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A MACRO –ECONOMETRIC STUDY OF OIL ENERGY: OPAEP PANEL'S DATA ANALYSIS[*]

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Abstract

The interest of this paper is to show the relationship GDP - Oil Production, that is to say that the trajectory of GDP is subject to oil production because a shortage in the oil sector will influence all other sectors therefore automatically GDP will decline. We will try to prove this relationship by applying the method of analysis of panel data on the member's countries of OAPEC. Previously, it was very difficult to make a logical explanation of changes in GDP because economists could not make a correct calculation because they are only interested in oil prices. The reason for using the analysis of panel data is that this method will allow us to proceed with the estimation of an equation valid for all countries by obtaining values of GDP and oil production in order to confirm that it is a relationship between GDP and oil production responding to the hypothesis posed at the beginning.

Key words: oil economy, OAPEC, macro-econometric modeling, trajectory of GDP, oil production, analysis of panel data, economic growth.

JEL Classification: B22, B23, C13, C22, C33, C51, N55.

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1. Introduction

The theme of energy and particularly the one of oil occupies a place of choice in the actual economy. The consumption countries try to decrease prices at the maximum however the production countries try to increase them. In this respect, the emergence of large organizations in the oil and gas sector such as OAPEC had as a main role to protect their common interests and keep control of prices to an acceptable level. The current researches aimed to prove that the increase and decrease of GDP is due to the production of oil and not to prices variations. Therefore, the problematic posed is the following: 'what is the impact of oil production on the trajectory of GDP in OAPEC?' Elements such as GDP, oil production, the `OAPEC organization', are going to be used for a macro-econometric modeling by the analysis of panel data.

2. Causality between oil energy consumption and economic growth: a synthesis of the literature

The economic growth represents the quantitative aspect of economic development and identifies in its broad sense, the increase of products and services produced by an economy over a given period. Since the 80s, and even before, researches on economic growth have developed in an extraordinary way by presenting theoretical and empirical models of the different determinants of economic growth. On the other hand, the availability of data on several countries has greatly facilitated the development of many empirical studies. Thus, neoclassical theories link economic growth to the factors of traditional production such as capital and labor through Cobb-Douglas' function of production whose failure lies in the fact that it does not explain the importance of economic growth and then, the need to add another residual factor representing technical progress. Studies of economic growth have attempted to estimate the direct effect of the investment on GDP growth by analyzing the nature of the investment and the investment ratio to GDP. The most detailed study on the determinants of economic growth is perhaps that of Barro and Sala-i-Martin (1995) and the one of Barro on the determinants of economic growth (1997). The new theories have come to say that the growth of endogenous sources, contrary to earlier theories assumed that growth had exogenous determinants.

Thus, the technical progress that was exogenous becomes endogenous being the consequence of economic growth, so, the determinants of endogenous growth embrace the accumulation of knowledge, human capital, technological capital and public infrastructure spending.

The effect existing between petroleum energy and economic growth is linked primarily to countries heavily dependent on this source of energy and that experience average growth rates. Studies dealing with this phenomenon are based on the Granger causality tests to verify the existence of causality between growth and abundance of natural resources (especially oil).

Other researches have been conducted on the relationship economic growth - energy through functions of production of KLEM type (K = capital, L = labor, E = energy, M = labor) that integrate energy as a production factor and this due to the fact that energy is never consumed to itself, but is considered as a means to operate an equipment capable of satisfying a need. KLEM functions have attracted much theoretical interpretations and empirical tests by economists during the decade 1970-1980 leading to two conclusions: the first is based on the strict complementarity between the different factors while the latter admits a partial substitutability or almost perfect between factors (Percebois 1989).

According to Percebois (1999), the relationship between energy consumption and GDP is highly variable in time and space. In a given country, this relationship depends on several variables: the structure of production, the climate, the technology used, the director of energy prices, the regulations and the behaviour of economic agents. Thus, countries with similar characteristics may have the energy consumption –GDP relations identical. This is also confirmed by Babusiaux (2001) who shows that in most developing countries, the elasticity of energy consumption to GDP ratio is often greater than or equal to 1. On the other hand, it is less than 1 and varies between 0.85 to 0.9 in industrialized countries due to the increasing share of tertiary sector in GDP and the technical progress favoring energy efficiency. He adds that the price - elasticity is very low at a short-term and the consumption is highly dependent on equipment that is to say, investments in the economy.

Other studies have highlighted the relationship between oil prices and economic activity, particularly with the work of Darby (1981) and those of Hamilton (1983). The latter showed that there is a significant negative relationship between rising oil prices and real GDP growth in the United States during the periods 1948-1972 and 1973-1980.

Moreover, it should be noted that energy is an expenditure item for households and businesses. It is essential to the daily needs (food, communication, water, production of goods, etc...). Thus, based on the Keynesian consumption function, we can affirm that the energy consumption is an increasing function of income. According to Friedman, individuals adjust their permanent consumption to permanent income.

Most of these studies have not used cross-sectional data but rather the time series for each country producer and exporter of oil. Al-Yousif (1997) uses co-integration tests and annual data on export, and GDP between 1973 and 1993 for four countries (Saudi Arabia, Kuwait, United Arab Emirates, and Sultanate of Oman). The author believes that there is a positive impact of exports on economic growth for the four countries, but the results of the co-integration suggest that there is no long-run relationship between exports and economic growth in these four countries. The same study was conducted by Abu-Quarn and Abu-Bader (2004) in the MENA region using time series data over several periods namely, the 1963-1999 period (Algeria, Egypt, Israel and Morocco) the period 1976-1999 (Iran), 1976-1998 (Jordan), the period from 1960 to 1991 (Sudan, Tunisia) and the periods 1963-1998 and 1966-1996 (Turkey). They believe there is a unidirectional causality link in the case of Iran and Algeria. Results also show that exports do not contribute similarly in most of these countries. From all these analyses, it appears that energy consumption and particularly the energy has a positive impact on growth and that growth leads to increased energy consumption. However, as the country develops the more energy intensity of GDP decreases. In addition, understanding the dynamics of the relationship between energy and economic growth must take into account the other factors of production.

3. The Econometrics of Panel Data

Since the early seventies, models combining specified data in instantaneous section and time-series models of panel data have become very popular and created another approach to applied economic analysis. In this regard, Baltagi (2001) notes that the number of articles published using the methods of econometrics panels greatly increased since the pioneering works of Balestra and Nerlove (1966) and Maddala (1971) on error component models from Swany (1970) on models with random coefficients and models of Zellner on SUR models (Seemingly Unrelated Regressions).

The development of econometrics panels has grown so much that in 1991 the Journal of Economic Literature introduced a new code in its classification. So today, econometrics panel that is introduced and taught in the university curriculum, constitute an area in its own right in the field of econometrics.

The increasing use of panels of econometrics is explained by two main technical reasons:

First, it should be by developing the collection of data done by the organizations of statistics. Sources of information are increasingly constituted by samples where individuals are repeatedly observed. Thus, the multi-pass surveys can compose panels.

Then, with the progress of technology and computer programs that have facilitated the practical implementation of economic methods.

From the applied economics point of view, the use of panel data has broadened the scope of econometric investigations.

Many advances are recognized in the works of micro-econometrics because of fairly direct correspondence between the theories of panel data. This is true for applications in macroeconomics.

3.1. Definitions

A panel observations on a group of individuals at various points of time (individuals= statistical unit observed: consumer, firm, region, etc ...).

Panel data (or longitudinal data) are representative of two dimensions: individual and temporal. A balanced panel has the same number of observations for all individuals; an unbalanced panel is a panel with missing observations for some individuals.

Panel data are representative of two dimensions: cross-sectional data and data in the form of time series. It uses a natural notation of two indexes: x_{it} notes the observation of the variable x of individual i at time t.

If we fix the individual observed, we obtain the series or longitudinal section, while if we fix the reporting period, we obtain a cross section, or instantaneous, for all individuals.

Table1. Example

	France (i=1)	**Germany (i=2)**	**…..**	**Italy (i=30)**
1975 (t=1)	$X_{1,1}$	$X_{1,2}$	…...	$X_{1,30}$
1976 (t=2)	$X_{2,1}$	$X_{2,2}$	…….	$X_{2,30}$
….	….	….	…….	….
2002 (t=28)	$X_{28,1}$	$X_{28,2}$	…….	$X_{28,30}$

3.2. Why panel data?

They are useful because there is a double dimension of data; a wealth of information to be investigated, advances in information technology, advances in econometric theory has led to the development of appropriate statistical methods.

3.3. Homogeneity tests

3.3.1. Sequential procedure tests

The choice of specification (homogeneity, heterogeneity) is very important to determine the structure of the panel. Hsiao (1986) proposes a sequential testing (Figure 1) to define the cases in which it is located:

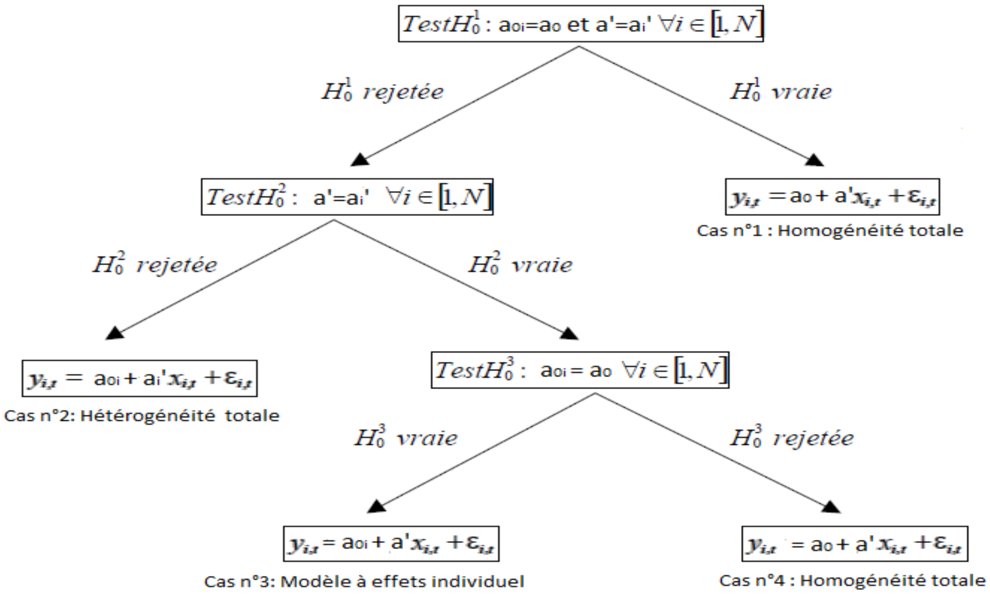


Figure 1: Graph sequential testing procedure

3.3.2. Tests construction

The three tests of Fisher from Hsiao's procedure have to determine if you have a model with specified individual time invariant.

In this case, you can use panel data estimation. Hypothesis tests are constructed from statistics of Fisher (Wald test of restrictions on the coefficients):

$$\text{Test } H_0^1 : a_{oi} = a_0 \ et \ a' = a_i' \quad \forall_i$$

This test of jointed hypotheses boils down to a Fisher test in which the statistic is given by:

$$F_1 = \frac{(SCR_{c1} - SCR) / (N-1)(k+1)}{SCR / (N \times T + N(k+1))}$$

SCR_{c1} : Sum of squared residuals of the restricted model under the assumption H_0^1 or estimated by MCO model by stacking all observations.

The degree of freedom is equal to: ($N \times T$: total number of observation) - (k +1): number of coefficients to be estimated).

SCR: sum of squared residuals of the unconstrained model, it is equal to the sum of N sumsofsquared residuals estimated on the T observations for each individual equation, either $SCR = \sum_{i=1}^{N} SCR_i$. The degree of freedom is the sum of the N degrees of freedom for each estimated equation, then $ddl = \sum_{i=1}^{N} (T - (k+1)) = N \times T - N(k+1)$

The degree of freedom of the numerator is equal to the difference of degrees of freedom of SCR_{c1} and SCR

$$ddl_n = [(N \times T) - (k+1)] - [(N \times T) - N(k+1)] = (N-1)(k+1)$$

F1 statistics is compared to the value read from the table of Fisher to degrees of freedom in the numerator and denominator. If $F_1 > F^{\alpha}_{ddl_n;ddl_d}$ we reject the hypothesis H_0^1 at level α.

Test : $H_0^2 = a' = a'_i \quad \forall_i$

This hypothesis testing is joined back to Fisher test whose statistic is given by:

$$F_2 = \frac{(SCR_{c2} - SCR) / ((N-1) \times k)}{SCR / (N \times T) - N(k+1)}$$

SCR_{c2} : sum of squared residuals of the restricted model under the assumption H_0^2 or estimate the individual fixed effects model[i]. The degree of freedom is equal to ($N \times T$ = number of observations) - (k + N) = number of coefficients to be estimated), we estimate coefficients k and N constant terms.

SCR = sum of squares of residuals of the non-restricted model. The degree of freedom of the numerator is equal to:

$$ddl_n = [(N \times T) - (k+N)] - [(N \times T) - N(k+1)] = (N-1) \times k$$

[a] When using the procedure of Hsiao and exactly when calculating SCRc2 (i.e. to estimate a fixed effects model), we must account for the specific type chosen that is to say specific individual, temporal, or individual-time. Specificity will be chosen from the significance of the coefficients, the ratio of Fischer and the model reduces to three criteria: AIC, SC and HQ.

F2 Statistics is compared to the value read from the table of Fisher to degrees of freedom in the numerator and denominator. If $F_2 > F^{\alpha}_{ddl_n;ddl_d}$ we reject the hypothesis H_0^2 at level α

Test: $H_0^3 : a_{0i} = a_0 \ \forall i$ This hypothesis testing is joined back to Fisher test in which the statistic is given by:

$$F_3 = \frac{(SCR_{c1} - SCR_{c2}) / (N-1)}{SCR_{c2} / (N \times (T-1) - k)}$$

SCR_{c2} : Sum of squares of residuals of the restricted model under the assumption H_0^2.

SCR_{c1} : Sum of squares of residuals of the restricted model under the assumption H_0^1 .

The degree of freedom of the numerator is equal to:

$$ddl_n = [(N \times T) - (k+1)] - [(N \times T) - (k+N)] = (N-1)$$

Statistics F3 is compared to the reading table Fisher degrees of freedom in the numerator and denominator. If: $F_2 > F^{\alpha}_{ddl_n;ddl_d}$ we reject the hypothesis H_0^3 at level α.

3.4. Fixed effects or random effects? The Hausman test

The specification test of Hausman (1978) is a general test that can be applied to many problems of specification in econometrics. But its most common application is the specification tests of individual effects in panel. It also serves to discriminate between fixed and random effects that we will study and test. The general idea of this test is both simple and general.

As noted earlier, the Hausman test is a test that will allow us to determine here whether the coefficients of the two estimates (fixed and random) are statistically different.

Under the null hypothesis H0 of orthogonality between explanatory variables and the error term of the random effects model, both estimators-LSDV (Least Square Dummy

Variable) and GLS(Generalized Least Squares)- are unbiased estimators and in this case there should be no significant difference between the LSDV and GLS estimates of the various coefficients. The MCG method is then retained: the model is at random effects.

hypothesis testing: 3

$H_0 : \hat{a}_{LSDV} - \hat{a}_{GLS} = 0 \rightarrow$ The model is at random effects.

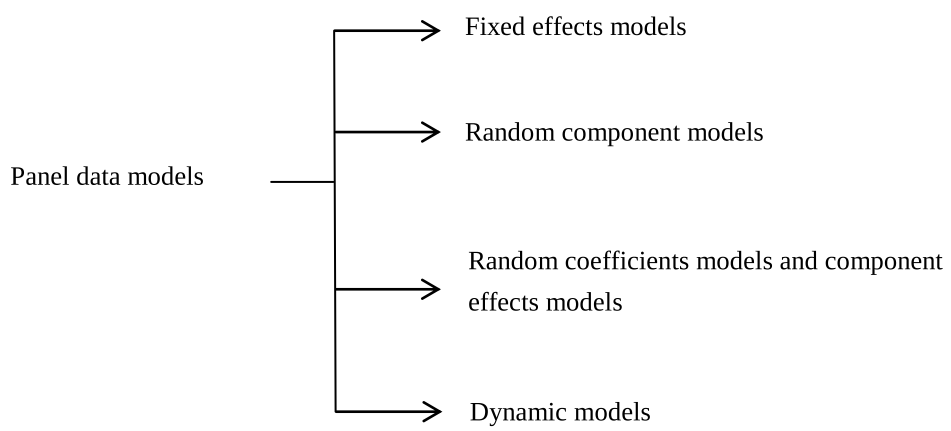
$H_1 : \hat{a}_{LSDV} - \hat{a}_{GLS} \neq 0 \rightarrow$ The model is at fixed effects.

We calculate the statistics:

$$H = (\hat{a}_{LSDV} - \hat{a}_{GLS})' \left[Var(\hat{a}_{LSDV}) - Var(\hat{a}_{GLS}) \right]^{-1} (\hat{a}_{LSDV} - \hat{a}_{GLS})$$

The H-statistic is distributed according to a khi-deux with k degrees of freedom. If H> X2 (k), for a threshold at α % fixed, the hypothesis H0 is rejected, LSDV estimator (or Within when it is used, depending on the estimation method chosen) is unbiased, then we reject the random effects specification and one chooses a fixed individual effects model.

3.5. Models in the econometrics of panel data



4. Case study

a. A case study of the OAPEC organization

Before starting the analysis, we will make an application on the object variables of the study and from a table, and a graph showing the evolution of the GDP in real value (dependent variable) and oil production (explanatory variable) for the five countries included in OAPEC, namely: Algeria, UAE - Saudi. Arabia - Iraq - Libya (see Appendix 1 and 2)

b. tests construction (Test Hsiao)

We begin by testing the hypothesis: a0i = a0 and $b' = b_i' \ \forall$ i.

$$F_1 = \frac{(SCR_{c1} - SCR)/(N-1)(K+1)}{SCR/(N-T)*N\,(K+1)} = \frac{(216408739991{,}431 - 148026213523{,}46)/8}{148026213523{,}46/70} = \frac{8547815808}{2114660193} = 4.04$$

$F_1 = 4.04 > F^{0.05}_{8,70} \approx 2.05$, we reject the hypothesis H_0^1 .

So we head to the left branch of Hsiao's test graph and then, test : $H_0^2 : \ a' = a_i' \ \forall i$

$$F_2 = \frac{(SCR_{c2} - SCR)/(N-1)*K}{SCR/(N*T) - N(K+1)} = \frac{(117133977898{,}37 - 148026213523{,}46)/4}{148026213523{,}46/70} = \frac{-7723058906}{2114660193} = -3{,}65 .$$

$F_2 = -3{,}65 < F^{0.05}_{4,70} \approx 2.42$ we accept the hypothesis H_0^2 So we head to the right branch of Hsiao's test graph .

Test $H_0^3 : a_{0i} = a_0 \ \forall i$

to calculate the statistic: $F_3 = \frac{(SCR_{c1} - SCR_{c2})/(N-1)}{SCR_{c2}/(N*(T-1)-K)}$ which we know all the elements.

$$F_3 = \frac{(216408739991{,}43 - 117133977898{,}37)/4}{117133977898{,}37/74} = \frac{24818690523}{1582891593} = 15{,}68.$$

$F_3 > F^{0.05}_{4,74} \approx 2.41$. we reject the hypothesis H_0^3

The panel has a structure of temporal effects (see Appendix 3)

c. Fixed-effects or random effects? The Hausman test

The following hypothesis testing: (MCG=GLS in French)

H_0 : $\hat{a}_{LSDV} - \hat{a}_{MCG} = 0 \rightarrow$ the model is at random effects

H_1 : $\hat{a}_{LSDV} - \hat{a}_{MCG} \neq 0 \rightarrow$ the model is at fixed effects

$H = (\hat{a}_{LSDV} - \hat{a}_{MCG})' \left[Var(\hat{a}_{LSDV}) - Var(\hat{a}_{MCG}) \right]^{-1} (\hat{a}_{LSDV} - \hat{a}_{MCG})$ = 6,779 .

With :

$\hat{a}_{LSDV}$ =22,34 ; $\hat{a}_{MCG}$ = 22,605 ; $Var(\hat{a}_{LSDV})$ = 3,206627 ;

$Var(\hat{a}_{MCG})$ = 3,196295.

($\hat{a}_{LSDV} - \hat{a}_{MCG}$)= -0,265; $Var(\hat{a}_{LSDV}) - Var(\hat{a}_{MCG})$ = 0.010332

H=6,779 > $\chi^2(1)$ of a threshold of 5 % that is 3,841

We reject the hypothesis H_0, The model is therefore at fixed temporal effects.
The final equation is given as follows:

$Y_{it} = a_{0t} + b_1 {*} X_{it} + \omega_{it} = a_0 + a_t + b_1 {*} X_{it} + \omega_{it} = a_0 + \text{PER\_EFFECT} + b_1 {*} X_{it} + \omega_{it}$

$$a_{0t} = a_0 + a_t$$

=> $Y_{it} = 29330{,}203 + \text{PER\_EFFECT} + 22{,}34 {*} X_{it}$

With :

PER_EFFECT = $\sum_{t=1}^{T} a_t$ / t = (1995 , 1996, …, 2010).

a_0 : the constant term

a_t : temporal effect (see annex n°4)

d. Residue Analysis

It can be noted from the five graphs of residues (Appendix 5) that the curves of the residues are different despite the fact that five countries have almost the same regression equation on panel data. Each country is characterized by a curve of different residues compared to other countries.

Forecast

Remark: In this case, we cannot perform the autocorrelation LM test since the number of observations is not large enough (N* T = 80 <500).

To achieve a GDP forecast for the five individuals in 2011 until 2014, we must do an early prediction of oil production for the period (2011-2014). We will define oil production as a dependent variable and time as an explanatory variable. You cannot get rid of it even if seasonality exists because the data are annual (for seasonally adjusted series data must be monthly or quarterly).

- The panel data model of oil production (dependent variable) and time (explanatory variable) can be written as follows:

$$X_{it} = a_{0i} + a_{1i} * t$$

a_{0i} : constant term for the individual i / i = [1,..,5]
a_{1i} : regression coefficient of the time for the individual i.

e. *Stationarity test*

Prior to the estimation of the equation, we must study the stationarity of five sets of oil production and ignore the seasonality of the series since the data are annual.

In this regard, we are going to test the stationarity of Philips Perron (PP) to each individual models for the three following models:

$$y_t = \phi_1 y_{t-1} + \varepsilon_t........(1) \quad auto\ regressive\ \mathrm{mod}\,el\ of\ one\ order$$

$$y_t = \phi_1 y_{t-1} + B + \varepsilon_t..(2) \quad auto\ regressive\ \mathrm{mod}\,el\ with\ \cos\tan t$$

$$y_t = \phi_1 y_{t-1} + Bt + c + \varepsilon_t..(3) \quad auto\ regressive\ \mathrm{mod}\,el\ with\ trend$$

From all of the stationarity tests performed on five individuals, we conclude that all individuals series are non-stationary of type DS.

To make the series stationary, we must make them in first differences or second differences, according to the PP test. So we will revisit the stationarity of all series in first differences and if the series is not stationary, we move to the method of stationarisation in second differences.

Table 2 Determination of orders p and q of the ARIMA process for each individual

Individual	Stationarity degree
Individual n°1	The series is stationary in first differences
Individual n°2	The series is stationary in second differences
Individual n°3	The series is stationary in first differences
Individual n°4	The series is stationary in first differences
Individual n°5	The series is stationary in first differences

From this table, we notice that only the series of individual n ° 1 is stationary in first differences, the rest of the series being stationary in second differences. We can now proceed to the step of determining the degree of p and q for the ARIMA = (p, q), estimate and choose the best model that minimizes the criteria AIC, SC, HQ, and that has at the same time significant regression coefficients (Student test "tcal> TTAB"). The final results are summarized in the table below:

Table 3. Determination of orders p and q of ARIMA

Individuals / Models	N°1	N°2	N°3	N°4	N°5
ARIMA	(0,1,8)	(5,2,7)	(1,2,4)	(5,2,4)	(0,2,7)

We can see that all the first differences follow an ARIMA process, the following results represent the equation then estimated for each individual:

UAE → $\Delta x_{1,t} = -0.85\varepsilon_{1,t-1} + 0.25\varepsilon_{1,t-8}$

Algérie → $\Delta(\Delta x_{2,t}) = 0.12\Delta(\Delta x_{2,t-4}) - 0.18\Delta(\Delta x_{2,t-5}) - 0.98\varepsilon_{2,t-7}$

A. Saoudite → $\Delta(\Delta x_{3,t}) = -0.51\Delta(\Delta x_{3,t-1}) - 0.93\varepsilon_{3,t-4}$

Irak → $\Delta(\Delta x_{4,t}) = -0.11\Delta(\Delta x_{4,t-5}) - 0.98\varepsilon_{4,t-4}$

Libye → $\Delta(\Delta x_{5,t}) = 0.72\varepsilon_{5,t-2} + 0.60\varepsilon_{5,t-7}$

f. Rediction by ARIMA

After estimating the equations of oil production in first differences for individual n ° 1 and second differences for individuals no: 2, 3, 4, 5, we will make a prediction about four years (from 2011 to 2012 - 2013 -2014) on the first and second differences and that in order to obtain a forecast of oil production. The forecasts appear in the following table:

Table 4. Projected oil production written by differences

Year / Individuals	2011	2012	2013	2014
UAE	196.85	-3.8	-0.17	42.34
Algeria	180.91	209.84	213.52	167.87
Saudi Arabia	-560	349.35	254.68	385.05
Iraq	182.15	27	20.36	100.81
Libya	-61.12	-11.31	118.34	59.76

The predicted values obtained (in first differences or second differences) represent sometimes a lower level of production and other time an increase of this level.

At Libya and Saudi Arabia, we notice a decline in production of Libya because of the events it has known and the instability that followed. There is also a significant decrease in the production of Saudi Arabia because of the instability of the political and economic situations in some countries such as Egypt, Bahrain.

After the fall of production in these two countries, the latter will know again an increase.

In addition, the decline in oil production in these two countries has allowed indirectly the increase of production in Algeria, Iraq and the UAE for the years 2011 and 2012.

g. Restaining series

After calculating the expected differences of the first and second oil production for the period 2011 - 2014, forecast of oil production are calculated as follows:

$$\Delta x_{it+1} = x_{it+1} - x_{it} \Rightarrow x_{it+1} = \Delta x_{it+1} + x_{it}$$

Table 3. Values of the projected oil production

Year / Individuals	2011	2012	2013	2014
UAE	2520.65	2516.85	2516.68	2559.02
Algeria	1370.71	1580.55	1794.07	1961.64
Saudi Arabia	7596	7945.35	8200.03	8585.08
Iraq	2540.15	2567.15	2587.51	2688.32
Libya	1425.48	1414.17	1532.51	1592.27

After obtaining new observations of oil production for the years 2011 - 2014 by the forecast, we go to the GDP forecast for all individuals in the same period. For the temporal fixed effects model, we can not forecast the dependent variable for each individual and for each year.

- The predictive value of GDP obtained is global for each year and for all individuals. In such cases of panel data (that is to say the temporal fixed effects models), the equation is almost identical for all the individuals.

- This equation is asymptotically close to the total homogeneity, thus obtaining direct predictive value of GDP for each country is almost impossible.

- The total GDP forecast for all panels is obtained as follows:

The calculation of the sum of the projected oil production for all individuals for each year

Table 5. The sum of the projected oil production

Year / Individuals	2011	2012	2013	2014
UAE	2520.65	2516.85	2516.68	2559.02
Algeria	1370.71	1580.55	1794.07	1961.64
Saudi Arabia	7596	7945.35	8200.03	8585.08
Iraq	2540.15	2567.15	2587.51	2688.32
Libya	1425.48	1414.17	1532.51	1592.27
$\sum$	**15452.99**	**16024.07**	**16630.8**	**17386.33**

The calculation of the sum of the coefficients a0t:

Table 6. The sum of the coefficients a_{0t}

Period	a_t	a_0	a_{0t}
1995	-23872,94	29330,2	5457,26
1996	-20290,19	29330,2	9040,01
1997	-22377,81	29330,2	6952,39
….	….	….	…….
2009	50555,31	29330,2	79885,51
2010	73501,68	29330,2	102831,88
Total	-	-	**469283,192**

At this stage, we simply replace X_{it} by the sum of the expected values of oil production for each year of the GDP forecast and a0t by the sum of a0t in the following equation:

$$Y_{it} = \sum_{t=0}^{T} a_{0t} + 22,34 * \sum_{i=1}^{5} X_{it}$$

$$Y_{it} = 469283,192 + 22,34 * \sum_{i=1}^{5} X_{it}$$

The final results of this study are the predicted values of GDP for all individuals for the period 2011 - 2014, these results are shown in the following table:

Table 7: Forecast of total GDP for all individuals

Years	2011	2012	2013	2014
$\sum_{i=1}^{5} X_{it}$	15452.99	16024.07	16630.8	17386.33
Total GDP	**814502,99**	**827260,92**	**840815,26**	**857693,80**

h. Analysis of the results

The most important information to remember from these two tables is that the trajectory of GDP (increasing or decreasing) is subject to oil production (GDP declines with the decline of oil production or otherwise if oil production increase). The results obtained in this study confirm the hypothesis, then the model used is reliable and consistent with the assumption of Robert Hirsch and stating at a conference in Houston, that the relationship between oil supply and economic growth is direct and that the trajectory of GDP cannot be explained by the price of oil. Regarding the estimation of peak oil, it is very difficult to make such an estimate. Economists can not make a correct calculation because they are only interested in oil prices.

5. Conclusion

Recourse to the use of panel data has become one of the highlights of the evolution of applied econometrics.

In this article, we have attempted to provide a succinct summary of the theoretical aspect of econometrics of panel data through the presentation of models of panel data and the various tests that accompany it. Secondly, the case study came to illustrate this theoretical aspect regarded as a raw material in the sequence with a panel data regression.

Despite laudable efforts by econometricians in the modeling of economic problems in panel data, there remains that some theoretical models are difficult to use, add to that some variables that are not directly observable or measurable. Finally, there are also errors that may arise from non-reliance on the economic data always subject to errors. All these observations can affect the forecasting process, the predicted values can be negatively affected and differ from the actual values with the phenomenon under study.

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Appendices

Appendix 1: Evolution of GDP from 1995 to 2010 for five countries in OAPEC
Unit: million

Pays / Année	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
UAE	42807	47079	49410	46191	51900	61504	63512	67349	78143	91978	113206	136704	165598	200204	213109	232356
Algerie	41240	45957	46187	45103	45395	50047	50317	51212	60064	73557	86625	97018	108720	135350	108761	126422
A,Saoudite	127811	138687	141357	122373	134905	153473	167134	169408	189385	216556	261570	287706	311739	377658	296608	349541
Irak	78055	76608	76116	75743	77352	77715	16148	15667	9374	21367	28243	34819	60158	59010	76616	94719
Libye	29393	31837	32344	26450	30053	33116	27426	18333	21664	27606	36242	44108	55201	68765	50212	57740

Source: Prepared by the authors based on: OAPEC report 2001-2011, groups of official statistics for the Arab countries, Arab economic report consolidated

Appendix 2: Evolution of oil production from 1995 to 2010 for five countries of OAPEC. Units: 1,000 barrels / day

Pays / Année	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
UAE	2160	2161	2267	2244	2154	2280	2231	2208	2601	2343,6	2378	2568	2529	2572,2	2241,6	2323,8
Algerie	752	806	846	827	795	796	842	730	942	1311,4	1352	1426	1398	1356	1240	1189,8
A,Saoudite	8023	8102	8012	8280	7565	8090	7890	7093	8410	8897	9353,3	9208	8978,6	8532	8190	8156,6
Irak	737	740	1384	2169	2541	2700	2600	2127	1378	2107,2	1912,7	1957,2	2035,2	2280,5	2336,2	2358,1
Libye	1399	1394	1396	1449	1287	1347	1324	1316	1432	1580,7	1693,2	1751,2	1673,9	1721,5	1473,9	1486,6

Source: Prepared by the authors based on: OAPEC report 2001-2011, groups of official statistics for the Arab countries, Arab economic report consolidated

Appendix 3: Comparison of three specific panel data (test Hsaio)

Criteria	individual fixed effects	Temporal fixed effects	Fixed Effets individuals-temporals
t_{a0}^{*}	-1,074	3,024	1,517

t_{b1}^{*}	3,394	12,644	0,812
F*	28,882	148,848	15,22
R^2	0,661	0,656	0,838
AIC	24,512	-	24,151
SC	24,691	-	24,777
HQ	24,584	-	24,402
Decision	Refused	Accepted	Refused

Source: Prepared by the authors using the program Eviews6.

Appendix 4: The test of Hausman

Correlated Random Effects - Hausman Test
Pool: Untitled
Test period random effects

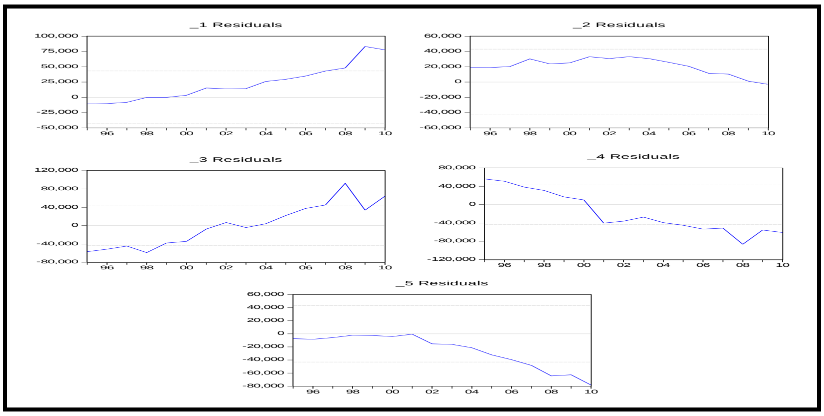
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	6.779565	1	0.0092

Period random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
X?	22.341035	22.605696	0.010332	0.0092

Source: Prepared by the authors using the program Eviews 6.

Appendix 5: Graphs of residuals for the five individuals



Source: Prepared by the authors using the program Eviews