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Households' Consumption, Oil Price, Exchange Rate and Inflation in Oil Exporting Countries: Evidence from the OPEC

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Abstract

We use annual data for the period 1995-2017 to examine the impact of consumption of households, exchange rate and oil price on inflation in the Organization of Petroleum Exporting Countries (OPEC). We utilize full sample size – all the OPEC member countries for the study and panel Autoregressive Distributed Lag (ARDL) model. The Mean Group (MG) and the Pooled Mean Group (PMG) were used to estimate the panel ARDL model, after which we choose the efficient estimator. Brent oil price is used for the main estimation, afterwards, we carry out robustness check using WTI oil price. Our evidence establishes that the estimates are not sensitive to the oil price used. Besides, our findings reveal that oil price and exchange rate are not major determinants of inflation in the short run. Also, we find final demand for goods and services (households' consumption) to be weak in promoting inflation in both the short and long run. In the long run however, oil price and exchange rate are key factors that cause inflation in the OPEC. We therefore conclude that in the long run, oil price and exchange rate determine inflation in the OPEC while households' consumption is not a main driver of inflation in these countries. Thus, we recommend that oil proceeds be channeled to the real sectors of the OPEC as well as the formulation and implementation of policies capable of strengthening the value of currencies of the OPEC member countries.

Keywords: Exchange Rate; Households; Consumption; Inflation; Oil Price;OPEC;Panel ARDL.

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1. Introduction

High rate of inflation is detrimental to the growth and development of every economy. Though, economists posit that certain amounts of inflation are good for the health of an economy, high rates raise apprehension for individuals, businesses, government and policy makers. Thus, because of its negative consequences for an economy, inflation is an evil that every government makes every effort possible to reduce to the least level possible. Understanding the fundamental factors that cause inflation is key to reducing it to an acceptable (or somewhat acceptable) level. Though drivers of inflation vary from country to country (developed and developing) and from time to time, traditional monetary theory regards excessive growth of money supply as a general cause of inflation ([1,2,3]). Several other factors such as excess demand for over supply of goods and services, shocks in commodity prices, changes in technology, natural disasters and economic policies cause inflation. More so, oil price and exchange rate have been empirically identified among the principal determinants of inflation in an economy ([4,5,6,7]). Furthermore, economic theory suggests that inflation is inevitable when there is excess demand for goods and services over the supply of them. Thus, understanding the link between oil price and inflation, exchange rate and inflation as well as between households' consumption and inflation is crucial for every government and its policy makers. A surge in crude oil prices translates into higher manufacturing costs leading to inflation ([4,8]). Oil being an essential input in the production of goods and services, all else constant, a sustained rise in its price is synonymous to a sustained rise in the cost of production, and by extension a sustained rise in the prices of the goods and services produced (inflation). Evidence suggests that oil price is positively related to inflation. For instance, a 10 percent increase in oil price rises inflation by 0.13 percent in 49 advanced and emerging economies of the world [9]. Similarly, a fall in the value of a country's currency leads to inflation in the country ([10,11]). Given that importation of goods and services is an integral part of every economy, all other things equal, a fall in the value of a country's currency vis-à-vis other currencies implies high costs of importation, thus, high prices of goods and services in the importing country. Besides, some of these imported goods are factor inputs in the domestic economy. Consequently, importing them at high prices adds to the cost of production, thereby increasing prices of the goods and services produced. Since the 1970s inflation has been an issue of global concern [12]. The highest global average inflation rate stood at 15 percent and 16 percent in the 1980s and 1990s respectively [13]. Equally, in the year 2010-2011 inflation posed serious threat to macroeconomic stability around the world [14]. It is important however to state that inflation is more serious in the developing than in the developed countries of the world. The developing countries experience an alarming average inflation rate of 37 percent [15]. Lately, members of the Organization of Oil Exporting Countries (OPEC) as well have continued to experience high inflation rates over time. For instance, Angola, Congo, Ecuador, Islamic Republic of Iran, Indonesia, Iraq, Libya, Nigeria and Venezuela have experienced inflation rates of as high as 2666, 42, 96, 39, 58, 53, 16, 17 and 22 in 1995, 1994, 2000, 2013, 1998, 2006, 2011, 2017 and 2015 respectively [16]. In fact, it was as high as 4145 for Angola in 1996 [16]. Thus, it is important to examine the impact of variables that are capable of causing inflation in the OPEC member countries. We therefore examine empirically, the impact of oil price, exchange rate and consumption of household on inflation in the OPEC member countries. Two reasons justify our focus on the OPEC member countries. First, they are oil producing and exporting countries, and oil being a key factor in production, a rise in its price is capable of causing inflation in both oil exporting and importing countries via

increase in the cost of production. Besides, for the oil exporting countries, if the revenue generated from the sale of oil is not spent prudently or invested in the real sectors, inflation becomes inescapable. Second, despite being exporters of an essential factor in the production of goods and services, a factor whose demand is not only inelastic but also capable of strengthening the value of their currencies in relation to other currencies (exchange rate appreciation), inflation rate has remained high in some member countries of OPEC. The remainder of this study is organized as follows. Section two is theoretical underpinnings, section three is literature review, section four is methodology of the study, section five is the result and discussion, section seven is summary and conclusion.

2. Theoretical Underpinnings

Inflation and oil price are linked in a cause and effect-based relationship. Oil is a key input in the production process and has been identified as a significant determinant of inflation. Empirically, increases or decreases in oil prices lead to inflation or recession ([17,9,18,19,20,6]). As established in the literature, oil price changes can affect the economy through two major channels. The first channel is through the supply side. Increase in oil prices mean higher production costs [21], which transmit into higher consumer prices and a fall in wage purchasing power, leading to higher inflation, all things being equal. The second channel is through the demand side. Higher consumption as a result of increase in government revenue from oil proceeds (for oil exporting countries) will lead to increase in demand for goods and services. Given the increase in the demand for goods and services without at least a corresponding increase in the supply of these goods and services, all else equal, prices of the goods and services will increase. Similarly, the theory of Purchasing Power Parity (PPP) suggests that in the long run, devaluation or depreciation of a currency leads to a proportional increase in prices in the country with depreciating currency [22]. In other words, a fall in the value of a country's currency results in inflation in the country. Given the PPP equation for two countries (country A and country B) below.

$$E_{\frac{A}{B}} = \frac{P_A}{P_B} \qquad (1)$$

where P_A represent price level in country A, P_Brepresent the price level in country B and $E_{(A/B)}$ represents number of units of country A's currency that are required to purchase one unit of country B's currency (i.e., exchange rate of country A). Equation 1 intuitively suggests that price level in country A is given by Equation 2 below.

$$P_A = P_B . E_{\frac{A}{B}} \qquad (2)$$

Equation 2 implies that price level in country A is a function of price level in country B and the number of country A's currency that are needed to purchase a unit of country B's currency. Holding price level in country B constant, variations in the number of units of currency of country A that must be exchanged for one unit of currency of country B determine price level in country A. Ceteris paribus, if more units of country A's currency are needed to buy a unit of country B's currency, price level in country A rises. The opposite of this holds true. Thus, currency devaluation or depreciation causes inflation in the country with devaluing or depreciating currency.

3. Empirical Review

Several studies have empirically evaluated the relationship between oil price and inflation and between exchange rate and inflation covering different regions and periods using different methodological approaches. These studies have provided different findings some of which have been reviewed. Previous studies have revealed that the inflationary effect of oil price vary across countries. Among these studies [23] employ Vector Autoregressive (VAR) model and quarterly data for the period January 2004 to September 2014 in order to analyse in detail the pass-through of oil prices to domestic prices at different stages of supply chain in Turkey. They observe that a 10 percent change in crude oil price is accompanied by a 0.42 percentage change in inflation. Similarly [24] employs linear and non-linear Autoregressive Distributed Lag (ARDL) model to examine how changes in oil price affect prices at different levels across sectors in Malaysia using annual data from 1980-2015 and finds that oil price changes have a significant positive impact on inflation. This is in line with the findings of [18] who assess the effects of oil price changes on inflation level in Algeria from 1970 to 2014 using the Non-Linear Autoregressive Distributed Lag (NARDL) and support the existence of a significant relationship between oil price increases and inflation rate. This finding is supported by [19] who apply VAR and Granger Causality to monthly data from January 2005 to December 2001 in order to examine the effects of oil price shocks on inflation in Malaysia and confirm that crude oil price affects inflation in the short run. Reference [6] seek to establish an open economy Dynamic Stochastic General Equilibrium (DSGE) model with two economies: China and the rest of the world. They apply Structural Vector Autoregressive Distributed Lag (SVADL) model to annual data for the period 1990-2013 and reveal that oil supply shocks driven by political events mainly produce short term effects on inflation. Reference [25] apply ARDL to daily data from 3rd January 2006 to 17th June 2016 to investigate the link between oil prices and market-based inflation expectations in the United States. They report a more intense impact of oil price changes on inflation when oil prices are above a threshold of 67 US Dollars per barrel. In comparing the effects of oil price changes on domestic inflation between 10 oil dependency index countries and 10 low oil dependency index countries [17] apply ARDL model to annual data that span from 1980-2010 and find that a rise in oil price rises inflation in low oil dependency group. In corroboration, Reference [20] utilise Panel ARDL and quarterly data to examine the relationship between oil price and inflation for 6 net oil exporting and 10 net oil importing countries and find a significant long-run positive relationship between oil price and inflation. To investigate the role of inflation targeting in the relationship between oil price movements and inflation, Reference [9] apply dynamic Generalised Methods of Moment (GMM) to annual data that run from 1980-2017. Findings of the study reveal that a 10 percent change in global oil price increases inflation by about 0.13 percent. Using Granger causality and quarterly data that span from first quarter to fourth quarter of 1973 and 1991 respectively, Reference [26] investigates the effect of higher oil prices caused by OPEC on economic activity in Organization for Economic Corporation and Development (OECD) countries. He confirms the existence of unidirectional causality from oil prices to domestic prices. On the contrary, findings of [27] suggests that oil price has a significant negative relationship with inflation. He applies Ordinary Least Square (OLS) method to monthly data covering January 1999 through September 2010 to examine the relationship between prime interest rate, exchange rate, money supply, oil price and inflation in South Africa. To establish the relationship between exchange rate and inflation in South Sudan, Reference [7] apply Granger causality to monthly data for the period August 2011-November

2014. He reveals that there exists a unidirectional causality from exchange rate to inflation. [10] use ARDL and annual data for the period 1971-2010 to investigate the inter-relationships existing between exchange rates movements, interest rate and inflation in Nigeria. They establish a short-run and long run positive significant relationship between inflation and exchange rate. Similarly, Reference [27] finds that exchange rate has a strong positive relationship with inflation in South Africa. Findings of [11] reveal that inflation is higher under floating rates than pegged rates. They utilise quarterly data form first quarter of 1957 to fourth quarter of 2016 and Pooled OLS to examine the impacts of exchange rate regimes on inflation persistence in 23 industrial countries of the world. From the reviewed literature, we discovered that the long and short run relationships between oil price and inflation, exchange rate and inflation as well as between households' consumption and inflation for all the OPEC has not yet been investigated by previous studies. We therefore fill these gaps thereby contributing to the stock of knowledge in the following ways: First, we examine how inflation responds to a rise in oil price in the OPEC member countries in the short and long run. Second, we investigate the impact of exchange rate on inflation in the short and long run in the OPEC. Third, we evaluate the short and long run impact of consumption of household on inflation in the OPEC. Lastly, the we use all the OPEC member countries to examine these relationships.

4. Methodology

4.1 Model Specification

In this study we investigate the impact of oil price, exchange rate and consumption of households on inflation in the OPEC. To achieve this objective, we employ panel Autoregressive Distributed Lag (ARDL) model developed by [28]. We use a sample of sixteen countries (i.e., all the OPEC member countries) and a period of twenty-three year (1995-2017). Since the number of cross-sample is less than the number of years, our choice of panel ARDL framework is appropriate. Among other advantages of the panel ARDL, is that even if the coefficients of the variables are not equal across the sampled countries, the model produces consistent estimates of the mean values of the parameters ([29,30]). In addition, it enables the estimation of both the short run and the long run simultaneously from a data set with large cross-sections and time dimension [30]. The ARDL model is stated below.

$$\Delta \inf_{i,t} = \phi_{i,t} + \sum_{a=1}^{A} \varphi_{i,a} \Delta \inf_{i,t-a} + \sum_{b=0}^{B} \delta_{i,b} \Delta exr_{i,t-b} + \sum_{c=0}^{C} \sigma_{i,c} \Delta op_{i,t-c} + \sum_{d=0}^{D} \beta_{i,d} \Delta hhc_{i,t-d} +$$

$$\gamma_{\mathrm{i}} \left[\inf_{i,t-1} - (\vartheta_{i,o} + \vartheta_{i,1} exr_{t-1} + \vartheta_{i,2} op_{t-1} + \vartheta_{i,3} hhc_{t-1}) \right] + \varepsilon_{i,t} \qquad (3)$$

$$i = 1,\ 2,\ \ldots\ldots\ldots,\ T; \qquad t = 1,\ 2,\ \ldots\ldots\ldots,\ N$$

In Equation 3, $\inf$, $er,\ op\ \ im$ denote inflation, log of exchange rate, log of oil price and log of consumption of households respectively. Δ denotes difference operator, i is country index, t denote time index, μ is group specific effect, ε is the white noise error term, while $\varphi,\ \delta,\ \sigma$ and β denote the short run

coefficients of inflation, exchange rate, oil price, and consumption of households respectively. Similarly, ϑ_i is the long run coefficients of the independent variables. We estimate Equation 3 using Mean Group (MG) and Pooled Mean Group (PMG) proposed respectively by [31,30], thereafter, we subject the estimates to hausman test to select the efficient estimator of the two estimators. The component of Equation 3 which represents the long run is derived from Equation 4.

$$\inf_{i,t} = \vartheta_{i,0} + \vartheta_{i,1} exr_{t-1} + \vartheta_{i,2} op_{t-1} + \vartheta_{i,3} hhc_{t-1} + \upsilon_{i,t} \quad (4)$$

where $\upsilon_{i,t}$ is the white noise error and is integrated of order one – it is I(0). Equation 4 is the term in square bracket in Equation 3.

4.2 Data

We utilise annual data that cover a twenty-three-year period, i.e., from 1995-2017 informed by available data on the variables chosen for the study. Variables used for the study are inflation proxied with Consumers Price Index (CPI) measured in percentage, exchange rate, price of oil (Brent and WTI) measured in the US Dollar and final consumption of households measured in nominal US Dollar. We source data on exchange rate, inflation and households' consumption from the 2017 World Development Index (WDI) databank of the World Bank, while data on price of oil (Brent and WTI) were sourced from the 2018 US Energy Information Administration (EIA). All the sixteen OPEC member countries which are Algeria, Angola, Congo, Ecuador, Equatorial Guinea, Gabon, Indonesia, IR Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela are included in the study.

5. Result and Discussion

We consider it important to verify the features of the all the variables. Result of the features of the variables is reported in Table 1. .

Table 1: Summary Statistics

Variable	Mean	Max.	Min.	Std. Dev.	No of Obs.
$\ln exr$	3.8201	10.4111	-5.8961	3.3832	368
$\inf$	32.9491	4145.106	-8.8139	258.0094	368
$\ln Brent$	3.7821	4.7152	2.5463	0.6724	368
$\ln WTI$	3.7902	4.6019	2.6686	0.6104	368
$\ln hhc$	24.3218	27.2371	17.0722	1.8036	368

Table 1 reports the summary statistics and reveals that exchange rate has the least while inflation has the greatest average values. With regard to the maximum value, the table shows that inflation has the greatest maximum value of 4145.106, while WTI has the smallest maximum value (4.6019). Similarly, inflation and private consumption respectively have the smallest (-5.8961) and the highest (17.0722) minimum values. The

standard deviation suggests that inflation with a standard deviation value of 258.0094 is the most unstable variable. On the other WTI with a standard deviation value of 0.6104 is the most stationary of the variables.

Table 2: Stationarity Tests

	inf	ln *exr*	ln *Brent*	ln *WTI*	ln *hhc*
Levin, Lin, Chu t*	-37.8102***[a]	-1.6567**[a]	-2.0480**[a]	-1.8985***[a]	-4.7161***[b]
Breitung t-Statistic	-1.5222*[a]	-4.8479***[b]	-10.7264***[b]	-11.1078***[b]	-8.4908***[b]
Hadri LM Test	-1.7578[b]	1.7313[b]	0.6013[b]	0.7738[b]	1.1852[b]

Note: *** and ** denote statistically significant at 1% and 5% respectively, while [a] and [b] signify model level and first difference respectively.

We conduct unit root test to establish the stationarity status of all the variables using three unit root tests - the Levin, Lin and Chu (LLC) [32], the Breitung [33] and the Hadri [34]. Null hypothesis of Levin Lin Chu and Breitung tests is unit root with common process and rejection of this null hypothesis implies that the series is stationary [35]. In contrast, the null hypothesis of Hadri is no (absence of) unit root with common unit root process [35], hence, not rejecting this hypothesis implies that the series is stationary. In dynamic heterogenous panel data models, unit root test is necessary because non-stationarity is a big concern. Table 2 reveals that all the variables we utilize for the study are stationary either at level i.e., I(0) or at first difference, i.e., I(1). Particularly, the LLC test confirms that inflation, exchange rate, oil price (Brent and WTI) are I(0) while HHC is I(1). Breitung test confirms that inflation is I(0) while all the other variables are I(1) and the Hadri test reveals that all the variables are stationary at I(1). The result supports our choice of the panel ARDL framework for the study. The unit root test result suggest that all the variables pass the unit root test i.e., estimates using the variables will not be spurious.

We utilize the Mean Group (MG) and the Pooled Mean Group (PMG) estimators to estimate Equation 3, afterwards we subject the estimates produced by the two estimators to hausman test to choose the efficient estimator between the two. In other words, the hausman test enables us to find out if there is symmetric difference between the two estimators.

Decision rule guiding the hausman test is that if the chi-square statistic of the test is not statistically significant, the Pooled Mean Group (PMG) is accepted as the efficient estimator. On the other hand, if the chi-square statistic of the test is statistically significant, the Mean Group (MG) is the efficient estimator of the two (Zumba, Adeshola, Chiagoziem & Abe, 2019).

Result of the hausman test in Table 3 discloses that the null hypothesis is not rejected, thus, we interpret the PMG estimates which is the efficient estimator.

Table 3: Symmetric Panel ARDL Estimate with Brent Oil Price

	MG	PMG		MG	PMG
Short Run			Long run		
Variable	Coefficient	Coefficient	Variable	Coefficient	Coefficient
$\Delta \ln exr_t$	70.47	69.9	$\ln exr_t$	13.84	3.953***
	(-63.11)	(-61.14)		(-8.781)	(-0.709)
$\Delta \ln op_t$	-2.386	1.995	$\ln op_t$	12.54	1.718***
	(-2.391)	(-5.145)		(-9.281)	(-0.64)
$\Delta \ln hhc_t$	9.049	41.31	$\ln hhc$	57.82	0.4
	(-13.06)	(-32.84)		(-48.02)	(-0.59)
$ect(-1)$	-0.752***	-0.665***	Constant	-11.35	-0.7748
	(-0.0797)	(-0.069)		(-932.3)	(-61.67)
Hausman test x^2	1.22 [0.7486]				
No. of Cross Sections	16				
No. of Observations	352				

Note: *** represents statistically significant at 1% levels.

We find an evidence of a long run relationship among consumption of households, exchange rate, inflation and oil price. Coefficient of the Error Correction Term (ECT) reported in Table 3 confirms that 66.50% of the short run deviation from the equilibrium of these variables is corrected in the current period until these variables attain their long run stationary state. Estimates in Table 3 propose that exchange rate, consumption of households and oil price play negligible role in rising inflation in the short run, i.e., they have positive insignificant impact on inflation in the short run. Ceteris paribus, if exchange rate, consumption of households and oil price rise by 10%, inflation will increase by 6.99 units, 0.1995 units and 4.131 units respectively in the short run; with none of them being statistically significant. In other words, exchange rate devaluation or depreciation, surge in oil price and boost in household spending play inconsequential role in rising inflation in the short run in the OPEC. Just like in the short run, in the long run, our evidence in Table 3 suggests that the role of households' consumption in increasing inflation is immaterial. If consumption of households increases by 10%, inflation rises by 0.40 units in the long run and is not statistically significant at any level; suggesting that the consumption of household is not a major determinant of inflation in the long run. On the other hand, the evidence reveals that oil price and exchange rate are major determinants of inflation in the OPEC in the long run. Table 3 affirms that a 10% soar in oil price and exchange rate will increase inflation by 0.1718 units and 0.3953 units respectively in the long run, and both are statistically significant at 1% level of significance; implying that the variables are key factors that cause inflation in the OPEC in the long run. Since these countries are oil exporters, we carry out robustness check in which we use WTI to investigate whether the impact of oil price on inflation is sensitive to

the oil price used and the result is presented in Table 4.

Table 4: Symmetric Panel ARDL Estimates with WTI Oil Price

	MG	PMG		MG	PMG
Short Run			Long run		
Variable	Coefficient	Coefficient	Variable	Coefficient	Coefficient
$\Delta \ln exr_t$	69.61 (-63.40)	69.77 (-61.13)	$\ln exr_t$	I6.60 (-9.632)	3.968*** (-0.706)
$\Delta \ln op_t$	-2.461 (-2.221)	2.871 (-6.045)	$\ln op_t$	16.69 (-13.07)	2.007*** (-0.679)
$\Delta \ln hhc_t$	8.72 (-13.93)	41.32 (-32.95)	$\ln hhc$	56.40 (-44.70)	0.323 (-0.584)
$ect(-1)$	-0.751*** (-0.0791)	-0.664*** (-0.0692)	Constant	-11.15 (-883.3)	-0. 7748 (-61.88)
Hausman test x^2			1.42 [0.7016]		
No. of Cross Sections			16		
No. of Observations			352		

Note: *** represents statistically significant at 1% level.

The hausman test suggests that the PMG estimator is preferred over the MG for the robustness check - the chi-square value is not statistically significant. The Result confirms that in the short run, oil price is not a major determinant of inflation; it has positive but statistically insignificant impact on inflation. On the other hand, the result supports that oil price is a major variable that increases inflation, i.e., its impact on inflation is positive and statistically significant at 1% level. We find that inflation rises by 0.2871 units in the short run and by 0.2007 units in the long run if oil price rises by 10%. Equally, the short and long run impacts of exchange rate and households' consumption on inflation do not change significantly; indicating that the estimates are insensitive to the oil price used. Hence, we conclude that the robustness check confirms that our result is highly reliable.

6. Summary and Conclusion

We investigate the impact of households' consumption, exchange rate and oil price on inflation in the OPEC using all the member countries. Annual data that span from 1995-2017 and panel ARDL model were employed for the study. We estimate the panel ARDL model using the MG and PMG, after which we expose the result produced by the two estimators to hausman test and the test confirms that the PMG is the efficient estimator of the two. Our findings reveal an evidence of short run positive statistically insignificant impact of exchange rate devaluation or depreciation, oil price and households' consumption on inflation. In the long run, consumption of households is positively, but insignificantly related to inflation. However, our evidence suggests that exchange rate and oil price have positive and statistically significant impact on inflation in the OPEC member countries in the long run. We therefore conclude that exchange rate, household consumption and oil price are weak determinants of inflation in the short run, while in the long run, exchange rate and oil price are major determinants of inflation in the OPEC.

7. Recommendations

Based on our findings, we recommend that the governments of OPEC member countries invest the revenue they generate from the sale of oil in the real sectors of their respective economies and not spend on consumption. This will increase the output and supply of goods and services, thereby reducing inflation. Besides, pragmatic policies capable of strengthening the rate at which their respective currencies are exchanged for the US Dollar should not only be formulated but also implemented. Strengthening the value of their currencies will reduce inflation in these countries in the long run.

8. Limitation of the Study

We intend to utilize data on the variable we use for the study for a time period longer than the period this study covers twenty-three years. Our desire is that the study covers the period 1980-2018. However, there is no complete data on some of the variables we use for the study for the years before 1995 for some countries. Similarly, there is no available data on the variables we use for this study for 2018.This limits the scope of the study to twenty-three years, i.e., from 1995-2017.

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