

Oil price change and Economy relationship: A global review using a nonlinear dynamic model for MENA Countries

Essahbi Essaadi and Rafik Jbir

Abstract:

This paper studies the macroeconomic effects of oil price shocks in a selection of MENA countries. The oil price shock is identified by assuming that an individual country's performance does not affect world oil prices. We put particular emphasis on the time-varying relationship between oil prices and macroeconomic variables and implement their approach in a Time-Varying Structural VAR model (TV-SVAR) framework. The main findings are that the macroeconomic effects of oil price shocks have evolved over time in MENA countries. Interestingly, however, we do not find a lot of heterogeneity among the MENA countries they consider, even though their list includes both net oil exporters (Algeria, Bahrain, Iran, Kuwait, Saudi Arabia) and net oil importers (Turkey and Tunisia).

Key-words: MENA Countries; TV-SVAR model; Oil prices; Macroeconomic

Essahbi Essaadi, University of Manouba, ESCT, QuARG UR17ES26, Campus Universitaire Manouba, 2010 Manouba, Tunisia

Rafik Jbir, University of Gabes, ISGG - Tunisia; Umm Al Qura University, College of Islamic Economics and Finance, Makkah, Saudi Arabi. ; E-mail: jbir.rafik@gmail.com.

Email: Essahbi.Essaadi@gmail.com. <https://orcid.org/0000-0003-4770-3785>

1. Introduction

Studying the oil price shocks and the global economy is a challenging energetic domain which has often assisted in the understanding of global political-economic for countries. Today, several authors argue that oil prices shocks impact has been reduced for developed countries in recent years. The development of other sources of energy, the change in the extraction technology and the characteristics of the oil market (supply and demand) lead to change this relationship. Blanchard and Gali (2007) and Peersman and Van Robays (2009) show that oil prices shocks impact have been changed. For these authors, this relationship has changed due to many factors such as the efficiency of monetary policy, flexibility in the labour markets, and the reduction in the importance of automobile sector. Also, Segal (2011) indicates that the dramatic rise in oil prices, up to mid-2008 the major economies in the world don't suffered from high inflation and there was a general view that this rise doesn't seriously affect the GDP growth rate as in the 1970s. Segal (2011) argues that the marginal role in the major global downturn is due to the change of the oil market from 'supply-driven' to 'demand-driven'. Moreover, the new arrival of the American shale gas has changed the relationship between oil price change and the first economy in the world. This evolution in oil prices in advanced economies exhort us to verify the stability of oil prices shock impact on emerging countries for economies who heavily rely on the oil sector and the net importing countries (MENA).

In this paper, we address the issue of the relationship between the oil price fluctuations and the global economy, especially the MENA region, by using the TV-SVAR model. Using a wide database covering the recent period of the oil price drop (1960Q1-2019Q3), our work is linked to the emerging literature that analyses the relationship between the oil market and macroeconomic variables. While previous studies have been conducted in developed countries (USA, Europe, Japan...) and the major developing countries (China, East Asia, Brazil...), our study focuses on the MENA region as the major oil reserve and production. There are many reasons to question the recent oil price-macroeconomics variables relationship for MENA countries. Firstly, as many authors indicated that there is a change in this relationship. Therefore, we use TV-SVAR model to into account possible change in the relationship between variables and to give dynamic variance decomposition for any dates. Indeed, a multivariate analysis using mostly the well knowing VAR model is unable to identify any changes in the relationship between variables and a comparative analysis can be conducted to verify possible changes between variables relationship. Secondly, as noted by Primiceri (2005), changes can affect both the transmission mechanism and/or the variance of the exogenous shocks in monetary policy. We identify the possible existence of a new transmission mechanism for both importing and exporting developing countries. Thirdly, using a new large quarterly data set, we can compare different past shocks effects. Fourthly, the MENA region is diversified contain both importing and exporting oil economies. Fifthly, existing literature suffers from some main drawbacks because these studies are static, neglecting the dynamic and changes in the economy react to oil price shocks. Finally, this study can show whether these countries especially the oil-exporting countries have succeeded in their reforms to diversify their incomes and subsequently constitute a symptom of existence or not the Dutch disease.

The remainder of the paper is organized as follows. Section 2 presents the literature review of oil prices fluctuations and economic growth. Section 3 focuses on data and methodology adopted in this paper. Section 4 analyzes empirical results. Section 5 concludes.

2. Literature review

The analysis of the link between oil price shock and macroeconomics variable is not new. In fact, since the 1973 crisis and its outcomes on the world economy, oil has become the dominant commercial energy source

all over the world. Shocks occurring in one market can affect others in the global economy mainly when it's the oil market, especially for commodity markets. Since the 70's a large body of researchers (Rasche and Tatom, 1981; Bruno and Sachs, 1982; Darby, 1982; Hamilton, 1983, 1985, 1996) has focused on the effects of oil price changes on the economy. The transmission channels of oil price shocks affect the relevant macroeconomic variables from the supply and demand side¹. Davis and Haltiwanger (2001) focus on the dispersion of the labour market. Bernanke (1983); Ferderer (1996); Lee and Ni (2002); Brown and Yücel (2002) and Hamilton (2003) has indicated that oil price socks affect economy mainly through global demand (consumption and investment). Pierce et al. (1974), Bernanke et al. (1997) and Barsky and Kilian (2004) argue that indirect transmission channels are the means that oil price socks hit economy. They showed that oil price shock affects the economy by the response of monetary policy to oil price shock and not by an oil price increase. Jbir and Zouari-Ghorbel (2009) has indicated that oil price increase attack economy by subsidy policy. Moreover, the literature suggests that there is an asymmetry in the oil price fluctuations-global economy relationship. The increase of oil price reduces economic activity but the fall in oil price does not stimulate the GDP².

However, several authors argue that oil prices shocks impacts have been reduced in recent years (Blanchard and Gali, 2007). Compared to the 1970s the dramatic rise in oil prices up to mid-2008 shows that the major economies in the world don't suffer from high inflation and there was a general view that this rise doesn't seriously affect GDP growth rate (Segal, 2011). He argues that the marginal role in the major global downturn is due to the change of oil market from "supply-driven" to "demand-driven". Also the technology of extraction and the characteristics of the oil market have changed a lot since the 1970s. Peersman and Van Robays (2009, 2012) indicate that this change is due especially to various from the efficiency of monetary policy, flexibility in their labour markets, to the reduction in the importance of automobile sector.

Recently, the effects of global oil price shocks have been investigated by a series of papers (Kilian, 2009; Cashin et al., 2014; Mohaddes and Pesaran, 2016, 2017; Mohaddes and Raissi, 2019). Kilian (2009) has distinguished between three oil price shocks: oil supply shock, oil demand shock driving by economic activity and oil specific demand shock driving by expectations of future change in oil conditions. Their results indicate that the macroeconomic effects of recent shocks (especially 2008) are moderate and this is can be the result of demand oil price shocks. Hamilton (2009) argues that the recent oil price shocks (2007-2008) caused by strong global demand. Mohaddes and Pesaran (2016) indicate that changes in an individual country oil production is unimportant relative to changes in the world oil supplies, and as a result the correlation of oil prices and country-specific oil supply shocks tend to zero for a large number of oil producers. Cashin et al. (2014) have used a VARX models model for 38 countries over the period 1979Q2-2011Q2, they fund that the results of oil price supply shocks on global economic activity are very different from those of oil price demand shocks and between the oil-importing countries and the oil-exporting countries. At the long run, the oil-importing countries have negatively affected by the oil price supply shocks. While it is positive for oil-exporting countries with large proven reserves of oil or gas. The oil price demand shocks lead to an increase in inflation rate, interest rate and real output and a decrease in equity price in all countries.

Mohaddes and Pesaran (2016) study using GVAR model for 27 countries show that oil supply shocks due to natural disaster or sanctions wars (for Iran) have a different impact on the global economy (real output and financial market). This impact depends on which country is subject to the shock. For Iranian shocks,

¹ For more detail see Jbir and Zouari-Ghorbel (2009) and Ghalayini (2011).

² See Brown and Yücel (2002).

the authors find that the negative impact on the global economy is neutralized by the increase of Saudi Arabia oil production and this can be explained by the permeant conflicts between the countries. However, Saudi Arabia shocks hurt the global economy by increasing the oil price. This increase in oil price leads to a fall in real GDP for both advanced and emerging economies, and a loss in real equity prices worldwide.

Mohaddes and Pesaran (2017) have focused on the impact of low oil price on the global economy in many countries. Their results show that a fall in oil price increase global real equity prices and real output and lowers the interest rate and inflation in most countries. The effect on real output has neutralized in 4 quarter after the shock. Also, Mohaddes and Pesaran (2017) in their paper, using monthly data for the US economy, they showed that there is a negative relationship between oil price and real dividend as a proxy for real output.

Mohaddes and Raissi (2019) confirm the Mohaddes and Pesaran (2017) results. Indeed, they investigated the impact of fall in oil price the US supply- driving oil price shock. Their finding indicates that the fall in oil price leads to an increase in real GDP for importing countries and a declining in commodity exporters and inflation rate in most countries. This increase in real GDP is due to an increase in spending by oil-importing countries which exceeds the decline in expenditure by oil exporters.

Allegret et al. (2017) studies the impact of oil price on the REER (real effective exchange rate) using a TVP-VAR model. Allow REER responses to vary according the various oil price shocks. For 1988Q1-2013Q2, they approve the time-varying nature of the relationship and they find that reaction will be different for oil supply shocks or oil demand shocks. While oil supply shocks play a small role, oil demand shocks have a sizeable effect and they are followed by an appreciation of the real exchanges rates of the oil exporters studied countries. Note that this time variation may not only be driven by changes in the transmission mechanism or variances of the structural shocks (Primiceri, 2005) but also by changes in the underlying drivers of oil prices. Indeed, recent evidence suggests that supply shocks have become less important over time while demand (like recent COVID-19 effect) shocks gained in importance (Baumeister and Peersman, 2013). There is some evidence that the sources of changes in oil prices vary over time. Interestingly, the macroeconomic variables could respond differently to an oil price change depending on the nature of the underlying shock (Allegret et al., 2017). Also, it depends if the countries are net oil exporter or net oil importer. We focus on the major region of oil reserve and production (MENA countries). MENA region is characterized by a high dependency on the USA, Europe and China. Our sample is composed of two groups of seven countries. The first group includes Algeria, Bahrain, Kuwait, and Saudi Arabia and refers to the oil exporter countries. The second group includes countries with energy deficit which are Morocco, Tunisia and Turkey. Acknowledging that past shocks in the oil market are different and they may have distinct effects. Also, the MENA countries are characterized by the most important oil reserve in the world. An increase of oil price affects positively these countries and permits additional revenue. In the other hand, an excessive increase affects negatively developed and developing economies and they rise interest rate to stop inflation augmentation. This fact will make pressure to the oil demand volume and prices will fall.

To analyze the dynamic change of the oil prices impact on macroeconomics variables, we consider a three steps procedure. First, given the unavailability of quarterly data, we resort to Chow and Lin (1971) temporal disaggregation method to estimate quarterly series using annual ones. By doing so, we can capture the possible changes in the link between our variables of interest for Algeria, Bahrain, Iran, Kuwait, Saudi Arabia, and Tunisia countries. Second, we detect endogenously structural changes in the oil price series. As several authors (Mork, 1989; Hamilton, 2003) define oil shocks as a substantial increase or decrease in price. The last definition corresponds to the main characteristic of the Bai & Perron test. Since this test is sensitive to the mean shift, it is a suitable instrument to measure shocks affecting oil markets. In the same

line, Liao and Suen (2006) apply Bai & Perron test to detect structural change tests for oil price data to identify a significant change in the global oil market. Third, to better track changes in oil prices on macroeconomic variables. We apply a dynamic structural VAR model to take as sources the evolution of oil prices and its effects on the macroeconomics of oil price movements vary over time.

3. Empirical Methodology

In this section, we adopt Bai and Perron (1998, 2003a,b) tests to detect mean shift break date in the oil prices series (table 2), then we describe the model.

3-1-Structural change test in Oil prices series

Some techniques have been developed to test multiple structural breaks. We adopt Bai and Perron (1998, 2003a,b) tests to detect a mean-shift in oil prices series. Using GAUSS software, we obtain estimates by running the Bai and Perron's codes. The choice of this type of model is motivated by the oil prices graphic characteristics. Indeed, the graphical analysis (see figure \ref{f1}) patterns of the series shows that it is affected only by breaks in mean. Using Bai and Perron (1998) allows us to determine endogenously break dates when the change is significant. The breakpoint is defined as changes in the underlying oil markets that occur as a response to exogenous events.

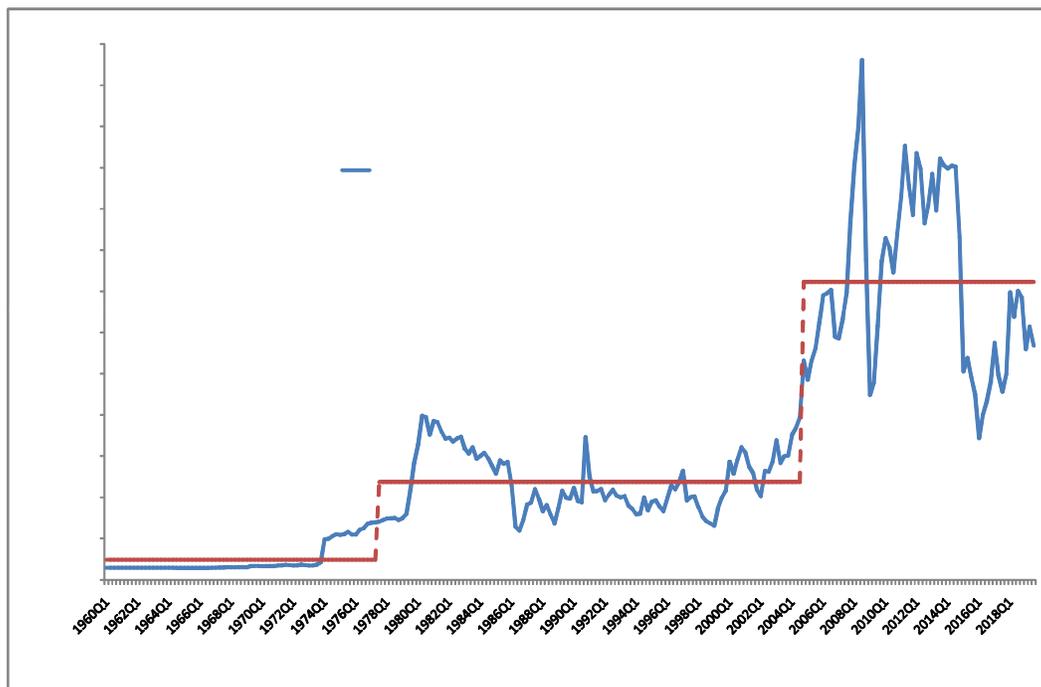


Figure 1: Oil price, in US Dollars

3-1-1 The model and estimators

We consider the following mean-shift model with m breaks, (T_1, \dots, T_m) :

$$\begin{aligned} op_t &= \mu_1 + u_t, & t = 1, \dots, T_1, \\ op_t &= \mu_2 + u_t, & t = T_1 + 1, \dots, T_2, \\ &\vdots \\ &\vdots \\ op_t &= \mu_{m+1} + u_t, & t = T_m + 1, \dots, T. \end{aligned} \quad (1)$$

for $i=1,2,\dots,m+1$, $T_0 = 0$ and $T_m + 1 = T$, where T is the sample size. Op_t is the international oil prices. μ_i are the means, and u_t is the disturbance at time t . The break points (T_1, \dots, T_m) are explicitly treated as unknown. Based on the ordinary least-squares (OLS) principle Bai and Perron (1998) estimate the regression coefficient vector. μ_j ($1 \leq j \leq m + 1$) by minimising the sum of squared residuals $\sum_{i=1}^{m+1} \sum_{t=T_{i-1}+1}^{T_i} (op_t - \mu_i)^2$. Let $\widehat{op}_t(\{T_j\})$ denote the resulting estimate. Substituting it in the objective function and denoting the resulting sum of squared residuals as $S_T(T_1, \dots, T_m)$, the estimated break dates $(\widehat{T}_1, \dots, \widehat{T}_m)$ are such that

$$(\widehat{T}_1, \dots, \widehat{T}_m) = \arg \min_{(T_1, \dots, T_m)} S_T(T_1, \dots, T_m), \quad (2)$$

where the minimization is taken over all partitions (T_1, \dots, T_m) such that $T_i - T_{i-1} \geq O$, where O takes some value³.

3-1-2 The test statistic and the model selection criteria

The test helps to detect multiple breaks without imposing any prior expectations on the data. The procedure estimates unknown regression coefficients together with the breakpoints when T quarters are available. To determine the number of breakpoints, we use Bayesian Information Criterion (BIC) as suggested by Yao (1988) and defined as follows:

$$\text{BIC}(m) = (T^{-1} S_T(\widehat{T}_1, \dots, \widehat{T}_m)) + p^* T^{-1} \ln(T), \quad (3)$$

where $p^* = 2m + 1$ is the number of unknown parameters. The author demonstrates that, for normal sequence of random variables with shifts in mean, the number of breaks can be consistently estimated.

Bai and Perron (1998) introduces some asymptotic critical values for the arbitrary small positive number (ε) and the maximum possible number of breaks (M): ($\varepsilon = 0.10$, $M=8$), ($\varepsilon = 0.15$, $M=5$), ($\varepsilon = 0.20$, $M=3$) and ($\varepsilon = 0.25$, $M=2$). For our empirical computation, we choose ($\varepsilon = 0.15$, $M=5$) and we use Bai and Perron (1998, 2003b) algorithm to obtain global minimisers of the squared residuals.

3-2 Time-Varying Structural VAR model (TV-SVAR): Analytical framework

The choice of the Structural VAR model is motivated by its capacity to fix a priori some particular values for a certain number of coefficients in the structural form to be in accordance with the theoretical assumptions. Contrary to the VAR model, SVAR model allows us the use of a nonrecursive structure.

³ From Bai and Perron (2003b), O is an arbitrary value correspond to the minimum distance, greater than q and not depending on T

The transformation of the structural form into a reduced form is as follows:

$$B_0 y_t = B_1 y_{t-1} + \dots + B_p y_{t-p} + u_t, \quad u_t \sim N(0, \Omega). \quad (4)$$

We can multiply the terms of each side by B_0^{-1} dimensions we obtain the reduced form:

$$\begin{aligned} y_t &= B_0^{-1} B_1 y_{t-1} + \dots + B_0^{-1} B_p y_{t-p} + B_0^{-1} u_t, \\ &= A_0 + A_1 y_{t-1} + \dots + A_p y_{t-p} + C^{-1} u_t. \end{aligned} \quad (5)$$

Where A_0 is a constant vector. The main contribution of such methodology is that the TV-SVAR approach, contrary to the usual linear VAR approach, allows measuring the effect of nonlinearity and the dynamic change in the transmission channel due to the change in the interdependence process.

Following Koop et al. (2009), we estimate a Time-Varying Structural VAR model (TV-SVAR) to detect changes in the response of each selected MENA economies to a specific oil prices shocks.

$$y_t = A_0 + A_1 y_{t-1} + \dots + A_k y_{t-k} + \varepsilon_t \quad t = 1, \dots, T \quad (6)$$

where y_t is an $n \times 1$ times vector of observed endogenous variables; $A_{0,t}$ is an $n \times 1$; $A_{i,t}$, for $i=1;\dots;k$ are $n \times n$ matrices of time-varying coefficients; ε_t is a $n \times 1$ Gaussian white noise process with zero mean and covariance Σ_t . Let $A_t = [A_{0,t}, A_{1,t}, \dots, A_{k,t}]$, $x_t' = [1_n, y_{t-1}', \dots, y_{t-k}']$, where 1_n is a row vector of ones of length n , let $vec(\cdot)$ denote the stacking column operator and let $\theta_t = vec(A_t')$. Then equation 6 can be written as follows:

$$y_t = X_t' \theta_t + \varepsilon_t, \quad (7)$$

where $X_t' = (I_n \otimes x_t')$ is a $n \times (nk+1)$ matrix, I_n is a $n \times n$ identity matrix, and θ_t is $(nk+1)n \times 1$ vector. We can treat θ_t as a hidden state vector, equation 7 represents the observation equation of the state space model. According to Primiceri (2005) and Koop et al. (2009), θ_t is specified as follows:

$$\theta_t = \theta_{t-1} + \zeta_t, \quad (8)$$

where ε_t are independent $N(0, H_t)$ random vector and ζ_t are independent $N(0, Q_t)$ random vector for $t=1, \dots, T$. The errors in the two equations (7 and 8) ε_t and ζ_s are independent of one another for all t and s .

This paper applies a new method to evaluate changes in the oil price shocks impact on macroeconomic aggregate in selective MENA countries during the three past decades. As stressed before, the appropriate way to tackle this objective is to estimate price oil effect during different periods test in a dynamic vision to take into account the change of oil price effect on economies for the region. Empirical investigation requires that we use a specific econometric method to contain this specific non-linear property of the regional integration process⁴. For this purpose, we introduce a TV-SVAR model to capture changes in the reaction of macroeconomic variables to oil prices shocks. In our knowledge it's the first study using TV-SVAR model in the oil prices macroeconomic literature in the recent years for MENA countries.

⁴ The nonlinearity properties hypothesis that we test in this subject comes for previous studies on some developed economies.

3-3 Modeling Macroeconomic Fluctuations in selected MENA Economies

This study provides novel evidence on the contribution of oil prices fluctuation to the structural changes in the selected countries of the MENA region. Contrary to the existing literature, we explicitly conduct a time-varying analysis and compare the reaction to an oil price shocks at different periods and between countries for the same region.

We adopt a Time-Varying Structural Vector Autoregressive model (TV SVAR model) as introduced by Primiceri (2005); Cogley and Sargent (2005); Koop et al. (2009). The multivariate time series model presented in this paper includes both time-varying coefficients and time-varying variance-covariance matrix of the additive innovations. Time-varying coefficient allows us to capture possible nonlinearities or changes in the lag structure of the model. This particular character of the model "*leaves it up to date to determine whether the time variation of the linear structure derives from changes in the size of the shocks (impulse) or from changes in the propagation mechanism (response)*" (Primiceri, 2005; pp. 823).

Moreover, we re-examine empirically the most tri-variate VAR model used in most of the related literature. Our main novelty is the use of such a model (TV-SVAR model) to exclude bias related to the non-linear properties of the studied process. The choice of break dates of such relationship between variable is based on Bai & Perron test (Table 2). Bai & Perron test is suitable in our case of studies due to its properties of mean shift sensitive.

3-4 Oil prices shocks: Experimental framework

In a first step, we analyze the change of the domestic economic aggregate to the external oil prices shock for each country. When the response to these common shocks is found to be similar for the selected MENA group, we can conclude that the process of propagation and their sensitivity to the oil market shocks remains fixe.

In this study, we follow Blanchard and Gali (2007) to test both the effect of oil prices shock on macroeconomic and possible variability in the reaction process for a selected MENA. Precisely, Blanchard and Gali (2007) use a baseline VAR model composed of the nominal price of oil, three inflation measures (CPI, GDP deflator, and wages) and two quantities (GDP and employment). Also, Park et al. (2011) select seven variables to run an SVAR model to analyse prices fluctuations effects on macroeconomic variables. Their SVAR model includes international oil price, industrial production, CPI, federal funds rate, money supply, domestic interest rate, and exchange rate. Due to the empirical model choice and it's the dynamic characteristic we will limit the numbers of variables to only three. Therefore, we estimate a trivariate SVAR model following Gómez-Loscos et al. (2011) and like Blanchard and Gali (2007) but with one variable in each three blocks namely: nominal oil prices in USD, domestic inflation and GDP. However, as in all part of this paper, we will be cautious about the potential presence of non-linearities in the process and for economic restriction in the model. All the variables in our model are expressed in logarithms except inflation is expressed in the first difference of logarithms of the domestic consumer prices index.

In our second empirical investigation, we will test similitude in the reaction of selected MENA economies to an exogenous oil prices shocks. For this reason, we run the following TV-SVAR model:

$$X_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + \dots = \sum_{i=0}^{\infty} A_i\varepsilon_{t-i},$$

$$X_t = A(L)\varepsilon_t \tag{9}$$

Vector X_t contains the variables for each country indicated above, $X_t = [op_t, y_{i,t}, \Delta cpi_t]'$. Where op_t the oil price, $y_{i,t}$ Domestic GDP for countries i , $cpi_{i,t}$ consumer price index. All variables are in logarithm and Δ means first difference, A is square matrix of order three. So the vector of the innovations is as follows:

$\varepsilon_t = [\varepsilon_t^{op}, \varepsilon_t^y, \varepsilon_t^{\Delta cpi}]'$ Where ε_t^{op} oil prices shock, ε_t^y GDP shock, $\varepsilon_t^{\Delta cpi}$ monetary shock. The model is writing as follows:

$$\begin{aligned} op_t &= A_{11}(L) \varepsilon_t^{op} + A_{12}(L) \varepsilon_t^y + A_{13}(L) \varepsilon_t^{\Delta cpi} , \\ y_t &= A_{21}(L) \varepsilon_t^{op} + A_{22}(L) \varepsilon_t^y + A_{23}(L) \varepsilon_t^{\Delta cpi} , \\ \Delta cpi_t &= A_{31}(L) \varepsilon_t^{op} + A_{32}(L) \varepsilon_t^y + A_{33}(L) \varepsilon_t^{\Delta cpi} , \end{aligned} \quad (10)$$

The economic literature enables us to reduce this last model. Kilian and Vega (2011) showed that oil prices do not respond to the US macroeconomic news instantaneously. Therefore, we assume that oil prices do not respond to the more small countries macroeconomic news. Local production and inflation in our selected MENA countries doesn't have any effect on oil prices ($A_{12}(L) = A_{13}(L) = 0$). The monetary shock ε_t^m does not have a long-term effect on the local production ($A_{23} = 0$). Then the model becomes:

$$\begin{aligned} op_t &= A_{11}(L) \varepsilon_t^{op} , \\ y_t &= A_{21}(L) \varepsilon_t^{op} + A_{22}(L) \varepsilon_t^y \\ \Delta cpi_t &= A_{31}(L) \varepsilon_t^{op} + A_{32}(L) \varepsilon_t^y + A_{33}(L) \varepsilon_t^{\Delta cpi} \end{aligned} \quad (11)$$

Since we work on a quarterly frequency and that the graph shows many effects of seasonality, we proceeded to a seasonality adjustment of the variables by the method X12. With this approach, we can show whether the transmission of oil price shocks has changed over time (compared to the 1970s) as suggested by many studies and, we can detect endogenously structural changes in oil prices series.

4. Empirical results

4-1 Data description

In this paper, we use oil crude prices, real GDP and CPI for seven Middle East North Africa countries, spanning the period 1960:Q1 - 2019:Q3⁵. The source of oil crude prices is the St Louisiana Federal Reserve Bank web site⁶. The Consumer Price Index (CPI) and the real gross domestic prices (RGDP), are obtained from IMF web site statistics: five oil exporters: Algeria (1974Q1: 2016Q4), Bahrain (1970Q1: 2016Q4), Iran (1970Q1: 2016Q4), Kuwait (1973Q1: 2016Q4), and Saudi Arabia (1971Q1: 2016Q4); two energy deficit countries: Tunisia (1987Q3: 2017Q4) and Turkey (1960Q1: 2019Q4).

We disaggregate each GDP series for a major oil exporter countries (Algeria, Bahrain, Iran, Kuwait and Saudi Arabia) and Tunisia using the Chow and Lin (1971) method taking the "Industrial production, Manufacturing, Non-durable manufacturing, Petroleum and coal products, Crude petroleum products, Index" as a proxy for the economic activity variability between different quarters. We use a filtered GDP series as a proxy for real outputs. The choice of proxy to interpolate data is motivated by the heavy

⁵ For more details see Table 1.

⁶ <https://fred.stlouisfed.org/series/WTISPLC>

dependence on oil income. Hydrocarbon industries represent more than 80 per cent of total government revenue and the sector of hydrocarbon per GDP is 50 per cent in the region. For the Tunisia case, the manufacturing component represents the basic activity in the economy so it can well play the role of proxy to the variability of the GDP. The technique of transforming annual data to quarterly ones is well used on several kinds of research and permit to span a large period (see Table 1). This technique is argued by the high number of lost observations (42 quarters for the use of Time-Varying and one quarter to calculate inflation from CPI).

Table 1: Data period

	GDP	Source	CPI	Source	Studied period	Number of Observations
Algeria	1971Q1-2016Q4	IFS: web site	1974Q1-2019Q3	IFS: web site	1974Q1-2016Q4	172
Bahrain						188
Iran	1970Q1-2016Q4	IFS: web site	1965Q1-2018Q4	IFS: web site	1970Q1-2016Q4	188
Kuwait	1970Q1-2016Q4	IFS: web site	1957Q1-2018Q3	IFS: web site	1970Q1-2016Q4	176
Saudi Arabia	1970Q1-2016Q4	IFS: web site	1973Q1-2018Q3	IFS: web site	1973Q1-2016Q4	184
Tunisia	1970Q1-2017Q4	IFS: web site	1971Q1-2019Q3	IFS: web site	1971Q1-2016Q4	122
Turkey	1970Q1-2017Q4	IFS: web site	1987Q3-2019Q1	IFS: web site	1987Q3-2017Q4	
	1960Q1-2019Q3	StLouisFed	1955Q1-2019Q3	IFS: web site	1960Q1-2019Q3	
Oil Price	1946Q1-2019Q3	StLouisFed				295

Using Matlab software, we estimate TV-SVAR model by running the code writhed by Gary Koop (Koop et al., 2009). The TV-SVAR results allow us to run our code to calculate impulse response function for the preselected data. In this paper, the break dates are chosen endogenously through the well knowing Bai and Perron (1998) test on oil prices series presented in table 2. Structural change present oil shocks and we estimate in each date the reaction of each country to it. For this reason, we will investigate the possible change in three dates: 1977Q2, 2004Q4 and 2016Q4.

Table 2: Structural change dates of oil prices

	\hat{T}_1		\hat{T}_2	
Break dates		1977Q2		2004Q4
Coefficients	4.990438		23.826843	71.988869
Standard errors	1.437451		1.165495	1.550806

Indeed, with the negative effect of the first oil price shock of 1973 who continued some quarters after the shock, the start of political tensions between Iran and Iraq and the weak rebound in global demand, the oil price has increased again and multiplied by 2.7 between 1977 and 1981 after the Iran revolution (1979). Kilian (2010) indicates that the 2004 increase oil price is caused by fluctuation in the global business cycle driven in large part by unexpected growth in emerging Asian superimposed on strong growth in the OECD countries. Hamilton (2011) has stressed the importance of Venezuelan unrest and the second Persian Gulf War as the origin of the increase of oil price in 2004. Indeed, he indicated that a general strike eliminated 2.1 MB/d of oil production from Venezuela in December of 2002 and January of 2003. This was followed shortly after by the U.S. attack on Iraq, which removed an additional 2.2 MB/d over April to July. Besides the depreciation of dollar in 2004 lead to an increase in the oil price to exceed 40 dollars the barrel in January 2005.

4-2 Dynamic Impulse Response Function Analysis

Following Gómez-Loscos et al. (2011), we test oil prices effects on macroeconomic of a selected MENA countries but with a time-varying view. By adopting the method of Koop et al. (2009), we estimated the Time-Varying Structural VAR model for each country. Then, we collect the dynamic impulse response to oil prices shock of the domestic real GDP and the price index respectively for each country of our sample. We want to trace out the time path, in three separated dates estimated by Bai & Perron test. In general, when oil prices shocks have the same effect on different dates we conclude that the similarity in the reaction seems that macroeconomic structure doesn't change over time. The sample of our study is characterized by both net importer and net exporter of the oil. Our results indicate that oil prices effects has changed at least in level for both inflation and GDP aggregate for all countries. This results comfort our initial choice of a dynamic model to better understand the economic oil impact on these countries.

Overall, our results indicate that the effects of oil prices have changed at least in level for both inflation and GDP aggregate for all countries. Figures 2 to 15 below are the results of the Impulse response function (IRF) analysis of different countries. As we can see in IRF figures, the oil price-economy relationship has relatively changed compared to the 1970s for both oil countries and non-oil countries as stressed by Schneider et al. (2004) and Bertrand and Justeau (2006). In the IRF figures, the line in blue color presents the response of variable (GDP or inflation) to oil price shock in 1977. The green line is the response of the variable in 2004 and the red line is the response of the variable in 2016.

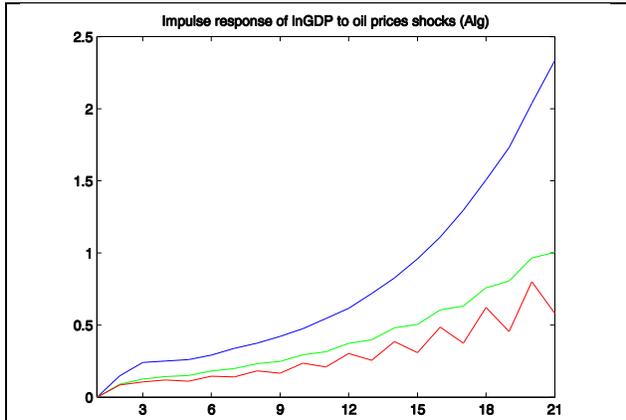


Figure 2: Impulse response of GDP to oil prices shocks (Algeria)

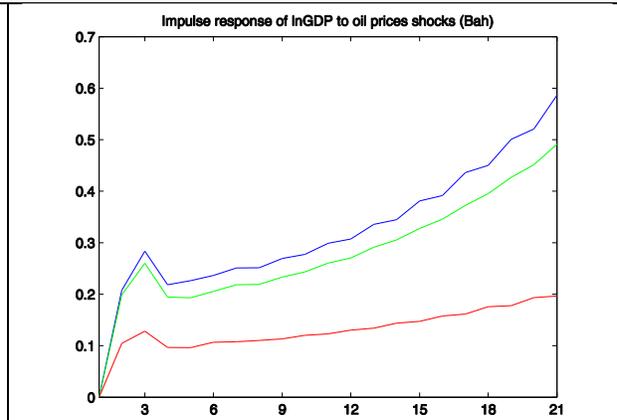


Figure 3: Impulse response of GDP to oil prices shocks (Bahrain)

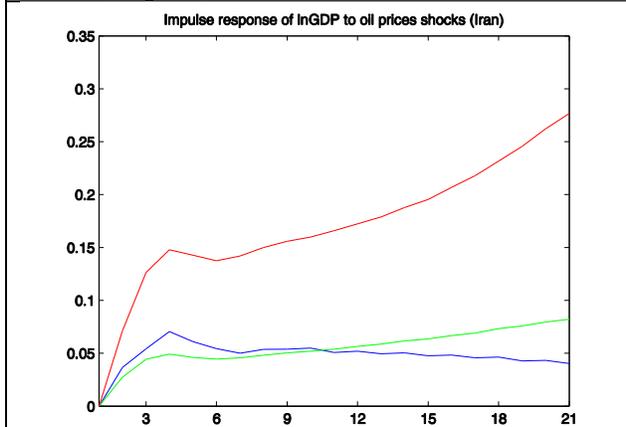


Figure 4: Impulse response of GDP to oil prices shocks (Iran)

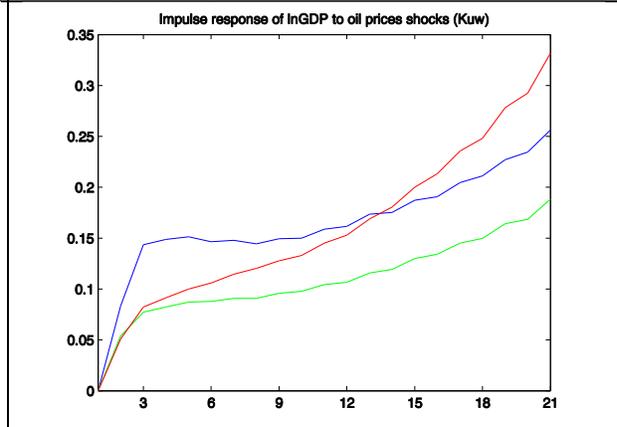


Figure 5: Impulse response of GDP to oil prices shocks (Kuwait)

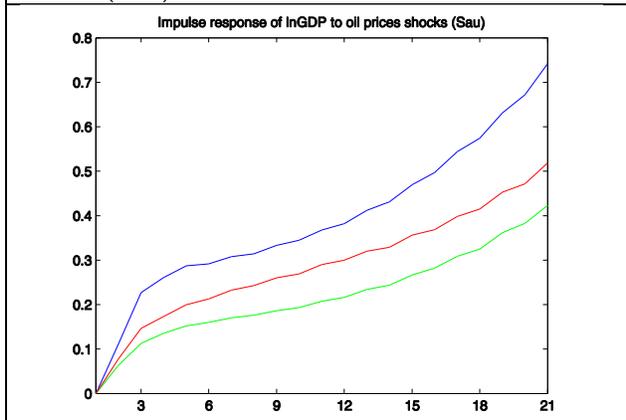


Figure 6: Impulse response of GDP to oil prices shocks (Saudi Arabia)

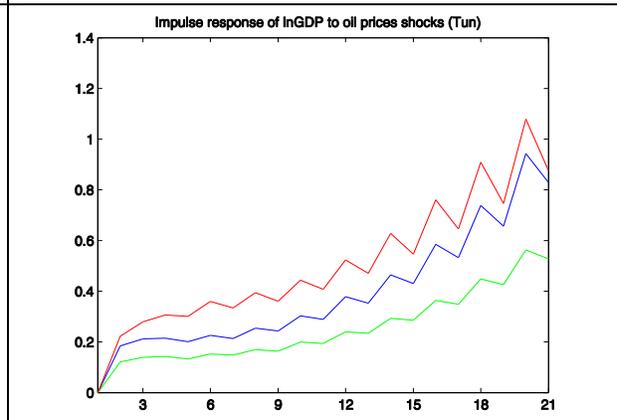
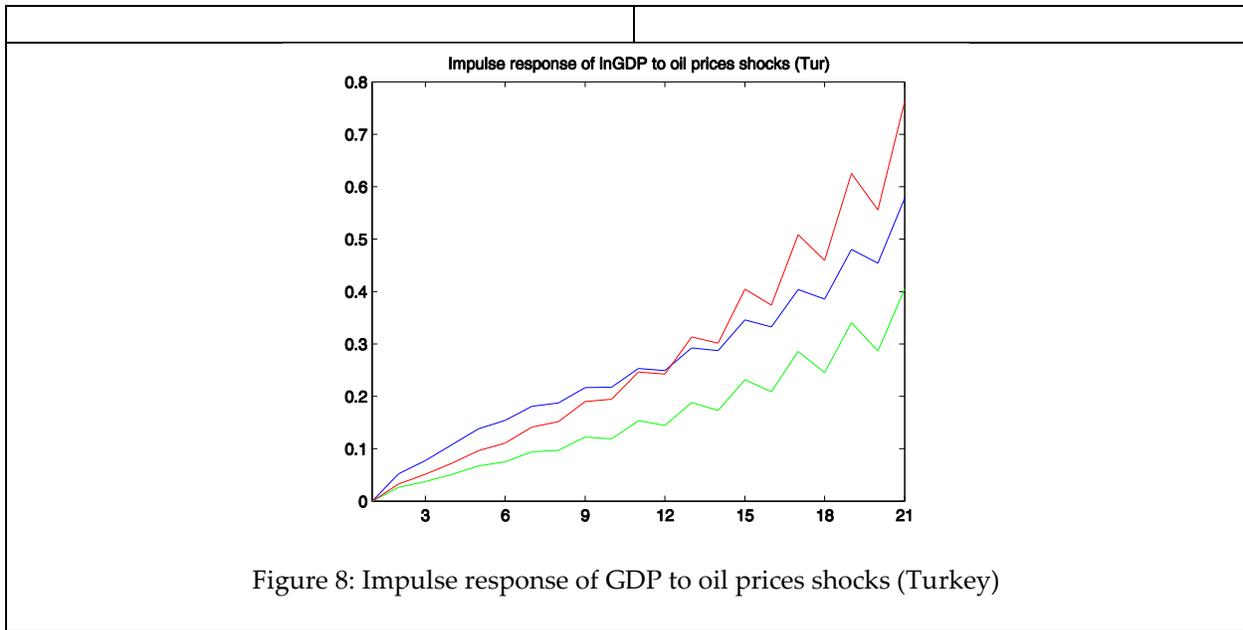
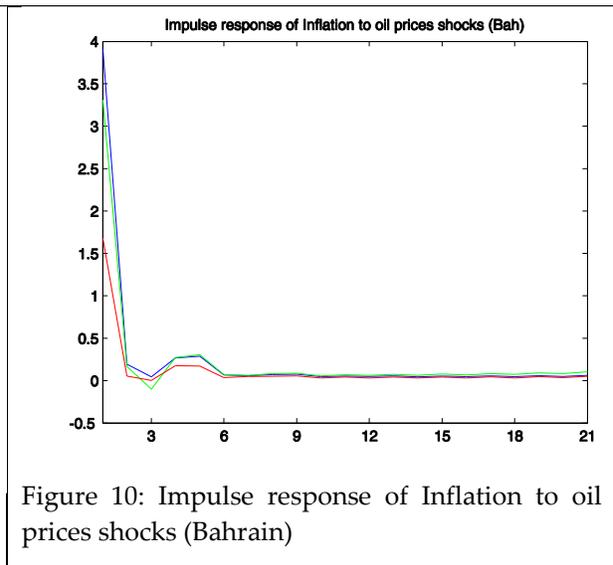
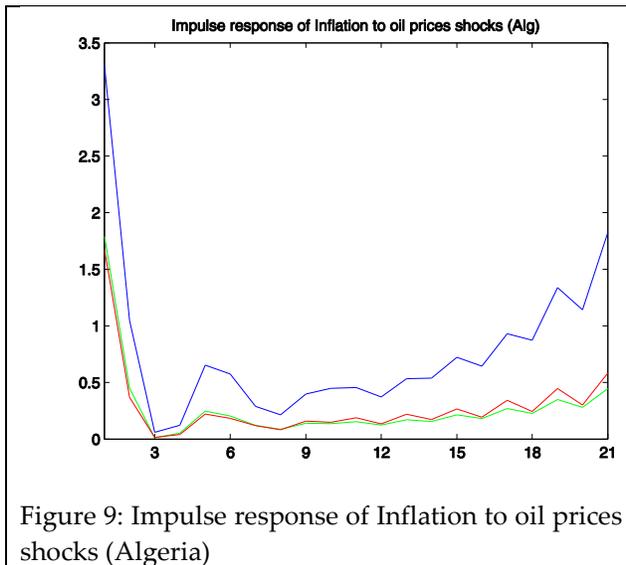


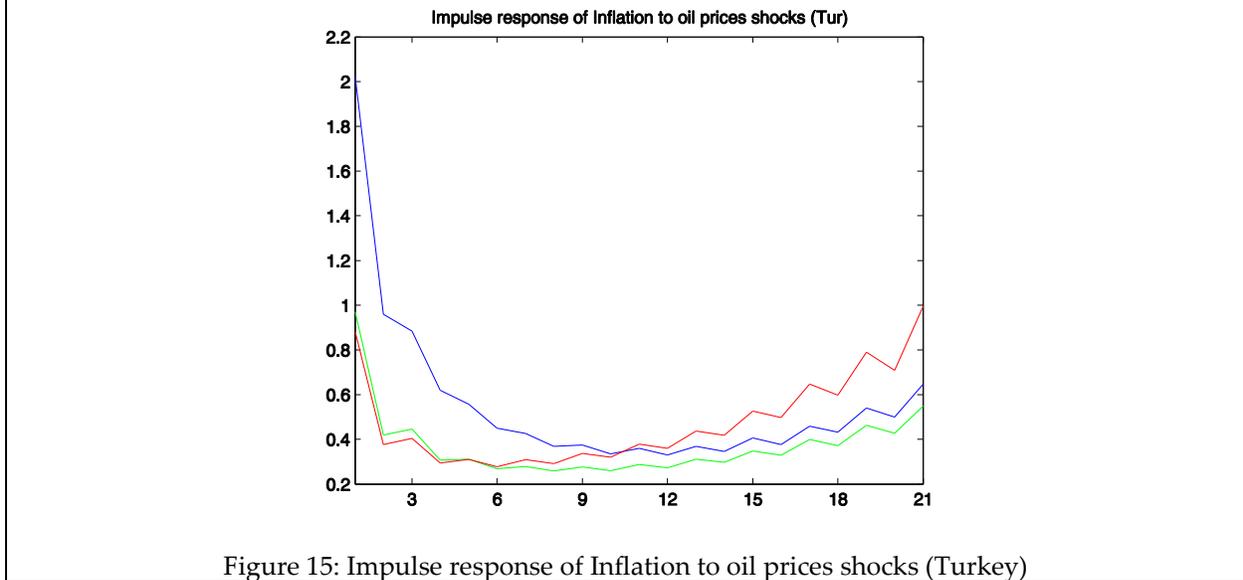
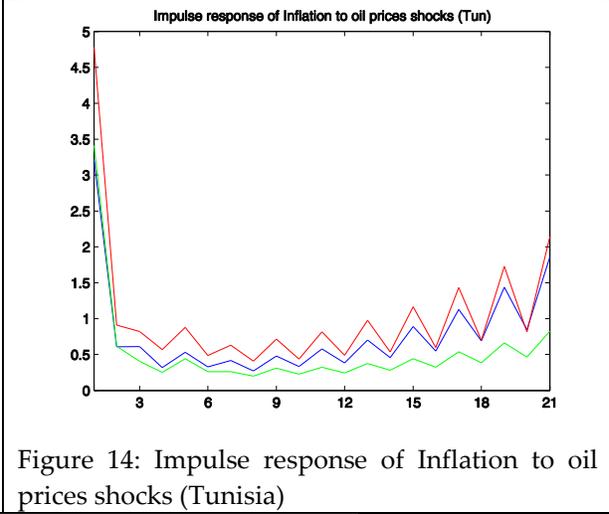
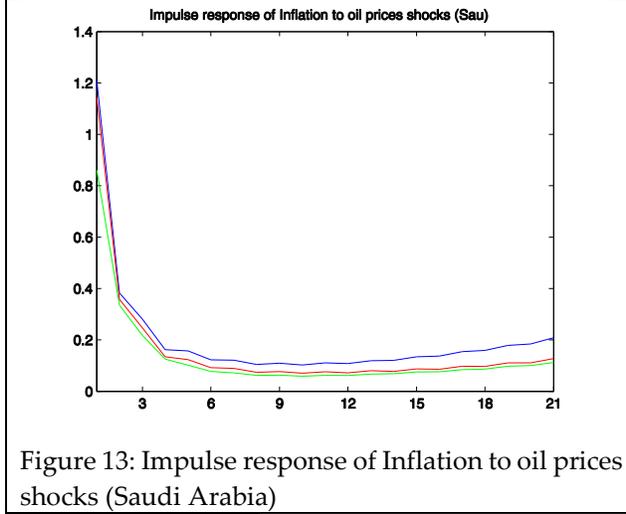
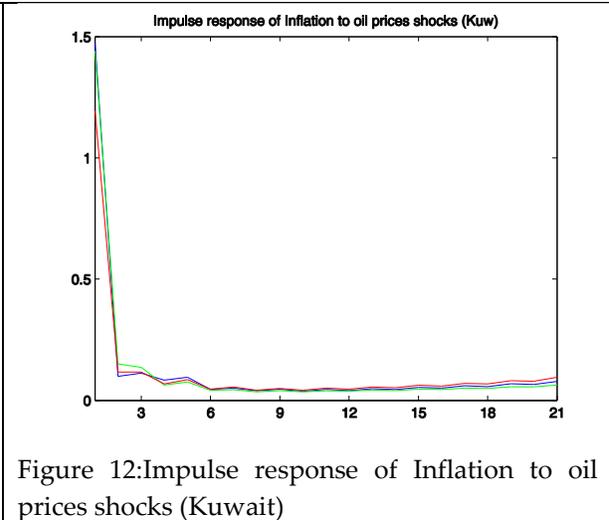
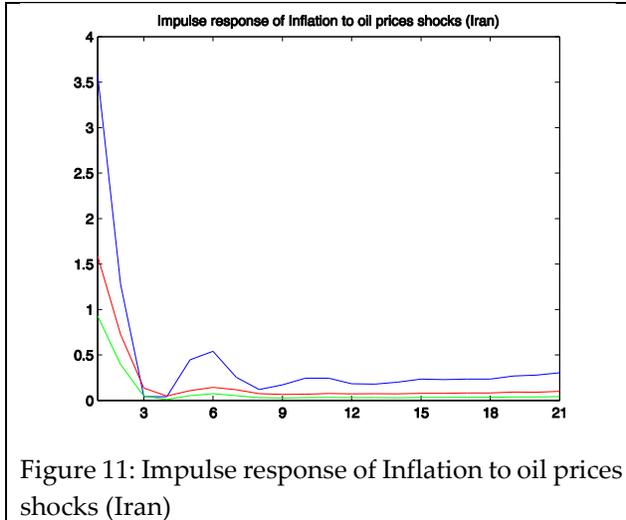
Figure 7: Impulse response of GDP to oil prices shocks (Tunisia)



7



⁷ For all figures: Blue '+' for 1977:Q2, green line 'x-' for 2004:Q4 and red line '--' for 2016:Q4. Due to the lack of data, the blue line design the first date of possible impulse response: 1985Q1 for Algeria, 1980Q4 for Bahrain, Iran, 1983Q4 for Kuwait, 2000Q4 for Morocco, 1981Q4 for Saudi Arabia, 1998Q2 for Tunisia.



From the IRF figures above, we can conclude that except for Iran and Kuwait countries, the response of GDP to oil price shocks almost is the same for all oil countries. The response of GDP to 1977 oil increase is more important than 2004 and 2016 oil increases. For Kuwait, figure 5 indicates that the response is the same as other oil countries for the first year, but after that, the relationship has changed. The impact of the oil price change on GDP is more important after four to five quarters in 1916 (red line) than in 1977 and 2004. For Iran, figure 4 shows also that the relationship between oil price shocks and GDP has changed. The response of GDP to the 2016 oil price increase (presented on the red line) is more different than those of 1977 and 2004. This is can be explained by the results of economic sanctions for the Iranian economy by the USA and the Iranian political problems with some countries in the Middle East especially Saudi Arabia.

Oil price effects on GCC countries (Bahrain, Kuwait, Saudi Arabia) and Algeria (figures 2, 3, 5 and 6) seem to be similar to a positive effect and permanent compared to Iran. For this reason, gulf countries have introduced recently a plan to upgrade their economic structure to be able to absorb negative oil price shocks by diversifying government revenues⁸.

For the non-oil countries, as shown by figure 7 and 8, the oil price-GDP relationship in 2016 has changed compared to the 1970s. But for Turkey, the response of GDP to oil price shocks begins to change only after nearly 11 months. Indeed, Turkey represents the most developed country in the region because it beneficiates for any early process of reforms (economic and political) to access the European Union. For Tunisia, also economic reforms have been introduced due to the popular demand⁹.

Regarding the relationship between the inflation rate and oil price shocks, there is a change only for some countries. For oil countries, only a few countries (Algeria and Iran) have shown a change in oil price shocks-inflation relationship as plotted in Figures 9 and 11. For remainder oil countries such as Bahrain, Kuwait, and Saudi Arabia the relationship has not changed.

For non-oil countries, there is a relative change in inflation rate response to oil price shocks, especially for Turkey. Indeed, for Turkey, the change in inflation-oil price shocks relationship begins after nearly 10 months from the shock.

5. Conclusion

To identify the dynamic relationship between oil price changes and global economy and to account for these potential changes, in this study, we applied the Time-Varying Structural VAR model (TV-SVAR) for MENA countries over the period 1960Q1 to 2019Q3.

Our empirical results provide a support of the change in the response of macroeconomic aggregates to the oil external shocks in the MENA region. Indeed, for the gulf economy, any increase of oil price leads to an increase in GDP and inflation rate as shown by many recent studies (Cashin et al., 2014; Mohaddes and Pesaran, 2017; Mohaddes and Raissi, 2019). However, the rise in inflation rate seems to be less permanent and the shocks will be absorbed into six quarters. Also, our results show that the impulse response functions indicate a different monetary policy of the MENA group and a lack of diversification in oil

⁸ In GCC countries, we have introduced large government reforms spurred by recent oil prices fall and encouraged by IMF: Vision 2030 in Saudi Arabia, Qatar National Vision 2030.

⁹ 17/12/2010 is the beginning date of the Tunisian revolution, called also the Jasmine revolution, it eventually placed the countries in a process of democratization and economic reforms and propagated this wave to other Arab countries. The Arab spring, exhort the Moroccan king to initiate political reforms.

exporter countries during the last three decays. Finally, we detect two structural change dates of oil prices in 1977Q2 and 2004Q4 (see table 2).

Compliance with Ethical Standards:

Acknowledgements: The authors received no specific funding for this work.

Ethical approval: This article does not contain any studies with human participants performed by any of the authors.

Data and computer code availability: The data and computer code used in the study can be made available upon request.

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