Oil prices and Macroeconomics variables relationship: 
TVP-VAR model approach

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First Draft

Abstract

The vast wide of literature tested oil prices and fundamental macroeconomic variables confirm the ambiguous relationship between them. Previous studies have relied in one hand, on the dynamic correlation between oil price and GDP and/or stock market in the time or the frequency domain. On other hand, a multivariate analysis using mostly the well knowing VAR model, characterized by a missing of any possible changes in the relationship between variables. In this paper, we suggest a different empirical approach that out performs former works. Indeed, our study use the Time Varying Parameter Vector Autoregressive model (TVP-VAR) to take into account these possible changes and with a multivariate analysis also. This paper focus principally on the changes of oil prices and the monetary policy response to this drastic decline. Moreover, the very recent drop registered in the world oil market are causing a possible slowdowns in the economic performance of the most oil exporters countries. Nevertheless, we can observe a positive effect on GDP for importer countries. Our principal interest is on MENA countries which present both oil importer and oil exporter genre.

Our main result can be summarized as follows: firstly, impulse response analysis confirm the change in the macroeconomic aggregate reactions (GDP and Inflation) to the oil external shocks. However, the sign remains the same. The changing in weight of oil sector in the economy can explain this variation in the reactions. Secondly, impulse response functions indicate different monetary policy of the MENA group.

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1 Introduction

The vast wide of literature tested oil prices and fundamental macroeconomic variables confirm the ambiguous relationship between them. Moreover, the characteristics of the oil market have changed a lot since the 1970s, technology of extraction too. Indeed, the new arrival, the American shale gas, have changed the relation between oil price and the first economy in the world. Then, empirical results are inconclusive due to this complexities in the crude oil markets.

Compared to the 1970s 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 GDP growth rate (Segal, 2011). Interestingly, Segal (2011) argue that the marginal role in the major global downturn is due to the change of oil market from 'supply driven' to 'demand driven'. Our work is related with the recent strand of literature that analyses relation between oil market and economic variables with a time varying view.

As stressed by Hamilton (1983), from 1948 to 1981 'all but one of the US recessions since World War II have been preceded, typically with a lag of around three-fourths of a year, by a dramatic increase in the price of crude petroleum’ (p. 228). This finding was also confirmed by several studies with different developed countries.

Using TVP-VAR model allow us to into account possible change in the relationship between variables and to give dynamic variance decomposition for any dates. Therefore, a comparative analysis can be conducted to verify possible changes between variables relationship.

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 underling shock (Allegret et al., 2015). Also, it’s depend if the countries are net oil exporter or net oil importer. Changes can affect both transmission mechanism and/or the variance of the exogenous shocks in monetary policy (Primiceri, 2005).

In one hand, previous studies have relied on dynamic correlation between oil price and GDP and/or stock market in the time or a frequency domain. On other hand, a multivariate analysis using mostly the well knowing VAR model, characterized by a missing of any changes in the relationship between variables. In this study, we contribute in three folds. First, we out perform previous studies by using a dynamic VAR model to take into account any changes of the relation ship between macroeconomic variables without any restriction. Second, relying on Chow and Lin (1971) technique that desegregate data from annual frequency to quarterly, we span a large period cover 1980Q1 to 2015Q3 for the most of countries. Third, possible structural change dates in the relationship between oil prices and macroeconomic variables are detected endogenously by testing presence of break dates in oil prices series with Bai and Perron (1998, 2003a,b) test.

In contrast to previous studies that interest on developed economies (USA, Europe, Japan...) and the major developing economies (China, East Asia, Brazil...), this paper focus on the major region of oil reserve and production. MENA region is characteristic by their big dependency to the three major world blocs (USA, Europe and China). 'For the Maghreb countries, the highest dependencies are observed for Algeria and Tunisia (with annual output elasticities of more than one-half)' (p. 33) (IMF)2. Considering a sample of seven MENA countries (four oil exporters + three energy deficit countries)3. Existence of the two groups

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1 see Table 1 for more details.
2 IMF Regional Economic Outlook: Middle East and Central Asia, Nov 2012.
3 four oil exporters: Algeria, Bahrain, Kuwait and Saudi Arabia; three energy deficit countries: Morocco,
permit to distinguish between oil producer reaction and oil importer one. Acknowledging that past shocks in oil market are different and they may have distinct effects. In this work, we investigate the time-varying property of the relationship between the oil price and macroeconomic variables of a selected MENA countries.

The remainder of this paper is organized as follows. Section 2 presents stylized facts about oil prices and economic growth and the related literature. Section 3 explains the methodology adopted in this paper. Section 4 analyzes our main empirical results. Section 5 concludes.

2 Oil price and Macroeconomic aggregate: some stylized facts

Since 1973 crisis, oil has gain importance to be the world’s major commercial energy source. In addition, shocks occurring in one market can affect others in global economy mainly when it’s the oil market especially for commodity markets. Any increase or decrease affect directly macroeconomic variables in all world economies. The MENA countries is characterized by a the most important oil reserve in the world. Oil export represent of the most of them the principal foreign currency revenue. However, we expect a mitigate effect of any change of oil price. In one hand, an increase of oil price affect positively these countries and permit an additional revenue. In other hand, an excessive increase affect negatively developed and developing economies and they tend to rise their interest rate to stop inflation rise. This fact will make pressure to the oil demand volume and prices will tend to decrease.

As stressed in the vast oil price effect literature, exogenous event affect oil market (War, Crisis,...) and tend to generate short to medium run effects (Oladosu, 2009). In order to assess oil price change effect on economies, different methodologies have been applied in the literature. The first strand of literature explain the oil-macroeconomy relationship by estimate various type of decomposition and correlation between variables (Oladosu, 2009). Empirical mode decomposition is used to decompose time series in a finite number of components interpreted as deferent cycle. Then, author compute a special type of Pearson correlation coefficients to test if there is any procyclical or countercyclical period in each cycle (Oladosu, 2009).

In the same line, Oladosu (2009) reach the negative relationship between oil prices and GDP, corresponding to the well knowing oil price changes as an input price shock. He find that a persistent increase in oil price contribute to declines in the US GDP as seen between 1980 and 1982 and he predict that the decline will be more persistent in the actual cycle due to the importance of demand component rather the supply one in the recent oil price run-up. Interestingly, Mork et al. (1994) find asymmetry in the impact of oil shocks, price rise was followed by GDP decline but not in the case of a price decline when GDP does’nt rise for a selective industrial economies.

A second strand of literature applies the Vector Auto Regressive model (Gómez-Loscos et al., 2011; Park et al., 2011; Bashar et al., 2013; Allegret et al., 2015). The SVAR model used to analysis the monetary transmission mechanism. Bashar et al. (2013) investigate both the relationship between oil price and oil price uncertainty and the some Canadian macroeconomic aggregates. They find that the asymmetry in the oil price effect on out put is due to the increase of uncertainty in the case of a fall in oil prices. They find that oil price level shocks do not play an important role of the Canadian out put variations, due to the developed nature of the studied countries in spit of its net oil exporter characteristic.

Tunisia and Turkey.
Allegret et al. (2015) studies the impact of oil price on the REER (real effective exchange rate) using a TVP-VAR model. Allowing the responses of the REER to change to different oil prices shocks. For the period of 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 following by an appreciation of the real exchanges rates of the oil exporters studied countries.

Existing literature suffer from some main drawbacks. Firstly, these studies are static, neglecting the dynamic and changes in the economy react to oil price shocks. Secondly, they are interested mainly on developed and emerging economies witch represent in the most the demand side in the oil market. In this paper, a new empirical methodology is adopted to overcome all these drawbacks. More interestingly, dynamic VAR model play a key role to reduce the sensitivity of our analysis goal to the Lucas critique. As mentioned by Segal (2011): ‘the structure of the economy is partly determined by agents expectations about variables in the economy, including the interest rate, and the parameters estimated in the VAR reflect these expectations. Hence if the monetary policy rule (or reaction function) changes, and agents in the economy know that it has changed, then the parameters estimated under the original reaction function will no longer be appropriate’ (p. 177).

Finally, we out performs existing literature in three folds. Firstly, we desegregate annuals data to quarterly frequency to catch possible change in the interdependence between variables. We relying on Chow and Lin (1971) method to estimate quarterly GDP for Algeria, Kuwait, Saudi Arabia and Tunisia countries. The use of such methodology is vital due to the lack or non-existent data for such frequency and countries. Secondly, we detect endogenously structural changes in oil prices series. Thirdly, to better capture the change in the oil prices effect on the macroeconomy, we use an advanced econometric tools. We apply a dynamic Structural VAR model to catch change in the oil prices effect on macroeconomy as the sources of changes of the oil prices 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. The results of running Bai & Perron code are presented in table 2 and the model will be presented in the next subsection.

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 1) 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. Break point is defined as changes in the underlying oil markets that occur as a response to an exogenous events.
3.1.1 The model and estimators

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

\[
\begin{align*}
op_t &= \mu_1 + u_t, \quad t = 1, \ldots, T_1, \\
op_t &= \mu_2 + u_t, \quad t = T_1 + 1, \ldots, T_2, \\
&\vdots \\
op_t &= \mu_{m+1} + u_t, \quad t = T_m + 1, \ldots, T.
\end{align*}
\]

(1)

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

\[
\left( \hat{T}_1, \ldots, \hat{T}_m \right) = \arg \min_{(T_1, \ldots, T_m)} S_T (T_1, \ldots, T_m),
\]

(2)

where the minimization is taken over all partitions \((T_1, \ldots, T_m)\) such that \( T_i - T_{i-1} \geq O \), where \( O \) takes some value.\(^4\)

3.1.2 The test statistic and the model selection criteria

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

\[
\text{BIC}(m) = (T^{-1} S_T (\hat{T}_1, \ldots, \hat{T}_m)) + p^* T^{-1} \ln(T),
\]

(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 \( \varepsilon \) 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.

\(^4\)From Bai and Perron (2003b), \( O \) is an arbitrary value correspond to the minimum distance, greater than \( q \) and not depending on \( T \)
3.2 Time-Varying Structural VAR model (TV-SVAR): Analytical framework

The choice of the Structural VAR model is made for its capacity to a priori some particular values for a certain number of coefficients in the structural form in order to conform to the assumptions of the economic theory. Contrary to the VAR model, SVAR model allows us the use of a nonrecursive structure.

The transformation of the structural form of the model to its reduced form is the following:

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

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

$$y_t = B_0^{-1} B_1 y_{t-1} + ... + B_0^{-1} B_p y_{t-p} + B_0^{-1} u_t, = A_0 + A_1 y_{t-1} + ... + A_p y_{t-p} + C^{-1} u_t.$$  \hfill (5)

The main contribution is that TV-SVAR methodology, contrary to the usual linear VAR approach, allows to measure 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 estimated in this paper a Time-Varying Structural VAR model (TV-SVAR) to detect changes in the response of each selected MENA economies to a specific oil prices shock.

$$y_t = A_{0,t} + A_{1,t} y_{t-1} + ... + A_{k,t} y_{t-k} + \varepsilon_t \quad t = 1, \ldots, T; \quad (6)$$

where $y_t$ is an $n \times 1$ vector of observed endogenous variables; $A_{0,t}$ is an $n \times 1$; $A_{i,t}$ for $i = 1; \ldots; k$ are $n \times n$ matrices of time-varying coefficients; $\varepsilon_t$ is a $n \times 1$ Gaussian white noise process with zero mean and covariance $\Sigma_t$. Let $A_t = [A_{0,t}, A_{1,t}, ..., A_{k,t}], x_t' = [1_n, y_{t-1}', ..., y_{t-k}']$, where $1_n$ is a row vector of ones of length $n$, let vec(.) 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 $n \times (nk + 1)n$ matrix, $I_n$ is a $n \times n$ identity matrix, and $\theta_t$ is $(nk + 1)n \times 1$ vector. We can treat $\theta_t$ 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), $\theta_t$ is specified as follows:

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

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

This paper applies a new method to evaluate changes of the oil prices shock impact on macroeconomic aggregate in a selective MENA countries during the two 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 process. For this purpose, we introduce, for the first time in the literature to our knowledge, a TV-SVAR model to complete our investigation if oil prices still play the same key role in MENA countries or not.

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 occurred in the selected countries of the MENA region. Contrary with existing literature, we explicitly conduct a time varying analysis and compare the reaction to a oil prices shock at different period and between countries for the same region.

In this paper, 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 is with 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 time varying 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).

In this paper, 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 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 (2). Bai & Perron test is suitable in our case of studies due to its properties of mean shift sensitive. The results of structural change confirm the finding of Alvarez-Ramirez et al. (2012) for the existence of a Kitchin inventory cycle that dominate crude oil markets. They retrieve a dominant period of about 4.5 years. The five sub-periods estimate by Bai & Perron test spanning 5 years or a multiplier of it.

3.4 Oil prices shocks: Experimental framework

In a first step, we analyze for each country the change of the domestic economic aggregate to the external oil prices shock. If the reaction to this common shocks appears similar in levels and if for the selected MENA group, we can conclude that the process of propagation and the 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 by 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

The nonlinearity properties hypothesis that we test in this subject comes for previous studies on some developed economies.
include: international oil price, industrial production, CPI, federal funds rate, money supply, domestic interest rate, and exchange rate. Due to the empirical model choice and its 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 first difference of logarithms of the domestic consumer prices index.

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

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

\[ X_t = A(L)\varepsilon_t. \]  

(9)

Vector \( X_t \) contains the variables for each country indicated above, \( X_t = [\text{opt}_t, y_{it}, \Delta \text{cpi}_t] \). Where \( \text{opt}_t \) the oil price, \( y_{it} \) Domestic GDP for countries \( i \), \( \text{cpi}_it \) consumer price index. All variables are in logarithm and \( \Delta \) means first difference, \( A \) is square matrix of order three. So the vector of the innovations is as follows:

\[ \varepsilon_t = [\varepsilon_{t}^{\text{opt}}, \varepsilon_{t}^{y}, \varepsilon_{t}^{\Delta \text{cpi}}]' \]. Where \( \varepsilon_{t}^{\text{opt}} \) oil prices shock, \( \varepsilon_{t}^{y} \) GDP shock, \( \varepsilon_{t}^{\Delta \text{cpi}} \) monetary shock. The model is writing as follows:

\[ \text{opt}_t = A_{11}(L)\varepsilon_{t}^{\text{opt}} + A_{12}(L)\varepsilon_{t}^{y} + A_{13}(L)\varepsilon_{t}^{\Delta \text{cpi}}, \]

\[ y_{t} = A_{21}(L)\varepsilon_{t}^{\text{opt}} + A_{22}(L)\varepsilon_{t}^{y} + A_{23}(L)\varepsilon_{t}^{\Delta \text{cpi}}, \]

\[ \Delta \text{cpi}_t = A_{31}(L)\varepsilon_{t}^{\text{opt}} + A_{32}(L)\varepsilon_{t}^{y} + A_{33}(L)\varepsilon_{t}^{\Delta \text{cpi}}. \]  

(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 the more small countries macroeconomic news. In fact, local production and inflation in our selected MENA countries does’nt have any effect on oil prices (\( A_{12}(L) = A_{13}(L) = 0 \)). The monetary shock \( \varepsilon_{t}^{m} \) does not have a long-term effect on the local production (\( A_{23} = 0 \)). Then the model becomes:

\[ \text{opt}_t = A_{11}(L)\varepsilon_{t}^{\text{opt}}, \]

\[ y_{t} = A_{21}(L)\varepsilon_{t}^{\text{opt}} + A_{22}(L)\varepsilon_{t}^{y}, \]

\[ \Delta \text{cpi}_t = A_{31}(L)\varepsilon_{t}^{\text{opt}} + A_{32}(L)\varepsilon_{t}^{y} + A_{33}(L)\varepsilon_{t}^{\Delta \text{cpi}}. \]  

(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.
4 Empirical results

4.1 Data description

In this paper, we use real GDP and CPI of ten Middle East North Africa countries + oil crude prices, spanning the period 1980:Q1 - 2015:Q4. The main source of oil crude prices is the St Louis Federal Reserve Bank website. However, for Consumer Price Index (CPI) and for the real gross domestic prices (RGDP), we extract its from IMF web site statistics and the IMF CD-Rom: four oil exporters: Algeria (1970Q1: 2015Q4), Bahrain (1970Q1: 2015Q4), Kuwait (1970Q1: 2015Q4), and Saudi Arabia (1970Q1: 2015Q4); three energy deficit countries: Morocco (1970Q1: 2015Q4), Tunisia (1970Q1: 2015Q4) and Turkey (1970Q1: 2015Q4). The six net oil producers represent 21.44% and 20.77% of the world oil production for 2013 and 2014 respectively.

We disaggregate each GDP series for a major oil exporter countries (Algeria, Kuwait, Oman, Qatar, Saudi Arabia and Tunisia) by using the Chow and Lin (1971) method with the "Industrial production, Manufacturing, Non-durable manufacturing, Petroleum and coal products, Crude petroleum products, Index" as a proxy for the variability of economic activity for 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 dependence on oil income. Hydrocarbon industries represent more than 80 percent of total government revenue and the sector of hydrocarbon per GDP is 50 percent in the region. For the Tunisia case, the manufacturing component represent 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 to quarterly data is well used on several researches and permit to span a large period (see Table 1).

As mentioned above, the sample contain net oil exporters and oil importers to capture deference effect of oil price shocks to the economy. 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 variance decomposition in different phases and the impulse response function for 1999Q2, 2004Q3, 2009Q4 and 2014Q4 respectively (see table 2). In this paper, the break dates are chosen endogenously through the well knowing Bai and Perron (1998) test presented in table 2. The first break dates estimated by the test (1985Q4) is excluded because the program needs 40 observations to calibrate prior distributions. For this reason, we will investigate possible change in forth dates: 1999Q2, 2004Q3, 2009Q4 and 2014Q4. For Algeria and Tunisia, due to the lack of data, we estimate the last dates at 2014Q3 and 2013Q4 respectively. In addition, we will exclude the proposed date of the 1999Q2 for Morocco and Tunisia for the same reason of data restriction.

4.2 Dynamic Impulse Response Function Analysis

In this section, we limit our analysis to only oil prices shocks. In general, when monetary policy have the same effect on different economies we can conclude that a common monetary policy will be suitable. However, the reaction to a specific shocks can significantly change in time when economic structural change. The sample of our study is characterized by profound changes in their monetary policy: this fact dictates the use of a time varying parameter analysis.

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6https://research.stlouisfed.org/fred2/series/POILWTIUSDQ/downloaddata
7Source: U.S. Energy Information Administration and author’s calculation
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 collected the dynamic impulsive response of a monetary shock on the domestic GDP and the price index respectively for each country of our sample. We want to trace out the time path, in four separated dates estimated by Bai & Perron test.

Our results, reported in graphs in appendix 2 to 15, indicate principally that oil prices effect have changed at least in level for both inflation and GDP aggregate for all countries. This results confort our initial choice of dynamic model to better understand economic oil impact to these countries. Oil prices effect on GCC countries (Bahrain, Kuwait, Saudi Arabia) seems to be similaire with a positive effect and permanent compared to Algeria. One possible explanation is the specific terms of trade of Algeria, witch export gas and oil in USD and import most of their need from Europe. Therefore, Algeria support both change in oil prices and the change in USD/Euro exchange rate.

On one hand, the inflation of all MENA countries react positively of any oil prices shocks. Graphs clearly show a excess for the last oil price increase during 2010-2014. On the other hand, the reaction of domestic GDP is not conclusive for Algeria and Turkey.

4.3 Dynamic Variance Decomposition Analysis

Dynamic Variance decomposition tells us how much of a change in a variable is due to its own shock and how much due to shocks to other variables in percentage. We expect that any positive shock in oil prices will have a positive effect on GDP of oil exporters countries in the short run, but for the long run previous results are inconclusive. An increase of oil prices can be transmitted to others prices of related commodities or these oil exporters depends extremly of the importations to provide their needs of different goods. In fact, the gain from oil prices appreciation can be losses by an increase of commodities prices.

5 Conclusion

There is substantial evidence suggesting that the oil role in international economy has fundamentally changed compared to the 1970s. We revisit the debate of the oil prices and macroeconomic relationship. With our two models we address an important question if whether the transmission of oil price shocks has changed over time. This paper lies within the scope of the literature relating to the oil shocks impact on MENA countries. The relations between oil prices and MENA countries could lead to a mitigate result. The difference in the role of oil on each economy can be the key of this result. Clearly, for gulf economy any increase of oil prices yield to a permanent increase in their GDP and also an increase in inflation rate. However, the rise in inflation seems to be less permanent and the shocks will be absorbed into six quarters. For the MENA deficit oil countries they react negatively to any rise of oil prices.
References


## Appendices

### Table 1: Data periods

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<tr>
<th>Country</th>
<th>GDP Source</th>
<th>CPI Source</th>
<th>studied period</th>
<th>number of observations</th>
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<td>1980Q1-2015Q3 StLouisFed</td>
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<td>143</td>
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* denotes with Author’s calculation.

### Figure 1: Oil price, in US Dollars

![Oil price graph](image)

### Table 2: Structural change dates of Oil prices

<table>
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<tr>
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<th>$T_1$</th>
<th>$T_2$</th>
<th>$T_3$</th>
<th>$T_4$</th>
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<td>1.4546</td>
<td>2.3753</td>
<td>2.3753</td>
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Figure 2: Impulse response of Inflation to oil prices shocks (Algeria)

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

Figure 4: Impulse response of Inflation to oil prices shocks (Kuwait)

Figure 5: Impulse response of Inflation to oil prices shocks (Morocco)

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

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

8Line cyan for 1999Q2, line green for 2004Q3, line blue for 2009Q4, line red for 2014Q4.
Figure 8: Impulse response of Inflation to oil prices shocks (Turkey)

Figure 9: Impulse response of GDP to oil prices shocks (Algeria)

Figure 10: Impulse response of GDP to oil prices shocks (Bahrain)

Figure 11: Impulse response of GDP to oil prices shocks (Kuwait)

Figure 12: Impulse response of GDP to oil prices shocks (Morocco)
Figure 13: Impulse response of GDP to oil prices shocks (Saudi Arabia)

Figure 14: Impulse response of GDP to oil prices shocks (Tunisia)

Figure 15: Impulse response of GDP to oil prices shocks (Turkey)