on GDP.

Osinubi and Amaghionyeodiwe (2009) explored the impact of exchange rate volatility on FDI in Nigeria using annual time series data for the period 1970-2004. The study utilized ECM as well as OLS method of estimation for this purpose. Results showed that exchange rate volatility was not a cause for concern for foreign investors. The study also revealed that real GDP, interest rate, and exchange rate had a positive influence on real inward FDI.

Ajisafe et al. (2006) investigated the causal relationship between external debt and foreign private investment in Nigeria using data over the period 1970-2003. The study found a bidirectional causal relationship between external debt and foreign private investment in Nigeria. This means that both external debt and foreign private investment affects each other.

Andinuur (2013) investigated linkages among inflation, FDI and economic growth in Ghana using annual time series data covering the period 1980 to 2011. The study employed cointegration test proposed by Pesaran, Shin and Smith (2001) and causality test suggested by Toda and Yamamoto (1995) to empirically examine the relationships among the variables under consideration. The study found that there were significant relationships among inflation, FDI and economic growth in Ghana. Inflation had a significant negative impact on FDI as well as economic growth. Economic growth had a significant positive impact on FDI and vice versa.

Anna et al. (2012) sought to find out the impacts of interest rate and other determinants on FDI inflows in Zimbabwe in the period from February 2009 to June 2011. Data was analyzed using the classical linear regression model (CLRM), ordinary least squares (OLS) approach. The study found that GDP, labor cost, and risk factors (political instability, war, and failure to observe democratic rights) were the major determinants of FDI in Zimbabwe. The study also found out that interest rates, inflation rate, and exchange rate had no significant effect on FDI.

Khalil (2015) aimed to distinguish the economic factors that affect FDI flows in Egypt throughout the period 1970-2013. Cointegration equation showed that the variables real GDP, households' expenditure, and trade exchange rate had positive impacts on FDI while interest rate, inflation rate, exchange rate, government expenditure, and unemployment had negative effects on FDI in Egypt.

2.2.1.4 Low Income Countries

Faroh and Shen (2015) examined the impact of interest rate on FDI flow in Sierra Leone using multiple regression analysis based on time series data for the period of 1985 to 2012. The study found trade openness and exchange rates as the key determinants of FDI flow in Sierra Leone having significant positive signs. Other variables namely GDP, inflation, and interest rate were found to be insignificant factors causing the variability of FDI flows.

Fornah and Yuehua (2017) developed an empirical framework to identify the impact of interest rate on the flow of FDI in Sierra Leone using time series data for the period of 1990-2016. For this purpose, Johansen and Juselius cointegration techniques and vector error correction model (VECM) were applied. Empirical analysis of the data revealed that GDP growth, trade openness, interest rate, and inflation were the major determinants of FDI in Sierra Leone. Inflation was negatively correlated with FDI whereas other three variables had significant positive effect on FDI. Exchange rate was found to be insignificant in explaining FDI.

Wani and Rehman (2017) empirically investigated the determinants of FDI in Afghanistan over the period of 2005-2015. Results of OLS estimation method showed that external balance, total external debt, total debt service, gross fixed capital formation, and inflation had significant impact on gross domestic foreign investment. External balance, total debt service, and gross capital formation exerted positive effect on FDI whereas total external debt and inflation exerted negative impact on FDI.

Chol (2020) tried to identify the location determinants of FDI inflows into Sudan using time series data for the period 1980-2018 employing vector auto-regression (VAR) model and Granger causality test. The empirical results revealed that market size, inflation, external debt, and investment incentive were key location determinants of FDI flows into Sudan. No significant effect of gross fixed capital formation and trade openness on FDI were found. The Granger causality showed unidirectional causality running from GDP, inflation, trade openness, external debt, and investment incentives to FDI.

2.2.1.5 Countries With Different Income Level (Panel Analysis)

Ranjan and Agrawal (2011) attempted to distinguish the factors affecting FDI flows in BRIC countries (Brazil, Russia, India, and China) during the period from 1975 to 2009. To identify the determinants of FDI, random effects model was employed. The findings of the study showed that trade openness, market size, labor cost, infrastructure facilities, and macroeconomic stability (inflation rate) were the probable determinants of FDI in BRIC countries where the first three factors had a positive impact on FDI and the second two had a negative effect on it. Labor force and gross capital formation were found to be insignificant in attracting FDI to the BRIC countries.

Jadhav (2012) brought economic determinants (market size, natural resource availability, inflation rate, trade openness), institutional determinants (corruption, voice and accountability, rule of law) and political determinants (political stability, government effectiveness, regulatory quality) of FDI together and explored their role in attracting FDI in BRICS (Brazil, Russia, India, China, and South Africa) economies using panel data covering the period from 2000 to 2009. Findings indicated that conventional economic determinants were more significant than institutional and political factors in BRICS economies. Results also revealed that trade openness, market size, natural resource availability, inflation rate, voice and accountability, and rule of law were the significant determinants of FDI in BRICS countries. Coefficients of trade openness, market size, inflation rate, and rule of law were positive while voice and accountability, and natural resource availability had negative impact on overall FDI inflows.

Wint and Williams (2002) developed a model of determinants of FDI to test the extent to which developing countries were able to attract foreign investment through promotional activities. Among the variables under consideration, only per capita income was significant with a positive correlation with FDI. The other variables namely interest rates, growth rate of per capita income, literacy rates, current account, and promotion were found to be insignificant in this study.

Kahai (2004) investigated the factors affecting FDI inflows into developing countries using data for the period from 1998 to 2000. The study extended earlier studies by incorporating both traditional and non-traditional determinants of FDI. Results indicated that among the traditional variables market size, infrastructure, inflation, labor cost, and export significantly affected FDI flows in developing countries. Exchange rate was found to be insignificant determinant of FDI with positive sign. Results also indicated that FDI was significantly influenced by several non-traditional factors such as the level of corruption, the level of economic freedom, and the level of international trade regulations by the host country.

Demirhan and Masca (2008) examined the factors that influence FDI flows to developing countries. For this purpose, cross-sectional data were collected for 38 developing countries over the period 2000 to 2004. Findings showed that degree of openness, growth rate of per capita GDP, and infrastructure had significant positive effect on FDI. The results also revealed that inflation rate and tax rate negatively affected FDI whereas labor cost and risks had no significant effect on FDI.

O'Meara (2015) conducted a study with a view to exploring the major determinants of FDI using cross-sectional data of a sample of both developed and developing countries. Findings indicated that traditional variables such as GDP per capita, population, the size of the labor force, and household final consumption were found have significant positive impact on FDI while variables such as tax incentives (corporate tax rate) and education (human capital) played no significant role in explaining FDI.

Kumari and Sharma (2017) tried to point out the principal determining factors of FDI flows in developing countries. For this purpose, the study collected unbalanced panel data from 20 developing countries of Asia covering the period 1990 to 2012. Random effects model (REM) was rejected by the Hausman (1978) specification test. Results of fixed effects model (FEM) indicated that market size, infrastructure, interest rate, and human capital significantly affected flows of FDI in developing countries where market size and human capital had positive impacts, infrastructure and interest rate had negative impacts. Trade openness, inflation, and research and development (R&D) were found to be insignificant in the study.

Jha et al. (2013) analyzed the determinants of FDI in six South Asian countries - India, Pakistan, Bangladesh, Sri Lanka, Nepal, and Maldives over the period 1990 to 2010.

Pooled OLS regression was employed to estimate the impacts of explanatory variables on FDI flows in South Asia. Results showed that GDP and domestic capital formation had a positive impact on FDI whereas real effective exchange rate and labor had a negative influence. Trade openness and interest rate were found having no significant impacts on FDI.

Onyeiwu and Shrestha (2004) applied the fixed and random effects models to explore the magnitude, dynamics, and determinants of FDI in Africa using a panel dataset for 29 African countries over the period 1975 to 1999. Regardless of whether the impact of country and time specific factors were fixed or stochastic, economic growth, inflation, openness of the economy, international reserves, and natural resource availability were found to be the significant determinants for FDI flows to Africa. External debt and taxes were found to be significant in random effects model but insignificant in fixed effects model. Interest rate, infrastructures, and political rights were found to be insignificant for FDI flows to Africa in both random effects and fixed effects model.

Anyanwu (2011) aimed at investigating the constituents that determine FDI inflows to African countries using data for the period from 1980 to 2007. For this purpose, ordinary least squares (OLS) method and generalized linear model (GLM) were performed. Estimated results indicated that market size, trade openness, government consumption expenditure, financial development, agglomeration, international remittances, and natural resource endowment were the significant determinants of FDI inflows to Africa with market size, trade openness, government expenditure, international remittances, agglomeration, and natural resource endowment having a positive relationship with FDI and a negative relationship with financial development. The study found no significant relationship of FDI with infrastructure, inflation rate, and exchange rate.

Suleiman et al. (2015) examined the determinants of FDI in Southern Africa Custom Union (SACU) countries namely Eswatini, Botswana, Namibia, Lesotho, and South Africa using a panel data set for the period of 1990-2010 and employing pooled OLS as the main estimation method. Results indicated that market size, trade openness and natural resource availability were the significant determinants of FDI having positive signs. To the contrary, infrastructure, labor cost, and gross capital formation were found to be insignificant with positive signs, while inflation was found to be negative and insignificant in the study.

Ali et al. (2018) examined the determinants of FDI inflows in Southern African Development Community (SADC) member countries using data for the period 1995-2016. The study employed pooled OLS as the main estimation method. Results revealed that inflation, infrastructure, trade openness and market size were the significant determinants of FDI inflows in SADC countries. Inflation had negative impact on FDI while infrastructure, trade openness and market size were positively related with FDI. The results also showed positive but insignificant effect of human capital on FDI inflows to SADC member countries.

Boga (2019) investigated the factors affecting FDI inflows in Sub-Saharan African countries using panel data from 23 countries for the period of 1975-2017. According to the results of Pooled Mean Group (PMG), trade openness, GDP growth, natural resources, domestic credit and telecommunication infrastructure were found to be the significant determinants in the long-run while trade openness and GDP growth were found to be the significant determinants in the short-run. Inflation was found to be insignificant in the study.

Jaiblai and Shenai (2019) explored the determinants of FDI in 10 sub-Saharan countries (Nigeria, Ghana, Sierra Leone, Liberia, Senegal, Cameroon, Mali, Ivory Coast, Niger, and Mauritania) using cross-sectional data for the period from 1990 to 2017. Results indicated that higher inflows of FDI in relation to GDP were connected with higher openness, better infrastructure, higher inflation, depreciation in the exchange rate, lower income levels (GNI per capita), and smaller markets, though the coefficients of openness and exchange rate were not statistically significant.

Botric and Skuflic (2006) examined the determinants of FDI in the Southeast European countries (SEEC) using generalized least squares (GLS) regression on a pooled sample of the period 1996-2002. The study attempted to find out whether the conventional and less conventional determinants were proved significant for SEE countries. Findings suggested that under different specifications, certain factors like trade regime, privatization, consistence of infrastructure, and agglomeration factor appeared to be significant. External debt was found to have a positive significant influence on FDI whereas inflation was found to have a positive but insignificant impact on FDI. The analysis also showed that market-seeking factors of FDI (such as GDP per capita) had given mixed indication in various specifications.

Walsh and Yu (2010) analyzed different macroeconomic, developmental, and institutional factors influencing FDI in emerging and developed economies using a dataset from 1985 to 2008. The study divided FDI flows into primary, secondary and tertiary sector. Secondary and tertiary sectors had different linkages to the macroeconomic, institutional and other qualitative indicators, although primary sector had little connection to these variables. The study found that macroeconomic variables openness, exchange rate, GDP growth, and FDI stock had positive significant relationship with tertiary FDI whereas GDP per capita had significant negative effect on it and the relationship of tertiary FDI with inflation was insignificant. Institutional variable infrastructure quality exerted positive significant impact on tertiary FDI. The study also established that the impact of these variables often differentiated between emerging and advanced economies.

Ho and Rashid (2013) investigated significant determinants of FDI in five ASEAN countries namely Indonesia, Malaysia, the Philippines, Singapore and Thailand from 1975 to 2009 applying both individual and panel data analyses. In this analysis, economic growth was found to be significant for Malaysia, Indonesia, and the Philippines but the estimated coefficient was negative. The coefficient of trade openness was positive and significant for all the countries except Malaysia. Inflation rate, exchange rate and manufacturing output were found to be significant for Thailand, Malaysia and the Philippines, respectively, although the relationship between inflation rate and FDI was not as expected. In Indonesia and the Philippines employment negatively affected foreign investments, while tourism positively affected FDI in the Philippines and Malaysia. Other factors such as the level of consumer income, skill and knowledge and infrastructure development were found to significant in one or more countries.

Hoang and Bui (2015) analyzed the factors influencing FDI inflows in ASEAN countries (Malaysia, Indonesia, Singapore, Vietnam, Thailand, and the Philippines) over the period from 1991 to 2009. Random effects model (REM) was considered appropriate through the Hausman test. Results indicated that trade openness, market size, human capital, quality infrastructure, nominal labor cost, labor productivity, exchange rate, political stability, and control of corruption were the key factors having positive effects on FDI flows in this region. Real interest rate affected FDI inflows negatively. Financial development and inflation rate were found to be insignificant in this analysis.

Tri et al. (2019) attempted to find out the primary factors that affect FDI inflows in ASEAN countries by employing panel ordinary least square (POLS) estimation for the period 1996-2016. The study found market size, trade openness, interest rate, and financial integration as the significant determinants of FDI. Financial integration and market size were found to have positive correlation with FDI inflows whereas interest rate and trade openness were negatively correlated with FDI. Though labor cost had the expected negative sign and infrastructure facilities had the expected positive sign, they were not statistically significant.

Othman et al. (2018) examined the impacts of government expenditure on the flow of FDI in the host country using panel data of 7 countries (ASEAN-5, India, and China) for the period from 1982 to 2016. For estimation, the study employed Pooled Mean Group

(PMG) method proposed by Pesaran et al. (1999). Results of the study showed that the government spending contributed positively and significantly towards FDI flows in the long-run. The results also revealed that market size, gross fixed capital formation, and infrastructure had significant positive impact on FDI whereas macroeconomic stability (inflation) had significant negative impact on it.

Hunady and Orvisca (2014) attempted to find out the major determinants of FDI in 26 EU countries using panel data for the period 2004-2011. The study concentrated especially on statutory corporate tax rate and its effect on FDI. Results suggested that corporate taxes had no significant impact on FDI. But the study found a significant positive effect of GDP per capita, openness of the economy, and public debt and a significant negative effect of labor costs and firing costs on FDI flows in EU countries. The results also revealed that inflation rate no insignificant effect on FDI.

Dornean and Oanea (2014) aimed to explore the effect of fiscal policy on FDI flows in Central and Eastern European (CEE) countries in the context of the recent global crisis using data for the period 1995-2012. Results of panel data regression suggested that both government expenditures and government revenues had a negative impact on FDI inflows though the latter was found to be insignificant. During crisis period, both instrument of fiscal policy became strongly significant. Hence, the study concluded that in response to monetary policy, financial crisis affected the magnitude of FDI.

Jahan (2020) intended to identify the underlying factors that affect the inflow of FDI to 24 emerging countries using panel data covering the period 1992-2016. The fixed effects model was chosen for this study through Hausman (1978) specification test. The empirical findings of this study demonstrated that market size, trade openness, infrastructure facilities, natural resources availability, financial development level, and inflation rate were the key factors affecting FDI flows into the emerging economies. Labor force played no significant role in attracting FDI in this region.

Azam (2010) examined the impacts of various macroeconomic factors on FDI flows in three Asian countries namely Kyrgyz Republic, Armenia, and Turkmenistan based on time series data for the period 1991-2009. Simple linear regression model in log form and the method of ordinary least squares had been used for this purpose. Results indicated a positive relationship of market size and official development assistance (ODA) with FDI while inflation had a negative relationship with it. However, inflation was found to have a negative but insignificant effect on FDI in Kyrgyz Republic and official development assistance (ODA) was found to be insignificant in Armenia with unexpected negative sign.

Ouhibi et al. (2017) conducted a study to investigate the causal relationship among FDI, economic growth, and public debt in the southern Mediterranean countries using annual data for 26 years from 1990 to 2015. Empirical findings showed that public debt had a significant negative impact on FDI. Findings also indicated that there existed a unidirectional Granger causality running from public debt to FDI. The impact of trade openness and economic growth on FDI was positive and significant. The effects of two more variables on FDI, namely inflation rate and exchange rate, were found to be insignificant.

Ostadi and Ashja (2014) analyzed the correlation between external debt and FDI in D-8 countries using panel data covering the period 1995-2011. Findings showed that external debt and government size had significant negative effect on FDI whereas GDP and population had significant positive effect on FDI in D-8 countries.

Le and Suruga (2005) investigated the interrelationships among FDI, public expenditures, and economic growth using a panel data set of 105 developed and developing countries covering the period from 1970 to 2001. Results of the fixed-effect model suggested that non-capital public spending had a significant negative effect on economic growth, and unrestricted public capital spending could hamper the positive impacts of FDI.

2.2.2 Literature on Other Variables

2.2.2.1 High Income Countries

Artige and Nicolini (2006) analyzed the macroeconomic catalyst of FDI inflows for three European regions (Baden-Württemberg, Catalunya and Lombardia) using panel data on FDI and potential determinants over the period 1995-2002. Results revealed that, a positive and statistically significant relationship existed between GDP and FDI per capita for all regions. Apart from that, there was no unique pattern across regions regarding FDI determinants. Despite choosing regions that present economic similarities, the study noticed that regional FDI inflows depended on a group of factors that differed from one region to another.

Dellis et al. (2017) provided an in-depth analysis on the factors which could encourage foreign investment into advanced economies with special concentration on the effect of economic structures and institutions. For this purpose, a set of panel data over the period 2005-2014 from 21 OECD countries were collected and utilized. Along with traditional variables (market size, trade openness, labor cost, and tax rates), the study included property rights, government spending, corruption, labor regulations, business regulations, monetary policies, fiscal policies, investment policies, trade policies, and rule of law as political institutions. Results suggested that economic structures and the quality of institutions played an important role in attracting FDI in developed countries. The study also confirmed previous findings on market size, labor costs, and trade openness of the recipient country.

2.2.2.2 Upper Middle Income Countries

Ali and Guo (2005) examined the decisive factor of FDI flows into China from the perception of country features to identify what were the key factors that influenced foreign companies' decision to invest in China. The study used both primary and secondary data. For primary data, the study analyzed feedback from 22 companies working in China on what motivated them to invest in China. Findings showed that China's vast market size was the most important factor in attracting FDI flows into China. Government incentive policies, low labor costs, high investment return, and global integration were other important factors that affect China's foreign investment.

Dumludag (2009) operated a questionnaire survey to investigate whether macroeconomic and institutional variables had any role to play for the reasons of the low level of FDI flows in Turkey. Results indicated that macroeconomic variables like market size, GDP per capita, and growth rate of GDP had positive impact on FDI. The results also showed that institutional variables like government stability, low level of corruption, political and economic stability, functioning of judicial system, legal and regulatory framework, enforcement of contract law, efficiency of justice, and intellectual property rights had significant impact on FDI in Turkey.

Fedderke and Romm (2006) investigated the determining factor of FDI inflows to South Africa on annual data for the period of 1956-2003 employing VECM framework. Findings suggested that market size, trade openness, wage cost, and corporate tax rate had a strong effect on FDI inflows in South Africa. Political structure (political risk, property rights etc.) also mattered for foreign investment liabilities in the country.

2.2.2.3 Lower Middle Income Countries

Sahoo (2006) explored the potential causal factors of FDI in South Asian countries (Bangladesh, Pakistan, India, Nepal, and Sri Lanka) using panel data over the period 1975 to 2003 under ADB. Results of Pedroni (1995, 1997) panel cointegration test showed that a long-run relationship existed between FDI and its potential determinants. Market size, trade openness, infrastructure index, and the growth of labor force were found as the major determinants of FDI in South Asia where coefficients of all the variables were significant with positive signs.

2.2.2.4 Countries With Different Income Level (Panel Analysis)

Tsai (1994) considered two time period 1975-1978 and 1983-1986, which stand for the seventies and eighties respectively, to examine the determinants of FDI and its impact on economic growth. There were 62 countries in the seventies and 51 in the eighties. For the eighties, the determinants market size, trade balance, labor cost, gross domestic saving, and growth rate of real exports were found significant. Trade balance was found to be the only significant determinant in the eighties. In both decades, economic growth and the growth rate of employment were found to be insignificant determinants.

Sichei and Kinyondo (2012) empirically examined the determinants of FDI in 45 African countries using panel data for the period 1980-2009. The study distinguished several factors that influenced FDI flows into Africa, including real GDP growth, availability of natural resources, agglomeration economies, and multinational investment treaties. It is noteworthy that agglomeration economies have been found to be the most significant determinant of FDI inflows to Africa.

Agiomirgianakis et al. (2004) concentrated on evaluating the elements that may affect FDI flows in OECD countries using a panel data regression on 23-year data from 1975 to 1997. In this analysis, density of infrastructure, trade regime, and human capital appeared to be the significant determinants of FDI under various specifications. The study also confirmed the prominent role played by the newly emerged agglomeration factor.

Mottaleb (2007) tried to find out the underlying factors that affect inflow of FDI in developing countries using panel data from 38 low-income and 22 lower-middle income countries covering the period 1993-2007. Findings showed that countries with large domestic market, high GDP growth rate, modern infrastructure (such as telephone and internet), and business friendly environment were able to attract more FDI. The study concluded that these factors, as described, encouraged FDI flows into developing countries.

2.2.3 Literature Regarding Bangladesh

Quader (2009) employed extreme bounds analysis (EBA) on annual time series data covering the period 1990-91 to 2005-06 in order to investigate the variables that act as a catalyst for FDI in Bangladesh. Results revealed that GDP growth, trade openness, wage, trade balance, and tax rate were the significant catalyst variables for FDI in Bangladesh. The study also found that two years lagged values of FDI and change in the level of domestic investment had a positive significant effect on economic growth in Bangladesh.

Shaheena (2014) traced the major determinants of FDI inflow in Bangladesh using annual time series data for the period of 1978 to 2011. To empirically analyze the long-run and short-run relationships between dependent and independent variables, Auto Regressive Distributive Lag (ARDL) approach was applied. Results indicated that GDP per capita (proxy of market size) and infrastructure did not have any significant impact on FDI in Bangladesh. The results also showed that trade openness had significant positive influence on FDI whereas wage rate had significant negative effect on it.

Akther and Akter (2016) explored the determining factors of FDI inflows in Bangladesh over the period of 2005-2015. To test the hypothesis, the study conducted linear regression analysis. Regression results showed that market size, openness, corporate tax rate, domestic investment, labor force, and exchange rate had no significant impact on FDI. The coefficients of market size and labor force had the negative sign whereas the coefficients of other factors had the positive sign. Interest rate had been found to be the only significant determinant exerting a negative impact on FDI. But the study did not apply any stationarity test that determines which model to use for the research. Moreover, the discussions of results contradict regression results. Hence, the results found in this study are not reliable.

Mahmood (2018) investigated the macroeconomic and political determinants of FDI flows in Bangladesh using data over the period 1975-2015. For this purpose ARDL estimation technique was employed. Findings of the study revealed that in the long run, GDP, interest rate, and democracy positively affected the flows of FDI in the Bangladesh. However, the effect of inflation had been found insignificant. The results also show that trade openness creates a negative impact on FDI inflows.

Hasan and Nishi (2019) aimed to find out the impact of some macroeconomic variables (GDP, trade openness, inflation rate, and market size) in attracting FDI in Bangladesh using data for the period 1997-2016. To find out the impact of different variables on FDI, the study applied OLS estimation method instead of VECM or ARDL model despite all the variables in their study being stationary at first difference, making their results unreliable. However, the results showed a positive and significant relationship of market size and GDP on inward FDI in Bangladesh. The results also indicated that trade openness and inflation rate had a negative but insignificant influence on FDI. The causality analysis indicated that there was a unidirectional Granger causality running from GDP to FDI.

2.3 Determinants of FDI

The factors responsible for increasing or decreasing investment in a country are called the determinants of investment. In general, no single variable can affect investment too much, but a set of variables can collectively influence investment. The determinants of the FDI are numerous. From the literature review of the previous section, it is evident that a significant number of empirical studies have attempted to investigate the determinants of FDI in different countries. It has been observed that time-series analysis has often been used in research conducted on a single country, while studies conducted on multiple countries have often employed panel data analysis. The choice of explained variable along with explanatory variables have also varied depending on the countries being investigated. For explained variables, most studies have used FDI inflows to host countries or the ratio of FDI inflows to GDP. The choice of independent variables have differed as well, although some variables have been used consistently. Below is an analysis of the explanatory variables frequently used in the literature.

2.3.1 Market Size

Market size, measured by GDP or per capita GDP, seems to be the most significant determinants of FDI, especially for market seeking FDI. According to Charkrabarti (2001), market size has so far been the single most widely accepted determinant of FDI. The flow of FDI is expected to be higher in countries that have large markets (Azam, 2010). According to Cuyvers et al. (2008), a bigger market size, better market growth potential, higher level of development, and higher per capita GDP growth are the factors considered when investors think to invest abroad. Jordaan (2004) states that FDI will shift to countries with bigger and growing markets and better purchasing power, where investing firms can possibly get a higher return from their investments. As indicated by Ranjan and Agrawal (2011), a huge customer market implies more capability of consumption and thereby greater scope for trade. Countries with bigger customer markets ought to attract more FDI flows than countries with smaller ones. Walsh and Yu (2010) point out that bigger markets of host countries might be connected with higher flows of FDI owing to greater potential demand and lower costs because of economies of scale. Miskinis and Juozenaite (2015) mention that when a multinational company searches for a suitable host country to invest in, they seek out whether the consumers of that country are able to buy more of their goods and services.

Many empirical studies have supported the notion that host country's market size is positively correlated with the country's inward FDI. For instance, among others, Tsai (1994), Grosse and Trevino (1996), Kinoshita (1998), Chakrabarti (2001), Wint and Williams (2002), Kahai (2004), Hara and Razafimahefa (2005), Fedderke and Romm (2006), Mottaleb (2007), Ang (2008), Dumludag (2009), Azam (2010), Anyanwu (2011), Jadhav (2012), Kaur and Sharma (2013), Hunady and Orvisca (2014), Hoang and Bui (2015), Pattayat (2016), Dellis et al. (2017), Hintosova et al. (2018), Tri et al. (2019), Chol (2020) and many others reported a positive relationship between host country's

GDP and FDI, indicating that a bigger market size attracts more FDI inflows. Walsh and Yu (2010), and Jaiblai and Shenai (2019) find a negative association of market size with FDI whereas Osinubi and Amaghionyeodiwe (2009), Shaheena (2014), and Faroh and Shen (2015) find no significant relationship between market size and FDI. So it is seen that most of the previous studies confirm the importance of market size.

2.3.2 Economic Growth

Economic growth is one of the most imperative determinants of FDI. It is measured by the annual percent change in total output or gross domestic product (GDP) of a country. To be most accurate, economic growth is usually measured in real terms (adjusted for inflation). The growth hypothesis states that a fast-growing economy offers comperatively more advantages for acquiring profits than ones growing gradually or not growing at all. Countries with high and stable growth rates accept more FDI inflows than unstable economies(Sahoo et al., 2014). This is because overseas companies look away from the current market size and consider the potential for future growth of the market. (Kahai, 2004).

Almost every study has found a positive correlation between economic growth and FDI. Schneider and Frey (1985), Lunn (1980), Billington (1999), Culem (1988), Obwona (2001), Onyeiwu and Shrestha (2004), Mottaleb (2007), Demirhan and Masca (2008), Udoh and Egwaikhide (2008), Dumludag (2009), Khan and Nawaz (2010), Walsh and Yu (2010), Awan et al. (2011), Sichei and Kinyondo (2012), Alavinasab (2013), Saleem et al. (2013), Jayasekara (2014), Ogono et al. (2017), Othman et al. (2018), and Boga (2019) noticed a significant positive impact of economic growth on FDI. Quader (2009) and Wanjiru (2014) found a negative relationship of economic growth with FDI. Tsai (1994), Akhtar (2001), Asiedu (2002), Agiomirgianakis et al. (2004), and Gharaibeh (2015) find no significant relationship between growth and FDI.

2.3.3 Trade Openness

Trade Openness is the ratio of trade (the sum of export and import) to GDP of a country.

That is, $Trade\ Openness = \frac{EXPORT + IMPORT}{GDP} \times 100$

It is one of the pull factors that affect the inflows of FDI to the host countries. It is typically used as a proxy of economic liberalization. According to Sahoo et al. (2014), trade openness usually positively affects the export-oriented FDI flows into a country. Jayasekara (2014) mentions that high trade volume and free trade policies may motivate FDI flows into a country. Hunady and Orvisca (2014) argued that the higher openness of economy means weaker barriers to market and the economy is more attractive to foreign investors.

Asiedu (2002), Agiomirgianakis et al. (2004), Onyeiwu and Shrestha (2004), Botric and Skuflic (2006), Hakro and Ghumrob (2007), Wijeweera and Mounter (2008), AW and Tang (2009), Mottaleb and Kalirajan (2010), Ranjan and Agrawal (2011), Sharif-Renani and Mirfatah (2012), Ho and Rashid (2013), Shaheena (2014), Faroh and Shen (2015), Fornah and Yuehua (2017), Ali et al. (2018), and Boga (2019) reported a strong positive effect of openness on FDI. However, Gharaibeh (2015), Hintosova et al. (2018), and Tri et al. (2019) found negative correlation between trade openness and FDI. Openness is found insignificant in the study of Jha et al. (2013), Jayasekara (2014), Pattayat (2016), Kumari and Sharma (2017), Jaiblai and Shenai (2019), and Chol (2020).

2.3.4 Infrastructure Facilities

Infrastructure typically refers to the physical structures and fundamental facilities that provides a variety of basic services to a country, city, or other area. It includes roads, railways, bridges, tunnels, water supply, sewers, flood management systems, power grids, communications (phone lines, internet, broadcasting), and so forth. It is the ground of a country's poverty reduction and economic growth. According to Alavinasab (2013), physical infrastructure is a prerequisite for any type of investment, be it domestic or foreign. It not only supports economic development but also affects the ability of firms to operate successfully. Ranjan and Agrawal (2011) note that well-founded and modern infrastructure facilities describe the affluence of a country and give benefits for FDI. When developing countries struggle for FDI, the country that is best organized to deal with infrastructural barriers will ensure more FDI (ADB, 2006). Asiedu (2002) states, better infrastructure improve the efficiency of investments and accordingly provokes FDI inflows. According to Onyeiwu and Shrestha (2004), the cost of production is usually lower in countries where infrastructures are developed than in countries where infrastructures are weak and therefore countries with better infrastructures are likely to attract more FDI flows. Uwubanmwen and Ajao (2012) mention that government ought to expand its spending on the development of infrastructure in order to attract more FDI in country.

Findings of Kinoshita (1998), Biswas (2002), Agiomirgianakis et al. (2004), Axarloglou (2004), Kahai (2004), Sahoo (2006), Mottaleb (2007), Ang (2008), Ranjan and Agrawal (2011), Alavinasab (2013), Jayasekara (2014), Hoang and Bui (2015), Ali et al. (2018), Othman et al. (2018), Boga (2019), and Jaiblai and Shenai (2019) indicate that better infrastructure has a positive impact on FDI. Kumari and Sharma (2017) found negative correlation between infrastructure and FDI inflows. Ho and Rashid (2013) found the same result in case of Indonesia. Onyeiwu and Shrestha (2004), Mottaleb and Kalirajan (2010), Anyanwu (2011), Ho and Rashid (2013), Shaheena (2014), Gharaibeh (2015), and Tri et al. (2019) found infrastructure facilities insignificant for FDI flows.

2.3.5 Inflation Rate

Price stability is a core indicator of a country's macroeconomic stability. If the rate of inflation high, investors will have to spend additional time, energy, and money to adapt to the growing price level. It increases the cost of capital to the user and reduces the return on investment. Subsequently, risk-averse foreign investors will reduce FDI in the host country as investors are unwilling to take the risk of the expected return from their investments. According to Jayasekara (2014), high rate of inflation debilitates FDI by decaying the actual value of investment and by reducing the return on investment. Botric and Skuflic (2006) mention that very high inflation or volatile inflation may be considered as an obstacle to FDI, as it is an obvious indicator of macroeconomic instability.

In most of the literature reviewed, no significant correlation of FDI with inflation was found. Obwona (2001), Grosse and Trevino (2005), Botric and Skuflic (2006), Mottaleb and Kalirajan (2010), Omankhanlen (2011), Anna et al. (2012), Mall (2013), Wanjiru (2014), Alshamsi et al. (2015), Kwoba and Kibati (2016), Kumari and Sharma (2017), Asongu et al. (2018), Boga (2019), and Dalwai et al. (2019) found inflation as in insignificant determinant of FDI. Hara and Razafimahefa (2005), Demirhan and Masca (2008), Azam (2010), Andinuur (2013), Khalil (2015), Wani and Rehman (2017), Ali et al. (2018), and Chol (2020) found a significant relationship between inflation rate and FDI with expected negative sign. AW and Tang (2009), Jadhav (2012), Saleem et al. (2013), Jayasekara (2014), Ogono et al. (2017), Jaiblai and Shenai (2019) found a significant positive relationship of inflation with FDI. Ho and Rashid (2013) reported a positive sign for Thailand. Inflation volatility/ uncertainty is found to have a significant negative correlation by Udoh and Egwaikhide (2008) and insignificant by Wanjiru (2014).

2.3.6 Exchange Rate

According to Hoang and Bui (2015), a direct correlation between exchange rate and FDI inflows is desired as a higher exchange rate (depreciation of the host country's currency in terms of the home country's currency) mirrors an enhancement in the competitiveness of exported products. Ramirez (2006) contends that depreciation of the host country's currency is likely to boost its exports, which in sequence persuades foreign companies to invest in export-oriented sectors. However, the theoretical predictions about the impacts of exchange rate on FDI are to some extent diverse throughout the literature.

Research work by Froot and Stein (1991) indicates that the United States received huge amount of inward FDI in the 1970s and 1980s due to weak dollar meaning that increase in exchange rate induces FDI. Akhtar (2001), Cuyvers et al. (2008), Alba et al. (2009), Walsh and Yu (2010), Omankhanlen (2011), Sharif-Renani and Mirfatah (2012), Bilawal et al. (2014), Hoang and Bui (2015), Pattayat (2016), and Khamphengvong et al. (2018) found the similar results. Grosse and Trevino (1996), Wijeweera and Mounter (2008), AW and Tang (2009), Khan and Nawaz (2010), Anyanwu (2011), Jha et al. (2013), Jayasekara (2014), and Khalil (2015) reported a significant negative relationship between exchange rate and FDI. Kahai (2004), Hara and Razafimahefa (2005), Parajuli and Kennedy (2010), Anna et al. (2012), Wanjiru (2014), Gharaibeh (2015), Kwoba and Kibati (2016), Ouhibi et al. (2017), and Dalwai et al. (2019) found no significant relationship between these two variables.

The stability of a country's currency is also an essential determinant of FDI. According to Jayasekara (2014), constant fluctuations of exchange rate refer to the instability of a country's currency. Hara and Razafimahefa (2005), Udoh and Egwaikhide (2008), and Sharif-Renani and Mirfatah (2012) found a negative relation between exchange rate volatility and FDI. Wanjiru (2014) found a positive effect of exchange rate volatility on FDI whereas Osinubi and Amaghionyeodiwe (2009), and Parajuli and Kennedy (2010) found no considerable relationship between exchange rate uncertainty and FDI.

2.3.7 Interest Rate/ Borrowing Costs/ Cost of Capital

Interest rate, which usually assesses the cost of borrowing capital, is also considered to be a decisive factor of FDI. However, the difference of opinion among economists on the relationship between the FDI and interest rates is notable. According to Lokesha and Leelavathy (2012), the aim of foreign firms is to diminish their production cost so as to keep up price competitiveness. Therefore, availability of capital at a lower interest rate in the host country would attract foreign investors to invest in that country. Hoang and Bui (2015) state that, since interest rate reflects the cost of capital, a low interest rate in the host country may motivate investors to increase capital in order to operate their investment activities. In line with them, Jayasekara (2014) mentions that high lending rate increases the cost of capital and discourages FDI inflows. In contrast to them, Gross and Trevino (1996) think that relatively high interest rate in the host country has a positive effect on FDI. Pondicherry and Tan (2017) also note that a higher interest rate will lead to a higher return on investment which will increase FDI. Beer and Cory (1996) state that a country's low interest rate persuade investors to borrow funds from that country causing a reduction in the flow of FDI in that country. Findings of Akhtar (2001), AW and Tang (2009), Osinubi and Amaghionyeodiwe (2009), Gharaibeh (2015), Khan and Zahra (2016), Fornah and Yuehua (2017), and Mahmood (2018) supported Gross and Trevino (1996).

Beer and Cory (1996), Wijeweera and Mounter (2008), Hoang and Bui (2015), Khalil (2015), Kumari and Sharma (2017), and Tri et al. (2019) found negative relationship whereas Wint and Williams (2002), Onyeiwu and Shrestha (2004), Hakro and Ghumrob (2007), Cuyvers et al. (2008), Udoh and Egwaikhide (2008), Parajuli and Kennedy (2010), Anna et al. (2012), Jha et al. (2013), Jayasekara (2014), Faroh and Shen (2015), and Pondicherry and Tan (2017) found no significant relationship between interest rate and FDI. Similarly, Wanjiru (2014) did not find any significant impact of interest rate as well as volatility of interest rate on FDI inflows.

2.3.8 Labor Cost/ Wage

Wage is one of the most substantial operating costs and is the most controversial among the probable determinants of FDI (Chakrabarti, 2001). A vital stimulus for a company to invest abroad is to externalize labor-intensive production in low-wage countries. According to Dunning and Lundan (2008), lower labor costs in the host country compared to the home country makes it more appealing for FDI to get involved in production activities in a foreign country. Cuyvers et al. (2008) mention that lower wage rates make countries with plentiful skilled and unskilled laborers more competitive and attractive, and are likely to persuade efficiency-seeking FDI. Hoang and Bui (2015) state that foreign companies frequently take benefits of inexpensive labor in developing countries to reduce their costs of production. According to Lokesha and Leelavathy (2012), wage gap is an issue that can ensure profitability of a company by making a low cost environment to attract foreign investment in the host country. Ranjan and Agrawal (2011) state that higher labor costs raise production costs and thereby lead to FDI outflows or less FDI inflows. Sichei and Kinyondo (2012) point out, higher labor costs refer to higher production costs and and are expected to restrict the flow of FDI.

Tsai (1994), Kinoshita (1998), Chakrabarti (2001), Kahai (2004), Botric and Skuflic (2006), Fedderke and Romm (2006), Wijeweera and Mounter (2008), Quader (2009), Ranjan and Agrawal (2011), Anna et al. (2012), Sakali (2013), Hunady and Orvisca (2014), Dellis et al. (2017), and Baskoro et al. (2019) found evidence about the negative relationship between labor cost and FDI in the host countries. Wheeler and Mody (1992), Beer and Cory (1996), Hakro and Ghumrob (2007), Parajuli and Kennedy (2010), Hoang and Bui (2015), and Hintosova et al. (2018) obtained a positive association between FDI and labor cost. Li and Park (2006), Demirhan and Masca (2008), Suleiman et al. (2015), and Tri et al. (2019) did not find any significant effect of wage on inward FDI.

2.3.9 Corporate Tax Rate

A corporate tax is a direct tax imposed by the government of a country on business profits. Both private and public companies that are registered in a country under the companies act, are responsible for paying corporate taxes. As other investors, foreign direct investors seek to maximize the after-tax return on investment. Higher corporate taxation is, therefore, expected to discourage FDI (Mistura and Roulet, 2019). Ang (2008) states that higher statutory corporate tax rate seem to debilitate FDI inflows. Also Jayasekara (2014) mentions that higher corporate tax rate in the host countries lowers the return on investment and debilitates FDI. For this reason, the practice of providing various types of tax incentives are noticed in different countries. Overall tax policies used to attract FDI involve reduction of corporate income tax, tax holidays, investment tax credits, accelerated depreciation, and privileged treatment of income such as lower taxes on export earnings (Kersan-Skabic, 2015). The literature remains fairly inconclusive concerning whether FDI might be responsive to tax incentives.

Onyeiwu and Shrestha (2004), Fedderke and Romm (2006), Ang (2008), Demirhan and Masca (2008), Quader (2009), Dellis et al. (2017), and Hintosova et al. (2018) observed that host country corporate taxes have a significant negative impact on FDI. Wheeler and Mody (1992), Beer and Cory (1996) (manufacturing), Axarloglou (2004), Hunady and Orvisca (2014), and O'Meara (2015) have concluded that corporate taxes do not have any significant inluence on FDI. On the other hand, Swenson (1994), Beer and Cory (1996) (all businesses), and Jayasekara (2014) found a positive effect.

2.3.10 Regional Trade Agreement/ Regional Integration/ Bilateral Trade

A regional trade agreement (RTA) is a pact endorsed by at least two nations to inspire free movement of goods and services across the borders of its member countries. The agreement defines the rules of trade for all signatories which member countries follow among themselves. Regional integration plays a vital role in the locational choice of multinational corporations. According to Sahoo et al. (2014), investors usually desire large markets and prefer to invest in countries where there is regional trade integration and in countries where there is provision for more investment opportunities in their business treaty. Cuyvers et al. (2008) state that economic integration with other countries of the world diminishes domestic trade costs which may influence the quantity and pattern of FDI both into and within the integrated region. They further note that regional integration can attract FDI from outside the integrated region as it turns out to be more appealing for foreign companies when the size of the combined market increases. Te Velde and Bezemer (2004) showed that membership of a particular region leads to additional regional FDI inflows, though it depends on the sort of regional provisions and the country's position within the region. Donnenfeld (2003) showed that Portugal and Spain benefited significantly from FDI inflows as a result of their participation in the European Union. Feils and Rahman (2008) found that the implementation of NAFTA had an in general positive impact on inward FDI into the entire region.

Findings of Grosse and Trevino (1996), Levy-Yeyati et al. (2002), Donnenfeld (2003), Te Velde and Bezemer (2004), Grosse and Trevino (2005), Cuyvers et al. (2008), Feils and Rahman (2008), Sichei and Kinyondo (2012), Sakali (2013), Tintin (2013), and Tri et al. (2019) point out a positiveand significant influence of regional integration on bilateral FDI. Cuyvers et al. (2008) found a positive correlation between bilateral trade and inward FDI for Cambodia.

2.3.11 Trade Balance (or, Trade Deficit)

The balance of trade is the distinction between the financial value of a country's exports and imports for a given period of time. A country's trade balance is positive (i.e., surplus in trade) when the value of exports exceeds the value of imports. Contrarily, a country's trade balance is negative (i.e., deficit in trade) when the value of imports exceeds the value of exports. Trade balance is the most significant component of the current account and the biggest component of the balance of payment that measures all international transactions. It is often cited as an essential determinant of FDI. Trade surplus is an indicator of a dynamic and wealthy economy with export potential and is therefore likely to stimulate the inflows of FDI. According to Jayasekara (2014), deficit in trade balance discourages FDI.

Schneider and Frey (1985), Torissi (1985), Dollar (1992), Lucas (1993), and Quader (2009) reported a strong positive correlation between trade surplus and FDI. On the other hand, Tsai (1994), and Obwona (2001) observed a significantly negative effect of trade balance on FDI whereas Jayasekara (2014), Wanjiru (2014), and Ogono et al. (2017) found trade balance insignificant in attracting FDI.

2.3.12 Trade Barriers/ Trade Regulation

Trade barriers refer to government policies that impose restrictions on global trade. Trade barriers either make trade more troublesome and costly or prevent trade completely. Imposing taxes on certain imports, placing a restriction on the number of imported goods, applying rules and regulations that make trade more complicated, providing subsidy by the government which gives the local firm a comparative advantage, an unconditional ban (trade embargo) on imports from a certain country are the examples of trade barriers. The impact of trade barriers on FDI has also been widely debated. According to Kahai (2004), the higher level of restrictions by the government on trade increases the transaction costs and, henceforth, lowers the inflows of FDI. Jayasekara (2014) states, high rates of taxes on international trade discourage FDI. Chakrabarti (2001) mention that trade liberalization allows products to move generously and, therefore, the quantity of foreign investment is expected to decline. In contrast, Goldar and Banga (2007) found that trade liberalization had a favorable effect on FDI flows. Lunn (1980), Schmitz and Bieri (1972), and Kahai (2004) found a positive and significant impact of trade barriers on FDI whereas Culem (1988) reported a negative significant correlation between these two. On the other hand, Beaurdeau (1986) found no significant relationship between trade barriers and FDI.

2.3.13 External Debt

External debt refers to money borrowed from a source outside the country. These loans, along with interest, must be paid in the currency in which the loan was made. According to Onyeiwu and Shrestha (2004), debt may be a result of improper macroeconomic strategies which debilitates foreign investment. There have been several studies on the relationship between external debt and foreign direct investment.

Azam and Khan (2011), Ostadi and Ashja (2014), Ouhibi et al. (2017), and Wani and Rehman (2017) found statistically significant negative relationship between external debt and FDI. Onyeiwu and Shrestha (2004), Botric and Skuflic (2006), Kaur and Sharma (2013), Hunady and Orvisca (2014), Kiprotich (2015), and Chol (2020) find that higher public debt positively influences FDI. Narayan (2014) found external debt insignificant in explaining the flow of FDI. Related to this, Wani and Rehman (2017) and Ogono et al. (2017) found a positive correlation between external debt service and FDI but Obwona (2001) did not find any significant relationship between this two variables.

2.3.14 Balance of Payment

The balance of payment (BOP) is the record of all global monetary transactions made by the inhabitants of a country over a particular period of time. Usually, the BOP is calculated every quarter and every calendar year. If a country receives money, it is considered as a credit, while if a country pays or gives money, it is treated as a debit. There have been several studies on the effect of FDI on BOP, but there has not been much research on the effect of BOP on FDI. Schneider and Frey (1985) concluded that countries with higher GDP per capita received a greater amount of FDI and consequently, they had a favorable effect on their balance of payments. Findings of Jaffri et al. (2012) show that increase in FDI causes increase in income outflows of balance of payments and worsens current account balance excluding current transfers of Pakistan in the long-run. Amir and Mehmood (2012) found that net impact of FDI on BOP of Pakistan is positive. Wint and Williams (2002), and Ogono et al. (2017) found a negative but insignificant impact of CAB on FDI. Wani and Rehman (2017) reported a positive impact of external balance (a situation of BOP equilibrium) on FDI. Rahman (2016) found a bidirectional Granger causality between capital account balance and FDI Inflows. This means that both the capital account balance and the inflows of FDI affect each other in India. Siddiqui et al. (2013) found a long-run unidirectional causality from FDI to current account in Pakistan but they did not find any long-run or short-run causality in the opposite direction. Mukherjee et al. (2014) also found a unidirectional causality from India's FDI to current account balance at 5% level.

2.3.15 Government Consumption Expenditure/ The size of the Government

Government spending is considered an important determinant of FDI. It is expected to have a negative correlation between government consumption and FDI on the ground that an enormous size of government spending may open the door for abuse of funds by the government officials (Alavinasab, 2013). Othman et al. (2018) state that government expenditure can boost economic growth, ensure better economic performance and high productivity, and attract FDI. Jayasekara (2014) mentions that high government consumption spending is thought to be an indicator of macroeconomic instability which debilitates FDI. Sahoo et al. (2014) note, high government spending creates high fiscal deficit that lead the country to more government liability and macroeconomic instability. Hence, the smaller fiscal deficit is considered to be a favorable environment for vigorous private investment. According to Anyanwu (2011), the smaller the government, the more efficient it will be and the more conducive the atmosphere will be for domestic and foreign private investment.

Findings of Anyanwu (2011), Gharaibeh (2015), Shah and Iqbal (2016), and Othman et al. (2018) reveal that there exist a significant positive relationship between government expenditure and FDI. On the other hand, Obwona (2001), Udoh and Egwaikhide (2008), Dornean and Oanea (2014), Ostadi and Ashja (2014), and Khalil (2015) reported a negative relation between them. Agiomirgianakis et al. (2004), Alavinasab (2013), and Jayasekara (2014) did not find any significant relationship between government spending and FDI inflows.

2.3.16 Foreign Exchange Reserves

Foreign exchange reserves are foreign currencies and assets held by the central bank of a country. It includes bonds, treasury bills and other government securities. For example, U.S. government bonds held by the Bank of Japan are foreign assets for Japan. The purpose of these reserves is to pay back liabilities and influence monetary policy.

Reserves are held in one or more reserve currencies, at the present time mostly in the U.S. dollar and a lesser extent in the euro. Several studies have found foreign exchange reserves as a vital determinant of FDI. According to Lokesha and Leelavathy (2012), an increase in foreign exchange reserve implies the development of a country's financial condition which encourages foreign investment. Onyeiwu and Shrestha (2004) mention that international reserves influence the flow of FDI to a country as foreign investors find confidence in economies having large international reserves. Findings of Awan et al. (2011), Kaur and Sharma (2013), and Matsumoto (2019) indicate that higher foreign exchange reserves attract FDI inflows. Onyeiwu and Shrestha (2004), and Narayan (2014) found a negative relationship between international reserves and FDI. Huang et al. (2011) and Osigwe & Uzonwanne (2015) obtained a bidirectional Granger causality between foreign exchange reserves and FDI.

2.3.17 Gross Capital Formation

Capital formation is a term used to express the net capital accumulation of a country during a particular period of time. Gross capital formation (GCF) is estimated by the total value of gross fixed capital formation, changes in inventories and acquisitions less disposals of valuables for a unit or sector. Generally, the higher the capital formation of a country, the sooner the country can increase its aggregate income. According to Ranjan and Agrawal (2011), higher gross capital formation contributes to higher economic growth as a result of improved investment climate which helps attract higher FDI inflows. The findings of Awan et al. (2011), Jha et al. (2013), Wani and Rehman (2017), and Othman et al. (2018) indicate that gross capital formation have a positive impact on FDI whereas Beer and Cory (1996) reported a negative correlation between them. Ranjan and Agrawal (2011), Akter (2015), Suleiman et al. (2015), and Chol (2020) found gross capital formation insignificant in determining the amount of FDI. Ugwuegbe et al. (2014) found a bidirectional causality between FDI and GCF in Nigeria but Megbowon et al. (2016) found no form of causality between FDI inflow and GCF in South Africa.

2.3.18 Return on Investment

The return on investment is the profit or loss created on the amount of investment enjoyed by an investor. It is typically exercised to assess the proficiency of an investment or compare the proficiency of various investments. It is generally estimated as the net return on investment divided by the cost of investment and is expressed as a percentage or proportion. The rate of return on investment in a host economy influences the investment decision. The higher the ratio, the greater the benefit earned. According to Asiedu (2002), FDI will shift to countries that pay a higher return on capital. Wenkai et al. (2012) observed that investment in China is high when the return on capital is high and the rate of investment is low when return on capital is low, implying that investment decision is significantly affected by return on capital. Findings of Asiedu (2002) indicate that a higher return on investment has a positive impact on FDI to non-SSA (Sub-Saharan Africa) countries, but have no significant impact on FDI to SSA. Alavinasab (2013) also found a significant positive relationship between return on investment and FDI. Ali and Guo (2005) found that high investment return is a key factor affecting FDI flows to China. Findings of Grosse and Trevino (1996) and Bosede et al. (2016) indicate that the apparently attractive rate of return on investment has no significant effect on FDI flows to the host countries.

2.3.19 Labor Productivity

Labor productivity, measured by GDP per employee, is a crucial determinant of FDI. It reflects the efficiency of labor in the economy (Hoang and Bui, 2015). According to Baskoro et al. (2019), an efficiency-seeking firm will probably decide to invest in a foreign country if that country provides a higher level of labor productivity along with lower wages. Cushman (1987), Axarloglou (2004), Bogheana and State (2015), Hoang and Bui (2015),_Baskoro et al. (2019) found a direct and positive connection between labor productivity and FDI inflows.

2.3.20 Geographical Distance

Geographical distance, the distance measured along the surface of the earth, is usually considered as an essential decisive factor of FDI location choice. According to Cuyvers et al. (2008), geographical distance may deter a firm from establishing a plant in a distant host country since distance is considered as an estimate of transaction costs of operating investment activities in a foreign country.

Empirical results of the literature regarding geographical distance as a determining factor of FDI are also diverse. Grosse and Trevino (1996), Frenkel et al. (2004), Gao (2005), Cuyvers et al. (2008), and Parajuli and Kennedy (2010) found evidence to support the hypothesis of a negative relationship between geographical distance and FDI inflows. But Wei and Liu (2001), Pan (2003), Tintin (2013), and Khamphengvong et al. (2018) reported that geographic distance does not seem to play any considerable role in affecting the inflow of FDI into the recipient country.

2.3.21 Human Capital

Human capital is a measure of the education, skills, training, intelligence, capacity, habits and attributes of labor which influence their productive capacity and earning potential. Noorbakhsh et al. (2001) concluded that human capital is one of the most important and statistically significant determinant of FDI inflows. According to Sahoo et al. (2014), countries with an abundant supply of skilled human capital draw more FDI, especially in sectors that are comparatively intensive towards skilled labor. They further note that, a more educated workforce can quickly learn and apply new technologies and are usually more productive. Sichei and Kinyondo (2012) state that higher levels of human capital are a fair index of the availability of skilled workforce that tends to enhance a country's locational advantages. According to Huang and Bui (2015), human capital represents the quality of labor in the host countries, quality workers can operate machines and new technologies rapidly and proficiently, and in general their productivity is high. Jayasekara (2014) mentions that high quality human capital encourages FDI. Findings of Axarloglou (2004) suggest that the quality of the labor force and the efforts to improve this quality are crucial in attracting FDI inflows.

Agiomirgianakis et al. (2004), Axarloglou (2004), Hakro and Ghumrob (2007), Sakali (2013), Gharaibeh (2015), Hoang and Bui (2015), Kumari and Sharma (2017), and Hintosova et al. (2018) reported that quality of labor exert a significant positive impact on FDI. Wint and Williams (2002), Mottaleb and Kalirajan (2010), Jayasekara (2014), O'Meara (2015), and Ali et al. (2018) found no significant effect of human capital on FDI. Ho and Rashid (2013) found a significant positive impact of human capital on FDI flows in Indonesia but a negative impact in Malaysia.

2.3.22 Agglomeration Economies (Past FDI Stock)

Recent literature has highlighted agglomeration factor as a significant determinant of attracting FDI. Agglomeration refers to the concentration of economic activities, which leads to positive externalities and the economies of scale (Sun et al., 2002). According to Sichei and Kinyondo (2012), agglomeration economies emerge from the fact that new overseas investors have little knowledge about the host country and its atmosphere, and so they will monitor the investment decisions by others as a decent indicator of encouraging investment situations.Wheeler and Mody (1992) found that the U.S. FDI was motivated by the size of the total inward FDI. Agiomirgianakis et al. (2004), Axarloglou (2004), Botric and Skuflic (2006), Wijeweera and Mounter (2008), Walsh and Yu (2010), Anyanwu (2011), Sichei and Kinyondo (2012), Wei (2013), and Yin et al. (2014) concluded that previous levels of FDI has a significant positive impact on inward FDI though Osinubi and Amaghionyeodiwe (2009) found a negative relation and Udoh and Egwaikhide (2008) found no relation between theses two variables.

2.3.23 Corruption

Transparency International defines corruption as 'the abuse of entrusted power for private gain'. Giving or accepting bribes or inappropriate gifts, under-the-table transactions, double-dealing, diverting funds, manipulating elections, defrauding investors, laundering money are some examples of corruption. According to Dumludag (2009), corruption creates uncertainty in the business environment that can ultimately have a negative impact on all companies that operate in the long run. Kahai (2004) mentions, the existence of corruption makes dealing with government officials less transparent and more costly, specifically to foreign investors.

Literature survey shows that the corruption variables have a negative impact on economic growth which in turn will lead to lower inward FDI. Findings of Grosse and Trevino (2005), Ohlsson (2007), AW and Tang (2009), Sadig (2009), Hoang and Bui (2015), Epaphra and Massawe (2017), and Canare (2017) show that the corruption level in the host country has an adverse effect on FDI inflows. In contrast to them, Kahai (2004), and Onyinyechi (2019) reported that corruption has a significant positive influence on FDI. On the other hand, Hunady and Orvisca (2014) found no significant association between these two variables.

2.3.24 Foreign Aid/ Official Development Assistance (ODA)

Official development assistance (ODA) is taken as an indicator of development activities (Azam, 2010). Hence, expenditures financed by official development assistance likely to improve a country's physical infrastructures and demonstrates good relations with global organizations which increase the confidence of foreign investors. Yasin (2005) and Azam (2010) reported that bilateral official development assistance has a significant positive effect on FDI flows. Mottaleb and Kalirajan (2010) found similar results for Kyrgyz Republic and Turkmenistan but found a negative relationship between ODA on FDI for Armenia.

2.3.25 Other Determinants of FDI

Both exports and imports affect FDI flows. Tsai (1994), Beer and Cory (1996), Grosse and Trevino (1996), Kahai (2004), Fedderke and Romm (2006), Khan and Nawaz (2010), and Baskoro et al. (2019) found a positive correlation, Hakro and Ghumrob (2007) and Khan and Zahra (2016) found a negative correlation, and Parajuli and Kennedy (2010), Narayan (2014), and Ogono et al. (2017) found no correlation between exports and FDI. On the other hand, Grosse and Trevino (1996), Chakrabarti (2001), and Fedderke and Romm (2006) reported a negative association between imports and FDI whereas Alavinasab (2013) found a positive association and Akhtar (2001) found no relation between them.

Natural resources plays an important role in attracting foreign investment. According to Dunning (1977), countries with abundant natural resources are likely to attract resource-seeking FDI. Onyeiwu and Shrestha (2004), Anyanwu (2011), Sichei and Kinyondo (2012), Suleiman et al. (2015), Boga (2019), and Jahan (2020) reported a significant positive impact of natural resource availability on FDI flows. However, Jadhav (2012) found a negative relation between natural resources and FDI and Asongu et al. (2018) found no significant relationship between them.

Political instability in a country is likely to discourage the inflow of FDI. It negatively affects FDI as shown by Grosse and Trevino (2005), Anna et al. (2012), and Hoang and Bui (2015). Hakro and Ghumrob (2007) found that political instability positively affects FDI, which is inconsistent with the relaty. However, Grosse and Trevino (1996), Akhtar (2001), Asiedu (2002), and Udoh and Egwaikhide (2008) did not find any significant relationship between them.

Unemployment also affects the flow of FDI in the host countries. Botric and Skuflic (2006), Ho and Rashid (2013), and Khan and Zahra (2016) found a positive relation; Hakro and Ghumrob (2007) and Khalil (2015) found a negative relation; Tsai (1994), Hunady and Orvisca (2014), and Hintosova et al. (2018) found no relation between unemployment and FDI. Morever, total labor force of a country, tariff, financial development, cultural similarities, financial and economic crisis, tourism, rule of law, voice and accountability also affect the flow of FDI in a country.

2.4 Conclusion and Research Gap

An individual firm can have large number of motivations to undertake FDI such as market-seeking, efficiency-seeking, resource-seeking, export-orientation, among others. These motivations are influenced by various factors. Hence there is no general theory of FDI that can broadly explain why a firm want to become multinational or where multinational corporations want to invest their capital. The literature on FDI generates a great deal of controversies due to differences in the geographical location, ideological ground, and methodological framework for analysis. Since each method has its own limitations and advantages, one way to verify the accuracy of the results is to analyze the same issue through different methodological filters. However, in order to identify the key determinants of FDI, we review significant numbers of literatures and observe that market size is the most important determinant of FDI. Almost all researchers have reached a consensus on its positive role on FDI. Economic growth, trade openness, regional trade agreement, infrastructure facilities, past FDI stock (agglomeration economies), and human capital have also been found to be the most important determinants of FDI with which there is not much disagreement among the researchers. Inflation rate, interest rate, exchange rate, labor cost, corporate tax rate, and external debt are also found to be significant determinants of FDI in various countries, although these determinants are highly controversial. From the findings of this study, it can be recommended that increasing the size of GDP, continuing the trend of economic growth, increasing exports and reducing imports, maintaining a stable price level, removing trade barriers, developing economic and social infrastructures and signing bilateral trade agreements with different countries, foreign investors can be attracted to invest in the host countries.

It is obvous from the literature that there has been a lot of research in different countries of the world to determine the various factors influencing FDI. A wide difference has been noticed in terms of these factors and their impacts on FDI across countries and over time. Although most of the studies are country specific, such research is very rare in Bangladesh. Moreover, not only in Bangladesh, but all over the world, very little research has been done on the effects of volatility of various variables on FDI. This creates a research gap in the literature on FDI determinants. That is why, this research empirically analyzes the impacts of some controversial variables and their volatilities on FDI in Bangladesh.

Chapter 3

Description of Variables and Data

3.1 Introduction

In order to apprehend the flow of FDI in a country, it is essential to first make acquainted the economic factors that may have an approximate impact on FDI. From the empirical literature reviewed in Chapter 2, we have already gained an idea of the major constituents that drive an investor to invest outside his own country. The aim of this chapter is to give a brief description of the variables and data used in the study.

The remainder of this chapter is organized as follows: Section 3.2 provides the rationale for selecting explanatory variables, Section 3.3 gives the description of the variables and sources of data, Section 3.4 covers the tabular and graphical presentation of data, Section presents the summary of descriptive statistics, and Section 3.6 gives the conclusion of the chapter.

3.2 Rationale for Selecting Explanatory Variables

Many factors affect the flow of FDI in a country. From the literature review in Chapter 2, we have learnt that there is no debate among researchers about the role of market size (measured by GDP or per capita GDP) on FDI. There are some variables whose role on FDI has been agreed by the most researchers. Economic growth, trade openness, regional trade agreement, infrastructure facilities, past FDI stock and human capital fall into this category. Since the role of these variables on FDI is fairly recognized, there is not much need for new research on them. There are other variables whose role on FDI is widely debated among researchers. Inflation rate, interest rate, exchange rate, labor cost, corporate tax rate and external debt fall into this category. Their impacts on FDI have been found to be different from country to country. The variables in this third category are the variables of interest in this study. In addition, gross national expenditure and air transport (proxy of transport facilities) have been included in the study subject to data availability and multicollinearity issue. However, due to lack of data, labor cost and corporate tax rate could not be included in the study.

3.3 Description of Variables and Sources of Data

The study is based on secondary data. To meet the purpose of the study, time series data on dependent and independent variables have been collected from various secondary sources covering the period 1980 to 2018. Table 3.1 shows the variables of this study and their secondary sources in brief.

Table 3.1: Description of Variable and Sources of Data

Variable	Label	Description	Sources of Data
Foreign Direct Investment	FDI	Net FDI inflows (millions of dollars)	World Development Indicators (World Bank)
Inflation Rate	INF	Annual Percentage Change in Average Consumer Prices	World Economic Outlook Database (IMF)
Interest Rate	INT	Real Interest Rate (%)	World Development Indicators (World Bank)
Exchange Rate	EXC	Average Official Exchange Rate (BDT per US$)	World Development Indicators (World Bank)
External Debt	EXD	External Debt Stocks (Percentage of GNI)	World Development Indicators (World Bank)
Current Account Balance	CAB	Current Account Balance (Percentage of GDP)	World Economic Outlook Database (IMF)
Gross National Expenditure	GNE	Gross National Expenditure (% of GDP)	World Development Indicators (World Bank)
Air Transport	AIR	Air Transport (Registered Carrier Departures Worldwide)	World Development Indicators (World Bank)

3.4 Tabular and Graphical Presentation of Data

This section attempts to comprehend the patterns and trends of the series by presenting the data of the variables through tables and graphs. The possible relationship of each explanatory variable with the dependent variable is also highlighted here.

3.4.1 Foreign Direct Investment (FDI)

According to the World Investment Report 2020, global FDI flows increased slightly (3%) in 2019 after a sharp decline in 2017 and 2018. In 2019, FDI flows into developing Asia declined by 5%. Despite this decline, it remained the largest FDI recipient region, hosting more than 30% of global FDI flows. The largest five recipients were China, Hong Kong, China, Singapore, India, and Indonesia. 2019 is not a good year for Bangladesh either. According to Bangladesh Bank Survey Report 2019 (July-December), the net inflows of FDI in Bangladesh has come down to US$ 2873.95 million in 2019 compared to a record amount of US$ 3613.30 million in 2018. That is, the net FDI inflows decreased by US$ 739.35 million or 20.46% in 2019. While in 2018 net FDI inflows was increased by US$ 1461.74 million or 67.94% compared to 2017. However, the 2019 FDI data of Bangladesh contradicts the World Invest Report 2020 by UNCTAD (US$ 1597 million), giving an indication of misinformation.

Table 3.2: Net FDI Inflows (millions of dollars)

Year	Net FDI Inflows (millions of dollars)
1980	8.51
1981	5.36
1982	6.96
1983	0.4
1984	-0.55
1985	-6.66
1986	2.43
1987	3.21
1988	1.84
1989	0.25
1990	3.24
1991	1.39
1992	3.72
1993	14.05
1994	11.15
1995	1.9
1996	13.53
1997	139.38
1998	190.06
1999	179.66
2000	280.38
2001	78.53
2002	52.3
2003	268.29
2004	448.91
2005	760.5
2006	456.52
2007	651.03
2008	1328.42
2009	901.29
2010	1232.26
2011	1264.73
2012	1584.4
2013	2602.96
2014	2539.19
2015	2831.15
2016	2332.72
2017	2151.37
2018	2940.22

Among the foreign investors in Bangladesh, China stood at the leading position with the net inflow worth US$ 625.92 million during 2019. The United Kingdom secured the second position with an investment of US$ 416.14 million, followed by Singapore (US$ 272.07 million), United States (US$ 197.52 million), Norway (US$ 194.19 million), Netherlands (US$ 191.70 million), United Arab Emirates (US$ 153.25 million), Hong Kong (US$ 145.31 million), India (US$ 115.99 million), and Japan (US$ 72.33 million). Japan has recently started the process of shifting its investments from China to Bangladesh. The largest single FDI flow in Bangladesh was made in November 2018 when Japan Tobacco International (JTI) acquired Akij Group's tobacco business for US$1.47 billion (The Daily Star, November 30, 2018). Since Japan has made such a huge investment in Bangladesh, it reflects Japan's confidence in doing business in the country, which could further contribute to attracting the attention of other large foreign investors.

Although the net FDI inflows in Bangladesh has increased significantly in recent years (Figure 3.1), the numbers are not up to the mark in comparison to the regional contemporaries. The trend lines in Figure 3.2 show that neighboring India and Pakistan seem to be doing much better.

Figure 3.1: Trends of FDI Flows in Bangladesh

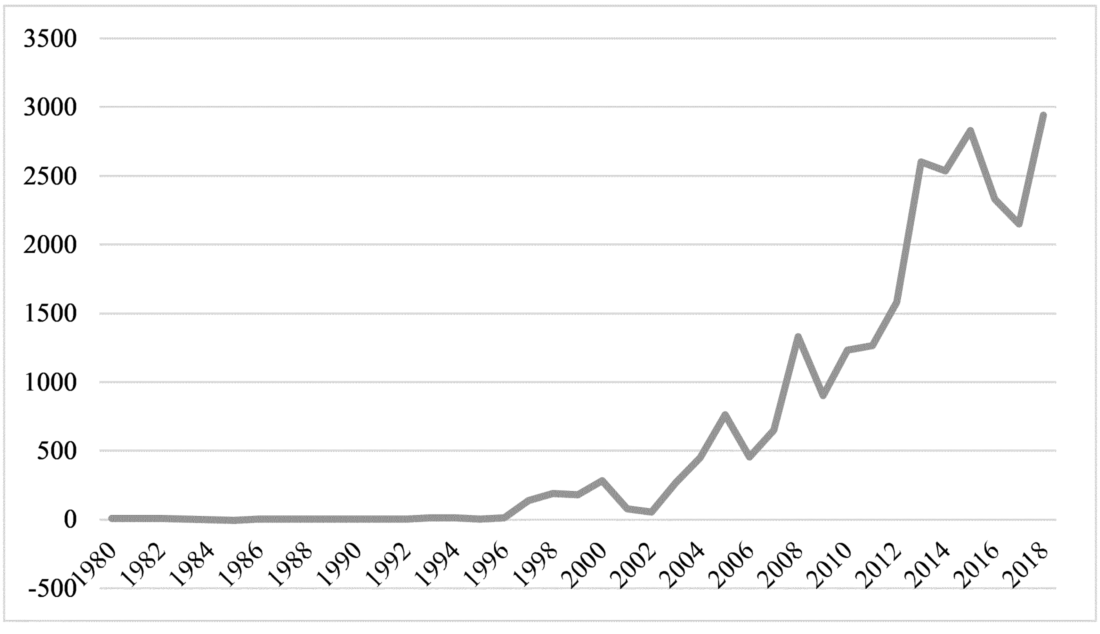
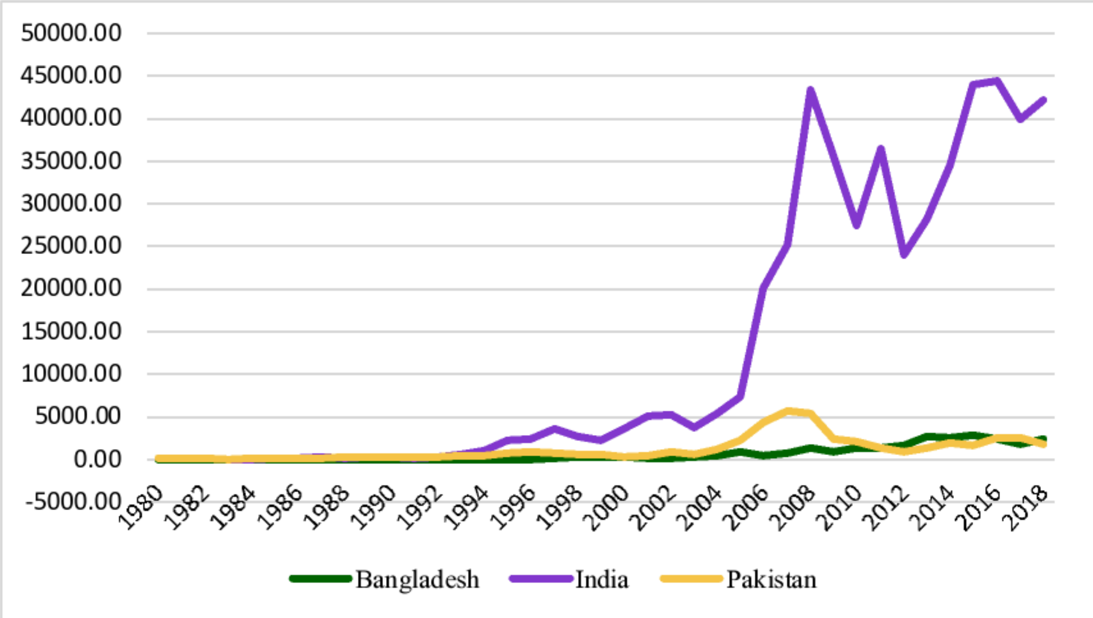


Figure 3.2: Trends of FDI Flows in Bangladesh, India and Pakistan



3.4.2 Inflation Rate

Inflation, a sustained rise in the general price level, is considered as one of the key indicators of macroeconomic stability in a country. Any form of instability introduce a form of uncertainty that distorts investor perception of the future profitability. Low inflation rate is taken to be an indication of domestic economic stability in the recipient country which encourages FDI. High inflation rate indicates inability of the government to adjust its budget and failure of the central bank to regulate proper monetary policy. So, a negative relationship between inflation rate and FDI inflows is expected. That is, the lower (higher) the inflation rate in the host country, the higher (lower) the FDI inflows.

Inflation is most commonly measured by the consumer price index (CPI). Precisely, it can be said that, the 1970s was an unstable period in the inflation history of Bangladesh. The 1980s was a bit stable with an average inflation rate more than 11%. Bangladesh experienced a moderate and more stable inflation rate in the 1990s with an average rate of 6.39%. The average inflation reduced to 5.63% in the 2000s.

Table 3.3: Annual Percentage Change in Average Consumer Prices (Base 2005)

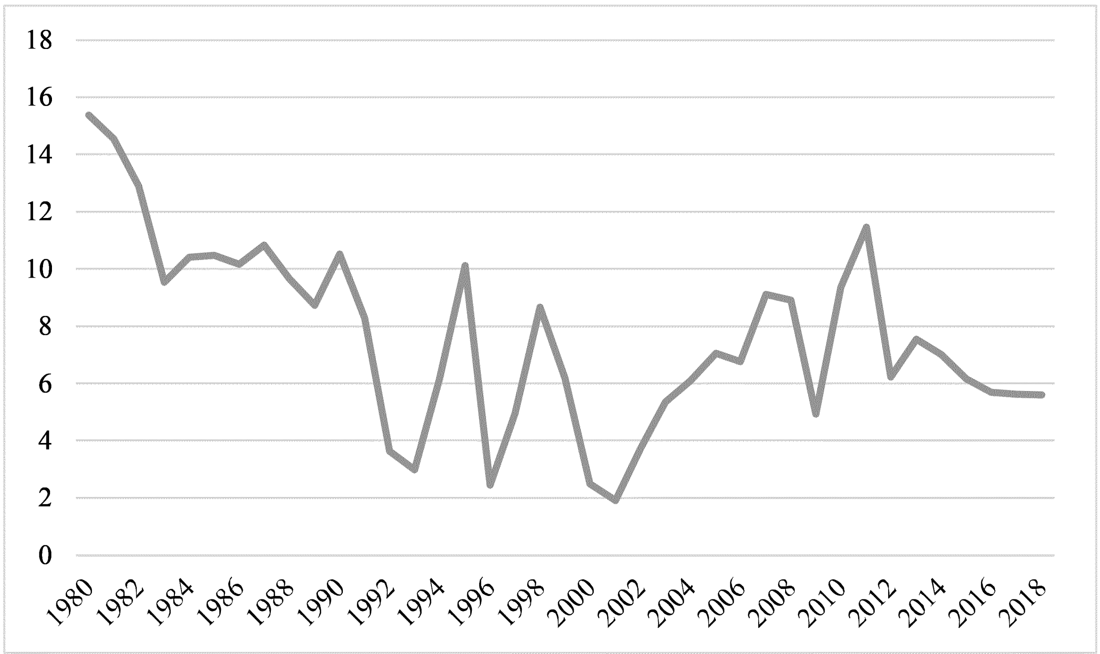
Year	Percentage Change in CPI
1980	15.385
1981	14.545
1982	12.875
1983	9.531
1984	10.414
1985	10.465
1986	10.175
1987	10.828
1988	9.674
1989	8.734
1990	10.522
1991	8.285
1992	3.624

Year	Percentage Change in CPI
1993	2.979
1994	6.150
1995	10.117
1996	2.455
1997	4.959
1998	8.648
1999	6.179
2000	2.483
2001	1.908
2002	3.719
2003	5.361
2004	6.103
2005	7.040

Year	Percentage Change in CPI
2006	6.770
2007	9.109
2008	8.900
2009	4.914
2010	9.365
2011	11.464
2012	6.229
2013	7.539
2014	7.009
2015	6.161
2016	5.678
2017	5.611
2018	5.608

Source: World Economic Outlook Database (IMF) updated on October 2019.

Figure 3.3: Trends of Inflation Rate in Bangladesh



In the current decade, from 2010 to 2018, the average inflation rate stood at 7.18%, which is significantly higher than the previous decade. In 2001, Bangladesh experienced the lowest inflation rate of only 1.91%. The rising rate of inflation in recent years has raised significant concern regarding its adverse effect on the economy. Figure 3.3 shows the trend line of average consumer prices (annual percentage change) which indicates the fluctuation of inflation rate in Bangladesh.

3.4.3 Interest Rate

An interest rate is the amount charged as a percentage of principal by the lender to the borrower for using his/her money or assets. Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator. It is a proxy for cost of capital. According to the neoclassical theory, a decrease in the interest rate reduces the cost of capital and stimulates investment. In contrast, Wijeweera and Mounter (2008) mention that higher interest rate in the host country provides unfavorable investment conditions for domestic companies and encourages foreign investors to source capital from their home country rather than from the host country. Moreover, having high interest rates in a country usually means that the central bank of that country is trying to deal with inflation which may induce a foreign investor to invest in that country. This study also expects a positive relationship between interest rate and FDI. That is, the higher (lower) the interest rate in the host country than in the home country, the higher (lower) the flow of FDI in the host country.

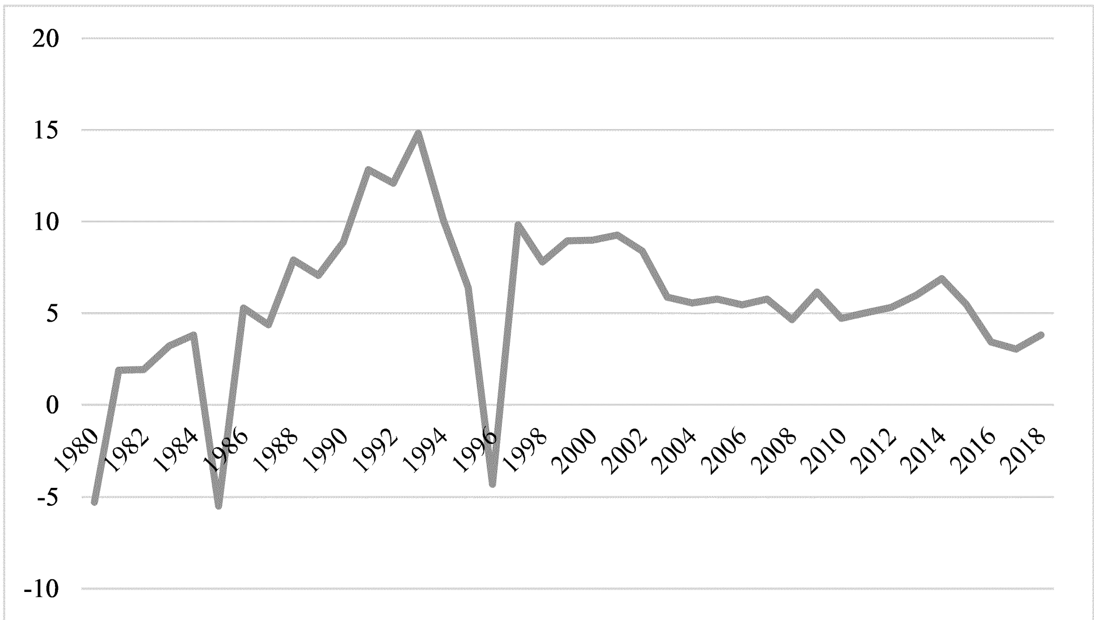
In the 1970s, the interest rates in Bangladesh were very unstable. It recorded both the highest and lowest interest rates of all time. The rate reached an all-time high of 34.76% in 1976 and a record low of -11.64% in 1978. Throughout the 1980s and 1990s, there was substantial fluctuation in the interest rates of Bangladesh. Interest rates have been relatively stable since 2003. The real interest rate in 2018 was approximately 3.84% which is much lower than the average rate of 6.01% for the period 1980-2018. The trend line in Figure 3.4 shows that real interest rate in Bangladesh was highly volatile during the period 1980 to 1997.

Table 3.4: Real Interest Rate (%)

Year	Real Interest Rate (%)	Year	Real Interest Rate (%)	Year	Real Interest Rate (%)
1980	-5.293	1993	14.821	2006	5.467
1981	1.916	1994	10.132	2007	5.789
1982	1.952	1995	6.398	2008	4.662
1983	3.237	1996	-4.317	2009	6.147
1984	3.823	1997	9.826	2010	4.736
1985	-5.481	1998	7.826	2011	5.064
1986	5.307	1999	8.979	2012	5.343
1987	4.392	2000	8.998	2013	5.989
1988	7.911	2001	9.257	2014	6.886
1989	7.072	2002	8.390	2015	5.513
1990	8.887	2003	5.884	2016	3.449
1991	12.837	2004	5.582	2017	3.069
1992	12.105	2005	5.764	2018	3.839

Source: World Development Indicators (World Bank) updated on December 2019.

Figure 3.4: Trends of Real Interest Rate in Bangladesh



3.4.4 Exchange Rate

In economics and finance, an exchange rate is defined as the price of one country's currency in terms of another country's currency. It represents how many units of a foreign currency a customer can purchase with one unit of their home currency. For instance, an inter-bank exchange rate of 80 Bangladeshi taka to the US dollar means that TK80 will be exchanged for each US$1 or US$1 will be exchanged for each TK80. In this case it is said that the price of a dollar in relation to taka is TK80, or equivalently that the price of a taka in relation to dollars is $1/80. A currency appreciates in respect of another when its value rises in terms of the other. The dollar appreciates with respect to taka if the TK/$ exchange rate rises. On the contrary, a currency depreciates with respect to another when its value falls in terms of the other. The dollar depreciates with respect to taka if the TK/$ exchange rate falls. Exchange rate fluctuations influence the value of the global investment portfolios, the international reserve value, and currency value of debt payments. With highly volatile exchange rate it is difficult to forecast costs and profits on FDI. Therefore, the exchange rate movement has a significant impact on the business cycle of a particular country's trade and capital flows.

Exchange rate is often cited as a critical determinant of FDI. It is generally believed that a depreciation (an increase in the exchange rate) in the currency of one country encourages FDI flows into that country by reducing the cost of international investment and by increasing return on foreign investment. Hence, we expect a positive effect of exchange rate on inward FDI. That is, the depreciation (appreciation) of the host country's currency relative to the home country's currency will induce (reduce) FDI flows into the host country.

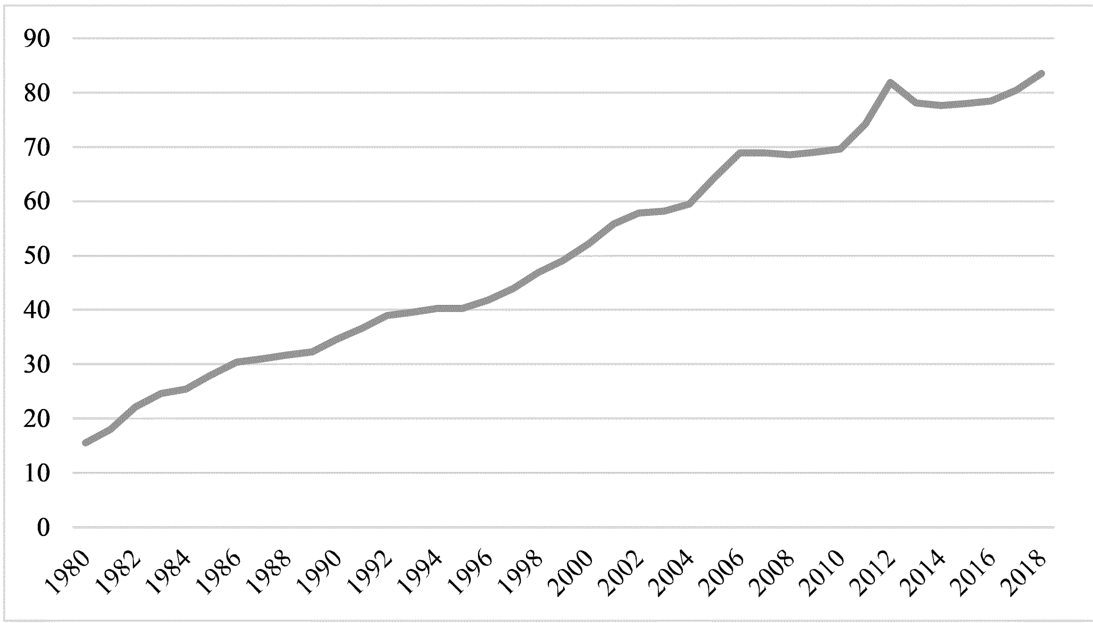
Different countries adopt different exchange rate policies. Bangladesh followed a fixed exchange rate system till 1979. From 1979 to mid-2003, it followed a managed floating exchange rate system. Since May 2003, Bangladesh adopted almost a new policy known as the 'clean floating' exchange rate policy by creating fully convertible current account.

Table 3.5: Average Official Exchange Rate (BDT per US$)

Year	Average Exchange Rate	Year	Average Exchange Rate	Year	Average Exchange Rate
1980	15.454	1993	39.567	2006	68.933
1981	17.987	1994	40.212	2007	68.875
1982	22.118	1995	40.278	2008	68.598
1983	24.615	1996	41.794	2009	69.039
1984	25.354	1997	43.892	2010	69.649
1985	27.995	1998	46.906	2011	74.152
1986	30.407	1999	49.085	2012	81.863
1987	30.950	2000	52.142	2013	78.103
1988	31.733	2001	55.807	2014	77.641
1989	32.270	2002	57.888	2015	77.947
1990	34.569	2003	58.150	2016	78.468
1991	36.596	2004	59.513	2017	80.438
1992	38.951	2005	64.327	2018	83.466

Source: World Development Indicators (World Bank) updated on December 2019.

Figure 3.5: Trends of Exchange Rate in Bangladesh



Before 1983, the currency of Bangladesh (Taka) was linked to British Pound Sterling. After independence, Bangladesh fixed the value of Taka with Pound Sterling on March 3, 1972. The official exchange rate of Bangladesh shows that the average value of taka per US dollar during the period 1971-2018 was 43.77 with a minimum of 7.7 in 1972 and a maximum of 83.47 in 2018. The upward sloping trend line of average official exchange rate of Bangladesh as shown in figure 3.5 indicates continuous depreciation of Bangladeshi taka against US dollar.

3.4.5 External Debt

External debt is the segment of a country's total debt that was borrowed from foreign lenders, including governments, commercial banks, or international monetary organizations. The Grey Book defines gross external debt as the amount, at any given time, of disbursed and outstanding contractual liabilities of residents of a country to nonresidents to repay principal, with or without interest, or to pay interest, with or without principal (IMF, 2003). It has both positive and negative effects on the economy. Though external debt creates a pressure on the economy, it is a vital source of financing government budget deficit. Proper utilization of public debt can promote economic growth and develop social welfare of the citizen. Yet, it is expected that public debt would be negatively related to FDI inflows. According to Azam and Khan (2011), debt burden implies the poor economic condition of a country which indicates a comparatively unfavorable atmosphere for foreign investment. Therefore, our hypothesis in this case, the more a country is burdened with foreign debt, the less the flow of FDI will be.

According to the data of Economic Relations Division (Ministry of Finance, Bangladesh), external debt in Bangladesh has reached to $33.51 billion in June 2018 from $28.34 billion in the previous year.

Table 3.6: External Debt Stocks (% of GNI)

Year	External Debt Stocks	Year	External Debt Stocks	Year	External Debt Stocks
1980	20.941	1993	41.460	2006	26.575
1981	20.443	1994	44.482	2007	25.466
1982	26.213	1995	40.246	2008	23.720
1983	29.500	1996	31.835	2009	22.999
1984	28.488	1997	28.738	2010	21.571
1985	28.824	1998	30.166	2011	19.649
1986	35.644	1999	31.135	2012	19.745
1987	39.160	2000	28.316	2013	19.648
1988	37.801	2001	26.930	2014	17.899
1989	36.375	2002	29.328	2015	17.478
1990	38.133	2003	29.469	2016	16.579
1991	41.108	2004	29.027	2017	18.106
1992	41.344	2005	25.518	2018	18.192

Source: World Development Indicators (World Bank) updated on December 2019.

Figure 3.6: Trends of External Debt in Bangladesh

Since independence, the country's foreign borrowing has been $51.83 billion till June, 2018. The government has repaid only $22.71 billion among which $16.84 billion is the principal amount and $5.87 billion is the interest. Hence the outstanding debt (principal) stood at $34.99 billion till June, 2018. As a result, the pressure of repayment is increasing over time. Figure 3.6 indicates that the external debt stock shows an upward trend till 1994 and then it goes downwards.

3.4.6 Current Account Balance

The current account is a record of a country's exports and imports of goods and services and international transfers of capital within a particular period of time (e.g., a year). It is one of the three main categories of balance of payment (BOP), the other two being the financial account and the capital account. The financial account is the record of increases or decreases in international ownership of assets while the capital account records the inflows and outflows of capital that directly influence the assets and liabilities of a country. Due to the fact that one of these three parts is more or less, there may be a surplus or deficit in the balance of payment. A surplus in BOP occurs when a country exports more commodities, services and capital than it imports. On the other hand, a deficit in BOP means that a country imports more than it exports. According to Lokesha and Leelavathy, a huge deficit in the balance of payment suggests that the country is living beyond its means. As indicated by Amir and Mehmood (2012), if FDI is concentrated in export promotion industries, it will increase exports of the host country which will improve BOP situation. Since foreign investor has to import capital and intermediate goods and services, FDI inflows tend to increase the imports of the host country which will deteriorate BOP of that country. This study assumes a positive relationship between current account balance and FDI. That is, Favorable current account balance will induce FDI flow in a country.

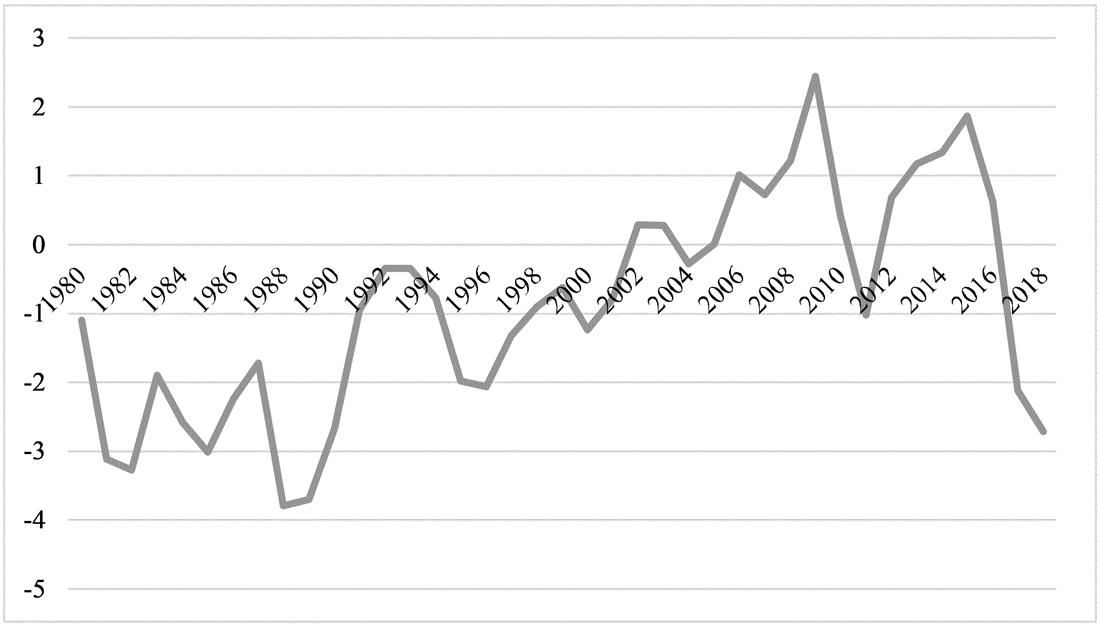
Bangladesh has been experiencing deficit in the current account balance since independence. In 2002, a surplus was seen for the first time. After several years of surplus, the current balance has seen a deficit again in 2017. The trend line of current account balance in Bangladesh is shown in Figure 3.7. It shows that most of the time the trend line is under the horizontal axis.

Table 3.7: Current Account Balance (% of GDP)

Year	Current Account Balance
1980	-1.099
1981	-3.119
1982	-3.275
1983	-1.896
1984	-2.586
1985	-3.017
1986	-2.241
1987	-1.724
1988	-3.792
1989	-3.706
1990	-2.672
1991	-0.948
1992	-0.345
1993	-0.345
1994	-0.776
1995	-1.982
1996	-2.069
1997	-1.322
1998	-0.905
1999	-0.624
2000	-1.241
2001	-0.786
2002	0.290
2003	0.278
2004	-0.278
2005	0.011
2006	1.009
2007	0.721
2008	1.217
2009	2.445
2010	0.415
2011	-1.020
2012	0.685
2013	1.176
2014	1.331
2015	1.861
2016	0.622
2017	-2.120
2018	-2.718

Source: World Economic Outlook Database (IMF) updated on October 2019.

Figure 3.7: Trends of Current Account Balance in Bangladesh



3.4.7 Gross National Expenditure

Gross national expenditure (formerly domestic absorption) is the sum of household final consumption expenditure, general government final consumption expenditure, and gross capital formation. OECD defines household final consumption expenditure (formerly private consumption) as the amount of expenditure made by resident households to meet their everyday needs, such as food, clothing, housing, energy, health costs, transport, leisure, durable goods, and miscellaneous services. General government final consumption expenditure (formerly general government consumption) means expenditure by the government in purchasing goods and services (including compensation of employees) for individual as well as collective consumption. It also incorporates a large portion of the national defense and security spending, but excludes government military spending which is a part of government capital formation. Gross capital formation (formerly gross domestic investment) is a term used to explain the net capital accumulation by a country during a particular period of time. It can be defined as the additions to fixed assets plus the net changes in inventories. Fixed assets consist of machinery, plant, equipment, and buildings, which are used to produce goods and services. Inventory contains raw materials and products available for sale.

All the three components of gross national expenditure play an important role in determining FDI flow in a country. The mixed relationship of FDI with the three parts of gross national expenditure is noticeable in the literature. However, this study expects a negative relationship between gross national expenditure and FDI. That is, the higher (lower) the gross national expenditure of a country, the lower (higher) the FDI inflows.

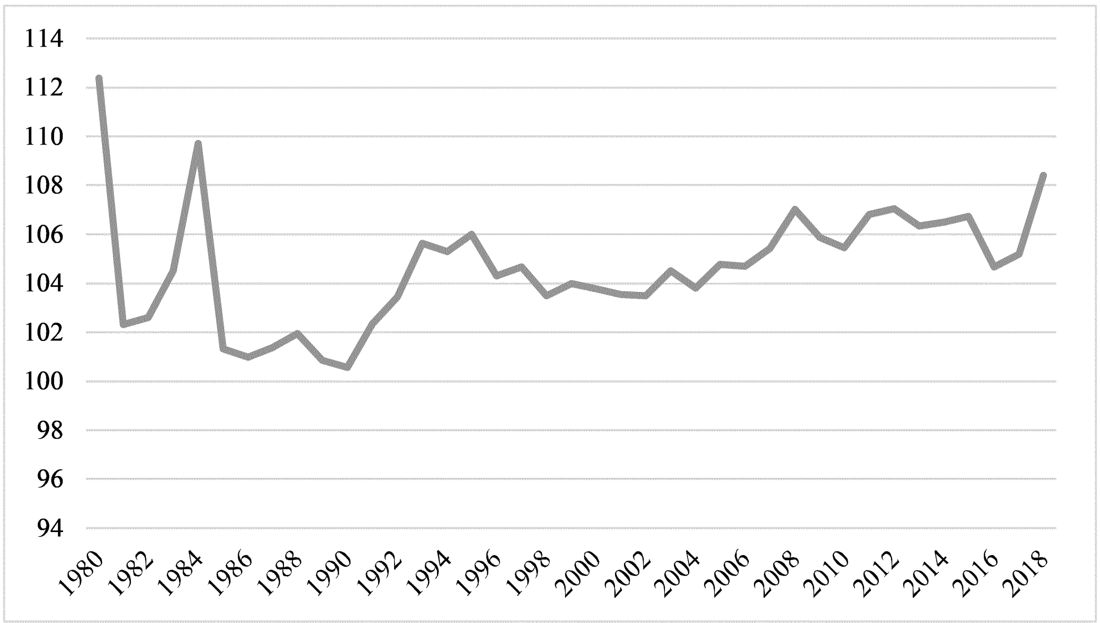
Gross national expenditure (as percentage of GDP) in Bangladesh was reported at 108.40% in 2018, according to the data of World Bank development indicators. The average value during the period 1980-2018 was 104.66% with a minimum of 100.56% in 1990 and a maximum of 112.39% in 1980. Figure 3.8 shows the trend of gross national expenditure of Bangladesh for the period 1980-2018.

Table 3.8: Gross National Expenditure (% of GDP)

Year	Gross National Expenditure	Year	Gross National Expenditure	Year	Gross National Expenditure
1980	112.389	1993	105.648	2006	104.708
1981	102.317	1994	105.299	2007	105.431
1982	102.582	1995	105.993	2008	107.013
1983	104.514	1996	104.310	2009	105.874
1984	109.707	1997	104.676	2010	105.437
1985	101.317	1998	103.486	2011	106.799
1986	100.965	1999	103.994	2012	107.039
1987	101.375	2000	103.790	2013	106.354
1988	101.957	2001	103.543	2014	106.488
1989	100.838	2002	103.502	2015	106.728
1990	100.552	2003	104.494	2016	104.675
1991	102.323	2004	103.804	2017	105.181
1992	103.441	2005	104.775	2018	108.400

Source: World Development Indicators (World Bank) updated on December 2019.

Figure 3.8: Trends of Gross National Expenditure in Bangladesh



3.4.8 Air Transport

Transportation plays a vital role in international trade. There are usually four types of transport systems used for carrying people or goods from one place to another – road transport, rail transport, sea transport, and air transport. Each type has some advantages and disadvantages. It is extremely essential to comprehend and know what sort of transportation is cost effective and proficient. There are several factors that affect a company's decision on the selection of the mode of transport. Destination country, type of goods, value of goods, transportation cost, time, safety, availability, reliability, and service regularity are the main issues usually considered while taking decision on which type of transport to use. According to Sahoo et al. (2014), labor costs may be lower in a country, but it would be a negative aspect if the transportation cost to get the item to the global market is high. Sellner & Nag (2010) concluded that air accessibility has positive effect on GDP as well as investment growth. Several studies reveal the fact that transportation facilities significantly affect foreign investments. The findings of Khadaroo & Seetanah (2009), Saidi & Hammami (2011), and Pradhan et al. (2013) indicate that better transport infrastructure attracts more FDI in the host country.

In this study, air transport (domestic takeoffs and takeoffs abroad of air carriers registered in the country) is taken as a proxy for transport facilities in the host country. Tiwari et al. (2018) mention that air transport is one of the fastest modes of public transport that permits inhabitants of various countries to cross international borders and travel to other countries for personal, business, medical, and tourism purposes. According to an analytical report by International Air Transport Association (IATA), a major economic flow, invigorated by superior air transport associations, is foreign direct investment, generating productive resources that will ensure a long-term flow of GDP. Doeringer et al. (2004) note that the presence of an international airport affects the location choices of both multinational and domestic plants. Our hypothesis in this case is: the greater the transport facilities of a country, the higher the flow of FDI.

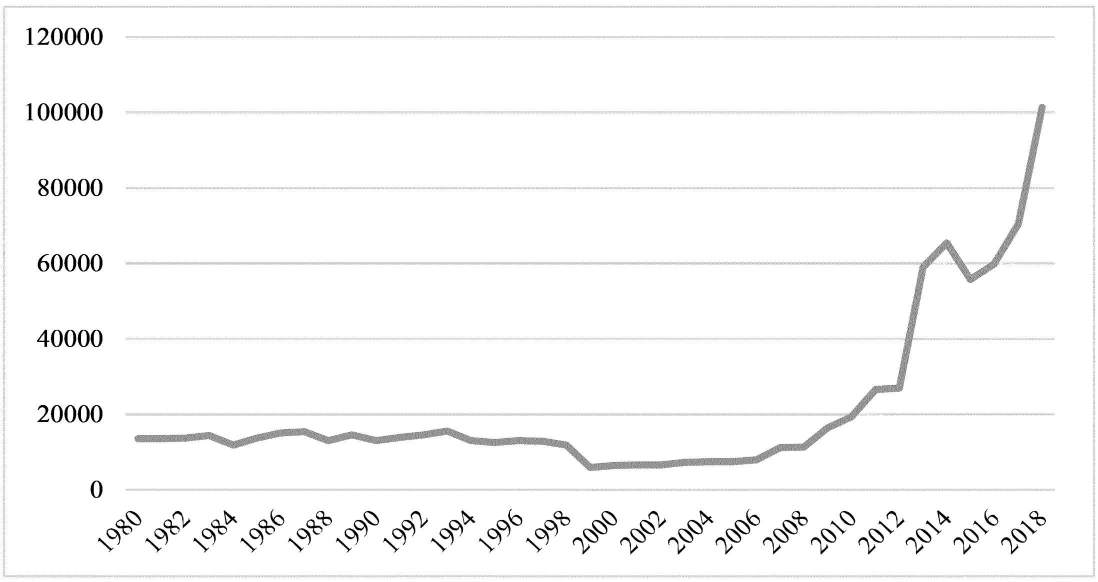
Figure 3.9 shows that the trend line of air transport is fairly stable from 1980 to 1998, then goes down a bit and remains stable till 2006. The upward trend is observed since 2007.

Table 3.9: Air Transport (Registered Carrier Departures Worldwide)

Year	Air Transport	Year	Air Transport	Year	Air Transport
1980	13500	1993	15600	2006	7971
1981	13400	1994	13000	2007	11139
1982	13700	1995	12600	2008	11308
1983	14300	1996	13100	2009	16399
1984	11800	1997	12800	2010	19300
1985	13600	1998	11900	2011	26535
1986	15000	1999	5900	2012	26996
1987	15400	2000	6313	2013	59064
1988	13100	2001	6486	2014	65364
1989	14600	2002	6464	2015	55864
1990	13000	2003	7165	2016	59728
1991	13800	2004	7403	2017	70503
1992	14600	2005	7399	2018	101384

Source: World Development Indicators (World Bank) updated on December 2019.

Figure 3.9: Trends of Air Transport in Bangladesh



3.5 Descriptive Statistics

The summary statistics of the variables are presented in Table 6.1. It is notable that the mean and median values of all other variables except FDI and air transport are very close and the standard deviation is also very small which indicates possible extreme values in the distribution of FDI and air transport. These two distributions are also highly skewed. The skewness also indicates that the distributions of interest rate and gross national expenditure are moderately skewed while the distributions of inflation rate, exchange rate, external debt, and current account balance are approximately symmetric. The kurtosis implies that the distributions of FDI, interest rate, gross national expenditure, and air transport are leptokurtic (peaked curve) whereas the distributions of inflation rate, exchange rate, external debt, and current account balance are platykurtic (flatted curve). The p-values of Jarque-Bera test statistic for FDI, interest rate, gross national expenditure, and air transport are significant meaning that these series are not normally distributed. On the other hand, the p-values of Jarque-Bera statistic for inflation rate, exchange rate, external debt, and current account balance indicate that these series are normally distributed.

Table 3.10: Descriptive Statistics (Original Variables)

Measures	FDI	INF	INT	EXC	EXD	CAB	GNE	AIR
Mean	648.333	7.629	5.696	51.17	28.42	-0.886	104.66	21473.96
Median	139.380	7.040	5.764	49.09	28.49	-0.905	104.68	13500.00
Maximum	2940.22	15.39	14.82	83.47	44.48	2.445	112.39	101383.5
Minimum	-6.66000	1.908	-5.481	15.45	16.58	-3.792	100.55	5900.000
Std. Dev.	937.881	3.234	4.234	20.58	7.933	1.611	2.4538	21745.84
Skewness	1.32607	0.302	-0.758	0.025	0.336	0.027	0.7123	2.140873
Kurtosis	3.33128	2.708	4.479	1.692	2.065	2.141	4.1783	6.796459
Jarque-Bera	11.6084	0.730	7.291	2.785	2.153	1.203	5.5542	53.21299
Prob. (JB)	0.00302	0.694	0.026	0.248	0.341	0.548	0.0622	0.000000

3.6 Conclusion

This Chapter presents the data and trends of net FDI inflows, average consumer prices (annual %), real interest rate (%), average official exchange rate (BDT per US$), external debt stocks (% of GNI), current account balance (% of GDP), gross national expenditure (% of GDP), and air transport (registered carrier departures worldwide) in Bangladesh over the period from 1980 to 2018. We find that before 1993, the flow of FDI in Bangladesh was very low, even in 1984 and 1985 it was negative. Compared to neighboring countries, FDI flows in India were much higher than in Bangladesh throughout the whole period, and the same picture can be seen for Pakistan except for a few years. The trend of average consumer prices indicates a massive rise and fall of inflation in Bangladesh, while the trend of real interest rate implies that interest rates in Bangladesh have been relatively stable since 1997. From the trend of average official exchange rate, it is obvious that the exchange rate of Bangladesh is moving upwards at a balanced pace. Til 1994, the amount of external debt in Bangladesh was going up. The good news is that the downward trend has continued since 1995. The trend of current account balance shows that there has been a fair surplus in the current account of Bangladesh since 2002 except for one or two years, although there has been a deficit again since 2017. Some stability is observed in the trend line of gross national expenditure of Bangladesh since 1993 while an upward trend is noticed in air transport since 2007.

The economy of a country is governed by the joint operations of numerous macroeconomic variables. Therefore, the more variables are included in a study, the more reliable the results of the study will be. However, due to various limitations it is not possible to include all the variables of interest in the study. A number of other factors are dropped from the list of investigation due to a variety of reasons: unavailability of data, similarity with other variables, and multicollinearity concerns. If it were possible to include those variables in our current study, the relationship of some more variables with FDI would be known.

Chapter 4

Theoretical Issues and Model Specification

4.1 Introduction

A theory is a scientifically acceptable principle that is intended to explain something. A theory does not merely describe or predict something, but rather explains why something happens. According to Mikkelson (2005), theories give us concepts, provide basic assumption, direct us to the important questions and suggest ways for us to sense of data. This study dealing with the relationship of FDI inflows with inflation rate, interest rate, and exchange rate is based on some existing theories regarding FDI and its determinants and multinational enterprises (MNEs). This chapter provides an overview of these theories and explains the conceptual framework for the linkage of inflation rate, interest rate, and exchange rate with FDI. The research model has also been specified in this chapter.

The remainder of the current Chapter is organized as follows: Section 4.2 discusses various theories and hypothesis on FDI, its determinants and MNEs, Section 4.3 presents a conceptual framework for the relationship of inflation rate, interest rate, and exchange rate with FDI, Section 4.4 formulates the research model, and Section 4.5 concludes the Chapter.

4.2 FDI Theories and Hypotheses

Numbers of theories and hypotheses have been adopted and explained by the researchers to explain the determinants of foreign direct investment. Among them, Vernon's (1966) product cycle theory, Buckley and Casson's (1976) internalization theory, Dunning's (1977) eclectic paradigm theory, Dunning and Lundan's (2008) motive-based theory are notable. But due to so many explanations and complexities of FDI, no single theory can be accepted as a general theory.

4.2.1 The Product Life Cycle Theory

In response to the failure of the Heckscher-Ohlin model to explain the perceived pattern of international trade, Raymond Vernon developed the product life cycle theory in 1966. This theory was first used after World War II to explain certain types of FDI made by some U.S. companies in the manufacturing industry of Western Europe. According to Vernon, a product goes through a life cycle of four stages from its invention to demise or removal from the market due to lack of demand: introduction, growth, maturity and decline. Vernon's product life-cycle hypothesis propose that foreign companies are involved in FDI at a certain stage of a product's life-cycle.

Stage 1: Introduction

New and Innovative products are introduced by a developed country to meet the local needs, and the surplus amounts are exported to other developed countries i.e. countries with analogous incomes, needs, and preferences. Since the customers are unaware about the product, producers promote the new product to stimulate sales. At this early stage of production, there are only a couple of contenders, profits are little and the items are not so standardized. The main goal of this stage is to build the demand for the product and hand it over to the customers. When more units of the product are sold, it automatically enters the following stage.

Stage 2: Growth

At this stage, the demand for the manufactured goods goes up and the sales increase at an increasing rate. As a result, production costs are reduced and profits become higher. Due to attractive profits, other companies enter the market with their own version of the product. Typically, they offer products at much lower selling prices. To attract customers, the company that introduced the original product reduces the price of the product and increases its promotional spending. At the end of the growth stage, sales begin to increase at a decreasing rate, and as a result, profits begin to decline.

Stage 3: Maturity

At the maturity stage, the product gradually becomes standardized and mass production begins, less skilled labor is needed and capital becomes more important. Competition becomes intense. Several competitors come forward to challenge the product, some of which may offer a higher quality version of the product at a lower price. To maintain market share and continue selling, the original producer may reduce prices. Sales increase at a decreasing rate. For a certain period of time, sales may remain stable. This level is called the saturation. Profits start to decline. Marginal producers are forced to leave the market. To entice non-customers and existing customers, each producer focuses on product enhancement and improvement. Since customers are now familiar with the product, the promotional spending will be lower than at the previous stage. The maturity stage is on average the longest of the four stages, and it is not unusual for a product to remain in this stage for decades. The maturity stage can be divided into three phases:

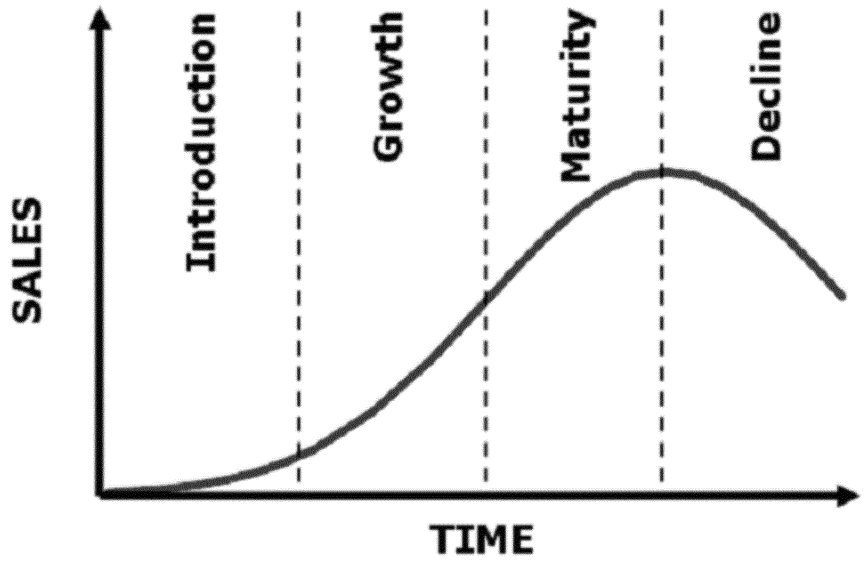
- Growing maturity: Sales grow at a declining rate.
- Stable maturity: Sales remain stable (saturation).
- Declining maturity: Sales start to decline.

Stage 4: Decline

The final stage begins when sales start to decline after a period of stable growth in the maturity stage. At this stage, the product becomes standardized and familiar to the customers, and the production process is well known to producers. There is a minimal profit or even a slight loss. Promotional costs are reduced to realize a small profit. Most sellers leave the market. This stage is faced only by those who survived in the maturity stage. In this situation, the production of the item may be stopped, or it may be offered to another organization. Production may be transferred to developing countries. Labor costs play a vital role in this case, and the developed countries are busy introducing other products. The trade pattern indiactes that the genuine producer and other developed countries have now began to import the item from developing countries.

Accordingly, this theory seems to indicate that market size, trade openness and production costs are the key determining factors of FDI. (Valli and Masih, 2014).

Figure 4.1: Stages of Product Life Cycle Theory



Source: Adapted from Levitt (1965)

4.2.2 The Internalization Theory

The theory of internalization was initially launched by Coase in 1937 and then developed by Buckley and Casson in 1976, Casson in 1979, Rugman in 1981, and Hennart in 1982. The theory concentrates on imperfections in the intermediate product markets in terms of knowledge. This theory attempts to explicate the expansion of multinational enterprises (MNEs) and their stimulus for attaining foreign direct investment (FDI). According to this theory, FDI occurs only when the convenience of utilizing firm-specific advantages surpasses the comparative costs of operations abroad.

Internalization means reducing or eliminating the cost of external transactions by increasing transactions within the subsidiaries. It refers to the activity in which a multinational enterprise (MNE) brings its globally dispersed foreign operations under a common ownership and control. This happens either because there is no market for the intermediate products required by multinational enterprises (MNEs) or because the external market for such products is inefficient. A firm involved in research and development (R&D) may build up a brand new equipment or procedure or inputs. It could be tough to move this innovation or offer the inputs to other irrelevant firms on the ground that those firms may discover the transaction costs to be excessively high. Confronted with this circumstance, a firm may decide to internalize by utilizing backward and forward incorporation, that is, the product of one auxiliary can be utilized as an input of another, or innovation created by one auxiliary may be used in others. When internalization includes operations in various countries, it without doubt implies FDI.

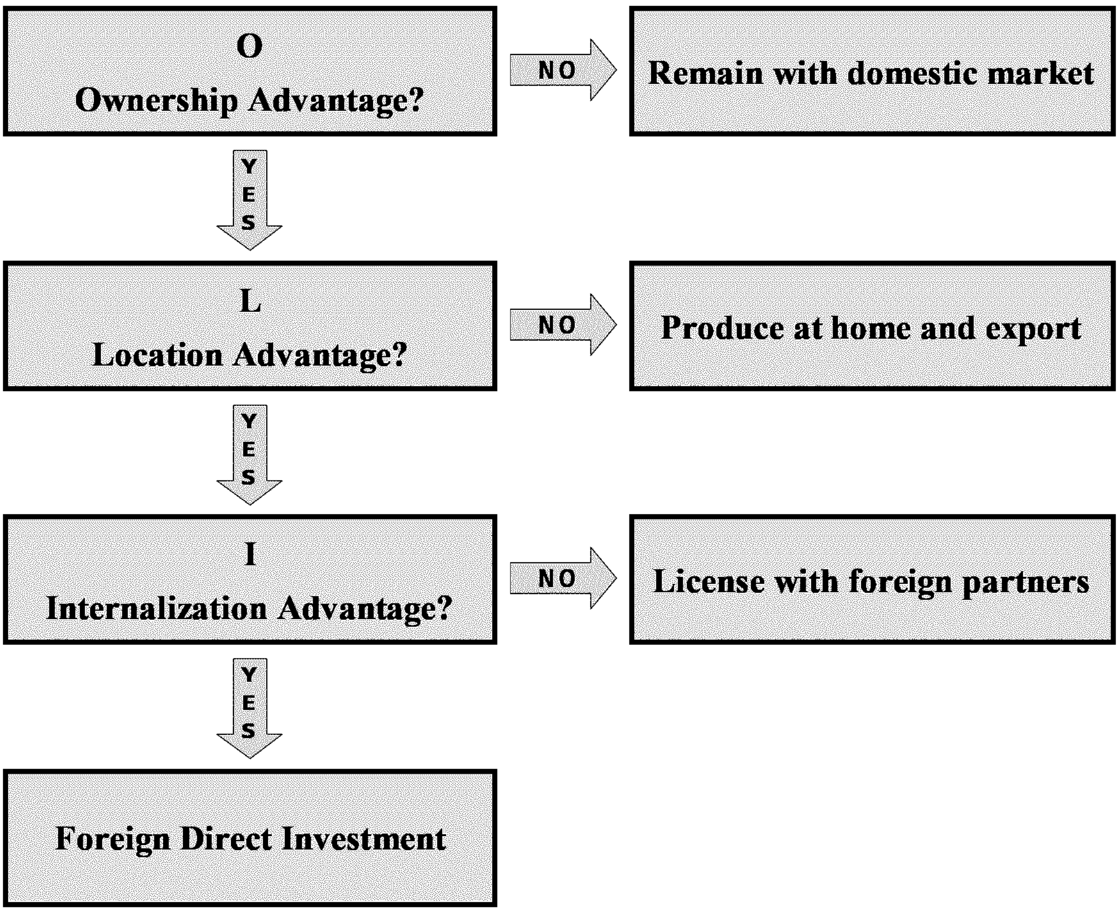
When internalization motivates FDI, the company may face political and commercial hazards due to its unfamiliarity with the foreign environment. These are known as 'costs of doing business abroad'. When such costs are high, a company may license or outsource production to an individual firm, or it may produce at home and export to other countries instead. Thus, in view of this theory, technological innovation and transaction cost seem to be important factors of FDI.

4.2.3 The Eclectic Paradigm Theory

One of the most widely used theories to explain FDI is the eclectic paradigm theory developed by John H. Dunning in 1977. According to this theory, three conditions should be fulfilled for a firm to be involved in FDI – Ownership advantages (O), Location advantages (L), and Internalization advantages (I), the combination of which is later known as the 'OLI-framework'. The principle idea of eclectic paradigm theory is the integration of three different theories of foreign direct investments namely location theory, industrial organization theory, and internalization theory into a common framework. The theory is based on the postulation that when internal transactions bear lower costs, companies will avoid open market transactions.

Ownership advantages refer to the competitive advantages of the entrepreneurs trying to get involved in direct foreign investment. These advantages include specific types of knowledge and benefits that a firm owns and are not obtainable to its rival. These are the net competitive advantages of the firm which emerge because of the imperfections in product and factor market. For example, copyright, trademark or patent rights, branding, production technique, entrepreneurial skills, returns to scale etc. The higher the competitive advantages of investing firms, the more likely they are to be engaged in overseas production. Companies consider most ownership advantages intangible.

Figure 4.2: FDI Decision based on OLI Framework



Source: Adapted from Sudarsanam (2003) and Welch et al. (2007).

Location advantages allude to particular types of facilities that a firm appreciates in light of the fact that it operates its manufacturing activities in a specific territory. These advantages may simply be geographical or due to the presence of inexpensive raw materials, skilled workforces, low wages, relative inflation levels, or special taxes and tariffs.

Internalization is the level of proprietorship and control. According to Buckley & Casson (1976), internalization advantages refer to the capability of a firm to internalize the knowledge-intensive intermediate commodity markets like machinery, manufacturing skill, or brand (Gaur et al., 2019). The internalization advantage states that global extension of a firm must have an advantage. It is easier for a firm to care for its assets and retain complete control over the process by producing inside the firm, instead of offering license to an external firm. The more the net advantage of internalization of the cross-border intermediate commodity markets, the more probable a firm would like to take part in overseas production itself rather than licensing the right to do so. Therefore, the 'eclectic paradigm theory' points out several potential determinants of FDI, including government incentives, market size, wage rate, inflation and accessibility of raw materials.

4.2.4 Motive-based Theory

According to Dunning and Lundan (2008), there are basically four types of FDI such as resource seeking, market seeking, efficiency seeking, and strategic asset seeking (Dunning and Lundan, 2008).

Resource Seeking FDI

It is a sort of FDI that is made to attain specific assets which are not available at home country or are available at a lower cost with respect to the home country. There are three types of resource seekers:

1. Looking for physical resources such as industrial minerals, mineral fuels, metals, raw materials, agricultural products, etc.
2. Looking for human resources such as cheap and well-motivated unskilled or semi-skilled labor.
3. Looking for innovative resources such as administrative, technological or organizational skills.

Market Seeking FDI

It is a sort of FDI that is made to find out new and growing markets for products. The principal aim of 'market-seeking' FDI is to invest outside the country in order to make profit from overseas markets implying that commodities are produced in the recipient country and sold in the market of domestic country. The relative size of the host country's market and its relative level of income play a vital role in stimulating this kind of FDI. As a result, factors like labor cost and inflation become essential features for market-seeking FDI in the host countries. (Valli and Masih, 2014).

Efficiency Seeking FDI

Efficiency Seeking FDI aims at minimizing the cost related to the factors of production at the global level. In this case, the investing firm seeks to benefit from factors that enable it to compete in international markets. The firm can gain the advantages of the economies of scale and the opportunity of risk diversification from the common control of globally scattered activities. The purpose of the efficiency seeking FDI is to take advantage of various factor endowments, market structures, demand patterns, institutional arrangements, economic policies and cultures.

Strategic Asset Seeking FDI

In this case, FDI aims at acquiring a new technological base rather than exploiting the existing resources. It is frequently done through consolidation or acquisition of foreign companies' assets as a competitive power in a new market, or by setting up a greenfield subsidiary or provide with cluster to acquire the knowledge of agglomeration economies. The main goal of strategic asset seeking FDI is to expand the company's worldwide portfolio with physical assets (such as equipment, human skills etc.) and intangible assets (such as brands) in order to increase its ownership-specific benefits, or deteriorate rivals' position.

4.2.5 Kojima's Theory of FDI Outflows

Kojima (1973, 1975, 1985) developed this theory regarding outflows of FDI from Japan. He considers direct investment as a way to transfer capital, technology, and managerial skills from home country to host country. He contended that the incapability of domestic firms to compete internally in Japan forced them to seek investment scope outside the country. He expressed the view that highly productive local firms were driving the less skilled firms out of the domestic market. Consequently, the more vulnerable firms were going abroad, particularly to other developing nations. Notwithstanding, Kojima's hypothesis failed to clarify the increase of business operations in global markets by locally skilled firms.

4.2.6 Modern Portfolio Theory

Modern portfolio theory (MPT), developed by Harry Markowitz in 1952, is concerned with risk and return. According to this theory, investors try to take the minimum risk in order to capture the maximum return for a given portfolio investment. This theory assumes that investors are risk averse, which means that if two portfolios offer the same expected return, investors will favor the less risky one. Thus, an investor will combat increased risk as long as compensated by higher expected returns. On the contrary, an investor who desires higher expected returns will have to take more risks.

MPT suggests that it is feasible to build an "efficient limit" of optimal portfolios, offering the utmost possible expected return for a particular level of risk. MPT shows that an investor can construct a portfolio of manifold assets which will maximize returns for a certain level of risk. Similarly, with a desired level of expected returns, an investor can build a portfolio with the minimum possible risk. MPT appraises the advantages of diversification, also referred to as 'not putting all the eggs in one basket'. Though MPT is one of the most prominent and influential economic theories working on finance and investment, the theory explains the acquisition of foreign investments in a portfolio, but could not explain the direct investments.

4.2.7 Strength of Currency Theory

Aliber (1970) presents a hypothesis that seeks to explicate FDI in terms of the relative strength of different currencies. The hypothesis predicates that firms in a country with a strong currency tend to invest abroad, while firms in a country with a weak currency do not have such a trend. To put it another way, countries that have strong currencies tend to be the sources of FDI, while countries where the currency is weak tend to be the recipients of FDI or host countries. This hypothesis is established on capital market connections, foreign exchange risks, and market's inclination for holding assets subjugated in strong currencies. Aliber tested this hypothesis and found the results compatible with FDI in the U.S., the U.K., and Canada. Although Aliber’s theory has received extensive support, the theory does not present any clarification for investment between two developed countries that have currencies of equal strength. Even, the theory cannot explain the investment of a developing country's (weaker currency) firm in a developed country (stronger currency).

On the same ground, Cushman (1985) showed that increase in the real exchange rate encouraged FDI made by U.S. dollar, while the appreciation of foreign currency decreased FDI in American. Cushman concluded that the appreciation of dollar led to a reduction in U.S. FDI by 25%. So, according to this theory, exchange rate is an important determinant of FDI.

4.2.8 Differential Rates of Return Hypothesis

The theory of differential rates of return is one of the primary attempts to explain FDI flows into a country. The key thought of this hypothesis is that foreign capital streams from countries with low rates of return towards countries with higher rates of return. The fundamental principle of this hypothesis is that firms considering FDI act in such a manner that marginal return on capital is equivalent to its marginal cost (Moosa, 2002). The hypothesis explicitly presumes risk impartiality, making the rate of return the sole factor upon which the FDI decision depends. Most of the empirical studies conducted to test this hypothesis failed to provide strong supporting evidence.

4.2.9 The Market Size Hypothesis

The market size hypothesis expounds the quantity and direction of FDI based on market size of the host country. In accordance with this theory, the amount of FDI in a host country relies upon its market size, which is estimated either by the sales of a foreign company in that country, or by the country's GDP. This applies specifically to the import-substituting FDI. Whenever the market size of a certain country increases to a level that ensures the exploitation of economies of scale, the country becomes a probable target for FDI. Empirical studies aimed at testing this hypothesis appear to support the hypothesis that higher level of sales and higher level of income in the host country are positively correlated with FDI. Several studies have also worked on market size as a determinant of FDI.

4.2.10 FDI Theories Regarding International Trade

Several endeavors have been made to coordinate FDI theories with international trade theories. Among them, absolute advantage theory by Adam Smith, comparative advantage theory by David Ricardo, and factor endowment theory by Heckscher and Ohlin are notable. These theories tried to give an explanation of the flow of FDI to different countries through international trade but failed.

4.2.10.1 Absolute Advantage Theory

The concept of absolute advantage in terms of international trade was first introduced by Adam Smith in 1776. An entity, company, or country is said to have an absolute advantage if it can produce a certain good or service at a lower cost than another party. When a producer has an absolute advantage, it means that less resources and less time are needed to supply an equivalent amount of products as compared to the other producer. According to Smith, countries should concentrate on producing goods and services in which they have absolute advantage and involve in free trade with other countries in order to sell their products. In the course of time, Smith's approach became known as the absolute advantage theory of trade and was the dominant trade theory until the theory of comparative advantage was developed by David Ricardo. However, Smith's theory failed to explain how trade developed between countries when one country was not involved in the production activities.

4.2.10.2 Comparative Advantage Theory

David Ricardo expanded Smith's theory in 1817 to fit a more general skeleton by introducing a theory on comparative advantage. The ability of a country to produce a certain good or service at a lower opportunity cost than another country is referred to as comparative advantage. It gives a country the ability to sell goods and services at comparatively lower price than its rivals and grasp robust sales margins. Assuming a single factor of production, a given stock of resources, full employment, and a balanced exchange of goods, Ricardo argued that world output would increase if countries specialize in producing goods and services in which they have a lower opportunity cost. Comparative advantage theory provides a solid argument in favor of free trade and specialization between countries. His theory, however, was flawed as it was based on the assumptions of two countries, two commodities, and perfect factor mobility, but did not support cross-border capital movements. It is direct contrast to the notion of Kindleberger (1969).

4.2.10.3 Heckscher-Ohlin Model

The Heckscher-Olin Model is an equilibrium model of international trade based on comparative advantage theory of David Ricardo. In contrast to Ricardo's theory, this theory explained the difference in advantages by relative factor endowments. The preliminary work behind Heckscher-Olin model was done by Eli Heckscher in 1919. Later it was developed by his student, Bertil Ohlin, in 1933. Given necessary assumptions, Heckscher-Ohlin theorem demonstrates that countries in which capital is relatively abundant and labor is relatively scarce will tend to export capital-intensive products and import labour-intensive products, while countries in which labor is relatively abundant and capital is relatively scarce will tend to export labor-intensive products and import capital-intensive products. This theory is also based on the assumption of international immobility of factors of production and hence do not explicitly answer the question of production outside national boundaries.

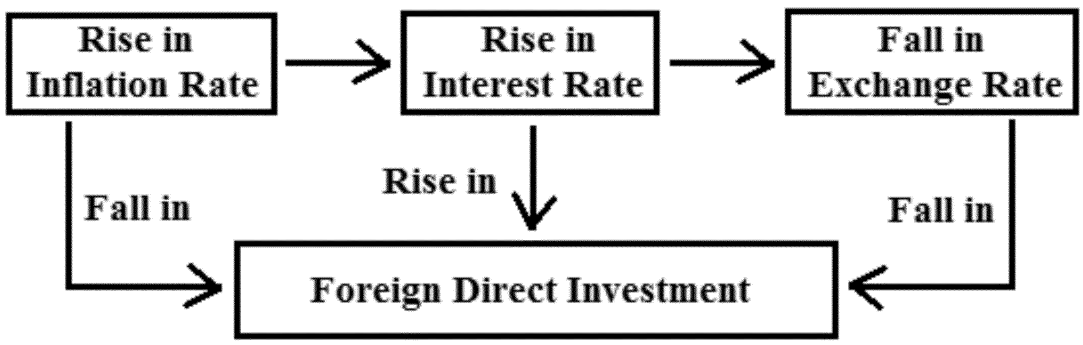
4.3 Conceptual Framework

According to the eclectic paradigm theory by Dunning (1979), our main predictable variables inflation rate, interest rate, and exchange rate refer to the location specific advantages of the host country and fall into the category of efficiency seeking factors according to the motive-based theory of Dunning and Lundan (2008). A conceptual framework of the macroeconomic relationship among these variables and FDI is presented below to show how these variables are interrelated to each other.

High inflation increases the user cost of capital and reduces the return on investment. Consequently, risk-averse foreign investors tend to reduce FDI in the host country. To cope with high inflation, the central bank of the country raises it's interest rate. As a result, the cost of borrowing capital will be high. If the cost of borrowing in the host country is higher than in the home country, home country's firms will have a cost advantage over their rivals in the host country, and will be in a better position to enter the host country through FDI which will lead to higher inflows of FDI into the host country. Again the higher interest rate in the host country will tend to attract foreign portfolio investment, increasing the demand for and value of the host country's currency (which means appreciation of the host country's currency or decrease in the exchange rate of host country's currency in terms of home country's currency). The appreciation of the host country's domestic currency decreases the wealth of foreign investors relative to that of domestic investors and thereby decreases FDI.

Suppose the interest rate both in the US and the UK is 5%. Now if the Fed increases the US interest rate from 5% to 6% to control high inflation, lots of UK people will withdraw their money from UK banks and will deposit in US banks (where they are paid a higher interest rate). In order to do this, they need to convert their pounds into dollars. Since they are selling pounds and buying dollars, the supply of the former and the demand for the latter increases, which is why the value of the dollar relative to the pound increases (exchange rate of dollar to pound decreases).

Figure 4.3: Conceptual Model Developed by the Researcher



4.4 Model Specification

4.4.1 Multiple Regression

In order to estimate the relationship between dependent and independent variables, a multiple regression model is used. It is the most common form of linear regression analysis. It often happens that our target variable is related to more than one independent variable. When a regression is based on more than one independent variable, it is referred to as a multiple regression. It generally explains the relationship between multiple independent variables and one dependent variable.

The multiple regression takes the form:

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots + \beta_k x_{ki} + u_i \qquad (4.1)$$

where y is the dependent variable, and $x_1, x_2, \cdots, x_k$ are the explanatory variables. β_0 is the intercept, the value of y when all the $x's$ are zero. $\beta_1, \beta_2, \cdots, \beta_k$ are the regression coefficients of k explanatory variables shown as $x_1, x_2, \cdots, x_k$. Note that β_i is the amount by which y changes when the particular x_i increases by one unit, with the values of all other independent variables held constant. u_i is the disturbance or error term.

The key assumptions lying behind multiple regression are:

1. There is a linear relationship between the dependent variable and the independent variables.
2. There is no multicollinearity, meaning that the independent variables are not highly correlated with each other.
3. The data are homoscedastic, that is, the variance is constant across all levels of the independent variables.
4. The residuals (the difference between the actual value and the estimated value of the dependent variable) are approximately normally distributed with a zero mean value.

4.4.2 Cobb-Douglas Production Function and Log-Linear Model

Through appropriate transformation process, we can convert nonlinear relationship into linear ones. The log-linear model is such a transformation process. The famous 'Cobb-Douglas production function' of production theory, developed by Charles Cobb and Paul Douglas during 1927–1947, can be considered as the basis of the log-linear model. The Cobb-Douglas production function, in its stochastic form, may be expressed as:

$$Y_i = \alpha_0 X_{1i}^{\beta_1} X_{2i}^{\beta_2} e^{ui} \qquad (4.2)$$

where

Y	=	output
X_1	=	labor input
X_2	=	capital input
u	=	stochastic disturbance term
e	=	base of natural logarithm
α_0	=	constant
β_1, β_2	=	parameters ($\beta_1 > 0$, $\beta_2 > 0$)

The term α_0 represents total factor productivity. The value of α_0 reflects the state of technology as well as the skill and education level of the workforce. β_1 and β_2 represent the elasticities of output with respect to capital and labor, respectively. The sum of the elasticities, $\beta_1 + \beta_2$, provides the returns to scale of the firms. If $\beta_1 + \beta_2 = 1$, the production operates under constant returns to scales, if $\beta_1 + \beta_2 > 1$ or $\beta_1 + \beta_2 < 1$, the production operates under increasing or decreasing returns to scale, respectively. Often, this function has the underlying assumption of constant returns to scale.

It is obvious from equation (4.2) that the relationship between output and two inputs is nonlinear. However, taking the natural logarithm of both sides of the equation yields:

$$\ln Y_i = \ln \alpha_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + u_i \qquad (4.3)$$

Letting constant $\ln \alpha_0 = \beta_0$ (constant) gives,

$$\ln Y_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + u_i \qquad (4.4)$$

Model (4.3) is linear in parameters β_0, β_1, β_2 and is therefore a linear regression model. Note that it is nonlinear in the variables Y and X but linear in the logs of these variables.

Now if we have k number of variables, log-linear model stands:

$$\ln Y_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \cdots\cdots + \beta_k \ln X_{ki} + u_i \quad (4.5)$$

Each of the regression coefficients, β_1 through β_k, is the (partial) elasticity of Y with respect to variables X_1 through X_k.

4.4.3 Research Model

In light of the above discussion of multiple regression, the empirical model of this study is specified as follows:

$$FDI = f\,(INF,\ INT,\ EXC,\ EXD,\ CAB,\ GNE,\ AIR) \quad (4.6)$$

Since our data will be collected at discrete points in time, the model can be expressed as:

$$FDI_t = f\,(INF_t,\ INT_t,\ EXC_t,\ EXD_t,\ CAB_t,\ GNE_t,\ AIR_t) \quad (4.7)$$

As we know, to avoid non-linearity problems in a regression model, variables are often expressed in logarithmic form. Logarithmic transformation is also a convenient way of converting a highly skewed variable into one that is more approximately normal. For this purpose, equation (4.7) is expressed in a multivariate Cobb-Douglas form as:

$$FDI_t = \alpha\, INF_t^{\beta_1} INT_t^{\beta_2} EXC_t^{\beta_3} EXD_t^{\beta_4} CAB_t^{\beta_5} GNE_t^{\beta_6} AIR_t^{\beta_7} e^{u_t} \quad (4.8)$$

After converting the data into logarithm form, the model can be represented as:

$$LFDI_t = L\alpha + \beta_1\, LINF_t + \beta_2\, LINT_t + \beta_3\, LEXC_t + \beta_4\, LEXD_t + \beta_5 LCAB_t$$
$$+ \beta_6\, LGNE_t + \beta_7\, LAIR_t + u_t \quad (4.9)$$

If we assume $L\alpha = \beta_0$, the model stands:

$$LFDI_t = \beta_0 + \beta_1\, LINF_t + \beta_2\, LINT_t + \beta_3\, LEXC_t + \beta_4\, LEXD_t + \beta_5 LCAB_t$$
$$+ \beta_6\, LGNE_t + \beta_7\, LAIR_t + u_t \quad (4.10)$$

In the above equation,

$LFDI_t$ = Natural logarithm of foreign direct investment at time t

$LINF_t$ = Natural logarithm of inflation rate at time t

$LINT_t$ = Natural logarithm of interest rate at time t

$LEXC_t$ = Natural logarithm of exchange rate at time t

$LEXD_t$ = Natural logarithm of external debt at time t

$LCAB_t$ = Natural logarithm of current account balance at time t

$LGNE_t$ = Natural logarithm of gross national expenditure at time t

$LAIR_t$ = Natural logarithm of air transport at time t

e = Base of natural logarithm

u_t = Error term/ random residual term/ stochastic disturbance term

β_0 = Intercept/ slope coefficient

β_1 to β_7 = coefficient parameters to be estimated.

To analyze the impacts of volatilities of explanatory variables on FDI, the following model has been used:

$$LFDI_t = \gamma_0 + \gamma_1 VINF_t + \gamma_2 VINT_t + \gamma_3 VEXC_t + \gamma_4 VEXD_t + \gamma_5 VCAB_t + \gamma_6 VGNE_t + \gamma_7 VAIR_t + u_t \quad (4.11)$$

Where,

$LFDI_t$ = Natural logarithm of foreign direct investment at time t

$VINF_t$ = Volatility of inflation rate at time t

$VINT_t$ = Volatility of interest rate at time t

$VEXC_t$ = Volatility of exchange rate at time t

$VEXD_t$ = Volatility of external debt at time t

$VCAB_t$ = Volatility of current account balance at time t

$VGNE_t$ = Volatility of gross national expenditure at time t

$VAIR_t$ = Volatility of air transport at time t

u_t = Error term

γ_0 = Intercept

γ_1 to γ_7 = coefficient parameters

4.5 Conclusion

In this Chapter, we provide a theoretical review of foreign direct investment (FDI). It is evident that there are several theories that have tried to explain the causes of cross-border capital movements. The principal aim of these theories is to provide an plausible explanation of the reasons for a firm's decision to invest abroad. Some theories are the outcome of trade theories under perfect market framework, while some theories have been evolved from imperfect market conditions. Examining the major FDI theories, it is unambiguous that there is no single theory that can explain FDI as a whole. This is why Kindleberger (1969) stated that in a world characterized by perfect competition, FDI would no longer exist. If the markets operate effectively and there are no hindrances to trade, then international trade is the only way to take part in the global market. However, despite different perspectives, these theories are unanimous in their opinion that a firm goes abroad to gain the advantages in the form of location-specific, firm-specific, or internationalization of markets. In this chapter, a conceptual framework has also been developed in the light of these theories. According to this model, a rise in inflation rate increases interest rate and as a result exchange rate declines. Again, an increase in inflation rate as well as in exchange rate leads to a reduction in FDI, while an increase in interest rate leads to an increase in FDI. In addition, after a short discussion on the multiple regression and log-linear model, we have formulated the necessary models for our research.

Chapter 5

Econometric Methodology

5.1 Introduction

Methodology of a study refers to the methods or rules or techniques of doing research. It is a systematic way to solve the research problem. Basically, the procedures that the researchers follow to analyze, explain, and predict their research phenomena are called research methodology. Its aim is to give the work plan of research. In a research paper, the methodology section considers the logic behind the methods the researcher uses in the context of his research topic and explains why he is using a particular method or technique and why he is not using others so that the results of the research are capable of being evaluated either by the researcher himself or by others.

This study is based on yearly time series data. It is assumed that time series data are stationary. Non-stationary time series data create some unusual problems in econometric analysis. So, it is essential to check whether the data are stationary or not. By using appropriate methods we have tested stationarity of our time series data. Based on the type of stationarity, next econometric methodology is applied. There are three types of stationarity used in the literature – stationary at levels, stationary at first difference, stationary at second difference. When all the variables are stationary at their levels, simply OLS method is applied. If the variables are stationary at different orders (at levels and at first difference), we adopt ARDL model. But if all the variables are stationary at first difference, we examine the cointegration between them. If the two series are cointegrated, we apply VEC model, but if the two series are not cointegrated, we apply unrestricted VAR model. Then Granger causality test is performed to know the direction of causality. By using the impulse responses we determine the sign of the causality and based on the variance decomposition we decide whether established causal relationships between variables persists beyond the sample period. Volatilities are measured by ARCH/GARCH techniques and moving average standard deviation.

Starting with a short introduction about this chapter, Section 5.2 summarizes the aspects of the descriptive statistics, Section 5.3 deals with the multicollinearity test, Section 5.4 illustrates the unit root test, Section 5.5 depicts the cointegration analysis, Section 5.6 describes the vector error correction model (VECM), Section 5.7 outlines the Wald test, Section 5.8 deploys the residual diagnostics tests, Section 5.9 assesses the stability tests, Section 5.10 discusses the causality test, Section 5.11 traces the impulse response function, Section 5.12 demonstrates the variance decomposition, Section 5.13 gives the details of volatility analysis, and Section 5.14 provides brief conclusion of this chapter.

5.2 Descriptive Statistics

Descriptive statistics is a branch of statistics that typically aims at describing the different characteristics of data involved in a study. The main purpose of descriptive statistics is to provide a brief summary of the samples and measures of a given data set. The commonly used measures of descriptive statistics are the mean, the median, the standard deviation, the skewness, the kurtosis, and the minimum and maximum values of the variables.

5.3 Multicollinearity Test

Multicollinearity is a sort of disorder in the data. If there exists a high correlation between any two independent variables, problem of multicollinearity arises. It makes a significant variable insignificant by increasing its standard error. If the standard error increases, t-value decreases and as a result p-value becomes higher. Then it becomes difficult to reject the null hypothesis. One popular method to detect multicollinearity is the bivariate correlation between two predictor variables. A common rule of thumb is that if the correlation coefficient between two variables is 0.80 or above, the multicollinearity is severe.

5.3.1 The variance inflation factor (VIF)

In a multiple regression model, the variance inflation factor (VIF) is used as a measure of multicollinearity among the predictor variables. It quantifies the extent of correlation between one predictor and the other predictors in a model. The VIF estimates how much the variance of a regression coefficient is inflated due to multicollinearity in the model. There is a VIF for each explanatory variable in an equation which is defined as:

$$VIF_i = \frac{1}{1 - R_i^2} \tag{5.1}$$

A value of 1 means that the predictor is not correlated with other variables. The higher the value, the greater the correlation of the variable with other variables. According to Hair et al. (1995), the maximum acceptable level of VIF is 10. A VIF above 10 indicates high correlation and is a cause for concern. Therefore, those variables must be excluded from the model.

5.4 Unit Root Test

Studies that involve time series analysis normally use historical data to establish relationships between variables in order to forecast the future. But if the variables are non-stationary and contain unit root, forecasting may not be appropriate. A unit root refers to a stochastic trend in time series which creates a problem in statistical inference. The presence of unit roots makes a time series non-stationary and breaks down the normal properties of various test statistics. Running a regression with such data may lead to invalid or spurious results which have no economic meaning. Therefore, it is important to check stationarity of data before proceeding with estimates.

A time series or a stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between two time series does not depend on the actual time at which the covariance is computed. A series Y_t is said to be stationary if the following conditions are fulfilled for all values of *t*, where t = 1, 2,…,T.

$$\text{Constant mean: } E(Y_t) = \mu \tag{5.2}$$

$$\text{Constant variance: } Var(Y_t) = E(Y_t - \mu)^2 = \sigma^2 \tag{5.3}$$

$$\text{Covariance: } Cov(Y_t, Y_{t+k}) = E[(Y_t - \mu)(Y_{t+k} - \mu)] = \gamma \tag{5.4}$$

Where γ_k (the covariance at lag k) is the covariance between the values of Y_t and Y_{t+k}. If $k = 0$, we obtain γ_0 , which is simply the variance of Y (σ^2).

Three basic regressions needs to be estimated to detect the presence of a unit root:

No constant, no trend (Y_t is a random walk):

$$\Delta Y_t = \delta Y_{t-1} + u_t \tag{5.5}$$

Constant, but no trend (Y_t is a random walk with drift):

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t \tag{5.6}$$

Constant and trend (Y_t is a random walk with drift around a stochastic trend):

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + u_t \tag{5.7}$$

Where, Δ is the difference operator, Y_t is the dependent variable, t is a deterministic trend, u_t is the error term, β_1 is the intercept, β_2 is the coefficient of time trend, δ is the parameter.

There are several tests of stationarity. Among them Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test, and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests are prominently applied in the literature. Arltova and Fedorova (2016) have shown that the most suitable tests for a short data series are the ADF and PP tests which yield significantly better results than other methods. Since the number of observations in this study is only 39, Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test are employed to test the unit root of the series.

5.4.1 Augmented Dickey-Fuller (ADF) Test

Dickey-Fuller test (Dickey and Fuller, 1979) is one of the widely known unit root tests. Augmented Dickey-Fuller (ADF) test is the modified version of it (Golab et al., 2014). It was developed by D. A. Dickey and W. A. Fuller in 1981. The ADF test adjusts the DF test to take care of possible serial correlation in the error terms by adding the lagged difference terms of the regressand. The Dickey-Fuller unit-root test is valid if the residuals are identically and independently distributed. But in case of ADF test, residuals are correlated. Three regressions of the ADF tests are as follows:

No constant, no trend : $\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + u_t$ (5.8)

Constant, but no trend : $\Delta Y_t = \beta_1 + \delta Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + u_t$ (5.9)

Constant and trend : $\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + u_t$ (5.10)

Where, Δ is the difference operator, Y_t is the variable of interest, t is a deterministic trend, p is the lag order selected based on Schwarz Information Criterion (SC), u_t is the stochastic error term, β_1 is the intercept, β_2 is the coefficient of time trend, δ and α are the parameters.

The null and alternative hypotheses are:

H_0 : $\delta = 0$; the time series is non-stationary (has a unit root)

H_1 : $\delta < 0$; the time series is stationary (has no unit root)

If the calculated value, in absolute term, is more than the t-statistic value (or the p-value is less than 5%), we reject the null hypothesis and conclude that the series is stationary. On the other hand, if the calculated value (in absolute term) is less than the t-statistic value (or the p-value is more than 5%), we fail to reject the null hypothesis and conclude that the series is non-stationary.

Note that if the null hypothesis is rejected at level (without differencing), then the order of stationary time series is designated as I(0) whereas if the null hypothesis is rejected at first difference, then the order of the series is designates as I(1).

5.4.2 Phillips-Perron (PP) Test

In 1988, Phillips and Perron developed a non-parametric statistical methods to take care of the serial correlation in the error terms without adding lagged difference terms. It takes the same estimation scheme as in Dickey-Fuller test, but it corrects for any serial correlation and heteroscedasticity in the errors of the test regression by directly modifying the test statistic. The Phillips-Perron test is based on asymptotic theory, which means that it works well in large samples. The PP test detects the presence of a unit root in a series by estimating the following regressions:

No intercept, no trend : $\Delta Y_t = \gamma Y_{t-1} + \varepsilon_t$ (5.11)

Intercept, but no trend : $\Delta Y_t = \alpha + \gamma Y_{t-1} + \varepsilon_t$ (5.12)

Intercept and trend : $\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \varepsilon_t$ (5.13)

where α is the intercept (constant), β is the coefficient of time trend t, γ is the parameter, ΔY is the first difference of Y series, and ε_t is the error term. Null and alternative hypothesis for the existence of a unit root in variable Y_t is:

H_0 : $\gamma = 0$; unit root is present

H_1 : $\gamma < 0$; there is no unit root

If the absolute value of the Phillips-Perron test statistic is greater than the absolute critical values (or the p-value is less than 5%) , we reject the null hypothesis and conclude that the series is stationary. On the other hand, if the absolute value of the Phillips-Perron test statistic is less than the absolute critical values (or the p-value is more than 5%), we fail to reject the null hypothesis and conclude that the series is non-stationary.

5.5 Cointegration Analysis

The concept of cointegration was first introduced by Granger in 1981 and developed by Engle and Granger in 1987 (Ericsson, 1992). To take care of the non-stationarity of the variables and confirm whether there exists a long run equilibrium relationship, the cointegration concept is used. It has been identified that two or more time series data can be cointegrated even though each of the series is individually non-stationary. When we go for running cointegration analysis, we assume that all the variables are non-stationary and integrated of the same order.

A time series is said to be integrated of order *d* if after differencing *d* times it becomes stationary and it is expressed as I(d). Hence, if the first difference of a non-stationary variable is stationary it is said to be I(1). Cointegration is said to exist between two or more non-stationary time series if they possess the same order of integration and a linear combination of these series is stationary. For example, cointegration exists if a set of I(1) variables can be modeled with linear combinations that are I(0). Even if the variables are not integrated in the same order, we still can continue with cointegration test. We call this situation 'multicointegration'.

There are three main methods for cointegration test:

1. Engle-Granger Two-Step Method (1987)
2. Johansen Cointegration Test (1988, 1990)
3. Phillips-Ouliaris Cointegration Test (1990)

The two step Engle and Granger (1987) cointegration test is based on the assumption of one cointegrating vector and is suitable for bivariate analysis. Although this method is valid with multiple variables, it cannot detect multiple cointegrating relations. Johansen (1988) and Johansen and Juselius (1990) method is compatible when there are more than two variables. Since the number of variables used in our study is 8, we employ Johansen cointegration approach to test for long run equilibrium relationships between dependent and independent variables. Moreover, Johansen method has better asymptotic properties which yield more robust results. The Philips-Ouliaris (1990) test works on the assumption that regression errors are independent with common variance which is rarely true in real life.

5.5.1 Johansen Cointegration Test

Engle and Granger (1987) suggest a two-step procedure for testing the hypothesis of cointegration using ordinary least square (OLS) method. Later, Johansen (1988), Johansen and Juselius (1990) introduce an alternative approach to test for cointegration which is applied in this study to examine the long run relationship that may exist among the variables. The Johansen approach suggests a maximum likelihood procedure to obtain cointegrating vectors and speed of adjustment coefficient identifying the number of cointegrating vectors within Vector Autoregressive (VAR) model. Since Johansen's method follows VAR-based cointegration test, considering a VAR model of order *p*:

$$Y_t = \alpha + A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + \varepsilon_t \qquad (5.14)$$

Where Y_t is an (n × 1) vector of non-stationary I(1) variables including both endogenous and exogenous variables, α is an (n × 1) vector of constants, A_i is an (n × n) matrix of coefficients, p is the maximum lag included in the model, and ε_t is an (n × 1) vector of error terms. Since, Y_t is assumed to be non-stationary, it is convenient to rewrite equation (5.14) in its first difference or error correction form as:

$$\Delta Y_t = \alpha + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \cdots + \Gamma_{k-1} \Delta Y_{t-(p-1)} + HY_{t-p} + \varepsilon_t \qquad (5.15)$$

Where, $\Gamma_i = (A_1 + A_2 + \cdots + A_{p-1} - I)$ represents the short-run dynamics of the model, $H = (A_1 + A_2 + \cdots + A_p - I)$ represents the long-run relationship among the variables included in the vector Y_t, and I is the identity vector. The key idea of the Johansen approach is to determine the rank r of the matrix Π, which represents the number of cointegrating vectors among the variables. If r = 0, then there are no cointegrating vectors.

Johansen suggests two test statistics for estimating the number of cointegrating vectors or equations – Trace test statistic and Max-eigen value test statistic.

Trace Test Statistics :

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i) \tag{5.16}$$

H_0 : $r \leq n$ (there are at most n number of cointegrating vectors)

H_1 : $r > n$ (there are at least n number of cointegrating vectors)

Max-eigen Value Test Statistics :

$$\lambda_{\max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1}) \tag{5.17}$$

H_0 : $r = n$ (there are exactly n number of cointegrating vectors)

H_1 : $r = n+1$ (there are exactly $n+1$ number of cointegrating vectors).

where, r is the number of cointegrating vectors, T is the sample size, and $\hat{\lambda}$ is the estimated eigenvalue. If the estimated statistic (Trace and/or Max-eigen Value) is greater than the critical value, then the relevant null hypothesis is rejected and alternative hypothesis is accepted, meaning that there is a long run relationship between dependent variable and independent variable(s). If there comes up a different result between trace statistic and maximum eigenvalue test, then the maximum eigenvalue result is preferred.

5.5.2 Selection of Lag

One of the difficult tasks of autoregressive process for a time series analysis is the selection of optimal lag length, based on a finite set of observations, since further analysis of the series is based on it. To overcome this difficulty, several lag order selection criteria have been proposed in the literature. In this study, we employ the following five criteria to determine the optimal lag length of our VAR model. Let us consider a K-dimensional autoregression of order p, which may be represented in VAR or in VEC form. The commonly used lag order selection criteria are:

1. Akaike Information Criterion (Akaike, 1973)

$$AIC(p) = \ln\left|\tilde{\Sigma}(p)\right| + \frac{2}{T} pK^2 \tag{5.18}$$

where $\tilde{\Sigma}(p) = \frac{1}{T}\sum_{t=i}^{T}(\varepsilon_t)^2$ [ε_t are the residuals estimated from the model]

2. Schwarz Information Criterion (Schwarz, 1978)

$$SC(p) = \ln\left|\tilde{\Sigma}(p)\right| + \frac{\ln T}{T} pK^2 \tag{5.19}$$

3. Hannan-Quinn Criterion (Hannan and Quinn, 1979)

$$HQ(p) = \ln\left|\tilde{\Sigma}(p)\right| + \frac{2\ln(\ln T)}{T} pK^2 \tag{5.20}$$

4. Final Prediction Error (Akaike, 1969)

$$FPE(p) = \left|\tilde{\Sigma}(p)\right| + \left(\frac{T+pK}{T-pK}\right)^K \tag{5.21}$$

$$\ln FPE(p) = \ln\left|\tilde{\Sigma}(p)\right| + K\ln\left(\frac{T+pK}{T-pK}\right) \tag{5.22}$$

5. Likelihood Ratio Test Statistic (LR)

$$LR(i) = T\left\{\ln\left|\tilde{\Sigma}(\overline{p}-i)\right| - \ln\left|\tilde{\Sigma}(\overline{p}-i+1)\right|\right\},\ i = 1,2,\ldots,\overline{p}-1. \tag{5.23}$$

The sequential modified likelihood ratio (LR) proposed by Sims (1980):

$$SLR(i) = (T-c)\left\{\ln\left|\tilde{\Sigma}(\overline{p}-i)\right| - \ln\left|\tilde{\Sigma}(\overline{p}-i+1)\right|\right\},\ \text{where}\ c = (\overline{p}-i+1)K \tag{5.24}$$

The lag order estimate $\hat{p}$ is chosen to minimize the value of the criterion function for $\{p : 1 \leq p \leq \bar{p}\}$ where $\bar{p} \geq p$. Here,

- $\widetilde{\Sigma}(p)$ is the determinant of the estimated noise covariance matrix (prediction error) for the VAR model of order p fit to the K-channel data.
- T is the sample size
- c is the total number of parameters estimated in the VAR model

5.6 Vector Error Correction Model (VECM)

The error correction mechanism (ECM) was first introduced by Sargan in 1964 and later developed and popularized by Engle and Granger in 1987 (Jalil et Al., 2016). It is a special case of vector autoregressive (VAR) model for variables that are stationary in their first differences. If there exist at least one or more cointegrating relationship among the variables, then Vector Error Correction Model (VECM) is used in order to estimate the long run causality and short run dynamics of the cointegrated variables.

The basis of VECM is the Granger Representation Theorem (Engle and Granger, 1987) which states that if two variables are cointegrated, then there exists a unidirectional or bi-directional Granger causality between them and an error correction model (ECM) combines the long-run relationship with the short-run dynamics of the model.

For our 8-variable case, the VECM is specified as,

$$\Delta LFDI_t = \alpha_0 + \alpha_1 ECT_{t-1} + \sum_{i=1}^{n} \beta_i \Delta LFDI_{t-i} + \sum_{i=1}^{n} \delta_i \Delta LINF_{t-i} + \sum_{i=1}^{n} \lambda_i \Delta LINT_{t-i}$$
$$+ \sum_{i=1}^{n} \sigma_i \Delta LEXC_{t-i} + \sum_{i=1}^{n} \mu_i \Delta LEXD_{t-i} + \sum_{i=1}^{n} \pi_i \Delta LCAB_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta LGNE_{t-i}$$
$$+ \sum_{i=1}^{n} \phi_i \Delta LAIR_{t-i} + \varepsilon_t \qquad (5.25)$$

Where, $ECT_{t-1} = LFDI_{t-1} - \gamma_0 - \gamma_1 LINF_{t-1} - \gamma_2 LINT_{t-1} - \gamma_3 LEXC_{t-1} - \gamma_4 LEXD_{t-1}$

$$- \gamma_5 LCAB_{t-1} - \gamma_6 LGNE_{t-1} - \gamma_7 LAIR_{t-1} \quad (5.26)$$

The error correction term (ECT) relates to the fact that last period deviation from long-run equilibrium (the error) influences the short-run dynamics of the dependent variable. Thus, the coefficient of *ECT*, α_1, is the speed of adjustment, because it measures the speed at which *LFDI* returns to the equilibrium after a change in explanatory variable(s).

Since our optimal lag is 2, the equation (5.25) can be rewritten as,

$$\Delta LFDI_t = \alpha_0 + \alpha_1 (LFDI_{t-1} - \gamma_0 - \gamma_1 LINF_{t-1} - \gamma_2 LINT_{t-1} - \gamma_3 LEXC_{t-1} - \gamma_4 LEXD_{t-1}$$

$$- \gamma_5 LCAB_{t-1} - \gamma_6 LGNE_{t-1} - \gamma_7 LAIR_{t-1}) + \beta_1 \Delta LFDI_{t-1} + \beta_2 \Delta LFDI_{t-2}$$

$$+ \delta_1 \Delta LINF_{t-1} + \delta_2 \Delta LINF_{t-2} + \lambda_1 \Delta LINT_{t-1} + \lambda_2 \Delta LINT_{t-2} + \sigma_1 \Delta LEXC_{t-1}$$

$$+ \sigma_2 \Delta LEXC_{t-2} + \mu_1 \Delta LEXD_{t-1} + \mu_2 \Delta LEXD_{t-2} + \pi_1 \Delta LCAB_{t-1} + \pi_2 \Delta LCAB_{t-2}$$

$$+ \varphi_1 \Delta LGNE_{t-1} + \varphi_2 \Delta LGNE_{t-2} + \phi_1 \Delta LAIR_{t-1} + \phi_2 \Delta LAIR_{t-2} + \varepsilon_t \quad (5.27)$$

The above equation is error correction equation where Δ shows the changes of the variables, α_1 is the adjustment parameter.

5.7 The Wald Test

The Wald test, described by Agresti (1990) and Polit (1996), is a way of testing the significance of particular explanatory variables in a statistical model. This test is usually performed on parameters that have been estimated by maximum likelihood approach.

The Wald test works by testing the null hypothesis that a set of parameters is equal to some value. In the model being tested here, the null hypothesis is that the two coefficients of interest are simultaneously equal to zero. If we fail to reject the null hypothesis, that is, if the test is not significant, this means that the parameters associated with these variables are zero and hence removing the variables from the model will not substantially harm the fit of that model. But if the Wald test is significant, then we would conclude that the parameters associated with these variables are not zero, so the variables should be included in the model.

The Wald test statistic for a single parameter is:

$$W = \frac{(\hat{\beta} - \beta_0)^2}{Var(\hat{\beta})} \tag{5.28}$$

Where $\hat{\beta}$ is the Maximum Likelihood Estimate (MLE).

The Wald test can be used to test a single hypothesis on multiple parameters, as well as to test jointly multiple hypotheses on single/multiple parameters. To test q hypotheses on p estimated parameters, let $\hat{\beta}$ be the p × 1 vector of estimated coefficients, R be the $q \times p$ hypothesis matrix, $\hat{V}$ be the estimated covariance matrix for $\hat{\beta}$, and r be the vector of hypothesized values for $\hat{\beta}$. Then the Wald test statistic for multiple parameter is:

$$W = (R\hat{\beta} - r)'(R\hat{V}R')^{-1}(R\hat{\beta} - r) \tag{5.29}$$

The resulting test statistic can be tested against a chi-square distribution or an F distribution. The chi-square distribution is preferable when the number of degrees of freedom is large, whereas the F distribution is preferable when the number of degrees of freedom is small (Korn and Graubard, 1990).

5.8 Residual Diagnostic Tests

The following diagnostic tests are extensively used in the literature to assess the goodness-of-fit of the model:

- Correlogram of Residuals (Autocorrelation)
- Breusch-Godfrey Test (Autocorrelation)
- Breusch-Pagan-Godfrey Test (Heteroskedasticity)
- ARCH Test (Heteroskedasticity)
- Jarque-Bera Test (Normality)

5.8.1 Autocorrelation/ Serial Correlation Test

Autocorrelation or serial correlation is a mathematical representation of the degree of similarity between a given time series and a lagged version of itself over successive time intervals. If there exists a pattern in a series of numbers such that values in the series can be predicted based on its previous values, then the series is said to exhibit autocorrelation. It occurs in time series when the errors associated with a certain time period carry forward into future time periods. When error terms from different time periods are correlated, we say that the error term is serially correlated.

Autocorrelation usually exists in the type of data set where the data comes from the same source instead of being randomly selected. When serial correlation is detected in the residuals of a model, it is suggested that the model is misspecified. One reason for this may be that some key variable or variables are missing from the model. The solution is to either include missing variables, or explicitly model the autocorrelation.

The presence of autocorrelation in the residuals of a model is generally unexpected by the researcher. This study uses Breusch–Godfrey LM test for serial correlation because this test is more general than the Durbin-Watson statistic which is only valid for non-stochastic regressors and for testing the possibility of a first order autoregressive model for the regression errors. The Breusch–Godfrey test has none of these restrictions, and is statistically more powerful than Durbin-Watson statistic.

5.8.1.1 Correlogram of Residuals

Correlogram is a frequently used tool for checking randomness in a data set. It is a visual way to show serial correlation (also called autocorrelation) in data that changes over time. There are three parts of correlogram test:

- Autocorrelation Function (ACF)
- Partial Autocorrelation Function (PACF)
- Ljung-Box Q-Statistics

5.8.1.1.1 Autocorrelation Function (ACF)

The autocorrelation function (ACF) at lag *k*, denoted by ρ_k, of a stationary stochastic process is defined as

$$\rho_k = \frac{Co\,\text{var}\,iance}{Varianc} = \frac{\gamma_k}{\gamma_0} \tag{5.30}$$

which is estimated by

$$\rho_k = \frac{\sum_{t=k+1}^{n}(Y_t - \bar{Y})(Y_{t-k} - \bar{Y})}{\sum_{t=1}^{n}(Y_t - \bar{Y})^2} \tag{5.31}$$

where *n* is the sample size and $\bar{Y}$ is the sample mean of *Y*. A plot of ρ_k against *k* is known as a correlogram.

Autocorrelation is a correlation coefficient. It lies between -1 and +1, as any correlation coefficient does. If ρ_k is nonzero, it means that the series is first order serially correlated. The dotted lines in the plots of the autocorrelations are the approximate two standard error bounds computed as $\pm 2/\sqrt{n}$. If the autocorrelation is within these bounds, it is not significantly different from zero at the 5% significance level.

5.8.1.1.2 Partial Autocorrelation Function (PACF)

The partial autocorrelation between Y_t and Y_{t-k} is defined as the conditional correlation between Y_t and Y_{t-k}, conditional on Y_{t-1}, Y_{t-2}, ... , $Y_{t-(k-1)}$, Y_{t-k}, the set of observations that come between the time points t and t-k.

The first order partial autocorrelation is defined to equal the first order autocorrelation. The second order partial autocorrelation is:

$$\phi_k = \frac{Covariance\ (Y_t, Y_{t-2} \setminus Y_{t-1})}{\sqrt{Variance\ (Y_t \setminus Y_{t-1})\ Variance\ (Y_{t-2} \setminus Y_{t-1})}} \tag{5.32}$$

The partial autocorrelation at lag k is estimated by

$$\phi_k = \hat{r}_1 \qquad \text{for k = 1} \tag{5.33}$$

$$\phi_k = \frac{\hat{r}_k - \sum_{j=1}^{k-1} \phi_{k-1,\, j} \hat{r}_{k-j}}{1 - \sum_{j=1}^{k-1} \phi_{k-1,\, j} \hat{r}_{k-j}} \qquad \text{for k > 1} \tag{5.34}$$

where $\hat{r}_k$ is the estimated autocorrelation at lag k and where,

$$\phi_{k,j} = \phi_{k-1,j} - \phi_k \phi_{k-1,k-j} \tag{5.35}$$

This is a consistent estimation of the partial autocorrelation. The dotted lines in the plots of the partial autocorrelations are the two approximate standard error bounds calculated as $\pm 2/\sqrt{n}$. If the partial autocorrelation is within these bounds, it is not significantly different from zero at the 5% significance level.

5.8.1.1.3 Ljung-Box Q-Statistics

The Ljung-Box test (1978) is a diagnostic tool used to test the lack of fit of a time series model. It is often used as a test of whether the series is white noise. The test examines k autocorrelations of the residuals. If the autocorrelations are very small, we conclude that the model does not show significant lack of fit.

In general, the Ljung-Box test is defined as:

H_0 : The model does not exhibit lack of fit (does not exhibit serial correlation)

H_1 : The model exhibits lack of fit (exhibits serial correlation)

The test statistic is:

$$Q = n(n+2)\sum_{j=1}^{k}\frac{\hat{r}_j^{\,2}}{n-j} \tag{5.36}$$

where n is the number of observations, k is the number of lags being tested, $\hat{r}_j$ is the sample autocorrelation of the series at lag j.

We reject the null hypothesis and say that the model exhibits lack of fit if

$$Q > \chi^2_{1-\alpha,h} \tag{5.37}$$

where $\chi^2_{1-\alpha,h}$ is the value found on the chi-square distribution table for significance level α with h degrees of freedom.

5.8.1.2 Breusch-Godfrey Test

The Breusch–Godfrey test ((Breusch, 1978, and Godfrey, 1978) is a test for serial correlation in the errors in a regression model. This test measures correlation between error term and multiple lagged error terms at the same time to see if they are correlated. It uses the residuals from the model considered in a regression analysis and a test statistic is derived from there.

Let us consider a linear regression model of the form:

$$y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \cdots + \beta_k x_{kt} + u_t \tag{5.38}$$

where the errors might follow an autoregressive model of order p, denoted as AR(p):

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-p} + \varepsilon_t \tag{5.39}$$

The simple regression model is first fitted by ordinary least squares to obtain a set of sample residuals $\hat{u}_t$. Breusch and Godfrey proved that, if the following auxiliary regression model is fitted

$$\hat{u}_t = \alpha_0 + \alpha_1 x_{1t} + \alpha_2 x_{2t} + \cdots \alpha_k x_{kt} + \rho_1 \hat{u}_{t-1} + \rho_2 \hat{u}_{t-2} + \cdots \rho_p \hat{u}_{t-p} + \varepsilon_t \qquad (5.40)$$

and if the usual R^2 statistic is calculated for this model, then the following asymptotic approximation can be used for the distribution of the test statistic

$$nR^2 \sim \chi^2(p) \qquad (5.41)$$

when the null hypothesis $H_0: \rho_1 = \rho_2 = \cdots = \rho_p = 0$ (that is, there is no serial correlation of any order up to p).

Here n is the number of data points available for the regression $\hat{u}_t$ and is defined as

$$n = T - p \qquad (5.42)$$

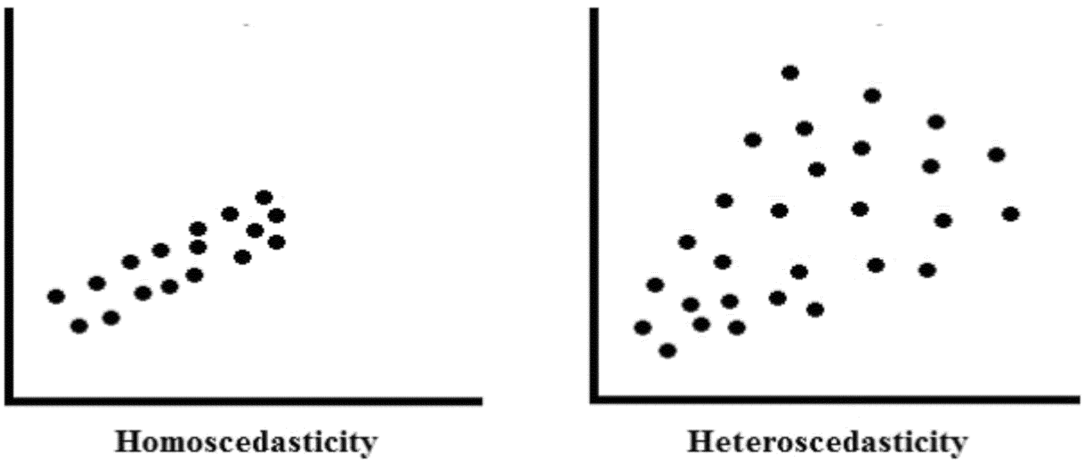
where T denotes the number of observations in the basic series. Note that the value of n depends on the number of lags of the error term (p).

The test statistic nR^2 is sometimes called the LM (Lagrange Multiplier) statistic.

5.8.2 Heteroscedasticity Test

Heteroscedasticity refers to the circumstance in which the variability of a variable is asymmetrical across the range of values of the predictor variables. Homoscedasticity means a situation where the variance of error term in a regression model is the same across all values of the independent variables. On the contrary, heteroscedasticity occurs when the error term is unequal across the values of the independent variables. A scatter plot of heteroscedastic data often takes the form of a cone-like shape, as the scatter (or variability) of the dependent variable widens or narrows as the value of the independent variable increases. Heteroscedasticity is a trouble because it violates the assumptions of linear regression modeling and therefore may affect the validity of econometric analysis. To test heteroscedasticity of data, the Breusch-Pagan-Godfrey test is applied in this study. Figure 5.1 shows homoscedastic and heteroscedastic distributions.

Figure: 5.1 Homoscedasticity and Heteroscedasticity



Source: Adapted from Wiley and Wiley (2020)

5.8.2.1 Breusch-Pagan-Godfrey Test

The Breusch-Pagan-Godfrey test (Breusch-Pagan, 1979, and Godfrey, 1978) is a Lagrange multiplier test of heteroskedasticity of the form $\sigma_t^2 = h(z_t' \alpha)$ in a linear regression model where z_t is a vector of independent variables. It tests whether the variance of the errors from a regression is dependent on the values of the independent variables.

The test statistic for the Breusch-Pagan-Godfrey test is:

$$nR^2 \text{ (with } k \text{ degrees of freedom)} \qquad (5.43)$$

Where

n = sample size

R^2 = coefficient of determination of the regression of squared residuals from the original regression

k = number of independent variables

The null and alternative hypotheses are defined as:

H_0 : Error variances are equal (no heteroscedasticity)

H_1 : Error variances are equal (heteroscedasticity)

The test statistic follows a chi-square distribution. If the test statistic has a p-value below a proper limit (e.g. $p < 0.05$), then the null hypothesis is rejected and heteroskedasticity is assumed. One way to try and avoid this issue is to convert variables into logs – this reduces impact of extreme values in data. Another is to use heteroscedasticity-consistent standard error estimates.

5.8.2.2 ARCH-LM Test

ARCH test devised by Engle in 1982 is the most commonly applied Lagrange Multiplier (LM) test to detect autoregressive conditional heteroscedasticity (ARCH) in the residuals. The test statistic is calculated from an auxiliary test regression. The null hypothesis is that there is no ARCH effect up to order q in the residuals (e_t).

To test the null hypothesis, the following regression is run:

$$e_t^{\,2} = \beta_0 + \sum_{s=1}^{q} \beta_s e^2_{t-s} + u_t \qquad (5.44)$$

where e is the residual and q is the length of ARCH lags. This is a regression of the squared residuals on a constant and lagged squared residuals up to order q. There are two commonly applied versions of the test. One is ARCH-LM test statistic which is calculated as the number of observations times the R^2 from the regression equation.

The other is F-statistic which is an omitted variable test for the joint significance of all lagged squared residuals.

5.8.3 Normality Test

Normality is a major concept used in various statistical calculations. A normal distribution is one that has a skew of zero (perfectly symmetric around the mean) and a kurtosis of three. Since a number of statistical analyses rely on the normality of a sample or population, it is often useful to test whether the underlying distribution is normal, or at least symmetric. There are several methods to verify whether data are normally distributed or not. In this study, however, Jarque-Bera test is used as it is a powerful tool to test the normality of a distribution.

5.8.3.1 Jarque-Bera Test

The Jarque–Bera test is a goodness-of-fit test to observe whether the skewness and kurtosis of sample data go with a normal distribution. The test statistic is always non-negative. If it is close to zero, it indicates that there is a normal distribution of data. It is normally used when the data size is large as other normality tests are not reliable when *n* is large. The test statistic of Jarque–Bera is defined as:

$$JB = n\left[\frac{S^2}{6} + \frac{(K-3)^2}{24}\right] \tag{5.45}$$

where n is the sample size, S is the sample skewness, K is the sample kurtosis. If the data belomgs to a normal distribution, the Jarque–Bera statistic asymptotically has a χ^2 distribution with 2 degrees of freedom. So, the statistic can be used to test the hypothesis that the data are from a normal distribution.

5.9 Stability Tests

To test the stability of the parameters, two types of tests are performed:

1. CUSUM (Cumulative Sum of Recursive Residuals) Test

2. CUSUM of Squares Test

Cumulative sum test helps to show whether the coefficients of the regression are changing systematically. On the other hand, cumulative sum of square test helps to show whether the coefficients of the regression changing suddenly.

Null Hypothesis (H_0): Parameters are stable

Alternative Hypothesis (H_1): Parameters are not stable

If plot remains within two straight lines, we accept the null hypothesis and reject the alternative hypothesis which is desirable.

5.9.1 Recursive Residuals

Recursive residuals are independently and identically distributed and, unlike ordinary residuals, do not have the problem of deficiencies in one part of the data being smeared over all the residuals (Galpin and Hawkins, 1984). The recursive residual w_t is defined as:

$$w_t = \frac{Forcast\ Error}{\sqrt{Forcast\ Variance}} \tag{5.46}$$

5.9.2 CUSUM test

The CUSUM test is a formula used to determine the gradual change in a series of quantities over time. Using the sequence of residual deviations from a model, the CUSUM statistic indicates whether the autoregressive model in time series analysis is misspecified. This option plots the cumulative sum together with the 5% critical lines. If the cumulative sum goes beyond the area between the two critical lines, it indicates that the parameter is instable. The CUSUM test is based on the statistic:

$$W_t = \sum_{r=k+1}^{t} \left(\frac{w_r}{s} \right) \tag{5.47}$$

for $t = k+1, ..., T$, where w is the recursive residuals defined above, and s is the standard deviation of the recursive residuals w_t.

If the β vector remains constant from period to period, $E(W_t) = 0$, but if β changes, W_t will tend to deviate from the zero mean value line. The significance of any departure from the zero line is assessed by reference to a pair of 5% significance lines, the distance between which increases with *t*. The 5% significance lines are found by connecting the points:

$$[\ k, \pm -0.948\sqrt{T-k}\ ] \text{ and } [\ T, \pm 3 \times 0.948\sqrt{T-k}\ ]$$

Movement of W_t outside the critical lines is an indication of coefficient instability.

5.9.3 CUSUM of Squares Test

The CUSUM of squares test is based on the test statistic:

$$S_t = \frac{\sum_{r=k+1}^{t} (w_r)^2}{\sum_{r=k+1}^{T} (w_r)^2} \tag{5.48}$$

The expected value of S_t under the hypothesis of parameter constancy is:

$$E(S_t) = \frac{t-k}{T-k} \tag{5.49}$$

which goes from zero at $t = k$ to unity at $t - T$. The significance of the departure of S from its expected value is assessed by reference to a pair of parallel straight lines around the expected value.

The CUSUM of squares test provides a plot of S_t against *t* and the pair of 5% critical lines. Like the CUSUM test, movement outside the critical lines indicates instability of the parameter or variance.

5.10 Causality Test

Although cointegration indicates presence of Granger causality, at least in one direction, it does not indicate the direction of causality between variables. So, after examining the unit root and cointegration in the time series setting, the next step is to know the direction of causality between variables. If there is no cointegration among variables, the standard Granger causality test (Granger, 1969) is suitable for testing the short-run relationship among the variables. But if the variables are cointegrated, results of standard Granger test may be incorrectly specified. In that case, VEC-based Granger causality test (Engle and Granger, 1987) is an appropriate one to determine the causal relationships. Typically Granger causality test is employed to investigate the short run linkages among the variables which are not cointegrated by using Johansen technique.

The concept of Granger causality is based on the assumption that the future cannot cause the past but the past causes the present or the future. A time series X is said to Granger-cause Y if it can be shown, usually through a series of t-tests and F-tests on lagged values of X (and lagged values of Y also), that those X values provide statistically significant information about future values of Y.

Causality between X and Y, that is, whether Y is caused by X (X→ Y) or X is caused by Y (Y→ X), can be represented by the following pair of regressions:

$$\Delta Y_t = \alpha_1 + \sum_{i=1}^{n} \beta_{1i} \Delta Y_{t-i} + \sum_{j=1}^{n} \gamma_{1j} \Delta X_{t-j} + \delta_1 ECT_{t-1} + u_{1t} \tag{5.50}$$

$$\Delta X_t = \alpha_2 + \sum_{i=1}^{n} \beta_{2i} \Delta X_{t-i} + \sum_{j=1}^{n} \gamma_{2j} \Delta Y_{t-j} + \delta_2 ECT_{t-1} + u_{2t} \tag{5.51}$$

Here it is assumed that the disturbances u_{1t} and u_{2t} are uncorrelated. Equation (5.50) postulates that current *Y* is related to past value of itself as well as that of *X*, and equation (5.51) postulates that current *X* is related to past value of itself as well as that of *Y*. The null and alternative hypothesis for the equations are as follows:

H_0 : X does not Granger cause Y and vice versa

H_1 : X does Granger cause Y and vice versa.

Between X and Y, if X Granger causes Y and Y Granger causes X, we call it bidirectional causality. If only one exists, then it is the case of unidirectional causality. If neither do exist, then the variables are independent to each other. According to Gujarati et al. (2012), four distinguished cases for equation (5.50) and (5.51) are:

(a) Unidirectional causality from *X* to *Y* exists if the set of estimated coefficients on the lagged *X* in equation (5.50) is statistically different from zero and the set of estimated coefficients on the lagged *Y* in equation (5.51) is not statistically different from zero.

(b) Conversely, unidirectional causality from *Y* to *X* exists if the set of lagged *X* coefficients in equation (5.50) is not statistically different from zero and the set of lagged *Y* coefficients in equation (5.51) is statistically different from zero.

(c) Bilateral causality exists when the sets of *X* and *Y* coefficients are statistically different from zero in both regressions.

(d) Finally, independence is indicated when the sets of *X* and *Y* coefficients are not statistically significant in either of the regressions.

5.11 Impulse Response Function

The impulse response function (IRF) is an important step in econometric analysis which is used in dynamic models such as vector autoregressive (VAR) to describe the impact of an exogenous shock in one variable on the other variables of the system. According to Panagiotidis et al. (2003), a unit (one standard deviation) increase in the *j-th* variable innovation (residual) is introduced at date *t* and then it is returned to zero thereafter. In general the path followed by the variable $y_{m,t}$ in response to a one time change in $y_{j,t}$, holding the other variables constant at all times *t*, is called the IRF (Panagiotidis et al., 2003).

Provided that the model is stable, a vector autoregression (VAR) can be written as a vector moving average (VMA). Let us consider a *p-th* order VAR, denoted VAR(*p*):

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \cdots + \phi_p y_{t-p} + \varepsilon_t \tag{5.52}$$

where the observation y_{t-i} (i periods back) is called the *i-th* lag of y, c is a k-vector of constants, ϕ_i is a time-invariant (k × k)-matrix and ε_t is a k-vector of error terms. Now if the model is stable, it can be expressed as a VMA model as:

$$y_t = \mu + \varepsilon_t + \psi_1 \varepsilon_{t-1} + \psi_2 \varepsilon_{t-2} + \cdots\cdots \tag{5.53}$$

Re-dating at time $t + s$:

$$y_{t+s} = \mu + \varepsilon_{t+s} + \psi_1 \varepsilon_{t+s-1} + \psi_2 \varepsilon_{t+s-2} + \cdots + \psi_s \varepsilon_t + \psi_{s+1} \varepsilon_{t-1} + \cdots \tag{5.54}$$

$$\frac{\delta y_{t+s}}{\delta \varepsilon_t'} = \psi_s = [\psi_{ij}^{(s)}] \quad \text{(multipliers)} \tag{5.55}$$

$$\frac{\delta y_{i,t+s}}{\delta \varepsilon_{jt}} = \psi_{ij}^{(s)} \quad \rightarrow \text{Reaction of the } i\text{-variable to a unit change in innovation } i.$$

(5.56)

That is, the row i, column j element of ψ_s identifies the consequences of one unit increase in the *j-th* variable's innovation at time t (ε_{jt}) for the value of the *i-th* variable at time $t + s$ ($y_{i,t+s}$), holding all other innovations at all dates constant. $\frac{\delta y_{i,t+s}}{\delta \varepsilon_{jt}}$ as a function of s is called the impulse response function. It describes the response of $y_{i,t+s}$ to a one-time impulse in y_{jt} with all other variables dated t or earlier held constant.

5.12 Variance Decomposition

In macroeconomic analysis, the concept of 'variance decomposition' or, more precisely, 'forecast error variance decomposition' is developed by Sims in 1980 and since then it is used by many economists and econometricians as an alternative to classical simultaneous equations model. This term is used for interpreting the relations between variables described by vector autoregressive (VAR) models. It helps to determine the proportion of variation of the dependent variable explained by each of the independent variables. It gives the percentage of unexpected variation in each variable that is produced by shocks from other variables. In addition, it shows which of the independent variables is 'stronger' in explaining the variability in the dependent variables over time. Let us consider a VAR(p) model of the following form:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + u_t \tag{5.57}$$

where y_t is a ($K \times 1$) vector of endogenous variables, A_i is the *i-th* ($K \times K$) matrix of parameters, y_{t-i} is the *i-th* lag of y, p is the lag order, u_t is a K-vector of error terms which is assumed to be white noise, that is, mean, $E(u_t) = 0$, and the covariance matrix $E(u_t u_t') = \Sigma_u$ is time invariant, and the u_t's are serially uncorrelated or independent.

Forecast error variance decomposition is carried out typically based on the moving average (MA) representation of a VAR(p) model. Equation (5.57) can be expressed as moving average (MA) form in the following way:

$$y_t = u_t + \Phi_1 u_{t-1} + \Phi_2 u_{t-2} + \cdots + \Phi_p u_{t-p} \tag{5.58}$$

An h-step ahead forecast error for the process can be written for h = 1, 2, ... , as

$$y_{t+h} = u_{t+h} + \Phi_1 u_{t+h-1} + \Phi_2 u_{t+h-2} + \cdots + \Phi_p u_{t+h-p} \tag{5.59}$$

Hence the forecast error turns out to be

$$y_{t+h} - y_t(h) = \sum_{i=0}^{h-1} \Phi_i u_{t+h-i} \tag{5.60}$$

with $y_t(h)$ being the optimal *h*-step forecast at period *t* for y_{t+h}. It is straightforward to compute the total forecast error variance of a variable in y_t for the *h*-step forecast horizon and the corresponding shares of individual innovations to this variance.

The covariance matrix of the structural innovations u_t is typically restricted to be an identity matrix without loss of generality. When decomposing the forecast error variances, it is furthermore assumed that the structural innovations do not exhibit any autocorrelation and correlation among their leads/lags. Under the aforementioned restrictions and assumptions, the mean squared error (MSE) of the h-step forecast of variable j is:

$$E[\{y_{t+h} - y_t(h)\}\{y_{t+h} - y_t(h)\}'] = \sum_{i=0}^{h-1} \Phi_i \Sigma_u \Phi_i' = \sum_{i=0}^{h-1} \Phi_i \Phi_i' \tag{5.61}$$

where Σ_u is the covariance matrix of the errors u_t and is set to be the *K*-dimensional identity matrix. The contribution of the *k-th* structural shock to the forecast error variance of the *j-th* variable for a given forecast horizon is computed by $\omega_{jk,h}$,

$$\omega_{jk,h} = \sum_{i=0}^{h-1} (e_j' \Phi_i e_k)^2 \tag{5.62}$$

where e_k is the *k-th* column of the *K*-order identity matrix. Given (5.61) and (5.62), it is simple to compute the share of a structural shock in the fluctuations of a variable.

5.13 Volatility Analysis

Volatility is a statistical measure of the variability of a market factor. It is commonly used to analyze the fluctuations in the price of securities in the stock market. Basically it shows the range to which the price of a security may increase or decrease. If the prices of a security fluctuate rapidly over a short period of time, it is termed to have high volatility. If the prices of a security fluctuate slowly over a long period of time, it is termed to have low volatility. In most cases, the higher the volatility, the riskier the security. Volatility (more precisely, historical volatility) is often measured as the standard deviation of asset returns over a particular period of time.

ARCH (Autoregressive Conditional Heteroscedasticity) and GARCH (Generalized ARCH) models have become important tools in the analysis of volatility of time series data, particularly in financial applications. These models are especially useful when the goal of the study is to analyze and forecast conditional variances of financial or economic series such as stock prices, bond prices, inflation rates, exchange rates, interest rates, unemployment rates, GDP and others. In this model we employ GARCH (1,1) model to analyze and forecast volatility of our time series data because the central requirement in almost all financial applications is that a volatility model must be able to forecast volatility (Engle and Patton, 2001) and no model provides a significantly better forecast than the GARCH (1,1) model (Hansen and Lunde, 2001). Likewise, Bahadur (2008) found GARCH (1,1) model as the appropriate model for volatility forecasting in Nepalese stock market. Gustafsson and Quinones (2014) mentioned that the most common form of the GARCH model is the GARCH (1,1) model and this model is sufficient in capturing the volatility clustering in the data.

5.13.1 The GARCH (1, 1) Model

ARCH model was introduced by Engle (1982) and generalized as GARCH by Bollerslev (1986) and Taylor (1986). ARCH method provides a way to model the change in variance over time in a series that is time dependent. The GARCH or Generalized ARCH allows ARCH model to support changes in the time dependent volatility, such as increasing and decreasing volatility in the same series.

A commonly accepted notation for a GARCH model is to identify the GARCH function with the p and q parameters GARCH (p, q); for example GARCH (1, 1) is the first order of GARCH model. A GARCH model includes ARCH models, where a GARCH (0, q) is equivalent to an ARCH (q) model.

We begin with the simplest GARCH (1, 1) specification:

Mean Equation: $Y_t = a_0 + u_t$ (5.63)

Variance Equation: $\sigma^2{}_t = b_0 + b_1 u^2{}_{t-1} + b_2 \sigma^2{}_{t-1}$ (5.64)

where the mean equation Y_t is expressed as its mean (a_0) plus a white noise error term (u_t). The error term is normally distributed with mean 0 and variance $\sigma^2{}_t$, that is, $u_t \approx N(0, \sigma^2{}_t)$. The variance of the residual or error term $\sigma^2{}_t$ is derived from the mean equation. Since $\sigma^2{}_t$ is the one-period ahead forecast variance based on past information, it is called the conditional variance. The conditional variance equation specified in (5.64) is a function of three terms:

- A constant term: b_0 (the mean)
- Information about volatility from the previous period, measured as the lag of the squared residual from the mean equation: $u^2{}_{t-1}$ (the ARCH term).
- The previous period's forecast error variance: $\sigma^2{}_{t-1}$ (the GARCH term).

Note that the variance equation follows: $b_0 \geq 0, b_1 \geq 0, b_2 \geq 0, b_1 + b_2 < 1$. The (1, 1) in GARCH (1, 1) refers to the presence of a first order autoregressive GARCH term (the first term in parentheses) and a first order moving average ARCH term (the second term in parentheses). An typical ARCH model is a particular case of a GARCH specification in which there are no lagged forecast variances in the conditional variance equation - that is, a GARCH (0, 1).

Higher order GARCH model, denoted GARCH (*p*, *q*), can be can be estimated by choosing either *p* or *q* greater than 1 where *p* is the order of the autoregressive GARCH term and *q* is the order of the moving average ARCH term. The demonstration of the GARCH (*p*, *q*) variance is as follows:

$$\sigma^2{}_t = b_0 + \sum_{i=1}^{q} b_i u^2{}_{t-i} + \sum_{j=1}^{p} b_j \sigma^2{}_{t-j} \quad (5.65)$$

5.13.2 The Moving Average Standard Deviation

The concept of standard deviation was first introduced by Karl Pearson in 1893. It is by far the most important and widely used measure of dispersion that provides a good indication of volatility. Dispersion is the difference between the actual value and the average value. The larger the difference between the actual value and the average value, the higher the standard deviation and the higher the volatility. The closer the actual values are to the average value, the lower the standard deviation and the lower the volatility.

Moving average standard deviation is a statistical measurement of market volatility. It does not give any prediction about the market trend but it may act as a confirming indicator. It simply calculates volatility as the unweighted standard deviation. While calculating moving average standard deviation, an investor is free to choose the time frame of the moving average. The most commonly used time periods are 15, 20, 30, 50, 100, and 200 days. The shorter the period used to calculate the average, the more sensitive it is to price changes. The longer the period, the less sensitive the average. Since our study has used only 39 annual observations, a 3-year moving average has been calculated.

We have calculated the rate of return at time t by the following formula as suggested by Hamori (2000):

$$R_t = \frac{y_t - y_{t-1}}{y_{t-1}} \tag{5.66}$$

where R_t is current period's return, y_t is the current period's value, and y_{t-1} is the previous period's.

The moving average standard deviation is then calculated by the following formula:

$$\sigma_n = \sqrt{\frac{1}{n-1}\sum_{t=1}^{n}(R_t - \overline{R})^2} \tag{5.67}$$

5.13.3 ARDL Bounds Test

Cointegration test is a way to detect the presence of long-run relationships between sets of variables. The concept was first introduced by Engle and Granger in 1987. Various cointegration techniques were developed to examine the existence of long-term correlations between different time series. All these techniques require that the series under consideration must be integrated of the same order. However, a recently developed cointegration approach, namely Autoregressive Distributed Lag (ARDL) model, also known as the Bounds Cointegration Test, eliminates this restriction.

ARDL model is the standard least squares regression that includes the lagged value(s) of the dependent variable, the current and lagged values of the explanatory variables as regressors. Although ARDL models have been used in econometrics for decades, they have gained popularity in recent years as a method of examining cointegrating relationships between variables through the work of Pesaran and Shin (1998) and Pesaran, Shin and Smith (2001). Since then, the ARDL method has been widely used in studies to examine the long-run relationships among the series that are integrated of different order. This study also employs ARDL bounds test approach for examining the long-run relationship between FDI and volatilities of the regressors because it has some advantages over the traditional approaches. Firstly, ARDL can be applied no matter what the order of integration is. Secondly, ARDL gives ingenious and accurate comprehensive information regarding the structural break of data. Thirdly, ARDL can be employed even the sample size is small. Fourthly, dummy variable can be included in the cointegration test process.

The ARDL bounds test equation takes the form (the conditional ARDL (p, q_1, q_2) model):

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{q_1} \delta_j \Delta X_{t-j} + \sum_{k=1}^{q_2} \gamma_k \Delta Z_{t-k} + \varphi_1 Y_{t-1} + \varphi_2 X_{t-1} + \varphi_3 Z_{t-1} + u_t \tag{5.68}$$

where β_i, δ_j, γ_k are ARDL short-run coefficients, φ_1, φ_2, φ_3 are error correction long-run coefficients, and u_t is the disturbance or error term.

Null Hypothesis, H_0 : $\varphi_1 = \varphi_2 = \varphi_3 = 0$ (cointegration does not exist among variables)

Alternative Hypothesis, H_1 : $\varphi_1 \neq \varphi_2 \neq \varphi_3 \neq 0$ (cointegration exists among variables)

Pesaran, Shin and Smith provide two asymptotic critical values for the test of cointegration: a lower bound critical value when regressor variables are $I(0)$, and an upper bound critical value when regressor variables are $I(1)$. If the F-statistic is above the upper critical value, the null hypothesis of no cointegration is rejected; if the test statistic falls below the lower critical value, the null hypothesis cannot be rejected; finally, if the statistic falls between the lower and upper critical values, the result is inconclusive.

From the bounds test results, if the variables are found cointegrated, both long-run and short-run models are to be estimated. For long-run analysis VEC model and for short-run analysis ARDL model can be specified. But if the variables are found 'not cointegrated' only short-run model is to be specified which is ARDL, not VECM.

If there is no cointegration, the ARDL (p, q_1, q_2) model is specified as:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{q_1} \delta_j \Delta X_{t-j} + \sum_{k=1}^{q_2} \gamma_k \Delta Z_{t-k} + u_t \tag{5.69}$$

If there is cointegration, the error correction model (ECM) model is specified as:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{q_1} \delta_j \Delta X_{t-j} + \sum_{k=1}^{q_2} \gamma_k \Delta Z_{t-k} + \lambda ECT_{t-1} + u_t \tag{5.70}$$

where error correction term (ECT_{t-1}) replaces the ARDL Bounds test long-run terms $(\varphi_1 Y_{t-1} + \varphi_2 X_{t-1} + \varphi_3 Z_{t-1})$. Coefficient, λ, is the speed of adjustment to long-run equilibrium.

5.14 Conclusion

To achieve the objectives of the study, advanced econometric techniques have been selected and applied. Econometric techniques that are employed in this study are analytically discussed in this Chapter. To check the stationarity of data, Augmented Dickey-Fuller (ADF) test and Phillips-Perron test are applied. A graphical representation is also used to verify the presence of unit roots in the series. Johansen Maximum Likelihood approach is used for cointegration test. Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), Final Prediction Error (FPE), Hannan-Quinn information criterion (HQ), and Likelihood Ratio Test Statistic (LR) are carried out to identify the optimal lag length. Vector Error Correction Model (VECM), and Wald test are performed to check whether there exists any long-run or short-run relationship between explained and explanatory variables. To know the direction of causality Granger causality test is applied. To evaluate the goodness-of-fit of the model, various diagnostic tests are performed. Correlogram test and Breusch-Godfrey LM Test are run to check for serial correlation, Breusch-Pagan-Godfrey test and ARCH test are run for heteroskedasticity test, Jarque-Bera test is run for normality test, and CUSUM test and CUSUM of Squares test are run for stability test. This chapter also discusses impulse response functions to trace the effects of a shock to an endogenous variable on the variables in the VAR and variance decompositions to determine the proportion of variation of the dependent variable. GARCH (1, 1) model is used to analyze volatilities of explanatory variables. ARDL Bounds Test is applied to examine the impacts of volatilities of explanatory variables on the dependent variable FDI.

Chapter 6

Estimated Results: Impacts and Causalities

6.1 Introduction

This study aims to investigate whether inflation rate, interest rate, exchange rate and some other macroeconomic variables and their volatilities have any short-run, long-run or causal relationship with FDI in Bangladesh. In this context, a complete econometric procedure has been carried out on the yearly time series data of the period 1980 to 2018 so that the objectives of the study are to be met up and the hypotheses are to be tested accordingly. Empirical results of those econometric techniques are presented and analyzed in this chapter.

The chapter starts with presenting the summary of descriptive statistics in section 6.2. The remainder of this chapter is organized as follows: section 6.3 gives the results of multicollinearity test, section 6.4 describes the results of unit root tests, Section 6.5 presents selection of optimal lag length, section 6.6 presents the results of cointegration test, section 6.7 presents the results of vector error correction model, section 6.8 depicts the results of ordinary least squares, section 6.9 illustrates the results of residual diagnostic tests, section 6.10 exhibits the results of stability tests, section 6.11 gives the results of Granger causality test, section 6.12 describes the impulse response functions, section 6.13 gives the description of variance decompositions, and finally section 6.14 presents the conclusion of the chapter.

6.2 Descriptive Statistics

The summary statistics of the log values of the variables used in the model are presented in Table 6.1. It is seen from the table that standard deviation of each variable is low, the mean and median values are very close to each other, and the range of variation between maximum and minimum value of LINF, LEXC, LEXD, and LGNE is reasonable. The relatively high difference between mean and median of

LCAB and between maximum and minimum values of LFDI, LINT, LCAB, and LAIR indicate possible extreme values in the distribution.

The skewness of FDI, inflation rate, and exchange rate are between -1 and -0.5 and the skewness of gross national expenditure is between +0.5 and +1 which indicate that these distributions are moderately skewed. The skewness of interest rate, and current account balance are less than -1 and that of air transport is greater than +1 meaning that these variables are highly skewed and the former two have a long left tail and the latter one has a long right tail. The skewness of external debt is between -0.5 and +0.5 which means that the distribution is approximately symmetric (normal) which is also supported by Jurque-Bera test statistic.

The excess kurtosis (kurtosis – 3) of FDI, interest rate, current account balance, gross national expenditure, and air transport are greater than zero (positive) which indicate that these distributions are leptokurtic (peaked curve). The excess kurtosis of exchange rate and external debt are less than zero (negative) which means that the distributions are platykurtic (flatted curve). The excess kurtosis of inflation rate is close to zero indicating that the distribution is normal (mesokurtic distribution). This is also supported by Jurque-Bera test statistic.

Table 6.1: Descriptive Statistics (Log Values of the Variables)

Measures	LFDI	LINF	LINT	LEXC	LEXD	LCAB	LGNE	LAIR
Mean	4.532	1.928	2.302	3.843	3.309	0.929	4.650	9.661
Median	4.984	1.952	2.465	3.894	3.349	1.130	4.651	9.510
Maximum	7.989	2.733	3.036	4.424	3.795	1.863	4.722	11.527
Minimum	-4.605	0.646	-0.656	2.738	2.808	-1.570	4.611	8.683
Std. Dev.	2.703	0.492	0.765	0.457	0.283	0.772	0.023	0.722
Skewness	-0.812	-0.786	-2.890	-0.563	-0.060	-1.512	0.622	1.058
Kurtosis	4.248	3.184	10.759	2.410	1.951	5.219	3.965	3.420
Jarque-Bera	6.821	4.071	152.123	2.626	1.812	22.868	4.030	7.556
Prob. (JB)	0.033	0.131	0.000	0.269	0.404	0.000	0.133	0.023

The p-value of Jarque-Bera statistic for FDI, interest rate, current account balance, and air transport are significant. So, the null hypothesis that the series are normally distributed is rejected. On the other hand, p-value of Jarque-Bera test statistic for inflation rate, exchange rate, external debt, and gross national expenditure are more than 0.05 or even 0.10. So, the null hypothesis cannot be rejected in this case and these distributions are normal.

6.3 Results of Multicollinearity Test

One popular method to detect multicollinearity is the bivariate correlation between two predictor variables. If the correlation coefficient between two variables is 0.80 or above, the rule of thumb says that we have multicollinearity. The results of bivariate correlations between variables used in the model are given in Table 6.2. The principal diagonal value gives the relationship between the same variables. That is why, we get the coefficient value 1 along the diagonal. Results show that the predictor variables interest rate, exchange rate, current account balance, gross national expenditure, and air transport have positive associations whereas inflation rate and external debt have negative associations with dependent variable FDI. We also see that inflation rate has negative correlation and interest rate has positive correlation with all other independent variables except gross national expenditure and air transport whereas exchange rate has positive correlation with all other independent variables except external debt. Results also show that the maximum correlation between external debt and air transport is -0.6. So, the correlation matrix in Table 6.2 indicates no high correlation (0.80 or above) between any two independent variables and hence there is no problem of multicollinearity in this model.

The variance inflation factor (VIF) is another means to detect multicollinearity between the independent variables of a model. As a rule of thumb, the VIF of all variables should be less than 10 in order to avoid troubles with the stability of the coefficients. The calculated VIF for our model is shown in Table 6.3. We see that VIF for each explanatory variable is less than 10. So it can be concluded that there is no multicollinearity in our model.

Table 6.2: Correlation Matrix

VAR.	LFDI	LINF	LINT	LEXC	LEXD	LCAB	LGNE	LAIR
LFDI	1.0000							
LINF	-0.2405	1.0000						
LINT	0.4175	-0.2503	1.0000					
LEXC	0.8285	-0.4278	0.3822	1.0000				
LEXD	-0.6643	-0.0824	0.2048	-0.4844	1.0000			
LCAB	0.5875	-0.3410	0.1871	0.5984	-0.3117	1.0000		
LGNE	0.4545	0.0168	-0.1869	0.2434	-0.5218	0.4338	1.0000	
LAIR	0.4136	0.1163	-0.0338	0.3770	-0.6000	0.0499	0.3226	1.0000

Table 6.3: Variance Inflation Factor (VIF)

Var.	*Coefficients*	*Standard Error (SE)*	*t-Statistic*	*P-value*	*Standard Deviation*	*VIF**
LINF	0.085438	0.388803	0.219747	0.827509	0.492364	1.481974
LINT	1.35449	0.256484	5.281001	0.000010	0.765433	1.558633
LEXC	2.430186	0.624895	3.888951	0.000497	0.456767	3.294678
LEXD	-4.59552	0.911296	-5.04284	0.000019	0.282653	2.683094
LCAB	0.18294	0.295647	0.618778	0.540584	0.772003	2.106659
LGNE	20.645	8.817922	2.341255	0.025825	0.023273	1.703192
LAIR	-0.2932	0.293899	-0.99761	0.326194	0.722461	1.823204
R Squared Adjusted R Squared Overall Standard Error (OSE) Total Observations (*n*)			0.89506 0.87136 0.96936 39	$^{*}VIF = \frac{(SE)^2 (n-1)(Std.Dev)^2}{(OSE)^2}$		

6.4 Results of Unit Root Test

To check whether the time series variables used in the study have any unit root or whether the series is stationary, Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test have been applied. To verify the ADF and PP test results, graphical representations of the variables are also depicted.

Although the test statistics of ADF and PP tests are different, the procedures of both the tests are the same. The null hypothesis is that the series has a unit root (i.e., the series is not stationary) contrary to the alternative hypothesis that the series has no unit root (i.e., the series is stationary). The null hypothesis is rejected if the absolute ADF/PP test statistic is greater than the absolute critical value or concerned P-value is less than 0.05 (5% significance level). To examine the stationary properties of the variables we run ADF and PP test on regression model with (i) constant, (ii) constant and trend, (iii) no constant and no trend. If the formerly mentioned condition of rejecting null hypothesis is met in all the three cases, then we conclude that the series is stationary. We first employ ADF and PP test on a series at level (without differenciencing). If the series is found non-stationary, then we apply ADF/PP test on its first difference. When a series is stationary at level, we denote it as I(0) whereas I(1) indicates that the series becomes stationery after its first difference.

The results of ADF test are presented in Table 6.4 and the results of PP test is shown in Table 6.5. Results of both the tables reveal that all the variables are non-stationary at their levels but become stationary after first difference. It is seen that in case of each variable the absolute ADF/PP test statistic is less than the absolute critical value and concerned P-value is greater than 0.05. So we fail to reject the null hypothesis at level. At first difference of each variable, the calculated ADF/PP test statistic and corresponding p-value clearly reject the null hypotheses of unit root at 5% significance level.

To verify the results of the ADF and PP tests, we have depicted two graphs for each time series variable - one for the level value of the variable and the other for the first difference of the variable (Figure 6.1). The graph for the level value of each variable shows either a uptrend or a downtrend from which we can easily take a decision that the series is non-stationary. The graph of first difference of each variable visually seems to have constant mean and constant variance over time which is consistent with the results of the ADF and PP tests.

Table 6.4: Results of Augmented Dickey-Fuller (ADF) Test

Variable	Test for Unit Root	Test Equation	ADF Test Statistic	Test Critical Value (5% Level)	P-Value	Stationary or not
LFDI	Level	Constant	-1.744882	-2.941145	0.4013	No
		Con. & Trend	-4.306493	-3.536601	0.0082	
		None	-0.420579	-1.949856	0.5249	
	1st difference	Constant	-6.177705	-2.945842	0.0000	Yes
		Con. & Trend	-6.119648	-3.540328	0.0001	
		None	-9.227609	-1.950117	0.0000	
LINF	Level	Constant	-3.365637	-2.941145	0.0187	No
		Con. & Trend	-3.409528	-3.533083	0.0651	
		None	-1.075632	-1.950394	0.2499	
	1st difference	Constant	-8.148221	-2.945842	0.0000	Yes
		Con. & Trend	-8.119125	-3.540328	0.0000	
		None	-8.188896	-1.950394	0.0000	
LINT	Level	Constant	-6.680031	-2.941145	0.0000	No
		Con. & Trend	-6.600477	-3.533083	0.0000	
		None	-0.478769	-1.950117	0.5015	
	1st difference	Constant	-10.28817	-2.943427	0.0000	Yes
		Con. & Trend	-10.16611	-3.536601	0.0000	
		None	-10.43195	-1.950117	0.0000	
LEXC	Level	Constant	-4.789217	-2.941145	0.0004	No
		Con. & Trend	-4.404594	-3.533083	0.0062	
		None	4.959109	-1.949856	1.0000	
	1st difference	Constant	-3.874374	-2.943427	0.0052	Yes
		Con. & Trend	-6.029961	-3.540328	0.0001	
		None	-2.983311	-1.950117	0.0039	
LEXD	Level	Constant	-0.666816	-2.941145	0.8430	No
		Con. & Trend	-4.011161	-3.536601	0.0169	
		None	-0.306770	-1.949856	0.5685	
	1st difference	Constant	-5.378942	-2.945842	0.0001	Yes
		Con. & Trend	-5.986407	-3.540328	0.0001	
		None	-4.523043	-1.950117	0.0000	
LCAB	Level	Constant	-1.843349	-2.945842	0.3543	No
		Con. & Trend	-1.951335	-3.540328	0.6072	
		None	-0.792133	-1.950394	0.3659	
	1st difference	Constant	-5.871021	-2.943427	0.0000	Yes
		Con. & Trend	-4.981794	-3.552973	0.0017	
		None	-7.223584	-1.950394	0.0000	
LGNE	Level	Constant	-4.806555	-2.941145	0.0004	No
		Con. & Trend	-6.589993	-3.533083	0.0000	
		None	-0.261548	-1.949856	0.5853	
	1st difference	Constant	-8.774968	-2.943427	0.0000	Yes
		Con. & Trend	-8.631709	-3.536601	0.0000	
		None	-8.934975	-1.950117	0.0000	
LAIR	Level	Constant	1.006748	-2.941145	0.9959	No
		Con. & Trend	-0.021761	-3.533083	0.9945	
		None	1.563638	-1.949856	0.9688	
	1st difference	Constant	-5.259282	-2.943427	0.0001	Yes
		Con. & Trend	-6.018394	-3.536601	0.0001	
		None	-5.034237	-1.950117	0.0000	

Table 6.5: Results of Phillips-Perron (PP) Test

Variable	Test for Unit Root	Test Equation	PP Test Statistic	Test Critical Value (5% Level)	P-Value	Stationary or not
LFDI	Level	Constant	-1.370472	-2.941145	0.5864	No
		Con. & Trend	-5.405719	-3.533083	0.0004	
		None	0.111344	-1.949856	0.7120	
	1st difference	Constant	-18.14811	-2.943427	0.0001	Yes
		Con. & Trend	-22.34719	-3.536601	0.0000	
		None	-10.54654	-1.950117	0.0000	
LINF	Level	Constant	-3.255343	-2.941145	0.0243	No
		Con. & Trend	-3.244312	-3.533083	0.0913	
		None	-1.098188	-1.949856	0.2419	
	1st difference	Constant	-9.822095	-2.943427	0.0000	Yes
		Con. & Trend	-11.59169	-3.536601	0.0000	
		None	-9.393497	-1.950117	0.0000	
LINT	Level	Constant	-6.680031	-2.941145	0.0000	No
		Con. & Trend	-6.603484	-3.533083	0.0000	
		None	-0.643204	-1.949856	0.4320	
	1st difference	Constant	-21.61501	-2.943427	0.0001	Yes
		Con. & Trend	-28.62832	-3.536601	0.0000	
		None	-20.80966	-1.950117	0.0000	
LEXC	Level	Constant	-4.293421	-2.941145	0.0016	No
		Con. & Trend	-4.168526	-3.533083	0.0113	
		None	3.537573	-1.949856	0.9998	
	1st difference	Constant	-3.777377	-2.943427	0.0067	Yes
		Con. & Trend	-4.131821	-3.536601	0.0126	
		None	-2.881780	-1.950117	0.0051	
LEXD	Level	Constant	-0.840203	-2.941145	0.7959	No
		Con. & Trend	-4.799466	-3.533083	0.0022	
		None	-0.291787	-1.949856	0.5741	
	1st difference	Constant	-4.510727	-2.943427	0.0009	Yes
		Con. & Trend	-4.947893	-3.536601	0.0015	
		None	-4.577076	-1.950117	0.0000	
LCAB	Level	Constant	-2.546031	-2.941145	0.1131	No
		Con. & Trend	-3.207895	-3.533083	0.0981	
		None	-1.618345	-1.949856	0.0987	
	1st difference	Constant	-7.071924	-2.943427	0.0000	Yes
		Con. & Trend	-9.343903	-3.536601	0.0000	
		None	-7.115503	-1.950117	0.0000	
LGNE	Level	Constant	-4.900056	-2.941145	0.0003	No
		Con. & Trend	-6.545627	-3.533083	0.0000	
		None	-0.393512	-1.949856	0.5355	
	1st difference	Constant	-17.97450	-2.943427	0.0001	Yes
		Con. & Trend	-19.88838	-3.536601	0.0000	
		None	-15.85611	-1.950117	0.0000	
LAIR	Level	Constant	0.868039	-2.941145	0.9940	No
		Con. & Trend	0.020365	-3.533083	0.9951	
		None	1.353175	-1.949856	0.9532	
	1st difference	Constant	-5.297949	-2.943427	0.0001	Yes
		Con. & Trend	-6.018394	-3.536601	0.0001	
		None	-5.082876	-1.950117	0.0000	

Figure 6.1: Graphical representation of the variables at log level and at first difference

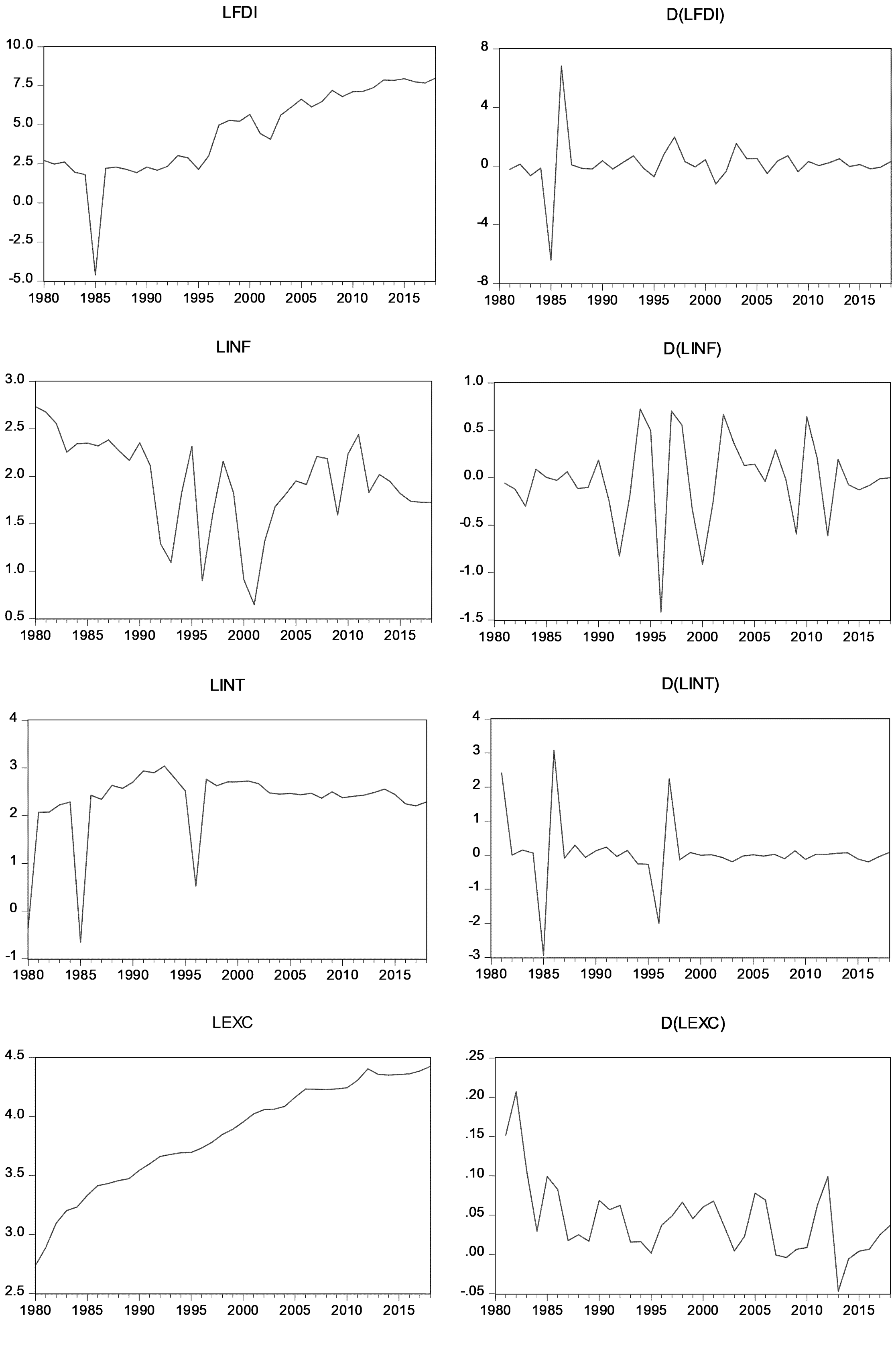
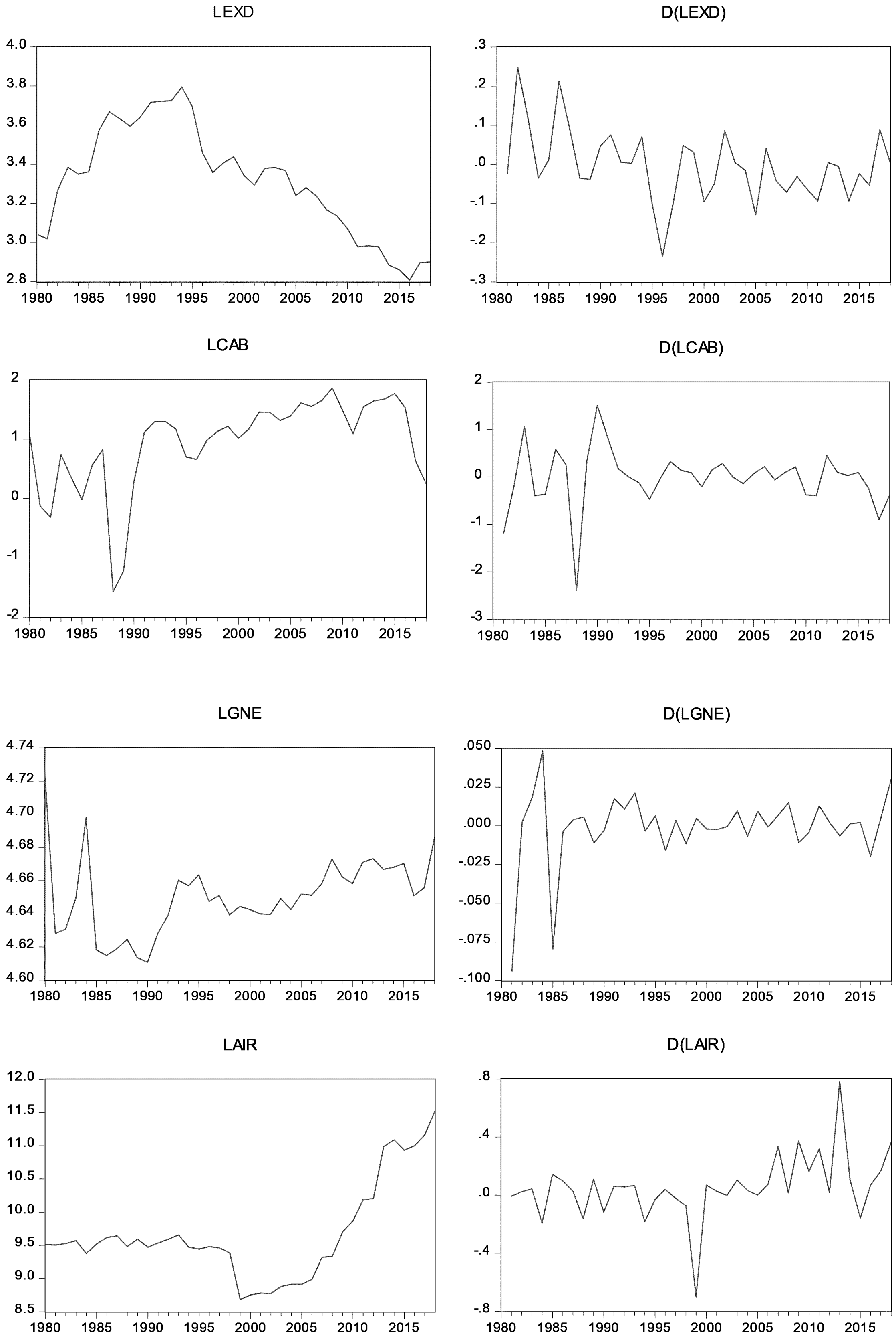


Figure 6.1 (Continued)



6.5 Selection of Optimal Lag Length

From the results of unit root test we have seen that all our variables are stationary at first difference, i.e., integrated of the same order. This suggests co-integration analysis to examine the long run relationship among the variables. The first step of cointegration test is the selection of optimal lag length. There are many methods that can determine the optimal lag period for the VAR model. We have performed five methods for this purpose that are widely used in the literature namely Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), Hannan-Quinn Criterion (HQ), Final Prediction Error (FPE), and Likelihood Ratio Test Statistic (LR). The results are shown in Table 6.6.

Liew (2004) found that Akaike's information criterion (AIC) and final prediction error (FPE) are superior than the other criteria under study in the case of small sample (60 observations and below), in the manners that they minimize the chance of under estimation while maximizing the chance of recovering the true lag length. Since our included observations 39 < 60, we can take decision as indicated by AIC and FPE criterions. AIC suggests us to take lag 2 whereas FPE along with other criterions suggest us to take lag 1.

From vector error correction estimates, we find:

When lag is 1, AIC = – 4.404112, SC = – 0.572740

When lag is 2, AIC = – 8.193311, SC = – 1.507342

The value of both AIC and SC is smaller when the lag is 2. The rule-of-thumb says, we have to choose the model that gives the lowest value because the lower the value, the better the model. Hence, the optimum lag is 2 for this model.

Table 6.6: VAR Lag Order Selection Criteria

Endogenous Variables: LFDI LINF LINT LEXC LEXD LCAB LGNE LAIR Exogenous Variables: C						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-61.30064	NA	5.85e-09	3.745980	4.094287	3.868775
1	173.6989	355.6750*	6.13e-13*	-5.497239	-2.362480*	-4.392090*
2	246.1829	78.36109	6.48e-13	-5.955835*	-0.034623	-3.868330

Note: * indicates lag order selected by the criterion

6.6 Results of Cointegration Test

After selecting optimal lag length for the VAR model, the next step is to determine the number of cointegrating vectors by using Johansen cointegration test. For deterministic trend assumption of the test, Johansen (1995) suggests five possible options:

1. No deterministic trend in data, no intercept and no trend in cointegrating equation;
2. No deterministic trend in data, intercept but no trend in cointegrating equation;
3. Linear deterministic trend in data, intercept but no trend in cointegrating equation;
4. Linear deterministic trend in data, intercept and trend in cointegrating equation;
5. Quadratic deterministic trend in data, intercept and trend in cointegrating equation.

It is very difficult to identify the appropriate one from these five intercept-trend cases. As per suggestion of Agung (2009), option (3) has been applied in this study. Results of Johansen test are presented in Table 6.7A, 6.7B, and 6.7C.

Table 6.7A: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value (at 0.05 level)	Prob.
None *	0.983516	369.3705	159.5297	0.0000
At most 1 *	0.902332	221.5763	125.6154	0.0000
At most 2 *	0.730850	137.8337	95.75366	0.0000
At most 3 *	0.664067	90.58415	69.81889	0.0005
At most 4 *	0.537490	51.31379	47.85613	0.0228
At most 5	0.311257	23.55464	29.79707	0.2199
At most 6	0.224129	10.13071	15.49471	0.2708
At most 7	0.027261	0.995030	3.841466	0.3185

Note: Trace test indicates 5 cointegrating equation(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 6.7B: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	Critical Value (at 0.05 level)	Prob.
None *	0.983516	147.7941	52.36261	0.0000
At most 1 *	0.902332	83.74267	46.23142	0.0000
At most 2 *	0.730850	47.24953	40.07757	0.0066
At most 3 *	0.664067	39.27036	33.87687	0.0103
At most 4 *	0.537490	27.75915	27.58434	0.0475
At most 5	0.311257	13.42393	21.13162	0.4140
At most 6	0.224129	9.135683	14.26460	0.2750
At most 7	0.027261	0.995030	3.841466	0.3185

Note: Max-eigenvalue test indicates 5 cointegrating equation(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 6.7C: Cointegrating Equation

Normalized cointegrating coefficients (standard error in parentheses)							
LFDI	LINF	LINT	LEXC	LEXD	LCAB	LGNE	LAIR
1.00000	-0.39365	-0.68375	-2.62391	3.69150	-0.45146	-25.8428	0.05567
	(0.08370)	(0.11896)	(0.26067)	(0.24543)	(0.10828)	(3.64233)	(0.04693)

As we know, the Johansen test has two forms: the trace test and the maximum eigenvalue test. The results of trace test (Table 6.7A) show that the λ_{trace} value for r = 0 is 369.3705 which exceeds its critical value of 159.5297 at 5% level (and also p-value 0 < 0.05). So we can reject the null hypothesis of no cointegration equations at 5% significance level. Similarly null hypotheses for $r \leq 1$ (at most 1 cointegration equation), $r \leq 2$ (at most 2 cointegration equations), $r \leq 3$ (at most 3 cointegration equations), and $r \leq 4$ (at most 4 cointegration equations) can be rejected. But at $r \leq 5$, the λ_{trace} value is 23.55464 which is less than its critical value of 29.79707 at 5% level (and also p-value 0.2199 > 0.05) meaning that we fail to reject the null hypothesis of existing at most five cointegration equations.

We also get similar results from maximum eigenvalue test (Table 6.7B). $\lambda_{\max}$ at $r = 0$ is 147.7941 exceeding its critical value of 52.36261 at 5% level (and also p-value 0 < 0.05) which rejects the null hypothesis of no cointegration equations at 5% significance level. Null hypotheses for $r = 1$, $r = 2$, $r = 3$, and $r = 4$ are also rejected in the same way. But at $r = 5$, the $\lambda_{\max}$ value 13.42393 is less than its critical value of 21.13162 at 5% level (and also p-value 0.4140 > 0.05) which means that we fail to reject the null hypothesis of existing exactly five cointegration equations.

So, both trace test and maximum eigenvalue test indicate 5 cointegrating equations at 5% significance level. Therefore, it can be concluded that a long-run relationship exists between dependent and independent variables.

In the presence of more than one cointegrating vector, Johansen and Juselius consider the first eigenvector to be the most useful (Mukherjee and Naka, 1995). Table 6.7C represents the normalized cointegrating coefficients for the first cointegrating equation. The signs of the coefficients are reversed in the equation because of the normalization process. As a result, the following long-run equation is found:

$$\begin{aligned} LFDI = {} & 0.39365\ LINF + 0.68375\ LINT + 2.62391\,LEXC - 3.69150\,LEXD \\ & + 0.45146\,LCAB + 25.8428\,LGNE - 0.05567\,LAIR \end{aligned} \tag{6.1}$$

The equation indicates that in the long run, inflation rate, interest rate, exchange rate, current account balance, and gross national expenditure have a positive impact on FDI. That is, an increase in any one of these variables will lead to an increase in FDI. The equation also indicates that external debt and air transport have a negative impact on FDI in the long run which means that an increase in external debt and air transport will lead to a decrease in FDI. Since Table 6.7C contains no p-value, we cannot say from this equation whether these relationships are significant or not. We will learn about this in the next discussion.

6.7 Results of Vector Error Correction Model (VECM)

The existence of cointegration vectors between variables suggests a long term relationship among the variables under consideration. In order to know the short-run and long-run relationship between the variables, the vector error correction model (VECM) is indicated. Table 6.8A and Table 6.8B represent the output of vector error correction model. Table 6.8A represents the cointegrating equation which can be expressed as follows:

$$\begin{aligned} ECT_{t-1} &= 1.000000\,LFDI_{t-1} - 0.393645\,LINF_{t-1} - 0.683746\,LINT_{t-1} \\ &\quad - 2.623906\,LEXC_{t-1} + 3.691501\,LEXD_{t-1} - 0.451464\,LCAB_{t-1} \\ &\quad - 25.84280\,LGNE_{t-1} + 0.055665\,LAIR_{t-1} + 115.7323 \end{aligned} \tag{6.2}$$

Where ECT is Error correction Term. From Table 6.8A, another equation (the long-run equation) can be formed as follows:

$$\begin{aligned} LFDI_{t-1} &= 0.393645\,LINF_{t-1} + 0.683746\,LINT_{t-1} + 2.623906\,LEXC_{t-1} \\ &\quad - 3.691501\,LEXD_{t-1} + 0.451464\,LCAB_{t-1} + 25.84280\,LGNE_{t-1} \\ &\quad - 0.055665\,LAIR_{t-1} - 115.7323 \end{aligned} \tag{6.3}$$

Excluding lag, equation (6.3) can be rewritten as:

$$\begin{aligned} LFDI &= 0.393645\,LINF + 0.683746\,LINT + 2.623906\,LEXC - 3.691501\,LEXD \\ &\quad 0.451464\,LCAB + 25.84280\,LGNE - 0.055665\,LAIR - 115.7323 \end{aligned} \tag{6.4}$$

Equation (6.4) looks like equation (6.1) with a constant. We may interpret equation (6.4) as follows: A one unit increase in inflation rate leads to a 0.39 unit increase in FDI in Bangladesh. Similarly a one unit increase in interest rate, exchange rate, current account balance, and gross national expenditure will increase FDI by 0.68, 2.62, 0.45, and 25.84 unit respectively. Again, FDI will decrease by 3.69 and 0.06 unit respectively due to a one unit increase in external debt as well as air transport.

Table 6.8A: Vector Error Correction Estimates (Cointegrating Equation)

Cointegrating Equation	Coefficients	Standard Errors	t-statistics
LFDI(-1)	1.000000	–	–
LINF(-1)	-0.393645	0.08370	-4.70316
LINT(-1)	-0.683746	0.11896	-5.74753
LEXC(-1)	-2.623906	0.26067	-10.0658
LEXD(-1)	3.691501	0.24543	15.0408
LCAB(-1)	-0.451464	0.10828	-4.16953
LGNE(-1)	-25.84280	3.64233	-7.09513
LAIR(-1)	0.055665	0.04693	1.18602
C	115.7323	–	–

Source: EViews output

Table 6.8B contains 8 columns for error correction estimates of 8 dependent variables namely D(LFDI), D(LINF), D(LINT), D(LEXC), D(LEXD), D(LCAB), D(LGNE), and D(LAIR). Among these 8 variables, our target dependent variable is D(LFDI). So we obtain the estimated VECM with D(LFDI) as target variable:

$$\Delta LFDI_t = 0.21741 ECT_{t-1} - 0.18759 \Delta LFDI_{t-1} + 0.33892 \Delta LFDI_{t-2}$$
$$+ 0.05779 \Delta LINF_{t-1} + 0.72954 \Delta LINF_{t-2} - 0.67040 \Delta LINT_{t-1} - 1.13460 \Delta LINT_{t-2}$$
$$+ 2.18055 \Delta LEXC_{t-1} + 2.82389 \Delta LEXC_{t-2} + 3.06611 \Delta LEXD_{t-1} - 0.00986 \Delta LEXD_{t-2}$$
$$+ 0.12706 \Delta LCAB_{t-1} + 0.06505 \Delta LCAB_{t-2} - 59.1326 \Delta LGNE_{t-1} - 9.78826 \Delta LGNE_{t-2}$$
$$+ 0.95540 \Delta LAIR_{t-1} + 0.89609 \Delta LAIR_{t-2} - 0.03157 \qquad (6.5)$$

Where ECT_{t-1} is defined in equation (6.2). Equation (6.5) is nothing but the numerical representation of the vector error correction model of equation (5.27). In equation (6.5), the coefficient of FDI_{t-1} is 0.18759. As an interpretation it can be said that a unit increase in FDI of lag 1 is associated with a 0.18759 times increase in FDI on average. Again, the coefficient of $LINT_{t-2}$ is -1.13460 which means that a unit increase in interest rate of lag 2 is associated with a 1.13460 times decrease in FDI.

Table 6.8B: Vector Error Correction Estimates

Error Correction	D(LFDI)	D(LINF)	D(LINT)	D(LEXC)	D(LEXD)	D(LCAB)	D(LGNE)	D(LAIR)
ECT	0.21741	0.08503	0.29747	-0.00412	-0.02793	0.33995	0.01956	-0.03217
D(LFDI(-1))	-0.18759	0.25780	0.14932	-0.00128	0.01270	-0.34653	-0.00871	-0.01551
D(LFDI(-2))	0.33892	0.04795	0.18503	0.00423	-0.01096	-0.37371	0.00048	0.03305
D(LINF(-1))	0.05779	-0.00170	-0.23580	0.02556	-0.00404	0.18576	0.00477	-0.14402
D(LINF(-2))	0.72954	-0.70545	-0.16451	-0.00939	-0.07359	0.14748	0.00011	0.00291
D(LINT(-1))	-0.67040	-0.42747	-0.80324	-0.01385	0.01784	0.24865	-0.00797	-0.11023
D(LINT(-2))	-1.13460	-0.12932	-0.50031	-0.00641	0.03287	0.15647	-0.01298	-0.15507
D(LEXC(-1))	2.18055	2.68021	6.24617	0.47124	1.11986	4.71978	0.14962	0.00679
D(LEXC(-2))	2.82389	1.06066	1.68793	-0.28523	-0.69619	-1.27015	-0.03355	-0.73669
D(LEXD(-1))	3.06611	1.86892	1.63865	-0.14510	0.14189	-1.82043	0.08888	1.19734
D(LEXD(-2))	-0.00986	-0.98440	0.04951	0.10712	0.04718	-0.80548	0.06426	-0.69094
D(LCAB(-1))	0.12706	-0.12309	0.02305	0.00388	0.00656	0.17924	0.00932	-0.07347
D(LCAB(-2))	0.06505	-0.16286	0.11408	-0.00152	-0.00906	-0.21084	0.00391	-0.01263
D(LGNE(-1))	-59.1326	-1.52741	-32.3287	0.45366	-0.96500	5.61989	-0.13571	5.85949
D(LGNE(-2))	-9.78826	13.9092	0.69307	-0.85011	0.64416	4.20786	-0.06646	-1.00780
D(LAIR(-1))	0.95540	0.17231	0.49018	-0.00191	0.01201	0.49034	0.03725	0.15245
D(LAIR(-2))	0.89609	0.58623	0.96434	-0.06887	-0.01333	0.13764	0.02567	0.11109
C	-0.03157	-0.23391	-0.38170	0.03173	-0.02742	-0.06088	-0.00323	0.07719

The first row of Table 6.8B represents the error correction terms. The coefficient of error correction term of FDI is 0.21741. That is, about 21.74% of disequilibrium corrected each year by the changes in FDI. The interpretation is that the previous periods deviation from long-run equilibrium is corrected in the current period as an adjustment speed of 21.74%. It confirms the stability of the system. The coefficient of error correction term of inflation rate is 0.08503. It implies that any divergence from equilibrium due to changes in inflation rate is corrected in the current period at a speed of 8.5%. It means that the speed of adjustment of inflation rate towards equilibrium is slow one. Similarly, the speed of adjustment towards equilibrium of interest rate, exchange rate, external debt, current account balance, gross national expenditure, and air transport are 29.75%, 0.4%, 2.79%, 34%, 1.96%, and 3.22% respectively.

6.8 Long-run and Short-run Relationship

Normalized cointegrating coefficients as well as VECM output produce no p-values and hence we cannot decide whether the existing long-run and short-run relationship between dependent and independent variables are significant or not. For this purpose we run ordinary least squares (OLS) method where equation (6.5) is specified as explicit equation. The results of OLS estimates are presented in Table 6.9. In the second column of the table, there are 17 coefficients and 1 constant denoted as C(1), C(2), and so on. Among these, C(1) is the long-run coefficient, C(2) to C(17) are the short-run coefficients, and C(18) is the constant.

6.8.1 Long-run Causality

In Table 6.9, C(1) is the error correction term or speed of adjustment towards long-run equilibrium. The value of C(1) has to be negative and statistically significant to retain its economic interpretation. By being negative, it tells us if there is a departure in one direction, the correction would have to be pulled back to the other direction so as to ensure that equilibrium is retained. Positive error correction coefficient is not a good sign for a model because it implies that the process is not converging in the long-run and that could be perhaps due to some instabilities in the model.

Table 6.9: VECM Coefficient with P-Values

Dependent Variable: D(LFDI)					
Method: Least Squares (Gauss-Newton / Marquardt steps)					
	Coefficient		Std. Error	t-Statistic	Probability
ECT	C(1)	0.217409	0.362261	0.600145	0.5559
D(LFDI(-1))	C(2)	-0.187594	0.346556	-0.541310	0.5949
D(LFDI(-2))	C(3)	0.338915	0.266002	1.274106	0.2188
D(LINF(-1))	C(4)	0.057791	0.539029	0.107212	0.9158
D(LINF(-2))	C(5)	0.729536	0.550259	1.325804	0.2015
D(LINT(-1))	C(6)	-0.670396	0.631318	-1.061899	0.3023
D(LINT(-2))	C(7)	-1.134596	0.497047	-2.282670	0.0348
D(LEXC(-1))	C(8)	2.180545	8.113015	0.268771	0.7912
D(LEXC(-2))	C(9)	2.823893	8.255974	0.342042	0.7363
D(LEXD(-1))	C(10)	3.066113	3.925007	0.781174	0.4449
D(LEXD(-2))	C(11)	-0.009856	3.198258	-0.003082	0.9976
D(LCAB(-1))	C(12)	0.127057	0.378010	0.336120	0.7407
D(LCAB(-2))	C(13)	0.065051	0.395870	0.164325	0.8713
D(LGNE(-1))	C(14)	-59.13262	17.85187	-3.312405	0.0039
D(LGNE(-2))	C(15)	-9.788259	16.42174	-0.596055	0.5586
D(LAIR(-1))	C(16)	0.955403	1.058882	0.902276	0.3788
D(LAIR(-2))	C(17)	0.896086	1.111596	0.806125	0.4307
C	C(18)	-0.031574	0.424467	-0.074384	0.9415
R^2		0.766718	Akaike info criterion		3.399987
Adjusted R^2		0.546396	Schwarz criterion		4.191746
F-statistic		3.479986	Hannan-Quinn criterion		3.676332
Probability (F-statistic)		0.005986	Durbin-Watson stat		1.994764

In our model, the value of C(1) is 0.217409 and the corresponding p-value is 0.5559. That is, C(1) is positive in sign and not statistically significant (since 0.5559 > 0.05). So, it can be said that there is no long-run causality running from independent variables (inflation rate, interest rate, exchange rate, external debt, current account balance, gross national expenditure, and air transport) to dependent variable FDI.

Table 6.10: Wald Test Results

Var.	Null Hypothesis	Test Statistic	Value	Prob.	Inference
LINF	C(4) = 0	F-statistic	0.011494	0.9158	Accepted
		Chi-square	0.011494	0.9146	
	C(5) = 0	F-statistic	1.757756	0.2015	Accepted
		Chi-square	1.757756	0.1849	
	C(4) = C(5) = 0	F-statistic	0.916925	0.4176	Accepted
		Chi-square	1.833849	0.3997	
LINT	C(6) = 0	F-statistic	1.127630	0.3023	Accepted
		Chi-square	1.127630	0.2883	
	C(7) = 0	F-statistic	5.210584	0.0348	Rejected at 5% level
		Chi-square	5.210584	0.0224	
	C(6) = C(7) = 0	F-statistic	2.675705	0.0961	Rejected at 10% level
		Chi-square	5.351410	0.0689	
LEXC	C(8) = 0	F-statistic	0.072238	0.7912	Accepted
		Chi-square	0.072238	0.7881	
	C(9) = 0	F-statistic	0.116993	0.7363	Accepted
		Chi-square	0.116993	0.7323	
	C(8) = C(9) = 0	F-statistic	0.180095	0.8367	Accepted
		Chi-square	0.360190	0.8352	
LEXD	C(10) = 0	Chi-square	0.610233	0.4449	Accepted
		F-statistic	0.610233	0.4347	
	C(11) = 0	Chi-square	0.000010	0.9976	Accepted
		F-statistic	0.000010	0.9975	
	C(10) = C(11) = 0	F-statistic	0.316428	0.7327	Accepted
		Chi-square	0.632857	0.7287	
LCAB	C(12) = 0	F-statistic	0.112977	0.7407	Accepted
		Chi-square	0.112977	0.7368	
	C(13) = 0	F-statistic	0.027003	0.8713	Accepted
		Chi-square	0.027003	0.8695	
	C(12) = C(13) = 0	F-statistic	0.069060	0.9335	Accepted
		Chi-square	0.138120	0.9333	
LGNE	C(14) = 0	F-statistic	10.97203	0.0039	Rejected at 1% level
		Chi-square	10.97203	0.0009	
	C(15) = 0	F-statistic	0.355282	0.5586	Accepted
		Chi-square	0.355282	0.5511	
	C(14) = C(15) = 0	F-statistic	5.817581	0.0113	Rejected at 1% level
		Chi-square	11.63516	0.0030	
LAIR	C(16) = 0	F-statistic	0.814101	0.3788	Accepted
		Chi-square	0.814101	0.3669	
	C(17) = 0	F-statistic	0.649838	0.4307	Accepted
		Chi-square	0.649838	0.4202	
	C(16) = C(17) = 0	F-statistic	0.810067	0.4604	Accepted
		Chi-square	1.620134	0.4448	

6.8.2 Short-run Causality

From Table 6.9 it is seen that among the short-run coefficients, only C(7) and C(14) are statistically significant. C(7) = – 1.134596 is the coefficient of interest rate at lag 2. That is, interest rate (at lag 2) has a significant negative relationship with FDI in the short-run. C(14) = – 59.13262, the coefficient of gross national expenditure at lag 1, also has a significant negative impact on FDI in the short-run. We run the Wald test to justify the short-run causalities of the variables. Results of Wald test are shown in Table 6.10.

C(4) and C(5) are the short-run coefficients associated with the variable inflation rate. C(4) is the coefficient of lagged 1 value and C(5) is the coefficient of lagged 2 value of the variable. Three hypotheses are tested to find out the short-run relationship of inflation rate with FDI:

1. C(4) = 0 (lagged 1 value of inflation rate has no short-run relationship with FDI)

2. C(5) = 0 (lagged 2 value of inflation rate has no short-run relationship with FDI)

3. C(4) = C(5) = 0 (lagged 1 and lagged 2 value of inflation rate jointly have no short-run relationship with FDI)

It is seen from the results presented in Table 6.10 that p-value of chi-square for null hypothesis C(4) = 0 is 0.9146 (> 0.05), for C(5) = 0 is 0.1849 (> 0.05), and for C(4) = C(5) = 0 is 0.3997 (> 0.05). So in any case, we cannot reject the null hypothesis of no short-run relationship with FDI. So, there is no short-run causality running from inflation rate to FDI. In other word, inflation rate is insignificant in explaining changes in FDI in the short-run.

The three hypotheses tested for checking the short-run relationship of interest rate with FDI are C(6) = 0, C(7) = 0, and C(6) = C(7) = 0. From the p-value of chi-square we see that the first null hypothesis is accepted whereas the second and third hypotheses are rejected at 5% and 10% significance level respectively. That is, there is a short-run causality running from interest rate to FDI. Since the coefficients are negative in sign, it can be said that interest rate has a significant negative impact on FDI in the short-run which is not consistent with the result of the long-run analysis where interest rate is found to have a positive relationship with FDI though this result is not significant.

For exchange rate, external debt, current account balance, and air transport, all the null hypotheses are accepted which means that there is no short-run causality running from these variables to FDI. For the variable gross national expenditure, null hypotheses C(14) = 0 and C(14) = C(15) = 0 are rejected at 1% significance level. So, gross national expenditure has a highly significant negative impact on FDI.

6.8.3 Discussion of Results

The impacts of various explanatory variables on FDI are summarized in Table 6.11. The results show that there exist a positive but insignificant impact of inflation rate on FDI in Bangladesh both in the long-run and short-run. This finding is not expected and contrary to our hypothesis. This may be due to the fact that many foreign investors are concentrated in export processing zones and they are not exposed to the local market (Jayasekara, 2014). According to Anna et al. (2011), inflation has a negative impact on investment only if it reaches a certain threshold. Usually a certain level of inflation, especially a single digit, is desirable to stimulate investment in an economy. However, our finding is similar to the findings of Botric and Skuflic (2006), Parajuli and Kennedy (2010), Anna et al. (2012), Hunady and Orvisca (2014), Alshamsi et al. (2015), Ouhibi et al. (2017), Asongu et al. (2018), Mahmood (2018), and Dalwai et al. (2019) where a positive but insignificant relationship between inflation and FDI has been reported. Not only that, AW and Tang (2009), Jadhav (2012), Saleem et al. (2013), Jayasekara (2014), Ogono et al. (2017), and Jaiblai and Shenai (2019) reported a positive significant relationship between these two.

Table 6.11: Long-run and Short-run Coefficients at a Glance

Independent Variable	Long-run Coefficients	Short-run Coefficients
Inflation Rate	0.393645	0.057791
Interest Rate	0.683746	-1.134596 **
Exchange Rate	2.623906	2.180545
External Debt	-3.691501	3.066113
Current Account Balance	0.451464	0.127057
Gross National Expenditure	25.84280	-59.13262 ***
Air Transport	-0.055665	0.955403

Note: ***, **, * denote 1%, 5%, and 10% significance level respectively

The long-run coefficient of interest rate has the expected positive sign but it is statistically insignificant as Hakro and Ghumrob (2007), Udoh and Egwaikhide (2008), Parajuli and Kennedy (2010), Anna et al. (2012), Wanjiru (2014), and Pondicherry and Tan (2017) found in their research. This finding is also consistent with the results of Akhtar (2001), AW and Tang (2009), Osinubi and Amaghionyeodiwe (2009), Gharaibeh (2015), Khan and Zahra (2016), Fornah and Yuehua (2017), and Mahmood (2018). The only difference is that the relationship is found to be significant in these studies. In contrast to the long-run relationship, the short-run coefficient reveals a negative and statistically significant (at 10% level) effect on FDI inflows. This implies that in the short-run, a 1% increase in interest rate leads to approximately 113.46% decrease in FDI in Bangladesh. This finding is in line with the findings of Beer and Cory (1996), Wijeweera and Mounter (2008), Jha et al. (2013), Hoang and Bui (2015), Khalil (2015), Kumari and Sharma (2017), and Tri et al. (2019).

Although statistically insignificant, the coefficient of exchange rate has the expected positive sign in the long-run as well as in the short-run. This means that the depreciation of Bangladeshi taka against U.S. dollar induces FDI flows in Bangladesh. Kahai (2004), Hara and Razafimahefa (2005), Gharaibeh (2015), and Fornah and Yuehua (2017) found the similar results. Froot and Stein (1991), Akhtar (2001), Cuyvers et al. (2008), Alba et al. (2009), Osinubi and Amaghionyeodiwe (2009), Walsh and Yu (2010, Omankhanlen (2011), Sharif-Renani and Mirfatah (2012), Bilawal et al. (2014), Faroh and Shen (2015), Hoang and Bui (2015), Pattayat (2016), and Khamphengvong et al. (2018) found positive and significant relationship between these two variables.

External debt, on the one hand, plays an important role in the economic development of a country, on the other hand, it exposes the weakness of the economy of that country. Therefore, it is difficult to come to a definite conclusion on whether external debt is conducive or a hindrance to the inflow of FDI in a country. Our results show that external debt burden has a negative but insignificant impact on FDI in the long-run which satisfies our previous assumption. This finding indicates that foreign investors are not interested in investing in a long-term debt-ridden country. This result is in line with the findings of Borensztein (1990), Shamsuddin (1994), Azam and Khan (2011), Ostadi and Ashja (2014), Ouhibi et al. (2017), and Wani and Rehman (2017). The short-run coefficient has the unexpected positive sign indicating that short-run debt is not a barrier to FDI inflows in Bangladesh. This result is similar to the findings of Onyeiwu and Shrestha (2004), Botric and Skuflic (2006), Kaur and Sharma (2013), Hunady and Orvisca (2014), Narayan (2014), Kiprotich (2015), and Chol (2020).

From 2012 to 2016, the current account balance of Bangladesh was continuously positive. It has been negative again in 2017 and 2018. This is not a good sign for the economy. Our results indicate that current account balance has a positive impact on FDI in the long-run as well as in the short-run. This means that a favourable current account balance attracts more FDI. Though coefficients in both cases are insignificant, this result is consistent with our hypothesis. Wint and Williams (2002) and Ogono et al. (2017) also reported an insignificant relationship between current account balance and FDI.

Gross national expenditure is found to have a significant negative effect on FDI in the short-run which satisfies our hypothesis. The coefficient value -59.13262 indicates that a one unit increase in gross national expenditure leads to a 59.13 unit decrease in FDI flows in Bangladesh. In Section 3.3.6 we have learnt that gross national spending is the combination of three types of spending viz government consumption spending, household consumption spending, and gross capital formation. There has been no research on gross national expenditure as a determinant of FDI, but it has been studied separately for each of the three types of expenditure. Anyanwu (2011), Gharaibeh (2015), Shah and Iqbal (2016), Othman et al. (2018), Agiomirgianakis et al. (2004), and Alavinasab (2013) found a positive correlation with government final consumption expenditure; Khalil (2015) and O'Meara (2015) found a positive correlation with household final consumption expenditure; and Awan et al. (2011), Jha et al. (2013), Wani and Rehman (2017), Othman et al. (2018), Akter (2015), Suleiman et al. (2015), and Chol (2020) found a positive correlation with gross capital formation. The results of these studies are consistent with our findings. However, the long-run coefficient in our model is found positive but insignificant. It is not impossible to come up with such a dichotomous result as the variable is a combination of three types of expenses. It may be that in the long run, consumption costs outweigh development and investment costs.

According to our result, transport facilities proxied by air transport (takeoffs of air carriers registered in the country) have a positive effect on FDI in the short-run. That is, the more the transportation facilities of a country, the higher its FDI inflows. Despite this result being insignificant, it is in line with the findings of Khadaroo and Seetanah (2009), Saidi and Hammami (2011), and Pradhan et al. (2013). The long-run relationship of air transport with FDI is found negative and insignificant. The results may not be contradictory if an appropriate proxy is available for transport facilities.

6.9 Results of Residual Diagnostic Tests

To evaluate the goodness-of-fit of the model, some diagnostic tests are performed. For this purpose, autocorrelation or serial correlation test, heteroskedasticity test and normality test are performed. The results of these tests are discussed in this section.

Table 6.12: Correlogram of Residuals

Q-statistic probabilities adjusted for 17 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.000	0.000	3.E-06	0.999
		2	-0.106	-0.106	0.4507	0.798
		3	-0.079	-0.080	0.7107	0.871
		4	0.159	0.150	1.7937	0.774
		5	0.137	0.126	2.6252	0.758
		6	0.083	0.114	2.9388	0.816
		7	-0.087	-0.038	3.2926	0.857
		8	-0.199	-0.203	5.2254	0.733
		9	-0.195	-0.276	7.1520	0.621
		10	0.324	0.252	12.674	0.242
		11	-0.155	-0.234	13.985	0.234
		12	-0.044	0.089	14.095	0.295
		13	-0.180	-0.076	16.016	0.248
		14	-0.042	-0.086	16.126	0.306
		15	0.103	0.126	16.823	0.330
		16	0.038	-0.070	16.920	0.391

*Probabilities may not be valid for this equation specification.

6.9.1 Results of Autocorrelation Test

Correlogram test and Breusch-Godfrey test are performed to check autocorrelation or serial correlation of the model,. Table 6.12 represents the results of Correlogram test. It is seen that AC and PAC at all lags are near zero and Q-statistics at all lags are insignificant since the concerned p-values are more than 5% meaning that we cannot reject the null hypothesis of no serial correlation. Moreover, all the spikes of ACF and PACF are within the dotted line which means there is no serial correlation in the model.

Table 6.13: Results of Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.231041	Probability of F-stat (2,15)	0.7963
Observed R^2	1.010500	Probability of χ^2 (2)	0.6034

Table 6.13 represents the results of Breusch-Godfrey Serial Correlation LM Test. It is seen that p-value of χ^2 is 0.6034 which is more than 0.05. Therefore we cannot reject the null hypothesis of no serial correlation. From the results of the both tests it is observed that there is no serial correlation in the model.

6.9.2 Results of Heteroskedasticity Test

To be confirmed about the existence of heteroskedasticity, Breusch-Pagan-Godfrey test and ARCH test are run. Results of Breusch-Pagan-Godfrey test are shown in Table 6.14. It is seen that p-value of χ^2 is 0.3386 which is more than 0.05. Therefore we the null hypothesis cannot be rejected indicating that there is no heteroskedasticity in the model.

Table 6.14: Results of Breusch-Pagan-Godfrey Heteroskedasticity Test

F-statistic	1.241104	Probability of F-stat (24,10)	0.3658
Observed R^2	26.29091	Probability of χ^2 (24)	0.3386

Table 6.15 presents the results of ARCH test. In this case, p-value of χ^2 is 0.9833 which is more than 0.05 meaning that we cannot reject the null hypothesis of no ARCH effect. So, there is no heteroskedasticity in the model.

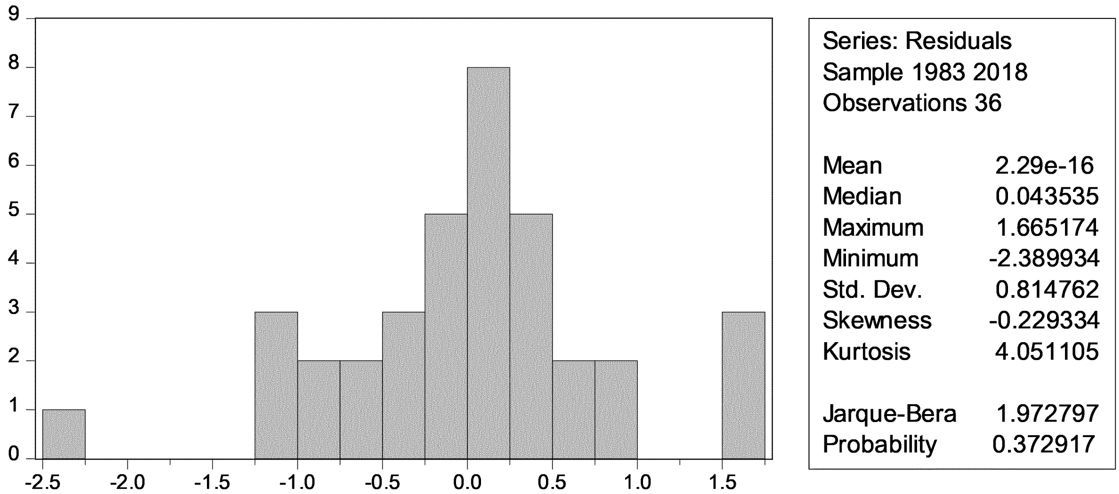
Table 6.15: Results of ARCH Heteroskedasticity Test

F-statistic	0.015353	Probability of F-stat (2,30)	0.9848
Observed R^2	0.033645	Probability of χ^2 (2)	0.9833

6.9.3 Results of Normality Test

Jarque-Bera test is performed to test for the normality of the model. Figure 6.2 shows that the p-value of Jarque-Bera is 0.372917 which is more than 0.05. So, we cannot reject the null hypothesis that the residuals are normally distributed. This is also supported by the skewness of the model (-0.229334) which lies between -0.5 and +0.5 meaning that the distribution is approximately symmetric.

Figure 6.2: Results of Jarque-Bera Normality Test



6.10 Results of Stability Tests

To test the stability of the parameters, CUSUM test and CUSUM of Squares test are performed. Since both the plots remain within critical bounds at 5% level of significance, we conclude that the model is structurally stable. In other words, there is no structural break in the model.

Figure 6.3A: Plot of CUSUM test

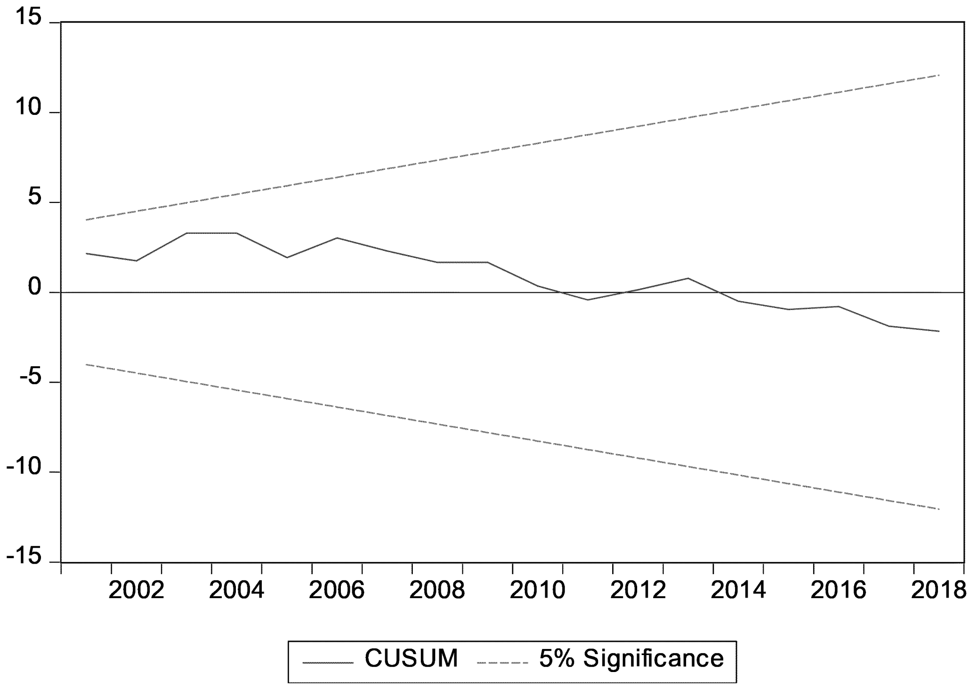
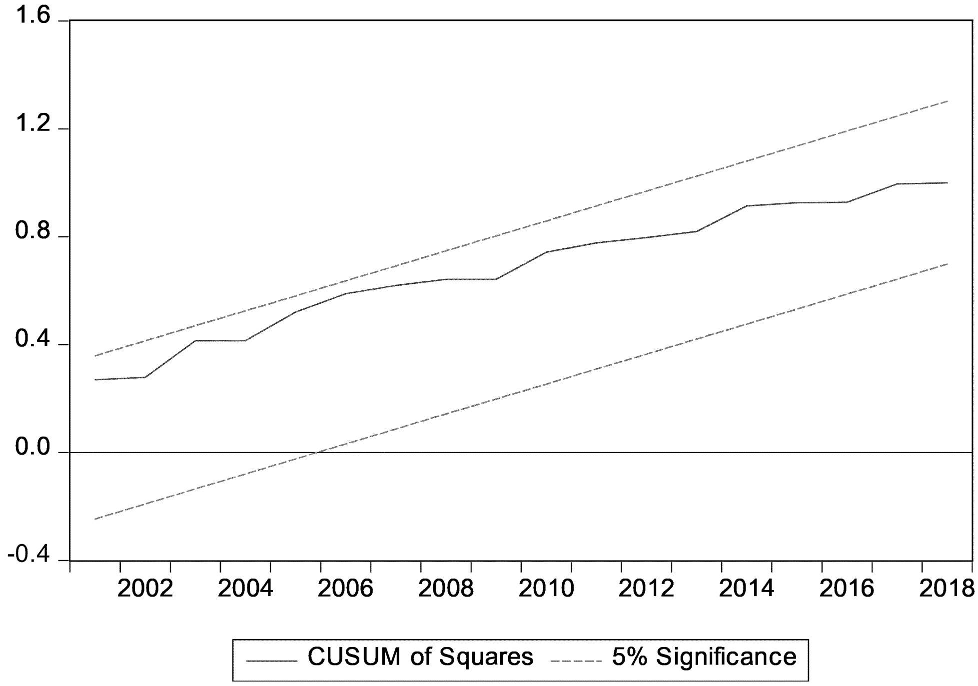


Figure 6.3B: Plot of CUSUM of Squares test



The model has no serial correlation, no heteroskedasticity/ARCH effect, it is normally distributed and structurally stable. The value of R-squared in the model is 0.766718 which means that 76.67% variation in FDI can be explained by explanatory variables jointly. The probability of F-statistic is 0.005986 which is less than 0.01 (that is, significant at 1% level). This means that explanatory variables can jointly influence FDI. So, it can be concluded that the model has a very good fit.

6.11 Results of Granger Causality Test

In a VEC model, there are two possible sources of causality: error correction term, which shows long-term causality, and lagged explanatory variables, which reveals short-run causality. If no cointegration exists between the series, short run relationships between the series are examined by employing Granger causality test for the VAR model. According to Alshogeathri (2011), if the variables are not cointegrated by Johansen technique, then Granger causality test is appropriate to examine the short run dynamic relationships among these variables. So we conduct VEC Granger causality test (Table 6.16) as well as Pairwise Granger causality test

(Table 6.17) among variables to test whether each of the independent variables affects the dependent variable or vice versa.

From Table 6.16 it is seen that in the case of INF ↔ FDI, we cannot reject the null hypothesis that changes in inflation rate do not Granger cause changes in FDI since the p-value in this case is more than 0.05 or even 0.10. So there is no short run causality running from inflation rate to FDI. But the reverse null hypothesis that changes in FDI do not Granger cause changes in inflation rate is rejected since the p-value in this case is less than 0.05 (0.0361). This result indicates that there exists a unidirectional short run Granger causality running from FDI to inflation rate. Results of Pairwise Granger causality test as shown in Table 6.17 indicate that there is no short run causality between inflation rate and FDI and they are independent to each other.

Table 6.16: Results of VEC Granger Causality Test

Null Hypothesis:	Chi-square	Probability	Inference
D(LINF) does not Granger Cause D(LFDI)	1.833849	0.3997	Accepted
D(LFDI) does not Granger Cause D(LINF)	6.641535	0.0361 **	Rejected
D(LINT) does not Granger Cause D(LFDI)	5.351410	0.0689 *	Rejected
D(LFDI) does not Granger Cause D(LINT)	3.010842	0.2219	Accepted
D(LEXC) does not Granger Cause D(LFDI)	0.360190	0.8352	Accepted
D(LFDI) does not Granger Cause D(LEXC)	0.453298	0.7972	Accepted
D(LEXD) does not Granger Cause D(LFDI)	0.632857	0.7287	Accepted
D(LFDI) does not Granger Cause D(LEXD)	1.208964	0.5464	Accepted
D(LCAB) does not Granger Cause D(LFDI)	0.138120	0.9333	Accepted
D(LFDI) does not Granger Cause D(LCAB)	16.18474	0.0003 ***	Rejected
D(LGNE) does not Granger Cause D(LFDI)	11.63516	0.0030 ***	Rejected
D(LFDI) does not Granger Cause D(LGNE)	5.289574	0.0710 *	Rejected
D(LAIR) does not Granger Cause D(LFDI)	1.620134	0.4448	Accepted
D(LFDI) does not Granger Cause D(LAIR)	0.534822	0.7654	Accepted

Note: ***, **, * denote 1%, 5%, and 10% significance level respectively

In the case of INT ↔ FDI, VEC causality test rejects the null hypothesis 'interest rate does not Granger cause FDI' at 10% significance level and Pairwise causality test rejects the hypothesis at 5% significance level. But no tests reject the reverse null hypothesis 'FDI does not Granger cause interest rate' indicating a unidirectional short run Granger causality running from interest rate to FDI.

In the case of GNE ↔ FDI, both VEC and Pairwise tests reject the null hypothesis that gross national expenditure does not Granger cause FDI at 1% significance level. VEC test rejects the reverse null hypothesis 'FDI does not Granger cause gross national expenditure' at 10% level but Pairwise test rejects the null hypothesis at 5% level. Therefore, a bidirectional Granger causality exists between gross national expenditure and FDI. This means that each leads to another.

Table 6.17: Results of Pairwise Granger Causality Test

Null Hypothesis:	F-Statistic	Probability	Inference
LINF does not Granger Cause LFDI	0.24222	0.7863	Accepted
LFDI does not Granger Cause LINF	0.33313	0.7191	Accepted
LINT does not Granger Cause LFDI	4.46797	0.0194 **	Rejected
LFDI does not Granger Cause LINT	0.31012	0.7355	Accepted
LEXC does not Granger Cause LFDI	9.45952	0.0006 ***	Rejected
LFDI does not Granger Cause LEXC	3.84569	0.0319 **	Rejected
LEXD does not Granger Cause LFDI	0.15243	0.8592	Accepted
LFDI does not Granger Cause LEXD	11.6071	0.0002 ***	Rejected
LCAB does not Granger Cause LFDI	0.62110	0.5437	Accepted
LFDI does not Granger Cause LCAB	1.22910	0.3060	Accepted
LGNE does not Granger Cause LFDI	8.19604	0.0013 ***	Rejected
LFDI does not Granger Cause LGNE	3.90844	0.0303 **	Rejected
LAIR does not Granger Cause LFDI	1.24273	0.3022	Accepted
LFDI does not Granger Cause LAIR	1.25358	0.2991	Accepted

Note: ***, **, * denote 1%, 5%, and 10% significance level respectively

Both tests signify that there is no short run causality between air transport and FDI. In the case of other explanatory variables, different causality has been found in both tests. In VEC test, exchange rate, external debt, and air transport are found independent to FDI and vice versa. VEC results also indicate that there exists a unidirectional short run Granger causality running from FDI to current account balance. The results of Pairwise causality test reveal that there exists a unidirectional Granger causality running from FDI to external debt and a bidirectional Granger causality between exchange rate and FDI. The Pairwise test results also point out that current account balance has no short-run Granger causality with FDI.

6.12 Impulse Response Function (IRF)

Figure 6.4 presents impulse response functions under VECM, which reveal impulses of LFDI to shocks in LFDI itself, LINF, LINT, LEXC, LEXD, LCAB, LGNE, and LAIR. We see different graphs with response of one standard deviation positive shock to the other.

Response of LFDI to LFDI: A highly sharp decrease is noticed in the response of LFDI from period 1 to period 2 due to a one standard deviation positive shock to LFDI itself. From period 2 to period 4, the change in response line is negligible. We notice a remarkable increase from period 4 to 5, a remarkable decrease from period 5 to 6, a stable condition from period 6 to 7, and a remarkable increase from period 7 to period 8. From period 8 to period 12, it remains almost stable. Noticeable matter is that the response line never goes under the zero line and hence it can be concluded that a shock to LFDI has a positive impact on itself both in the long-run and short-run.

Response of LFDI to LINF: Due to a one standard deviation positive shock to LINF, we notice a gradual increase in response of LFDI until period 4. Then the response line sharply decreases at period 5 and remains almost stable until period 6. After period 6, a noticeable rise is seen until period 7. Then a slow decrease is seen until period 10. From period 10 to period 12, the change is negligible. The whole time the response line is above the zero line. So, the concluding remark is that a shock to LINF does have a positive impact on LFDI both in the long-run and short-run.

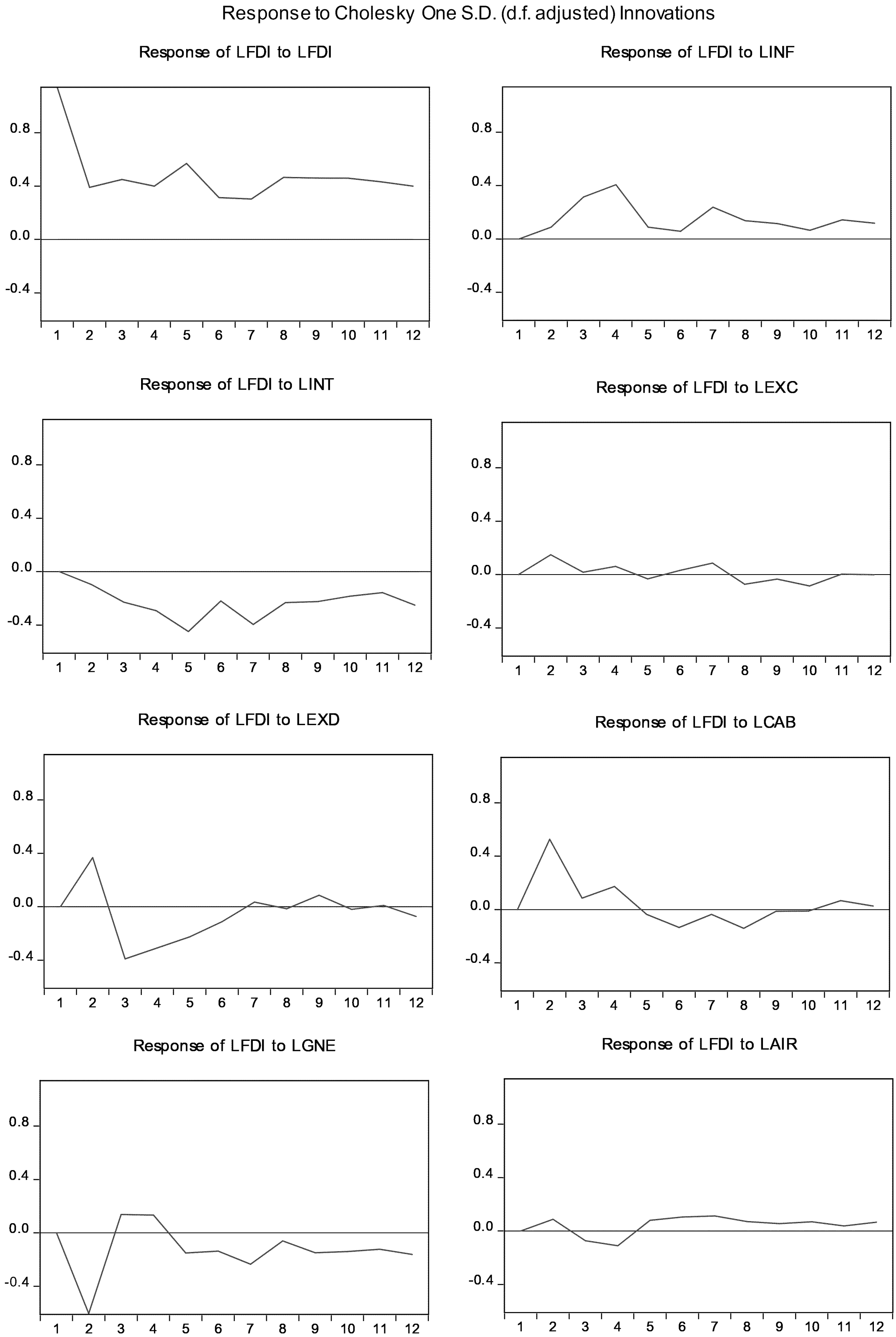
Response of LFDI to LINT: A one standard deviation positive shock to LINT has a negative impact on LFDI from the beginning. Initially a gradual decline in the response is seen until period 5. Then we see an increase from period 5 to period 6, a decrease from period 6 to period 7 and again an increase from period 7 to period 8. From period 8 to the rest of the period, the change in response line is not so significant. However, the response line is in the negative region the whole time. Hence, a shock to LINT does have a negative impact on LFDI both in the long-run and short-run.

Response of LFDI to LEXC: A one standard deviation positive shock to LEXC increases LFDI until period 2. Then the response line begins to decline and touches the zero line at period 3 and after that a slight increase is seen until period 4. Again a slight decrease is seen and at period 5, it enters into the negative region. Then a slow increase is noticed until period 7. This time the response line enters into the positive region. Again the response line declines and remains into the negative region for the rest of the period. So, it can be said that a shock to LEXC has asymmetric impacts on LFDI in the short-run as well as in the long-run.

Response of LFDI to LEXD: Due to a one standard deviation positive shock to LEXD, LFDI increases sharply until period 2 and then sharply declines until period 3. Between period 2 and 3, the response line enters into the negative region. After period 3, a gradual increase is seen until period 7 and at this time it enters into the positive region. Then a slight increase in one period and a slight decrease in the next period – continues like this. In this case it can be concluded that a shock to LEXD has asymmetric impacts on LFDI both in the short-run and long-run.

Response of LFDI to LCAB: A one standard deviation positive shock to LCAB has a positive impact on LFDI in the beginning. In the positive region, the response rises sharply from period 1 to period 2, then sharply falls until period 3, and again rises until period 4. Then a gradual decrease is seen until period 6. However, at period 5, it enters into the negative region and remains in this region until period 10. So, a shock to LCAB has asymmetric impacts on LFDI both in the short-run and long-run.

Figure 6.4: Plot of Impulse Response Function



Response of LFDI to LGNE: A one standard deviation positive shock to LGNE causes LFDI to decrease sharply until period 2 in the negative region. This negative response suddenly begins to rise until period 3. From period 3 to period 4, we notice a stable condition in the positive region. Then it declines and enters into the negative region again and remains in this region until the rest of the period. However, from period 5 to 6, a stable condition is noticed, from period 6 to 7, a slow decrease is seen, and from period 7 to 8, a remarkable rise is noticed. For the rest of the period, the response line remains approximately stable. It can be concluded that a shock to LGNE has asymmetric impacts on LFDI in the short-run whereas a negative effect in the long-run.

Response of LFDI to LAIR: The response of LFDI due to a one standard deviation positive shock to LAIR starts in the positive region and rises gradually from period 1 to period 2, then the response begins to decline and enters into the negative zone at period 3. From period 3 to period 4, the response remains approximately steady in the negative region. After period 4, the response gradually increases until period 5 and enters into the positive zone again. Then the response line remains approximately steady for the rest of the period. In this case it can be concluded that a shock to LAIR has asymmetric impacts on LFDI in the short-run but has a positive impact in the long-run.

6.13 Variance Decompositions

Variance decomposition is an alternative method to impulse response function for investigating the effects of shocks to the dependent variables. It determines how much of the forecast error variance of a variable is explained by innovations or shocks to other explanatory variable, over a series of time horizons. Usually own series shocks explain most of the error variance, although the shock also affects other variables in the system. Table 6.18 presents the variance decompositions of FDI. So all the figures here represents the percentage of the forecast error variance for FDI. We choose 12 periods meaning that we want to forecast 12 years into the future.

In period 1, the forecast error variance of FDI is explained 100% by itself. That is, in period 1, impulse or innovation or shock to FDI can cause 100% variation of the fluctuation in FDI itself. In period 2, the forecast error variance of FDI is decomposed into its own variance (63.6%) followed by inflation rate (0.35%), interest rate (0.41%), exchange rate (0.98%), external debt (5.99%), current account balance (12.2%), gross national expenditure (16.13%), and air transport (0.34%). In subsequent years we see that influence of FDI itself, current account balance, and gross national expenditure are decreasing while the influence of interest rate, and air transport are increasing as we move further into the future. It tells us that FDI is exhibiting weak endogenous influence on FDI itself; current account balance and gross national expenditure are exhibiting strong exogenous influence on FDI, and interest rate and air transport are exhibiting strong endogenous influence on FDI as we move on into the future. The other variables do not show any trend.

Table 6.18: Variance Decomposition of FDI using Cholesky Factors

Period	S.E.	LFDI	LINF	LINT	LEXC	LEXD	LCAB	LGNE	LAIR
1	1.1361	100.000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	1.5063	63.5968	0.3485	0.4113	0.9802	5.9930	12.202	16.1327	0.3356
3	1.6752	58.6008	3.8105	2.1974	0.8045	10.291	10.123	13.7156	0.4570
4	1.8370	53.4782	8.0538	4.3528	0.7800	11.372	9.2948	11.9254	0.7433
5	1.9975	53.3765	7.0081	8.7067	0.6868	10.883	7.8940	10.6559	0.7888
6	2.0494	53.0433	6.7341	9.4080	0.6765	10.635	7.9258	10.5634	1.0135
7	2.1406	50.6229	7.4135	12.023	0.7840	9.7750	7.2941	10.8810	1.2067
8	2.2146	51.6932	7.3108	12.329	0.8388	9.1369	7.2209	10.2399	1.2302
9	2.2832	52.6874	7.1295	12.558	0.8108	8.7387	6.7964	10.0638	1.2153
10	2.3439	53.8343	6.8424	12.531	0.8995	8.2981	6.4509	9.9058	1.2383
11	2.3973	54.7151	6.9009	12.406	0.8601	7.9343	6.2431	9.7325	1.2086
12	2.4536	54.8972	6.8181	12.881	0.8211	7.6642	5.9713	9.7212	1.2263

6.14 Conclusion

This study is conducted to investigate the impacts of some macroeconomic variables on FDI in Bangladesh. We examine the long-run, short-run, and causal relationship of inflation rate, interest rate, exchange rate, external debt, external balance, current account balance, and GDP growth rate with FDI in Bangladesh. For showing the relationships, the study uses some time series econometric techniques.

We execute some tests to check usual and conventional properties of time series. To check multicollinearity of the series, bivariate correlation and variance inflation factor are calculated and justified. Results of both procedures ensure us that there is no multicollinearity in the model. We have run ADF and PP unit root tests to check for the statioanrity properties of the variables. All the variables are found stationary in their first differences. The graphical representations of the variables also verifies this results. This means that all the variables are integrated of order one which suggests cointegration analysis as the next step.

The optimal lag length for the VAR system is selected using five different criteria. The likelihood ratio test statistic (LR), final prediction error (FPE), Schwarz information criterion (SC), and Hannan-Quinn criterion (HQ) suggests for lag 1, whereas Akaike information criterion (AIC) suggests for lag 2. Since the vector error correction estimates give the lower AIC and SC value when the lag is 2, the optimum lag for this model is 2 because the lower the value, the better the model.

Both trace test and maximum eigenvalue test of Johansen cointegration test support 5 cointegrating vectors at 5% significance level which indicates that there exists a long-run relationship between FDI and independent variables. In case of more than one cointegrating vector, the first eigenvector is considered to be the most useful in examining the long run relationship between variables in the system. The normalized cointegrating coefficients for the first cointegrating vector gives the long run relationship between FDI and the explanatory variables. It indicates that inflation rate, interest rate, exchange rate, current account balance, and gross national expenditure have a positive impact on FDI whereas external debt and air transport have a negative impact on FDI in the long-run.

Results of VECM show that the coefficient of error correction term of FDI is positive (0.217409) and insignificant. It indicates that there is no long run causality running from the explanatory variables (inflation rate, interest rate, exchange rate, external debt, current account balance, gross national expenditure, and air transport) to the dependent variable (FDI). The error correction term implies that about 21.74% of the last year's disequilibrium is corrected this year by changes in FDI.

To see the short-run dynamics of the model, Wald test is performed. In Wald test results, interest rate and gross national expenditure are found to have a significant negative impact on FDI in the short-run. To investigate the short-run causality of the explanatory variables, VEC Granger causality test and pairwise Granger causality test are run. Results of both tests show that there exists a unidirectional short run Granger causality running from interest rate to FDI. Both tests also signify that a bidirectional short-run Granger causality exists between gross national expenditure and FDI and there is no short run causality between air transport and FDI. In the case of other explanatory variables, different causality has been found in both tests.

From the findings of this study, it can be recommended that in order to increase FDI inflows in Bangladesh, a stable price level should be maintained, the rise in interest rate needs to be controlled, devaluation of foreign currencies against taka should be prevented, excessive reliance on external debt should be avoided, a favourable current account balance should be maintained, unnecessary spending should be reduced, and transportation facilities should be increased.

Chapter 7

Estimated Results: Volatility Analysis

7.1 Introduction

Volatility refers to fluctuations in a variable over a period of time. Numbers of variables are subject to volatility, which can be measured by the variance of the relevant time series. According to Marra (2015), uncertainty is inherent in every financial model. The purpose of this chapter is to analyze volatilities of different explanatory variables of our study and investigate their impacts on FDI in Bangladesh. Hence, this chapter has been divided into two main parts. In the first part, volatility of different macroeconomic variables are analyzed and forecasted. In the second part, the impacts of volatility of various macroeconomic variables on foreign investment are examined.

The first part (Section 7.2) is organized as: Section 7.2.1 Eligibility for ARCH/GARCH model, Section 7.2.2 Descriptive Statistics, Section 7.2.3 Unit Root Test, Section 7.2.4 Volatility of Inflation Rate, and Section 7.2.5 Volatility of Exchange Rate. The second part (Section 7.3) is organized as: Section 7.3.1 Results of Multicollinearity Test, Section 7.3.2 Results of Unit Root Test, Section 7.3.3 Selection of Optimal Lag Length, Section 7.3.4 Results of ARDL Bounds Cointegration Test, Section 7.3.5 Results of ARDL Error Correction Regression, Section 7.3.6 ARDL-ECM (OLS Approach), Section 7.3.7 Discussion of Results. Section 7.4 presents the Conclusion of this chapter.

7.2 Volatility of Variables

This section aims to analyze the volatility of inflation rate, interest rate, exchange rate, external debt, current account balance, gross national expenditure, and air transport through GARCH (1,1) model.

7.2.1 Eligibility for ARCH/GARCH Model

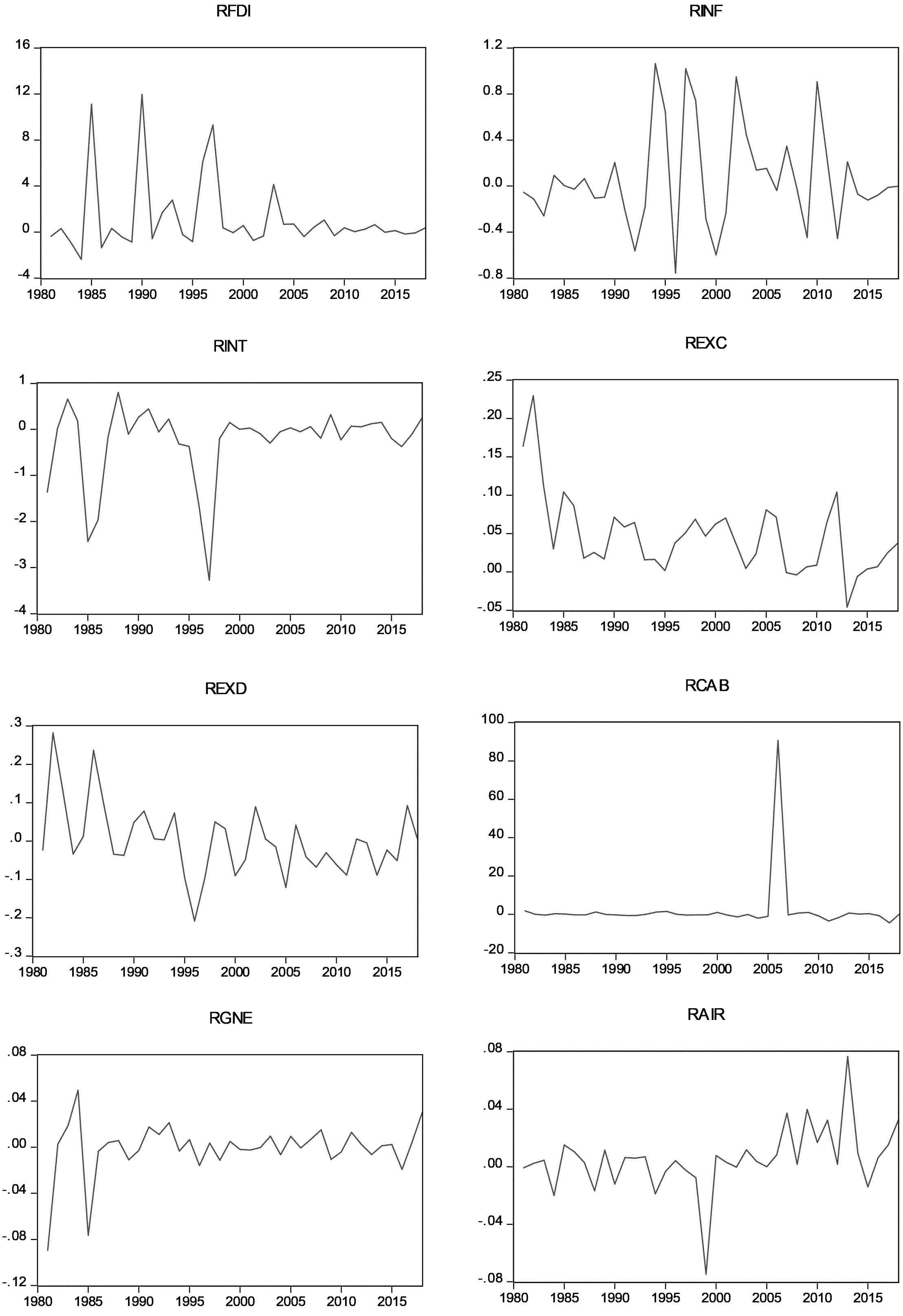
Whether or not GARCH methodology can be applied to a series is usually verified in two ways: (i) the clustering volatility, (ii) the presence of ARCH effect. Volatility clustering, as noted by Mandelbrot (1963), refers to the observations when large changes tend to be followed by further large changes, and small changes tend to be followed by further small changes. Since we have only 39 observations, it is not possible to understand the volatility clustering by looking at the graphical representations of the series (Figure 7.1). Hence, we test for the possible presence of ARCH effects before estimating ARCH models. We do not need to estimate the ARCH model if there is no ARCH effect in the series because in that case the ARCH model does not exhibit the appropriate results.

Results of ARCH heteroskedasticity test are presented in Table 7.1. It is seen that the p-value of chi-square is 0.0671 for RINF which is less than 0.10. In this case, the null hypothesis of no ARCH effect is rejected at 10% significance level. So, there is ARCH effect in the RINF series. Similarly, the null hypothesis of REXC series are rejected at 5% significance level. The other series namely RFDI, RINT, REXD, RCAB, RGNE, and RAIR do not exhibit ARCH effect. Therefore, we estimate ARCH model for RINF and REXC series. Note that while formulating the models, *t* distribution is applied since REXC series is not normally distributed and the AIC value of RINF series is lower in *t* distribution than in normal distribution, although RINF is normally distributed.

Table 7.1: Heteroskedasticity Test - ARCH

Var.	Observed R^2	Probability of χ^2	Null Hypothesis	Inference
RFDI	0.022869	0.8798	Accepted	No ARCH effect
RINF	3.353012	0.0671	Rejected at 10%	ARCH effect
RINT	1.055002	0.3044	Accepted	No ARCH effect
REXC	6.487882	0.0109	Rejected at 5%	ARCH effect
REXD	0.013573	0.9073	Accepted	No ARCH effect
RCAB	0.028148	0.8668	Accepted	No ARCH effect
RGNE	0.939302	0.3325	Accepted	No ARCH effect
RAIR	0.467766	0.4940	Accepted	No ARCH effect

Figure 7.1: Graphical Representations of the Return Series



7.2.2 Descriptive Statistics

Descriptive statistics, such as, mean, median, standard deviation, skewness, kurtosis and Jarque-Bera are estimated in this section. Table 7.2 reveals that the standard deviation of INF and EXC returns are 0.441474 and 0.051007 respectively. The higher the standard deviation, the higher the volatility and the riskier the asset. So, RINF shows higher volatility than REXC. The coefficient of skewness shows that RINF is moderately skewed whereas REXC is highly skewed. The value of excess kurtosis (kurtosis – 3) for RINF is close to zero which indicates that the distribution is normal (mesokurtic). This is also supported by the Jarque-Bera statistic since the concerned p-value (0.207431) is greater than 0.05 which fails to reject the null hypothesis of normality. The excess kurtosis for REXC is greater than zero (positive) which indicates that the distributions are leptokurtic, that is, has more higher values (peaked curve). The p-value of Jarque-Bera statistic for REXC indicates that the distribution is not normal.

Table 7.2: Descriptive Statistics

Measures	RINF	REXC
Mean	0.065104	0.046545
Median	-0.02533	0.037465
Maximum	1.064451	0.229680
Minimum	-0.75734	-0.045920
Std. Dev.	0.441474	0.051007
Skewness	0.701540	1.417178
Kurtosis	3.135117	6.048355
Jarque-Bera	3.145911	27.43290
Probability (JB)	0.207431	0.000001

7.2.3 Unit Root Test

Since GARCH processes are based on the concept of stationarity, we have to make sure that the return series are stationary. To investigate whether the return series of INF and EXC are stationary, Augmented Dickey Fuller (ADF) test and Phillips-Perron (PP) test have been applied. Results of ADF and PP unit root tests in Table 7.3 and Table 7.4 reveal that the null hypothesis of unit root is strongly rejected at 5% significant level for RINF and REXC. It confirms that all the series under consideration are stationary, that is, they do not follow a random walk. Hence, we can follow GARCH processes.

Table 7.3: Results of ADF Test

Var.	Test for Unit Root	Test Equation	ADF Test Statistic	Test Critical Value (5% Level)	P-Value	Stationary Order
RINF	Level	Constant	-6.851216	-2.945842	0.0000	I(0)
		Con. & Trend	-6.778542	-3.540328	0.0000	
		None	-6.551220	-1.950394	0.0000	
REXC	Level	Constant	-3.848994	-2.943427	0.0055	I(0)
		Con. & Trend	-6.237108	-3.540328	0.0000	
		None	-3.015709	-1.950117	0.0036	

Table 7.4: Results of PP Test

Var.	Test for Unit Root	Test Equation	PP Test Statistic	Test Critical Value (5% Level)	P-Value	Stationary Order
RINF	Level	Constant	-6.242109	-2.943427	0.0000	I(0)
		Con. & Trend	-6.226660	-3.536601	0.0000	
		None	-5.982225	-1.950117	0.0000	
REXC	Level	Constant	-3.770774	-2.943427	0.0068	I(0)
		Con. & Trend	-4.020393	-3.536601	0.0166	
		None	-2.925581	-1.950117	0.0046	

7.2.4 Volatility of Inflation Rate

Inflation refers to the ongoing decline in the overall purchasing power of the currency unit. Modern economists always support a mild but stable inflation as it indicates the dynamics of the economy. Among the harmful effects of inflation, the negative consequences of inflation volatility are of particular concern (Rother, 2004). High and volatile inflation creates uncertainty in the economy and makes financial planning difficult. Economic research shows that high inflation volatility imposes significant costs on an economy because the future inflation rate is that much less predictable. Evidences from literatures indicate that high and volatile inflation retards economic growth and raises both poverty and income inequality. Although there has been much discussion about high inflation, considerable attention has not been paid to inflation volatility, though it has a significant impact on the way people make economic decisions.

The importance of inflation volatility has become a major issue in the literature on the relationship between inflation and growth. There is a general perception that inflation, in particular, uncertainty about future inflation, has a negative correlation with economic growth. The findings of Judson and Orphanides (1999), Dotsey and Sarte (2000), Bhar and Mallik (2012), and Fountas et al. (2006) have supported the notion. Froyen and Waud (1987) found that high inflation induces high inflation volatility and uncertainty in the USA, Germany, Canada and UK. Berument and Sahin (2010) point out that inflation level in an economy may not really be what matters strictly to macroeconomists, but its volatility. Fischer (2013) showed that periods of high inflation volatility are associated with substantial reductions in total investment. A 1% increase in inflation volatility (approximately 0.87 standard deviations of the historical mean), is associated with an 10% reduction in total business investment. Arize and Malindretos (2005) argue that inflation volatility adversely affect real money demand of the eight less developed countries used in their study for both short and long run analysis. Udoh and Egwaikhide (2008) found that inflation uncertainty exerted significant negative effect on foreign direct investment in Nigeria during 1970-2005.

Empirical regularities underline the fact that inflation volatility in developing countries is substantially higher than the developed countries. During the 1950s and 1960s, inflation in Bangladesh was moderately high and volatile under a fixed exchange rate system. It peaked between 1974 and 1975 and fell sharply during the late 1970s (Hossain, 2015). From 1980 to 1991, inflation was remarkably high and volatile. It fell to a very low level in 1992 and remained low for over a decade (except 1995). Inflation rose and has been volatile since 2007. In this study we analyze and forecast inflation volatility of Bangladesh by using annual time series data from 1980 to 2017.

Table 7.5 shows the results of GARCH (1,1) model for inflation rate. The first portion of the table indicates the mean equation and the second portion is the variance equation. From the mean equation we see that the average return on inflation is -0.001643 but the p-value indicates that it is not significant. We obtain from second portion of the table,

$$b_0 = 0.001195,\ b_1 = 1.232891,\ b_2 = 0.328654$$

So, the variance equation stands:

$$\sigma^2{}_t = 0.001195 + 1.232891 u^2{}_{t-1} + 0.328654 \sigma^2{}_{t-1}$$

The time-varying volatility includes a constant (intercept) plus two components among which one depends on past errors (ARCH term, $u^2{}_{t-1}$) and the other depends on previous period's residuals variance or volatility of inflation rate (GARCH term, $\sigma^2{}_{t-1}$). The coefficient of ARCH term ($b_1 = 1.232891$) is statistically significant at 5% level since p-value 0.0240 < 0.05. So, previous period's information about volatility influence the volatility of inflation rate. Since $b_1 > 1$, it breaks the stability condition which means that volatility will be explosive (will continue to rise over time). The coefficient of GARCH term ($b_2 = 0.328654$) is also significant at 5% level (p-value 0.0116 < 0.05) which indicates volatility clustering. It also implies that volatility of inflation rate is significantly affected by previous period's volatility.

Table 7.5: Results of GARCH (1,1) Model (RINF)

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Probability
C	-0.001643	0.024236	-0.067779	0.9460
Variance Equation				
C	0.001195	0.008407	0.142195	0.8869
RESID(-1)^2	1.232891	0.546304	2.256787	0.0240
GARCH(-1)	0.328654	0.130139	2.525398	0.0116
R-squared	-0.023476	Akaike info criterion		0.951206
Adjusted R-squared	-0.023476	Schwarz criterion		1.123583
Durbin-Watson stat	1.962087	Hannan-Quinn criterion		1.012537

Note: Dependent Variable: RINF, Method: ML ARCH - Student's *t* distribution

Volatility is said to be persistent if today's volatility has a significant effect on the volatility of many periods in the future. It is measured by the sum of the coefficients of ARCH and GARCH term $(b_1 + b_2)$. It is also an estimation of the rate at which the response function decays with time. According to Chan (2010), persistence of volatility occurs when $b_1 + b_2 = 1$. In practice, it is often found that $b_1 + b_2 \cong 1$. The closer to unity is the value of persistence measure, the slower is the decay rate (Zarour and Siriopoulos, 2008). In our model, $b_1 + b_2 = 1.234085 > 1$. Since this is not very close to 1, a shock to inflation rate volatility would not last a long time. It also indicates that the conditional variance is unstable and the entire process is non-stationary as it does not satisfy the stationary condition $b_1 + b_2 < 1$.

Forecast uses the estimated ARCH model to compute static and dynamic forecasts of the mean, its forecast standard error, and the conditional variance. A static forecast uses the actual values of the explanatory variables in making the forecast. A dynamic forecast uses the forecast value of lagged dependent variables in place of the actual value of the lagged dependent variables. We see unsteady rise and fall in the plot of the conditional variance of inflation rate (Figure 7.2).

Figure 7.2: Conditional Variance (RINF)

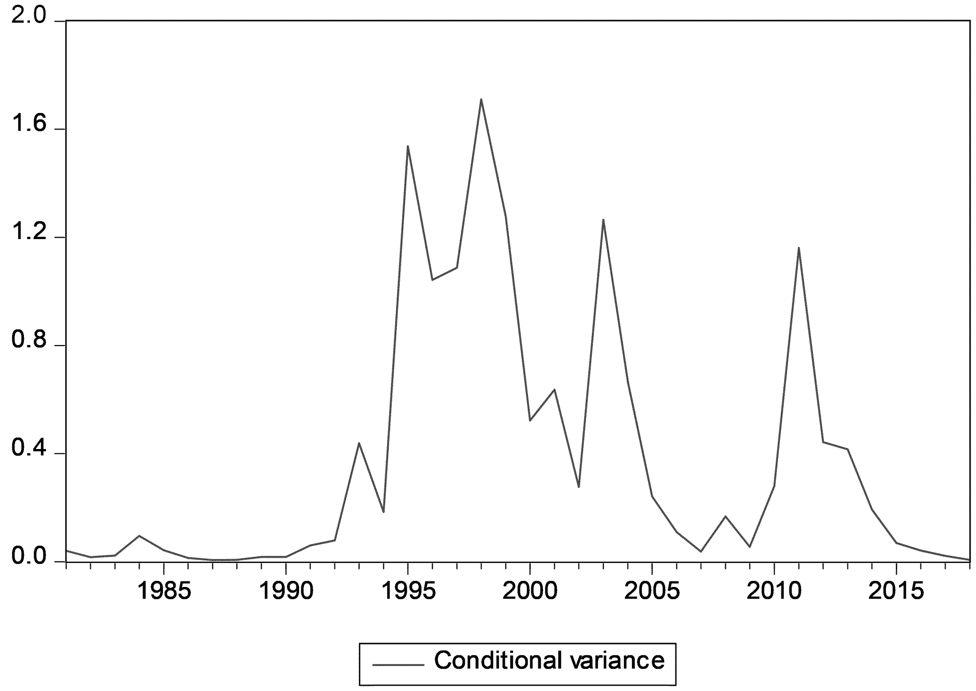


Figure 7.3: Dynamic Forecast of RINF

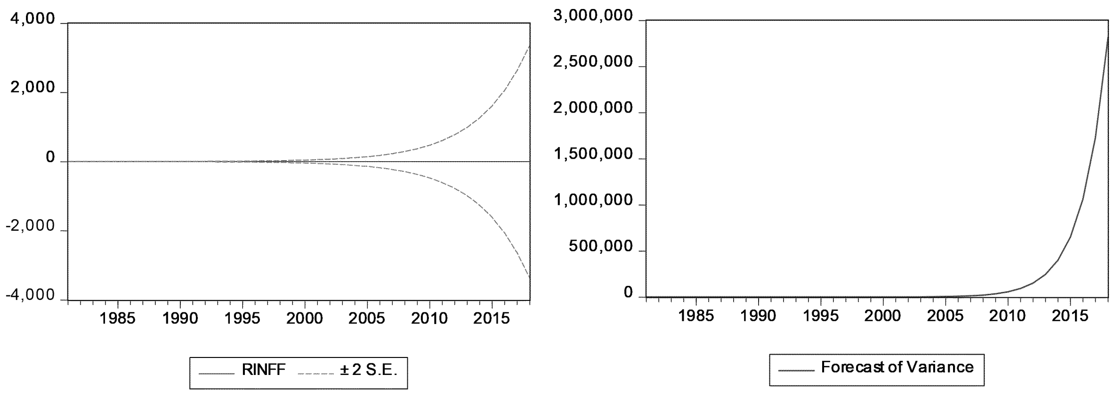
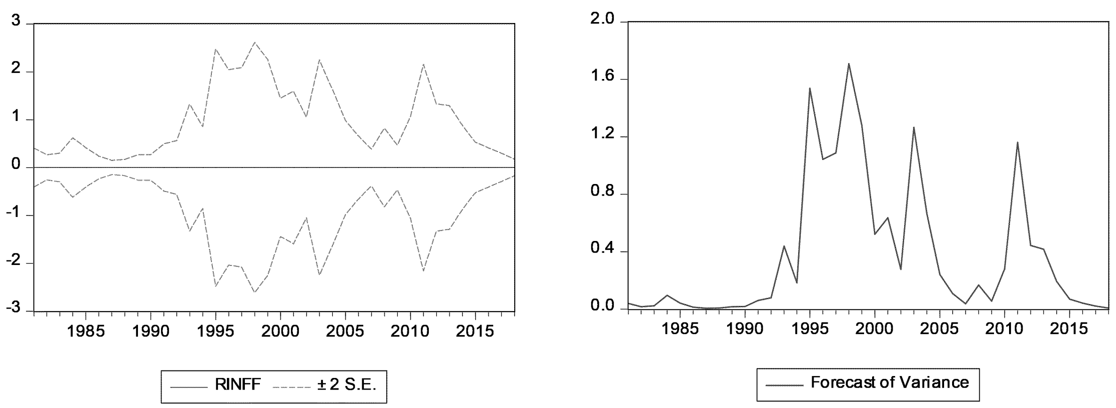


Figure 7.4: Static Forecast of RINF



Dynamic forecast of inflation rate is shown in Figure 7.3. We see that forecast of variance is stable till 2005. After that it is increasing over time which indicates that volatility is not stable. The plot of static forecast takes the form of the plot of the conditional variance (Figure 7.4).

7.2.4.1 Residual Diagnostic Tests (RINF)

Table 7.6 presents the results of ARCH test. The p-value of χ^2 is 0.3838 which is more than 0.05 indicating that the null hypothesis cannot be rejected. So, there is no heteroscedasticity/ ARCH effect in the model.

Table 7.6: ARCH Heteroscedasticity Test (RINF)

F-statistic	0.732391	Probability of F-stat (1,34)	0.3979
Observed R^2	0.758373	Probability of χ^2 (1)	0.3838

Result of Jarque-Bera test is shown in Figure 7.5. The p-value of Jarque-Bera is 0.605074 which is more than 0.05. So, the null hypothesis that the residuals are normally distributed cannot be rejected. The measure of skewness (0.372355) also supports the concept. It is between -0.5 and +0.5 which means that the distribution is approximately symmetric (normal).

Figure 7.5: Jarque-Bera Normality Test (RINF)

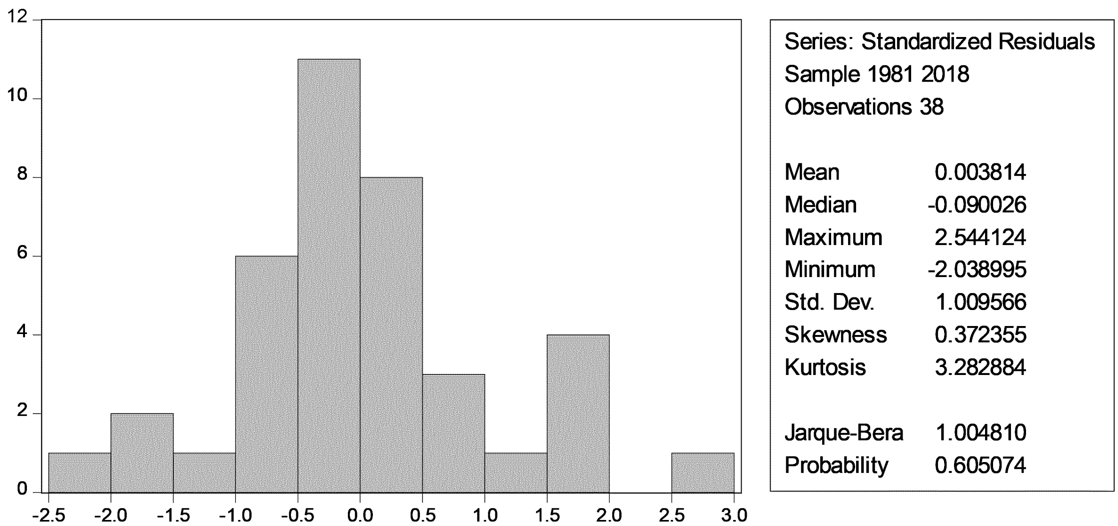


Table 7.7 represents the results of Correlogram test of residuals squared. It is seen that Q-statistics at all lags are insignificant since the concerned p-values are more than 0.05. So, the null hypothesis cannot be rejected indicating that there is no serial correlation in the model.

Table 7.7: Correlogram Standardized Residuals Squared (RINF)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.141	-0.141	0.8203	0.365
		2	0.263	0.248	3.7303	0.155
		3	-0.062	0.001	3.8980	0.273
		4	-0.071	-0.155	4.1234	0.390
		5	-0.058	-0.074	4.2808	0.510
		6	-0.176	-0.145	5.7496	0.452
		7	-0.076	-0.100	6.0327	0.536
		8	0.062	0.127	6.2266	0.622
		9	-0.167	-0.142	7.6802	0.567
		10	-0.030	-0.187	7.7286	0.655
		11	-0.041	-0.017	7.8216	0.729
		12	-0.048	-0.050	7.9544	0.789
		13	0.070	0.018	8.2535	0.827
		14	-0.100	-0.089	8.8854	0.838
		15	0.249	0.158	12.983	0.604
		16	0.034	0.068	13.062	0.668

*Probabilities may not be valid for this equation specification.

The model has no ARCH effect and it is normally distributed. Moreover it is not serially correlated. So, the model is pretty good and we can rely on the model.

7.2.5 Volatility of Exchange Rate

The price of one currency in terms of another is referred to as exchange rate. A market-based exchange rate changes whenever the value of either of the two currencies changes. How rapidly the exchange rate fluctuates is its volatility. It alludes to the tendency of foreign currencies to appreciate or depreciate in value, thus affecting the profitability of foreign exchange trades. Exchange rate volatility is a major obstacle to economic development which makes planning more problematic and investment more risky (Adesina et al., 2017). It can affect the investment decisions of multinational firms by creating unexpected profit in trade and non-trade sectors and also by the ambiguous cost of imported goods (Latief and Lefen, 2018). Economic growth, international trade and foreign direct investment are also greatly influenced by the volatility of the exchange rate. Alagidede and Ibrahim (2016), Aghion et al. (2009), Dollar (1992), and Vieira et al. (2013) found that exchange rate volatility adversely affects economic growth.

The effect of exchange rate volatility on trade is a controversial issue in international economics. Latief and Lefen (2018), Mukherjee and Pozo (2011), Byrne et al. (2008), and Cheong et al. (2005) show that exchange rate volatility negatively affects international trade. According to Olarewaju and Olasehinde (2017), appreciation of exchange rate increases imports and reduces exports while depreciation of exchange rate induces exports and discourages imports which tends to cause a shift from foreign goods consumption to domestic goods consumption. The findings of Vieira and MacDonald (2016), Sukar and Hassan (2001), Subanti et al. (2019), Subanti et al. (2019) show that the exchange rate volatility has negative impact on exports whereas the findings of Serenis and Tsounis (2014) suggest that there is a positive effect of volatility on exports of Croatia and Cyprus. The results of Kim (2017) indicate that USD/KRW exchange rate volatility has a statistically significant negative influence on Korea's seaborne import volume. However, Hwang and Lee (2005) identifies the existence of a positive relationship between exchange rate volatility and imports in the U.K. in the 1990s. Campa (1993), Benassy-Quere et al. (2001), Kiyota and Urata (2004), Udoh and Egwaikhide (2008), Kyereboah-Coleman and Agyire-Tettey (2008), Sharifi-Renani and Mirfatah (2012), Sami Ullah et al. (2012), Yousaf et al. (2013), Asmah and Andoh (2013), Boahen and Evans (2014), and Bianco and Loan (2017) found a negative relation between exchange rate volatility and FDI. Cushman (1985, 1988), Goldberg and Kolstad (1995), and MacDermott (2008) found a positive effect of exchange rate volatility on FDI whereas Gorg and Wakelin (2002) found no strong and substantial relationship between real exchange rate uncertainty and FDI.

Since independence, Bangladeshi taka has always been depreciated against the US dollar, except once or twice. Bangladesh adopted floating exchange rate regime since May 31, 2003. In both the fixed exchange rate and floating exchange rate systems, the value of the dollar against taka has been shown to increase continuously. Sometimes this increase was too much which was unanticipated. Those periods of unusual rise indicate the exchange rate volatility in Bangladesh.

Results of GARCH (1,1) model for exchange rate is shown in Table 7.8. The mean equation shows that the average return is $a_0 = 0.038092$. It is highly significant since the p-value 0.0000 < 0.01. The variance equation gives the result of the GARCH (1,1) Model. We obtain from the table 7.8,

$$b_0 = 0.000421,\ b_1 = 0.466040,\ b_2 = 0.270906$$

So, the variance equation takes the form:

$$\sigma^2{}_t = 0.000421 + 0.466040u^2{}_{t-1} + 0.270906\sigma^2{}_{t-1}$$

Table 7.8: Results of GARCH (1,1) Model (REXC)

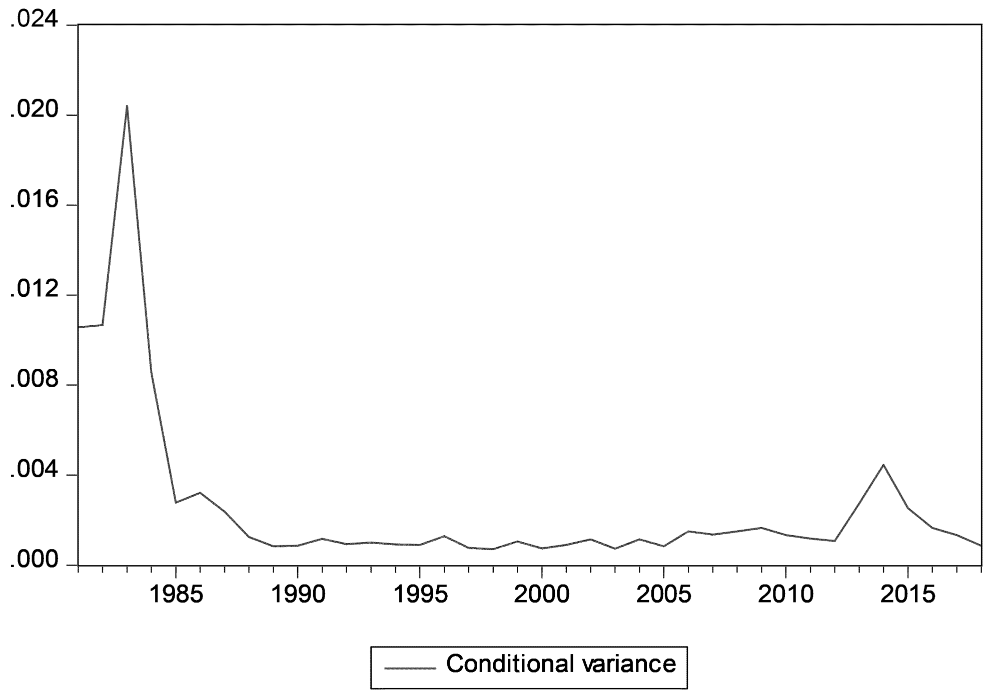
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.038092	0.005452	6.987046	0.0000
Variance Equation				
C	0.000421	0.000541	0.779241	0.4358
RESID(-1)^2	0.466040	0.499567	0.932887	0.3509
GARCH(-1)	0.270906	0.472623	0.573197	0.5665
R-squared	-0.028205	Akaike info criterion		-3.450739
Adjusted R-squared	-0.028205	Schwarz criterion		-3.278362
Durbin-Watson stat	0.852474	Hannan-Quinn criterion		-3.389409

Note: Dependent Variable: REXC, Method: ML ARCH - Student's *t* distribution

The three coefficients in the variance equation are listed as the intercept (0.000421), coefficient of the ARCH term (0.466040), and the coefficient of the GARCH term (0.270906). All the three coefficients are statistically insignificant since the p-value in each case is more than 0.05 or even 0.10. So, the interpretation in this case is that, neither the previous period's information about volatility nor the previous period's conditional variance (volatility) can significantly affect the volatility of exchange rate. The sum of the ARCH and GARCH coefficients (0.466040 + 0.270906) = 0.736946 < 1 which indicates that the series is stationary. This also indicates low persistence of exchange rate volatility since the sum is not very close to 1.

The plot of the conditional variance is shown in Figure 7.6. It is seen that the plot increases sharply from 1982 to 1983 and decreases sharply from 1983 to 1985. From 1989 to 2012 it is almost stable. We notice a sudden rise from 2012 until 2014. From 2014 until the rest of the time, it continues to decline.

Figure 7.6: Conditional Variance (REXC)



From the plot of the dynamic forecast of exchange rate in Figure 7.7 it is seen that the plot is decreasing till 1995 and after that it is stable. The plot of the static forecast looks the same as the plot of the conditional variance.

Figure 7.7: Dynamic Forecast of REXC

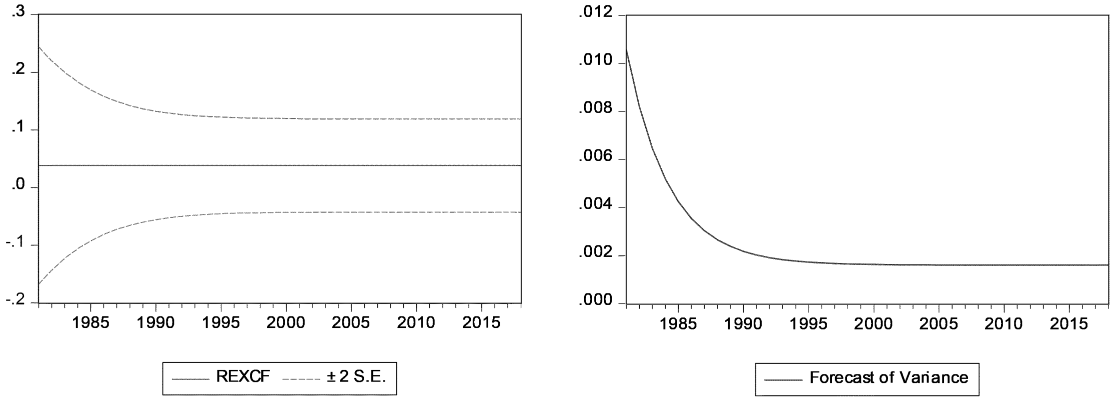
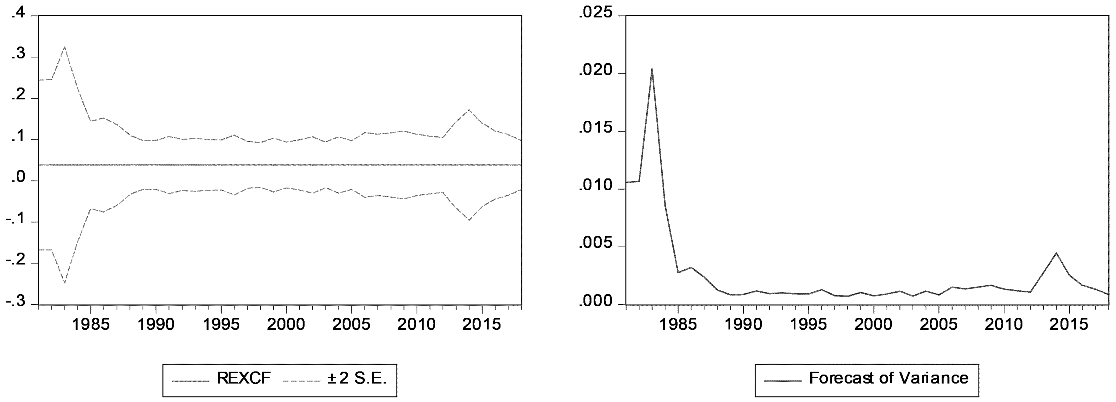


Figure 7.8: Static Forecast of REXC



7.2.5.1 Residual Diagnostic Tests (REXC)

Results of the ARCH test is shown in Table 7.9. The p-value of χ^2 is 0.6214 which is more than 0.05 indicating that the null hypothesis cannot be rejected. So, there is no heteroscedasticity/ ARCH effect in the model.

Table 7.9: ARCH Heteroscedasticity Test (REXC)

F-statistic	0.232290	Probability of F-stat (1,34)	0.6328
Observed R^2	0.243945	Probability of χ^2 (1)	0.6214

Figure 7.9: Jarque-Bera Normality Test (REXC)

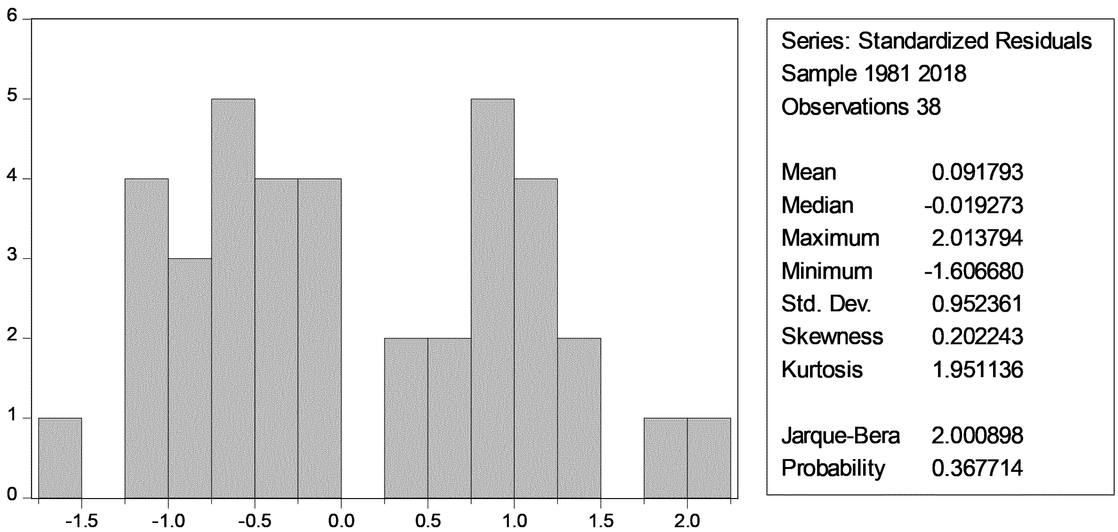


Figure 7.9 shows the results of Jarque-Bera test. The p-value of Jarque-Bera is 0.367714 which is more than 0.05. So, we cannot reject the null hypothesis that the residuals are normally distributed. The measure of skewness (0.202243) also supports the decision. It lies between -0.5 and +0.5 which means that the distribution is approximately symmetric (normal).

Table 7.10: Correlogram Standardized Residuals Squared (REXC)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.079	0.079	0.2577	0.612
		2	-0.127	-0.134	0.9342	0.627
		3	0.014	0.037	0.9429	0.815
		4	-0.043	-0.066	1.0243	0.906
		5	-0.024	-0.007	1.0503	0.958
		6	-0.197	-0.216	2.8951	0.822
		7	0.100	0.149	3.3867	0.847
		8	0.078	-0.012	3.6952	0.884
		9	-0.042	-0.001	3.7894	0.925
		10	-0.015	-0.040	3.8010	0.956
		11	-0.088	-0.083	4.2407	0.962
		12	-0.063	-0.095	4.4739	0.973
		13	0.020	0.066	4.4973	0.985
		14	-0.086	-0.126	4.9613	0.986
		15	-0.062	-0.059	5.2128	0.990
		16	-0.069	-0.118	5.5391	0.992

*Probabilities may not be valid for this equation specification.

Results of Correlogram test of residuals squared is presented in Table 7.10. It is evident that Q-statistics at all lags are insignificant since the concerned p-values are more than 0.05. So, we cannot reject the null hypothesis of no serial correlation. There is no ARCH effect (heteroscedasticity) in the model. It is normally distributed and free from serial correlation. So, the model has pretty good fit.

7.3 Impacts of Volatilities on FDI

Literature shows that foreign investment is influenced by various macroeconomic variables as well as their volatilities. In this part of the chapter, we will discuss the impacts of volatilities of our explanatory variables on foreign direct investment in Bangladesh. To calculate the volatilities, we apply the three year moving average standard deviation.

7.3.1 Results of Multicollinearity Test

A correlation matrix is a table showing correlation coefficients between variables. Each cell in the table shows the correlation between two variables. Each random variable in the table is correlated with each of the other values. This allows us to see which pairs have the highest correlation. The correlation matrix presented in Table 7.11 shows that volatility of interest rate (VINT), volatility of exchange rate (VEXC), volatility of external debt (VEXD), and volatility of gross national expenditure (VGNE) have negative association with FDI whereas volatility of inflation rate (VINF), volatility of current account balance (VCAB), and volatility of air transport (VAIR) have positive association. The correlation between VGNE and VINT is 0.5381 which indicates the maximum correlation of any two independent variables. Therefore, no high correlation (0.80 or above) between any two independent variables is observed.

Table 7.11: Correlation Matrix

Var.	LFDI	VINF	VINT	VEXC	VEXD	VCAB	VGNE	VAIR
LFDI	1.0000							
VINF	0.0981	1.0000						
VINT	-0.5141	0.1147	1.0000					
VEXC	-0.0875	-0.2353	-0.0148	1.0000				
VEXD	-0.4511	-0.0890	0.5217	0.3409	1.0000			
VCAB	0.2323	-0.2101	-0.2546	0.1313	-0.0154	1.0000		
VGNE	-0.5598	-0.3272	0.5381	0.2787	0.4660	-0.1606	1.0000	
VAIR	0.2699	-0.0254	-0.1088	0.0653	-0.2238	-0.0637	-0.1760	1.0000

Table 7.12: Results of Augmented Dickey-Fuller (ADF) Test

Variable	Test for Unit Root	Test Equation	ADF Test Statistic	Test Critical Value (5% Level)	P-Value	Stationary or not
LFDI	Level	Constant	-1.744882	-2.941145	0.4013	No
		Con. & Trend	-4.306493	-3.536601	0.0082	
		None	-0.420579	-1.949856	0.5249	
	1st difference	Constant	-6.177705	-2.945842	0.0000	Yes
		Con. & Trend	-6.119648	-3.540328	0.0001	
		None	-9.227609	-1.950117	0.0000	
VINF	Level	Constant	-2.278210	-2.948404	0.1843	No
		Con. & Trend	-2.166199	-3.544284	0.4927	
		None	-1.378820	-1.950687	0.1530	
	1st difference	Constant	-8.140849	-2.951125	0.0000	Yes
		Con. & Trend	-8.235458	-3.548490	0.0000	
		None	-8.264613	-1.951000	0.0000	
VINT	Level	Constant	-2.724145	-2.948404	0.0801	No
		Con. & Trend	-3.190143	-3.544284	0.1028	
		None	-2.135892	-1.950687	0.0332	
	1st difference	Constant	-7.133412	-2.951125	0.0000	Yes
		Con. & Trend	-7.021047	-3.548490	0.0000	
		None	-7.251168	-1.951000	0.0000	
VEXC	Level	Constant	-4.538798	-2.951125	0.0009	No
		Con. & Trend	-3.484454	-3.557759	0.0582	
		None	-1.249280	-1.952473	0.1897	
	1st difference	Constant	-4.967172	-2.963972	0.0004	Yes
		Con. & Trend	-5.732086	-3.568379	0.0003	
		None	-5.018788	-1.952473	0.0000	
VEXD	Level	Constant	-3.528567	-2.948404	0.0130	Yes
		Con. & Trend	-3.968877	-3.544284	0.0193	
		None	-1.764900	-1.610907*	0.0738	
VCAB	Level	Constant	-2.720330	-2.948404	0.0808	No
		Con. & Trend	-2.721112	-3.544284	0.2348	
		None	-2.553631	-1.950687	0.0122	
	1st difference	Constant	-5.300889	-2.957110	0.0001	Yes
		Con. & Trend	-5.228283	-3.557759	0.0009	
		None	-5.394615	-1.951687	0.0000	
VGNE	Level	Constant	-3.424929	-2.948404	0.0167	No
		Con. & Trend	-3.107694	-3.544284	0.1203	
		None	-2.750755	-1.950687	0.0074	
	1st difference	Constant	-7.594568	-2.951125	0.0000	Yes
		Con. & Trend	-7.566688	-3.548490	0.0000	
		None	-7.743600	-1.951000	0.0000	
VAIR	Level	Constant	-3.441697	-2.948404	0.0160	Yes
		Con. & Trend	-4.616179	-3.552973	0.0042	
		None	-1.785590	-1.611059*	0.0707	

Note: * denotes 10% significance level

Table 7.13: Results of Phillips-Perron (PP) Test

Variable	Test for Unit Root	Test Equation	PP Test Statistic	Test Critical Value (5% Level)	P-Value	Stationary or not
LFDI	Level	Constant	-1.370472	-2.941145	0.5864	No
		Con. & Trend	-5.405719	-3.533083	0.0004	
		None	0.111344	-1.949856	0.7120	
	1st difference	Constant	-18.14811	-2.943427	0.0001	Yes
		Con. & Trend	-22.34719	-3.536601	0.0000	
		None	-10.54654	-1.950117	0.0000	
VINF	Level	Constant	-2.111540	-2.948404	0.2415	No
		Con. & Trend	-2.166199	-3.544284	0.4927	
		None	-1.190912	-1.950687	0.2092	
	1st difference	Constant	-8.031461	-2.951125	0.0000	Yes
		Con. & Trend	-8.123853	-3.548490	0.0000	
		None	-8.149608	-1.951000	0.0000	
VINT	Level	Constant	-2.724145	-2.948404	0.0801	No
		Con. & Trend	-3.225463	-3.544284	0.0960	
		None	-2.087367	-1.950687	0.0370	
	1st difference	Constant	-7.065628	-2.951125	0.0000	Yes
		Con. & Trend	-6.953553	-3.548490	0.0000	
		None	-7.175588	-1.951000	0.0000	
VEXC	Level	Constant	-3.187718	-2.948404	0.0293	No
		Con. & Trend	-3.143804	-3.544284	0.1124	
		None	-1.957755	-1.950687	0.0492	
	1st difference	Constant	-7.616818	-2.951125	0.0000	Yes
		Con. & Trend	-7.778682	-3.548490	0.0000	
		None	-7.306011	-1.951000	0.0000	
VEXD	Level	Constant	-3.417329	-2.948404	0.0170	Yes
		Con. & Trend	-3.876172	-3.544284	0.0239	
		None	-1.731193	-1.611059*	0.0790	
VCAB	Level	Constant	-2.457437	-2.948404	0.1343	No
		Con. & Trend	-2.406936	-3.544284	0.3698	
		None	-2.408053	-1.950687	0.0175	
	1st difference	Constant	-10.30469	-2.951125	0.0000	Yes
		Con. & Trend	-10.48225	-3.548490	0.0000	
		None	-10.51955	-1.951000	0.0000	
VGNE	Level	Constant	-4.346825	-2.948404	0.0015	No
		Con. & Trend	-2.742956	-3.544284	0.2268	
		None	-2.785199	-1.950687	0.0067	
	1st difference	Constant	-10.53997	-2.951125	0.0000	Yes
		Con. & Trend	-17.76813	-3.548490	0.0000	
		None	-10.61235	-1.951000	0.0000	
VAIR	Level	Constant	-3.052587	-2.948404	0.0398	No
		Con. & Trend	-3.070416	-3.544284	0.1289	
		None	-1.740631	-1.950687	0.0775	
	1st difference	Constant	-12.39256	-2.951125	0.0000	Yes
		Con. & Trend	-12.28006	-3.548490	0.0000	
		None	-12.70605	-1.951000	0.0000	

Note: * denotes 10% significance level

7.3.2 Results of Unit Root Test

To check the existence of unit root in the model, Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test are applied. The results obtained in both tests are somewhat different. In both tests, volatility of external debt (VEXD) is found stationary at level whereas log of FDI, volatility of inflation rate (VINF), volatility of interest rate (VINT), volatility of exchange rate (VEXC), volatility of current account balance (VCAB), and volatility of gross national expenditure (VGNE) are found stationary at their first differences. Volatility of air transport (VAIR) is found stationary at level in ADF test whereas it is found stationary at first difference in PP test. But this distinction in ADF and PP test does not hamper our purposes as we know if series are integrated of different orders, that is, a combination of both level and first difference stationarity, we apply bounds cointegration test to establish a long-run relationship.

7.3.3 Selection of Optimal Lag Length

An important aspect of empirical research based on the vector autoregressive (VAR) model is the choice of the lag order, since all inferences in this model depend on the correct model specification (Gutierrez et al., 2009). There are several methods of how to select the lag order of a non-stationary VAR model subject to cointegration restrictions.

Table 7.14 VAR Lag Order Selection Criteria

Endogenous Variables: LFDI VINF VINT VEXC VEXD VCAB VGNE VAIR Exogenous Variables: C						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	126.9850	NA	1.26e-13	-6.999116	-6.639972*	-6.876637
1	230.6680	152.4751	1.35e-14	-9.333413	-6.101120	-8.231109
2	325.7644	95.09642*	4.31e-15*	-11.16261*	-5.057173	-9.080484*

Note: * indicates lag order selected by the criterion

Five methods are employed in this study to choose the optimal lag length: Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), Hannan-Quinn Criterion (HQ), Final Prediction Error (FPE), and Likelihood Ratio Test Statistic (LR). Each criterion suggests a lag indicated by its minimum value (marked by asterisks in Table 7.14). Here we see that al criteria except SC suggest lag 2 whereas SC criterion suggests lag 1 for this model. From results of ARDL error correction regression (our suggested model), we find the following results:

Criterion	Lag = 1	Lag = 2
AIC	3.617511	1.818372
SC	3.839703	2.177516
HQ	3.694212	1.940850

It is seen that AIC, SC, and HQ values are lower when the lag is 2. Since the lower the value, the better the model, hence the optimum lag is 2 for this model.

7.3.4 Results of ARDL Bounds Cointegration Test

In unit root test, the variables are found integrated of different orders, that is, a combination of both I(0) and I(1) series which suggests co-integration test to examine the long run relationship among the variables. In this case, the Johansen cointegration test or other traditional methods are no longer valid. The appropriate test in this case is bounds cointegration test proposed by Pesaran, Shin and Smith (2001). The results of bounds test are presented in Table 6.18. We see that the calculated F-statistic (3.300066) is greater than the critical value for the upper bound I(1) at 10% level. Therefore, we can reject the null hypothesis of no cointegration equation and accept the alternative hypothesis that the variables included in the model are cointegrated. So, there is long-run relationship between dependent and independent variables and we have to apply ARDL error correction regression to justify the existing long-run relationship.

Table 7.15: Results of ARDL Long Run Form and Bounds Test

Dependent Variable: D(LFDI)		Selected Model: ARDL (1, 0, 2, 1, 1, 0, 2, 0)		
Levels Equation Case 3: Unrestricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Probability
VINF	-4.887117	2.510094	-1.946986	0.0665
VINT	-6.353718	2.839739	-2.237430	0.0374
VEXC	-60.12297	47.33707	-1.270103	0.2194
VEXD	68.12587	42.13586	1.616815	0.1224
VCAB	-0.047842	0.046558	-1.027577	0.3171
VGNE	-84.25967	78.07856	-1.079165	0.2940
VAIR	164.7543	63.79185	2.582686	0.0182
EC = LFDI - (- 4.8871*VINF - 6.3537*VINT - 60.1230*VEXC + 68.1259*VEXD - 0.0478*VCAB - 84.2597*VGNE + 164.7543*VAIR)				
F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Significance	I(0)	I(1)
			Asymptotic: n = 1000	
F-statistic	3.300066	10%	2.03	3.13
k	7	5%	2.32	3.50
		2.5%	2.60	3.84
		1%	2.96	4.26
Actual Sample Size	34		Finite Sample: n = 35	
		10%	2.300	3.606
		5%	2.753	4.209
		1%	3.841	5.686
			Finite Sample: n = 30	
		10%	2.384	3.728
		5%	2.875	4.445
		1%	4.104	6.151

In bounds test result, the long-run relationship is specified by the following equation:

$$EC = LFDI - (- 4.8871VINF - 6.3537VINT - 60.1230VEXC + 68.1259VEXD - 0.0478\ VCAB - 84.2597\ VGNE + 164.7543\ VAIR) \quad (7.1)$$

The above equation can be rewritten as:

$$LFDI = - 4.8871\ VINF - 6.3537\ VINT - 60.1230\ VEXC + 68.1259\ VEXD - 0.0478\ VCAB - 84.2597\ VGNE + 164.7543\ VAIR + EC \quad (7.2)$$

From equation (7.2) it is seen that volatility of inflation rate (VINF), volatility of interest rate (VINT), volatility of exchange rate (VEXC), volatility of current account balance (VCAB), and volatility of gross national expenditure (VGNE) have negative long-run association with FDI which is desired. On the other hand, volatility of external debt (VEXD) and volatility of air transport (VAIR) have undesired long-run positive relationship with FDI.

7.3.5 Results of ARDL Error Correction Regression

7.3.5.1 Long-run Causality

Results of bounds test presented in Table 7.15 indicate that volatility of inflation rate (VINF) and volatility of interest rate (VINT) have significant negative relationship with FDI in the long-run, the former is significant at 10% level and the latter one is at 5% level. A one unit increase in VINF leads to a 4.887117 unit decrease in FDI whereas a one unit increase in VINT leads to a 6.353718 unit decrease in FDI in the short-run. The results also reveal that volatility of air transport (VAIR) has a positive impact on FDI in the long-run which is significant at 5% level. The other variables are found insignificant. In Table 7.16, C(8) is the error correction term or speed of adjustment towards long-run equilibrium. The value of C (8) needs to be negative and statistically significant in order for the long-term relationship to persist. In our model, the value of C(8) is -0.222871 and the corresponding p-value is 0.0000. That is, C(8) is negative in sign and statistically significant at 1% level (since $0.0000 < 0.01$).

So, it can be said that a highly significant long-run causality running from independent variables (volatility of inflation rate, volatility of interest rate, and volatility of air transport) to dependent variable (FDI) exists. The value of C(8) in our model also tells us that about 22.29% of departures from long-run equilibrium is corrected each period.

Table 7.16: Results of ARDL Error Correction Regression

Dependent Variable: D(LFDI)		Selected Model: ARDL (1, 0, 2, 1, 1, 0, 2, 0)			
ECM Regression Unrestricted Constant and No Trend					
Variable		Coefficient	Std. Error	t-Statistic	Prob.
C	C(1)	1.517802	0.217369	6.982609	0.0000
D(VINT)	C(2)	-0.507312	0.229703	-2.208552	0.0397
D(VINT(-1))	C(3)	2.802703	0.290659	9.642572	0.0000
D(VEXC)	C(4)	19.93747	5.272282	3.781565	0.0013
D(VEXD)	C(5)	-4.678230	3.541889	-1.320829	0.2022
D(VGNE)	C(6)	-53.36089	9.822061	-5.432758	0.0000
D(VGNE(-1))	C(7)	58.75263	9.737842	6.033434	0.0000
ECT*	C(8)	-0.222871	0.037080	-6.010577	0.0000
R-squared		0.922470	Akaike info criterion		1.818372
Adjusted R-squared		0.901597	Schwarz criterion		2.177516
F-statistic		44.19373	Hannan-Quinn criterion		1.940850
Prob. (F-statistic)		0.000000	Durbin-Watson stat		2.483675

Note: * p-value incompatible with t-Bounds distribution.

7.3.5.2 Short-run Causality

In Table 7.16, C(2) to c(7) are the short-run coefficients associated with different explanatory variables. We see that the value of C(2) is -0.507312 and p-value of t-statistic is 0.0397 which is significant at 5% level. So, it can be said that the volatility of inflation rate (VINF) has a strong short-run causal negative effect on FDI. A one unit increase in VINF leads to a 0.507312 unit decrease in FDI in the short-run. Once more, the value of C(3) is 2.802703 and associated p-value is 0.0000 which is significant at 1% level. That is, one period lagged value of VINF has a significant positive effect on FDI in the short-run. Later we will see through Wald test results whether C(2) and C(3) jointly affect FDI or not. Similarly, volatility of external debt (VEXD) and volatility of gross national expenditure (VGNE) have a negative effect on FDI in the short-run, the former is insignificant and the latter is significant at 1% level. Volatility of exchange rate (VEXC) poses a positive impact on FDI in the short-run which is significant at 1% level.

The joint effect of a regressor and its one period lagged value can be explained by Wald test results. From Table 7.17 it is seen that null hypotheses constructed for the variable VINT and VGNE to examine their joint effects with one period lagged value can be rejected as the p-value of chi-square in each case is less than 0.01. Hence VINT (as well as VGNE) and its one period lagged value can jointly affect FDI in the short-run at 1% significant level.

Table 7.17 Results of Wald Test

Variable	Null Hypothesis	Chi-square	Probability	Inference
VINT	C(2) = C(3) = 0	9.870271	0.0072	Rejected at 1% level
VGNE	C(6) = C(7) = 0	14.34808	0.0008	Rejected at 1% level

7.3.5.3 Residual Diagnostic Tests

Breusch-Godfrey Serial Correlation LM Test, ARCH Heteroskedasticity Test and Jarque-Bera Normality Test are performed in order to evaluate the goodness-of-fit of the model. Table 7.18 represents the results of Breusch-Godfrey Serial Correlation LM Test. It is seen that p-value of χ^2 is 0.0098 which is less than 0.05. Therefore, we fail to reject the null hypothesis of no serial correlation. So, the model suffers from the problem of serial correlation.

Table 7.18: Results of Breusch-Godfrey Serial Correlation LM Test

F-statistic	3.181695	Probability of F-stat (2,17)	0.0670
Observed R^2	9.260441	Probability of χ^2 (2)	0.0098

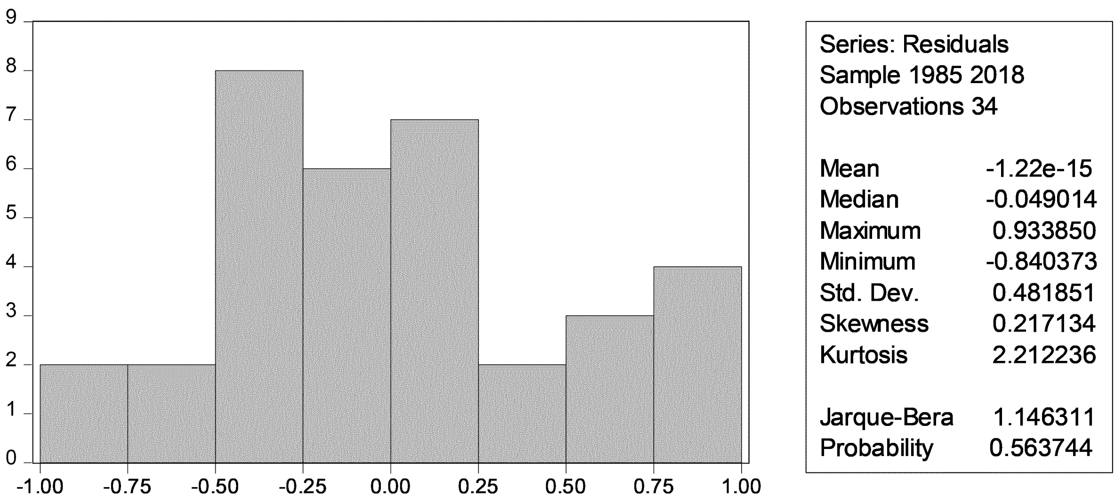
Table 7.19 presents the results of ARCH heteroskedasticity test. In this case, p-value of χ^2 is 0.9919 which is significant at 5% level meaning that we cannot reject the null hypothesis of no ARCH effect. So, there is no heteroscedasticity/ ARCH effect in the model.

Table 7.19: Results of ARCH Heteroskedasticity Test

F-statistic	0.007347	Probability of F-stat (2,29)	0.9927
Observed R^2	0.016206	Probability of χ^2 (2)	0.9919

Jarque-Bera test is performed to test for the normality of the model. Figure 7.10 shows that the p-value of Jarque-Bera is 0.563744 which is more than 0.05. So, we fail to reject the null hypothesis that the residuals are normally distributed.

Figure 7.10: Results of Jarque-Bera Normality Test



7.3.5.4 Stability Tests

To test the stability of the parameters, CUSUM test and CUSUM of Squares test are performed. From Figure 7.11A we see that the plot of CUSUM test remains within the 5% boundary line. It indicates that the model is structurally stable. Figure 7.11B it is seen that the plot of CUSUM of Squares test slightly deviates from the 5% boundary line which does not greatly interfere with the stability of the model.

The value of R^2 in the model is 0.922470 which means that 92.25% variation in FDI can be explained by explanatory variables jointly. The probability of F-statistic is 0.000000 which is less than 0.01 (that is, significant at 1% level). This means that explanatory variables can jointly influence FDI. The model has no heteroskedasticity/ ARCH effect and it is normally distributed. All these are good signs. But the model is serially correlated and there is also a little problem with its stability. So, it can be concluded that the model does not have a good fit.

Figure 7.11A: Plot of CUSUM test

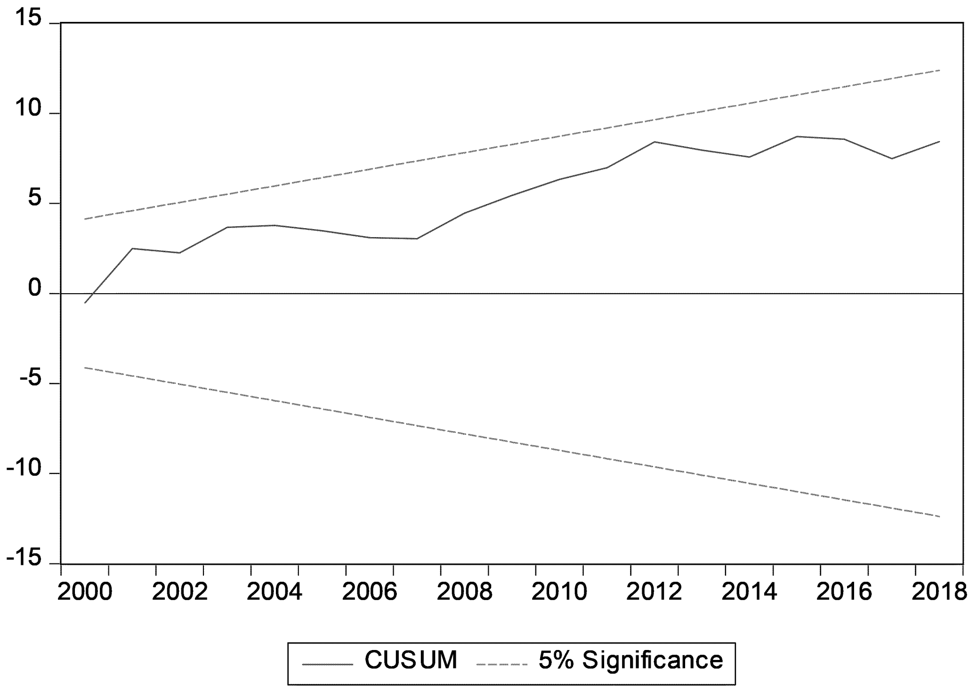
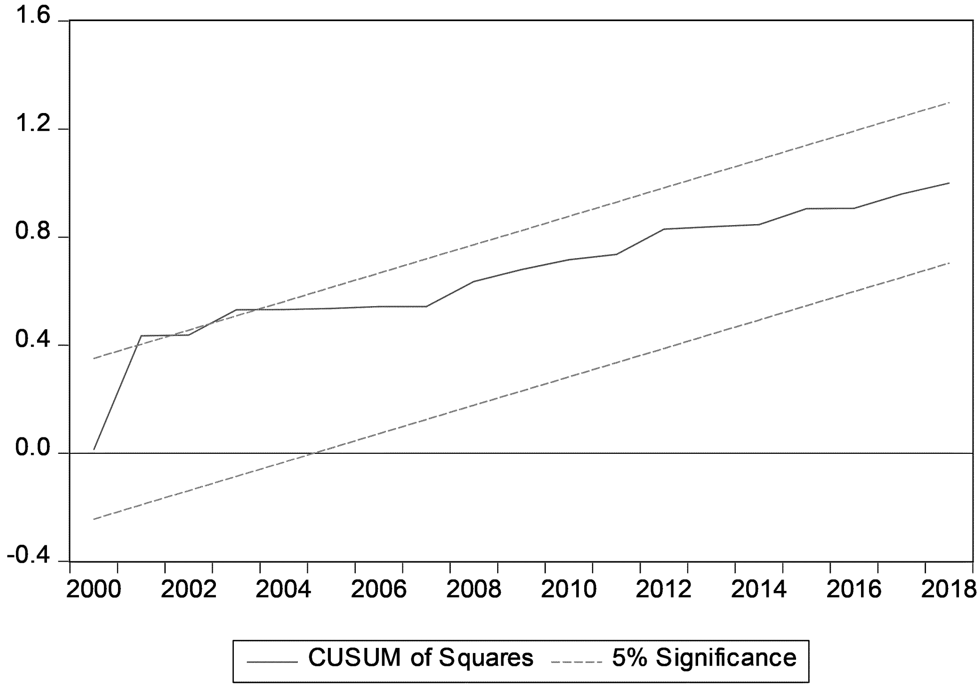


Figure 7.11B: Plot of CUSUM of Squares test



7.3.6 ARDL-ECM (OLS Approach)

The long-run relationships and the short-run dynamics can also be explained by ARDL-ECM (OLS Approach). The results of the OLS approach are shown in Table 7.20. The coefficient of ECM, C(17), is positive (0.008923) and not significant (p-value 0.9750 > 0.10). So, the condition for persistent long-run equilibrium is not satisfied here. The speed of adjustment towards long-run equilibrium is also very low (only 0.89%). This means that no equilibrium long-run relationship exists between dependent and independent variables.

Among short-run coefficients, C(6), C(7), C(9), C(13), and C(14) are significant at various level. Volatility of external debt (VEXD) and volatility of gross national expenditure (VGNE) have significant negative impact on FDI in the short-run. Volatility of inflation rate (VINF), volatility of interest rate (VINT), volatility of current account balance (VCAB), and volatility of air transport (VAIR) also have negative long-run relationship with FDI but these relationships are not significant. Though volatility of exchange rate (VEXC) exert a positive significant impact on FDI in the short-run, its one period lagged value (VEXC(-1) = -2.99589) has a negative impact on FDI, though it is insignificant.

Table 7.20: Results of ARDL-ECM (OLS Approach)

Dependent Variable: D(LFDI) Method: Least Squares					
Variable	Coefficient		Std. Error	t-Statistic	Probability
C	C(1)	0.374329	0.155423	2.408450	0.0276
D(LFDI(-1))	C(2)	-0.302369	0.237362	-1.273876	0.2198
D(VINF)	C(3)	-0.574426	0.834703	-0.688181	0.5006
D(VINF(-1))	C(4)	-0.042232	0.798261	-0.052905	0.9584
D(VINT)	C(5)	-0.573176	0.399039	-1.436392	0.1690
D(VINT(-1))	C(6)	1.605681	0.387508	4.143605	0.0007
D(VEXC)	C(7)	16.19460	8.849140	1.830076	0.0848
D(VEXC(-1))	C(8)	-2.995890	8.837052	-0.339015	0.7388
D(VEXD)	C(9)	-12.20313	6.259633	-1.949496	0.0679
D(VEXD(-1))	C(10)	4.914000	6.818786	0.720656	0.4809
D(VCAB)	C(11)	-0.006763	0.012832	-0.527017	0.6050
D(VCAB(-1))	C(12)	0.001516	0.013963	0.108557	0.9148
D(VGNE)	C(13)	-50.14706	16.46677	-3.045349	0.0073
D(VGNE(-1))	C(14)	59.38189	15.98648	3.714506	0.0017
D(VAIR)	C(15)	-6.086830	12.30245	-0.494766	0.6271
D(VAIR(-1))	C(16)	-12.00022	12.71145	-0.944048	0.3584
ECM(-1)	C(17)	0.008923	0.281072	0.031746	0.9750
R^2		0.890195	Akaike Info Criterion		2.695832
Adjusted R^2		0.786849	Schwarz Criterion		3.459012
F-statistic		8.613738	Hannan-Quinn Criterion		2.956098
Prob. (F-statistic)		0.000029	Durbin-Watson Stat		2.237795

The Wald test results presented in Table 7.21 show that volatility of interest rate (VINT), volatility of gross national expenditure (VGNE), and volatility of external debt (VEXD) along with their respective lagged value jointly affect FDI in the short-run at 1% and 5% significant level respectively.

Table 7.21: Results of Wald Test

Variable	Null Hypothesis	Chi-square	Probability	Inference
VINF	C(3) = C(4) = 0	0.592087	0.7438	Accepted
VINT	C(5) = C(6) = 0	24.35475	0.0000	Rejected at 1% level
VEXC	C(7) = C(8) = 0	3.741256	0.1540	Accepted
VEXD	C(9) = C(10) = 0	7.045401	0.0295	Rejected at 5% level
VCAB	C(11) = C(12) = 0	0.341862	0.8429	Accepted
VGNE	C(13) = C(14) = 0	24.66541	0.0000	Rejected at 1% level
VAIR	C(15) = C(16) = 0	1.029431	0.5977	Accepted

Results of Breusch-Godfrey Serial Correlation LM Test in Table 7.22 show that p-value of χ^2 is 0.1329 which is more than 0.05 meaning that the null hypothesis of no serial correlation cannot be rejected. Therefore, the model is free from serial correlation.

Table 7.22: Results of Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.010309	Probability of F-stat (2,15)	0.3876
Observed R^2	4.036340	Probability of χ^2 (2)	0.1329

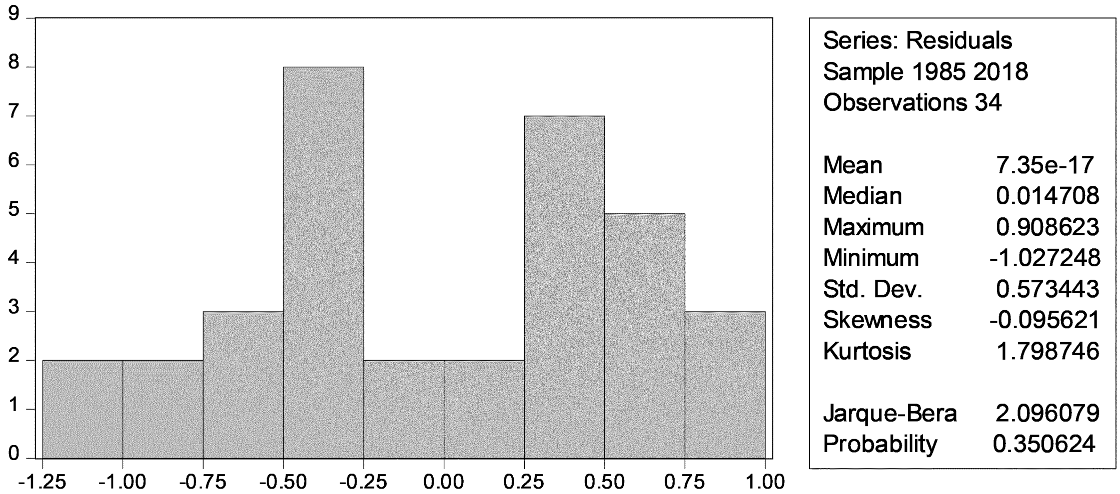
ARCH Heteroskedasticity test results (Table 7.23) show that p-value of χ^2 is 0.9154 which is more than 0.05. So, there is no heteroscedasticity/ ARCH effect in the model as we fail to reject the null hypothesis of no ARCH effect.

Table 7.23: Results of ARCH Heteroskedasticity Test

F-statistic	0.080551	Probability of F-stat (2,29)	0.9228
Observed R^2	0.176786	Probability of χ^2 (2)	0.9154

Results of Jarque-Bera normality test are presented in Figure 7.12. It is seen that p-value of Jarque-Bera is 0.350624 which is more than 0.05. So, the null hypothesis cannot be rejected and the residuals are normally distributed.

Figure 7.12: Results of Jarque-Bera Normality Test



Both the plot of CUSUM test (Figure 7.13A) and the plot of CUSUM of Squares test (Figure 7.13B) falls within the critical bounds at 5% level of significance. So, it can be said that the model is structurally stable.

Figure 7.13A: Plot of CUSUM test

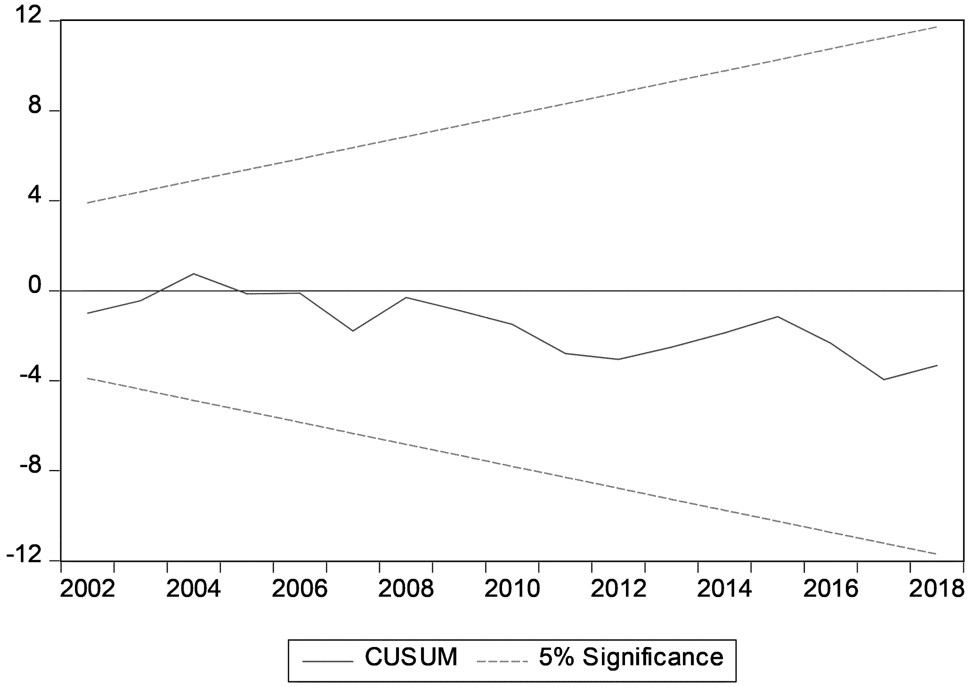
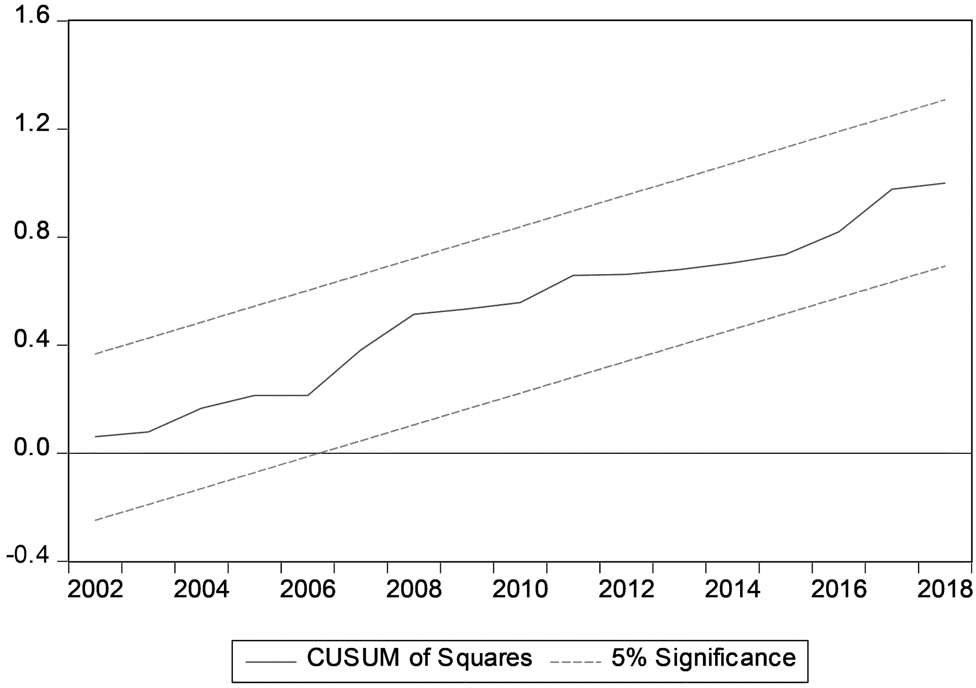


Figure 7.13B: Plot of CUSUM of Squares test



The value of R^2 in the model is 0.890195 which means that 89.02% variation in FDI can be explained by explanatory variables jointly. The probability of F-statistic is 0.000029 which is less than 0.01 (that is, significant at 1% level). This means that explanatory variables can jointly influence FDI. The model has no serial correlation and no heteroscedasticity/ARCH effect. It is normally distributed and structurally stable. There is no evil side of the model. So, the model has a very good fit and it is superior than the previous model.

7.3.7 Discussion of Results

Although very small in quantity, the existing literature discusses the effect of volatility of three variables on FDI - inflation rate, interest rate, and exchange rate. No research has yet been done on the effect of volatility of other variables on FDI. The results summarized in Table 7.24 show that the volatility of inflation rate has significant negative effect on FDI in the long-run and insignificant negative effect in the short-run. This result is consistent with the findings of Udoh & Egwaikhide (2008). The volatility of interest rate is found to have a significant negative effect on FDI in the long-run as well as in the short-run. Volatility of exchange rate has a significant positive effect on FDI in the short-run. Though this result is similar to the findings of Wanjiru (2014), it contradicts the findings of Hara & Razafimahefa (2005), Udoh & Egwaikhide (2008), and Sharif-Renani & Mirfatah (2012). However, volatility of exchange rate is found to have an insignificant negative effect on FDI in the long-run. This reslut is in line with the findings of Osinubi & Amaghionyeodiwe (2009), and Parajuli & Kennedy (2010).

Among other variables, volatility of gross national expenditure exerts a negative effect on FDI both in the long-run and short-run. But in case of long-run, the relationship is insignificant. Volatility of current account balance has a negative but insignificant effect in the long-run as well as in the short-run. In the case of volatility of external debt and volatility of air transport, short-term and long-term cotradictory results have been found. Volatility of external debt is found to have significant negative relationship with FDI in the short-run and insignificant positive relationship in the long-run whereas volatility of air transport is found to have significant positive impact on FDI in the long-run and insignificant negative effect in the short-run.

Table 7.24: Long-run and Short-run Coefficients at a Glance

Independent Variable	Long-run Coefficients	Short-run Coefficients (ECM Approach)	Short-run Coefficients (OLS Approach)
Volatility of Inflation Rate	-4.887117 *	—	-0.574426
Volatility of Interest Rate	-6.353718 **	-0.507312 **	-0.573176
Volatility of Exchange Rate	-60.12297	19.93747 ***	16.19460 *
Volatility of External Debt	68.12587	-4.678230	-12.20313 *
Volatility of Current Account Balance	-0.047842	—	-0.006763
Volatility of Gross National Expenditure	-84.25967	-53.36089 ***	-50.14706 ***
Volatility of Air Transport	164.7543 **	—	-6.086830

Note: ***, **, * denote 1%, 5%, and 10% significance level respectively

7.4 Conclusion

This Chapter explains results of the volatilities of explanatory variables and to examine their impacts on FDI. The test for the presence of ARCH effects allows us to estimate volatilities through ARCH models for inflation rate and exchange rate. The ADF and PP unit root tests confirm us about the stationarity of the variables which is a precondition of applying ARCH model. From the results of the ARCH model, we find that volatility of inflation rate is highly influenced by previous period's information about volatility as well as previous period's conditional variance. But in the case of exchange rate volatility, these findings are not statistically significant.

In the second part of this chapter, we have examined the impacts of volatilities (measured as 3 year moving average standard deviation) of explanatory variables on FDI. The correlation matrix of the variables show no problem of multicollinearity. The results of ADF and PP tests indicate that the series are integrated of different orders, that is, a combination of both I(0) and I(1), which allows us to apply bounds cointegration test to establish a long-run relationship.

Results of ARDL bounds test, ARDL-ECM, and OLS estimation methods indicate that there exists a significant long-run and short-run relationship between dependent and independent variables. Volatility of inflation rate (VINF), volatility of interest rate (VINT), volatility of current account balance (VCAB), and volatility of gross national expenditure (VGNE) are found to have negative relationship with FDI both in the long-run and short-run. On the other hand, volatility of exchange rate (VEXC), volatility of external debt (VEXD), and volatility of air transport (VAIR) give cotradictory long-run and short-run results. Volatility of external debt and volatility of air transport are found to have positive relationship with FDI in the long-run and negative relationship in the short-run. Volatility of exchange rate just gives the reverse results. The diagnostic tests of residuals indicate that between ECM and OLS, the latter model is superior than the former model as the former suffers from some issues.

It is obvious from the results summarized in Table 7.24 that the volatility of most of the variables has a negative effect on FDI. Therefore, in order to increase the flow of FDI in the country, it is necessary to prevent the frequent fluctuations of various macroeconomic variables.

Chapter 8

Conclusion

8.1 Introduction

This study explores the relationship between the inflow of FDI in Bangladesh and some of the factors that affect it. Although there has been a lot of research on this subject in different countries around the world, such research is very scarce in Bangladesh. The influential factors have been selected through extensive literary reviews and subject to data availability and multicollinearity issues. This chapter concludes the current study by providing a brief summary of previous chapters. This chapter also presents some policy implications on how to increase FDI inflows to boost Bangladesh's economic growth.

The remainder of this chapter is structured as follows: Section 8.2 summarizes the thesis, Section 8.3 gives the policy implications of results, and Section 8.4 presents the concluding remarks of the study.

8.2 Summary of the Thesis

The objective of this study is to investigate whether inflation rate, interest rate, exchange rate and some other macroeconomic variables such as external debt, current account balance, gross national expenditure and air transport (proxy of transport facilities) as well as their volatilities have any impacts on FDI in Bangladesh. To meet this objective, sufficient numbers of literature are reviewed to find out the research gap, identify the key determinants of FDI and highlight the rationale for selecting research variables. Annual time series data for the period 1980 to 2018 are collected from reliable sources and several econometric methods are used to examine the effects of explanatory variables and their volatilities on FDI. And finally some policy implications are recommended.

8.2.1 Key Determinants of FDI

Variables frequently used as the determinants of FDI in literature review are market size, economic growth, trade openness, infrastructure facilities, inflation rate, exchange rate, interest rate, labor cost, corporate tax rate, regional trade agreement, trade balance, trade barriers, external debt, balance of payment, government consumption expenditure, foreign exchange reserves, gross capital formation, return on investment, labor productivity, past FDI stock, export, import, geographical distance, natural resources, official development assistance, human capital, and corruption. Among these variables, market size has been found to be the most important determinant of FDI. Economic growth, trade openness, regional trade agreement, infrastructure facilities, past FDI stock, and human capital have also been found to be important determinants of FDI, the positive role of which is not much disputed among the researchers. Inflation rate, interest rate, exchange rate, labor cost, corporate tax rate, and external debt have been found as the critical determinants of FDI. The latest category variables are the variables of interest in this study. This is because their impact on FDI varies from country to country. However, due to lack of data, labor cost and corporate tax rate could not be included in this study.

8.2.2 Econometric Methods

To check the multicollinearity of variables, bivariate correlation matrix and Variance Inflation Factor (VIF) methods are employed. Stationarity of data are examined by applying Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test. The Johansen and Juselius (1990) cointegration approach has been used to find out whether there is any long-run relationship between variables. The long-run and short-run causalities are examined by Vector Error Correction Model (VECM). The causal relationships of variables are investigated through Granger causality test. Volatility of variables are analyzed by using GARCH (1,1) model. Autoregressive Distributed Lag (ARDL) model is employed to explore the impacts of volatilities of explanatory variables measured by moving average standard deviation on FDI. Goodness-of-fit of models are measured by employing various diagnostic tests.

8.2.3 Impacts and Causalities

The Jarque-Bera test statistic indicates that inflation rate, exchange rate, external debt, and gross national expenditure series are normally distributed but FDI, interest rate, current account balance, and air transport series are not normally distributed.

The coefficient of skewness shows that the distributions of interest rate, current account balance, and air transport are highly skewed; the distributions of FDI, inflation rate, exchange rate, and gross national expenditure are moderately skewed; and the distribution of external debt is approximately symmetric (normal).

The coefficient of kurtosis indicates that the distributions of FDI, interest rate, current account balance, gross national expenditure, and air transport are leptokurtic (peaked curve); the distributions of exchange rate and external debt are platykurtic (flatted curve); and the distribution of inflation rate is mesokurtic (normal).

Results of the correlation matrix show that the predictor variables interest rate, exchange rate, current account balance, gross national expenditure, and air transport have positive associations with the dependent variable FDI whereas inflation rate and external debt have negative associations with it. The correlation matrix also show that there is no high correlation (0.80 or above) between any two independent variables. The variance inflation factor (VIF) for each explanatory variable is also found to be less than 10 indicating that there is no problem of multicollinearity in the model.

Results of both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests reveal that the condition for stationarity is satisfied in all the 3 cases (constant, constant and trend, no constant and no trend) after first difference of each variable.

Akaike Information Criterion (AIC) suggests lag 2 for this model whereas Schwarz Information Criterion (SC), Hannan-Quinn Criterion (HQ), Final Prediction Error (FPE), and Likelihood Ratio Test Statistic (LR) suggest lag 1. The value of both AIC and SC produced by vector error correction estimates is smaller when the lag is 2. As we know, the lower the value, the better the model. Hence, the optimum lag has been taken 2.

Both trace test and maximum eigenvalue test of Johansen cointegration approach indicate 5 cointegrating equations. Therefore, it can be concluded that a long-run relationship exists between dependent and independent variables and vector error correction model (VECM) needs to be applied to explain these relationships. The normalized cointegrating coefficients produced by Johansen test indicate that in the long run, inflation rate, interest rate, exchange rate, current account balance, and gross national expenditure have a positive impact on FDI whereas external debt and air transport have a negative effect on FDI in the long run.

To persist a significant lon-run relationship between dependent and independent variables, the coefficient of error correction term (ECT) has to be negative and statistically significant. The value of the coefficient is 0.21741. It is positive in sign and not statistically significant. So, there is no significant long-run causality running from independent variables to dependent variable. The ECT coefficient also indicates that the speed of adjustment towards long-run equilibrium is very low, only 21.74%.

Table 8.1: Long-run and Short-run Relationships at a Glance

Independent Variable	Long-run Effect on FDI	Short-run Effect on FDI
Inflation Rate	Positive	Positive
Interest Rate	Positive	Negative **
Exchange Rate	Positive	Positive
External Debt	Negative	Positive
Current Account Balance	Positive	Positive
Gross National Expenditure	Positive	Negative ***
Air Transport	Negative	Positive

Note: ***, **, * denote 1%, 5%, and 10% significance level respectively

The VECM equation indicates that in the short-run both lags (lag 1 and lag 2) of inflation rate, exchange rate, current account balance, and air transport have positive association with FDI, both lags of interest rate and gross national expenditure have negative association with FDI, lag 1 of external debt and lag 2 of FDI itself have positive association with FDI, and lag 2 of external debt and lag 1 of FDI itself have negative association with FDI. The Wald test results show that interest rate and gross national expenditure have a significant negative impact on FDI in the short-run. The other variables do not exhibit any short-run causality towards FDI.

Correlogram test and Breusch-Godfrey test confirm that the model is free from serial correlation. Results of Breusch-Pagan-Godfrey test and ARCH test verify that there is no heteroskedasticity in the model. Jarque-Bera normality test indicates that the residuals are normally distributed. CUSUM test and CUSUM of Squares test reveal that the model is stable and there is no structural break in the model. The value of R-squared indicates that 76.67% variation in FDI can be explained by explanatory variables jointly. The F-statistic implies that explanatory variables can jointly influence FDI. All these results indicate that the model has a very good fit.

Results of both VEC and Pairwise Granger causality test reveal that (i) there exists a unidirectional short-run Granger causality running from interest rate to FDI; (ii) a bidirectional short-run Granger causality exists between gross national expenditure and FDI; and (iii) no short run Granger causality exists between air transport and FDI. In the case of other explanatory variables, different causality has been found in both tests. VEC test indicates a unidirectional short-run causality running from FDI to inflation rate and from FDI to current account balance whereas Pairwise test indicates a unidirectional short-run causality running from FDI to external debt and a bidirectional Granger causality between exchange rate and FDI.

Impulse response function shows that a one standard deviation positive shock to inflation rate and FDI itself will have a positive impact on FDI in the short-run as well as in the long-run. A positive shock to interest rate will have a negative impact on FDI both in the long-run and short-run. A shock to gross national expenditure has asymmetric impacts on FDI in the short-run whereas a negative effect in the long-run. A shock to air transport has asymmetric impacts on FDI in the short-run but has a positive impact in the long-run. A positive shock to exchange rate, external debt, and current account balance have asymmetric impacts on FDI both in the short-run and in the long-run.

Variance decomposition of our model shows that in period 1, the forecast error variance of FDI is explained 100% by exogenous shocks to FDI itself. In period 2, the forecast error variance of FDI is decomposed into its own variance (63.6%) followed by inflation rate (0.35%), interest rate (0.41%), exchange rate (0.98%), external debt (5.99%), current account balance (12.2%), gross national expenditure (16.13%), and air transport (0.34%). As time goes on, the influence of FDI itself, current account balance, and gross national expenditure are decreasing while the influence of interest rate, and air transport are increasing. The other variables do not show any trend.

8.2.4 Volatility Analysis

The ARCH Heteroskedasticity test indicates that out of 8 variables, ARCH effect exists in the series of inflation rate (RINF) and exchange rate (REXC). Therefore, the volatility of RINF and REXC series can be analyzed through ARCH model.

The p-value of Jarque-Bera statistic indicates that the distribution of RINF is normal, but the distribution of REXC is not. The coefficient of skewness shows that RINF is moderately skewed whereas REXC is highly skewed. The coefficient of kurtosis indicates that the distribution of RINF is mesokurtic (normal) and the distribution of REXC is leptokurtic, that is, has more higher values (peaked curve). The standard deviation of RINF and REXC indicates that RINF shows higher volatility than REXC.

GARCH processes are based on the concept of stationarity. The results of Augmented Dickey Fuller (ADF) test and Phillips-Perron (PP) unit root tests confirm that both the series are stationary at level. Hence, the GARCH processes can be followed for RINF and REXC series.

Results of GARCH (1,1) model for inflation rate indicate that the coefficients of both ARCH term and GARCH term are statistically significant which means that the volatility of inflation rate is influenced by the previous period's information about volatility as well as previous period's conditional variance (volatility). The results also reveal that volatility will continue to rise over time but it will not last long. The dynamic forecast shows that after 2005, the forecast of variance is increasing over time which indicates that volatility is not stable. ARCH test shows that there is no heteroscedasticity in the model. Correlogram test indicates that there is no serial correlation. Jarque-Bera test reveals that the residuals are normally distributed. So, the model has a pretty good fit.

Results of GARCH (1,1) model for exchange rate show that coefficient of the ARCH term and the coefficient of the GARCH term are not statistically significant. So, neither the previous period's information about volatility nor the previous period's volatility can significantly affects the volatility of exchange rate. Since the sum of the ARCH and GARCH coefficients is not very close to 1, the volatility of exchange rate will not persist a long time. The dynamic forecast indicates that the forecast of variance is decreasing till 1995 and after that it is stable. ARCH test indicates that there is no heteroscedasticity. Correlogram test confirms that there is no serial correlation in the model. Jarque-Bera test shows that the residuals are normally distributed. So, the model has a very good fit.

8.2.5 Impacts of Volatilities on FDI

The correlation matrix shows that volatility of interest rate (VINT), volatility of exchange rate (VEXC), volatility of external debt (VEXD), and volatility of gross national expenditure (VGNE) have negative association with FDI whereas volatility of inflation rate (VINF), volatility of current account balance (VCAB), and volatility of air transport (VAIR) have positive association. No high correlation (0.80 or above) between any two predictor variables is observed.

In both ADF and PP tests, volatility of external debt (VEXD) is found stationary at level whereas log of FDI, volatility of inflation rate (VINF), volatility of interest rate (VINT), volatility of exchange rate (VEXC), volatility of current account balance (VCAB), and volatility of gross national expenditure (VGNE) are found stationary at their first differences. Volatility of air transport (VAIR) is found stationary at level in ADF test whereas it is found stationary at first difference in PP test. But this difference in ADF and PP test does not hamper the selection of model since a combination of both level and first difference stationarity indicates ARDL bounds test for cointegration.

LR, FPE, AIC, and HQ criteria suggest lag 2 whereas SC criterion suggests lag 1 for this model. From the results of ARDL error correction regression (our suggested model), we see that AIC, SC, and HQ values are lower when the lag is 2. Therefore, the optimum lag is 2 for this model.

From the results of bounds test, we see that the calculated F-statistic is greater than the critical value for the upper bound I(1). Therefore, we can reject the null hypothesis of no cointegration equation and accept the alternative hypothesis that the variables included in the model are cointegrated. So, there is long-run relationship between dependent and independent variables and we have to apply error correction model (ECM) to justify the existing long-run relationship.

The long-run relationship specified by the bounds test results indicates that volatility of inflation rate (VINF), volatility of interest rate (VINT), volatility of exchange rate (VEXC), volatility of current account balance (VCAB), and volatility of gross national expenditure (VGNE) have negative long-run association with FDI which is desired. On the other hand, volatility of external debt (VEXD) and volatility of air transport (VAIR) have undesired long-run positive relationship with FDI.

Results of ARDL error correction regression show that the coefficient of the error correction term (ECT) is negative and statistically significant. So, there exists a significant long-run causality running from independent variables to dependent variable. The value of the coefficient indicates that about 22.29% of departures from long-run equilibrium is corrected each period.

The results also reveal that in the short-run, volatility of interest rate (VINT) and volatility of gross national expenditure (VGNE) have a significant negative effect on FDI whereas volatility of exchange rate (VEXC) has a significant positive effect. Volatility of external debt (VEXD) has negative but insignificant effect on FDI in the short-run.

Residual diagnostic tests indicate that there is no heteroscedasticity in the model and the residuals are normally distributed. The value of R-squared indicates that 92.25% variation in FDI is explained collectively by independent variables. The F-statistic indicates that explanatory variables can jointly affect FDI. But the model suffers from the problem of serial correlation. In addition, the plot of CUSUM of Squares test slightly deviates from the 5% boundary line which means that the model has some issues with its stability. So, it can be concluded that the model does not have a good fit.

The long-run and short-run relationships are also verified by ARDL-ECM (OLS Approach). The results of OLS approach indicate no equilibrium long-run relationship between dependent and independent variables. The speed of adjustment towards long-run equilibrium is also very low (only 0.89%). The results also show that in the short-run, volatility of external debt (VEXD) and volatility of gross national expenditure (VGNE) have significant negative impact on FDI in the short-run whereas volatility of exchange rate (VEXC) has a significant positive effect on it. Volatility of inflation rate (VINF), volatility of interest rate (VINT), volatility of current account balance (VCAB), and volatility of air transport (VAIR) also have negative long-run relationship with FDI but these relationships are not significant.

Table 8.2: Long-run and Short-run Relationships at a Glance

Independent Variable	Long-run Effect on Return of FDI	Short-run Effect on Return of FDI (ECM)	Short-run Effect on Return of FDI (OLS)
Volatility of Inflation Rate	Negative *	—	Negative
Volatility of Interest Rate	Negative **	Negative **	Negative
Volatility of Exchange Rate	Negative	Positive ***	Positive *
Volatility of External Debt	Positive	Negative	Negative *
Volatility of Current Account Balance	Negative	—	Negative
Volatility of Gross National Expenditure	Negative	Negative ***	Negative ***
Volatility of Air Transport	Positive **	—	Negative

Note: ***, **, * denote 1%, 5%, and 10% significance level respectively

Results of various diagnostic tests show that there is no serial correlation and heteroscedasticity in the model and the residuals are normally distributed. In addition, the model is structurally stable. The value of R-squared and F-statistic also indicate goodness-of-fit of the model. So, the model has a very good fit and it is superior than the error correction model (ECM).

8.3 Policy Implications

On the basis of the findings, this study provides some policy implications for Bangladesh.

In 2018, the inflation rate in Bangladesh was 5.5% which is higher than the average inflation of 162 countries in 2018 which is 3.8%.[1] From this, the issue of high inflation in Bangladesh is easily conceivable. But the relief for foreign investors is that this high inflation rate in Bangladesh is not a cause for their concern. This is because inflation up to a certain limit (below double digits) is not a barrier to FDI, but rather mild inflation indicates the dynamics of the economy. However, the volatility of inflation rate negatively affects FDI. So, the policy makers should develop and implement measures that will ensure that the rate of inflation remains at a fairly stable level which will ensure an increase in the level of FDI.

Although research on the effects of interest rate on FDI has different results, everyone agrees that frequent fluctuations in interest rate have a negative impact on FDI and the results of this study also indicate that. Therefore, in order to increase the flow of FDI in the country, it is necessary to keep the interest rate stable and prevent its frequent fluctuations.

Findings of this study indicate that depreciation of Bangladeshi taka against U.S. dollar encourages FDI flows in Bangladesh. So, in order to encourage the flow of FDI in Bangladesh, necessary steps should be taken to prevent the devaluation of foreign currencies against Bangladeshi taka.

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[1] https://www.theglobaleconomy.com/rankings/Inflation/

The economy of Bangladesh is largely dependent on external debt. A large part of the funding required for Bangladesh's development activities comes from external debt. Due to low repayment, this burden of debt is increasing day by day. The debt burden indicates a country’s poor financial condition and it badly affects the investment climate of a country. Results of this study indicate that FDI is negatively affected by the country’s poor debt conditions in the long-run. As it is now proven that FDI is conducive to the economic development of a country, necessary steps should be taken to attract more FDI by avoiding excessive reliance on external debt as a crucial requirement for the economy. Moreover, policies need to be formulated to improve the debt service of the country.

We have already learned that in just a few years, the balance of payment of Bangladesh was favorable. Almost every year a huge difference is noticed in Bangladesh's transactions with neighboring India and other countries which is responsible for the unfavourable condition in the balance of payment of Bangladesh. According to the results of the study, a favourable current account balance induces more FDI inflows. Therefore, it is necessary to reduce the huge differences in the transactions of Bangladesh with other countries which may improve the country's balance of payment situation.

This research finds a significant negative correlation between gross national expenditure and FDI in the short-run and an insignificant positive correlation in the long-run. Since gross national expenditure is the sum of three types of expenditure, it is normal to come up with contradictory results between short-term and long-term. If the increase in aggregate expenditure is for infrastructural development and capital formation, it will increase FDI inflows. But if the increase in overall spending is just for consumption, or if corruption is involved in development and investment spending, it will reduce FDI. So, in order to increase the flow of FDI in Bangladesh, it is necessary to reduce consumption expenditure and increase expenditure on infrastructural development and capital formation.

In this study, air transport (proxy for transportation facilities) is found to have a positive effect on FDI in the short-run. Although this finding is not significant, it is consistent with our hypothesis. However, the long-run coefficient is negative and insignificant. Various studies have shown that foreign investors do not show much interest in investing in a country unless they have adequate facilities to transport capital goods, raw materials, and manufactured products. Therefore, in order to increase the flow of FDI in Bangladesh, it is necessary to develop transport infrastructures and increase other transportation facilities.

8.4 Conclusion

Since the decades of the United Nations Development in the 1960s, the role of investment in economic growth and development, especially foreign direct investment (FDI), has become a controversial issue. Always opinions have been expressed in favor and against it. Some argue that foreign investment contributes to the economic development of the country as a whole by increasing economic growth and productivity. In contrast, others emphasize the risk of foreign investment such as destroying local capacities and exploiting natural resources of the poor countries without adequate compensation to them. It is, however, now proven that FDI can be a win-win situation for both the related parties. The investor can gain cheap access to the production of goods or services and the host country can get locally unattainable investment. That is why, countries around the world take various steps to attract FDI. Bangladesh is also making regular efforts to increase the flow of FDI in the country but it has not been very successful. The low inflow of FDI in Bangladesh indicates the need for reforms in policies and regulations to restructure the business environment and gain investors' confidence. Nomura, a Japanese financial services firm, reported that none out of the 51 companies who relocated their production out of China between April 2018 and August 2019 chose Bangladesh.[2] Therefore, in order to increase the flow of FDI in the country, Bangladesh must address several overarching issues that stand in the way.

[2] The Business Standard: September 01, 2020.

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APPENDICES

Appendix 1: Net FDI Inflows in South Asian Countries

(in millions of dollars)

Year	Bangladesh	Pakistan	India
1980	8.51	63.63	79.16
1981	5.36	108.08	91.92
1982	6.96	63.83	72.08
1983	0.4	29.46	5.64
1984	-0.55	55.51	19.24
1985	-6.66	131.39	106.09
1986	2.43	105.73	117.73
1987	3.21	129.38	212.32
1988	1.84	186.49	91.25
1989	0.25	210.60	252.10
1990	3.24	245.26	236.69
1991	1.39	258.41	73.54
1992	3.72	336.48	276.51
1993	14.05	348.56	550.37
1994	11.15	421.02	973.27
1995	1.9	722.63	2143.63
1996	13.53	921.98	2426.06
1997	139.38	716.25	3577.33
1998	190.06	506.00	2634.65
1999	179.66	532.00	2168.59
2000	280.38	308.00	3584.22
2001	78.53	378.00	5128.09
2002	52.3	826.00	5208.97
2003	268.29	534.00	3681.98
2004	448.91	1118.00	5429.25
2005	760.5	2201.00	7269.41
2006	456.52	4273.00	20029.12
2007	651.03	5590.00	25227.74
2008	1328.42	5438.00	43406.28
2009	901.29	2338.00	35581.37
2010	1232.26	2022.00	27396.89
2011	1264.73	1326.00	36498.65
2012	1584.4	859.00	23995.69
2013	2602.96	1333.00	28153.03
2014	2539.19	1887.00	34576.64
2015	2831.15	1673.00	44009.49
2016	2332.72	2576.00	44458.57
2017	2151.37	2496.00	39966.09
2018	2940.22	1737.00	42117.45

Source: World Development Indicators, updated on December 2019.

Appendix 2: Time Series Data Collected from World Bank and IMF Websites

Year	FDI	INF	INT	EXC	EXD	CAB	GNE	AIR
1980	8.51	15.385	-5.293	15.454	20.941	-1.099	112.389	13500
1981	5.36	14.545	1.916	17.987	20.443	-3.119	102.317	13400
1982	6.96	12.875	1.952	22.118	26.213	-3.275	102.582	13700
1983	0.4	9.531	3.237	24.615	29.500	-1.896	104.514	14300
1984	-0.55	10.414	3.823	25.354	28.488	-2.586	109.707	11800
1985	-6.66	10.465	-5.481	27.995	28.824	-3.017	101.317	13600
1986	2.43	10.175	5.307	30.407	35.644	-2.241	100.965	15000
1987	3.21	10.828	4.392	30.950	39.160	-1.724	101.375	15400
1988	1.84	9.674	7.911	31.733	37.801	-3.792	101.957	13100
1989	0.25	8.734	7.072	32.270	36.375	-3.706	100.838	14600
1990	3.24	10.522	8.887	34.569	38.133	-2.672	100.552	13000
1991	1.39	8.285	12.837	36.596	41.108	-0.948	102.323	13800
1992	3.72	3.624	12.105	38.951	41.344	-0.345	103.441	14600
1993	14.05	2.979	14.821	39.567	41.460	-0.345	105.648	15600
1994	11.15	6.150	10.132	40.212	44.482	-0.776	105.299	13000
1995	1.9	10.117	6.398	40.278	40.246	-1.982	105.993	12600
1996	13.53	2.455	-4.317	41.794	31.835	-2.069	104.310	13100
1997	139.38	4.959	9.826	43.892	28.738	-1.322	104.676	12800
1998	190.06	8.648	7.826	46.906	30.166	-0.905	103.486	11900
1999	179.66	6.179	8.979	49.085	31.135	-0.624	103.994	5900
2000	280.38	2.483	8.998	52.142	28.316	-1.241	103.790	6313
2001	78.53	1.908	9.257	55.807	26.930	-0.786	103.543	6486
2002	52.3	3.719	8.390	57.888	29.328	0.290	103.502	6464
2003	268.29	5.361	5.884	58.150	29.469	0.278	104.494	7165
2004	448.91	6.103	5.582	59.513	29.027	-0.278	103.804	7403
2005	760.5	7.040	5.764	64.327	25.518	0.011	104.775	7399
2006	456.52	6.770	5.467	68.933	26.575	1.009	104.708	7971
2007	651.03	9.109	5.789	68.875	25.466	0.721	105.431	11139
2008	1328.42	8.900	4.662	68.598	23.720	1.217	107.013	11308
2009	901.29	4.914	6.147	69.039	22.999	2.445	105.874	16399
2010	1232.26	9.365	4.736	69.649	21.571	0.415	105.437	19300
2011	1264.73	11.464	5.064	74.152	19.649	-1.020	106.799	26535
2012	1584.4	6.229	5.343	81.863	19.745	0.685	107.039	26996
2013	2602.96	7.539	5.989	78.103	19.648	1.176	106.354	59064
2014	2539.19	7.009	6.886	77.641	17.899	1.331	106.488	65364
2015	2831.15	6.161	5.513	77.947	17.478	1.861	106.728	55864
2016	2332.72	5.678	3.449	78.468	16.579	0.622	104.675	59728
2017	2151.37	5.611	3.069	80.438	18.106	-2.120	105.181	70503
2018	2940.22	5.608	3.839	83.466	18.192	-2.718	108.400	101384

Source: FDI, INT, EXC, EXD, GNE, AIR from World Development Indicators (World Bank) updated on December 2019; INF, CAB from World Economic Outlook Database (IMF) updated on October 2019.

FDI = Net FDI Inflows (millions of dollars), INF = Average Consumer Prices (annual %)
INT = Real Interest Rate (%), EXC = Average Official Exchange Rate (BDT per US$)
EXD = External Debt Stocks (% of GNI), CAB = Current Account Balance (% of GDP)
GNE = Gross National Expenditure (% of GDP)
AIR = Air Transport (Registered Carrier Departures Worldwide)

Appendix 3: Logarithmic Version of Appendix 2

(Used to investigate the impacts and causalities)

Year	LFDI	LINF	LINT	LEXC	LEXD	LCAB	LGNE	LAIR
1980	2.7200	2.7334	-0.3462	2.7379	3.0417	1.0651	4.7220	9.5104
1981	2.4874	2.6772	2.0689	2.8896	3.0176	-0.1267	4.6281	9.5030
1982	2.6123	2.5553	2.0734	3.0964	3.2662	-0.3216	4.6307	9.5252
1983	1.9559	2.2545	2.2233	3.2034	3.3844	0.7438	4.6493	9.5680
1984	1.8116	2.3432	2.2848	3.2329	3.3495	0.3464	4.6978	9.3759
1985	-4.6052	2.3480	-0.6565	3.3320	3.3612	-0.0171	4.6182	9.5178
1986	2.2083	2.3199	2.4255	3.4147	3.5736	0.5647	4.6148	9.6158
1987	2.2905	2.3821	2.3410	3.4324	3.6677	0.8224	4.6188	9.6421
1988	2.1412	2.2694	2.6327	3.4574	3.6323	-1.5702	4.6246	9.4804
1989	1.9344	2.1672	2.5705	3.4741	3.5939	-1.2242	4.6135	9.5888
1990	2.2935	2.3535	2.7005	3.5430	3.6411	0.2837	4.6107	9.4727
1991	2.0869	2.1144	2.9358	3.5999	3.7162	1.1158	4.6281	9.5324
1992	2.3408	1.2876	2.8962	3.6623	3.7219	1.2961	4.6390	9.5888
1993	3.0311	1.0916	3.0360	3.6780	3.7247	1.2961	4.6601	9.6550
1994	2.8803	1.8165	2.7808	3.6942	3.7951	1.1706	4.6568	9.4727
1995	2.1483	2.3142	2.5175	3.6958	3.6950	0.7021	4.6634	9.4415
1996	3.0057	0.8981	0.5207	3.7328	3.4606	0.6580	4.6474	9.4804
1997	4.9839	1.6012	2.7617	3.7817	3.3582	0.9851	4.6509	9.4572
1998	5.2818	2.1573	2.6265	3.8481	3.4067	1.1298	4.6394	9.3843
1999	5.2275	1.8212	2.7066	3.8936	3.4383	1.2167	4.6443	8.6827
2000	5.6597	0.9095	2.7079	3.9540	3.3434	1.0149	4.6424	8.7504
2001	4.4450	0.6461	2.7250	4.0219	3.2932	1.1675	4.6400	8.7774
2002	4.0770	1.3135	2.6665	4.0585	3.3785	1.4563	4.6396	8.7740
2003	5.6166	1.6792	2.4752	4.0630	3.3833	1.4535	4.6491	8.8770
2004	6.1216	1.8088	2.4495	4.0862	3.3682	1.3143	4.6425	8.9096
2005	6.6427	1.9516	2.4651	4.1640	3.2394	1.3890	4.6518	8.9091
2006	6.1381	1.9125	2.4395	4.2331	3.2800	1.6112	4.6512	8.9836
2007	6.4887	2.2093	2.4672	4.2323	3.2374	1.5520	4.6581	9.3182
2008	7.1968	2.1861	2.3667	4.2283	3.1663	1.6519	4.6729	9.3333
2009	6.8112	1.5921	2.4970	4.2347	3.1355	1.8633	4.6622	9.7050
2010	7.1220	2.2370	2.3736	4.2435	3.0713	1.4850	4.6581	9.8679
2011	7.1479	2.4392	2.4037	4.3061	2.9780	1.0919	4.6709	10.1862
2012	7.3722	1.8292	2.4286	4.4050	2.9829	1.5444	4.6732	10.2035
2013	7.8670	2.0201	2.4840	4.3580	2.9780	1.6440	4.6668	10.9864
2014	7.8422	1.9472	2.5561	4.3521	2.8848	1.6735	4.6680	11.0877
2015	7.9508	1.8182	2.4434	4.3560	2.8609	1.7683	4.6703	10.9307
2016	7.7576	1.7366	2.2459	4.3627	2.8082	1.5308	4.6509	10.9976
2017	7.6770	1.7247	2.2048	4.3875	2.8963	0.6313	4.6557	11.1634
2018	7.9885	1.7242	2.2863	4.4244	2.9010	0.2484	4.6858	11.5267

N.B. Before applying the logarithm, a constant is added to some variables containing one or more negative values so that the negative values can be avoided and a minimum positive value is found. These variables are: LFDI = Log (FDI + 6.67), LINT = Log (INT + 6), LCAB = Log (CAB + 4)

Appendix 4: Rate of Return Calculated from Appendix 2

(Calculated for GARCH model by using the following formula)

$$R_t = \frac{y_t - y_{t-1}}{y_{t-1}}$$

Year	RFDI	RINF	RINT	REXC	REXD	RCAB	RGNE	RAIR
1980	--	--	--	--	--	--	--	--
1981	-0.3702	-0.0546	-1.3620	0.1639	-0.0238	1.8380	-0.0896	-0.0008
1982	0.2985	-0.1148	0.0188	0.2297	0.2822	0.0500	0.0026	0.0023
1983	-0.9425	-0.2597	0.6587	0.1129	0.1254	-0.4211	0.0188	0.0045
1984	-2.3750	0.0926	0.1810	0.0300	-0.0343	0.3639	0.0497	-0.0201
1985	11.109	0.0049	-2.4337	0.1042	0.0118	0.1667	-0.0765	0.0151
1986	-1.3649	-0.0277	-1.9683	0.0862	0.2366	-0.2572	-0.0035	0.0103
1987	0.3210	0.0642	-0.1725	0.0179	0.0986	-0.2307	0.0041	0.0027
1988	-0.4268	-0.1066	0.8013	0.0253	-0.0347	1.1995	0.0057	-0.0168
1989	-0.8641	-0.0972	-0.1060	0.0169	-0.0377	-0.0227	-0.0110	0.0114
1990	11.960	0.2047	0.2565	0.0712	0.0483	-0.2790	-0.0028	-0.0121
1991	-0.5710	-0.2126	0.4445	0.0586	0.0780	-0.6452	0.0176	0.0063
1992	1.6763	-0.5626	-0.0570	0.0643	0.0057	-0.6361	0.0109	0.0059
1993	2.7769	-0.1780	0.2244	0.0158	0.0028	0.0000	0.0213	0.0069
1994	-0.2064	1.0645	-0.3164	0.0163	0.0729	1.2493	-0.0033	-0.0189
1995	-0.8296	0.6450	-0.3685	0.0017	-0.0952	1.5541	0.0066	-0.0033
1996	6.1211	-0.7573	-1.6747	0.0376	-0.2090	0.0439	-0.0159	0.0041
1997	9.3016	1.0200	-3.2763	0.0502	-0.0973	-0.3610	0.0035	-0.0024
1998	0.3636	0.7439	-0.2036	0.0687	0.0497	-0.3154	-0.0114	-0.0077
1999	-0.0547	-0.2855	0.1473	0.0465	0.0321	-0.3105	0.0049	-0.0748
2000	0.5606	-0.5982	0.0022	0.0623	-0.0905	0.9888	-0.0020	0.0078
2001	-0.7199	-0.2316	0.0288	0.0703	-0.0490	-0.3666	-0.0024	0.0031
2002	-0.3340	0.9492	-0.0937	0.0373	0.0891	-1.3690	-0.0004	-0.0004
2003	4.1298	0.4415	-0.2986	0.0045	0.0048	-0.0414	0.0096	0.0117
2004	0.6732	0.1384	-0.0513	0.0234	-0.0150	-2.0000	-0.0066	0.0037
2005	0.6941	0.1535	0.0326	0.0809	-0.1209	-1.0396	0.0094	-0.0001
2006	-0.3997	-0.0384	-0.0516	0.0716	0.0414	90.7273	-0.0006	0.0084
2007	0.4261	0.3455	0.0589	-0.0008	-0.0417	-0.2854	0.0069	0.0373
2008	1.0405	-0.0229	-0.1947	-0.0040	-0.0686	0.6879	0.0150	0.0016
2009	-0.3215	-0.4479	0.3185	0.0064	-0.0304	1.0090	-0.0106	0.0398
2010	0.3672	0.9058	-0.2295	0.0088	-0.0621	-0.8303	-0.0041	0.0168
2011	0.0263	0.2241	0.0693	0.0647	-0.0891	-3.4578	0.0129	0.0323
2012	0.2528	-0.4566	0.0551	0.1040	0.0049	-1.6716	0.0022	0.0017
2013	0.6429	0.2103	0.1208	-0.0459	-0.0049	0.7168	-0.0064	0.0767
2014	-0.0245	-0.0703	0.1498	-0.0059	-0.0890	0.1318	0.0013	0.0092
2015	0.1150	-0.1210	-0.1994	0.0039	-0.0235	0.3982	0.0023	-0.0142
2016	-0.1761	-0.0784	-0.3743	0.0067	-0.0514	-0.6658	-0.0192	0.0061
2017	-0.0777	-0.0118	-0.1103	0.0251	0.0921	-4.4084	0.0048	0.0151
2018	0.3667	-0.0005	0.2509	0.0377	0.0047	0.2821	0.0306	0.0325

RFDI = Rate of Change in Foreign Direct Investment,
RINF = Rate of Change in Inflation Rate,
RINT = Rate of Change in Interest Rate, and so on.

Appendix 5: 3 Year Moving Average Standard Deviation (Volatility)

(Calculated from Appendix 4 by using the following formula)

$$\sigma_n = \sqrt{\frac{1}{n-1}\sum_{t=1}^{n}(R_t - \bar{R})^2}$$

Year	VFDI	VINF	VINT	VEXC	VEXD	VCAB	VGNE	VAIR
1980	--	--	--	--	--	--	--	--
1981	--	--	--	--	--	--	--	--
1982	--	--	--	--	--	--	--	--
1983	0.6211	0.1054	1.0327	0.0585	0.1530	1.1918	0.0585	0.0027
1984	1.3379	0.1771	0.3326	0.1003	0.1583	0.3951	0.0239	0.0136
1985	7.4062	0.1834	1.6647	0.0456	0.0822	0.4084	0.0658	0.0181
1986	7.5104	0.0622	1.3948	0.0387	0.1450	0.3174	0.0633	0.0191
1987	6.7679	0.0466	1.1940	0.0455	0.1134	0.2374	0.0445	0.0063
1988	0.8447	0.0855	1.4050	0.0375	0.1357	0.8335	0.0049	0.0140
1989	0.5993	0.0960	0.5440	0.0046	0.0779	0.7727	0.0092	0.0144
1990	7.2811	0.1771	0.4567	0.0292	0.0488	0.7901	0.0084	0.0151
1991	7.3209	0.2155	0.2798	0.0284	0.0601	0.3129	0.0147	0.0124
1992	6.6812	0.3841	0.2533	0.0063	0.0363	0.2088	0.0104	0.0105
1993	1.7063	0.2128	0.2514	0.0265	0.0426	0.3699	0.0053	0.0005
1994	1.5086	0.8504	0.2705	0.0279	0.0396	0.9592	0.0124	0.0146
1995	1.9277	0.6320	0.3283	0.0083	0.0844	0.8235	0.0124	0.0130
1996	3.8457	0.9541	0.7696	0.0181	0.1418	0.7986	0.0113	0.0117
1997	5.1812	0.9368	1.4564	0.0252	0.0651	1.0093	0.0122	0.0041
1998	4.5305	0.9564	1.5368	0.0156	0.1297	0.2218	0.0102	0.0059
1999	5.2852	0.6880	1.8835	0.0119	0.0803	0.0279	0.0090	0.0403
2000	0.3142	0.7022	0.1763	0.0114	0.0764	0.7516	0.0082	0.0439
2001	0.6404	0.1979	0.0773	0.0121	0.0624	0.7669	0.0041	0.0464
2002	0.6569	0.8086	0.0644	0.0172	0.0940	1.1833	0.0010	0.0041
2003	2.6955	0.5923	0.1654	0.0329	0.0696	0.6920	0.0064	0.0062
2004	2.3412	0.4097	0.1322	0.0164	0.0552	0.9997	0.0082	0.0062
2005	1.9897	0.1708	0.1722	0.0398	0.0676	0.9794	0.0093	0.0060
2006	0.6256	0.1067	0.0485	0.0308	0.0824	53.2610	0.0081	0.0042
2007	0.5701	0.1919	0.0577	0.0448	0.0812	52.7653	0.0052	0.0196
2008	0.7227	0.2173	0.1272	0.0428	0.0574	52.2675	0.0078	0.0189
2009	0.6821	0.3970	0.2566	0.0054	0.0196	0.6741	0.0131	0.0214
2010	0.6810	0.6923	0.3068	0.0068	0.0204	0.9824	0.0133	0.0192
2011	0.3444	0.6768	0.2744	0.0329	0.0294	2.2450	0.0122	0.0117
2012	0.1735	0.6812	0.1685	0.0478	0.0484	1.3418	0.0086	0.0153
2013	0.3119	0.3891	0.0346	0.0777	0.0517	2.0945	0.0097	0.0377
2014	0.3353	0.3349	0.0485	0.0776	0.0516	1.2449	0.0047	0.0413
2015	0.3520	0.1784	0.1938	0.0264	0.0442	0.2929	0.0047	0.0472
2016	0.1456	0.0272	0.2668	0.0066	0.0328	0.5536	0.0121	0.0127
2017	0.1480	0.0550	0.1343	0.0115	0.0761	2.5246	0.0132	0.0150
2018	0.2892	0.0421	0.3139	0.0156	0.0723	2.4801	0.0249	0.0134

VFDI = Volatility of Foreign Direct Investment,
VINF = Volatility of Inflation Rate,
VINT = Volatility of Interest Rate, and so on.