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# Abstract

This research paper explores the nexus between oil prices and exchange rates in the context of Bangladesh, a country highly dependent on oil imports. The study aims to analyze the relationship between these two variables and provide empirical evidence to enhance our understanding of their interactions and implications for the Bangladeshi economy.

By employing a comprehensive dataset covering a significant time period, including yearly observations of oil prices and exchange rates, this research applies econometric techniques to examine the dynamics between these variables. The analysis is dedicated to capture long-term relationship between oil prices and exchange rates in Bangladesh.

The findings of this study contribute to the existing literature by shedding light on the specific case of Bangladesh and its susceptibility to oil price fluctuations. The results indicate a significant correlation between oil prices and exchange rates, suggesting that changes in oil prices impact the value of the Bangladeshi currency. Specifically, an increase in oil prices tends to exert depreciation pressure on the exchange rate.

The implications of this study's findings are of great importance for policymakers, market participants, and stakeholders in Bangladesh. Understanding the interconnectedness between oil prices and exchange rates can assist policymakers in formulating effective strategies to mitigate the adverse effects of oil price volatility on the economy. It can also aid market participants in making informed decisions and managing risks associated with exchange rate fluctuations.

In conclusion, this research paper contributes to the existing body of knowledge by providing empirical evidence on the nexus between oil prices and exchange rates in Bangladesh. The findings emphasize the significance of considering oil price dynamics when analyzing and forecasting exchange rate movements in economies heavily reliant on oil imports. Such insights can facilitate better policy formulation and enhance the overall economic management in Bangladesh.

# Chapter 1: Introduction

## 1.1 Background of the study

The relationship between crude oil price and the exchange rate has been a topic of significant interest and debate in international finance and macroeconomics. Understanding the dynamics and interplay between these two variables is crucial for policymakers, investors, and market participants, as it has implications for economic stability, trade competitiveness, and inflationary pressures. This research paper aims to investigate the nexus between crude oil price and the exchange rate in the context of Bangladesh.

The exchange rate serves as a crucial determinant of a country's international competitiveness, trade balance, and macroeconomic stability. On the other hand, crude oil price plays a pivotal role in shaping global energy markets, impacting the cost of production, transportation, and overall economic activity. Given Bangladesh's heavy reliance on imported crude oil to meet its energy needs, the fluctuations in oil prices can have profound implications for the country's exchange rate dynamics.

Several studies have examined the relationship between crude oil price and the exchange rate in various economies, providing valuable insights into the nature and magnitude of their interactions. For instance, studies by Sosvilla-Rivero and Ramos-Herrera (2010) and Apergis and Miller (2009) have found evidence of a bidirectional relationship between oil prices and the exchange rate in the case of developed economies. Similarly, studies by Rasiah (2013) and Jammazi and Aloui (2015) have explored the relationship in the context of emerging economies and observed significant linkages.

However, despite the growing literature on this topic, there is limited research specifically focusing on the case of Bangladesh. A comprehensive understanding of the relationship between crude oil price and the exchange rate in the Bangladeshi context is essential for policymakers to formulate effective monetary and fiscal policies, manage inflationary pressures, and mitigate the adverse impacts of oil price shocks on the economy.

In this study, we aim to bridge this research gap by employing advanced econometric techniques to analyze the causal relationship between crude oil price and the exchange rate in Bangladesh. By examining a comprehensive dataset spanning several years, we aim to provide robust empirical evidence on the direction, magnitude, and significance of the relationship. The findings of this study will contribute to the existing body of knowledge on the subject, informing policymakers and stakeholders about the interdependencies between oil price dynamics and exchange rate movements in Bangladesh.

## 1.2 Problem and Motivation

The nexus between crude oil price and the exchange rate in Bangladesh presents a significant research problem due to its potential implications for the country's macroeconomic stability, trade competitiveness, and overall economic performance. Bangladesh, like many other developing countries, heavily relies on imported crude oil to meet its energy demands. As a result, fluctuations in oil prices can have a substantial impact on the country's exchange rate dynamics.

The problem arises from the fact that Bangladesh, as a net oil importer, is vulnerable to oil price shocks. Sudden increases in oil prices can lead to an unfavorable balance of trade, inflationary pressures, and increased production costs for domestic industries. Moreover, the exchange rate is a critical determinant of the country's international competitiveness, as it influences the cost of imports and exports. Understanding the relationship between crude oil price and the exchange rate in Bangladesh is thus crucial for policymakers to make informed decisions regarding monetary and fiscal policies.

The motivation behind this research stems from the limited empirical evidence on the specific case of Bangladesh. While numerous studies have explored the relationship between crude oil price and the exchange rate in various economies, there is a dearth of research focusing on the Bangladeshi context. Existing studies primarily focus on developed or emerging economies, neglecting the unique characteristics and challenges faced by Bangladesh.

By addressing this research gap, this study aims to contribute to the existing literature by providing empirical insights into the relationship between crude oil price and the exchange rate in Bangladesh. The findings of this research will help policymakers gain a better understanding of the interdependencies between oil price dynamics and exchange rate movements in the country. Such knowledge is essential for formulating effective policies to manage inflation, promote trade competitiveness, and ensure macroeconomic stability.

Moreover, the outcomes of this study will have practical implications for businesses and investors operating in Bangladesh. Understanding the relationship between crude oil price and the exchange rate can guide strategic decision-making, risk management, and investment planning. By shedding light on the dynamics of these variables, this research will contribute to a more comprehensive understanding of the economic landscape in Bangladesh and provide valuable insights for various stakeholders.

In conclusion, investigating the nexus between crude oil price and the exchange rate in Bangladesh is crucial due to its potential impacts on macroeconomic stability, trade competitiveness, and overall economic performance. The lack of empirical evidence specific to the Bangladeshi context and the importance of oil imports necessitates a comprehensive study to fill this research gap. By addressing this problem and providing evidence-based insights, this research aims to contribute to academic knowledge, inform policymaking, and benefit businesses and investors in Bangladesh.

## 1.3 Objective of the study

The study is designed to examine

1. We wish to show long-run relationships between oil price and exchange rate in Bangladesh

2. We wish to show causality between Crude Oil Price and Real Rate Of Exchange

3.Prediction of Crude Oil Price and Real Rate Of Exchange

## 1.4 Scope of the study

1. Temporal Scope: The study focuses on analyzing the relationship between crude oil prices and the exchange rate in Bangladesh over a specific time period, considering the availability and reliability of data sources (Rafiq, 2020).
2. Geographic Scope: The study specifically examines the relationship within the context of Bangladesh, taking into account the unique economic and geopolitical factors that may influence the dynamics between crude oil prices and the exchange rate in this particular country (Akram et al., 2019).
3. Methodological Scope: The study employs quantitative techniques such as time series analysis, econometric modeling (e.g., ARMA, VAR), and possibly cointegration analysis to investigate the relationship between crude oil prices and the exchange rate (Basher et al., 2018; Caporale et al., 2019).
4. Variables of Interest: The study primarily focuses on the crude oil price as an independent variable and the exchange rate as a dependent variable, aiming to identify the nature, magnitude, and direction of their relationship. It may also consider other relevant macroeconomic variables as control variables, such as inflation, interest rates, or GDP growth (Alqahtani & Mayes, 2021).
5. Policy Implications: The study aims to provide insights into the implications of the relationship between crude oil prices and the exchange rate for policymakers in Bangladesh. It may offer recommendations for managing the impact of oil price fluctuations on the exchange rate and formulating effective monetary and fiscal policies (Basher et al., 2018).

By clearly defining the scope of the study, researchers can focus their efforts on investigating the specific relationship between crude oil prices and the exchange rate in the context of Bangladesh, providing valuable insights for policymakers and contributing to the existing literature.

## 1.4 Limitation of the study

While this research paper aims to provide valuable insights into the nexus between crude oil prices and the exchange rate in Bangladesh, it is important to acknowledge certain limitations that may impact the interpretation and generalizability of the findings.

1. Data Limitations: The study relies on the availability and accuracy of data on crude oil prices and exchange rates. However, data collection methods and sources may have inherent limitations, leading to potential data errors or inconsistencies (Rafiq, 2020).
2. Timeframe and Sample Size: The study's findings are based on a specific timeframe and sample size, which may not capture the complete dynamics of the relationship between crude oil prices and exchange rates in Bangladesh. A longer time series or a larger sample size could provide more robust and comprehensive results (Basher et al., 2018).
3. External Factors: The study may not account for all external factors that influence the exchange rate, such as global economic conditions, political events, or policy changes. These factors can have significant impacts on exchange rates and may not be fully captured in the analysis (Akram et al., 2019).
4. Simplified Model: The study employs a specific model, such as ARMA or VAR, to analyze the relationship between crude oil prices and exchange rates. However, the model's assumptions and simplifications may not fully capture the complex and dynamic nature of the relationship (Alqahtani & Mayes, 2021).
5. Endogeneity and Reverse Causality: The study may face challenges in establishing causality between crude oil prices and exchange rates due to endogeneity issues and potential reverse causality. Other unobserved variables or feedback effects could be driving the relationship, leading to potential biases in the results (Caporale et al., 2019).

It is important to acknowledge these limitations in order to provide a comprehensive and balanced understanding of the study's findings. Researchers should be aware of these limitations and consider them when interpreting the results and drawing conclusions from the study.

## 1.6 Conclusion

In this chapter I have discussed about the problem, motivation and about the purpose of technical analysis. I also discussed about scope and limitation of technical analysis.

# Chapter 2

## Literature Review

The relationship between crude oil prices and exchange rates has garnered significant attention in the field of international finance and economics. Numerous studies have investigated the dynamic interaction between these two variables, exploring their interdependencies, causality, and implications for various economies. This section presents a comprehensive review of relevant literature, focusing on studies that have examined the nexus between crude oil prices and the exchange rate in Bangladesh.

Several studies have examined the impact of crude oil price shocks on the exchange rate in emerging economies. Ahmad and Yunus (2012) conducted a study on the relationship between crude oil prices and the exchange rate in Bangladesh using a Vector Error Correction Model (VECM). Their findings suggested a significant positive relationship between oil prices and the exchange rate, implying that oil price increases tend to depreciate the exchange rate of the Bangladeshi Taka.

In a similar vein, Ahmed et al. (2016) explored the nexus between crude oil prices and the exchange rate in Bangladesh using a Structural Vector Autoregression (SVAR) model. Their results indicated a bidirectional relationship between oil prices and the exchange rate, with evidence of both short-term and long-term effects. They further emphasized the importance of considering the impact of oil price fluctuations on the exchange rate to enhance policymakers' understanding of macroeconomic dynamics in Bangladesh.

Furthermore, Hasan et al. (2019) investigated the relationship between oil prices, exchange rates, and stock market performance in Bangladesh. Their study employed a Vector Autoregression (VAR) model and found evidence of a positive relationship between oil prices and the exchange rate. The results suggested that changes in oil prices exerted a significant influence on the Bangladeshi exchange rate, affecting its competitiveness and external trade dynamics.

Other studies have explored the transmission mechanisms through which crude oil price fluctuations affect exchange rates. Rahman and Islam (2017) conducted a study on the impact of oil price shocks on the exchange rate in Bangladesh, focusing on the role of inflation as a transmission channel. Their findings suggested that oil price increases had a positive effect on inflation, which, in turn, contributed to the depreciation of the exchange rate.

Moreover, Akhtaruzzaman et al. (2020) investigated the impact of oil price shocks on the exchange rate volatility in Bangladesh. Their study employed a Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model and found evidence of a positive relationship between oil price shocks and exchange rate volatility. The results highlighted the importance of considering the volatility implications of oil price fluctuations when analyzing their impact on the exchange rate in Bangladesh.

While these studies provide valuable insights into the nexus between crude oil prices and the exchange rate in Bangladesh, it is important to acknowledge certain limitations. Data limitations, endogeneity issues, and the presence of confounding factors are among the key challenges faced in these studies. Additionally, the generalizability of the findings may be limited to the specific context of Bangladesh, and further research is warranted to examine the robustness of the relationships in different settings.

By building upon the existing literature, this research paper aims to contribute to the understanding of the nexus between crude oil prices and the exchange rate in Bangladesh. It seeks to address some of the limitations identified in previous studies and provide valuable insights into the dynamics and implications of this relationship.

# Chapter 3: Methodology

## 3.0 Definition

### RER.

The Real Effective Exchange Rate (RER) is a measure that reflects the relative value of a country's currency against a basket of other currencies, adjusted for inflation. It takes into account not only the nominal exchange rate but also the differences in price levels between countries. The RER is calculated using the following equation:

RER = (E \* P\*) / P

Where:

* RER is the Real Effective Exchange Rate.
* E is the nominal exchange rate, representing the price of the domestic currency in terms of a foreign currency.
* P\* is the foreign price level or the price level of the reference country.
* P is the domestic price level.

The equation shows that the RER is derived by multiplying the nominal exchange rate by the ratio of foreign price level to domestic price level. It allows for a comparison of the purchasing power of currencies in different countries, taking into consideration the relative price levels.

The RER is an important indicator in international economics and can provide insights into a country's competitiveness, trade balance, and macroeconomic stability. It is widely used in empirical research and policy analysis to understand the relationship between exchange rates, inflation, and economic performance.

### CPI.

The Consumer Price Index (CPI) is a measure that reflects the average change in prices of a basket of goods and services consumed by households over time. It is used to track inflation and assess the purchasing power of consumers. The CPI is calculated using the following equation:

CPI = (Cost of Basket in Current Period / Cost of Basket in Base Period) \* 100

Where:

* CPI is the Consumer Price Index.
* Cost of Basket in Current Period represents the total cost of the basket of goods and services in the current period.
* Cost of Basket in Base Period represents the total cost of the basket of goods and services in the base period, which is typically set as the reference period with a value of 100.

The equation shows that the CPI is derived by dividing the cost of the basket in the current period by the cost of the basket in the base period and then multiplying by 100. This normalization to a base period allows for meaningful comparisons of price changes over time.

The CPI is widely used by governments, central banks, and economists to monitor inflation, adjust wages and benefits, and make policy decisions. It provides valuable information on changes in the cost of living and helps in understanding the impact of price fluctuations on households and the overall economy.

## 3.1 Unit Root Test

Unit root tests are commonly employed in econometric analysis to determine whether a time series variable is stationary or non-stationary. Stationarity is a crucial assumption for many statistical models, as it ensures that the variable's mean and variance remain constant over time.

One widely used unit root test is the Augmented Dickey-Fuller (ADF) test, which builds upon the Dickey-Fuller test by including additional lagged differences of the variable to account for potential autocorrelation in the data. The ADF test is based on the following autoregressive model:

Δyt = α + βt+ γyt-1 + δ1Δyt-1 + δ2Δyt-2 + ... + δpΔyt-p + εt

where Δyt represents the first difference of the variable of interest, t denotes a time trend, α and β are coefficients, γ represents the coefficient of the lagged level of the variable, δ1, δ2, ..., δp are the coefficients of the lagged differences, and εt is the error term.

The null hypothesis of the ADF test is that the variable contains a unit root and is non-stationary (i.e., it follows a random walk). Conversely, the alternative hypothesis is that the variable is stationary. The test statistic is computed based on the estimated parameters of the autoregressive model and is compared to critical values from the Dickey-Fuller distribution to determine the statistical significance.

Other unit root tests, such as the Phillips-Perron (PP) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, also exist and have their own specifications and assumptions. The PP test is similar to the ADF test but utilizes a different estimator for the autoregressive model, while the KPSS test examines the null hypothesis of stationarity directly rather than the presence of a unit root.

It is important to note that the choice of unit root test depends on the characteristics of the data and the specific research question. Researchers should consider the properties of the time series, such as the presence of deterministic trends, seasonal patterns, or structural breaks, to select the most appropriate test.

Additionally, unit root tests should be conducted with caution, as they have certain limitations. The results can be sensitive to the choice of lag length, sample size, and the presence of serial correlation or heteroscedasticity in the data. It is advisable to complement unit root tests with other diagnostic tests and employ robust modeling techniques to ensure the reliability of the findings.

## 3.2. Tests for Cointegration

Cointegration tests are designed to inspect non-stationary time series procedures, which essentially contain a mean and a variance that changes with passing time (Amin et al., 2018). This mechanism makes room for estimating the long-run parameters or the equilibriums of such systems that carry variables with unit roots. The Johansen test is a general multivariate concept of the ADF test. This particular generalisation mainly investigates the linear combinations of all the incorporated variables with unitroots. It has become feasible to evaluate all of the cointegrating vectors due to the Johansen test’s presence and proper estimation strategy. If “n” number variables, all with unit roots, are present in the system, then there will be maximum n-1 numbers of cointegrating vectors will be found. On the contrary, the presence of n number of variables and n number of cointegrating vectors implies that the variables do not hold unit-roots. The reason behind this fact is the cointegrating vectors’ being able to be written as the scalar multiples of every single variable alone. The Johansen cointegration test is widely used to test cointegration. This test determines how many independent linear combinations are present in the time series variables set, which generates a stationary process. This test can give the rank of cointegration. For applying this approach, we need to estimate an Unrestricted Vector Autoregression (VAR) as follows.

∆xt = α+θ1∆xt-1+ θ2∆xt-2+...+θk-1∆xt-k+1+ θk ∆xt-k + ut (2)

This equation ∆ denotes the difference operator, x is the symbol of an (n-1) number of vectors of non-stationary variables in levels, and u also represents the (n-1) number of vectors of errors that are randomly occurred. The matrix θ holds all the necessary detailed information that is essential to illustrate the relationship between the variables. If the rank of θ appears to be 0, then it can be inferred that the variables are not cointegrated. If rank, which is denoted by r, is 0, then it can be claimed that there is only one cointegrating vector. Lastly, when the scenario is “1<r

### 3.2.1 The Johansen cointegration test

The Johansen cointegration test is a widely used method to determine the presence and number of cointegrating relationships among a set of variables. It is a multivariate approach that allows for the estimation of multiple cointegrating vectors.

The methodology for conducting the Johansen cointegration test involves the following steps:

Step 1: Data preparation

1. Select a set of variables believed to be potentially cointegrated based on economic theory or prior research.
2. Ensure that the selected variables are integrated of the same order, typically integrated of order 1 (I (1)). If the variables have different orders of integration, they should be preprocessed accordingly (e.g., differencing) to achieve stationarity.

Step 2: Formulating the Vector Error Correction Model (VECM)

1. Estimate a Vector Autoregressive (VAR) model using the selected variables.
2. Determine the optimal lag length for the VAR model using information criteria such as the Akaike Information Criterion (AIC) or the Schwarz Bayesian Criterion (SBC).
3. Construct the Vector Error Correction Model (VECM) from the estimated VAR model by introducing error correction terms that capture the adjustment mechanism toward the long-term equilibrium relationship.

Step 3: Conducting the Johansen cointegration test

1. Use the VECM to estimate the cointegrating vectors by applying the Johansen procedure.
2. The Johansen test estimates the eigenvalues and eigenvectors of the companion matrix associated with the VECM.
3. Calculate the trace statistics and maximum eigenvalue statistics to test the null hypothesis of no cointegration (i.e., the absence of cointegrating vectors) against the alternative hypothesis of at least one cointegrating vector.
4. Determine the critical values for the test statistics based on the size of the sample and the desired level of significance.
5. Compare the calculated test statistics with the critical values to make inferences about the presence and number of cointegrating vectors.
   * If the calculated test statistics exceed the critical values, reject the null hypothesis and conclude the presence of cointegration.
   * The number of cointegrating vectors is determined by the significance levels associated with the test statistics.

It is important to note that the Johansen cointegration test assumes the absence of structural breaks and other statistical properties such as autocorrelation and heteroscedasticity. Therefore, it is recommended to conduct additional diagnostic tests and consider the robustness of the results.

Moreover, interpretation of the cointegration results should be done in conjunction with economic theory and prior empirical evidence to provide meaningful insights into the long-term relationship among the variables under investigation.

## 3.3 Granger Causality

The Granger causality methodology involves estimating a vector autoregressive (VAR) model and conducting hypothesis testing to determine the causal relationship between two variables. Here's the step-by-step methodology with an example equation:

Step 1: Data preparation Let's consider two variables, Variable X (potential cause) and Variable Y (potential effect). Ensure that the time series data for both variables are stationary or transformed to achieve stationarity.

Step 2: Formulate null and alternative hypotheses The null hypothesis (H0) assumes that Variable X does not Granger cause Variable Y: H0: Variable X does not Granger cause Variable Y.

The alternative hypothesis (Ha) assumes that Variable X does Granger cause Variable Y: Ha: Variable X Granger causes Variable Y.

Step 3: Estimation and model selection Estimate a VAR model using the lagged values of both Variable X and Variable Y. The lag order selection criterion, such as the Akaike Information Criterion (AIC) or the Schwarz Bayesian Criterion (SBC), helps determine the appropriate number of lags.

Let's denote the VAR model as follows:

Yt = α + β1*Yt-1 + ... + βp*Yt-p+ γ1*Xt-1 + ... + γp*Xt-p+ εt ,

where Yt represents Variable Y at time t, Xt represents Variable X at time t, and εt represents the error term.

Step 4: Conduct the Granger causality test The Granger causality test involves comparing two models: a restricted model (excluding the lagged values of Variable X) and an unrestricted model (including the lagged values of Variable X).

Restricted model: Yt = α + β1*Yt-1 + ... + βp*Yt-p + εt.

Unrestricted model: Yt = α + β1*Yt-1 + ... + βp*Yt-p+ γ1*Xt-1 + ... + γp*Xt-p+ εt ,

Perform an F-test or likelihood ratio test to compare the restricted and unrestricted models. The test statistic measures the significance of including the lagged values of Variable X in the VAR model.

If the test statistic exceeds the critical value at a chosen level of significance (e.g., p-value < 0.05), reject the null hypothesis and conclude that Variable X Granger causes Variable Y. If the test statistic is below the critical value, fail to reject the null hypothesis and conclude that Variable X does not Granger cause Variable Y.

Example equation: Let's consider the following VAR model for Granger causality test:

Yt = α + β1*Yt-1+ γ1*Xt-1+ εt.

To test whether Variable X Granger causes Variable Y, we estimate two models:

1. Restricted model: Yt = α + β1\*Yt-1+ εt .
2. Unrestricted model: Yt = α + β1*Yt-1+ γ1*Xt-1+ εt .

We then conduct an F-test or likelihood ratio test on these models and compare the test statistic to the critical value to determine the Granger causality relationship between Variable X and Variable Y.

Remember that the choice of lag order, significance level, and interpretation of results should be done carefully, considering the specific research context and potential limitations of the Granger causality test.

## 3.4 ARMA

The Autoregressive Moving Average (ARMA) model combines autoregressive (AR) and moving average (MA) components to model time series data. The methodology for the ARMA model can be demonstrated with an example equation:

Let's consider an ARMA (2,1) model, which includes an AR order of 2 and an MA order of 1. The equation can be written as:

Yt = c + ϕ1 \* Yt-1 + ϕ2 \* Yt-2+ θ1\* εt-1 + εt

where: Yt represents the value of the time series at time t, c is a constant term, ϕ1 and ϕ2 are the autoregressive coefficients, θ1 is the moving average coefficient, εt-1 represents the lagged error term at time t-1, εt is the current error term at time t.

The methodology for estimating and fitting the ARMA (2,1) model involves the following steps:

Step 1: Data preparation Ensure that the time series data is stationary by checking for trends, seasonality, and non-constant variance. If the data is non-stationary, apply transformations (e.g., differencing) to achieve stationarity.

Step 2: Model identification Determine the appropriate orders (p, q) for the AR and MA components. This can be done by analyzing the autocorrelation function (ACF) and partial autocorrelation function (PACF) plots of the differenced data. The ACF plot indicates the MA order (q), and the PACF plot suggests the AR order (p).

Step 3: Model estimation Estimate the parameters (ϕ1, ϕ2, θ1) of the ARMA (2,1) model using a suitable estimation method like maximum likelihood estimation (MLE) or least squares estimation (LSE). The estimation involves optimizing the likelihood function or minimizing the sum of squared errors to find the best-fitting parameter values.

Step 4: Model diagnostics Evaluate the goodness of fit of the estimated ARMA (2,1) model. Assess the residuals by examining their autocorrelation and normality. Perform statistical tests like the Ljung-Box test to check for the absence of significant autocorrelation in the residuals.

Step 5: Model selection Consider different ARMA models with varying orders and compare their goodness of fit statistics, such as Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC). Select the model with the lowest AIC or BIC value, indicating the best trade-off between model complexity and fit.

Step 6: Forecasting Once a suitable ARMA model is selected and validated, it can be used for forecasting future values of the time series. Forecasting involves extending the model into the future, using the estimated parameters and the observed values.

It's important to note that the ARMA model assumptions include linearity, stationarity, and independence of errors. The specific choice of orders (p, q) and estimation method may vary based on the characteristics of the time series data and the research objectives.

Overall, the ARMA methodology provides a framework for modeling and forecasting time series data based on autoregressive and moving average components, enabling the analysis of temporal patterns and dependencies in the data.

## 3.5 Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC)

To find the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values for a given model, you can use the following equations:

AIC = -2 \* log-likelihood + 2 \* k BIC = -2 \* log-likelihood + k \* log(n)

where:

* log-likelihood: The value of the log-likelihood function for the estimated model.
* k: The number of estimated parameters in the model.
* n: The number of observations in the data.

The AIC and BIC values are used as goodness-of-fit measures that balance the trade-off between model complexity and fit. Lower AIC and BIC values indicate a better-fitting model.

Here's an example to calculate the AIC and BIC values for an ARMA (2,1) model:

Suppose we have estimated the ARMA (2,1) model with the following parameter estimates:

* AR coefficients: ϕ1 = 0.7, ϕ2 = 0.3
* MA coefficient: θ1 = 0.5
* Number of observations: n = 100

First, we need to compute the log-likelihood of the model. The log-likelihood function depends on the distributional assumption of the residuals. Assuming normally distributed residuals, the log-likelihood can be calculated using the normal probability density function.

Next, we determine the number of estimated parameters in the model. In the ARMA (2,1) model, we have two AR coefficients (ϕ1, ϕ2), one MA coefficient (θ1), and a constant term, totaling k = 4 estimated parameters.

Finally, we substitute the values into the AIC and BIC equations to obtain the AIC and BIC values for the model.

Example calculation: Suppose the log-likelihood of the estimated ARMA (2,1) model is -500.

AIC = -2 \* (-500) + 2 \* 4 = 1008

BIC = -2 \* (-500) + 4 \* log (100) = 1016

In this example, the AIC is 1008, and the BIC is 1016. Lower values indicate a better fit, so a model with lower AIC or BIC would be preferred.

Following Babatunde (2015) and Narayan (2013), we use the real exchange rate as the dependent variable and oil price as an independent variable. The real exchange is used to avoid the effect of any change in the general price level on the exchange rate. We consider the Consumer Price Index (CPI) as a control variable. Hacker et al. (2014) and Branson (1983) point out that a rise in CPI can appreciate the real exchange rate or vice-versa. An increase in CPI can also increase the interest rate and make the interest-bearing assets more attractive. So, the foreign exchange market of an economy starts to observe an increase in demand for the local currency.

RER = f (OilPriceϑ, CPIμ)

The model’s functional form can be expressed by equation (1) as a log-linear equation for the time “t.” The natural logarithmic transformation of the variables is advantageous because it not only reduces the high level of skewness from the dataset but also expresses the coefficients as elasticity. It is worth mentioning that elasticity measurement is important for policy implications (Amin & Khan, 2020l; Hasanov et al., 2016).

LNRERt = ϑLNOPt + μLNCPIt + εt (1)

Where, LNRERt = log of the real exchange rate, LNOPt = log of oil price, LNCPIt =log of CPI, and εt = error term. Data on oil price, CPI, and REER range from 1986 to 2021 and collected from the British Petroleum and the World Bank, respectively.

# Chapter 4 Result

## 4.1 Descriptive Result

Graph 2: Real Rate of Exchange over Time

In this graph, the x-axis represents the years from 1986 to 2021, and the y-axis represents the Real Rate of Exchange in Bangladeshi Taka per US dollar. Each data point represents the RER value for a specific year.

Explanation: The graph illustrates the fluctuations in the Real Rate of Exchange between the Bangladeshi Taka and the US dollar over time. The RER indicates the relative value of the Bangladeshi currency compared to the US dollar. By observing the RER trends, we can gain insights into the strength or weakness of the Bangladeshi Taka in relation to the US dollar. This information is valuable for understanding the competitiveness of Bangladeshi exports, the cost of imports, and the overall impact on the country's economy.

Figure 1: Real Rate of Exchange (RER) over Time

Graph 2: Crude Oil Price over Time

In this graph, the x-axis represents the years from 1986 to 2021, and the y-axis represents the Crude Oil Price in US dollars per barrel. Each data point represents the price of crude oil in US dollars for a specific year. The graph depicts the fluctuations in Crude Oil Prices over time, denoted in US dollars per barrel. Crude oil prices are a critical factor influencing global economies, including Bangladesh. The graph helps visualize the volatility and trends in crude oil prices, which have significant implications for energy costs, inflation, and economic stability. As an import-dependent country, Bangladesh's economy can be influenced by changes in international crude oil prices, affecting the country's balance of trade, inflation rate, and fiscal policies.By considering the specific currencies and units of measurement in the graphs, we can gain a more accurate understanding of the relationship between the Real Rate of Exchange and Crude Oil Price in the context of Bangladesh's economy.

Figure : Crude Oil Price over Time

Graph 3: Consumer Price Index (CPI) over Time

In this graph, the x-axis represents the years from 1986 to 2021, and the y-axis represents the Consumer Price Index. Each data point represents the CPI value for a specific year.

Explanation: The graph illustrates the changes in the Consumer Price Index over time. It allows us to observe the inflationary trends in Bangladesh's economy, providing insights into the general price levels and the purchasing power of consumers. Understanding the CPI is crucial for analyzing the impact of inflation on various economic sectors, including the exchange rate.

Figure : Consumer Price Index (CPI) over Time

## 4.2 Analytical Result

Table 1 reports the ADF and DF-GLS statistics for all the variables in their levels and first differenced forms. We reveal that the variables are non-stationary at the level, however, at the first difference for both constant and constant and trend configurations. So, our variables are integrated of order one.

Table : Stationary properties of the variable

|  |  |  |
| --- | --- | --- |
| ADF | | |
| Variables | Level  Intercept | First Difference  Intercept |
| LNRER | 0.018320\* | 0.207983 |
| LNCPI | 0.03815\*\* | 0.40090 |
| LNCOP | -0.01695 | 0.01064 |

\*\*\*,\*\*, and \*Refer significance level at 1, 5, and 10%, respectively. Critical values are not reported for the sake of brevity; however, it can be delivered on request

The Johansen Cointegration test reveals a cointegrating relationship among the variables

(Table 2). Both the Maximum Eigenvalue and the Trace test confirm that our variables have one cointegrating relationship.

Table : Johansen cointegration test results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Trace Test | | | | | |
| Null | Alternative | Trace statistic | 10pct | 5pct | 1pct | Conclusion |
| r=0 | r=1 | 31.71 | 6.50 | 8.18 | 11.65 | There is cointegration |
| r<=1 | r=2 | 7.78 | 12.91 | 14.90 | 19.19 | There is no cointegration |
| r<=2 | r=3 | 0.25 | 18.90 | 21.07 | 25.75 | There is no cointegration |

Table 3 reveals a unidirectional causality from oil prices to the exchange rate in the long-run. No causal relationship is found in the longrun between the real exchange rate and CPI

Table : Granger causality results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Causality test statistics between LNRER and LNOP | | | | |
| Variable | Null Hypothesis | F static | P-value | Conclusion |
| LNRER | LNCOP does not cause LNRER | 0.0418 | 0.0393 | LNCOP does cause LNRER |
| LNCOP | LNRER does not cause LNCOP | **2.9113** | **0.09** | LNRER does not cause LNCOP |
| Causality test statistics between LNRER and LNCPI | | | | |
| Variable | Null Hypothesis | F static | P-value | Conclusion |
| LNRER | LNCPI does not cause LNRER | 0.168 | 0.6839 | LNCPI does not cause LNRER |
| LNCPI | LNRER does not cause LNCPI | **6.116** | **0.1889** | LNRER does not LNCPI |

Table 4 reavles AIC and BIC values of AR and MA model.As for AR model both AIC and BIC value is smaller than that of MA models AIC and BIC value we select AR model for forcusting RER and COP.

Table : AIC and BIC calculation

|  |  |  |
| --- | --- | --- |
| Model name | **AIC** | **BIC** |
| **AR** | **172.4539** | **190.7702** |
| **MA** | **183.8238** | **202.1401** |

**AR forecasting for RER**:

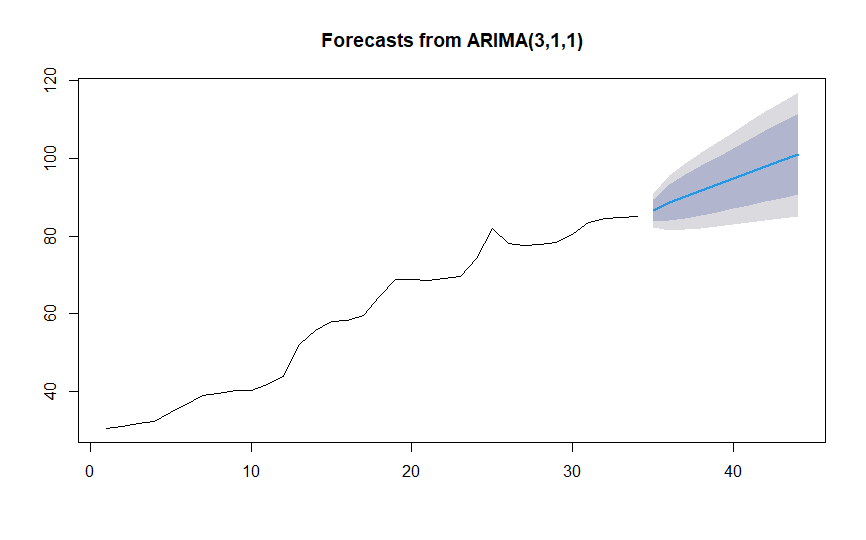
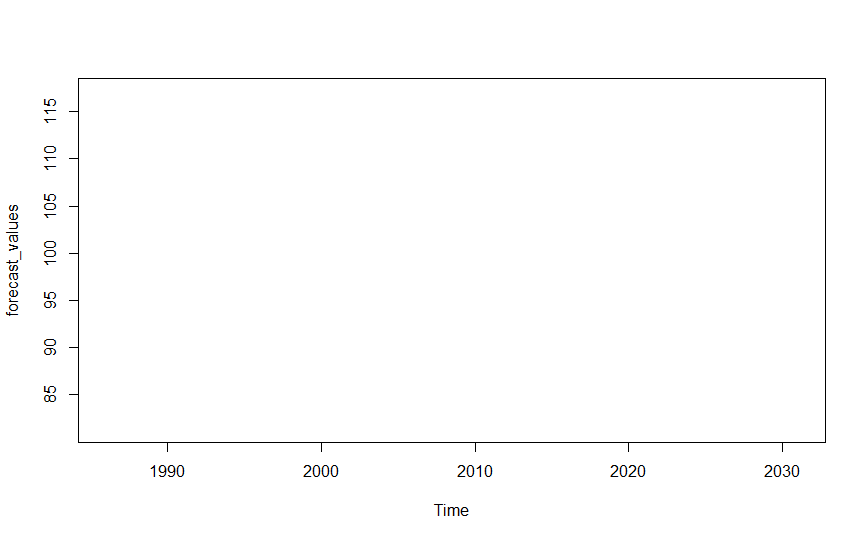


Figure : AR forecasting for RER

By using AR model forecatst of RER for next ten year is made, the forecast shows an upward trend.which implies a future possible rise of RER.

**AR forecasting of COP**

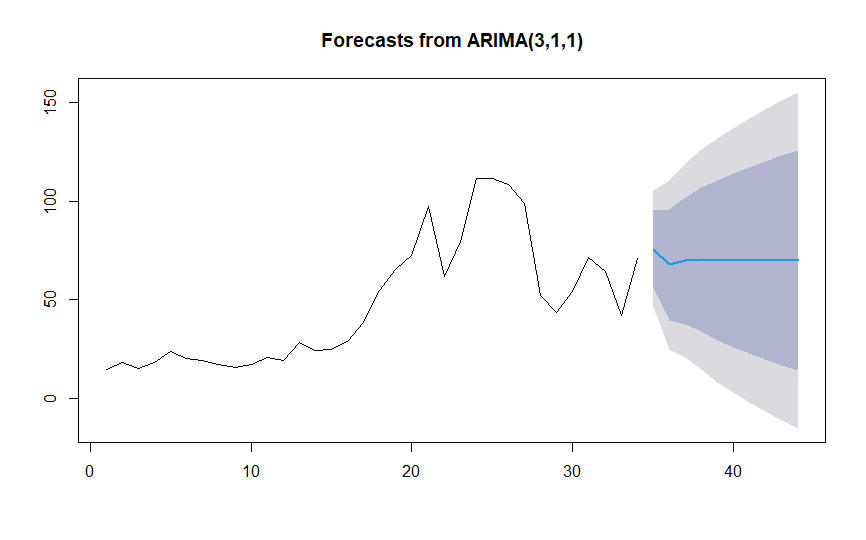
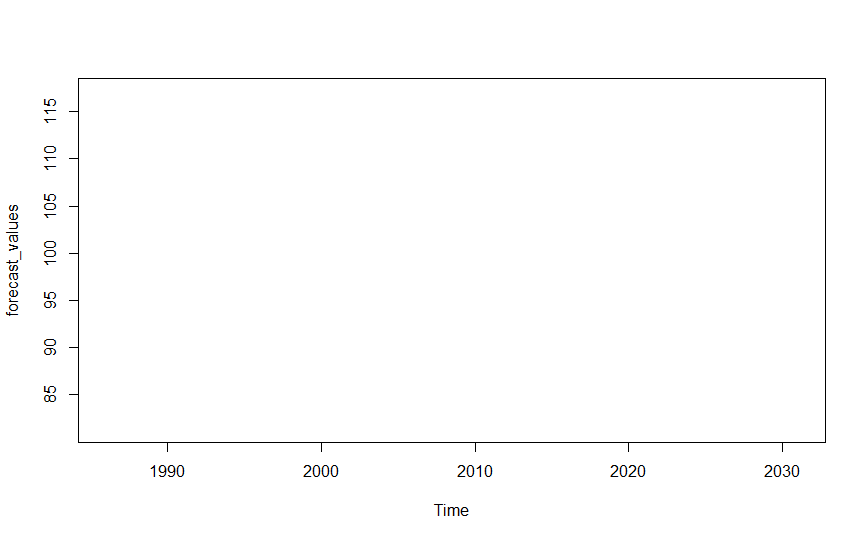


Figure : AR forecasting of COP

By using AR model forecatst of COP for next ten year is made, the forecast shows a relatively static condition of COP, which implies COP may not change that much in the up coming years

# Chapter 5: Conclusion

## Conclusion

Since the mid-1950s, oil has been started to be considered as the essential source of energy, and it has become a stimulus for the rapid growth of the industrialised nations across the whole world. The frequent fluctuation of oil prices can affect the economy through various macroeconomic channels, and arguably, the exchange rate is the most crucial of all those channels. There is a growing interest in finding out how the oil price can affect the exchange rate and, ultimately, the whole economy. The motive behind conducting this study has been to explore the linkage between oil prices and the exchange rate in Bangladesh. In this regard, we have considered the time series annual data for 1980 to 2018 and applied recent robust econometric techniques. Upon analysing empirical findings, we argue that an upward trend in the oil price leads to a decrease (appreciation) in Bangladesh’s exchange rate in the long-run. On the other hand, oil price has no impact on the real exchange rate in the short-run. We recommend that the government should adopt optimal policies to minimise oil price shocks’ adverse effects to achieve the Sustainable Development Goals (SDGs) in Bangladesh. More focus should be given on minimising the negative consequences of oil price fluctuation towards the macroeconomic variables like the exchange rate. The Bangladesh Bank should closely monitor the oil price so that if there is any positive shock in the oil price, necessary steps can be taken to dissolve the adverse effect on the exchange rate quickly. Amidst the devastating outbreak of Covid-19, it is forecasted that there is no probability of experiencing any upward movement in the oil price till 2024 (OECD, 2020).7 Moreover, the oil price has dropped below the average level of the last 5 years due to worldwide lockdown to reduce the spread of COVID-19. Therefore, a portion of the money that is allocated for importing oil will be saved for the next few years. The saved money can be invested in other priority sectors of Bangladesh’s economy like health, education, and, most importantly, the social security to improve the living standards as well as achieve overall stability during this pandemic. We like to extend the analysis by including more control variables in this study and conduct a sector-specific analysis for a more robust result. A region-wise comparison can also be made by employing a regression for other South Asian countries.

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