Migration Letters

Volume: 20, No: 7, pp. 845-854

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)
www.migrationletters.com

The Impact of Oil Prices on Inflation in Jordan: The Philips Curve Model

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Abstract

This study uses the crude oil price worldwide as a variable in the Phillips function to analyze the effects of fluctuating global oil prices on the Jordanian economy. To accomplish this, the (short/long run) correlations between inflation, oil prices, unemployment, and interest rates were examined using the Auto Regressive for the Distributed Lag model. From the Q1 of 2004 through that of 2020, quarterly statistics are used in this analysis. According to a marginal coefficient, the rising oil prices variable has a long-term favorable beneficial effect on consumer prices (The Jordanian inflation rate will climb by 0.28% for every percent increase in oil prices.).

Keywords: *Inflation, Oil price, Philips Curve Model, ARDL approach.*

1. Introduction

Globalization continuously shapes the economic conditions of several nations. The economy of recent periods can be studied in two stages: phases observed at times of low and high oil prices. Numerous empirical studies reveal a strong linear association between inflation and oil price. However, whether a country exports or imports oil affects the sign and importance of this relationship. Oil price changes impact production costs, the amount of products and services produced, and eventually, key macroeconomic variables such as inflation, growth rate, and unemployment in countries that import crude oil as a raw resource.

As the worldwide financial crisis began, Jordan went through an economic crisis, which the outbreak of the Arab Spring in many Arab countries exacerbated, in addition to the closure of borders with Iraq and Syria, especially after 2003, when the oil purchase agreement with Iraq ended and the signs of a global oil crisis emerged. The drop in oil prices impacted the economic growth rates, exports, aid, and grants in Jordan, as well as the decline in remittances sent home by Jordanians living abroad, particularly in the Arab Gulf states.

Furthermore, over the past few decades in Jordan and other nations around the world, both short- and long-term shifts in global oil prices have made the task of business leaders and policymakers more difficult. Oil price shocks have been considered one of the main factors affecting the performance of the overall economy. The 1960s and 1970s witnessed a series of oil crises, followed by crises in 1983, 1986, and 2000. Additionally, prices increased during the 1991 Gulf War, the Iraq War in 2003, and the Iraq War with Iran.

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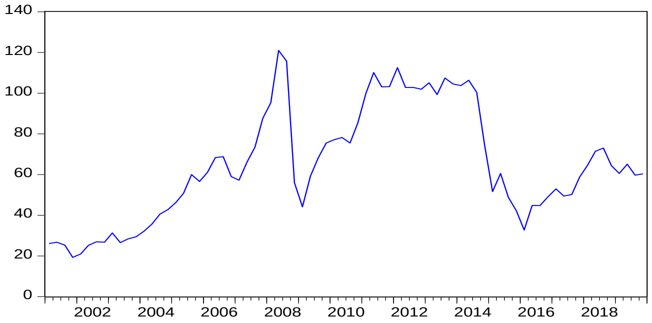
The global economy entered a complete recovery phase in 2002 as a result of every nation implementing expansionary economic policies to support its economic development. Hence, the global economy generally displayed a positive state. The price of oil reached a continuous high of around $150 per barrel in 2008 due to the considerable increase in the demand for crude oil the economic recovery brought on (Fig. 1). However, as a result of the worldwide financial crisis, it fell sharply to its lowest level in recent years in 2009 to $40 a barrel. Oil prices fluctuated from 2010 to 2014, and from $105 per barrel in 2014 to $30 per barrel in 2016.

They then marginally increased, reaching $51.94 per barrel in 2017. A historical aberration affected the oil futures markets in April 2020 when the COVID-19 epidemic caused the May WTI Crude futures contract to fall to a negative $40.32.

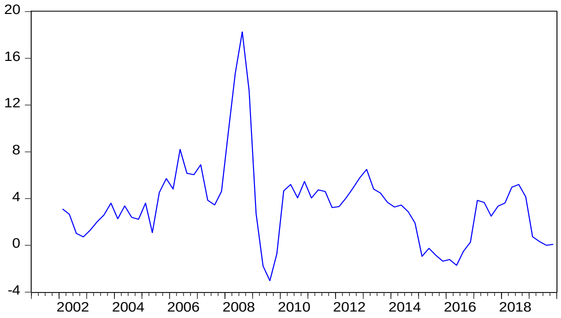
Fig.1 Oil Price Index



Source: International Monetary Fund, commodity prices

Figure 2 illustrates how Jordanian inflation rates have significantly changed as a result of shifts in global oil prices.

Fig.2 Inflation in Jordan (percentage change on consumer price index)



Source: International Monetary Fund, commodity prices

Changes in oil prices have recently been one of the most significant macroeconomic factors in Jordan because they directly affect inflation, consumption, and interest rates. They impact GDP estimates, in which oil is one of the key production inputs. Additionally, the central bank of Jordan faces the challenge of oil price shocks, and high oil prices may trigger a recession as a result of rising production costs and inflation. Hence, the central bank of Jordan faces the challenge of determining the best monetary policy, which could be either a contractionary policy to fight inflation or an expansionary policy to boost production.

2. Literature Review

Numerous research papers that looked at the effects of oil price shocks on different economic indicators and even the modeling of these changes and shocks were published in the prior period. Particularly during the 2007–2009 oil crisis, the negative consequences of these shocks and the significance of this research were apparent at the level of European nations, the United States of America, and several other nations across the world.

Several studies, whether at the level of individual nations, regions, or worldwide economy, have directly evaluated the influence of oil price shocks on macroeconomic variables without referring to the Phillips function. Papapetrou (2001) used the multivariate VAR model and adopted changes in production as a mediator to explain changes in interest rates, real stocks, and prices. He attempted to explain the effect of oil price shocks on changes in employment and production growth in Greece and discovered its negative impact, especially on industrial production. Cunado and Gracia (2003), on the other hand, broadened the society they utilized, employed the model they used in more than one European country, and narrowed their attention to the standard effect of macroeconomic variables such as inflation and industrial production. International oil was occasionally used, and then crude oil prices and national oil prices evaluated at real prices for each country in the study sample for the years 1960 to 1999 were used. They explained that because the national oil price index is estimated at prices, the exchange rate affects the various effects of oil price shocks on the earlier variables. The reality is based on an exchange rate regime in which the euro was at the time weaker than the dollar.

Supported by Barsky and Kilian (2004), they charted a different direction with their research and found a strong correlation between the crises in the Middle East and changes in oil prices, as well as the effects of these changes or shocks on the overall economy in developed nations. This author explained that this relationship is complicated by the timing of these shocks, which are important in influencing alterations to the economy as a whole. When Segal (2011) discussed in his study the explanation of the impact of the high oil prices up until 2008 on the global economy and compared three different arguments with the axes being the effect of the change in oil prices on inflation and production, as well as the role of monetary policy as a reaction, he moved the debate to a higher level of controversy. These arguments begin by stating that oil prices have never been as significant as people believe. Second, rising interest rates as a result of monetary policy impact on output by slowing the growth of production. Third, while inflation was not the main effect of high oil prices, they did not have a huge impact on the global recession in 2008 and 2009; instead, other factors were at play.

Roeger (2005) and Castillo et al. (2020) both tried to examine the effect of oil prices on macroeconomic variables, using a more theoretical approach. By maximizing the benefit to the household sector and maximizing net wealth, Roeger (2005) based his analysis on the QUEST model. His research found that oil directly affects production as an input from production, just as oil prices affect consumption because demand for it is a final demand. Including the profits to producers in his model and the formula of the Douglas Cobb function and taking into account the budgetary constraints of the family sector and the constraints on the cost of the productive sector, demand is derived simultaneously. On one hand, the wage reaction to price change has direct impacts, and on the other, it has indirect effects. Monetary policy adjustments and changes in exchange rates have additional implications. By resolving the balance of reasonable expectations, Castillo et al. (2020), using the Keynesian approach, examined the relationship between average inflation and oil price volatility, finding that higher oil price volatility causes higher average levels of inflation. At a certain level of prices, average inflation is higher when oil prices affect the marginal costs of the product, and the shape of the Phillips curve is convex, of course. The significance of this pilot study is that it has been applied to the United States since the beginning of 2000, which increases average inflation while decreasing average production.

In his study, Hooker (2002) also compared the Phillips inflation curves before and after 1981, as well as the ensuing structural change in the United States. Despite the fact that monetary policy seems to have responded less strongly to variations in oil prices since 1979, those same changes were largely responsible for the drastic rise in oil prices that year.

LeBlanc and Chen (2004), however, came to the opposite conclusion in their research in the years prior to the 2008 oil crisis after estimating the effects of changes in oil prices on inflation, using the Phillips curve for Japan, USA, UK, Germany, and France, and using the enhanced. In the United States, Europe, and Japan, it barely makes a dent in inflation. For instance, an increase (10%) in oil prices will directly raise inflation, with rates in the United States of America and the European Union ranging from 0.1% to 0.8%, observing that Europe appears to be more susceptible to oil-price swings than the US is.

In the study by Kalimeris and Papasyriopoulos (2009), they used the Phillips model and a joint integrated VAR analysis of the variables of unemployment, interest rates, and inflation for the period (1997–20/07) to show the impact and effect of oil price shocks on macroeconomic variables in both the European Union and the US economies. According to the study, the European Union and the US as a whole tend to have slightly different effects of oil price changes on inflation. The European economy has, however, seen a volatility spike following the oil price shock, in contrast to the US economy, as the VAR method illustrates.

Ojo and colleagues (2020) aimed to build the conventional Phillips curve model, apply it to oil (exporting and importing) nations, and calculate accuracy by contrasting the impact of oil price on the demand side with the subsequent changes on the supply side. The forecasting of each example shows that the enhanced Phillips curve model—which includes oil prices as a supply-side component—performs better than the stochastic approach and that the classic (demand-driven) projected performance of the Phillips curve increases as oil prices rise. As an alternative to the supply-side issue, he prefers to utilize the expanded Phillips curve model with variations in oil prices.

This study is important because it may be able to determine the impact of shocks of the oil price on the macroeconomic variables using the approach of Phillips's function for Jordan as a country in the Middle East, which is considered a non-oil producing country. Previous studies using the Phillips model have primarily focused on European countries and the United States. This shows the lack of empirical studies on this topic in other countries, especially developing countries, and emphasizes the importance of this study.

	Model	
Papapetrou (2001)	VAR model	Shocks to the price of oil substantially account for variations in the production and employment growth of Greece.
Hooker (2002)	Phillips curve	In his research, Phillips analyzed his inflation curves for the US before and after 1981.
Cunado (2003)		discovered that the indication used to predict oil prices will vary, which will affect how this indicator affects inflation and industrial production.
LeBlanc (2004)	Phillips curve	using the enhanced Phillips curve, that increasing oil prices are not. It has only a modest effect on inflation in the United States, Europe, and Japan.
Barsky (2004)		linking the crises that occurred in the Middle East with changes in oil

		prices, and then the impact of these changes or shocks on the macroeconomics in developed countries
Roeger (2005)	QUEST model	found that oil affects production directly as input from production, just as oil prices affect consumption, and indirect effects arise from the response of wages to the change in prices.
Kalimeris (2009)	Phillips curve By VAR analysis	they indicated the effect of oil price shocks on macroeconomic variables in both the European Union and the United States economies, The variables are inflation, unemployment, and interest rates,
Segal (2011)		The explanation of why the rise in oil prices until 2008 has affected the global economy, through different arguments
Ojo (2020)	Phillips curve	attempted to construct the traditional model, compare the effect of oil price shocks on the demand side with the resulting changes on the supply side, applying this to oil-exporting and oil-importing countries
Castillo (2020)		found the relationship between average inflation and volatility of oil prices by resolving the balance of rational expectations. (Keynesian approach)

Source of Data

For the following variables: consumer price index (CPI), oil price index, unemployment, and interest rates on loans, this analysis uses quarterly data from 2004 (Q1) to 2020 (Q1). The monthly Statistical Bulletin of the Central Bank of Jordan as well as the International Monetary Fund provided the data on the variables.

3. Methodology

To examine the relationships between Jordanian inflation and oil prices, an empirical application of limits testing was developed along with the ideas of Pesaran (2001). In many earlier studies, such as Adelakun and Ngalawa (2020), the Phillips function is also calculated, with the unemployment rate and the interest rate on loans and advances serving as the other variables. The price index is modeled as a function of three independent variables to examine the relationship between the variables: To analyze the relationship between the variables, the price index is model as a function of three independent variables:

$LCP_t = f(LX_t, LF_t, LR_t)$ ….. (1)

where LCP is the logarithm of the consumer prices index (proxy inflation rate), LX of oil price, LF of the unemployment rate, and LR of Interest Rates on Loans and Advances. Pesaran et al. (2001) developed and introduced the autoregressive for the distributed lag model (ARDL) bound testing approach to co-integration, which is used to evaluate this effect. The ARDL approach was chosen for this study because of its adaptability, as it may be used when the variables are integrated in different orders in studies with a limited sample size. Bounds testing will therefore be relevant for the current study. Additionally, the ARDL method may simultaneously estimate the model's long- and short-run parameters.

The ARDL model can be specified as:

$$LCP_t = \beta_0 + \sum_{i=1}^{P} \theta_i \Delta LCP_{t-i} + \sum_{i=1}^{P} \alpha_i \Delta LX_{t-i} + \sum_{i=1}^{P} \vartheta_i \Delta LF_{t-i} +$$

$$\sum_{i=1}^{P} \gamma_i \Delta LR_{t-1} + \beta_1 LCP_{t-1} + \beta_2 LPX_{t-1} + \beta_3 LF_{t-1} + \beta_1 LR_{t-1} + U_t \;\dots\dots(2)$$

The slope parameters (i=1,2,...,4) and the constant parameter (i=0) need to be approximated. u is an error term with a zero mean, constant variance, and identical and independent distribution. Equation (2) was regressed, and the Wald test (F-statistic) was calculated to determine the long-term relationship between the relevant variables. The following are the alternative and null hypotheses:

H0: All of the parameters = 0 ➔ (no long-run relationship)

Against the alternative hypothesis

H1: none of the parameters = 0 ➔ (a long-run relationship)

4. Empirical Results

4.1 Unit Root Test

The ADF test, which is performed on each variable, is based on the null hypothesis that the variables are nonstationary. To prevent the problem of spurious regression, the research variables are subjected to adequate differencing to induce stationarity, as the null hypothesis implies.

Table 1 displays the outcomes of the ADF test on the included variables. Every variable is I(1), with the exception of Interest Rates on Loans, which are integrated at the level and would become stationary if they were differed once.

When the critical propriety of the ADF test at level for at least one of the variables is less than 0.05 but the others are less at first difference, the ARDL model can be used. The Johnson co-integration model cannot therefore be applied in this situation. Whether the variables are I(0) or I(1), the ARDL limits testing approach can be used, according to Pesaran & Pesaran, 1997.

Table (1): Results of Unit Root Test (Augmented Dickey-Fuller)

Variables	Level		First deference		Decision
	ADF*	ADF	ADF	ADF	
Lcp	-1.21	-1.41	-5.6	-5.7	I(1)
LX	-2.2	-2.0	-6.8	-6.8	I(1)
Lr	-3.2	-3.2	-7.2	-7.3	I(0)
LF	-0.8	-0.5	-16.7	-8.1	I(1)

Where LF is the logarithm of the unemployment, LR of Interest Rates on Loans and Advances, LX of Oil Price, and LCP of the Consumer Prices Index. Unit root test with constant and trend is represented by ADF, standing for the unit root test.

*MacKinnon (1996)

4.2 Bounds Test for the Integration

When sure that the variables are not stationary at the same level, the second step should be applied by using the bounds test way to determine whether the long-run regression is present. According to Table 2, the critical value of the asymmetric bound testing approach at 5% is 4.01 and 5.07, respectively, while the calculated F-statistic value is 8.5, which is greater than the I(I) value and shows a counteraction between LCP, LX, LF, and LR from 2004: Q1 to 2020: Q1 in Jordan.

TABLE (2): Bounds Test

Fischer Statistics	Sig- level	Bound Critical Values	
		I(0)	I(1)
8.5	1%	3.47	4.45
	5%	4.01	5.07
	10%	3.69	4.89

4.3 Long- and Short-Run Estimates

The next stage of the procedure was to estimate the short- and long-run correlation coefficients. The ARDL model allows for the use of various lags for both dependent and independent variables. Selecting a suitable lag for each of them is necessary before applying the ARDL model. Using the Akaike info criterion (AIC) method, the lag determination for the ARDL model was carried out in this study. The ARDL model (1,2,0,0,3) performs the best for lags one and two, according to the AIC results.

Table (3): Long-Run Estimated Coefficients Using ARDL Model

Dependent variable: Lcpi				
Variable	estimations	Std.Error	*t- value*	*p-* value
LX	0.28	0.011	3.612	0.0000
LR	0.048	0.011	6.08	0.0001
LF	-0.037	0.010	-5.83	0.0005
C	0.705	0.145	22.534	0.0000
@TREND	0.002	0.0003	31.45	0.0000

The results show a long-term causal relationship (Table 3) between the CPI (inflation) and the price of oil (X), interest rates on loans and advances (R), and unemployment rate (F) when the error correction term (ECT) was large, negatively skewed, and smaller than one. Furthermore, with the exception of the unemployment rate (F), all independent variables have been noted to considerably and positively impact inflation as the estimated coefficients of the long-run association indicate. Furthermore, a 1% increase in oil prices will increase inflation by 0.28% in Jordan. All findings agree with the earlier investigation.

4.4 Short-run Analysis

Additionally, the ARDL framework used to predict the short-run dynamics is provided in Equation (2). Table 4 shows that oil price coefficients in the near term notably and positively impact the CPI (inflation), with a 1% increase in oil prices anticipated to increase inflation by just 0.03% at a level and 0.03% after one quarter, and the outcome is substantial at a level of 5%.

Table (4): Short-Run Representation for the ARDL Model

Variable	Coefficient	Std.Error	t-Statistic	p-value
D(LCPI(-1))	0.228	0.102	2.236	0.029
D(LCPI(-2))	0.232	0.100	2.315	0.024
D(LP)	0.033	0.007	4.407	0.000
D(LX(-1))	0.029	0.009	3.230	0.002
D(LR)	0.088	0.023	3.772	0.000
D(LF)	0.0002	0.017	-0.012	0.991
D(LF(-1))	0.023	0.017	1.376	0.174
D(LF(-2))	0.061	0.016	3.908	0.000
D(@TREND())	0.003	0.001	4.102	0.000
CointEq(-1)	-0.331	0.076	-4.373	0.000

4.5 Diagnostic Test

The short-term model for the Lagrangian multiplier for regression, ARCH Impacts, and Serial Correlation appears to pass every test for diagnosis based on the heteroskedasticity and normality of the residual terms shown in Table 4. In the study, the reliability was assessed using these diagnostic tests. The residuals are normally distributed, no evidence of white or autoregressive conditional heteroskedasticity is discovered, and the functional form of the model appears sufficiently characterized.

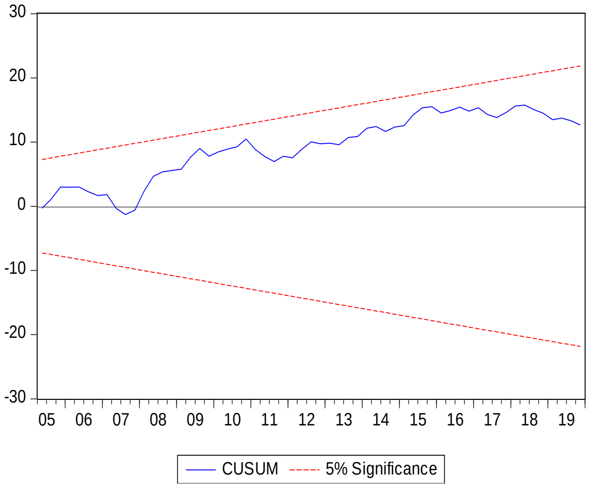
Table (5): Diagnostic Test

	Coefficient	p-value
Wald test (F)	1884918.0	0.0000
Serial correlation	0.861	0.6500
Heteroskedasticity	5.669	0.9318
ARCH value test	0.001	0.9700

4.6 Reliability and Stability tests of the model

The cumulative sum of recursion residuals (CUSUM) test was utilized in this work to examine the stability of the estimates. Brown et al. (1975) established the CUSUM tests of the stabilization plot of the parameters and frequently updated test statistics across time to determine whether any discernible statistical break was found. The findings from Figure 1 of this test show that all of the coefficients of the estimated model are stable over time as long as they stay within the 5% critical constraints. The results of this model can be trusted, based on the findings of this stability test.

Fig.3 CUSUM Plots for Stability Test



5. Concluding Remarks

In Jordan, the oil prices significantly influence the rate of inflation. The ARDL Bounds test results reported in this study demonstrated the cointegration through the oil price (X)., interest rates on loans and advances (R), the unemployment rate (F), and the consumer price index (inflation) (CP). In the long run, oil prices positively impact consumer prices, according to the marginal coefficient of determination from the worldwide test on the resulting ARDL model (an increase of 1% in the price of oil will increase inflation in Jordan of 0.28%).

Oil prices indirectly affect the CPI (inflation) through transmission from import prices and changes in production costs. Variations in oil prices can affect oil-intensive industries more. Furthermore, the regulation of the impact of the oil price on domestic price inflation depends on the implementation of monetary policy with the goal of fostering low inflation (for example, by regulating consumer prices and offering oil subsidies).

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