Economics Bulletin

Volume 37, Issue 3

The threshold effect of oil-price shocks on economic growth

Nabil Alimi
University of Tunis el Manar , Faculty of Economic Sciences and Management of Tunis

Nabil Aflouk
University of Jendouba, Faculty of Law, Economics and Management of Jendouba

Abstract

This paper investigates the effects of positive and negative oil price shocks on economic growth in GCC economies over the period 1980 - 2015, using the Panel Smooth Transition Regression (PSTR) model. The findings confirm that firstly, the relationship between economic growth and oil price shocks is non-linear and it is characterized by the presence of a threshold effect. Secondly, the effect of the oil price shock is larger than as long as it is below the threshold level.

The authors are grateful to the referees for their comments leading to the improvement of the paper.
Citation: Nabil Alimi and Nabil Aflouk, (2017) "The threshold effect of oil-price shocks on economic growth", *Economics Bulletin*, Volume 37, Issue 3, pages 1942-1958
Contact: Nabil Alimi - nabil.alimi@fsegt.rnu.tn, Nabil Aflouk - aflouknabil@yahoo.fr.
Submitted: March 27, 2017. **Published:** August 31, 2017.

1 Introduction

Despite an abundance literature discussing the effect of oil price shock on the net oil importing countries, few studies have been interested to oil exporters. Farzanegan and Markwardt(2009)[10] proved a positive link between positive oil price changes and industrial output growth for the Iranian economy. Mehrara and Mohaghegh (2011)[26], in their panel VAR study for OPEC countries, found that oil shocks have significant positive impacts on economic output. Elotony and Al-Awadi (2001)[8] showed that oil price shocks are the main determinants in Kuwait economic activities. The same effect was demonstrated by Emami and Adibpour (2012) for Iran economy. In Negeria, output is not affected by the oil price shock, as it was shown by Olomola and Adejumo (2006)[28]. Berument et al.(2010)[4] pointed out that the effect of a positive oil price shock on the output of most oil net exporting countries is positive and significant and vice-versa. Berument and Ceylan (2007)[4] indicated that, in some selected MENA countries, the effect of positive oil price shock on the output of most producing countries is positive and significant.

Nevertheless, a large body of researchers argued that the suggestion that oil price shocks contribute directly to economic downturn remains controversial. A number of authors have attributed this live debate to mis-specification of the functional form. Loungani (1986)[23], Mork (1989)[27], Lee et al. (1995)[19], Hamilton (1996)[14], Davis et al. (1996), Davis and Haltiwanger (2001)[7], Balke et al. (2002)[2], and Cuñado and Gracia (2003)[6], among others, have suggested that the relation between oil prices and economic activity is nonlinear.

Sadorsky (1999)[30] used a two-regime model and investigated the asymmetrical relationship between economic activities and oil price changes, proved a nonlinear relation between the oil price change (or its volatility) and economic activities (output, stock returns, and interest rates).

Hamilton (2003)[15] strongly supported the claim of a nonlinear relation: oil price increases affect the economy whereas decreases do not. Hamilton made evident that the relation between oil prices and GDP is nonlinear and he suggests that one should use a nonlinear function of oil price changes if the goal is to predict the economic growth and it is clear that oil price increases are much more important for predicting GDP than they are decreases.

Looking at the asymmetric effect of oil price changes on the output for a set of European countries, Cuñado and Garcia (2003) provided the evidence that a non-linear relationship may exist between oil price and output. Later, using a multivariate threshold model to analyze the impact of oil price change on economic activity in three industrial nations (Canada, Japan, and the US), Huang and al. (2005)[16] suggested the presence of threshold level and concluded that an oil price change or its volatility has a limited impact on the economies if the change is below the threshold levels. However, if the change is above the threshold levels, the change in oil price better explains macroeconomic variables than the volatility of the real interest rate for example.

Mehrara (2008)[25] found that oil revenue shocks tend to affect the output in asymmetric ways and nonlinear ways. While positive oil shocks have a limited effect on the economic growth, negative shocks decrease it significantly. Mehrara defined a threshold beyond which the oil revenue growth imposed a negative effect on the output[1]. In addition, Iwayemi and Fowowe (2011)[18] supported the existence of asymmetric effect of oil price.

Studying the dynamic relation between output, government expenditure, liquidity and oil revenue shocks in Iran by a Structural Vector Autocorrelation, Emami and Adibpour (2012)[9], demonstrated that a positive oil shock boosts the economic growth and the negative oil shock has a negative effect on output. Emami and Adibpour added that the coefficient of negative oil revenue shock is greater than that of the positive oil shock coefficient, which means asymmetric effects of oil revenue shocks on output.

In the line of these studies pointed out before, using the Panel Smooth Transition Regression (PSTR) model, the purpose of this paper is to study the effect of oil price shocks on economic growth in the Golf Corporation Council (GCC) states: Bahrain, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates[2], over the period 1980 - 2015, specifying the effect of positive and negative shocks. Indeed, altough the question of oil price shock is very important for net exporting countries, it is more important for those where oil revenue is the main financial source of government, and so it is the main source of macroeconomic fluctuation (Emami and Adibpour, 2012[9]), as it is the case of GCC states.

The findings prove that the economic performance of the GCC states is

[1] The symptom of the Dutch disease.

[2] Oman is exclude because missing data.

crucially depended on oil price shocks. We highlighted too, that the effects of the positive and negative oil price shocks are not linear but there is a threshold effect.

The rest of this paper is structured as follows. Section 2 presents the modeling approach. Section 3 reports the empirical results and Section 4 concludes.

2 Methodology

To study the link between economic growth and oil price shock for the GCC countries over the period 1980 - 2015, and see if there is a threshold effect in this relationship, we will use the Panel Smooth Transition Regression model (PSTR) developed by González et al. (2005)[11] which is an enlargement of the Panel Transition Regression model (PTR) proposed by Hansen (1999). PSTR representation with two regimes is defined as follow :

$$z_{it} = \mu_i + \beta_0^{'} X_{it} + \beta_1^{'} X_{it} g(q_{it}; \gamma, c) + \varepsilon_{it} \tag{1}$$

With z_{it} denoting the dependent variable which is the real Gross Domestic Product (GDP) growth rate expressed as a log difference. μ_i represents the individual fixed effects, and ε_{it} are the errors.

X_{it} is a vector of k exogenous variables including the control variables and an oil price shock measure (the interest variable) .

Following Levine and Renelt (1992)[22] paper's where they identified the main control variables for growth models, and the theoretical contributions to the new growth theory literature following Romer (1990)[29], the control variables[3] included in equation 1 are: financial development (FINDEV) measured by the credit to Private sector / GDP, human capital (HK) measured as the average years of schooling for individuals in the total population over age 25 in 1980, investment (INVEST) defined as the investment fraction of GDP ($\frac{I}{GDP}$), and the population growth rate (POP).[4] .

$\sigma =$ A measure of oil-price shocks. The empirical literature on this subject defined different measures of oil price shocks (Hamilton, 1983[13], 1996 and

[3]Control variables are from World Development Indicators, except the measure of human capital which is from Barro and Lee.

[4]See Appendix A for the sources and descriptive statistics.

2003; Mork, 1989; Lee et al.,1995, etc...)[5]. In this paper we use the following proxies of oil price shocks. First, we distinguish between positive and negative oil price changes separately as follows:

$$\begin{cases} \Delta\ ln\ oil^{+}_{i,t} = max(0, \Delta\ ln\ oil_t) \\ \Delta\ ln\ oil^{-}_{i,t} = -min(0, \Delta\ ln\ oil_t) \end{cases} \tag{2}$$

Later, we use the proxy defined by Lee et al., the *scaled oil price increases.*

$$SOPI_t = max\left(0, \frac{\hat{\varepsilon}_t}{\sqrt{\hat{h}_t}}\right) \tag{3}$$

$$SOPD_t = -min\left(0, \frac{\hat{\varepsilon}_t}{\sqrt{\hat{h}_t}}\right) \tag{4}$$

SOPI stands for scaled oil price increases (positive oil price shock), while SOPD stands for oil price decreases (negative oil price shock).

Where:

$$\begin{cases} \Delta\ oil_t = \alpha + \sum_{j=1}^{k} \beta_j \Delta oil_{t-j} + \varepsilon_t,\ \varepsilon_t \mid I_t \to N(0, h_t) \\ h_t = \gamma_0 + \gamma_1 \varepsilon^2_{t-1} + \gamma_2 h_{t-1} \end{cases} \tag{5}$$

Hence, we estimate firstly the effect of a positive oil price shock using the two measure of this later ($\Delta\ ln\ oil^{+}_{i,t} = max(0, \Delta\ ln\ oil_t)$ and $SOPI_t = max\left(0, \frac{\hat{\varepsilon}_t}{\sqrt{\hat{h}_t}}\right)$). Secondly, we study the effect of a negative oil price shock on macroeconomic growth using the both measure as it was defined ($\Delta\ ln\ oil^{-}_{i,t} = -min(0, \Delta\ ln\ oil_t)$ and $SOPD_t = -min\left(0, \frac{\hat{\varepsilon}_t}{\sqrt{\hat{h}_t}}\right)$).

g(q_{it};γ,c) is the transition function, normalized and bounded between 0 and 1, q_{it} the threshold variable, γ the speed of transition from one regime to the other and c is the threshold parameter[6]. The error term ε_{it} is independent and identically distributed.

To estimate the PSTR model González et al. (2005) propose the follwing procedure: (i) Test the linearity against the PSTR model; (ii) Parameter

[5]See Mehrara (2008) for more details.

[6]In this model, the observations in the panel are divided into two regimes (it is possible to extend the PSTR model to more than two regimes) depending on whether the threshold variable is lower or larger than the threshold c

estimation[7]; (iii) Test for number of transition function.[8]

As it was point out before, the PSTR is an extension of the Panel transition Regression Model proposed by Hansen (1999) which is for stationary regressors. Therefore, we use the panel unit root tests (Levin-Lin-Chu (LLC) (Levin, Lin and Chu, 2002[21]), Im-Pesaran-Shin (IPS) [17], Fisher- Dikkey-Fuller (FDF) (Choi, 2001)[5], and Hadri (2000)[12] tests) to test the assumption that all variables in Equation 1 are *I(0)* process. Unit root tests results reported in table 1 show that all variables, except the financial development, (FINDEV) are *I(0)*. [9]

Table 1: **Panel unit root tests**

	LLC	IPS	FDF	Hadri
GDP	-9.371	-9.629	89.361	1.309
	(0.000)	(0.000)	(0.000)	(0.095)
FINDEV	1.640	1.669	4.635	4.396
	(0.949)	(0.952)	(0.914)	(0.000)
$\triangle FINDEV$	-6.607	-7.801	71.920	-0.631
	(0.000)	(0.000)	(0.000)	(0.736)
INVEST	-1.721	-2.315	22.907	3.760
	(0.000)	(0.010)	(0.011)	(0.101)
POP	-8.685	-10.132	99.619	-0.173
	(0.000)	(0.000)	(0.000)	(0.568)
$\Delta\ ln\ oil^{+}_{i,t}$	-8.757	-7.768	71.575	1.316
	(0.000)	(0.000)	(0.000)	(0.094)
$\Delta\ ln\ oil^{-}_{i,t}$	-7.836	-10.567	102.906	-0.773
	(0.000)	(0.000)	(0.000)	(0.000)
SOPI	-8.763	-8.977	85.001	-0.220
	(0.000)	(0.000)	(0.000)	(0.587)
SOPD	-7.760	-9.929	95.729	-0.475
	(0.000)	(0.000)	(0.000)	(0.682)

Source: authors' estimates

[7]The Nonlinear Least Squares Methods are used for estimation parameter.

[8]See Aflouk and Mazier[24] and Alimi and Aflouk (2017)[1] for more details.

[9]Financial development is I(1), thus in our estimation we introduce the first difference of FINDEV.

3 Results and Discussions

3.1 Linearity and results

Using the LM, LMF and LRT tests we check for the linearity of the relationship between oil price shock (positive and negative) and economic growth. If linearity hypothesis is rejected, we then determine the optimal number of transition functions to capture all the non-linearity relationships.

For the positive oil price shock we note specification 1 the regression where we use the first measure ($\Delta\ ln\ oil^{+}_{i,t} = max(0, \Delta\ ln\ oil_t)$) and specification 2 the one where we use the second measure ($SOPI_t = max\left(0, \frac{\hat{\varepsilon_t}}{\sqrt{\hat{h_t}}}\right)$). The same for the negative oil price shock we note specification 1 the regression where we use for the first measure ($\Delta\ ln\ oil^{-}_{i,t} = -min(0, \Delta\ ln\ oil_t)$ and specification 2 the one where we use the second measure ($SOPD_t = -min\left(0, \frac{\hat{\varepsilon_t}}{\sqrt{\hat{h_t}}}\right)$. The results of these tests are presented in table 2. The null hypothesis of linearity is rejected at the 5% significance level in the case of positive oil price shock (specification 1 and 2) and only for specification 2 in the case of a negative oil price shock[10]. We thus employ the PSTR model to estimate the effect of the oil price shock on economic growth in the GCC countries.

3.2 The effect of a positive oil price shock

The estimated slope coefficients for the PSTR model, the smoothing parameters, and thresholds parameters results are given in Table 3. The common result of the specification 1 and specification 2 is that the relationship between oil price shock and economic growth in the GCC economies is non-linear.

In the specification 1, where $\Delta\ ln\ oil^{+}_{i,t} = max(0, \Delta\ ln\ oil_t)$ was used as a proxy of oil price shock, the threshold effect is 3%. While, in the specification 2 where the scaled oil price increases ($SOPI_t = max\left(0, \frac{\hat{\varepsilon_t}}{\sqrt{\hat{h_t}}}\right)$) was used the threshold is nearly 103.3%. In the both specification, our findings prove that a positive oil price shock boost economic growth. However, we should mention that oil price shock impacts differently economic growth on

[10]Thus, in the case of the effect of a negative oil price shock, the regression will only be made with the second measure (SOPD).

Table 2: **Linearity tests versus the PSTR alternative**

	Positive oil price shock					
	Specification 1			**Specification 2**		
	LM	LMF	LRT	LM	LMF	LRT
H_0 : r = 0	3.992	3.946	4.037	3.689	3.641	3.727
vs						
H_1 : r=1	(0.045)	(0.048)	(0.044)	(0.045)	(0.050)	(0.035)
H_0 : r=1	5.079	2.512	5.152	3.766	1.848	3.806
vs						
H_1 : r=2	(0.078)	(0.084)	(0.076)	(0.152)	(0.160)	(0.149)

	Negative oil price shock					
	Specification 1			**Specification 2**		
	LM	LMF	LRT	LM	LMF	LRT
H_0 : r = 0	1.951	1.907	1.962	3.173	3.122	3.201
cvs						
H_1 : r=1	(0.162)	(0.169)	(0.161)	(0.048)	(0.028)	(0.035)
H_0 : r=1	42.067	1.005	2.079	4.921	2.431	4.990
vs						
H_1 : r=2	(0.162)	(0.169)	(0.161)	(0.085)	(0.090)	(0.082)

Source: authors' estimates

either side of the threshold.

The coefficient on oil price shock is larger than in regime 1 (in the both specifications 1 and 2). Precisely, in specification 1, when the oil price shock is less than 3%, a one standard deviation in the oil price around its mean leads to an increase in economic growth by 10.82%[11] when the transition function g(.) tends to 0. However, when the transition function g(.) tends to 1, a one standard deviation in the oil price change around its mean increases the economic growth by 0.22%[12]. In specification 2, below 103% a one standard deviation in the SOPI around its mean gives rise to an increase in economic growth by 3% in regime 1, and by 0.79% in regime 2. These results mean that while oil price shock (positive) is below the threshold level has a large positive effect on economic growth, and above the threshold level

[11] 0.814×0.133 (Std.dev of $\Delta\ ln\ oil^{+}_{i,t}$ in table 6, Appendix A) = 10.82%.

[12] The coefficient in the regime 2 is $= \beta_0 + \beta_1 = 0.814 + (-0.797) = 0.017$.

the effect of a positive oil price shock dies out, leading to a small change of economic growth.

The asymmetric effect of the positive oil price shock can be argued by the fact that in an-oil dependent economy, as it is the case of the GCC countries, the oil revenue streams following a positive oil price shock can finance productive investments and thus stimulate economic output until a certain level (threshold). However, above the threshold level the effect on economic growth is dampened because too much oil revenues lead to an increase in public spending which reduces spending quality. Thus the allocation of the oil revenues becomes more and more inefficient. Mehrara (2008) stipulated that "Efficiency often suffers from a high proportion of unfinished projects as well as from capital investments that cannot be effectively used because of shortages of recurrent resources". In addition, an oil boom with an appreciation of the real exchange rate[13], as it was noted in the case of the GCC countries, possibly increase consumption imports, deteriorate competitiveness and contracts the tradable sectors which can leads to a small economic growth.

Our findings for both specifications (specif.1 and specif.2) consistently show significant and negative effect of the population growth on economic growth. A decrease by 10 percentage points in the population rate will boost economic growth by 6 percentage points. Human capital have the expected sign and that it is always a locomotive to economic growth. The credit to private sector/GDP as a proxy of financial development (FINDEV), is an handicap to economic growth in the CCG states. This result reflect the fact that for oil exporting countries the predominance of oil activities, generally associated with less efficient allocation of resources, affects the efficiency of credit allocation by the financial sector. In oil-exporting countries, the beneficial effects of an increase in bank credit on growth are lower.

In order to check the robustness of our results, we employ the Instrumental-variables regression (IVR) to estimate the model which contains a quadratic interaction term as follow:

$$z_{it} = \mu_i + \beta_0' X_{it} + \beta_1' (oilpriceshock)^2 + \varepsilon_{it} \tag{6}$$

With *oilpriceshock* is one of the measures of oil price shock ($\Delta\ ln\ oil^{+}_{i,t}$, SOPI, $\Delta\ ln\ oil^{-}_{i,t}$ and SOPD). The interaction term is introduced in equation

[13]Especially over the first decade of 2000s.

(6) to examined nonlinear economic growth effect of oil price shock.

IV regression methodology gives coefficient estimates corrected for endogeneity, heteroskedasticity and autocorrelation. Since for the oil export countries, there are some factors that affect oil prices and economic growth simultaneously, we instrumented the oil price shock by the world economic growth rate. The results of the IV regressions for specification 1 and specification 2 are presented in column 4 and 5 of table 3. All coefficient signs of these regressions are consistent with those of PSTR regressions.

Table 3: **PSTR and IVR (Dependent variable: Growth rate of GDP)**

	PSTR		**IVR**	
Variables	**Specif.1**	**Specif.2**	**Specif.1**	**Specif.2**
FINDEV	-0.001**	-0.001**	-0.142*	-0.131*
	[-2.030]	[-2.072]	[-1.91]	[-1.68]
HK	0.002**	0.001**	0.238**	0.82
	[2.349]	[1.984]	[2.35]	[0.07]
INVEST	-0.025	-0.025	-0.030	0.034
	[-0.319]	[-0.317]	[-0.37]	[0.41]
POP	-0.660***	-0.741***	-0.675***	-0.854***
	[-4.468]	[-4.860]	[-4.49]	[-3.82]
$\Delta\ ln\ oil^{-}_{i,t}$	-0.021**	-	-1.351**	-
	[-2.336]	-	[-2.61]	-
$\Delta\ ln\ oil^{+}_{i,t}$	0.814**	-	29.125**	-
	[2.336]	-	[2.83]	-
$\Delta\ ln\ oil^{+}_{i,t}$ * G(.)	-0.797**	-	-	-
	[-2.167]	-	-	-
$(\Delta\ ln\ oil^{+}_{i,t})^2$	-	-	-66.159**	-
	-	-	[-197]	-
SOPD	-	-0.091***	-	-4.103*
	-	[-2.903]	-	[-1.68]
SOPI	-	0.059***	-	32.311*
	-	[2.749]	-	[1.66]
SOPI * G(.)	-	-0.044**	-	-
	-	[-2.121]	-	-
$SOPI^2$	-	-	-	-19.110*
	-	-	-	[-1.63]
c	0.0298	1.033	-	-
γ	5.000	5.000	-	-
F-stat	8.321	8.510	-	-
Significance level of F	0.000	0.000	-	-
Wald Chi2	-	-	47.96	49.75
Prob> Chi2	-	-	0.00	0.00

*Notes: Values in parentheses are t-values. ***, **, * indicate the estimate is signicant at 1%, 5% and 10%; respectively.*

3.3 The effect of a negative oil price shock

As long as the negative oil price shock is lower than the threshold level (39%), a one standard deviation in the oil price around its mean leads to a decreases in economic growth by 4.5%[14] when the transition function g(.) tends to 0. However, when the transition function g(.) tends to 1, a one standard deviation in the SOPD around its mean decreases the economic growth by 0.4%[15] .

Two arguments, at minimum, can be advanced to argue the asymmetry effect of the negative oil price shock. First, in an-oil dependent economy[16] a drop of the oil price until the threshold level (39%) leads to a fell of economic growth. Above this threshold governments put in place policies to reduce the negative effect of the decrease in oil price and the allocation resources is more efficient. For example The Kingdom of Saudi Arabia slashed its transport and infrastructure budget in 2016 by 63% compared to 2015. In Qatar many projects were been stalled or canceled. Second, the oil price and the exchange rate of the dollar usually move in the same direction, with a causality ranging from the price of crude to the exchange rate (Lescaroux and Mignon, 2008)[20]. Thus a depreciation of the dollar following a fall in the price of oil leads to a depreciation of the GCC exchange rate given that GCC countries' currencies (except Kuwait[17]) are pegged to the US dollar. The depreciation of the exchange rate can boost the competitiveness of the tradable sectors and subsequently reduces the negative effect of the fall in oil prices.

The population growth rate and the human capital are with the expected sign. The banking credit to private sector is negative and significantly associated to economic growth. This result reflect that in oil-exporting countries, the weakness of the finance-growth link is due to the low quality of bank intermediation and is in accordance of with the findings of Barajas et al.(2011)[3] and others who demonstrated that the greater the dependence of a country on oil, the lower the impact of financial development on growth.

[14] $0.045 = -0.079 \times 0.571 (Std.of SOPD)$.

[15] The coefficient in the regime 2 is $= \beta_0 + \beta_1 = -0.079 + 0.072 = -0.007$.

[16] In 2015, the hydrocarbon sector contributed around 28.9% to GDP and constituted 64.5of the GCC countries exports (Institute of International Finance, 27 July 2016).

[17] Kuwait is pegged to a basket of currencies dominated by the US dollar.

Table 4: **PSTR and IVR (Dependent variable: Growth rate of GDP)**

Variables	**PSTR**	**IVR**
FINDEV	-0.001*	-0.175**
	[-1.779]	[-2.27]
HK	0.001*	0.129
	[1.883]	[1.04]
INVEST	-0.008	-0.044
	[-0.110]	[-0.52]
POP	-0.679***	-0.644***
	[-4.576]	[-4.10]
SOPI	0.050***	0.019**
	[2.433]	[2.44]
SOPD	-0.079**	-14.107*
	[-2.102]	[-1.65]
SOPD* G(.)	0.072**	
	[2.205]	
$SOPD^2$	-	7.365*
	-	[1.67]
c	0.389	-
γ	5.00	-
F(6,173)	8.587	-
Significance level of F	0.000	-
Wald Chi2	-	45.00
Prob>Chi2	-	0.000

*Notes: Values in parentheses are t-values. ***, **, * indicate the estimate is signicant at 1%, 5% and 10%; respectively.*

4 Conclusions and policy implications

The aim of this paper was to study the effect of the oil price shock on economic growth in the GCC states. Some studies didn't fail to demonstrate the effect of the oil shock on economic growth in oil exporting countries. The contribution of this study is to test if there is a threshold effect. Using the PSTR model, we proved that over the period covered by this study GCC economy's performance crucially depends on the oil revenue. In addition, a negative oil shock weighs heavily on these economies. This finding may be made to the absence of the stabilization system to cushion the oil shock. In fact, these countries suffer from an undiversified economy with a high dependency to oil revenues originated from abroad. Thus, these economies are seriously asked to diversify the real sector and their budgetary resources to limit the harmful effects of oil price shocks, and efficiently allocate oil rents in the periods of oil price boom.

Furthermore, in the GCC states the credit allocation by the financial sector is less efficient which translates into a negative relationship between economic growth and the credit to private sector.

References

[1] Nabil Alimi and Nabil Aflouk. Terms-of-trade shocks and macroeconomic volatility in developing countries: panel smooth transition regression models. *The Journal of International Trade & Economic Development*, 26(5):534–551, 2017.

[2] Nathan S Balke, Stephen PA Brown, and Mine K Yücel. Oil price shocks and the us economy: Where does the asymmetry originate? *The Energy Journal*, pages 27–52, 2002.

[3] Adolfo Barajas, Ralph Chami, and Reza Yousefi. *The finance and growth nexus re-examined: Do all countries benefit equally?* Number 13-130. International Monetary Fund, 2013.

[4] M Hakan Berument, Nildag Basak Ceylan, and Nukhet Dogan. The impact of oil price shocks on the economic growth of selected mena countries. *The Energy Journal*, pages 149–176, 2010.

[5] In Choi. Unit root tests for panel data. *Journal of international money and Finance*, 20(2):249–272, 2001.

[6] Juncal Cuñado and Fernando Pérez de Gracia. Do oil price shocks matter? evidence for some european countries. *Energy Economics*, 25(2):137–154, 2003.

[7] Steven J Davis and John Haltiwanger. Sectoral job creation and destruction responses to oil price changes. *Journal of monetary economics*, 48(3):465–512, 2001.

[8] M Nagy Eltony and Mohammad Al-Awadi. Oil price fluctuations and their impact on the macroeconomic variables of kuwait: a case study using a var model. *International Journal of Energy Research*, 25(11):939–959, 2001.

[9] Karim Emami and Mehdi Adibpour. Oil income shocks and economic growth in iran. *Economic Modelling*, 29(5):1774–1779, 2012.

[10] Mohammad Reza Farzanegan and Gunther Markwardt. The effects of oil price shocks on the iranian economy. *Energy Economics*, 31(1):134–151, 2009.

[11] Andrés González, Timo Teräsvirta, and Dick van Dijk. Panel smooth transition regression models. Technical report, SSE/EFI Working Paper Series in Economics and Finance, 2005.

[12] Kaddour Hadri. Testing for stationarity in heterogeneous panel data. *The Econometrics Journal*, 3(2):148–161, 2000.

[13] James D Hamilton. Oil and the macroeconomy since world war ii. *The Journal of Political Economy*, pages 228–248, 1983.

[14] James D Hamilton. This is what happened to the oil price-macroeconomy relationship. *Journal of Monetary Economics*, 38(2):215–220, 1996.

[15] James D Hamilton. What is an oil shock? *Journal of econometrics*, 113(2):363–398, 2003.

[16] Bwo-Nung Huang, MJ Hwang, and Hsiao-Ping Peng. The asymmetry of the impact of oil price shocks on economic activities: an application of the multivariate threshold model. *Energy Economics*, 27(3):455–476, 2005.

[17] Kyung So Im, M Hashem Pesaran, and Yongcheol Shin. Testing for unit roots in heterogeneous panels. *Journal of econometrics*, 115(1):53–74, 2003.

[18] Akin Iwayemi and Babajide Fowowe. Impact of oil price shocks on selected macroeconomic variables in nigeria. *Energy policy*, 39(2):603–612, 2011.

[19] Kiseok Lee, Shawn Ni, and Ronald A Ratti. Oil shocks and the macroeconomy: the role of price variability. *The Energy Journal*, pages 39–56, 1995.

[20] François Lescaroux and Valérie Mignon. Déterminants du prix du pétrole et impacts sur l'économie. *Revue française d'économie*, 23(2):179–214, 2008.

[21] Andrew Levin, Chien-Fu Lin, and Chia-Shang James Chu. Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of econometrics*, 108(1):1–24, 2002.

[22] Ross Levine and David Renelt. A sensitivity analysis of cross-country growth regressions. *The American economic review*, pages 942–963, 1992.

[23] Prakash Loungani. Oil price shocks and the dispersion hypothesis. *The Review of Economics and Statistics*, pages 536–539, 1986.

[24] Jacques Mazier and Nabil Aflouk. Exchange rate misalignments and economic growth: A threshold panel approach. *Economics Bulletin*, 33(2):1333–1347, 2013.

[25] Mohsen Mehrara. The asymmetric relationship between oil and economic activities: The case of oil-exporting countries. *Energy Policy*, 36:1164–1168, 2008.

[26] Mohsen Mehrara and Mohsen Mohaghegh. Macroeconomic dynamics in the oil exporting countries: a panel var study. *International Journal of Business and Social Science*, 2(21), 2011.

[27] Knut Anton Mork. Oil and the macroeconomy when prices go up and down: an extension of hamilton's results. *Journal of political Economy*, 97(3):740–744, 1989.

[28] Philip A Olomola and Akintoye V Adejumo. Oil price shock and macroeconomic activities in nigeria. *International Research Journal of Finance and Economics*, 3(1):28–34, 2006.

[29] Paul M Romer. Human capital and growth: theory and evidence. In *Carnegie-Rochester Conference series on public policy*, volume 32, pages 251–286. Elsevier, 1990.

[30] Perry Sadorsky. Oil price shocks and stock market activity. *Energy Economics*, 21(5):449–469, 1999.

Appendix A:
Descriptive statistics

Table 5: **Descriptives Statistics**

Variable	**Obs.**	**Mean**	**Std.Dev.**	**Min**	**Max**
GDP growth	180	-0.663	6.934	-24.567	33.990
SOPI	180	0.391	0.526	0.000	1.613
SOPD	180	0.403	0.571	0.000	2.118
$\Delta\ ln\ oil^{+}_{i,t}$	180	0.107	0.133	0.000	0.451
$\Delta\ ln\ oil^{-}_{i,t}$	180	0.088	0.168	0.000	0.658
FINDEV	180	40.577	17.738	6.804	98.599
INVEST	180	22.772	7.062	10.665	46.810
POP	180	5.092	3.455	0.053	19.273

Source: Authors calculations