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Asymmetric Effect of Oil Price on Economic Activity: Evidence from Lebanon Using NARDL Model

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ABSTRACT

The aim of this paper is to investigate the impact of oil prices on the real economic activity of Lebanon, represented by the Gross Domestic Product (GDP) while controlling for inflation. For this purpose, this study employs a non-linear auto-regressive distributed lag model (NARDL) that enables to take into consideration the asymmetrical nature of the relationship between these two variables. The empirical findings confirm the asymmetric impact of changes in oil prices on economic activity. Notably, reductions in oil prices positively influence GDP in the long term and exert a more pronounced fluctuating effect compared to increases in oil prices, which are statistically insignificant. In other words, the country's GDP, serving as a measure of the total value of finished goods and services, does not respond significantly to oil price rises but is influenced by oil price reductions. This empirical analysis focuses particularly on Lebanon, and time series data spanning from 1988 to 2021 are used to explore this relationship. This study guides Lebanon's policymakers, revealing the impact of declining oil prices on economic activity. It highlights growth opportunities amidst challenges like economic crises and corruption. Advocating for prudent policies and strategies, it offers a pathway for sustainable development.

Keywords: Non-linear Auto-regressive Distributed Lag Model, Gross Domestic Product, Oil Price, Inflation, Asymmetry, Lebanon
JEL Classifications: C01, C32, H76, O44, O47, Q43, Q50

1. INTRODUCTION

The fluctuations of the crude oil prices have an essential factor that affect the economic world. These fluctuations in the oil prices differ from oil importing countries and oil exporting countries. Oil is considered as the best traded goods, and plays an essential role in the oil-importing and oil-exporting countries. When oil prices increase, it reflects negatively on oil-importing countries like Lebanon; and it is expected to raise the costs of local goods. Therefore, the rise in oil prices is accompanied with a rise in economic and financial uncertainty including inflation and unemployment, which may be also led to decrease investment. These reasons cause an economic slowdown. Tariff structures and import dependency should be assessed to reduce vulnerability to oil price shocks. Moreover, subsidy reforms and price controls can help mitigate the adverse effects of oil price increases on fiscal balances (Mork, 1994).

While, for oil-exporting countries, oil prices increase is expected to impact the net export and the budget revenue of the government which lead to improve the economic growth (Charfeddine and Barkat, 2019). Also, on fiscal level, trade policy implications involve managing trade imbalances and promoting export diversification and sustainability such as developing renewable energy sources and enhancing energy efficiency (Oyeyemi, 2013; Idrisov et al., 2015; Brini et al, 2017). Finally, results upon the relationship between oil prices and GDP have been unclear and more negative especially for emerging oil importing countries.

Therefore, maintaining monetary stability is essential for promoting investment and ensuring stable economic growth (Jiménez-Rodríguez, 2008). The presence of asymmetric responses between global oil prices and GDP has important policy implications on all levels. So, policymakers need to consider the differential effects of oil price shocks and develop appropriate responses to mitigate risks and leverage opportunities. In the case of oil price increases, policies could focus on managing inflationary pressures, promoting energy efficiency measures, and diversifying energy and revenue sources and build fiscal buffers to cushion against oil price shocks (Idrisov et al., 2015 and Benli et al., 2019).

It is related by the supply and demand in the oil market; the supply is linked to the production of oil and the rise in their prices leads to an increase in cost of production that encourage companies to reduce the production. While from the demand side, changes in oil prices affect the consumption and investment. Consumption is impacted indirectly by its relation with disposable income. Moreover, the investment is affected by raising the company's costs (Ghalayini, 2011).

Several studies showed that there is asymmetry in the time series relationship between oil prices and GDP taking into consideration many other variables also like inflation, unemployment, trade openness, financial liberalization, COVID 19, financial development and etc. (Salem et al., 2022; Benli et al., 2019; Okonkwo and Mojekwu, 2018; Akinsola and Odhiambo, 2020).

In conclusion and according to some theoretical policy implications, including, monetary policies, diversification policies, fiscal policies and others, the heavy impact of oil prices on GDP can be understood through various theoretical frameworks also, and all of them have suggested similar strategies as remedies.

Therefore, this paper uses the Nonlinear Autoregressive Distributes Lag (NARDL) to detect the effect of both relationships in the short- run and long-run. This asymmetric co-integration model was developed by applying a model to estimate the changing structure of oil prices and the economic activity in the context of Lebanon.

This study will test the relationship between oil prices and economic growth in Lebanon during the period 1988-2021. By using NARDL model, co-integration test, and Wald test.

This study will be divided as follows. First section presents the literature review. Second section presents the data. Third section presents the methodology. The Fourth section shows the results. The last section presents the conclusion.

2. LITERATURE REVIEW

This literature review examines the relationship between global oil prices and the Gross Domestic Product (GDP) of emerging economies. The oil market plays a crucial role in shaping the economic performance of emerging nations due to their heavy reliance on energy imports. Understanding the impact of global oil price fluctuations on GDP can provide valuable insights for policymakers and stakeholders in these economies. This literature review analyzes existing studies to identify the key factors influencing this relationship within a linear and a non-linear perspective. The findings highlight the complex dynamics between global oil prices and the GDP of oil importing economies and its resemblance to the Lebanese case. While emphasizing the need for comprehensive policy measures to mitigate the potential risks and harness the benefits of oil price movements.

Kriskkumar et al. in 2022 study seeks to determine if Malaysia, a small, open, dynamic oil exporter country, has an uneven relationship between the price of oil and growth between 1981 and 2017. The augmented autoregressive distributed lag model (ARDL) bound test methodology and the newly developed nonlinear autoregressive distributed lag (NARDL) model, are the empirical techniques used in this work. More specifically, the outcome shows that Malaysia's economic development is affected asymmetrically by changes in the price of oil. The potential of Malaysia to be both an oil-producing nation and a trading nation can be achieved by taking advantage of both the rise and fall in the price of oil, which supports Malaysia's economic expansion.

Akinsola and Odhiambo in 2020 in their study investigated the effects of oil prices on economic growth in seven low-income Sub-Saharan African (SSA) nations that import oil, including Ethiopia, Gambia, Mali, Mozambique, Senegal, Tanzania, and Uganda. They investigated the asymmetric impact of oil price on economic growth by dividing oil price into negative and positive changes using the Non-linear Autoregressive Distributed Lag (NARDL) model. They discovered that whereas a rise in oil prices has a large negative impact on growth, a drop in oil prices has a positive and considerable influence.

As the past studies a group of researchers investigated the causes and consequences of the oil shock in 2007-08, analyzing its impact on GDP growth, inflation, and unemployment using ARDL model. Results from the ARDL estimates reveal that crude oil price has a positive significant effect on real GDP growth. This effect is consistent both in the short-run and long-run (Miamo and Ashuo, 2021).

According to the paper of Kakanov and other two researchers in 2018, that studies 24 exporting countries; they say there is indirect evidence that the effects of oil price shocks are partially offset by fiscal and monetary policy, especially in oil-dependent countries. Statistically, oil price volatility does not appear to have a significant impact on GDP over the long term. Likewise, the exchange rate regime seems to play a role. While taking into consideration nominal exchange rate as an independent variable, results showed countries that allow volatility in their currencies appear to benefit from a positive shock in oil prices in the short term, but in the longer term, perhaps due to aggressive stabilization by sovereign wealth funds, a fixed exchange rate system is associated more with such funds allowing them to counter oil shocks and create an increase in GDP (Kakanov et al., 2018).

From a more pessimistic view, Mohaddes and Pesaran in (2017) investigated the relationship between oil prices and the global economy, considering both advanced and emerging economies. The study utilized a global vector autoregressive (GVAR) model and found that oil price increases negatively affect GDP growth in both advanced and emerging economies. The findings suggested that the impact of oil price shocks on economic activity is not significantly different between these two groups of countries. Also rising global oil prices have shown to negatively impact and hinder the economic development of any major oil importing country. Countries like, Vietnam, China, and South Korea which are highly dependent on crude oil imports, experience a negative relationship between oil prices and GDP growth. In the short term, an increase in oil prices leads to a decrease in GDP, while in the long term, the impact is slightly less pronounced Yoshino and Taghizadeh-Hesary (2014). The findings in Yoshino and Taghizadeh-Hesary paper emphasize the importance of oil price increases as a factor contributing to economic downturns.

From an optimistic perspective, in any small open economy and a fixed exchange rate, like the Lebanese financial system with unutilized factors and heavy capital accumulation, aggregate demand has a vital impact on its monetary policy according to the Keynesian view. And as investors' demand in the short run is expected to increase with increasing global oil prices, enabling the transition to optimal capital levels and efficient utilization of production factors in the long-run (Idrisov et al., 2015). Higher global oil prices and domestic prices increases may accelerate aggregate demand and multiply growth and decreases interest rates in the short run. So short-term impact of global oil price changes' on real GDP may exceed the long-term under expansionist monetary policies. Therefore, the effect of oil price changes on GDP is affected by companies' and central bank financial frameworks/responses to intensify factor utilization and short-term aggregate demand changes, limited by inter-temporal consumption (Idrisov et al., 2015). Furthermore, targeted support to sectors and services affected by changes energy costs, such as transportation or manufacturing, can help maintain economic stability.

Therefore, this paper will illustrate the magnitude of the asymmetric effect, global oil prices have on Lebanon's GDP. Findings this paper will be referred generally to one specific timeframe that had various changes in its nominal exchange rate, as from 1988 until the end of 2019, marking a phase for Lebanon where it had a fixed peg for its nominal exchange rate set by the central bank, however and as 2019 was coming to an end and because of the current financial crisis, the Lebanese financial system has been suffering from a disastrous multiple exchange rate regime (mix of fixed and floating nominal exchange rate). But as a result data on nominal exchange rate in Lebanon is neither reachable nor accurate, but data concerning inflation is available, therefore this paper will study the impact of oil prices on Lebanon's GDP while controlling for inflation only.

3. DATA

3.1. Data Selection

Conducting a thorough examination of the impact of oil price fluctuations on economic development and Gross Domestic Product (GDP) is of paramount importance for Lebanon. In this study, Inflation serves as a control variable, considering Lebanon's ongoing major financial crisis, which has prompted the country to seek international assistance, including support from the International Monetary Fund (IMF) since 2019.

The sudden onset of the 2019 crisis is, in fact, the culmination of 30 years of excessive debt accumulation post-civil war. This strategic debt accumulation was aimed at projecting an illusion of stability and fostering confidence to attract capital inflows that could positively influence GDP. Moreover, crucial public services such as water, electricity, transportation, healthcare, education, and social security were already underfunded prior to the crisis. The occurrence of a series of shocks since 2019 has significantly impacted both the supply and demand sides in vital sectors, further compounding the challenges faced by Lebanon (World Bank, 2022 report).

Pre-2019, the monetary policy of the Central Bank of Lebanon was characterized by a controlled nominal exchange rate system, specifically pegging the Lebanese pound (LBP) at 1,507 per US dollar since the conclusion of 1997. However, due to a severe shortage of dollars, this peg began to depreciate from 2019 onwards. Given the necessity to acquire dollars for import purchases, banks were obligated to maintain a specified level of dollar liquidity. Lebanon heavily relies on imports, particularly food, fuel, oil, and various other products (Holtmeier, 2019). The central bank reserves, amounting to $15.6 billion in 2022 compared to $34.8 billion in 2021, correspond to the value of these imports.

The liquidity shortages have exerted pressure on transfers, leading the central bank to impose restrictions on domestic and foreign exchanges. Multiple factors contribute to this recent development, including a slowdown in remittances from countries with substantial Lebanese diaspora populations, such as Latin America and the Gulf Cooperation Council. Additionally, the lack of domestic reforms and US sanctions targeting Iran-backed Hezbollah has deterred international donors from investing (Holtmeier, 2019).

According to the IMF's 2019 and 2023 reports, Lebanon is one of the most indebted countries in the world, has a debt ratio of over 150% of GDP. The country's debt ratio as a percentage of GDP was 172.3% in 2019 and 150% in 2022. As a result a parallel currency exchange systems have already been put in place, allowing people to withdraw dollars from ATMs and sell them at currency exchanges to take advantage of higher exchange rates, further increasing pressure on commercial banks to restrict dollar withdrawals. Moreover, all this has led to a significant drop in demand and supply, with almost 80% of the Lebanese population now living below the poverty line, leading to a severe confidence crisis, triggering hyperinflation and reducing socioeconomic impacts (IMF, 2022). Multiple exchange rates in 2023 has been created, the floating black market exchange rate that ranges in between 90.000 and 100.000 LBP to $1. And the "Sayrafa" exchange rate which is at 80.000, the platform created by Banque du Liban (BDL) for foreign currency money transfer from the ATMs. BDL says he cannot do anything to unify all exchange rates before a uniform consensus with the IMF and with the absence of real fiscal measures the ongoing situation is still persisting and is expected to continue.

The crises have laid bare the vulnerability of Lebanon's provisioning model, which arises from the appropriation of public resources by elites for personal gain. Consequently, numerous factors have adversely impacted Lebanon's economic growth, particularly over the past 4 years. These factors are diverse and stem from the causal effects of the current financial crisis, encompassing aspects such as inflation, depreciated exchange rates, and international elements, including oil prices, as addressed in this study. However, it is worth noting that obtaining data for Lebanon is constrained, with only inflation data readily available, while data for other variables is challenging to acquire promptly. Hence, this paper will focus on examining the influence of global oil prices on Lebanese GDP while controlling for the inflation variable, as elucidated earlier.

Data for the oil prices are obtained from West Texas Intermediate (WTI) and it refers to the spot of a barrel of benchmark crude oil (price for buyers and sellers of crude oil). Moreover, Lebanon's GDP (current US $) at purchaser's prices is obtained from the World Bank data, it is the sum of gross value added by all resident producers in the economy in addition to the product taxes and minus any subsidies not included in the value of products. Inflation measured by growth rate of GDP annually implicit deflator, indicates the rate of price that is varying in the whole economy, and this data is obtained from the World Bank (WB). The data takes during the period 1988-2021 in Lebanon.

3.2. Data Description

Figure 1 exhibits the visual analyses of three selected time series data spanning from 1988 to 2021, encompassing GDP, inflation in Lebanon, and global oil prices. Over this period, inflation and global oil prices demonstrate a consistent upward trend. In contrast, Lebanon's GDP exhibits an increasing trend until 2018, reaching a peak of 566.391 billion US dollars, followed by a gradual decline to 231.300 billion US dollars in 2021 (World Bank data). The oil price per barrel fluctuates significantly throughout the years, reaching its maximum at $91.48 per barrel in 2008 and its minimum at $11.91 per barrel in 1998 (WTI data). Notably, cumulative inflation experiences a sharp rise, surging to triple digits between December 2019 and December 2021, with consumer prices increasing by more than 150% in the respective periods (World Bank data).

4. METHODOLOGY

4.1. Non-linear Auto-regressive Distributed Lag Model (NARDL) Models

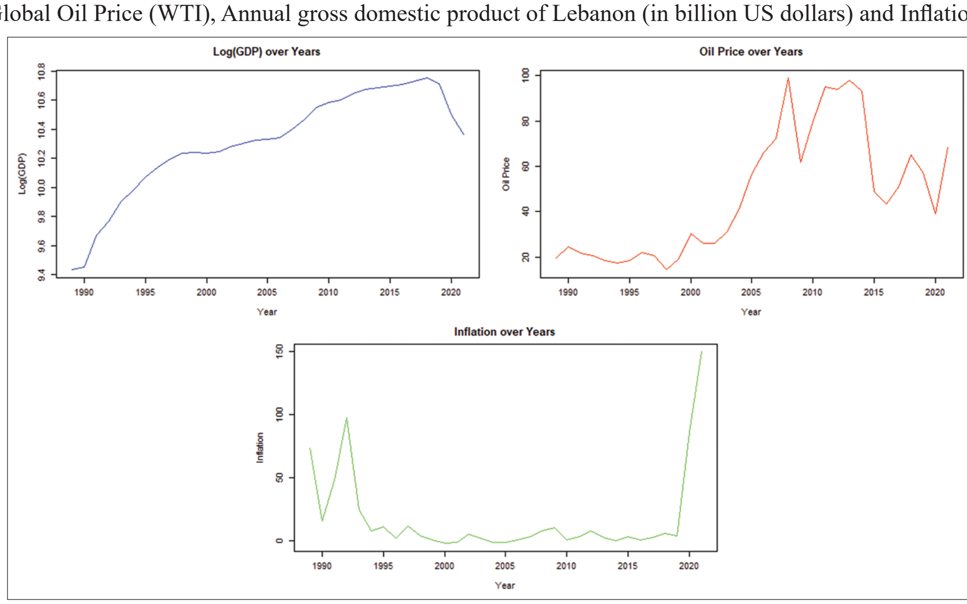
The study of asymmetry or nonlinear model grows from linear models' miscarriage to interpret oil price fluctuations in the US economic activity (Herrera et al., 2011). Standard time series models such as VAR, ARDL, and VECM can determine the short run and long run relationship between the variables. However, they are not able to capture the possibility of asymmetric efficient between the variables. The NARDL model, the most recent and creative model in asymmetric studies, was used in this study. The development of the NARDL model by Shin et al. (2014) began with Schorderet's (2001) approach to study asymmetric co-integration, based on partial sum decomposition. The study's exogenous series will be split into positive and negative variables or a positive and negative partial sum. Assume that x_t is presented as an exogenous variable, therefore the positive partial sum changes in the series can be presented as x^+_t, while the negative partial sum is presented as x^-_t. These can be generated as:

$$x^+_t = \sum_{j=1}^{t} x_j^+ = \sum_{j=1}^{t} \max(\Delta x_j, 0) \quad (1)$$

$$x^-_t = \sum_{j=1}^{t} x_j^+ = \sum_{j=1}^{t} \min(\Delta x_j, 0) \quad (2)$$

Various techniques have been introducing to test this asymmetry, Threshold ECM, Smooth transition regression ECM, Markov-

Figure 1: Global Oil Price (WTI), Annual gross domestic product of Lebanon (in billion US dollars) and Inflation in Lebanon



Source: World Bank Development Indicators, 2021 switching ECM and recently Non-linear Autoregressive Distributed Lag (NARDL) model, suggested by Shin et al. (2014). This last incorporates asymmetries both in the long-run and short-run relationships, and similarly it collects the asymmetries in the dynamic adjustment. Therefore, it allows the regression of variables from mixed order of I (0) and I (1).

The exogenous variable x_t is split into x^+_t and x^-_t around a threshold of zero to identify among positive and negative variation in the rate of growth of x_t. The NARDL approach processes the failure of the previous approaches in testing asymmetry (Schorderet, 2001); it is an extension of the ARDL approach (Pesaran et al., 1998; Pesaran et al., 2001). The general form of the nonlinear ARDL (p,q) model:

$$y_t = \sum_{j=1}^{p} \varnothing j y_{t-1} + \sum_{j=0}^{p} (\theta_j^+ x_{t-j}^+ + \theta_j^- x_{t-j}^-) + \mu t \quad (3)$$

Where x_t is a K x 1 vector of multiple regressors of the partial positive and negative variation of x_t such that $x_t = x_0 + x^+_t + x^-_t$. The ϕ_j is the autoregressive parameter, θ^+_j and θ^-_j are the asymmetric distributed-lag parameters, and the μt is an independent and identically distributed (iid) process with zero mean and constant variance.

The general NARDL model can be rewritten following Pesaran et al. (2001) into an error correction form. It sustains a data generating process to achieve a conditional nonlinear error correction model to assure zero contemporaneous correlation among the regressors and error term.

4.2. The General Form of NARDL ECM

$$\Delta y_t = \rho\xi t_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{q-1} (\Pi_j^+ \Delta x_{t-j}^+ + \Pi_j^- \Delta x_{t-j}) + e_t \quad (4)$$

The p and q represent the lag orders for the dependent and the exogenous variables, respectively. The $\xi t = y_t - \beta^+ x^+_t - \beta^- x^-_t$ is the nonlinear error correction term where $\beta^+ = -\theta^+/\rho$ and $\beta^- = -\theta^-/\rho$ are the related asymmetric long-run parameters.

4.3. NARDL Model Identification

The appropriate model identification starts by evaluating whether the time series is stationary or not, through plotting the initial data and implementing unit root tests (such as Augmented Dickey and Fuller). Afterwards, the differencing degree I (0) or I (1) or I (2) is selected accordingly for different chosen variables. NARDL's model allows the regression of mixed order variables.

4.4. NARDL Model Estimation

Non-linear method remains the most common methods used. NARDL models with different orders are estimated. The best fit is selected on the basis of minimum Akaike's Information Criterion (AIC) of the assessed tentative models. NARDL model explicitly distinguishes the reactions of both directions short-run and long-run. GDP denotes by LGDP (transform GDP into log), inflation presents by INF (control variable), oil prices denotes by LOP (transform oil prices into log), intercept by C and residuals by U_t. The simple OLS two-variable model takes the following form:

$$LGDPt = C + \beta\, LOP_t + INF_t + U_t \quad (5)$$

To capture the possible asymmetric effects of oil prices on GDP, NARDL model decomposes the oil prices into two parts. First partial sum of positive changes in oil prices denoted by LOP^+, second partial sum of negative change in oil prices denoted by LOP^-. The model becomes:

$$LGDPt = C + \beta_1\, LOP_t^{+} + \beta_2\, LOP_t^{-} + INF_t + U_t \quad (6)$$

4.5. The NARDL Model is Explained as it Follows

$$\Delta LGDPt = C + \rho LGDP_{(t-1)} + \theta^+ LOP^+(t-1) + \theta^- LOP^-(t-1) + \sum_{t=1}^{p-1} \varphi i\, \Delta LGDP(t-i) + \sum_{t=0}^{q} \pi_i^+ \Delta LOP(t-i)^+ + \sum_{t=0}^{q} \pi_i^- \Delta LOP(t-i)^- + INF_t + U_t \quad (7)$$

Where $\Delta LGDPt$ is the first difference of LGDP, $LGDP_{(t-1)}$ presents the first lag of GDP_t, LOP^+ (t–1) shows the first lag of partial sum of positive change in LOP_t^+, LOP^- (t–1) presents the first lag of partial sum of negative change in LOP_t^-, $\Delta LGDP$(t–i). Presents the sum lags for first difference of $LGDP_t$, $\Delta LOP(t-i)^+$ is the sum lags for first difference of LOP_t^+, $\Delta LOP(t-i)^-$ is the sum of lags for first difference of LOP_t^-. And INF_t represents the control variable. C, ρ, θ^+, θ^-, φ, π_i^+, π_i^- are the parameters.

4.6. Co-Integration Test

After estimating the NARDL model, the long run relationship between the dependent and independent variables is studied using the co-integration test called bound test. Bound testing compares the critical value to affirm the presence of long run relationship in Pesaran et al. (2001). If the calculated F statistics is found to be greater than the critical value then there is evidence of co-integration. If not, the variables are not co-integrated, as if their lags are not related in the long-run. According to this test, the results can show if there exists a long-run relationship between variables.

4.7. Wald Test

At the end, the Wald test is applied to check for the presence of asymmetrical effects concerning both positive and negative oil shocks on economic activity in the long-run in the context of Lebanon from 1988 to 2021. In other words this test examines if the coefficients of the variations in global oil prices are equal or not. So the results from studying the difference between the coefficients should not be shown to be equal. If they are equal then there is no asymmetry (null hypothesis) and if they are not therefore there is evidence of asymmetry (proof of NARDL model). That means, if the $P < 0.05$, then the Wald-test indicates that there is asymmetry in the long-run effect of oil prices on economic activity in Lebanon.

5. EMPIRICAL RESULTS

5.1. Model Identification

A standard Unit-Root test examines whether a time series variable is non-stationary and possesses a Unit-Root. The Augmented Dickey-Fuller (ADF) is the most Unit-Root test used to check the stationarity of economic variables.

By applying standard unit root tests on each individual series (in logarithms), GDP variable is found stationary at level, and the oil price is stationary at first difference at 5% (level of significance), and inflation is stationary at first difference. The results are presented in the Table 1.

The unit root tests result presented in Table 1 show that all variables are either I(0) or I(1), which proof the NARDL model. The optimal lag length for the inflation equation is NARDL (4, 1, 4, 2) was chosen in the model. This finding explains that positive and negative oil price varies in the previous years may still influence economic growth.

ADF represents the Augmented Dickey-Fuller test. GDP is stationary at level with intercept and trend. While, Oil price and Inflation are stationary at first difference with intercept. All variables are stationary at (0.05) level of significance.

5.2. Co-Integration Test

Therefore, the co-integration test result is showed in Table 2. The test's F-statistics is more than the critical values at a 1 % level of significance for both I(0) and I(1); this explain the existence for the long-run relationship between the variables in the model. Critical value at 1% of sig. level Asymmetry test.

Since the calculated F-statistics 10.853 (Table 2) is greater than the critical value 6.36 at 1% significance level, there is strong evidence of co-integration at 1% significance level. Overall, the bound testing results reinforce the presence of a dependent long-term correlation between oil prices and economic activity. As a result, the model is co-integrated. Hence, the long-run and short-run GDP, NARDL model was concluded as it follows:

The empirical findings presented in Table 3 provide evidence of the asymmetric impact of oil price variations on economic growth, as measured by gross domestic product (GDP).

Specifically, the table confirms that the effect of oil price increases on economic growth in the long run is negative and statistically insignificant, whereas the effect of oil price decreases exhibits a positive and significant impact at a 1% level of significance. Consequently, the asymmetric influence on the growth variable, as represented by GDP, is expected to be more influenced by negative shocks in global oil prices. The results indicate that a 1% decline in oil prices corresponds to a subsequent rise of approximately 1.49% in the expected Lebanese economic growth or GDP variable in the long run. Furthermore, it is noteworthy that the Inflation variable solely affects Lebanese economic growth in the short run, demonstrating no significant long-run impact.

$$\Delta LGDP = -0.293\ LOP^{+} + 1.491\ LOP^{-} - 0.390\ LGDP_{(-1)} + 0.582\ LOP^{-}_{(-1)} + 0.419\ \Delta LGDP^{-}_{(-1)} + 0.259\ \Delta LOP^{-} - 0.361\ \Delta LOP^{-}_{(-1)} - 0.398\ \Delta LOP^{-}_{(-2)} + -0.371\ \Delta LOP^{-}_{(-3)} - 0.001\ INF_{t} \quad (8)$$

As a result, 1 dollar increase in oil prices will lead to a decrease in GDP by 0.293 dollars. While a decrease of 1 dollar in oil prices will cause a 1.491 increase in GDP in dollars terms.

Table 1: Unit root test

Variable	At level	At first difference
GDP	0.012*	0.000*
Oil price	0.486	0.000*
Inflation	0.703	0.000*

GDP: Gross domestic product

Table 2: Bounds test for nonlinear co-integration result

F-statistics	K	I (0)	I (1)	LR	SR
10.853***	3	5.17	6.36	6.566***	35.393***

***Presents rejection of the null hypothesis at 1% level of significance. The null hypothesis is no level relationship. The Lebanese economy is affected more by the negative change in oil prices. LR: Indicates long-run, SR: Indicates short-run

Table 3: Nonlinear auto-regressive distributed lag model ECM estimates and results from the asymmetry test

Variable	Coefficient	SD	P
C	8.839***	15.284	0.006
@trend	0.078	0.135	0.007
LGDP (−1)	−0.390***	0.673	0.006
LOP+ (−1)	−0.114	0.452	0.210
LOP- (−1)	0.582***	0.803	0.001
INF (−1)	0.00	0.000	0.818
Δ(LGDP [−1])	0.419*	1.131	0.058
Δ(LGDP [−2])	0.076	1.261	0.738
Δ(LGDP [−3])	−0.291	1.125	0.169
Δ(LOP+)	−0.259***	0.509	0.013
Δ(LOP-)	0.121	0.446	0.154
Δ(LOP- [−1])	−0.361***	0.446	0.003
Δ(LOP- [−2])	−0.398***	0.548	0.000
Δ(LOP- [−3])	−0.371***	0.509	0.000
Δ(INF)	−0.003***	0.469	0.001
Δ(INF[−1])	0.001	0.000	0.146
LOP^{+}	−0.293	1.272	0.217
LOP^{-}	1.491***	3.037	0.016
INF	0.001	0.000	0.827
W^{LR}_{oil}		6.566 (0.024)	
W^{SR}_{oil}		35.393 (0.000)	

***Presents significant at 1% level. The noted "+" and "–"signs indicates positive and negative partial of sums, respectively, whereas LOP^{+} and LOP^{-} are the estimated long-run coefficients defined by $\beta^{+} = -\theta^{+}/\omega$ and $\beta^{-} = {}^{-}\theta^{-}/\omega$, respectively. FPSS is the F-test proposed by Pesaran et al. (2001) for the joint null of $\omega = \theta^{+} = \theta^{-} = 0$. W^{LR} and W^{SR} are the long-run and short-run symmetrical Wald tests, respectively, on the null of $\theta^{+} = \theta^{-}$. SD: Standard deviation

5.3. Wald Test

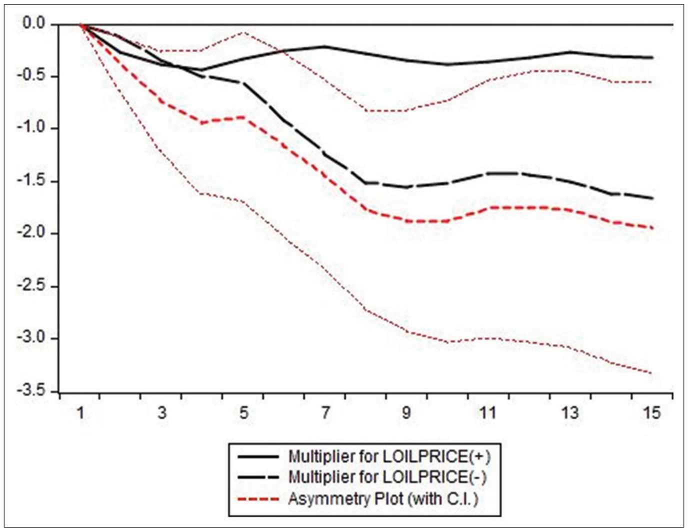
Wald-test will be detected to establish a long-run linkage between gross domestic product and oil prices under NARDL model.

Both the positive changes and the negative changes, have the long-run positive effect on the Lebanese GDP. The test of asymmetry using Wald test is basically tested if the coefficients are equal or not. In this case, we can formulate the possible hypothesis:

- Null hypothesis H_0: The coefficients are equal indicating no asymmetric co-integration
- Alternative hypothesis H_1: The coefficients are not equal indicating asymmetric co-integration.

Thus, the null hypothesis is rejected since the $P < 0.05$ (5% level of significance). Wald test indicates that there is exists asymmetry in the long-run impact of oil prices on the economic activity (GDP) in Lebanon (Table 2).

Figure 2: Asymmetric multiplier of oil price



Source: Authors' Calculations using EViews Software, 2021

Thus, asymmetric co-integration program between oil prices and gross domestic product in Lebanon was proven under NARDL model. However, the importance of income impact will be greater the less elastic the demand for energy is, but its importance will be determined by the share of energy expenditure on aggregate individual consumption expenditure. That means, it exists an asymmetric response of aggregate economic activity if oil prices rise or reduce.

5.4. Asymmetric Dynamic Multiplier

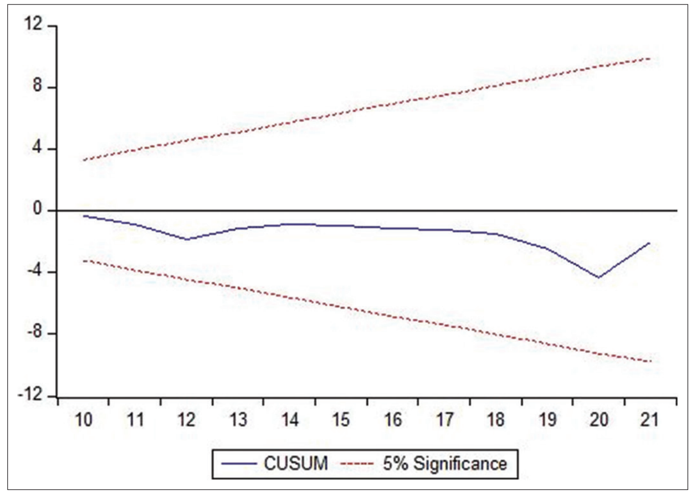
The dynamic multipliers illustrate the anticipated asymmetric adjustments of the GDP NARDL model in response to a 1% alteration in the partial sum of the oil price's positive and negative components (Figure 2). The asymmetric curve depicts the linear association of dynamic multipliers in connection with positive and negative shocks, aimed at elucidating whether asymmetry effects on Lebanese GDP stem from negative or positive shocks. As such, the subsequent figure is constructed within the confines of the 95% confidence level intervals.

Figure 2 displays the cumulative dynamics of Lebanese GDP in response to a 1% decrease and increase in oil prices, represented by the upper and lower dashed lines, respectively. The figure indicates a relatively stronger short-term effect of negative price shocks. The equilibrium adjustment is achieved within approximately 8 periods (equivalent to 17 years). Overall, the findings demonstrate that the GDP variable exhibits higher sensitivity to a decline in oil prices in the short run, while in the long run, Lebanese GDP remains unresponsive to positive shocks in the global oil price. Notably, the pass-through of negative oil shocks to output growth in the long-run equilibrium is estimated at approximately 1.49%. The observed behavior of the dynamic multiplier aligns with the concept of short- and long-run asymmetry.

5.5. Stability Test

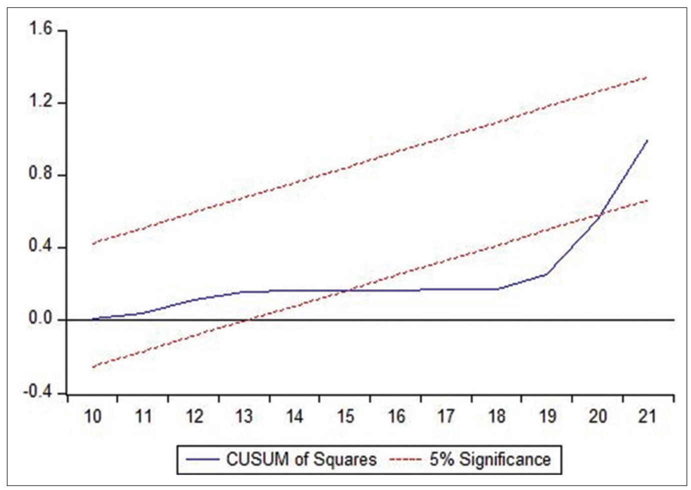
The CUSUM and CUSUM squats test the stability of the model. The results indicate that the coefficients of the GDP NARDL model are stable at 5% at level of significance during the period 1988-2021 (Figures 3 and 4). The blue line includes the critical boundaries at 5% level of significance. These findings prove that the coefficients of the GDP NARDL model are stable.

Figure 3: CUSUM of the gross domestic product non-linear auto-regressive distributed lag model



Source: Authors' Calculations using EViews Software, 2021

Figure 4: CUSUM squares of the gross domestic product non-linear auto-regressive distributed lag model



Source: Authors' Calculations using EViews Software, 2021

6. CONCLUSION

This empirical research examines the oil prices-output relationship in Lebanon using data from 1988 to 2021. The study employs econometric tests to investigate asymmetric co-integration or standard long-run relationships between the variables. The results confirm the existence of asymmetric co-integration under the NARDL model, implying specific forms of asymmetry.

The principal result of this study reveals that a decline in oil prices exerts a significant impact on Lebanese economic activity over an extended time horizon, exhibiting a more pronounced fluctuating influence in contrast to statistically insignificant oil price increases. Consequently, output growth exhibits responsiveness to oil price reductions but not to increases, indicating an incomplete pass-through effect of oil prices on economic growth, in alignment with preceding research findings.

This discovery carries significant policy ramifications for Lebanon in its capacity as an oil-importing nation. Reduced oil prices may indicate more consumption in oil related sectors and consequently more investment focuses on oil sector and non-tradable commodities by policy makers which may increase economic development. Thus in the case of Lebanon, output growth is shown to be positively affected by oil prices decreases, so when oil prices decreases, Lebanon's GDP is actually positively impacted. And this is consistent with theoretical expectation for oil importing countries (Taher, 2021; Akinsola and Odhiambo, 2020; Suleiman, 2013; Behmiri and Manso, 2013). Especially in low income countries low oil prices provide opportunities to increase savings and create a favorable environment for tax reforms with acceptable impact on domestic prices which may influence growth and investment in other non-related sectors as well.

However, considering Lebanon case, with ongoing offshore gas exploration, Lebanese policymakers are recommended to develop a comprehensive, economic approach to draw savings to nurture sound fiscal policies (Taher, 2020). With the absence of real policy ramifications and high level of corruption along to the ongoing economic crisis, it is considered more difficult and complex to understand the real effect of oil prices reduction on GDP without taking into consideration the other factors, along to the absence of real accurate data.

Policymakers in Lebanon ought to prudently formulate tailored monetary and fiscal policies, aimed at mitigating fluctuations in oil prices effects and spending like hedging (Gershon et al., 2019) while fostering diversification and technological advancement across aggregate output when confronted with periods of diminishing oil prices (Akinsola and Odhiambo, 2020).

Subsequent investigations may direct their attention towards examining the impact of various additional variables on the economic growth of Lebanon and analogous importing nations. Such studies could incorporate data pertaining to the nominal exchange rate, unemployment rate, domestic credits extended to private sectors, and other dimensions related to trade and financial openness.

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