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The Effect of Crude Oil Prices on Inflation: Evidence from Jordan

Mansour Alkhazaleh

Assistant Professor Department of Finance and Banking Al-Albayt University - Mafraq - Jordan

Email: Mansour.alkhazaleh@aabu.edu.jo

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Abstract

The primary objective of this study is to assess how fluctuations in crude oil prices impact inflation in Jordan. Annual time series quarterly data from 2000 to 2021 are employed for this purpose. An autoregressive distributed lag (ARDL) model is utilized to assess this impact. The findings indicate the presence of both short-run and long-run effects of oil prices on inflation, as revealed by the ARDL-ECM (1, 0). Additionally, stability in the ARDL model coefficients for the long-run relationship between oil prices and inflation is affirmed by the CUSUM tests.- ECM (1,0) highlights the existence of short-term and long-term effects of oil prices on inflation.

Keywords: Crude Oil Price, Inflation, Autoregressive Distributed Lag Model

Introduction

Oil stands as a fundamental cornerstone in the economies of numerous countries worldwide, exerting significant influence on both economic and social progress. Essentially, the presence of oil fosters sustainable development within these nations. Like many other countries, Jordan heavily relies on oil to drive various sectors of its economy. Consequently, fluctuations in crude oil prices can significantly influence the overall macroeconomic landscape of any nation. Numerous macroeconomic factors, both global and domestic, can influence the inflation rate.

The influence of fluctuations in oil prices manifests differently for countries that export and import oil. Exporting nations rely heavily on revenue generated from oil. Consequently, an increase in oil prices translates to a higher amount of funds available for funding developmental projects. Conversely, the relationship between oil prices and economic growth does not remain consistent across diverse business cycles or periods of oil price increases (Kilian and Vigfusson, 2011; Das et al., 2018).

Fluctuations in oil prices can influence specific price components, particularly considering that oil serves as a vital energy source for the manufacturing of various goods (Shrestha et al., 2019; Pal and Mitra, 2018). Additionally, a separate segment of the literature has focused on

studying the unequal effects of oil pass-through on specific inflation rates within diverse sectors (Babuga and Naseem, 2021; Balcilar et al., 2018; Iwayemi and Fowowe, 2011).

The main contributions of this study is to investigate the impact of fluctuating oil prices on inflation, utilizing quarterly data spanning a twenty-years time series for oil prices specific to the case of Jordan. However, given Jordan's significant dependence on oil as a primary driver of economic growth. The primary objective of this study is to investigate the long-run and short-run effects of oil prices on inflation. To the best of our knowledge, this research represents a one of rare examinations of the relationship between oil prices and inflation. Moreover, it stands as one of the initial studies to encompass the post-devaluation period, assessing the effects of oil price fluctuations on Jordan's economy.

Literature Review

Oil serves as the primary driving force behind global production dynamics. Consequently, fluctuations in oil prices impact inflation rates worldwide, with economic and social implications that affect populations across all countries. In other words, changes in crude oil prices can influence all economic activities within any given economy (Nazarian and Amiri, 2014; Adam, 2016). There exists an extensive literature that examines the relationship between crude oil prices and the inflation rate, including studies by Bhattacharya and Bhattacharya (2001), Zhang et al. (2018), Gómez-Loscos et al. (2012), Hamilton (1996), and Jones et al. (2004).

Abundant studies, such as those by Berument et al. (2010), Akinlo and Apanisile (2015), Hassan and Abdullah (2015), and Musa (2017), have indicated a positive correlation between crude oil prices and economic growth. Conversely, other analyses on various countries conducted by Hamilton (1983), Guo and Klieses (2005), Jiménez-Rodríguez and Sánchez (2005), Malik (2008), Bhusal (2010), Berk and Aydogan (2012), Farhani (2012), Ahmad (2013), Nazir and Qayyum (2014), and Eyden et al. (2019) have argued for a negative relationship between oil and economic growth.

Mukhtarov et al. (2020) revealed a positive correlation between oil prices and economic growth, exports, and inflation in the context of Azerbaijan. On the other hand, they noted a negative impact of oil prices on the exchange rate. Chen et al. (2015) discovered a positive relationship between oil prices and the Consumer Price Index (CPI) in the case of China. Abounoori et al. (2014) established that oil prices positively influence inflation in both the short and long run within the framework of Iran. Conversely, Katircioglu et al. (2015) found a negative impact of oil prices on inflation in OECD countries. Meanwhile, Cologni and Manera (2008) identified the presence of the influence of oil prices on inflation.

Brown and Yucel (2002) demonstrated that higher oil prices result in increased production costs, leading to reduced output and a decline in the growth rate. This, in turn, can lead to a decrease in real wage rates, the closure of production facilities, and an increase in the unemployment rate. Chuku et al. (2010) argued that there is no direct connection between economic growth and crude oil prices. This lack of direct relationship stems from the interdependence of these factors within a country's macroeconomic framework, documented structures, and sectoral organization.

Long and Liang (2018) acknowledged the presence of an asymmetrical impact in the long run of global oil price fluctuations on China's Producer Prices Index (PPI) and Consumer Prices Index (CPI) through the application of the Autoregressive Distributed Lag (ARDL) and Nonlinear and Asymmetric Autoregressive Distributed Lag (NARDL) models. In contrast, Abu-Bakar and Masih (2018) utilized both ARDL and NARDL techniques to investigate the

relationship between global oil prices and inflation in India. The ARDL results indicated no significant association between the two variables. Another study by Bhat et al. (2018) concluded that a country functioning as a net food exporter and net oil importer experiences a negative impact from global oil and food price shocks.

Several empirical studies have demonstrated diverse impacts of oil prices on economic performance, with some indicating strong correlations while others suggesting negative effects (for instance, Min Li 2005; Jazz 2006; Aljalal 2006; Almajali 2008; AlHiti et al. 2008; and Aljrah 2011). Min Li (2005) identified a non-linear relationship between inflation and economic growth. Jazz (2006) uncovered long-term interactions and causal connections between money and prices in Algeria during the period 1995 to 2001. Aljala (2006) concluded that an increase in both the volume of domestic liquidity in the Yemeni economy and annual growth rates of GDP contribute to inflationary pressures. Almajali (2008) demonstrated a robust impact of interest rates in the banking sector on the inflation rate.

AlHiti, Khalaf, and al-Tai (2008) highlighted the varying roles of financial instruments in the fluctuations of inflationary processes within the Iraqi economy. Aljrah (2011) emphasized the significance of external factors (such as global industrial production and world export rates) in explaining inflation in Saudi Arabia, considering both long-run and short-run constraints. The findings also underscored the significance of monetary policy in influencing the inflation rate over both the long-run and short-run periods.

Sujit and Kumar (2011) utilized an Autoregressive Unrestricted Model and an Autoregressive Integrated Model to establish the significant influence of economic variables on the exchange rate. Sindhu (2013) conducted an analysis on the effects of various factors, including the price of crude oil and the inflation rate, on the price of gold. The study revealed that crude oil prices impact the price of gold, while the inflation rate is positively associated with an increase in gold prices.

Data and Methodology

Data

The data utilized in this study comprise information on crude oil rates (measured in USD per barrel) and inflation (expressed in %). Both the crude oil price and consumer price index data are quarterly, covering the period from 2000 to 2021.

Methodology

In order to investigate the influence of oil rates on inflation, we adopt the ARDL model proposed by Heij et al. (2004) and Pesaran and Shin (1999). This involves the incorporation of the crude oil rate. To test this impact, we utilize a multivariate ARDL model, with one equation utilized as shown in equation (1).

$$I_t = a_1 + \sum_{i=1}^{p_1} \mu_{1i} I_{t-i} + \sum_{i=0}^{q_1} \psi_{1i} O_{t-i} + \tau_{it} \quad (1)$$

In this context, the symbol O represents crude oil prices, while the symbol I signifies inflation. Additionally, τ_{it} (i=1) denotes the error term, and the parameters of the regression equation are denoted as a, μ, ψ .

$$D(I_t) = \psi_{10} D(O_t) + \lambda_1 \mathrm{Res}1_{(t-1)} + \sum_{i=1}^{p_1-1} \mu_{1i} D(I_{t-i}) + \sum_{i=1}^{q_1-1} \psi_{1i} D(O_{t-i}) + \tau_{1t} \quad (2)$$

Here, the term D(O) represents the first difference form of Oil. Equation (2) is referred to as the error correction model. The parameters τ_{it} (i=1) within equation (2) have been positioned in the subsequent subsection. If the variables in the equation are not co-integrated, the

outcome will be the ARDL equation in the first difference. The residual variable denotes the error correction variable, represented by Res, as seen in equations (3).

$$\mathrm{Res1}_{(t-1)} = I_{t-1} - \frac{a_1}{1-\sum_{i=1}^{p_1}\mu_{1i}} - \frac{\sum_{i=1}^{q_1-1}\psi_{1i}}{1-\sum_{i=1}^{p_1}\mu_{1i}} O_{t-1} \quad (3)$$

Objectives of the Study

The main objectives of this study are the following:

1. Evaluating the extent to which fluctuations in crude oil prices affect inflation in Jordan by using quarterly time series data from 2000 to 2021.
2. Examining the impact of oil prices volatilities on inflation in Jordan in the short- term and long- term.

Findings and Discussion

Findings

Initially, our analysis focuses on the stationary test, known as the Augmented Dickey-Fuller (ADF) test, initially developed by Dickey and Fuller in 1979. For comparative purposes, the Philip Perron (PP) test can also be utilized, developed by Phillips and Perron in 1988. The null hypothesis for both tests suggests that the time series is not stationary, while the alternative hypothesis posits that the time series is indeed stationary.

The initial step involved conducting stationary tests. The outcomes of the ADF test and the PP test are condensed in table 1. The variable I is found to be stationary at the level, whereas the variable Oil is stationary at the first difference or integrated of order I(1).

Next, the co-integration test can be utilized. If the time series is found to be stationary at the first difference. This approach involves the adoption of the Engle-Granger Cointegration test. The first step of this test includes estimating the regression between inflation and oil, incorporating one residual. The second step involves examining the stationarity of the residual using the ADF test. If the test results indicate stationarity at the level, it signifies that the time series is co-integrated. The third step involves estimating the parameters of the model (2) through the utilization of the multivariate ordinary least square technique, which assumes that the errors are dependent on each other or that autocorrelation exists (IHS, 2017). The Portmanteau multivariate test, as proposed by Lütkepohl (2004), is employed to achieve this objective. Additionally, if there is evidence of a long-run impact, the stability of the long-run coefficients based on the ARDL model is tested using the CUSUM test, as detailed by Brown et al. (1975).

Table 2 highlights the cointegration between oil prices and inflation. The analysis, based on the p-value of the tau-statistic, indicates a conclusive finding that oil prices and inflation are indeed co-integrated. Consequently, it can be inferred that the prices of oil and inflation have a long-term relationship.

Table 1:
Stationary test results

Variable	ADF test statistic		Phillips-perron test **statistic**	
	Constant	Constant and trend	Constant	Constant and trend
I	-3.311	-3.5717	-6.7292	-6.440
OP	-2.863	-2.6977	-2.5635	-2.506
D(OP)	-6.5863	-6.6014	-7.4221	-7.442

Additionally, in line with the findings of the Portmanteau test in the multivariate autocorrelation analysis, it is evident that error term εt exhibits autocorrelation. This confirms the validity of employing the multivariate ordinary least square (OLS) method. The outcomes of the multivariate autocorrelation are presented in Table 3.

Based on the assessment of time lag, the estimated ARDL models incorporate a one-way relationship from oil prices to inflation. Notably, the analysis reveals both short-run and long-run effects of oil prices on inflation, as indicated by ARDL-ECM (1, 0) in panel A. Furthermore, the stability of the ARDL model coefficients regarding the long-run relationship between oil prices and inflation is confirmed by the CUSUM tests, illustrated in figure 1.

Table 2
Engle granger co-integration test

Dependent Variables	Independent variables	Residual variables	ADF Test (P-value)
Inflation	OP	Residual 2	0.0000

Table 3
Autocorrelation Test

Lag	Q-statistic	P-value
Lag 1	24.6201	0.0053
Lag 2	31.0521	0.0376
Lag 3	45.2531	0.0212
Lag 4	54.7658	0.2103

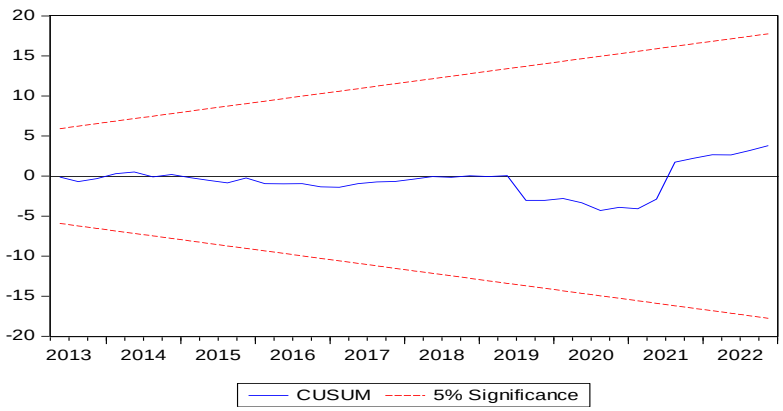

Figure 1: CUSUM test regarding the stability of ARDL between oil prices and inflation

Discussion

The findings indicate both short-run and long-run effects of oil prices on inflation, aligning with the conclusions of Cologni and Manera (2008) who similarly identified the impact of oil prices on inflation. Comparable results have been observed by Reicher (2010) and Eryigi (2012). Several other studies have also explored the relationship between oil prices and inflation. For instance, Ahmed and Wadud (2011) found a negative relationship between oil prices and inflation. Conversely, Iwayemi and Fowowe (2011) and Roeger (2005) found no significant association between oil prices and inflation. On the other hand, Adam et al. (2016) discovered that the dynamics of the effect of world crude oil prices on inflation were positive, with multiplier effects of 0.33%. Additionally, Cunado and De-Gracia (2005) identified a lasting impact of oil prices on inflation in the short run, along with asymmetric effects of oil prices on the production index.

What explains the results of this study is that a country like Jordan imports the vast majority of its energy needs from many countries. It is, of course, a non-oil-producing country, at the same time it depends in most of its economic activities, like other countries, on oil. Therefore, any fluctuation in global oil prices will undoubtedly cast a shadow over the various economic sectors within the country, and will also affect the money that will be paid in exchange for importing its oil needs and other energy sources that depend on oil.

However, the tremendous rise in oil prices as a result of the unstable conditions in the world and in the Middle East region in particular, imposes new situations on the citizen's bill for the residents of these countries, including Jordan. Intuitively it is known that Jordan, by virtue of its geographical location, is located within a region of turbulent conflicts. The surrounding circumstances make Jordan affected economically and socially, whether directly or indirectly The most important of these circumstances are: the Arab-Israeli conflict since the 1940s: the ongoing civil war in the Syrian Arab Republic: the repercussions of the results of the war in Iraq: as Iraq is considered a major source of oil to Jordan: the crises afflicting the neighboring country Egypt: not to mention the ongoing conflict between Saudi Arabia and Yemen: and finally, the Russian-Ukrainian war, as these two countries are major exporters of grain and oil not only to Jordan, but to the majority of countries in the region. Accordingly, the price level in Jordan has witnessed a significant increase over the past years, especially since the purchasing power of the Jordanian dinar has decreased significantly.

Table 4

Estimation results of multivariate ARDL using multivariate OLS.

Independent variables	Dependent and constant	Coefficient	probability
Panel A: ARDL-ECM (1,0) Model Short-run effect			
D(I)	D(I(-1))	0.2097	0.0067
	D(OP)	0.1489	0.0032
Breusch-Godfrey Serial Correlation LM Test			0.6508
Long-run effect			
I	C	0.2456	0.0013
	OP	0.1395	0.0001
Breusch-Godfrey Serial Correlation LM Test			0.5210

Conclusion

This study aims to investigate the impact of crude oil prices on inflation, utilizing quarterly time series data for Jordan from 2000 to 2021. To assess this impact, the study employs an autoregressive distributed lag (ARDL) equation and a multivariate ARDL model. The parameters of the multivariate model were calculated using the multivariate OLS method. The analysis reveals both short-run and long-run effects of oil prices on inflation, as evidenced by the findings of the ARDL-ECM (1, 0) in panel A. Furthermore, the stability of the ARDL model coefficients concerning the long-run relationship between oil prices and inflation is confirmed by the results of the CUSUM tests, depicted in figure 1.

This study contributes to discovering the impact of global oil price fluctuations on inflation in Jordan in the long and short term. It is distinguished from other studies at the level of Jordan's economy as one of the most updated studies in recent times. The study period included many important events that took place in the world, in particular the Middle East region. It represents an extension of previous efforts that addressed this area by using the ARDL model for quarterly data that reflects the impact of oil prices on inflation in an accurate manner. Thus, it provides financial policy makers and decision makers with determining the actions that they can employ based on the results of the study in the short term or long term.

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