No.89-2021

Economic Studies

Asymmetric Responses of Economic Growth to the Fluctuations in Oil Prices in the GCC Region

Jamel JOUINI

Sofiene GAALOUL

صندوق النقد العربي
ARAB MONETARY FUND

Asymmetric Responses of Economic Growth to the Fluctuations in Oil Prices in the GCC Region

Jamel JOUINI **Sofiene GAALOUL**

Arab Monetary Fund
December 2021

These economic studies are the product of the staff of the Economic Department at the AMF. The AMF publishes these studies which survey issues pertinent to monetary, fiscal, banking, trade and capital market policies and their impact on Arab economies.

All correspondence should be addressed to:
Economic Department
Arab Monetary Fund
P.O. Box 2818
United Arab Emirates
Telephone No.: +9712-6171552
Fax No: +9712-6326454
E-Mail: economic@amfad.org.ae
Website: www.amf.org.ae

Contents

Abstract 5
Introduction 7
1. Literature review 9
2. Model and estimation issues 12
2.1. Model 12
2.2. Estimation issues 13
3. Empirical illustration 16
3.1. Unit root analysis 17
3.2. Estimate results 18
3.3. Asymmetric impact of oil price 19
Conclusion and policy implications 21
References 23

List of Tables

Table 1. Summary statistics 26
Table 2. Cross-section dependence test results 26
Table 3. CIPS unit root test results...26
Table 4. Estimate results of the panel-ARDL model 27
Table 5. Estimate results of the panel-NARDL model..28

Abstract

The study employs the Pooled Mean Group (PMG) estimation approach in the framework of panel Autoregressive Distributive Lag (panel-ARDL) models to investigate the effects of changes in oil prices on economic growth in both the long-run and the short-run, by controlling for investment, labor force, and trade openness into the model, for the Gulf Cooperation Council (GCC) countries from 2000 to 2019. Given the increasing literature supporting the importance of the asymmetric analysis, we make use of the panel non-linear ARDL (panel-NARDL) model to examine the impacts of oil price increases and decreases on economic growth.

The findings indicate that real GDP reacts positively and significantly to oil price fluctuations in the long-run, thus meeting expectations. By decomposing oil price into increases and decreases, the asymmetric effect becomes obvious and the magnitude of the effect of oil price on real GDP becomes more important. Positive changes in oil prices have a positive and significant impact on real GDP, while negative changes in oil prices affect negatively and significantly real GDP in the long-run. In addition, the responses of real GDP to oil price decreases are higher than the responses to oil price increases, implying that economic activity seems to be more sensitive to negative than to positive oil price shocks. The results also reveal that investment and trade openness exert a positive and significant effect on real GDP.

These results imply that sustained increases in world oil prices lead to increase economic growth, to support the external and fiscal balance, and to boost savings, thus alleviating macroeconomic and financial vulnerabilities of the GCC countries. However, sustained oil price drops have adverse impacts on external and fiscal balance, savings, and economic growth of a higher magnitude than those of increases in oil prices. This insight incentivizes most GCC countries to implement economic diversification programs to reduce the reliance of economies to oil, especially in times of sharp oil price decreases, thus creating permanent sources of income.

Introduction

The relationship between economic growth and oil price has been extensively assessed in the economic development literature. Indeed, empirical studies have showed that the responses of economic growth to shocks in oil prices in developed and developing economies are divergent in the literature and depend on whether the country is oil-exporting or oil-importing (see Cunado and Perez-de Gracia, 2005; Blanchard and Gali, 2007; Lescaroux and Mignon, 2008; Berument et al., 2010; Du and Wei, 2010; Akinsola and Odhiambo, 2020; among others). Theoretical explanation of the growth-oil nexus focuses on both demand and supply-side impacts. Regarding the demand side, oil price declines lead to increase disposable income for oil-importing economies, thus enhancing the demand for other goods, especially commodities with high-income elasticity. As regards the supply side, increases in oil prices influence energy-based products, as they generate increases in production costs, thus rising inflation and affecting economic growth.

The current study examines the responses of economic growth to changes in oil prices in both the long-run and the short-run, conditioned on auxiliary drivers, namely investment, labor force, and trade openness, in the GCC countries over the period 2000-2019. The effect of fluctuations in oil prices on the GCC economies is twofold. First, oil price increases are beneficial to the GCC economies, as they have positive impacts on the terms of trade and the balance of payments. Second, drops in oil prices may influence steeply income of the GCC countries that are highly dependent on oil. The analysis is based on panel data models. Indeed, we make use of the PMG estimation approach in the framework of panel-ARDL models to assess the growth-oil nexus. We also opt for the panel-NARDL model to examine the asymmetric effects of oil price on economic growth by decomposing oil price into positive and negative changes.

The obtained results reveal that real GDP reacts positively and significantly to the changes in oil prices in the long-run, which is in line with expectations, while the relationship between economic growth and oil price is not significant in the short-run. When decomposing oil price into positive and negative changes, oil price increases affect significantly and positively real GDP, while negative changes in oil prices exert a significant and negative impact on real GDP in the long-run, which is aligned with expectations for oil-exporting countries. Investment and trade openness are also found to have a positive and significant effect on real GDP in the long-run.

The rest of the paper is structured as follows. Section 1 reviews previous studies in the field. Section 2 introduces the model and estimation issues to deal with the growth-oil nexus. Section 3 discusses the empirical results to highlight the asymmetric effects of oil price on economic growth. Concluding comments and policy implications of the outcomes are set forth at the end of the study.

1. Literature review

The growth-oil nexus in oil-exporting and importing countries has received increasing attention in the literature. Within this context, Hamilton (1983) outlines that oil price shocks contribute to some of the US economic recessions prior to 1972. Cunado and Perez de Gracia (2005) examine the sensitivity of economic activity and consumer price indexes to oil price shocks for a set of six Asian economies over the period 1975-2002. The findings reveal that oil price affects significantly economic activity and consumer price indexes only in the short-run. In addition, the macroeconomy-oil nexus is found to be asymmetric for some Asian economies. Guo and Kliesen (2005) examine the responses of US macroeconomic activity to oil price shocks over the period 1984-2004. The results indicate that future GDP growth reacts negatively and significantly to a volatility proxy built based on daily crude oil futures prices.

Jiménez-Rodríguez and Sánchez (2005) investigate the sensitivity of real economic activity to oil price shocks for some OECD countries based on VAR models. It is found that positive changes in oil prices influence GDP growth of a higher magnitude than that of negative changes in oil prices. Blanchard and Gali (2007) assess the macroeconomic performance of industrialized countries in response to oil price shocks, and show that the responses of expected inflation to oil price fluctuations have greatly decreased over time. Hanabusa (2009) assesses the growth-oil nexus for the Japanese economy over the period 2000-2008 in the framework of Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) models. The estimate results reveal bidirectional Granger-causality in mean and variance between economic growth and oil price changes.

Balke et al. (2010) investigate the effects of supply and demand shocks in oil prices on US economic activity based on a dynamic stochastic general equilibrium model. The results indicate that oil price fluctuations have been driven significantly by oil supply and demand shocks, and that domestic shocks have contributed largely to US output fluctuations. Berument et al. (2010) examine the responses of the output growth to oil price shocks for a set of selected Middle East and North Africa (MENA) economies based on Vector Autoregressive (VAR) models. The outcomes reveal that the outputs of Algeria, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Syria, and the United Arab Emirates respond significantly and positively to oil price increases. On the other hand, oil price shocks do not have the power to exert any significant impact on the outputs of Bahrain, Djibouti, Egypt, Israel, Jordan, Morocco, and Tunisia.

Du et al. (2010) assess the links between the macroeconomy and oil price for China from 1995 to 2008 based on VAR models. The results show evidence of a significant effect of oil price on economic growth and inflation. However, economic activity is not a relevant driver of oil price, suggesting that oil price is still exogenous with respect to the macroeconomy in China. Ahmed and Wadud (2011) investigate the effects of oil price volatility on macroeconomic indicators in Malaysia in the framework of structural VAR models over the period 1986-2009. The results reveal a prolonged moderating impact of oil price shocks on the industrial production. They also indicate that oil price volatility is the second most influential factor to explain the industrial production variance after its own shocks.

Akinsola and Odhiambo (2020) investigate the responses of economic growth to oil price changes in seven African oil-importing countries over the period 1990-2018 in the framework of panel data models. The findings reveal that oil price affect negatively economic growth in the long-run. By decomposing oil price into positive and negative changes, the results show that oil price decreases have positive effects on economic growth, while oil price increases exert a negative impact on economic growth. The study recommends policymakers to establish efficient energy policies to mitigate oil price risks.

More recently, Sarmah and Bal (2021) examine the reactions of economic growth and inflation to oil price fluctuations over the period 1997-2016 in India based on structural VAR models. The outcomes reveal a positive relationship between oil price and inflation and negative links between oil price and economic growth. By decomposing oil price into positive and negative changes, the findings show evidence of a similar result in the case of oil price increases on economic growth and inflation, and of a significant negative relationship in the case of oil price decreases on economic growth.

2. Model and estimation issues

2.1. Model

The empirical model to assess the sensitivity of economic growth to oil price changes, conditioned on three relevant auxiliary variables (investment, labor force, and trade openness), for a panel dataset of six GCC countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE)) based on annual data[1] over the period 2000-2019,[2] is specified as follows:

$$RGDP_{it} = \alpha_0 + \alpha_1 OIL_{it} + \alpha_2 GCF_{it} + \alpha_3 LF_{it} + \alpha_4 TO_{it} + u_{it} \quad (1)$$

where the cross-section index $i = 1, 2, \dots, N$ refers to the country, the time-dimension index $t = 1, 2, \dots, T$ refers to the time period, $RGDP_{it}$ represents the real gross domestic product (constant 2010 US$), OIL_{it} depicts oil price,[3] GCF_{it} is the gross capital formation as

[1] Data are sourced from the World Development Indicators (published by the World Bank) and the United Nations Conference on Trade and Development (UNCTAD) databases.

[2] The sample period is long enough to examine the sensitivity of economic growth and oil price changes, conditioned on relevant drivers, in the panel data framework.

[3] We consider the Brent spot oil price, which benchmarks about two thirds of the world crude oil production, including GCC countries' production, and several oil-

a share of GDP, LF_{it} is the labor force participation rate proxied by the proportion of the population ages 15-64 that is economically active, TO_{it} is the trade openness measured by the sum of exports and imports of goods and services as a percentage of GDP,[4] and u_{it} refers to the disturbance term.

2.2. Estimation issues

In order to examine the growth-oil nexus, we make use of panel-ARDL model developed by Pesaran et al. (1999). This approach has the advantage to consider variables integrated of order zero, $I(0)$, and/or variables integrated of order one, $I(1)$, to provide consistent coefficient estimates even in case of endogenous independent variables, to employ a single equation instead of a system of equations, to be suitable for any simple size unlike other cointegration procedures that are sensitive to sample size and cannot be used with small samples, to introduce heterogeneity in the

based products. Additionally, there is no available data for domestic oil price for the GCC countries, suggesting that the Brent oil price can be considered as the best uniform substitute.

[4] Table 1 reports summary statistics of the variables. There is evidence of substantial variations in the oil price since the maximum value represents four and a half times the minimum value. It is also found that real GDP is positively correlated to oil price and negatively connected to the auxiliary drivers. These insights are not conclusive regarding the causality between the variables and, thus, an in-depth analysis of the growth-oil nexus based on reliable estimation issues is required to achieve the study objectives.

Note that $y_{i,t-1} - \varphi_i' X_{it}$ represents the error correction term that stands for the long-run relationship between the variables, the coefficient θ_i is expected to be statistically significant and negative[5] and measures the speed of adjustment of real GDP towards its long-run equilibrium state in case of any disturbance in the independent variables, and the coefficients β_{ij}^* and γ_{ij}^* assess the short-run effects of the past own values of real GDP and the explanatory variables on the current values of real GDP.

Since economic agents respond differently to oil price changes (see Raheem, 2017), we assess the long-run and short-run asymmetric responses of economic growth to oil price fluctuations by decomposing oil price into negative and positive changes for each country i as follows:

$$\begin{cases} OIL_{it}^{+} = \sum_{j=1}^{t} \max(\Delta OIL_{ij}, 0) \\ OIL_{it}^{-} = \sum_{j=1}^{t} \min(\Delta OIL_{ij}, 0) \end{cases} \qquad i = 1, 2, \dots, 6$$

We adapt the non-linear ARDL (NARDL) model, developed by Shin et al. (2014) for time series, to the panel setting. As a result, the panel-

[5] The statistical significance and negativity of the coefficient θ_i point to cointegration between real GDP and the set of independent variables.

dynamic panel setting, the short-run dynamics and the long-run equilibrium state, and to investigate both the short-run and long-run linkages simultaneously. Specifically, the panel-ARDL(p, q) model takes the following form:

$$y_{it} = \mu_i + \delta_i t + \sum_{j=1}^{p} \beta_{ij} y_{i,t-j} + \sum_{j=0}^{q} \gamma'_{ij} X_{i,t-j} + \varepsilon_{it} \qquad (2)$$

where y_{it} is the dependent variable (real gross domestic product), $X_{it} = (OIL_{it}, GCF_{it}, LF_{it}, TO_{it})$ is the vector of independent variables, μ_i and δ_i represent the country specific effects, ε_{it} is the error term, and p and q are the numbers of time lags that are selected by the Schwarz information criterion.

In order to structure the long-run and short-run dynamics, the error correction model is specified as follows:

$$\Delta y_{it} = \mu_i + \delta_i t + \theta_i \left(y_{i,t-1} - \varphi'_i X_{it} \right) + \sum_{j=1}^{p-1} \beta^*_{ij} y_{i,t-j} + \sum_{j=0}^{q-1} \gamma^{*\prime}_{ij} X_{i,t-j} + \varepsilon_{it} \qquad (3)$$

where Δ stands for the first difference operator and

$$\begin{cases} \theta_i = \sum_{j=1}^{p} \beta_{ij} - 1, \quad \varphi_i = \dfrac{\sum_{j=0}^{q} \gamma_{ij}}{1 - \sum_{j=1}^{p} \beta_{ij}} \\ \beta^*_{ij} = -\sum_{l=j+1}^{p} \beta_{il}, \quad \gamma^*_{ij} = -\sum_{l=j+1}^{q} \gamma_{il} \end{cases}$$

NARDL(p, q) model and the error correction model are given by Eqs. (2)-(3), respectively, with $X_{it} = (OIL_{it}^{+}, OIL_{it}^{-}, GCF_{it}, LF_{it}, TO_{it})$.

The error correction models resulting from the panel-ARDL(p, q) and panel-NARDL(p, q) models are estimated by either the Mean Group (MG) or the Pooled Mean Group (PMG) estimation approaches. The MG estimator, developed by Pesaran and Smith (1995), allows all model coefficients to be heterogeneous across countries over both the long-run and the short-run. However, the PMG estimator, proposed by Pesaran et al. (1999), allows homogeneous coefficients across countries over the long-run, and heterogeneous coefficients and error correction terms across countries over the short-run. To select between the MG and PMG estimators, we can conduct the Hausman test, discussed by Pesaran et al. (1996), to test for homogeneity of the long-run coefficients across countries. Indeed, in case of long-run homogeneity, we opt for the PMG estimator; however, we favor the MG estimator if the test rejects the long-run homogeneity.

3. Empirical illustration

We assess the variables' integration order by performing a panel unit root test. If the variables are not integrated of order two, $I(2)$, we examine the growth-oil nexus by estimating the panel-ARDL model to determine the effects of oil price and the auxiliary determinants on real GDP over both the long-run and the short-run. We finally assess the asymmetric responses of economic growth to oil price changes by estimating the panel-NARDL model.

3.1. Unit root analysis

To check whether the above econometric approach is suitable, we test for unit root to determine the variables' integration order. For this purpose, the unit root test (CIPS) of Pesaran (2007) is conducted based on two test equations, namely a specification with intercept only and a specification with intercept and time trend. The test allows for heterogeneity of the variables, as countries may behave differently given some intrinsic features in terms of the economic climate of the GCC economies. In addition, it accounts for cross-section dependence, as GCC countries are economically linked and share common features regarding economic and trade policies.

Before applying the unit root test, we check for dependence across countries by conducting the cross–section dependence test (CD) of Pesaran (2004), that has satisfactory size and power properties even for small values of the cross-section and time series dimensions, N and T. The test is based on the pairwise cross–country correlation coefficients of the ordinary least squares (OLS) residuals from the estimated individual ADF regressions. The results presented in Table 2 indicate that the test concludes in favor of cross–country dependence since it rejects the null hypothesis of no cross-section dependence at the 1% significance level for all variables. Therefore, the CIPS test is suitable to examine the integration properties of the variables under consideration.

The CIPS test results reported in Table 3 reveal that real GDP, oil price, gross capital formation, and labor force are stationary at first difference regardless of the test specification. However, trade openness is stationary at level for the specification with intercept only, and stationary at first difference for the specification with intercept and time trend. Therefore, we can opt for the above models to assess the growth-oil nexus with respect to other auxiliary drivers, as the variables under consideration are not integrated of order two, $I(2)$.

3.2. Estimate results

The Hausman test, discussed by Pesaran et al. (1996), concludes in favor of long-run coefficients homogeneity across countries, implying that we opt for the PMG estimator to assess the growth-oil nexus. The PMG estimate results reported in Table 4 reveal the long-run and short-run estimates[6] and the adjustment speed towards the steady-state. The long-run estimates indicate that real GDP responds positively and significantly to oil price changes, as the related coefficient is positive and statistically significant at the 1% level. This outcome meets the expectation that oil price has the power to

[6] Note that the PMG short-run estimates are obtained by averaging the coefficients across countries.

influence positively GDP for GCC countries. The auxiliary drivers do not exert a significant effect on real GDP, except for gross capital formation.

Regarding short-run estimates, the oil price and most auxiliary variables are not relevant drivers of real GDP, as the related coefficients are not statistically significant at conventional levels. However, the error correction term is statistically significant and negative, thus meeting the theoretical requirements and suggesting the return to the long-run equilibrium state in case of any disturbance in the independent variables. Indeed, the current deviations from the steady-state are corrected by 7.1% in the next year, implying that the convergence to the long-run equilibrium state will be restored in 14 years.

3.3. Asymmetric impact of oil price

We assess the magnitude of the responses of real GDP to oil price increases and decreases, thus highlighting the asymmetric effect of oil price on economic growth. For this purpose, as mentioned earlier, we estimate the panel-NARDL model that includes oil price increases and decreases as independent variables instead of oil price. The Hausman test shows evidence of homogeneous coefficients over the long-run across countries, suggesting that the PMG estimation approach is appropriate to assess the asymmetric effect of oil price. The estimate results reported in Table 5 reveal that by decomposing oil price into positive and negative changes, the asymmetric effect becomes obvious. Indeed, the PMG long-run estimates indicate that oil price increases affect positively and significantly real GDP, while oil price decreases exert a negative and significant impact on real GDP. It is worth noting that the magnitude of the effect of oil price on real GDP becomes more important after decomposing oil price into positive and negative changes. Additionally, the magnitude of the responses of real GDP to negative changes in oil prices is higher than that of the responses to positive changes in oil prices.[7]

These outcomes have pertinent macroeconomic and financial implications for the GCC economies. Indeed, sustained rises in global oil prices lead to increase economic growth, to enhance the external and fiscal balance, and to improve savings of the GCC economies. However, sustained oil price decreases have adverse effects on external and fiscal balance, savings, and economic growth of a higher magnitude than those of oil price increases.

The results also reveal that the auxiliary drivers, namely investment and trade openness have the power to influence positively and significantly real GDP over the long-run. Regarding the short-run estimates, most determinants are not relevant drivers of real GDP, as the related coefficients are not statistically significant at conventional levels. As expected, the error correction term is statistically

[7] In a similar context, Jiménez-Rodríguez and Sánchez (2005) show that positive changes in oil prices exert an effect on GDP growth of a higher magnitude than that of negative changes in oil prices for the OECD economies.

significant and negative, implying a return to the steady-state in case of any disturbance in the independent variables.

Conclusion and policy implications

The study presents an empirical analysis of the relationship between real GDP and oil price, conditioned on three relevant auxiliary drivers, namely investment, labor force, and trade openness, for a panel of six GCC economies over the period 2000-2019. The panel-ARDL model and the PMG estimation approach are employed to examine the nexus. Given the increasing empirical studies supporting the need to conduct an asymmetric analysis, the effects of positive and negative changes in oil prices on economic growth are investigated by adopting the PMG estimation approach in the framework of panel-NARDL models.

The estimate results indicate that real GDP responds positively and significantly to oil price fluctuations in the long-run, while the growth-oil nexus is not significant in the short-run, implying that the positive impact of oil price on real GDP is limited to the long-run. When decomposing oil price into positive and negative changes, the findings bring new insights into the relationship between real GDP and oil price. Indeed, positive changes in oil prices have the power to significantly and positively affect real GDP, while oil price decreases exert a significant and negative effect on real GDP in the long-run, which is consistent with expectations for oil-exporting economies. It is also found that investment and trade openness have a positive and significant impact on economic growth in the long-run, which is aligned with the theory that conventional drivers boost economic growth.

Our outcomes reveal that sustained increases in oil prices lead to support economic growth, to improve the external and fiscal balance, and to boost savings, thus alleviating macroeconomic and financial vulnerabilities of the GCC economies. On the other hand, sustained decreases in oil prices impact negatively on economic growth, justifying recourse of most GCC countries to implement economic diversification programs to reduce the reliance of economies to oil, especially in times of sharp oil price declines, thus creating permanent sources of income.

References

Ahmed, H.J.A. and Wadud, I.M. (2011). Role of oil price shocks on macroeconomic activities: An SVAR approach to the Malaysian economy and monetary responses. Energy Policy, 39, 8062–8069.

Akinsola, M.O. and Odhiambo, N.M. (2020). Asymmetric effect of oil price on economic growth: Panel analysis of low-income oil-importing countries. Energy Reports, 6, 1057–1066.

Balke, N.S., Brown, S.P.A. and Yücel, M.K. (2010). Oil price shocks and U.S. economic activity: An international perspective. Research Department Working Paper 1003, Federal Reserve Bank of Dallas.

Berument, M.H., Ceylan, N.B. and Dogan, N. 2010. The impact of oil price shocks on the economic growth of selected MENA countries. The Energy Journal, 31, 149–176.

Blanchard, O.J. and Gali, J. (2007). The macroeconomic effects of oil shocks: Why are the 2000s so different from the 1970s? Working Paper 13368, NBER Working Paper Series.

Cunado, J. and Perez de Gracia, F. (2005). Oil prices, economic activity, and inflation: Evidence for some Asian countries. The Quarterly Review of Economics and Finance, 45, 65–83.

Du, L., He, Y. and Wei, C. (2010). The relationship between oil price shocks and China's macroeconomy: An empirical analysis. Energy Policy, 38, 4142–4151.

Guo, H. and Kliesen, K.L. (2005). Oil price volatility and U.S. macroeconomic activity. Federal Reserve Bank of St. Louis Review, 87, 669–683.

Hamilton, J.D. (1983). Oil and the macroeconomy since world war II. Journal of Political Economy, 91, 228–248.

Hanabusa, K. (2009). Causality relationship between the price of oil and economic growth in Japan. Energy Policy, 37, 1953–1957.

Jiménez-Rodríguez, R. and Sánchez, M. (2005). Oil price shocks and real GDP growth: Empirical evidence for some OECD countries. Applied Economics, 37, 201–228.

Lescaroux, F. and Mignon, V. (2008). On the influence of oil prices and other macroeconomic and financial variables. OPEC Energy Review, 32, 343–380.

Pesaran, M.H. (2007). A simple panel unit root test in the presence of cross-section dependence. Journal of Applied Econometrics, 22, 265–312.

Pesaran, M.H. (2004). General diagnostic tests for cross section dependence in panels. University of Cambridge. Working Paper No. 435.

Pesaran, M.H., Shin, Y. and Smith, R. (1999). Pooled mean group estimation of dynamic heterogeneous panels. Journal of the American Statistical Association, 94, 621–634.

Pesaran, M.H., Smith, R.P. and Im, K.S. (1996). Dynamic linear models for heterogeneous panels. Chap.5 in Matyas and Sevestre.

Pesaran, M.H. and Smith, R.P. (1995). Estimating long-run relationships from dynamic heterogeneous panels. Journal of Econometrics, 68, 79–113.

Raheem, I.D. (2017). Asymmetry and break effects of oil price-macroeconomic fundamentals dynamics: The trade effect channel. The Journal of Economic Asymmetries, 16, 12–25.

Sarmah, A. and Bal, D.P. (2021). Does crude oil price affect the inflation rate and economic growth in India? A new insight based on structural VAR framework. Forthcoming in The Indian Economic Journal, https://doi.org/10.1177/0019466221998838.

Shin, Y., Yu, B. and Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In: Sickles R., Horrace W. (eds) Festschrift in Honor of Peter Schmidt. Springer, New York, NY.

Table 1. Summary statistics

Variable	Mean	Max.	Min.	Std. Dev.	Corr.
RGDP	1.93E+11	7.04E+11	1.53E+10	1.90E+11	-
OIL	64.588	111.571	24.456	28.516	0.128
GCF	25.892	48.869	10.666	7.510	-0.001
LF	70.905	88.510	50.820	10.835	-0.342
TO	106.746	191.873	61.862	31.274	-0.207

Note: Corr. denotes correlation between real GDP and the other variables.

Table 2. Cross-section dependence test results

Variable	CD statistic	Prob.
RGDP	16.506*	0.000
OIL	17.321*	0.000
GCF	9.099*	0.000
LF	15.220*	0.000
TO	8.507*	0.000

Notes: The CD test is normally distributed under the null hypothesis of no cross-section dependence. * denotes cross–country dependence at the 1% level.

Table 3. CIPS unit root test results

	Level		First difference	
Variable	Intercept	Trend	Intercept	Trend
RGDP	-1.834	-2.642	-2.418**	-3.354***
OIL	-1.545	-2.682	-2.558**	-3.154**
GCF	-2.033	-2.591	-4.284***	-3.537***
LF	-2.164	-1.687	-2.957***	-3.258***
TO	-2.745***	-2.081	-3.388***	-3.538***

Notes: The CIPS test is built under the null hypothesis of unit root. For the variables in level, the critical values of the CIPS test are -2.61 (1%), -2.35 (5%) and -2.21 (10%) for the model with intercept, and -3.17 (1%), -2.89 (5%) and -2.74 (10%) for the model with trend. For the variables in first difference, the critical values of the CIPS test are -2.62 (1%), -2.35 (5%) and -2.21 (10%) for the model with intercept, and -3.19 (1%), -2.90 (5%) and -2.75 (10%) for the model with trend. *** and ** denote stationarity at the 1% and 5% levels, respectively.

Table 4. Estimate results of the panel-ARDL model

Exp. Variable	Coefficient	Std. Dev.
Long-run		
Oil	0.011***	0.004
GCF	0.045*	0.024
LF	0.058	0.038
TO	0.015	0.015
Short-run		
ECT	-0.071*	0.037
D(OIL)	-4.18E-4	2.56E-4
D(GCF)	-0.003***	0.001
D(LF)	-0.006	0.018
D(TO)	0.001	0.001
Constant	1.336*	0.693
Trend	-0.004**	0.002

Notes: "D" stands for first difference. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5. Estimate results of the panel-NARDL model

Exp. Variable	Coefficient	Std. Dev.
Long-run		
Oil^{+}	0.037^{***}	0.003
Oil^{-}	-0.078^{***}	0.006
GCF	0.190^{***}	0.015
LF	-0.002	0.002
TO	0.228^{***}	0.019
Short-run		
ECT	-0.010^{***}	0.001
D(RGDP(-1))	-0.062	0.248
$D(OIL^{+})$	-0.001	0.001
$D(OIL^{+}(-1))$	-0.001	0.001
$D(OIL^{-})$	0.001	0.001
$D(OIL^{-}(-1))$	-0.001	0.001
D(GCF)	-0.004^{**}	0.002
D(GCF(-1))	-0.003	0.007
D(LF)	-0.011	0.019
D(LF(-1))	0.043^{**}	0.019
D(TO)	-0.001	0.004
D(TO(-1))	0.006	0.004
Constant	0.097^{***}	0.033
Trend	-0.013	0.008

Notes: "D" stands for first difference. *** and ** denote statistical significance at the 1% and 5% levels, respectively.

http://www.amf.org.ae

صـنـدوق النـقـد الـعـربــي
ARAB MONETARY FUND