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Impact of Crude Oil Price Volatility on Economic Activities: Evidence from Bangladesh

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ABSTRACT: This paper empirically examines the impact of oil price volatility on economic activities of Bangladesh. The study employed yearly data from 1987 to December 2022. The Least square model was employed to analyze the impact of oil price volatility on economic activities of Bangladesh. GDP Growth, Exchange Rate, Unemployment Rate, Interest Rate, Investment, inflation rate, Trade Balance and crude oil price were used as control variables in the models estimated. The findings indicate that crude oil prices had a positive but insignificant effect on economic growth. The study recommends therefore recommends that the government can continue to invest in promoting domestically sourced energy to overcome reliance on imported oil as it remains cautious of the effect of oil price volatility on the economy. This would ensure that the economy of Bangladesh is not tightly connected to crude oil, especially as the country joins the list of oil producing countries.

I. INTRODUCTION

Background of the Study: Crude oil is unfinished oil imported by the oil importing countries for refining them after which it is used as an input. Crude oil is one of the most imperative driving forces of the global economy and any changes in the price of oil have significant effects on the growth of the economy. Crude oil is important commodity to run their machines in production process, generation of power and for transportation function. The rising demand for crude oil led to an increase in its price throughout the world. But its price declines when its demand declines. So, such variations (rise and fall in oil price) influence the World's economic growth. The variation in the price of oil also influences the price of other fuels like electricity, gas, petrol and coal. So, such variations in the prices of oil influence the growth of both oil importers and oil exporters. This mechanism shows a strong link between the variation in price of oil and the growth of an economy (Ullah, & Abu Seman, 2018; Ullah, Nor, & Seman, (2021). Ullah, Nor, Abu Seman, Ramli, & Rasedee, (2023a; Uddin, Ullah, Rashid, & Chowdhury, (2024. The fluctuations in oil prices influenced the economies of the world differently depending on which country is an oil exporter and which one is the oil importer. As oil is the primary component in the production process, the increase in its price invites economic crises and hence declines the economic growth of the oil dependent countries. An increase in oil price has a positive impact on the economic growth of oil exporting countries but this will affect the oil importing countries in a negative way. According to "Eita, Manuel and Naimhwaka (2018) non-producing oil countries like Bangladesh, whose key imports are oil and oil products, rely heavily on oil as input in industrial, transport and electricity sector. Additionally, many developing countries generate electricity from low cost sources such as water and wind. Nevertheless, in Bangladesh oil is the key source to produce goods (commodities) in agriculture, mining and fishery as well as for transportation" .

Oil "and exchange rate are some of the commodity prices that significantly affect economic growth. According to Kurihara (20 15) oil price variation is considered from a perspective of whether the country is an oil importing or oil exporting country. He further noted that oil price increase is commonly good news for oil exporting countries and bad news for oil importing countries. The oil exporting countries profited significantly when the oil price rose. Governments earn profits that are beneficial to the country. Oil importing countries like

Bangladesh benefit from lower oil prices as it reduces transport and other business costs. Nkomo (2006) noted that falling oil prices help to decrease the cost of living causing oil-related transport costs to directly fall, leading to lower cost of living, lower inflation and higher output. Low oil prices have had an optimistic impact on producer and motorists, the overall economic impacts are not as clear-cut (Bank of Namibia, 2014). Jawad and Niazi (20 17) pointed out that the country faces fiscal imbalances with oil price declining because the country's economy was highly dependent on oil revenues. It is due to a decline in oil revenues that fiscal imbalance occurred. A decrease in oil revenue occasioned in the purchasing power of oil crude oil prices" (Ullah, Nor, Seman, Ramli, & Rasedee, (2023b; Ullah, (2016; Nor, Ullah, Seman, Ramli, & Rasedee, (2022; Ullah, Uddin, Rashid, Uddin, M. & Hasan, (2024) and Ullah (2024).

According to Sidra et al,.(2014), Adiqa (2011), Ahmad, (2013), Malik, (2008) and Imran et al., (2012) crude oil price negatively affect economic growth in case of Bangladesh due to the rise in the cost of production making the process of production very costly affecting the end consumer demand. There are three oil markets existing in the world, these are: the European Brent, the WTI (West Texas Intermediate) and the OPEC (Organization of Petroleum Exporting Countries). Bangladesh is under least developed countries and not an oil producing country. Furthermore, being one of the non-OPEC countries, it fulfills its domestic demand by the way of import. So any trivial fluctuation in the oil prices can have both direct and indirect influence on the economy (Ullah, (2022; Ullah, (2021; Ullah, Mat Nor, Abu Seman, & Uddin, (2018; Ullah, Mat Nor, Abu Seman, Ainna Binti Ramli, & Fadly, (2023). Oil price changes impact real economic activities on both the supply and demand side

(Jimenez-Rodriguez and Sanchez, 2005). The "increase in oil price is reflected in a higher production cost that exerts adverse effects on supply. The higher production cost lowers the rate of return on investment, which affects investment demand negatively. Besides, increased volatility in oil price may affect investment by increasing uncertainty about future price movements. As oil is directly linked to the production process, it can have a significant impact on inflation, employment, and output. An oil price shock can increase inflation by increasing the cost of production (Ullah, & Rashid, (2024; Ullah, Barua, Haque, Arif Hosen Raja, & Tahsinul Islam, (2024; Ullah, N., Belal Onisha, Evnath Khanam, Rahman, & Jahan, (2023). It also affects employment, as inflationary pressure may lead to a fall in demand and this, in turn, leads to a cut in production, which can create unemployment (Loungani, 1986). Therefore, the present study primarily focuses on the oil price volatility and its impact on the growth of the economy as the economic growth is the increase in the inflation- adjusted market value of the goods and services produced by" an economy over time.

Statement of the Problem : Crude "oil production often affects macroeconomic variables such as inflation and exchange rate of a country through crude oil prices since the country is exposed to the volatility in crude oil price (Dagher et al., 2010; Trang, Tho, & Hong, 2017). The commodity is also a dominant input in key sectors such as transportation, manufacturing, and power generation, thereby positioning the country's economy to the dire effects of price volatility. Knowledge of the benefits of crude oil production to the non-oil sectors of an economy is imperative since these sectors contribute to economic growth. This has been evident in the study by Ekperiware and Olomu (2015) who reported a positive impact of oil sector on agricultural sector which extended to economic growth. There is also a need to ascertain how oil production affects fiscal balance, real effective exchange rate and inflation since oil production could affect the other sectors through these macroeconomic variables" . Earlier studies have emphasized largely on the impact of crude oil

production on economic growth, and revealed varied responses (Djelloul & Talbi, 2017; Lucky & Nwosi, 2016; Mohammed, 2018; Tamba, 2017). Kibunyi et al., (2018) on a study for Bangladesh found that crude oil prices had a positive effect on economic growth in the long term, signifying a permanent positive effect and therefore contradicting the long-held paradigm of an inverse relationship in effect supporting. Based on the above reasons

I have formulated my research question as follows:

1. What is the relationship between impact of crude oil production on GDP growth, exchange rate, unemployment rate, interest rate, investment, inflation rate and trade balance in Bangladesh?

Objectives of the Study : The main objective of this study was to investigate the Impact of crude oil price volatility on economic activities in Bangladesh.

The specific objective of the study was: To examine the impact of crude oil production on GDP growth, exchange rate, unemployment rate, interest rate, investment, inflation rate and trade balance.

Significance of the Study : The "study is substantial because it employed a causal relation research design in order to empirically evaluate the relationship between crude oil prices and economic growth in developing countries such as Bangladesh, which are heavily reliant on oil as a primary input in the production of most goods. Bangladesh falls under the net-importers category in crude oil trade, exposing the country to the dramatic impacts of price volatilities such as immediate increase in commodity prices (Ullah, Showrav, & Eram, (2023; Ullah, Rashid, Islam, Tanzi, & Utsho, (2023; Ullah, (2021; Ullah, & Uddin, (2018). One way to minimize these effects is to identify and acknowledge the influence that crude oil prices have on the country's economy both directly and indirectly. This comprehension is vital for developing alternative sources of fuel including" biofuels, which

can be used as substitutes of the fossil fuel. This understanding is also vital for finding adequate instruments for "smoothing the effects of high crude oil prices. Without understanding the effects of oil prices on the economy and developing remedies, macroeconomic intervention to address economic growth may be ineffective. Studies analyzing the impact of oil price volatility are now needed for developing countries. In the face of global competition, maintaining economic stability has become the crucial task for policy makers in these countries. Moreover, the economies of developing countries are fundamentally different from those of developed countries. Developing countries are generally characterized by relatively high unemployment, less-developed financial markets, weak infrastructure, etc. Moreover, the dependence of developing countries on oil is forecasted to be increasing over the next couple of decades. Thus, it is of utmost importance to identify what impact oil price volatility has on the economic activities of these countries. As no known studies have examined this aspect in the context of developing countries, this remains an untapped area of serious research. This study intends to make some contribution to an understanding of the issue of oil price volatility and its impact on the real economic activities of one of these developing countries, Bangladesh. Secondly, this study serves as literature to researchers who might wish to pursue studies in this field. Lastly, the findings would help students and policymakers in seeking to understand the problems associated with the changes in oil prices and" economic growth.

Scope of the Study : The study examined the relationship between crude oil prices and economic activities in Bangladesh from the period of 1987 to 2022, the study only focused on the economic activities, crude oil price, GDP Growth, Exchange Rate, Unemployment Rate, Interest Rate, Investment,
inflation rate and Trade Balance. These variables were relevant in explaining crude oil prices and economic activities.

Limitations of the Study : The "study was based on Bangladesh thus; the study could not be generalized to other countries because of resources and time constraints. The study was also limited to the availability of data as Bangladesh, more variables and extended data could not be obtained. The study was limited to secondary data obtained from the world economic indicator (The World Bank, 2022) and the Bangladesh Bank for the period of 1987 to 2022. Consequently, the results of the study might not be generalized to other areas" or time periods.

Organization of the Study : The study is organized into five chapters. Chapter one presents the background of the study, statement of the problem, objectives of the study, significance of the study, scope of the study, limitations of the study and organization of the study. Chapter two presents an overview of crude oil price volatility and economic activities, theoretical review and framework, and a critical examination of empirical literature related to the study. The methodological issues and techniques adopted in conducting the study are presented in chapter three. Chapter four focuses on the results and discussion of crude oil price volatility and economic activities. Chapter five summarizes the findings of the study and provides conclusions and recommendations based on the outcome of the study.

II. LITERATURE REVIEW

Cunado and Gracia (2005) "examine the impact of oil price shocks on economic activities and inflation in six Asian countries, namely Japan, Singapore, South Korea, Malaysia, Thailand, and the Philippines. Using quarterly data from 1975Q1 to 2000Q2 they find that oil prices have a significant impact on both economic growth and inflation, and this result is more significant when oil price is measured in local currencies. They also find evidence of the asymmetric effect of oil prices on economic activities in their" study.Downa, Mgbame and Onobun (2015) "examined the relationship between oil price volatility and the Nigerian economic growth, the study revealed that Gross Domestic Product growth increases due to high global prices in the short-run whereas, in the long run there is a negative relationship between oil price volatility and GDP growth due to inconsistency of oil prices and Jack of diversification of base productive" factors.Bouzid (2012) "examined the relationship of

oil prices and economic growth in Tunisia, found that, Tunisia as an oil importing country resulted that increases in oil price reduce economic growth and there is a long-run relationship between oil prices and economic growth whereby series are integrated of order one and the Granger pair wise causality showed unidirectional causality from real GDP" to oil prices. Ghalayini (2011) examined the interaction between crude oil prices and economic growth from a global perspective. The study also examined whether crude oil prices affected economic growth to varying degrees in different countries including the G7 countries, Russia, China, and India. The data was analyzed using the Granger causality test to determine whether there was any significant interaction between the select variables.Mureithi (2014) "assessed the effect of oil import volatility on the economic growth of Kenya. Economic growth was examined from the purview of GDP growth rate, exchange rate, money supply, and lending rate. Data were analyzed using the Johansen-Juselius approach to co- integration and vector error correction. The study yielded a statistically significant effect of oil import volatility on the exchange rate in the short-run. However, the effect is negative on GDP growth in both the short run and the" long run. Gisser and Goodwin (1986) "work on the US economy covering the period 1961Q1–1982Q4. They employ a reduced-form approach to assess the quantitative significance of the impact of crude oil prices on the US economy. They find that crude oil prices have a significant impact on output, even exceeding the impacts of monetary and fiscal" policies.

Mork and Olsen (1994) "examine the correlation between oil price and GDP in seven OECD countries (the USA, Canada, Japan, West Germany, France, the UK, and Norway) over the period of 1967Q3–1992Q4. They find a significant negative correlation between oil price increases and GDP in most of the countries studied. They estimate bi-variate correlations as well as partial correlations within a reduced-form macroeconomic model. The correlations between oil price increases and GDP are found to be negative and significant for most of the countries, but positive for Norway, whose oil producing sector is large relative to the economy as a whole. The correlations" with oil price decreases are mostly positive, but significant only for the USA and Canada. Lardic and Mignon (2006) study the "long-run equilibrium relationship between oil prices and GDP in 12 European countries using quarterly data spanning from 1970Q1 to 2003Q4. This study finds that the relationship between oil price and economic activities is asymmetric; that is, rising oil prices retard aggregate economic activity more than falling oil prices stimulate it. Their results show that, while the standard co-integration between the variables is rejected, there is asymmetric co-integration between oil prices and GDP in most of the participating European countries. This paper makes a significant contribution to the literature on the asymmetric impact of oil price" on GDP.

Akinlo and Apanisile (2015) "examined how changes in oil prices affected the economic growth of twenty countries in Sub Saharan Africa (SSA). The study used data from 1986 through 2012 and analyzed the data through panel-pooled OLS. The study yield that changes in oil prices has a significant positive effect on the economic growth of both oil exporters. The relationship was, however, insignificant, albeit positive for non-oil-exporting countries in SSA. The study also furthers the maxim" that the inverse relationship between economic growth and crude oil prices vary from one economy to another. Jimenez-Rodriguez and Sanchez (2004) evaluated "the effect of oil price shocks on real economic activity of some industrialized OECD (Organization for Economic Co-operation and Development) countries using a multivariate V AR analysis. Their study found evidence of a non-linear impact of oil prices on real gross domestic product. Oil price increases are found to have a negative impact on economic activity in all cases but Japan with oil price increases affecting UK (United Kingdom) negatively and Norway positively. A Bayesian Markov Switching-Vector Autoregressive (MS-VAR) analysis approach by Balcilar et al (2014) examined the impact of oil price on South African gross domestic product growth, found low

growth state to be shorter-lived compared to the higher growth state. Another study on the relationship between oil revenues and economic growth is that carried out by Mehrara et al (2010) used threshold methods and found that the reaction of economic growth to oil revenue growth in low regimes of oil revenues is better than" in high regimes of oil revenues. Gadea et al (2016) examined the "changes in the long-run relationship between oil price and the United States of America's (USA) economic growth. The study found a significant relationship in some sub-periods by carrying out a rolling analysis and also by studying the presence of structural breaks in the multivariate framework. Their study also found that the negative effect is greater at the time of large oil price increases". Cunado and Gracia (2005) examine "the impact of oil price shocks on economic activities and inflation in six Asian countries, namely Japan, Singapore, South Korea, Malaysia, Thailand, and the Philippines. Using quarterly data from 1975Q1 to 2000Q2 they find that oil prices have a significant impact on both economic growth and inflation, and this result is more significant when oil price is measured in local currencies. They also find evidence of the asymmetric effect of oil prices on economic activities" in their study.

Guo and Kliesen (2005) look into "the impact of oil price volatility on the US economy. Using the measure of realized volatility constructed from daily crude oil future prices traded on the NYMEX, they find that, over the period 1984–2004, oil price volatility has a significant effect on various key US macroeconomic indicators, such as fixed investment, consumption, employment, and the unemployment rate. The findings suggest that changes in oil prices are less significant than the uncertainty about" future prices. Apergis et al (2015) investigated the "dynamic relationship between oil prices and growth across the United States of America (U.S.A.) using the panel data framework. Their study showed that the long-run coefficients are found to be statistically significant across all empirical models, with positive oil prices reducing output, hence negative oil prices increasing output. The study further revealed that both in the short-run and long-run; there is unidirectional causality between aggregate oil prices and" output. Gummi et al (2017) "studied the relationship between oil price and economic growth in Nigeria using annual time series data for the period 1974 to 2014. The findings indicated that there is no long run relationship among all the variables".

Aimer (2016) investigated "the effects of oil price volatility on the economic sectors of Libya. The findings revealed that there is a long run relationship between oil prices and certain economic sectors such as agriculture, construction, manufacturing and transport. He further noted that increases in oil price did not significantly affect the manufacturing sector in aggregate terms like the other" sectors. Kibunyi et al., (2018) "examined the effect of oil prices on GDP growth and selected macroeconomic variables for the economy of Kenya in both the short run and the long run using time series data from 1970 through 2016 for real exchange rates, rate of inflation, and GDP growth for the country, which allowed for the capturing of different oil shocks. Three Autoregressive Distributed Lag (ARDL) models were estimated for inferential analysis for the study. A positive effect of crude oil prices on GDP growth was observed in the long run, which was attributed to the fact that Kenya is an importer and a secondary exporter of the commodity. A positive long-run effect of crude oil prices on inflation was observed, while the positive" short-

run effect had a lag of one. They also determined that oil prices had a negative long-run effect on the real exchange rate. Rostin et al., (2019) "examined the effect that crude oil prices had on the inflation, interest rates, and economic growth of Indonesia. The study was conducted using quarterly time-series data from 2001 through 2017 for the three variables. The cause-effect relationship between the variables was analyzed using a multivariate ARDL model from which three observations were made. It was observed that crude oil prices had no effect on both short-term and long-term economic" growth. Ishmael, Matthew and Park (2017) investigated "the impact of changes in crude oil prices on economic growth in Nigeria. The study revealed a positive unidirectional relationship between crude oil prices and economic growth" . Awunyo-Vitor, Samanhyia and Bonney (2018) "examined the causal linkage between oil price change and economic growth. The results of the study revealed that there IS an inverse relationship between oil price change and economic growth in Ghana. Although, the effect of oil price change on economic growth is statistically insignificant in the long" run. Yong, Fung and Yuen (2011) examined "the long run relationship between oil prices and real GOP in ten sub-Saharan countries by using the Panel data for the period of 1980-2008, which indicated a strong positive relationship between positive oil price changes on economic growth in the selected oil exporting" countries.

Research Gap : The "empirical literature reviewed above was far reaching with respect to the relationship between crude oil prices and economic growth both in oil importing and oil exporting countries. The earlier researchers employed ordinary least square as estimation technique with a very small sample period. On the other hand, the few studies that employed cointegration and error correction model either used Engel and Granger or Johansen and Juselius with different sample periods. Therefore, this study intended to run an ADRL model for Bangladesh over a sample size of 36" years.

III. RESEARCH METHODOLOGY

This chapter provides a framework on the research design, procedure and data analysis that were used in this study. It discusses the methodology used to analyze the relationship between crude oil price and economic growth in Bangladesh.

Research Design : The time series data from the "World Development Indicator" from 1987 to 2022 were used in this "study to look at how crude oil price volatility impact on economic activities in Bangladesh (World Development Indicators | Data Bank 2022). The model's dependent variable is crude oil price and independent variables are (i) Gross Domestic Product (GDP) Growth, (ii) Exchange Rate (ER), (iii) Unemployment Rate (UR), (iv) Interest Rate (IR), (v) Investment (INV), (vi) Inflation Rate (INF) and (iv) Trade Balance (TB). The ARDL model was used in this research to assess the impact of crude oil price volatility on economic activities in

Bangladesh. For time series analysis, it is required to check the stationarity of the data. Different tests can be used to run unit root testing, but one of the most well-known ones is the "Augmented Dickey-Fuller (ADF)" test (Dickey and Fuller 1979). It is required to determine whether or not the variables in this investigation are stationary. If time series is at I (0) and I (1) stationary, the autoregressive distributed lag (ARDL) model (Pesaran et al. 2001) must be utilized to calculate the impact of crude oil price volatility on economic activities in Bangladesh. A sample of the research variables passed the unit root test, indicating that they are all stationary at the first difference (I (1)), but none are stationary at the second difference (I (2)). The ordinary least square (OLS) method-based autoregressive distributed lag" (ARDL) model is suitable for the non-stationary and mixed-order integration order of time series. The ARDL Model is an unrestricted error correction model, so keep that in mind (ECM).

Model Specification

To examine the connection between the variables under investigation, the general equation shown below is suggested:

$(COP)t = \beta0 + \beta1GDPt + \beta2ERt + \beta3URt + \beta4IRt + \beta5INVt + \beta2INFt + \beta3TBt + \varepsilon t$

……(1) Where,

COP = Crude Oil Prices,

GDP = Gross Domestic Product ER = exchange rate]

UR = Unemployment Rate IR = Interest Rate

INV = Investment INF = Inflation Rate TB = Trade Balance β0 = the constant,

β1 to β4 = independent variable coefficients,

εt = the error term, with the subscript (t) denotes time.

Data Analysis : Autoregressive distributed lag bounds test The "long-term link between the research variables was investigated using a bound test when all of the study variables were at the same level. All research variables in this study are thus stationary at the first difference. Therefore, the optimum method for determining whether two or more series are cointegrated is the autoregressive distributed lag bounds test. The ARDL bound test model described below was utilized to look into the long-term relationship between the research" variables:

□(COP)t □ □ 0 □ □1 (COP)t □1 □ □ 2GDPt □1 □ □3 ERt □1 □ □ 4URt □1 □ □5 IRt □1 □ □ □6 INVt □1 □ □ 7INFt □1 □ □8 TBt □1 □

$$\sum_{i=1}^{q} \beta1\ \Delta(COP)t-1 + \sum_{i=1}^{q} \beta2\ \Delta(GDP)t-1 + \sum_{i=1}^{q} \beta3\ \Delta(ER)t-1 + \sum_{i=1}^{q} \beta4\ \Delta(UR)t-1 + \sum_{i=1}^{q} \beta5\ \Delta(IR)t-1 + \sum_{i=1}^{q} \beta6\ \Delta(INV)t-1 + \sum_{i=1}^{q} \beta7\ \Delta(INF)t-1 + \sum_{i=1}^{q} \beta8\ \Delta(TB)t-1 + \varepsilon t$$

…… (2) Where:

Δ = represents the difference operators,

COP = Crude Oil Prices,

GDP = Gross Domestic Product ER = exchange rate]

UR = Unemployment Rate IR = Interest Rate

INV = Investment INF = Inflation Rate TB = Trade Balance

t–1 = represents the Akaike information criterion's best choice of lags (Sakamoto et al. 1986),

Ψ and β = examined for the long-run relationship among selected variables.

The short-run and long-run ARDL models are utilized due to the study variables having long- run connections. The following are the null and alternative hypotheses for the bound test:

H 0 : □i □ 0 for all, i □ 1, 2, 3, 4, 5
H1 : □i □ 0 for all, i □ 1, 2, 3, 4, 5

The "null hypothesis can either be accepted or rejected based on the value of the F statistic. According to Pesaran et al. (2001), a long-term relationship exists between the research variables if the estimated F-statistics values exceed the upper bound. The decision is inconclusive if the computed F-statistics value falls between the lower and upper limits values. There is no long- term association if the computed F-statistics value is less than the lower bounds" value.

ARDL Model

The ARDL model was proposed by Pesaran et al. (1999) and Pesaran et al. (2001). The ARDL model has various benefits over other time-series models. Short temporal data may be utilized with the ARDL model, claims Haug (2002). The ARDL model can be used if the series is stationary at I (0), I (I), or both. Different delays can be used by dependent and independent variables. The anticipated ARDL bound test findings indicate that the research variables are co- integrated. The long-term ARDL model appears to be as follows:

$$(\mathrm{COP})t = \alpha 0 \sum_{i=1}^{q} \sigma 1\, \Delta(COP)t-1 + \sum_{i=1}^{q} \sigma 2\, \Delta(GDP)t-1 + \sum_{i=1}^{q} \sigma 3\, \Delta(ER)t-1 + \sum_{i=1}^{q} \sigma 4\, \Delta(UR)t-1 + \sum_{i=1}^{q} \sigma 5\, \Delta(IR)t-1 + \sum_{i=1}^{q} \sigma 6\, \Delta(INV)t-1 + \sum_{i=1}^{q} \sigma 7\, \Delta(INF)t-1 + \sum_{i=1}^{q} \sigma 8\, \Delta(TB)t-1 + \varepsilon t$$

……(3)

The symbol σ in the equation above represents the research variables' long-run variation. For each variable, the Akaike information criteria were used to choose appropriate lags. The next was then used for the short-run ARDL model:

$$\Delta(\mathrm{COP})t = \alpha 0 \sum_{i=1}^{q} \beta 1\, \Delta(COP)t-1 + \sum_{i=1}^{q} \beta 2\, \Delta(GDP)t-1 + \sum_{i=1}^{q} \beta 3\, \Delta(ER)t-1 + \sum_{i=1}^{q} \beta 4\, \Delta(UR)t-1 + \sum_{i=1}^{q} \beta 5\, \Delta(IR)t-1 + \sum_{i=1}^{q} \beta 6\, \Delta(INV)t-1 + \sum_{i=1}^{q} \beta 7\, \Delta(INF)t-1 + \sum_{i=1}^{q} \beta 8\, \Delta(TB)t-1 + \varepsilon t$$

…… (4)

In "the equation (4), β indicates the short-run variance and ECT is the error correction term that determines the rate of correction from disequilibrium, ranging from 0 to 1. If the term for error correction is statistically significant and negative, any shock is adjusted to approach equilibrium on the following occasion. Cumulative sum (CUSUM) and cumulative sum of squares (CUSMSQ) were used to test the model's stability (Brown et al. 1975). Breusch- Godfrey Lagrange multiplier was used to examine serial correlation. To determine whether there was heteroscedasticity, the Breusch-Pagan-Godfrey (BG), autoregressive conditional heteroscedasticity (ARCH) and Jarque-Bera tests were applied. The Jarque-Bera test was also used to see if there was residual normality. Finally, the model requirements were validated by" the Ramsey reset test.

IV. RESULTS AND DISCUSSION

The purpose of this study was to investigate the Impact of crude oil price volatility and economic activities in Bangladesh. It further examined what effect control variables such as exchange rate, unemployment rate, interest rate, investment, inflation rate and trade balance would have on economic growth in Bangladesh. Using a time-series econometric statistical package (EViews 9), the study began by conducting a unit root test to check the stationarity of data and the order of integration.

Descriptive Statistics

	Crude Oil Price	GDP Growth	Exchange Rate	Unemployment Rate	Interest Rate	Inflation	Investment	Trade Balance
Mean	51.46556	5.423418	59.52111	3.572778	5.676458	6.279400	0.865954	-6.716084
Median	43.90000	5.367990	60.20000	3.842000	5.776690	6.116700	0.452714	-3.033288
Maximum	117.7800	7.881907	84.91000	5.209000	13.74097	11.39520	2.831153	-1.448600
Minimum	14.60000	2.416257	30.63000	1.850000	-13.64210	2.007200	0.000248	-26.63448
Std. Dev.	34.52270	1.350686	18.61091	1.022069	4.580008	2.192591	0.927867	6.689897
Skewness	0.663421	-0.304199	-0.122840	-0.265505	-2.245801	0.062571	0.698517	-1.507428
Kurtosis	2.109175	2.348022	1.556183	1.708781	10.72163	2.987102	2.099447	4.363977
Jarque-Bera	3.831114	1.192835	3.217449	2.923826	119.6971	0.023740	4.144050	16.42469
Probability	0.147260	0.550781	0.200143	0.231792	0.000000	0.988200	0.125930	0.000271
Observations	36	36	36	36	36	36	36	36

Source: Authors ' computations of EViews output.

Table 1. Descriptive statistics of the selected macroeconomic factors

The first descriptive analysis is given below according to the selected macroeconomic factors. Table 1 displays the descriptive statistics for all macroeconomic factors. The average Crude Oil Price in Bangladesh is 51.46556 and the standard deviation is 34.52270. The maximum Crude Oil Price is 117.7800, and the minimum is 14.60000. Crude Oil Price, Inflation and Investment are positively skewed whereas GDP growth, exchange rate, unemployment rate, interest rate and trade balance are negatively skewed. Kurtosis statistics show that all variables are platykurtic except Interest Rate and Trade Balance which is leptokurtic. The Jarque-Bera test shows that the result of the residuals of Interest Rate and Trade Balance are not normally distributed, whereas, Crude Oil Price , GDP growth, exchange rate, unemployment rate, interest rate and Investment are normally distributed.

Correlation Matrix

	Crude Oil Price	GDP Growth	Exchange Rate	Unemployment Rate	Interest Rate	Inflation	Investment	Trade Balance
Crude Oil Price	1							
GDP Growth	0.66714	1						
Exchange Rate	0.806641	0.72971	1					

Unemployment Rate	0.684369	0.609277	0.928557	1				
Interest Rate	-0.22773	-0.33092	-0.37349	-0.31749	1			
Inflation	0.393589	0.158976	0.119396	0.042306	-0.10636	1		
Investment	0.751844	0.668871	0.874825	0.739503	-0.4165	0.167394	1	
Trade Balance	-0.58302	-0.56209	-0.80215	-0.68298	0.401833	-0.04762	-0.74887	1

Source: Authors ' computations of EViews output. Table 2. Correlation matrix for selected variables

Table 2 illustrates that Crude Oil Price are positively correlated with GDP Growth, Exchange Rate, Unemployment Rate and Investment at a 1% level of significance, and Inflation is positively correlated at a 5% significance level but negatively correlated with interest rate and trade balance at a 5% level of significance.

Unit Roots Test

Variable	Unit Roots Augmented Dickey-Fuller (ADF)				Order of Integration	Decision
	Level		1st Difference			
	Intercept	Intercept with trend	Intercept	Intercept with trend		
Crude Oil Price	-1.170856	-2.335801	-5.016950	-4.937020	I (1)	1st difference stationary
GDP Growth	-3.402034	-5.920926	-7.107950	-7.210571	I (1)	1st difference stationary
Exchange Rate	-0.973983	-1.286972	-5.248278	-4.297080	I (1)	1st difference stationary
Unemployment Rate	-1.518209	-3.015805	-6.135250	-6.142639	I (1)	1st difference stationary
Interest Rate	-4.455484	-5.366678	-8.847195	-8.721548	I (1)	1st difference stationary
Inflation	-4.484554	-4.543013	-7.639973	-7.549996	I (1)	1st difference stationary
Investment	-1.115202	-3.025211	-2.753809	-2.695614	I (1)	1st difference stationary

Trade Balance	4.615781	0.700563	0.809920	-1.366557	I (1)	1st difference stationary

Source: Authors ' computations of EViews output.

Table 3. Unit Roots Test

It is crucial to ensure that no series are I (2) before using the ARDL model, otherwise the findings will be unreliable. The unit root of each series was examined using the unit root test ADF. None of the variables are stationary at I (2), according to the findings of the analysis. The anticipated results of the above unit roots test indicate that the ARDL model could be utilized with the provided time series.

The Bound Test for Cointegration Analysis : The bounds "test to cointegration was tested using the Wald Test. According to Narayan (2005) if the F-statistic of the Wald test is below the lower bound critical value 1(0) then the null hypothesis (Ho) could not be rejected (concluding that there is no long run relationship between the variables). If it is above the upper bound critical value I (I), than the null hypothesis (Ho) is rejected (concluding that there is a long run relationship between variables). Thus, if the F- statistic falls between the two bounds than it is inconclusive and awareness of the order of the integration of the underlying variables is required before conclusive inferences could be made. The study have employed a set of critical F values by Narayan (2005) for samples size ranging from 30 to 80, which is appropriate for the sample" used (36 observations).

Critical Value	Lower bound	Upper bound
10%	2.69	3.89
5%	3.28	4.63
F-statistic = 5.46		

Source: Authors ' computations of EViews output. Table 4. Bounds test results for cointegration analysis

In keeping with the objectives of the study, the bounds test for cointegration was estimated. As shown in table

4.1, it was observed that the computed F-statistic lies above the upper bound at 5% and 10% level of significance; the null hypothesis can be rejected; indicating cointegration and therefore a long run relationship among the variables.

ARDL Estimation

Dependent Variable: CRUDE_OIL_PRICE

Method: ARDL

Date: 12/25/23 Time: 14:04

Sample: 1987 2022

Included observations: 36

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP_GROWTH	1.881384	3.482788	0.540195	0.5933
EXCHANGE_RATE	2.176284	0.833787	2.610121	0.0144
UNEMPLOYMENT_RATE	-12.25902	9.568562	-1.281177	0.2106
INTEREST_RATE	0.819330	0.747235	1.096483	0.2822
INFLATION	4.151500	1.447188	2.868666	0.0078
INVESTMENT	3.048269	7.561041	0.403155	0.6899
TRADE_BALANCE	0.938206	0.825488	1.136548	0.2654

C	-71.53249	21.21928	-3.371108	0.0022
R-squared	0.781712	Mean dependent var		51.46556
Adjusted R-squared	0.727140	S.D. dependent var		34.52270
S.E. of regression	18.03329	Akaike info criterion		8.815446
Sum squared resid	9105.584	Schwarz criterion		9.167339
Log likelihood	-150.6780	Hannan-Quinn criter.		8.938266
F-statistic	14.32440	Durbin-Watson stat		1.255582
Prob(F-statistic)	0.000000			

Source: Authors ' computations of EViews output.

Table 4. ARDL Estimation

From the "estimated results, the only significant variables were the trade balance and exchange rate as their p values were less than α (at 10% level of significance). The results imply that economic growth and the current price of crude oil have no influence on economic growth in Bangladesh. The result of insignificance of crude oil price was not expected given Bangladesh's dependency importation of oil. The implication being that even though Bangladesh is so dependent on oil imports, no matter the price of oil, oil imports will not be significantly affected, especially in the long run. Of further significance from the results, is that, while the price of oil is insignificant; the terms of trade, the exchange rate and inflation rate are significant in affecting economic growth at 10% level of significance. This is of significance in that, oil imports are part of the terms of trade. However, even with the heavy import dependence on oil, oil on its own is insignificant in affecting economic growth. It is worth noting that other imports for example, capital goods might be of significance in comparison to oil and in turn oil prices. However, it is further worth noting that as the terms of trade increases, economic growth reduces which is in line with the economic theory. Of further interest is that, the exchange rate is significant and Bangladesh's currency has depreciated over the period under study. This has however, not stopped or slowed down oil imports, further highlighting the insignificance of the price of oil to Bangladesh over the long run. The model was found to be jointly statistically significant as the probability F statistic is 0.000000 and the F statistic is 14.32440. However, as the probability F statistic is 0.000000 (low) it is worth noting that there might be issues with the fitting of data (i.e., the independent variables are not purely random with respect to the dependent variable)- which is" expected to an extent, given the set objectives. The R-squared is at 0.781712 and the adjusted R- squared = 0.727140 are relatively low, indicating that the model does very little in explaining the variability of the response of the data around its mean. Regardless of the low adjusted R-squared, the results could be interpreted and relied upon, because the study found individual significance and overall significance of the model.

V. CONCLUSION AND RECOMMENDATIONS

Introduction : This chapter concludes the study. It provides recommendations and alludes to other perspectives that could be looked at to build on the present study.

Conclusion : The main objective of the study was to investigate the Impact of crude oil price volatility on economic activities in Bangladesh. The macroeconomic determinants used in the study include: economic growth, crude oil price, GDP growth, exchange rate, unemployment rate, interest rate, investment, inflation rate and trade balance. The study employed Least Squares model. Firstly, the bounds test for cointegration was estimated to determine if there existed a long run relationship amongst the variables. It was then found that cointegration was present as the F- statistic fell outside the upper bound of the test. From the estimated results, the only significant variables were exchange rate and trade balance (at 10% level of significance). The results implied that economic growth and the current price of crude oil have no influence on economic growth in Bangladesh. The result of insignificance of crude oil price was not expected given that Bangladesh is heavily reliant on imported oil. This implies that no matter the price of oil, specifically in the long run, oil imports will not be significantly affected. According to the significance from the results, is that the terms of trade and the exchange rate are significant while the oil price is not. This is with reference that, the Bangladesh currency has undergone considerable depreciation which is reflected in the terms of trade results although surprisingly not the oil price. This finding was not expected as the importation of crude oil makes up a considerable amount in the terms of trade, however, the results suggest the price has no effect on economic growth. Therefore, other imports might be of significance in comparison to oil and in turn oil prices.

Recommendations: Although, crude "oil prices are insignificant in affecting economic growth in Bangladesh, the challenge Bangladesh faces is to reduce its dependence on imported oil. At the same time, Bangladesh has to meet the challenge of development and economic growth. This dependency needs to be addressed through various ways, for instance, diversifying the energy sources. Capital goods that use alternative energy sources could be used, however, a transition in its entirety is not guaranteed. Not forgetting the short term expense to be incurred in the short to medium term. It is worth noting that fiscal tools could be used to reassure oil management. However, taxation and quotas may be redundant as the main imports of crude oil in Bangladesh are the government itself and gas stations. Such policies would be lost on the government who impose subsidies on crude oil, leaving the gas stations as an integral player who would largely pass costs imposed on them to the consumers. Given the dependency in the country fiscal policy, it would be of little help. However, there is also an encounter for energy policy for Bangladesh in terms of producing oil as well as exploiting renewable. Hence, all these likely developments should be pursued through a combination of incentives, investments, and other measures that affect choices made with the available assortment of technological possibilities and through research and development. In conclusion, the oil costs plunge can offer a window of chance for each oil commercialism and oil mercantilism nations to begin genuine fuel rating and tax collection change. The study recommends therefore recommends that the government can continue to invest in promoting domestically sourced energy to overcome reliance on imported oil as it remains cautious of the effect of oil price volatility on the economy". This would ensurethat the economy of Bangladesh is not tightly connected to crude oil, especially as the country joins the list of oil producing countries.

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70. Appendix

Years	GDP Growth	Exchange Rate	Unemployment Rate	Interest Rate	Investment	Inflation	Trade Balance	Crude Oil Price
1987	3.772402	30.63	1.87	3.353218	0.003205	9.8747	-1.4486	19
1988	2.416257	31.25	1.85	6.837362	0.001838	7.4128	-1.62983871	15.93
1989	2.836582	32.14	2.08	6.006888	0.000248	6.0455	-1.813076879	17.63
1990	5.622258	32.92	2.17	7.803216	0.003239	6.1267	-2.085202591	24.21
1991	3.485228	35.68	2.2	11.71899	0.00139	6.3574	-2.259240017	20.7
1992	5.442686	38.15	2.295	11.05036	0.003722	3.6341	-1.722661064	20.16
1993	4.711562	39.14	2.339	13.74097	0.01405	3.0148	-1.509549072	17.91
1994	3.890126	40.00	2.381	9.125765	0.011148	5.3137	-1.687195767	16.76
1995	5.121278	40.20	2.464	5.455285	0.001896	10.2978	-1.642094763	18.53
1996	4.522919	40.84	2.51	-5.16455	0.01353	2.3771	-2.45858209	21.81
1997	4.489896	42.70	2.694	8.853321	0.139376	5.3056	-3.094229829	21.78
1998	5.177027	45.46	2.895	7.825648	0.190059	8.4022	-2.549601874	14.6
1999	4.670156	48.06	3.068	8.978643	0.179603	6.1067	-2.182026432	18.38
2000	5.293295	50.31	3.27	8.998203	0.280385	2.2083	-2.497212978	30.79
2001	5.077288	53.96	3.618	9.256956	0.078527	2.0072	-2.47278871	26.61
2002	3.833124	57.45	3.934	8.389699	0.052305	3.3326	-2.874981468	25.8
2003	4.739567	57.90	4.32	5.884454	0.268285	5.6687	-2.269650009	31.24
2004	5.239533	59.01	4.272	5.582356	0.448905	7.5875	-2.884974093	40.93
2005	6.535945	61.39	4.25	5.764269	0.813322	7.0466	-2.972345847	56.71
2006	6.671905	67.08	3.59	5.466994	0.456523	6.7653	-3.896617886	66.71
2007	7.058599	68.87	4.092	5.789111	0.65103	9.107	-3.881819535	77.13
2008	6.01379	68.60	4.548	4.661743	1.328423	8.9019	-4.738271069	107.83
2009	5.045125	68.83	5	6.146538	0.901287	5.4235	-6.692012826	63.4

2010	5.571788	69.18	3.38	4.736124	1.232258	8.1267	-6.366463189	82.6
2011	6.464379	71.17	3.75	5.064198	1.264725	11.3952	-6.633869734	115.66
2012	6.521459	79.10	4.099	5.343333	1.584403	6.2175	-9.746514028	117.78
2013	6.013606	79.93	4.43	5.988694	2.602962	7.5304	-10.38541121	114.19
2014	6.061059	77.72	4.393	6.885866	2.539191	6.9916	-10.8302979	107.05
2015	6.55264	77.67	4.371	5.512644	2.831153	6.1943	-11.29764846	57.9
2016	7.113478	77.67	4.35	-13.6421	2.332725	5.5135	-14.46048945	46.87
2017	6.59025	79.12	4.37	4.27654	1.810396	5.7021	-9.261368204	56.99
2018	7.319413	82.10	4.38	3.634304	2.421626	5.5436	-12.80840385	76.03
2019	7.881907	84.03	4.382	5.689545	1.908045	5.592	-23.02699648	70.21
2020	3.448026	84.78	5.209	4.289205	1.525312	5.6911	-18.92661898	50.21
2021	6.938679	84.81	5.097	3.076216	1.723856	5.5457	-20.13789091	72.04
2022	7.099829	84.91	4.699	1.972481	1.555405	7.697	-26.63448234	110.68

GDP Growth Source
https://www.macrotrends.net/countries/BGD/bangladesh/gdp-gross-domestic-product
Unemployment Rate https://www.macrotrends.net/countries/BGD/bangladesh/unemployment-rate
Inflation Rate Source https://www.macrotrends.net/countries/BGD/bangladesh/inflation-rate-cpi
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