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| RESEARCH ARTICLE

The Relationship of Crude Oil Prices and the U.S. Dollar Exchange Rate in the Philippines

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| ABSTRACT
This paper examines the U.S. dollar exchange rate, gasoline octane 95, diesel, and kerosene prices in one econometric model. These comprehensive literature reviews related to this topic of interest prove evidence of variations in the relationship that exists between the U.S. dollar exchange rate, gasoline octane 95, diesel, and kerosene prices. This study will undertake to find out the effect of the rising crude oil prices in the Philippines on the U.S. dollar exchange rate during these times. Significantly, Through the ARDL bounds testing approach, the research adds to the body of literature by examining the relationship between crude oil prices and the U.S. dollar exchange rate in the Philippines. The study adopted the Autoregressive Distributed Lag (ARDL) model to estimate the causality function, F-Bounds Test to establish long-run causal significance, and Error Correction Term (ECT) to determine how long until the adjustment of short-run errors to re-equilibrate to the long-run equilibrium. The results show that the lag of crude oil prices has a significant relationship with the lag of the U.S. dollar exchange rate in the short run. In regards to the long-run, the crude oil prices were found to be insignificant, but the kerosene and gasoline prices may still have a positive long-term impact, and diesel has a negative long-term impact on the U.S. dollar exchange rate against Philippine Peso.

| KEYWORDS

Autoregressive Distributed Lag Model, Crude Oil Prices, U.S. Dollar Exchange Rate, Philippine Peso

| ARTICLE INFORMATION

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1. Introduction

1.1 Background of the Study

With the recent happenings between dispute between Ukraine and Russia, the price of commodities began to elevate because of the resources that they are exporting to the Philippines (Simeon, 2022). One example is crude oil which is limited due to a lack of supply resulting in an increase in its price on a day-to-day basis, conforming to the market equilibrium (McFarlane, 2022). Because of these phenomena, it affects not only the way people live, especially commuters and drivers, but also economic activities. Once the crude oil price tends to rise up, it affects most of the indicators, specifically investments, output, commerce, and even purchasing power (Ahmad et al., 2022). The exchange rate, which is a very common indicator, was also affected by the crude oil price change.

Exchange rates are crucial to a country's amount of commerce, which is critical to nearly every free market economy on the planet. As a result, exchange rates are among the most closely monitored, examined, and manipulated economic measures (Twin, 2022). Apart from that, it tremendously affects the overall economic performance both in the short-term and long-term (Picardo, 2021). The exchange rate significantly affects the prices occurring to imported products, as we all know, but this explains whether the base currency is weak or strong against any other currencies. It also contributes to investment performance, interest rate, and inflation that can even extend to control the labor market and real estate sector.

There have been studies about the connection between the exchange rate and crude oil prices. An effect on the nominal exchange rate may change if the price of tradable goods is no longer fixed as assumed. If these crude oil prices increase, the currencies of

the economies with a large dependence on oil will probably depreciate due to elevated inflation (Beckmann et al., 2017). When this happens, people should expect that the nominal exchange rate will influence the real exchange rate depending on the impact of changes in any price of tradable and non-tradable. A study was conducted where the equation explains that an appreciation in the U.S. dollar increases the price of oil measured in terms of the domestic currency (Beckmann et al., 2017). This will cause a lower demand for oil outside the United States which will result in a drop in the oil price, ceteris paribus.

Understanding the ties between one another and cost activities in a single setting force a thoughtful or contradicting response in the other. This relationship endures for some reasons, including asset conveyance, the equilibrium of exchange, and market brain science. There's additionally unrefined petroleum's critical commitment to inflationary and deflationary tensions that heightens these interrelationships while firmly moving periods-both to the potential gain and to the disadvantage. This often has to do with the distribution of resources and a nation's balance of trade. Behaviors and sentiment in the market and the effect that crude oil has on inflation also play out in the relationship between the commodity and currencies.

1.2 Statement of the Problem

Oil prices have been affected by many factors, such as the market and geopolitics (Bajpai, 2022). It is basically the most volatile commodity. On the other hand, the exchange rate is used to evaluate the currency of one country against other countries' currencies (Amadeo, 2022). The connection between crude oil prices and exchange rates has been questioned throughout different studies in accordance with their volatility and movement towards economic activities.

In this case, these are the research questions:

- Is there a significant relationship between crude oil prices and the U.S. dollar exchange rate in the Philippines?
- Do crude oil prices affect the U.S. dollar exchange rate in short-run and long-run interactions?
- Do the short-run dynamics between crude oil prices and the U.S. dollar exchange rate affect the long-run equilibrium?

We propose to investigate the correlation between the crude oil price and the U.S. dollar exchange rate after doing this research. The researchers will use a quantitative approach to gather secondary data and information to establish the relationship between the price of crude oil in general and the pricing of diesel, gasoline with an octane rating of 95, and kerosene in particular. The researchers must specify and identify the short- and long-term consequences of the factors.

1.3 Objectives of the Study

The main objective of the study is to find out the relationship between oil price and exchange rate in short-run and long-run equilibrium. This will also assess the U.S. dollar exchange rate, gasoline, octane 95, diesel, and kerosene prices in one econometric model.

This study aims to provide an informative investigation and analysis of the rising crude oil price in relation to the exchange rate affecting the economic flow in the Philippines and to forecast whether it will produce a good effect for the succeeding months. The objectives are as follows:

- To examine the correlation of the crude oil prices to the U.S. Dollar exchange rate against the Philippine Peso.
- To analyze the effects of changes in the short-run equilibrium of crude oil prices and the U.S. Dollar Exchange rate against the Philippine Peso.
- To analyze the effects of changes in the long-run equilibrium of crude oil prices and the U.S. Dollar Exchange rate against the Philippine Peso.

1. 4 Significance of the Study

The purchasing power of a currency in another country is determined by its exchange rate, which may constantly fluctuate in some countries or remain fixed in others, as explained by Amadeo (2022). The exchange rate is influenced by various economic and social factors of a country. In addition, crude oil plays a critical role in the production process, and understanding the causes of its price fluctuations is essential for accurately predicting energy prices and dealing with unexpected shocks, as noted by Yoshino and Akina (2020).

This research is significant because it contributes to sustainable development by improving the standard of living and forecasting how fluctuations in crude oil prices may affect exchange rates. Moreover, the study provides empirical evidence to better understand the impact of government policies on the economy. Those interested in predicting future exchange rates can benefit from this analysis to make informed economic decisions. Furthermore, this research sheds light on how crude oil prices can affect

the value of the U.S. dollar, which is valuable information for policymakers and businesses operating in the global market. The study serves to provide valuable information on the following:

● Community. This study will help to increase public awareness and understanding of how they can relate the crude oil prices and exchange rates in the country.

● Government. This study will help the government identify economic policies that they need to mandate for the betterment of the country. This can be a basis for making government policies that can uplift the awareness of sustaining the prices of crude oil in the Philippines.

● Future Researchers. This study will serve as their basis and guide in their future studies. This will provide information and data on how the crude oil price affects the exchange rate market in the Philippines.

1.5 Scope and Delimitations

Most of the past pieces of literature have studied the relationship between these variables. This study is done to test the relationship between the exchange rate and crude oil prices through short-run and long-run associations in the Philippines. The study will focus on regressing the elevated gasoline price and US dollar exchange rate that exists in this time of pandemic in the Philippines. The researchers chose this topic for the reason that their observation in society nowadays affects the way people live and the way they cope with the new system and recent happenings regarding the dispute between Ukraine and Russia. The prices of Gasoline, Octane 95, Diesel, and Kerosene as the independent variables. In order to assess the present influence of the country's economic growth on living standards empirically, it is also necessary to examine earlier research that had produced ambiguous results.

An autoregressive distributed lag model was used by Musa et al. (2019) to examine how currency rates and crude oil prices affected Nigeria's economic development from 1982 to 2018. It is important to note that in this case, researchers attempt to adjust various variables based on the variables observed in the Philippines, where crude oil prices and US dollar exchange have been confirmed to exist. The researchers also stressed that the validation of the crude oil price and US dollar exchange rate hypothesis is responsive to the sample of countries chosen, the sample size, and the econometric method used by using balanced panel data methodology, a careful and systematic investigation in carrying out the applicability in the Philippines using the most recent sample of U.S. Dollar exchange rate, Gasoline Octane 95, Diesel, and Kerosene in the Philippine setting.

2. Review of Related Literature

The previous chapter discusses the background of the present research problem and primary matters regarding the research. Moreover, for any specific research to comply with the needed spaces in the development of the study, the researchers must thoroughly and efficiently be familiar with any related previous research and theories to support the concreteness of the study. This chapter provides some insights regarding the strong points and ideologies of previous studies. It enables us to improve the investigation and process of the study.

2.1 Crude oil and its prices

As the COVID-19 pandemic is a novel and currently ongoing situation, the literature regarding its impact on economic variables is scarce. However, the US Bureau of labor and statistics (2020) asserts that after a customary decline due to business closures for the Chinese New Year celebrations in January 2020, oil demand from China continued to fall due to economy-wide pandemic-related closures. In addition, demand for oil dropped by 3 million barrels per day, accounting for roughly 20% of the country's total oil consumption. Thus, "as the COVID-19 pandemic spread, Saudi Arabia, the world's second-largest oil producer after the United States, urged fellow Organization of Petroleum Exporting Countries (OPEC) members and Russia to reduce production" (US Bureau of labor and statistics, 2020).

According to Crismundo (2022), the public experienced fluctuating prices in regard to petroleum products by February 2022, which was significantly affected by the uptrend in the international price of oil because of geopolitical risk, specifically the dispute between Russia and Ukraine. The Department of Energy also stated that there was an existing major disruption in Turkey where pipeline explosions cost over 400,000 barrels a day of oil supply and concerns regarding the spare capacity of OPEC + to meet its increasing demand.

According to the International Trade Administration (n.d.), the Philippines is said to be an import-based country when it comes to different crude oil products. In 2019, an estimated total of 85 percent of the crude mix was imported by the United Arab Emirates, Kuwait, Russia, and Saudi Arabia. The remaining 15 percent was sourced from Australia, Taiwan, South Korea, and ASEAN Countries. With regard to production in the Philippines, there is an ongoing exploration of resources of petroleum-producing fields. As of

2020, Malampaya and Galoc offshore north-west Palawan and Alegria on the shore of Cebu are the active petroleum-producing fields in the Philippines (Bautista, 2020).

Republic Act No. 8479 declaration policy states that "the policy of the state to liberalize and deregulate the downstream oil industry in order to ensure a truly competitive market under a regime of fair prices, adequate and continuous supply of environmentally clean and high-quality petroleum products. To this end, the State shall promote and encourage the entry of new participants in the downstream oil industry and introduce adequate measures to ensure the attainment of these goals." This allows the market to control the prices of petroleum products, and the government has no authority to regulate them to ensure a fair and competitive market.

According to Trans-overseas Industrial Corporation (n.d.), there are several factors why petroleum prices vary from different regions in the Philippines. Price is usually determined and set by the retail managers in different oil companies. It was based on where they got their resources or distributors. The cost of transport or delivery also affects the price, which is highly observable in far-flung regions rather than in urban areas. Expressways also have higher prices. And lastly, competition exists in the oil and gas market, which usually brings lower prices during the "price war" in an attempt to be competitive with the other firms.

2.2 U.S. Dollar Exchange Rate

According to Chen (2022), an exchange rate is the value of one currency concerning another. When compared to the money of other nations, each country's currency has a distinct worth. In other words, the amount of one currency you receive for a certain amount in another currency depends on the exchange rate. Moreover, based on supply and demand, as well as other economic considerations, exchange rates fluctuate. A bank, a government, or a financial institution alone does not control the exchange rate. Instead, they change according to circumstances in the world market. The value of the currency rises as supply and demand increase. The value of that nation's comic health is related. Exchange rates can also be influenced by a wide range of other variables, including inflation, interest rates, public debt, and even a country's deficit. In other words, a country's currency's worth on the international market directly correlates to its economic health.

Because the world's marketplaces are always shifting, currency rates vary constantly. Supply and demand, interest rates, and other economic variables are constantly changing, even at the minute level. Exchange rates swing equally quickly. The value of a currency changes as the economy of a country changes, and money exchange rates are a current indicator of that economy's health.

Currency exchange rates are significant because they affect both the value of commodities sold domestically and abroad. For instance, the exchange rate affects the price at which you sell American goods abroad. It also has an impact on how much-imported items cost concerning domestic goods. The value of imports is directly impacted by the exchange rate, which also has an impact on supply and demand in the global market. This implies that it will have an impact on the dollar's exchange rate.

The value of a country's currency will rise when there is a great demand for it. The economic health of a nation can also cause an increase in the exchange rate. A positive exchange rate might also result from rising trade and interest rates. For instance, numerous nations use US dollars to make purchases. The value of the U.S. dollar can rise even further if additional countries decide to utilize American currency.

As the value of the dollar declines, an exchange rate may also do so. The value of the dollar may be negatively impacted by economic distress, a decline in the demand for the nation's currency on the international market, a decline in the supply and demand for exports, and falling interest rates. The exchange rate may fall when the value of the dollar declines. These variances can change from day to day.

2.3 Literature Review

From an analytical perspective, Samaniego (2020) examined the relationship between the COVID-19 pandemic, oil prices, and the exchange rates of the U.S. dollar in five emerging economies. Results in the autoregressive distributed lag analyses reveal a positive co-movement between the fatality rates and the foreign exchange rates of three of those countries. Moreover, In 2020, the researcher also collected a study and found a negative relationship between oil prices and the exchange rates of Colombia, Mexico, Russia, South Africa and Brazil.

On the other hand, the paper reviews recent theoretical and empirical studies on the relationship between oil prices and exchange rates, according to Beckman et al. (2017). The researchers' initial work focused on hypothesized transmission routes that suggest reciprocal causation. Empirical research is categorized and demonstrates that the evidence varies significantly depending on the sample, country of choice, and empirical approach. Empirical research is centered on either explaining or forecasting one variable

with the other. However, there are some recurring themes: (i) over the long run, it is common to observe strong correlations between exchange rates and oil prices; and (ii) in the short run, either exchange rates or oil prices have the potential to be useful predictors of the other variable, but their effects are strongly time-varying. Importantly, the inverse causality from US dollar depreciation to increases in the price of oil frequently materializes at a daily frequency or over a few months. They also identify some important avenues for future research, such as addressing time-varying predictability and optimal sample choice for forecasting. Furthermore, the relationship between US dollar depreciation and oil price hikes typically manifests itself on a daily basis or over a period of several months.

As same as the recent study about the effects of oil prices and exchange rates. Roubaud and Arouri (2018) add to the existing literature on the linkages between oil prices, exchange rates, and stock markets by taking into account the implications of economic policy uncertainty (EUP). VAR and multivariate Markov switching vector autoregressive (MS-VAR) models were used. First, they show that currency, energy, and stock markets are all closely connected. Second, it demonstrates that the relationships between the variables are non-linear. Third, it shows that while the relationships between the variables shift from one period to the next, they are greater during volatile periods. Fourth, oil is a key player in the transmission of price shocks to the exchange rate and stock markets.

In agreement with the recent study, the exchange rate pass-through (ERPT) to inflation in Nigeria and South Africa is revisited in this paper by incorporating structural breaks and using time series variables, such as the consumer price index, nominal effective exchange rate, gross domestic product, and crude oil price, according to Balcilar et al. (2019). Their empirical data reveals that the long- and short-run ERPT to inflation for Nigeria is full, but it is imperfect in both the long and short runs for South Africa, based on the Maki cointegration test and a flexible estimate technique of the Autoregressive Distributed Lag (ARDL) model. This suggests that South Africa's pricing is more stable than Nigeria's. The contrast between Nigeria and South Africa demonstrates the ERPT's importance of inflation targeting and central bank credibility. The findings also show that Nigerian output growth raises inflation in the long run while being anti-inflationary in the near run. Output growth has a negligible impact on South Africa's economy. Furthermore, the long-run influence of oil prices is negative and substantial for Nigeria, whereas the short-run effect is positive and significant for South Africa.

Current research on the effects of oil prices on exchange rates, according to Baek & Choi (2021), assumes that fluctuations in crude oil prices have symmetric effects on a country's real exchange rate. The contribution of this paper is to analyze whether crude oil prices are asymmetrically passed on to the real exchange rate in Indonesia using the non-linear autoregressive distributed lag (ARDL) method of Shin, Yu, and Greenwood-Nimmo (2014). They find that oil price fluctuations affect the Indonesian rupiah asymmetrically in both the long and short run; that is, the Indonesian rupiah appears to be more responsive to rising oil prices than to dropping oil prices.

In addition, the World Bank investigated the possible repercussions of the oil price drop for emerging markets and developing economies. In 2020, the study presented four major findings; first, the record drop in oil prices was primarily driven by demand factors, as widespread measures to combat the pandemic resulted in an unprecedented drop in oil demand, but an increase in oil inventories also weighed on oil prices. Second, the most recent drop in oil prices was preceded by six previous drops over the last half-century in which energy exporters and importers experienced similar initial output losses (around 0.5 percent) that were reversed within three years. Third, the current period of low oil prices holds little promise for boosting the global economy due to widespread restrictions and limited fiscal space in energy-exporting emerging markets and developing economies. Fourth, many emerging markets and developing economies entered the current public health crisis with precarious fiscal positions; current low oil prices thus provide an opportunity to review energy-pricing policies, including remaining energy subsidies, in order to mobilize domestic resources.

Besides, this study explores the dynamic relationship between international oil prices, international gold prices, exchange rates, and the stock market index in Mexico, according to Singhal et al. (2019). Mexico is a large exporter of oil and gold, as well as a major importer of petroleum products. On daily data from January 2006 to April 2018, the ARDL Bound testing cointegration technique was applied. The study's findings imply that international gold prices have a beneficial impact on Mexico's stock price, while oil prices have a negative impact. Oil prices have a long-term negative impact on the exchange rate, but gold prices have no substantial impact on the exchange rate. Given the pressure crude oil prices exert on stock markets and exchange rates, the findings of this study have significant consequences and provide some signals to monetary and fiscal authorities.

Most empirical literature explores the relationship between oil prices and exchange rates using various models. Those models measure the link on two-time scales (long and short terms) and frequently miss the co-movement of these variables across time, according to Hussain et al. (2017). Those models measure the link on two-time scales (long and short terms) and frequently miss the co-movement of these variables across time. They analyze the co-movements of the oil price and the exchange rate in 12 Asian

nations using a detrended cross-correlation technique (DCCA). The co-movements of the oil price and the exchange rate are calculated using this model at various time scales. The unit root problem can be seen in the exchange rate and oil price time series. It is tough to determine their correlation and cross-correlation. As a result, when a periodic trend or unit root problem emerges in these time series, it becomes spurious. These methods control the unit root problem by measuring possible cross-correlation at various time scales. Their empirical findings back up the theory that oil prices and the exchange rate move in lockstep. For most Asian nations in their sample, their findings confirm a weak negative cross-correlation between oil price and currency rate. The findings have significant consequences for these countries' monetary, fiscal, inflationary, and trade policies. In plain terms, the investigation was unrelated to one another.

Many factors influence crude oil prices through various phenomena, such as economic activities, political agendas, and industrialization. Based on the study by Salles (2020) assessed the price movement and volatility of crude oil prices to understand the stochastic processes. He also experimented with its relationship with the exchange rate through data testing and analyses. It then concluded that the result does not represent a cointegration between the two variables implying that there is no correlation in the long-term run.

In consonance with the contribution to the literature on crude oil price and exchange rate market co-movement by examining their dynamics in the temporal and frequency domain. Yang et al. (2019), the researchers discovered substantial but not uniform relationships between all of the countries studied around the year 2008 and from 2005 onwards for the oil-exporting countries. For oil-importing countries, however, the strong interdependence zone is limited. Moreover, they find a negative association between crude oil prices and the exchange rates for oil-exporting countries, but the relationships for oil-importing countries are unclear. As a result, their findings have significant and intriguing implications for policymakers and investors.

In the country of Nigeria, crude oil prices have a significant component in their economy because they have an impact on foreign revenues and reserves. Conforming to the study, Ighodalo (2019) anticipates that changes in crude oil prices will have a favorable or negative impact on growth. This is because a drop in oil prices can diminish or raise foreign exchange revenues, as well as discourage or encourage infrastructure and resource allocation investment. Furthermore, their research provided some insight into exchange rate volatility and proved its negative impact on economic growth, as well as the need for a stable environment. Consequently, their research included crude oil prices as a variable in the analysis of exchange rate volatility and economic development from the perspective of emerging countries. As a result, it is clear that while inflation has a negative and large impact on economic development, private sector credit and crude oil prices have a positive and considerable impact on Nigeria's economic growth. Their findings suggest that, in addition to other macroeconomic variables, exchange rate stability is a significant component in achieving economic growth.

In accordance with the negative effect of crude oil prices on the US dollar exchange rate, Wen et al. (2017) analyze the nonlinear Granger causation and time-varying effect between crude oil prices and the US dollar (USD) exchange rate in their work using a structural vector autoregression model with time-varying parameters. First, crude oil prices are the nonlinear Granger cause of the USD exchange rate, but not the other way around, according to their empirical study. Second, in the short run, the USD exchange rate has a bigger and more constant negative impact on crude oil prices, which progressively fade at a future date. Finally, disregarding structural breaks can lead to a worsening of the negative volatility connection between the oil and USD exchange rate markets, which was most noticeable during the economic meltdown.

Furthermore, oil price movements have different effects on the financial indicators of global markets and economies. This study intends to look at the relationship between crude oil prices and stock market indices, as well as currency rates, across a variety of economies classified as developing/emerging markets and oil importer/exporter countries. According to Kayalar et al. (2017), The long period enables a thorough examination of the impact of the global financial crisis on the aforementioned dependency system. The inclusion of a 1-to-30-day analysis to capture the variance in dependency as duration changes is a unique element of this study. Importantly, they discover that most oil exporter countries' exchange rates and stock indices are more dependent on oil prices, whereas emerging oil importer markets are less subject to price swings. The worldwide crisis, as well as the recent dramatic drop in oil prices, has significant consequences.

Additionally, this paper examines the co-integration or long-term link between the USD/INR Exchange Rate and Indian Crude Oil Price. They used the VAR-VECM framework, the direction of causality, and impulsive responses from deviation or shock to the crude oil price and exchange rate and also found a negative relationship between the two variables. Inumula and Solanki (2017) assert that, given that India imports over 80% of its total oil requirements, the dynamics of the crude oil price and dollar exchange rate play a significant impact in the development of an economy like India. Since August 2016, the ratio of 68.2:31.8 between the sour and sweet grades of Brent (dated) and Oman & Dubai crude defines the makeup of the Indian crude basket. The findings indicate that the exchange rate and the price of Indian crude oil are co-integrated and that there is a unidirectional causal

relationship connecting the exchange rate and the price of oil. This suggests that changes in the price of crude oil are caused by changes in the exchange rate. This has important policy implications for the apex bank because it shows that a decline in crude oil prices may have strengthened the dollar but not the Indian rupee. Instead of being cautious about the rise or fall of crude oil prices, the apex bank should monitor and strengthen the Indian rupee by implementing more economic reforms.

This work attempts to analyze the dynamics of oil price volatility by investigating interactions between the oil market and the US dollar/euro exchange rate, based on the study of Jawadi et al. (2016). They employ recent instant data to assess realized volatility and study the immediate daily links between different types and indicators of oil price and US$/euro volatilities, in contrast to earlier relevant studies that focused on low-frequency data and GARCH volatility measures. They also pinpoint the causes of oil price volatility by focusing on significant US$ exchange rate fluctuations. As a result, they discover a negative link between the US dollar/euro and oil returns, implying that an increase in the US dollar lowers the price of oil. Second, they point out that volatility from the US exchange market has spilled over into the oil market. Surprisingly, these spillover effects appear to be caused by intraday spikes in both markets at the same time.

As stated in Grisse's (2010) study, "changes in the US Dollar exchange rate may have an impact on oil prices due to their impact on global demand for oil and their impact on the price setting behavior of oil producers", and because oil is priced in US dollars on international financial markets when the US dollar falls in value, oil becomes less expensive in terms of purchasing power of local currency for non-Dollar-country consumers. However, he explained that this could increase their oil demand, resulting in higher oil prices. Although this channel provides an instinctive explanation for the recent negative relation between oil prices and the Dollar, there is little empirical evidence that global demand for oil is responsive to changes in the Dollar.

Oil price shocks arising from changes in demand and risk have a large impact on exchange rate volatility, whereas supply shocks have a negligible impact. According to Malik and Umar (2019), the interconnectedness of the relationship between oil price shocks and currency rates has expanded dramatically. They also discovered that oil price shocks have little effect on exchange rate volatility. They do, however, show that exchange rates are inextricably linked in terms of volatility. As a result, their findings have significant policy implications and financial market repercussions.

In agreement with a recent study about the significant relationship between oil prices and exchange rates in three African countries is examined using a Vector Autoregressive (VAR) model in this study, which is based on the work of Pershin et al. (2016). The researchers looked at daily data on nominal exchange rates, oil prices, and short-term interbank interest rates from January 12, 2003, to February 7, 2014. The findings imply that the exchange rates of the three nations studied behave differently in the event of an oil price shock, not just before and after the July 2008 oil high but also among themselves. As a result, there is no comprehensive rule for net oil importers in Sub-Saharan Africa, such as Botswana, Kenya, and Tanzania. Moreover, they argue that the Botswana pula appreciates significantly against the US dollar, Kenyan shilling, and Tanzanian shilling after an oil price peak.

Furthermore, an autoregressive distributed lag model was used to analyze the impact of crude oil prices and exchange rates on economic growth in Nigeria from 1982 to 2018. Musa et al. (2019), their findings revealed that the price of crude oil and the exchange rate has a strong favorable impact on economic growth in both the long and short run. Their study's findings revealed that the price of crude oil and the exchange rate, which were the study's key points, might affect economic growth in both the long and short run.

There is also a study that provides a significant relationship between crude oil prices and the US Dollar exchange rate. In their journal paper, Volkov and Yuhn (2016) examine the effects of oil price shocks on changes in exchange rates in five major oil exporting nations: Russia, Brazil, Mexico, Canada, and Norway. When oil prices are factored in, the R-squared of the fundamental model doubles in Russia and Brazil but increases marginally in Canada and Norway. Exchange rate volatility in response to oil price shocks is high in Russia, Brazil, and Mexico but low in Norway and Canada. In Russia, Brazil, and Mexico, the exchange rate takes substantially longer to achieve the initial equilibrium level than in Norway and Canada. The asymmetry of exchange rate volatility among countries appears to be linked to the effectiveness of financial markets rather than the economic relevance of oil income.

Moreover, this article state that the time frame of their research is from Q1-2004 to Q4-2013, and the series is derived from official government sources, such as the RBI databases for exchange rate information and Indian Oil Corporation, which were cross-checked with Index Mundi data to determine the rupee pricing of the Indian basket of crude oil. Ramanujam & Paldon (2015), when both series have produced integration of the same vector order, stationery is first applied to the series and only then is the Johansen Cointegration test used to examine the long-term relationship. As the trace statistic exceeds a 5% threshold point, the cointegration test demonstrates that oil and exchange rates move together over the long term. Meaning that they accept the long-run link between oil and currency rates, or cointegration, as the alternative hypothesis and reject the null hypothesis. This test result demonstrates the existence of the buying power parity theory in the Indian market, which suggests that the relative

price ratio between two countries and their exchange rate should be cointegrated. Johansson's Cointegration test was then performed. The series is discovered to have significant long-run equilibrium. Since practically everything in the world is a by-product of crude oil, it is impossible to completely avoid using it. This is especially true for countries like India, whose consumption of crude oil is always rising, although it may be possible to lessen some of the consequences.

However, some studies result in both significant and insignificant relationships. From February 1991 through December 2015, this study examines the time-varying trilateral correlations among real oil prices, exchange rate changes, and stock market returns in China and the United States using the diagonal BEKK model and dynamic impulse response functions. As a result, they draw attention to a few crucial points and the negative correlation between crude oil prices and the US Dollar exchange rate. The researchers used a VAR-BEKK-GARCH model, a multivariate GARCH model proposed by Engle and Kroner, to estimate the conditional mean function and conditional volatility function of high-dimensional relationships, which they used to test volatility spillovers between multi-markets, according to Bai & Koong (2018). First, aggregate demand shocks have a positive and considerable impact on oil prices. Second, positive oil supply shocks affect the Chinese stock market negatively and severely. Third, oil price shocks have a long-term and severe negative influence on the trade-weighted US dollar index. Fourth, the stock markets in the United States and China are positively correlated, just as the dollar index and the exchange rate are. Fifth, there is a large inverse relationship between the stock market in the United States and the dollar, as well as the stock market in China and the exchange rate. Last but not least, in recent years, the Chinese stock market has been more volatile and susceptible to aggregate demand and oil price shocks than the US stock market.

In consonance with the recent study that there is both a significant and insignificant relationship, the dynamic relationship between oil price, Nigeria-US exchange rate, stock market activity, Kilian's global economic activity index, and world oil output is investigated in this article by Olayeni et al. (2020). They create a robust, stable single-equation error correction model in which the exchange rate bears the only responsibility for short-run adjustments, with causal influences from the other variables in the model. They discover that asymmetry plays a role in the long run, proving the existence of equilibrium-path adjustment asymmetry and implying that positive and negative variations must be taken into account when constructing the policymaking process to ensure stable exchange rate movement.

In keeping with studies that also checked the linkage between crude oil prices and exchange rates specifically in Nigeria, Adegoriola and Onimisi (2021) have tested the relationship between the variables using the Johansen cointegration test. The result shows a long-run relationship between crude oil prices and exchange rates. As they have stated, "1 percent increase in crude oil price will lead to a 2.66 percent increase in naira per US dollar exchange rate." However, they have also recommended that immediate actions should be deployed in order to de-link the long-run movement of two variables because of the high volatility rate.

Further, this study looked at the impact of oil prices on the volatility of the Nigerian currency rate over a thirty-five (35) year period. In order to examine the data stream from 1983 to 2019, the Granger causality test and Vector Error Correction Model (VECM) techniques were utilized. According to Igbinovia & Ogiemudia (2021), the unit root test, descriptive statistics, and the co-integration preliminary test were all used in a dynamic framework analysis. Particularly, the empirical results demonstrate that the correlation between the price of oil and other variables (interest rate, inflation rate, and external reserve) has a varying degree of significant relationship with the volatility of the exchange rate in Nigeria both in the short and long runs during the retro under review. The outcome of their research demonstrates that, in both the short and long run retro under consideration, the correlation between the oil price and other variables (interest rate, inflation rate, and external reserve) has a varying degree of significance concerning exchange rate fluctuation in Nigeria. Particularly, both in the short and long terms, the price of oil has little effect on the exchange rate in Nigeria. Only in the long run do other auxiliary variables, such as interest rate and inflation rate, have a substantial impact on exchange rate volatility. This demonstrates that exchange rate volatility in Nigeria is significantly influenced by interest and inflation rates.

The main purpose of this paper is to look into the drivers of volatility in crude oil and foreign exchange markets, as well as the jump spillover between them. They looked at the currencies of two key oil-importing countries from January 1, 2013, to October 31, 2019. (India and China). According to Ahmad (2020), they discover evidence of positive return spillover from the oil market to the foreign exchange market but no evidence of negative return spillover. Surges in oil prices appear to have a negative impact on exchange rate conditional volatility, which respond asymmetrically to both positive and negative oil price spikes. They also talk about how disentangled exchange rate surges have a big impact on conditional oil price volatility. These results, however, are asymmetric due to the nature of leaps and other oil price series. Finally, there has been no evidence of a co-jump between the oil and foreign exchange markets. These discoveries have far-reaching implications for investors and politicians.

Nevertheless, there is also another study of significant and insignificant relationships. The Nigerian stock market and crude oil prices have a short-run positive association, as one would anticipate from an oil-exporting country, and the direction is from crude

oil prices to the Nigerian stock market, not the other way around. According to Iheanacho (2016), the relationship between crude oil prices, exchange rate, and stock market performance in Nigeria from January 1995 to December 2014 was studied using a multivariate Vector Error Correction Model (VECM) that used the Granger causality test and generalized variance decomposition analysis. The exchange rate and the Nigerian stock market have a positive short-run relationship, with the direction of travel being from the exchange rate to the Nigerian stock market. In the short run, the exchange rate is likewise found to be positively associated with crude oil price changes, with the causation moving from crude oil prices to the exchange rate. However, the findings of a multi-variate Johansen cointegration test imply that the three variables have a negative connection in the long term. The results of the Variance Decomposition study demonstrate that changes in Crude Oil prices have a significant impact on the performance of the Nigerian stock market and the behavior of the exchange rate.

Moreover, there is no specified economic theory that can help people explain the linkage between the commodity and exchange rate market. Hadi et al. (2019), they have tested the impact of crude oil price fluctuations on Malaysian and Brunei exchange rates. They have utilized the Eagle-Granger 2-Step Cointegration Test as an estimation tool in their data analysis. It resulted in a long-term relationship between the two currencies and crude oil prices. Additionally, they have concluded that there is a significant causality that is unidirectional from the crude oil prices and the two currencies.

This study stated that it also believed that the relationship between crude oil prices and exchange rates had been an interesting topic to be discussed by academics and analysts in such a way that there is no empirical evidence or theoretical framework that justifies the linkage of the two indicators. According to Orzeszko (2021), the researcher believed that the studies were focused mainly on causality, which restricted the area of linearity. He tested the prices of crude oils and currencies by the Nonlinear-Granger Causality test, which shows that there is a strong bidirectional relationship between the crude oil prices and Euro, US Dollar, and GB Pound Sterling and a weaker relationship between the Japanese Yen paired with US Dollar.

Conversely, this study primarily establishes the long-term correlation between exchange rates and oil prices with their indirect relationship to each other. According to (Rotimi et al., 2022), this is accomplished by looking at the variables affecting exchange rates in Nigeria. The analysis uses monthly data for the years 1980 to 2017 that include exchange rates, interest rates, inflation, oil prices, exchange rates, and debt/GDP. The choice of cut-off is determined by data availability. The Central Bank of Nigeria's (CBN) statistical bulletin, the National Bureau of Statistics (NBS), and World Development Indicators are the primary sources of data for this study (WDI). To analyze the effect of the real oil price shocks on the real exchange rates, the study uses the ARDL estimating technique over the period 1980 to 2017. The findings show that real oil price shocks have a considerable impact on real exchange rates. The findings specifically show that real oil prices and exchange rates have a highly proportional relationship, suggesting that exchange rates react negatively to increases in oil prices and vice versa. The analysis shows that there is a long-run relationship (also known as a cointegration relationship) among the variables. Additionally, it demonstrates that the model is stable and that exchange rates and oil prices are correlated.

The researchers analyze the effects of oil price shocks on the foreign exchange rates of the US dollar with currencies in 16 OECD nations, according to Chen et al. (2016). Their empirical findings show that the responses of dollar exchange rates to oil price shocks varied significantly depending on whether supply or aggregate demand drives changes in oil prices. Oil price shocks can account for around 10%–20% of long-term fluctuations in exchange rates. After the global financial crisis, oil shocks have a far stronger potential to explain exchange rate changes. They find no evidence of nonlinear relationships between oil prices and currency rates using parametric and nonparametric testing. In simple terms, the effects of oil supply and shocks on exchange rates are heterogeneous.

Meanwhile, this article claims it investigates the relationship between oil prices and exchange rates in the Russian Federation, and it also proves that the exchange rate of the dollar against the ruble and oil prices are inextricably linked. Blokhina et al. (2016), This relationship has been accurately depicted by the regression model. The interrelationship with a foreign policy component - US and European Union sanctions - is also revealed. The exchange rate of the dollar against the ruble and oil prices are inextricably linked. This relationship has been accurately depicted by the regression model. Brent crude oil prices, at least in the long run, are the most important component in the establishment of the ruble's currency exchange rate mechanism. Currency swings and uncertainties will be reduced once world oil prices are stabilized and sanctions are lifted. Because all shocks affect the economy in the short and long term, the conclusions of this study can be used by international and domestic investors when making judgments. Unfortunately, this study looks at the correlation between South Africa's exchange rates and oil prices over the years 1970 through 2021. According to Hlongwane (2022), high oil prices and a poor South African Rand to US Dollar exchange rate are problems. The South African Reserve Bank provided annual time series data for the study. The Granger Causality test was used in the study along with an ARDL model to analyze the relationships between the variables. Based on the analysis, there is a bad correlation between South African exchange rates and oil prices. The analysis also showed that there is no causal relationship between South African

currency rates and oil prices. In order to preserve the South African Rand's value relative to the US Dollar, the report advises that policies to lower oil prices be put into place.

Additionally, according to (Obi., et al. 2018), the study examines the relationships between the oil price, exchange rate, and implied volatility using the ARDL bounds testing methodology. Their goal is to ascertain whether implied volatility affects crude oil value and, consequently, the observed inverse link between the price of oil and the US dollar exchange rate. Their study discovers evidence of cointegration among the variables using empirical data from the time following the 2008 financial crisis. In particular, there is a bi-directional long-run causal relationship between oil price and implied volatility as well as between oil price and exchange rate. However, in the short term, unidirectional causality between the price of oil and the exchange rate, as well as the implied volatility, is discovered. All the while, the relationship between volatility and exchange rates is weak, leading them to believe that the oil-dollar inverse dynamic is primarily due to the market's sense of dread, which is represented in implied volatility. They also provide a series of policy recommendations based on their findings that emphasize the advantages of domestic resource exploitation and economic diversification.

Lastly, Zhang (2013) mentioned in his study that when the price of oil rises, the income of oil-producing countries rises. In the short run, these countries use their increased income to buy more US dollar-denominated assets, causing the US dollar to appreciate. Higher income will result in higher expenditure in the long run. Assume these countries use their higher income to buy European goods. Then they have to exchange US dollars for Euros, which causes the US dollar to depreciate. Thus at the end of his paper, he concluded that "the implication is that, while the price of crude oil and the value of the US dollar is stable in real terms, the correlation is subject to structural breaks over time."

2.4 Synthesis

It described the backdrop of the relationship between crude oil prices, such as kerosene, gasoline, and diesel, and the US dollar exchange rate, based on all associated studies and inquiries. They have diverse findings from studies conducted in various nations, which show that there is no causality and that the variables are partially insignificant. Furthermore, it demonstrates that the relationship between crude oil prices and the exchange rate is negligible. However, in the long run, those variables have both positive and negative significance. It is hard to determine which of these studies can contribute to the linkage between oil price and the exchange rate since it has been described that even up to this date, the relationship between these variables is being questioned through different empirical studies and models. The essence of these studies provides necessary information that the effects of oil price fluctuations vary from one country to another in accordance with the base currency against foreign currency.

Through various data analyses and interpretations within the literature, it has shown that there are various results which come up with different implications towards the relationship between oil price and exchange rate. The relationship through short-run and long-run association of the variables differs for each country because of the given circumstances of oil-exporting and oil-importing cases of the nations. It also describes the relationship between the factors as well as their impacts in such a way that policymakers may create and implement rules on how those oil prices affect the exchange rate.

2.5 Research Gap

Objectively, there are numerous variations in the findings of other researchers' tests on the same factors. As a result, the uncertainty of this study's results and interpretation may not be favorable to other investigations, and their arguments may be dismissed. Other researchers, aside from this study, used different approaches to treat their data and used different units of measurement. Furthermore, there are too many studies that are too closely related to the research that the researchers are conducting, but still, it has outdated literature and no strong evidence and specific theoretical framework that can be used for this research which could lead to discrepancies and inconsistencies in the investigation's support of one's argument and pointed conclusion. Therefore, this study provides the utilization of the Autoregressive Distributed Lag method in forecasting and quantifying the relationship of the given variables for the both short-run and long-run association. Thus, this paper acquired an advantage in providing new information to the existing body of knowledge regarding the relationship between crude oil prices and exchange rates in the Philippine setting.

2.6 Theoretical Framework

There have been studies that define the relationship between crude oil prices and the exchange rate market, but none of which have shown any theoretical framework regarding the linkage of the two variables (Orzesko, 2021; Hadi et al., 2019). Based on the literature, they have said that there is no economic theory that explains or justifies the nexus between commodities and exchange rates, which is somehow questionable at the same time, interesting.

With the recent studies regarding a commodity-to-currency relationship, John Maynard Keynes' Price Stickiness or Sticky Price Model is the propensity of prices to constantly remain or slowly adjust to their level despite changes in the valuation of producing

and selling the commodities. It also states that when commodity prices elevate, they will eventually produce inflationary pressures on different economic indicators, such as the exchange rate. In that case, inflation will be more likely to devalue a currency since it is equated with a decrease in purchasing power.

Another theory that is connected with the commodity-to-currency relationship is Branson's Portfolio-Balance Exchange Rate Determination, which explains that the exchange rate is set as a part of a system under the financial market that accompanies the demand for resources in line with the stock supplies. It also means that the exchange rate of countries responsible for exporting commodities is dependent on foreign-determined asset supply and demand fluctuations. Technically, if the commodity price increases, it will lead to a balance of payments surplus and an increase in foreign holdings of the country's currency. These factors will lead to an increase in demand for the country's currency leading to positive currency returns.

These theories were both used by Chan, Tse, and Williams (2009). In their paper, they tested the relationship between commodity prices and the currency exchange rate backed up with evidence from the Futures Markets. They have utilized the commodity-exporting countries' currency returns and a range of index-based commodity returns. They found out that the commodity-currency relationships exist simultaneously, but the lag behavior in both directions seems to be failing, resulting in the commodity and currency futures prices responding to information shocks simultaneously on a daily basis.

INPUT	PROCESS	OUTPUT
Objectives of the Study: **1.** To examine the correlation of the crude oil prices to the U.S. Dollar exchange rate against the Philippine Peso. **2.** To analyze the effects of changes in the short-run equilibrium of crude oil prices and the U.S. Dollar Exchange rate against the Philippine Peso. **3.** To analyze the effects of changes in the long-run equilibrium of crude oil prices and the U.S. Dollar Exchange rate against the Philippine Peso. **Dependent Variable (Y)** U.S. Dollar Exchange Rate **Independent Variable (X)** Gasoline Price Diesel Price Kerosene Price	**The data will be gathered from** Petrol Global Prices The data will be assessed and analyzed through the: **1.** Descriptive Statistics **2.** Stationary Test (ADF) **3.** Correlation Matrix **4.** XY Scatter Plot **5.** Autoregressive Distributed Lag model **The validity of the results will be screened using the:** Diagnostic Test: F-Bounds Test Cointegration Test Error Correction Term Test Breusch-Pagan-Godfrey Test Breusch-Pagan Test Jarque Bera Test Durbin Watson Statistic Variance Inflation Factor Ramsey RESET	**The Relationship of Crude Oil Prices and the U.S. Dollar Exchange Rate in the Philippines** **The study will reveal the following:** **1.** The correlation of crude oil prices to the U.S. dollar exchange rate in the Philippines **2**. The analysis of the short-run equilibrium of the U.S. Dollar exchange rate in accordance with the movement of crude oil prices. **3.** The analysis of the long-run equilibrium of the U.S. Dollar exchange rate in accordance with the movement of crude oil prices

Figure 1. IPO Conceptual Framework

This figure shows the input, which consists of the objectives of the study and the variables that will be used to conduct this study. Also, the researchers decided to produce a process which includes data testing and diagnostic tests to examine the significance of the relationship between the variables in order to have the desired output.

2.7 Hypotheses

Upon investigation, the researchers will show some studies where these variables can affect economic growth by gathering sufficient data for the validation and reliability of the study. The author believed that this study would be timely and relevant and would generate thorough knowledge and clear information.

To confirm the significance of the integration between the variables, hypothesis testing will be utilized. The null hypothesis will be rejected if the p-value is less than a 5% significance level, which signifies that there is no relationship between the variables. These are the following claims:

$\mathbf{H}_{01}$: There is no significant relationship between the gasoline price and the U.S. Dollar exchange rate in the short run.
$\mathbf{H}_{02}$: There is no significant relationship between the diesel price and the U.S. Dollar exchange rate in the short run.
$\mathbf{H}_{03}$: There is no significant relationship between the kerosene price and the U.S. Dollar exchange rate in the short run.

If the model shows that there is evidence of a long-run correlation between the variables, these are the following claims:

$\mathbf{H}_{01}$: There is no significant relationship between the gasoline price and the U.S. Dollar exchange rate in the long-run.
$\mathbf{H}_{02}$: There is no significant relationship between the diesel price and the U.S. Dollar exchange rate in the long-run.
$\mathbf{H}_{03}$: There is no significant relationship between the kerosene price and the U.S. Dollar exchange rate in the long-run.

Hence, if the p-value is greater than a 5% significance level, the alternative hypothesis ($\mathbf{H}_1$) will be accepted, which denotes that there is a significant relationship between the variables.

3. Methodology

The methods and processes that were employed to conduct this research are presented in this chapter. In order to show the findings from the study, which are helpful for data collection and the statistical tools that were utilized for analysis and interpretation of the data that was acquired, software applications like MS Excel and Eviews are employed.

3.1 Research Design

Because this study regressed measurable data of the dependent variable, which is the U.S. dollar exchange rate, a quantitative descriptive research method was adopted, the U.S. dollar exchange rate, as well as the independent variables, which are the prices of gasoline, diesel, and kerosene; the purpose of this study is to describe the short-run and long-run relationship between the dependent and independent variables in order to comprehend the components of the exchange rate. The Autoregressive Distributed Lag Model testing approach, F-bounds test, and error correction term are used in the study to assess the short-run and long-run causal influence.

3.2 Research Procedure

The researcher used secondary data utilizing quantitative data collection tools through online data available on a certain website, specifically Petrol Global Prices. Through a 45-week time series analysis from May 31, 2021 up until April 4, 2022, the researcher gathered data on crude oil prices, namely: gasoline prices, diesel prices and kerosene prices, and the U.S. Dollar exchange rate. In order to fulfill the objectives of the study by means of the inputs were tested through different data analyses, which included the econometric model itself and diagnostic tests in order to verify the robustness of the result.

3.3 Data Collection

According to Petrol Global Prices (n.d.), they have gathered the data in each country that comes from government agencies and private sector sources and uses international and regional averages through statistical diagnostics to avoid anomalies and inconsistencies. In order for the model to be accepted, diagnostic tests were performed in accordance with the CLRM Assumptions. For easy access and compilation, the researcher will use Excel in order to store the data and run smoothly through the software EViews. In this manner, the researcher was able to focus on the interpretation and analysis of the investigation.

3.4 Research Ethics Approaches

The researchers ensured that this study was conducted with integrity and transparency. With all the data and information presented, the researcher was responsible for all the grievances that occurred because of unjustifiable actions such as plagiarism and disregarding the rights of an individual to have access to this study. These issues were identified in advance so as to prevent future problems that could arise during the research process.

3.5 Data Analysis

This research generated information regarding the effects of commodity prices through oil prices on the exchange rate market. Through this, the researcher was able to present and assess the relationships of the variables without miscalculations and biased computations since the data gathering was conducted through regression under inferential analysis. The goal of the researcher is to acquire and provide the generated p-value and r-squared to the readers. This also illustrated graphs and figures of tests, which also include diagnostic tests in order to provide organized patterns and predictions.

3.6 Autoregressive Distributed Lag Model

3.6.1 The Econometric Model

This study also aims to assess the relationship between the variables in both the short and long run. ARDL model is used to determine the short-run and long-run cointegration of independent variables of this study, which are the prices of gasoline, diesel, and kerosene, to the dependent variable, precisely the U.S. dollar exchange rate. Based on the result of the ADF Test, all of the variables are said to be non-stationary. It is common in time series panels when oil price and exchange rate are used as variables (Hussain et al., 2017). The researchers decided to convert all of the variables into first-differenced form to overcome the problem of non-stationary and which was accepted at ARDL bound testing (Nkoro & Uko, 2016).

Furthermore, to determine the effect of crude oil prices on the exchange rate in Nigeria, researchers in Nigeria used an ARDL approach to co-integration. The effect was examined between 1983 and 2017. At first, this study assessed for co-integration in the model after selecting the optimum lag and found that all the variables in the model were co-integrated. The long-run model was also estimated, and the results revealed that crude oil price has a negative and significant impact on the exchange rate, while oil revenue and gross domestic product have a positive and significant impact on the exchange rate. A short-run model was estimated for the model in addition to the long-run model estimation. The findings also showed that whereas oil revenue and gross domestic product have a positive and significant influence on the exchange rate, the crude oil price has a negative and significant influence. Dynamic OLS and fully modified OLS were used for the robustness check, and their findings supported those of the long-run ARDL model. Significantly, this shows that the price of crude oil, the main focus of this study, may affect the volatility of the exchange rate over both the long and short term (Musa et al., 2019).

With these, the following econometric model is specified:

$$\Delta USDER_t = \beta_0 + \sum_{i=n}^{n} \beta_{1i} \Delta(USDER_{t-1}) + \sum_{i=n}^{n} \beta_{2i} \Delta(GAS95_{t-1}) + \sum_{i=n}^{n} \beta_{3i} \Delta(DSL_{t-1}) + \sum_{i=n}^{n} \beta_{4i} \Delta(KRSN_{t-1}) + \theta_1 USDER_{t-1} + \theta_2 GAS95_{t-1} + \theta_3 DSL_{t-1} + \theta_4 KRSN_{t-1} + \epsilon_t - \epsilon_{t-1}$$

Whereas β is the short-run coefficient, ϵ is the error term and θ as the long-run coefficient of the model. Δ represents the first difference operator, *t* indicates the time period, and *n* is the maximum number of lags in the model.

As needed, the ARDL model must follow the hypothesis of cointegration where in the F-bounds test:

- If the model is found to be cointegrated in the long-run, then it will be examined through the Error Correction Model test for estimating the long-run causal significance. And;
- If the model is not found to be cointegrated in the long-run, the ARDL bounds testing model will be applied to estimating the short-run causal significance.

Therefore, the researchers presented that they will accept the null hypothesis that there is a non-existing relationship at any level between the U.S. Dollar exchange rate and crude oil prices, and the alternative hypothesis suggests that there is an existing relationship at any level between the U.S. dollar exchange rate and crude oil prices:

Null Hypothesis of no long run cointegration	Alternative Hypothesis of having long-run cointegration
H0: $\theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$	H1: $\theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq 0$

The utilization of the F-bounds test is to analyze whether the given independent variables have a long-run cointegration with the dependent variable. With the result of the F-statistics, if it comes to be lower than the critical value, which is 5%, then the null hypothesis of no long-run cointegration will be accepted. If it happens that the F-statistics is higher than the critical value, then the alternative hypothesis of having long-run cointegration will be accepted. If it falls in between the lower-bound and upper-bound of the critical value, the relationship of the variables will be defined as inconclusive.

This study will also evaluate the short-run behavior of coefficients of the given variables in the Error Correction Model if it happens to be cointegrated. With these, the ECM formulation will be:

$$\Delta USDER_t = \beta_0 + \sum_{i=n}^{n} \beta_{1i} \Delta(USDER_{t-1}) + \sum_{i=n}^{n} \beta_{2i} \Delta(GAS95_{t-1}) + \sum_{i=n}^{n} \beta_{3i} \Delta(DSL_{t-1}) + \sum_{i=n}^{n} \beta_{4i} \Delta(KRSN_{t-1}) + \theta_1 ECM_{t-1} + \epsilon_t$$

Whereas θ is the coefficient of the error-correction term. In order for the ECM to be accepted, the coefficient should be in a negative sign in order to generate the marginal rate of adjustments of the equilibrium to stabilize to its original setting, which was caused by shocks.

Diagnostic tests will also be utilized in order to follow the CLRM Assumptions. that the researchers will use are:

- Variance Inflation Factor for the observance of multicollinearity.
- Breusch-Pagan-Godfrey Heteroskedasticity test for the observance of heteroskedasticity.
- Breusch-Godfrey Serial Autocorrelation test for observance of autocorrelation.
- Jarque Bera test and Histogram for the observance of normality of the residuals.
- Ramsey RESET test for the observance of correct specification of the model.
- CUSUM Stability test for the observance of a structural break.

4. **Results and Discussion**

Presented in this chapter are the analyses and findings that the researcher will conduct based on the availability of data and the interrelationship of each variable in connection with the country's economic growth. It will also provide graphs and figures about the investigation and experimentation in order to present the linearity and effects over time.

4.1 Variable and Data Sources

4.1.1 Data Description

This study uses weekly time-series data from May 31, 2021, to April 4, 2022, with a total of 45 observations that were obtained from the Global Petrol Prices. The following variables used are listed as follows:

Variables	Obtained From	Unit
U.S. Dollar Exchange Rate (USDER)	Global Petrol Prices	U.S. Dollar ($)
Gasoline Prices (GAS95)	Global Petrol Prices	Philippine Peso (₱)
Diesel Prices (DSL)	Global Petrol Prices	Philippine Peso (₱)
Kerosene Prices (KRSN)	Global Petrol Prices	Philippine Peso (₱)

Table 1: Data Description of the variables.

4.1.2 Descriptive Statistics:

	USDER	KRSN	GAS95	DSL
Mean	0.019816	54.85900	60.38889	49.42044
Median	0.019740	52.50000	60.70000	46.30000
Maximum	0.020970	74.95500	76.65000	75.45000
Minimum	0.018970	47.88500	49.95000	38.80000

Std. Dev	0.000446	6.230567	5.938366	7.901281
Jarque-Bera	6.421286	18.04310	2.141760	28.62446
JB Prob.	0.040331	0.000121	0.342707	0.000001
Observations	45	45	45	45

Table 2: Descriptive Statistics of the variables.

Table 2 presents the descriptive statistics that show the number of observations, mean, maximum and minimum of the data set. Upon examining the values, the U.S. dollar exchange rate has an average of 0.0198$ as it reached the minimum value of as low as 0.0189$ on March 14, 2022, and reached the maximum value of 0.0209$ on June 7, 2021. With regards to crude oil prices, kerosene prices have an average value of 54.859 pesos with a minimum of 47.885 and a maximum of 74.955 pesos. Gasoline prices have an average value of 60.3888 pesos, with a minimum of 49.95 and a maximum of 76.65. Lastly, the diesel prices have an average value of 49.42 pesos, with a minimum of 38.8 pesos and a maximum of 75.45.

4.1.3 Stationarity Test:

Hypothesis	t-statistics	p-value
GAS95 has unit root	-0.818012	0.8038
DSL has unit root	0.751897	0.9920
KRSN has unit root	0.531503	0.9859
USDER has unit root	-2.640060	0.0928

Table 3: Augmented Dickey-Fuller test for Stationarity of the variables.

This table shows the result of the unit root test using Augmented Dickey-Fuller to check if the variables are stationary. If one variable has a unit root, it implies that it is not stationary. Given the 0.05 level of significance, the p-value should be evaluated below the significance level to reject the null hypothesis of variables having a unit root. The result shows that all series of variables are nonstationary, which were evaluated at 0.0928 and above, which is higher than the level of significance.

***4.1.4 Correlation Matrix*:**

Variables	USDER	
	R-value	Probability (P-value)
KRSN	**-0.737599**	**0.0000**
GAS95	**-0.740639**	**0.0000**
DSL	**-0.689984**	**0.0000**

Table 4: Correlation Matrix test of the variables.

This table presents the correlation of the independent variables to the dependent variable. It is also shown in *Figure 6* that an increase in U.S. dollar exchange rate has significantly affected crude oil prices to decrease, showing a negative correlation between the variables.

4.1.5 XY Scatter Plot:

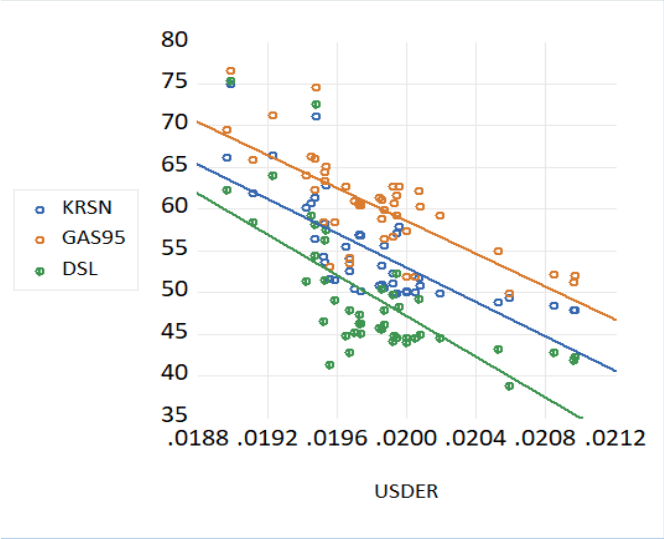

Figure 2: XY Scatter plot of the variables (USDER being the dependent variable).

Figure 2 presents the correlation between the variables using a scatter plot diagram. This shows that the trend indicates an inverse correlation between the U.S. dollar exchange rate and crude oil prices, which comprise kerosene, gasoline, and diesel, respectively. It explains that if crude oil prices increase, then the U.S. dollar exchange rate decreases, which supports the idea of the correlation matrix in Figure 6.

4.2 Result of the Model

Model selection method: Akaike info criterion (AIC)

Number of models evaluated: 500
Selected Model: ARDL(3, 2, 3, 3)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
USDER(-1)	0.742562	0.158002	4.699712	0.0001
USDER(-2)	-0.389629	0.197874	-1.969075	0.0593
USDER(-3)	0.344604	0.149875	2.299277	0.0295
KRSN	-2.26E-05	1.62E-05	-1.397706	0.1736
KRSN(-1)	6.61E-06	1.73E-05	0.382254	0.7053
KRSN(-2)	3.01E-05	1.55E-05	1.948931	0.0618
GAS95	-1.44E-05	9.66E-06	-1.487232	0.1485
GAS95(-1)	1.16E-05	9.84E-06	1.177928	0.2491
GAS95(-2)	-1.54E-05	1.05E-05	-1.455507	0.1571
GAS95(-3)	2.90E-05	9.60E-06	3.018810	0.0055
DSL	1.30E-05	1.23E-05	1.057155	0.2998
DSL(-1)	-1.28E-05	9.98E-06	-1.277035	0.2125
DSL(-2)	7.32E-06	1.03E-05	0.710034	0.4838
DSL(-3)	-3.76E-05	1.28E-05	-2.948964	0.0065
C	0.005987	0.002929	2.044331	0.0508

R-squared	0.882895	Mean dependent var	0.019736
Adjusted R-squared	0.822174	S.D. dependent var	0.000341
S.E. of regression	0.000144	Akaike info criterion	-14.58604
Sum squared resid	5.57E-07	Schwarz criterion	-13.96545
Log likelihood	321.3069	Hannan-Quinn criter.	-14.35857
F-statistic	14.54013	Durbin-Watson stat	1.876773
Prob(F-statistic)	0.000000		

Table 5: Autoregressive Distributed Lag Model

Based on Table 5, it can be observed that KRSN and KRSN lags 1 to 2, GAS95 and GAS95 lags 1 to 2, and DSL and DSL lags 1 to 2 do not have any significant relationship effects as their corresponding p-values are greater than 0.05. However, GAS95 (-3) and DSL (-3) demonstrate significant relationship effects as their p-values are less than 0.05. Specifically, the beta values for GAS95 (-3) and DSL (-3) are β = 0.0000290 and β = 0.0000376, respectively. The positive signs of these coefficients indicate that both GAS95 (-3) and DSL (-3) have a positive relationship with USDER.

According to the beta coefficient estimated in this model, if gasoline prices increase by 1 Peso after three years, the USDER will decrease by 0.0029%. This suggests that the effect of increasing gasoline prices will not be noticeable for the first three years, but it will start to have an impact from the third year onwards. Meanwhile, the beta coefficient for DSL shows that a 1% increase in diesel prices after three years will cause the USDER to increase by 0.00376%.

The model selection method used was the Akaike Information Criterion, which resulted in 500 models being generated. From these models, the ARDL (3,2,3,3) was chosen as the most suitable one. The model is considered significant as the F statistic p-value is equal to or greater than 0.05. The R-squared value of 0.882895 indicates that the model only accounts for 88.28% of the variability. Several variables, including USDER(-1), USDER(-2), USDER(-3), KRSN, KRSN(-1), KRSN(-2), GAS95, GAS95(-1), GAS95(-2), DSL, DSL(-1), and DSL(-2), were found to be insignificant as their t-statistic values were below |2| and their p-values were greater than 0.05. The Durbin-Watson (DW) statistic scored 1.87, but it is not a reliable estimator for autocorrelation in residuals since the model used the dependent variable as an independent variable.

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	3.861701	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

Table 6: Cointegration Test in ARDL bounds testing.

The table above shows the cointegration test using ARDL bounds testing. F-statistics must be evaluated higher than the critical value of the 5% significance level in I(1) for us to accept the alternative hypothesis of having a long-run relationship between the variables. In other cases, F-statistics must be evaluated lower than the critical value of the significance level 5% in I(1) for us to accept the null hypothesis of no long-run relationship between variables. If it falls between 2.79 I(0) and 3.67 I(1), then the relationship will be inconclusive. With the given result, F-statistics is evaluated at 3.861701, which interprets that the KRSN, DSL, and GAS95 scored higher than the upper bound, concluding that it accepts the alternative hypothesis of having a long-run relationship with the USDER.

Levels Equation Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
KRSN	4.66E-05	5.41E-05	0.860377	0.3972
GAS95	3.59E-05	5.33E-05	0.673080	0.5066
DSL	-9.95E-05	6.26E-05	-1.588784	0.1238
C	0.019794	0.002391	8.278829	0.0000
EC = USDER - (0.0000*KRSN + 0.0000*GAS95 -0.0001*DSL + 0.0198)				

Table 7: Cointegration Test in ARDL bounds testing.

The levels equation explains the long-run association of the variables through the use of the f-bounds test and error correction term model. Through this evaluation, KRSN, GAS95, and DSL were found to be insignificant in the long-run, showing that their p-value is above the 5% level of significance. In addition to that, the slope of the coefficient still explains that KRSN and GAS95 may have a positive long-run relationship with USDER, and DSL has a negative long-run relationship with USDER.

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(USDER(-1))	0.045025	0.123752	0.363834	0.7188
D(USDER(-2))	-0.344604	0.134473	-2.562620	0.0163
D(KRSN)	-2.26E-05	1.36E-05	-1.666287	0.1072
D(KRSN(-1))	-3.01E-05	1.34E-05	-2.249700	0.0328
D(GAS95)	-1.44E-05	7.97E-06	-1.802413	0.0827
D(GAS95(-1))	-1.36E-05	8.53E-06	-1.596712	0.1220
D(GAS95(-2))	-2.90E-05	7.97E-06	-3.635806	0.0012
D(DSL)	1.30E-05	8.82E-06	1.471230	0.1528
D(DSL(-1))	3.03E-05	9.59E-06	3.163141	0.0038
D(DSL(-2))	3.76E-05	8.74E-06	4.305408	0.0002
CointEq(-1)*	-0.302463	0.064239	-4.708399	0.0001

R-squared	0.580633	Mean dependent var	-3.26E-05
Adjusted R-squared	0.445353	S.D. dependent var	0.000180
S.E. of regression	0.000134	Akaike info criterion	-14.77652
Sum squared resid	5.57E-07	Schwarz criterion	-14.32141
Log likelihood	321.3069	Hannan-Quinn criter.	-14.60970
Durbin-Watson stat	1.876773		

Table 8: Error Correction Term Test

The importance of the error correction term is to present the volatility of converting short-run equilibrium back to its original point in long-run equilibrium. Also, this model can be used as an observation of short-run cointegration between the variables if they have no significant relationship in the long-run. Also, the data are transformed into the first-difference form, making the variables stationary at the level I. This dictates the confirmation of having a stable long-run relationship between the variables. According to the result of the test, the short-run coefficient under lag 1 (-1), KRSN (-1), and DSL (-1) is found to be significant, having a p-value below the 5% level of significance. Moreover, under lag 2 (-2), USDER (-2), GAS95(-2), and DSL(-2) were found to be significant, having a p-value below a 5% significance level. The rest of the generated variables are insignificant in the short run. CointEq(-1) is the error correction term in lag 1, has a coefficient of 0.302463, and the p-value is evaluated at 0.0001, which is below the 5% level of significance. If ECM is evaluated at -2 and above, the model is incorrect. This specifies that the weekly series of USDER in this model is corrected at a speed of 30.24% by the following week. The correction rate of -1 interprets that 100% conversion of equilibrium will take 1 week for the equilibrium to be corrected.

4.3 Link Findings to the Review of Related Literature

By the generated results of the diagnostic tests and the model itself, the correlation matrix suggested that the crude oil prices – which includes gasoline, octane 95, diesel, and kerosene – have a moderate to strong negative correlation with the U.S. dollar exchange rate against Philippine Peso. In line with the studies conducted by other researchers, they have also found that oil prices have a negative correlation with their exchange rate (Samaniego, 2020; Hussain, 2017; Jawadi, 2016).

In regards to the stationary test, it has been said that there is a usual presence of unit root when evaluating the relationship between oil price and exchange rate (Hussain, 2017). Moreover, the Autoregressive Distributed Lag Model has proven that in some of the independent variables, including their distributed lags, there is a significant relationship between crude oil prices and exchange rates in short-run equilibrium. A lot of literature has said that there is a short-run association between oil price and exchange rate existing within their specified country (Malik & Umar, 2019; Pershin et al., 2016; Iheanacho, 2016; Roubaud & Arouri, 2018; Balcilar et al., 2019; Igbinovia & Ogiemudia, 2021; Musa et al., 2019). On the other hand, This result cannot be seen in different

literature which also tests the relationship between oil prices and exchange rates (Yang et al., 2019; Ahmad, 2020; Baek & Choi, 2021; Grisse, 2010; Hlongwane, 2022, Kayalar, 2017).

But with, the result of the long-run equilibrium using the f-bounds test and cointegration test determines that there is no significant relationship between the independent variables and dependent variables. There are also studies which have similar results (Salles, 2020; Balcilar et al., 2019; Zhang, 2013; Igbinovia & Ogiemudia, 2021). However, there are studies that do not support this claim in accordance with their experimentation (Bai & Koong, 2018; Olayeni et al., 2020; Baek & Choi, 2021; Adegoriola & Onimisi, 2021, Hadi et al., 2019; Singhal et al., 2019; Blokhina et al. 2016; Ramanujam & Paldon, 2015; Inumula & Solanki, 2017; Rotimi et al. 2022; Musa et al., 2019).

4.4 Implications and Summary of the Result

The study showed the econometric model specified as Autoregressive Distributed Lag and chose to focus on the respected p-value of the variables' likelihood of getting results basically as outrageous as the noticed aftereffects of a factual speculation test, expecting that the invalid theory is right. The p-value is utilized as an option in contrast to dismissal focuses on giving the littlest degree of importance at which the invalid theory would be dismissed. A more modest p-value implies that there is more grounded proof for elective speculation. It denotes whether a certain variable is significantly related to a dependent variable. The p-value should be less than 0.05 under a 95% confidence interval.

Based on the ARDL analysis, the results of the model (as shown in Figure 8) are statistically significant, with an R-squared value of 0.882895, indicating that the model explains 88.28% of the variability and a p-value of 0.0001 which is lower than the 5% significance level. The f-bounds test and cointegration test reveals that there is a long-run relationship between crude oil prices and the U.S. dollar exchange rate. However, in the levels equation, the crude oil prices were found to be insignificant in the long run, but the slope/coefficient of the independent variables suggest that it may still have an impact in the long-run positively and negatively in accordance with the movement of crude oil prices. Finally, the error correction term shows the relationship of the variables in the short-run association, which presents that with their distributed lags, the crude oil prices were found to be significant. Additionally, Cointegration Equation (CointEq) was estimated at -0.302463, indicating that the equilibrium will return to its original position 30.24% slower than a week. Thus, this study fulfils the objectives:

1. The crude oil prices have a moderate to strong negative correlation with the U.S. dollar exchange rate, which explains that an increase in crude oil prices - gasoline, kerosene, and diesel - decreases the U.S. dollar exchange rate.
2. From the result of the Error Correction Model, which shows the relationship between the independent variables and dependent variables in the short-run, the short-run coefficient under lag 1 (-1), KRSN (-1) and DSL(-1) are found to be significant having a p-value below the 5% level of significance. Moreover, under lag 2 (-2), USDER (-2), GAS95(-2), and DSL(-2) were found to be significant, having a p-value below a 5% significance level. The rest of the generated variables are insignificant in the short run.
3. From the result of the ARDL F-bounds testing and Cointegration test, it has been determined that there is a long-run relationship between the crude oil prices and the U.S. Dollar exchange rate. But the levels equation implies that the crude oil prices are said to be insignificant. With the given slope of the coefficient, it still gives an idea that kerosene and gasoline prices have a positive long term impact on the U.S. dollar exchange rate, and diesel has a negative long-term impact on the U.S. dollar exchange rate.

5. **Conclusion and Recommendation**

The purpose of the study is to see how the effects of three recognized variables which are gasoline prices, diesel prices, and kerosene prices, interact with the US Dollar exchange rate. Schryder and Peersman (2015), this research found that there is an inverse correlation between the US dollar exchange rate and the crude oil prices explaining why the correlation hardly shows an inverse trend between the parameters.

The model indicates that the independent variables with their distributed lags have a significant relationship between the U.S. dollar exchange rate and crude oil prices in the short-run equilibrium. However, the analysis still revealed there is no presence of a long-run association between these variables. Moreover, it is quite uncertain that the crude oil prices may still affect the exchange rate in the long run equilibrium in the Philippines. In addition, The Philippines does not belong to a commodity-to-currency relationship because it only exists in currencies that are most prevalent in developing countries in which the said countries are the currency that co-move with the world prices of primary commodity products, and due to these countries' heavy dependency on the export of certain raw materials for income.

Based on the results, it can be concluded that crude oil prices do not have a significant impact on the U.S. dollar exchange rate. To avoid undesirable fluctuations in the exchange rate, macroeconomic policies should be implemented to separate the real economy from crude oil price revenues. This can be achieved by promoting exports in sectors such as agriculture, industry, and tourism, which can also provide employment opportunities. Additionally, to accurately predict the direction of the U.S. dollar exchange rate relative to crude oil prices, monetary policies should be implemented more strictly. This will help to develop more accurate policies that can address potential financial problems in the future and predict their potential occurrence.
The researchers have addressed several critical questions regarding the predictability of the U.S. Dollar exchange rates and crude oil prices, both of which are difficult to forecast due to their time-varying nature. To forecast one based on the other, various techniques have been developed to account for the changing significance over time. One possible approach is to use an adaptable econometric framework in a data-rich environment, but the abundance of tools available makes it challenging to identify a single optimal framework.

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Appendices:

Appendix A: Raw Data

Date	USDER	GAS95	DSL	KRSN
31/05/2021	0.02096	51.2	41.85	47.885
07/06/2021	0.02097	52	42.25	47.935
14/06/2021	0.02085	52.2	42.8	48.455
21/06/2021	0.02053	54.9	43.2	48.755
28/06/2021	0.02059	49.95	38.8	49.405
05/07/2021	0.02019	59.2	44.55	49.855
12/07/2021	0.01994	59.2	44.55	49.855
19/07/2021	0.0197	60.95	45.25	50.48
26/07/2021	0.01986	61.05	45.55	50.955

02/08/2021	0.02008	60.3	44.95	50.845
09/08/2021	0.01984	61.35	45.75	50.88
16/08/2021	0.01974	60.7	45.05	50.13
23/08/2021	0.01993	60.7	44.75	49.73
30/08/2021	0.02	57.35	44	50.105
06/09/2021	0.02	51.85	44.6	50.055
13/09/2021	0.02005	51.85	44.6	50.055
20/09/2021	0.01992	56.7	44.2	51.08
27/09/2021	0.01956	53.1	41.35	51.605
04/10/2021	0.01967	53.5	47.85	52.5
11/10/2021	0.01967	54.1	42.75	54.03
18/10/2021	0.01965	62.75	44.8	55.53
25/10/2021	0.01973	60.4	46.3	56.815
01/11/2021	0.01974	60.4	46.3	56.815
08/11/2021	0.01996	62.7	48.25	57.865
15/11/2021	0.01994	61.7	52.27	57.04
22/11/2021	0.01973	60.8	47.3	56.94
29/11/2021	0.01987	59.95	46.1	55.64
06/12/2021	0.01986	58.85	50.47	53.235

13/12/2021	0.01987	56.45	47.82	50.535
20/12/2021	0.02007	62.2	49.17	51.735
27/12/2021	0.01992	62.75	49.72	52.285
03/01/2022	0.01959	58.4	49.07	51.435
10/01/2022	0.01953	64.4	51.47	53.6
17/01/2022	0.01952	58.45	46.5	54.335
24/01/2022	0.01947	66.05	54.37	56.365
31/01/2022	0.01953	63.35	56.27	58.335
07/02/2022	0.01942	64.1	51.3	60.19
14/02/2022	0.01947	62.3	58.22	61.34
21/02/2022	0.01945	66.35	59.27	60.685
28/02/2022	0.01954	65.05	57.45	62.84
07/03/2022	0.01912	65.95	58.45	61.885
14/03/2022	0.01897	69.55	62.3	66.15
21/03/2022	0.01899	76.65	75.45	74.955
28/03/2022	0.01923	71.2	64	66.405
04/04/2022	0.01948	74.6	72.65	71.105

Diagnostic tests on Autoregressive Distributed Lag model
Appendix B: Variance Inflation Factor (VIF)

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
USDER(-1)	0.024965	19866.71	7.123383
USDER(-2)	0.039154	31291.60	13.22261
USDER(-3)	0.022463	18037.46	8.191850
KRSN	2.63E-10	1656.449	19.85584
KRSN(-1)	2.99E-10	1850.376	19.55664
KRSN(-2)	2.39E-10	1451.403	14.49209
GAS95	9.33E-11	712.4526	5.939585
GAS95(-1)	9.68E-11	726.3963	5.606757
GAS95(-2)	1.11E-10	821.6787	6.159172
GAS95(-3)	9.21E-11	666.0135	4.142969
DSL	1.51E-10	783.7973	18.87434
DSL(-1)	9.97E-11	501.6682	10.13040
DSL(-2)	1.06E-10	522.6325	9.861188
DSL(-3)	1.63E-10	770.6121	9.635359
C	8.58E-06	17458.54	NA

Table 9: Results from Variance Inflation Factor

Based on the diagnostic test of the Autoregressive Distributed Lag model, Small VIF values, VIF < 3, indicate low correlation among variables under ideal conditions. Therefore, as you can see in the table above almost all of the VIF values are below 3, and only one exceeds which is the first difference diesel that accounts for 3.560739. However, it is still acceptable because VIF values that are below 10 are still acceptable. The variance inflation factor is a test to look for multicollinearity in the model that the ARDL approach is creating. According to Potters (2022), the Centered VIF should be less than 10 to show that the variables are not multicollinear. Estimates that are higher than the necessary value indicate the presence of multicollinearity and should be removed from the model.

Appendix C: Breusch-Pagan-Godfrey Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.908418	Prob. F(14,27)	0.0727
Obs*R-squared	20.88970	Prob. Chi-Square(14)	0.1045
Scaled explained SS	7.912033	Prob. Chi-Square(14)	0.8939

Table 10: Results from Breusch-Pagan-Godfrey Heteroskedasticity Test

Breusch-Pagan-Godfrey Heteroskedasticity test is used to determine if the model has a presence of heteroskedasticity or unequal spread or variances. With the test being utilized, the p-value should be above 0.05 level of significance in order to accept the null hypothesis of homoscedasticity.

With the result on the diagnostic test of Autoregressive Distributed Lag model, the rest presents that the p-value is above 0.05 level of significance which means that the null hypothesis of homoscedasticity should be accepted.

Appendix D: Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	3.022711	Prob. F(2,25)	0.0667
Obs*R-squared	8.178587	Prob. Chi-Square(2)	0.0168

Table 11: Results from Breusch-Godfrey Serial Correlation LM Test

For the presence of the autocorrelation in the model, Breusch-Godfrey Serial Correlation LM Test is employed. The autocorrelation is the representation of the degree of similarities between the given time series. The p-value should be above 0.05 level of significance in order to accept the null hypothesis of no serial correlation at up to 2 lags.

After the diagnostic test of the Autoregressive Distributed Lag model, the p-value has changed, evaluated at 0.0667, which is above the level of significance of 0.05. Because of that, it implies that the null hypothesis of no serial correlation at up to 2 lags is now accepted and the model is now free from autocorrelation.

Appendix E: Jarque-Bera Test and Histogram

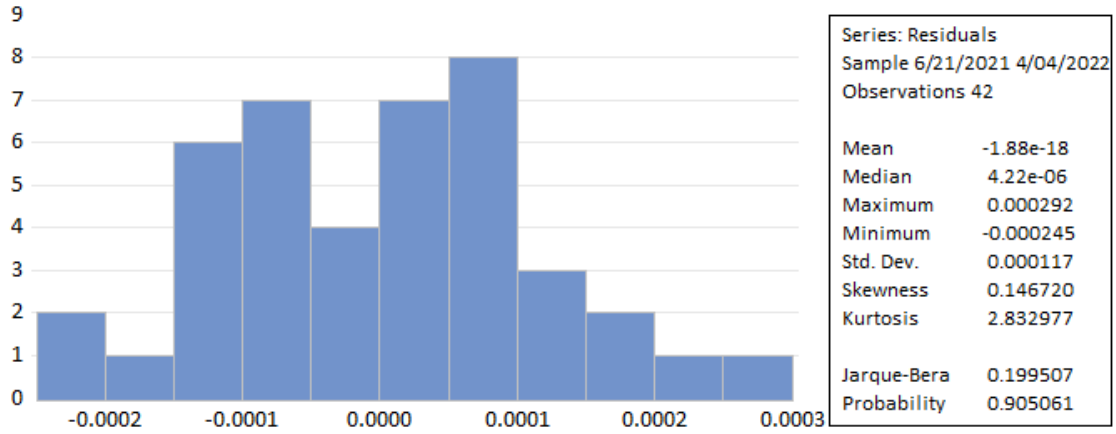

Figure 3: Results from Jarque-Bera Test and Histogram

In regards with the normality of the residuals, the researchers utilized the Jarque-Bera test with Histogram. It examines whether the error terms are normally distributed. The p-value should be above 0.05 level of significance in order to accept the null hypothesis of normal distribution of the error terms.

With the result of the histogram, it reveals that the p-value of the Jarque-Bera test is evaluated at 0.905 which is above the significance level 5% which indicates that the researchers should accept the null hypothesis of normal distribution of error terms.

Appendix F: Ramsey RESET Test

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: USDER USDER(-1) USDER(-2) USDER(-3) KRSN KRSN(-1) KRSN(-2) GAS95 GAS95(-1) GAS95(-2) GAS95(-3) DSL DSL(-1) DSL(-2) DSL(-3) C

	Value	df	Probability
t-statistic	1.393850	26	0.1752
F-statistic	1.942817	(1, 26)	0.1752
Likelihood ratio	3.026673	1	0.0819

Table 12: Results from Ramsey RESET Test

To assess whether the model is correctly specified, the researchers will use the Ramsey RESET test. It examines the non-linear combination of the fitted values that explains the responsible variables. The p-value should be above 0.05 level of significance in order to accept the null hypothesis of correct specification of the model generated by the ARDL.

This test represents the correct specification of the generated model. With the given probability value, it is evaluated at 0.1752 which is above the level of significance 5% stating that the generated model is in correct specification.

Appendix G: CUSUM Stability test

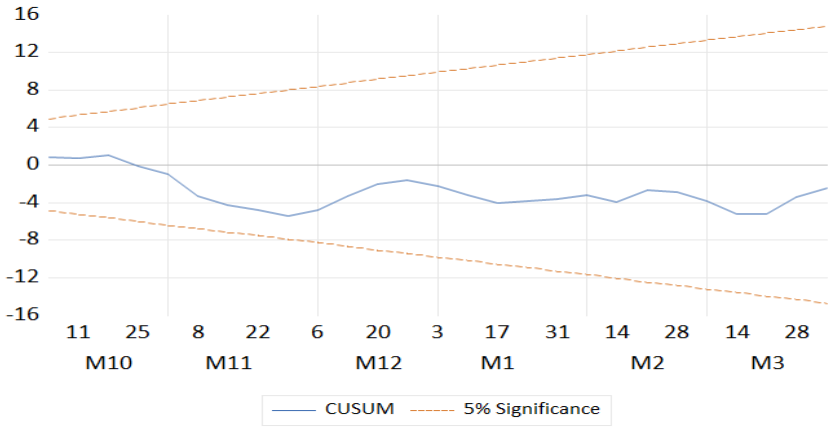

Figure 4: Result from the CUSUM Test

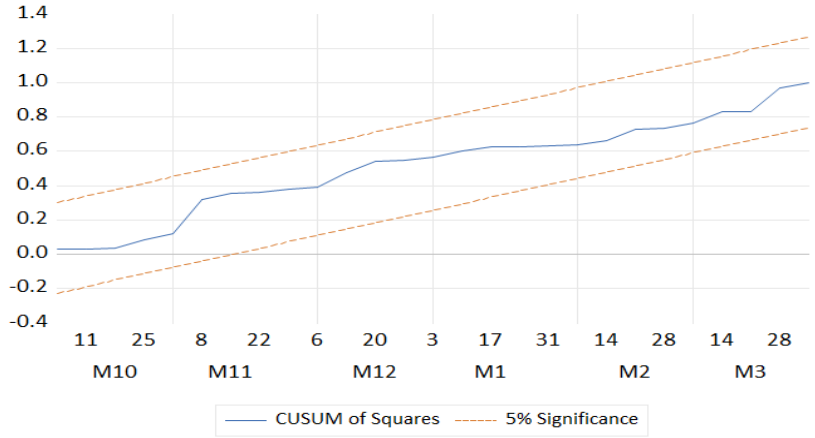

Figure 5: Result from the CUSUM of the Squares Test

With regards to the structural break of the equation, CUSUM stability test is a substitute for Chow Breakpoint test in the Autoregressive Distributed Lag Model. It assesses the stability of the coefficients in the given equation. Given the result of these diagnostic tests, it implies that the equation is correctly specified and the line does not pass the bounds of 5% significance level. It also implies that these tests suggested that the model generated can be used for forecasting.