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The Dynamic Effect of Oil Rent on Industrial Value Added: a SVAR Approach

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Abstract

This paper studies the dynamic effect of oil rents on industrial added value in a sample of countries with different levels of development. Using a SVAR model, we tested the effect of a real shock and a nominal shock on the variables of the model. The main obtained results are three. First, we confirmed that the Dutch disease (DD) problem is a short-term phenomenon that takes place each time there is a shock on oil rents. Second, the ephemeral nature of the phenomenon confirms the neoclassical assumption stating that the effect of nominal shocks on real variables is only short term. Third, the effect of long-term real shock on oil rents is positive for all countries which score interdependence between industry on the one hand and oil rents on the other.

Key words: Dutch disease, Oil rents, Industrial added value, SVAR, Tunisia.

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Introduction

Several studies have focused on the effect of the increase of oil rents (positive oil shock) on manufacturing industry and this in order to check for the Dutch Disease (DD) phenomenon initially observed in the Netherlands (during the 1960s and the 1973 oil crisis) and largely reproduced in several countries as reported in many related studies. Nevertheless, two observations are in order.

The first is that no study has tested the DD phenomenon (including the manufacturing and energy industries). Such oblivion of all industrial activities might bias analysis for three main reasons. First, there is an interdependence relationship between the two sectors. Then, it is noted in many countries that when oil resources are abundant, non-manufacturing industry may benefit from low costs of intermediary goods (energy), given that national oil price is significantly inferior to international prices (Libya, Saudi Arabia, Algeria . . . etc).

Second and consistent with World Bank classification, the fact of highlighting manufacturing industry meanes excluding mines, conctruction, electricity, water and gas sub-sectors. Excluding these sectors does not allow to objectively evaluate the DD effect given that some losses in the manufacturing sector may be counterbalanced by gains generated from other industry branches.

Third, the hypotheses on which the DD model is founded are less compatible with the reality of many oil-exporting countries. Indeed, Corden and Neary model (1982) adheres to a model of a real economy (where monetary aspects are ignored) characterized by absence of factorial distortions, salaries flexibility, full employment as well as inter-sectorial labour mobility. Nevertheless, in most oil-exporting countries (mainly developing countries), these hypotheses are rarely tested. Likewise, in developing countries, a small portion of production is exported given that most investments will be streamed towards industrial branches strongly dependent on oil (which are excluded from research like electricity, mines, gas ..etc).

The second observation is that most previous studies did not determine time horizons in which DD is triggered. Differently put, is the said effect short or long-term?

Then, in order to mend for these specification insufficiencies, in this paper we will try to determine the effect of oil rents on industrial added value using a SVAR model.

Then, this paper is structured as follows. The first section reviews the relevant literature on DD theory and its effects on oil rents. The second section presents the methodology in terms of econometric estimations and data. The third section presents the results of our estimations. The fourth section interprets the results. The final section concludes the paper.

1 The Literature review

It is extremely important to signal out the DD theory is relatively old, although the name given to it is recent. The negative effect of a massive exportation of natural resources (or massive currency flows) on industry seems, to us, old. Indeed, bullionist mercantilism (Portuguese and Spanish) which enabled massive flows of gold and silver did not allow these two countries to develop productive structures like their French and English rivals. Moreover, occasional wealth has increased prices and played an obstacle to growth. Nevertheless, Colbertist France has developed industry which enabled it to ripe intensive and extensive accumulation of capital and to outperform as of the beginning of the 21st century Spain and Portugal.

The modeling approach of Corden and Neary (1982), which mainly relied on the cases of the Netherlands, Britain, Australia and other OPEC countries (which knew an increase in their financial resources generated from exporting natural resources and which has amplified through the 1960s and 1970s) enabled to conclude that massive exportation of natural resources negatively affects manufacturing industry and employment. Likewise, a deterioration of trade balance and a real decrease in returns of specific manufacturing factors are recorded. According to the authors, increase in energy prices resulted in a relative increase in prices of tradable goods (energy and manufacturing industry) compared to prices of non-tradable goods (services). This makes the manufacturing industry less competitive which forces it to adjust itself by reducing its production tempo and consequently reducing employment.

Buiter and Pervis (1983, 1993), Eastwood and Venables (1982), while proposing models similar to that of Corden and Neary, concluded that new revenues(generated from new discoveries of natural resources or from a sudden increase in prices) cause a simultaneous increase in current and permanent incomes, which in itself increases currency demand. In the case where currency offer is set, then an exchange rate appreciation will take place and this in view of readjusting the monetary market.

Cox and Harvie (1982) concluded that an increase in prices of natural resources, although it allows in the short-term an increase in real income, an increase in wealth of the private sector and an improvement in current accounts balance, it negatively influences the demand and offer of manufacturing goods. Likewise, the said increase in prices contributes to deteriorating of trade balance of manufacturing goods. According to the same authors, the mechanism through which these effects are produced is explained by real exchange rate appreciation which reduces competitiveness of the manufacturing sector and creates fluctuations of the financial market. Loss of production capacity by the manufacturing industry will be accompanied by losses in employment which may negatively affect long-term growth. In this regard, Kareem Ismail (2010) tried to test the "Dutch Disease" effect on manufacturing sectors of oil-exporting countries and this within a time horizon covering the 1977-2004 period. Four results have been obtained. As a first, the author indicated that these countries truly check the DD phenomenon (a negative relationship between permanent increases in prices of oil and manufacturing goods). Second, shocks of oil rents have more important effects in countries where capitals are more open to foreign investors. Third, prices of labour compared to capital and capital intensity of the manufacturing sector are appreciated in as long as revenues increase. Fourth, capital of manufacturing sectors is less affected by an ultimate oil rents shock.

Lama and Medina (2010) tried to evaluate exchange rate stabilisation policies undertaken to face DD's negative effects. Proposing a model of small countries where exporting sector is characterized by rigidity of nominal prices and openness on learning-by doing, the authors showed that by facing exchange rate appreciation, we may prevent an ultimate loss of production capacity in the exporting sector. Nevertheless, such a strategy may negatively affect other sectors of the economy. Likewise, the authors concluded that any intervention on exchange rate will negatively affect well being and may be a source of creating economic distortions.

HC Bjørnland (1996) tried to study the main sources of business cycles in the economies strongly dependent on oil and the effect of an energy boom on the manufacturing sector and this in Norway and the UK. Using a structural VAR model, the authors indicated that an energy boom positively contributed during the 1979-1981 period and negatively during the 1982-1984 period. Starting from 1985, its role has become quite null. As for the effect of a shock on prices, the authors indicated that there is a positive effect by the end of the 1970s. The authors deduced that the DD phenomenon is of a short-term in the UK and that the long-term negative effect recorded on manufactories is relatively weak.

HC Bjørnland (1998) tried to examine, using a VAR model (by which the author supposed the presence of an offer and demand shock according to which long-term restrictions have been imposed), dynamic effects of an energy shock on manufacturing production in Norway and the UK. According to the author no evidence of DD presence was detected in Norway given that increases in oil prices have positively affected the manufacturing sector. For the case of the UK, the author concluded that DD is a long-term phenomenon whatever the economy may score improvements following an oil shock during the first five years. Olusi and Olagunju (2005) tried to test DD phenomenon in Norway using a VAR model consisting of an analysis of impulse response functions and an analysis of variance decomposition. The authors concluded that the Norwegian economy was subject to long-term DD.

2 Methodology and data

In this paper, the adopted methodology opts for a dynamic multivariate analysis. We propose to test sensitivity of economies of eight countries checked for DD theory through the study of the dynamic relationship[2] between industrial added value (ind_t) and oil rents ($rent_t$) using a Structural Vector Autoregressive (SVAR) model. We believe that sensitivity of a given economy to DD phenomenon should be treated both in the short-term and the long-term.

SVAR models initiated by Sims (1986), Bernanke (1986) and Blanchard and Watson (1986) try to cast an economic meaning to results generated by multivariate models. This motivation is based on the attempt to identify a series of independent shocks hitting the economy by means of some theoretical restrictions[3]. These restrictions are said to be short-term in the absence of instantaneous impact of the shock under study on the model's variables. However, when identifying the structural form of a long-term VAR model, restrictions should be imposed on dynamic multipliers of structural shocks. This second identifying approach proposed by Shapiro and Watson (1988) and Blanchard and Quah (1989) aims at considering that only a part of the identified shocks have a permanent effect on the system's components. The restrictions express then in this case the absence of long-run effect of some impulses on the model's variables[4].

In as much as the identifying approach retained by our study rests on Blanchard and Quah's decomposition (1989), it is convenient to portray the gist of the results of this approach. Blanchard and Quah consider through a bivariate model consisting of production and unemployment rates that an economy governed by two types of shocks: an offer shock and a demand shock. These two authors consider that by opposition to a demand shock, an offer shock affects production in the long-term. These two hypotheses are then used to

[2] The study of this dynamic relationship is conducted in the framework of a SVAR model, based on the impulse response functions (IRF) and forecast error variance decomposition (FEVD).

[3] these shocks are considered as the ultimate source of stochastic variation of the endogenous variables in a VAR model.

[4] The fact that the effects exerted by shocks are permanent implies non stationarity of one or more variables in the model. This observation comes from the fact that these shocks continue to accumulate over time due to their long-term nature.

identify transient and permanent components of production[5]. Economic theory is used in this paper while considering aggregated demand innovations as transient shocks and those of aggregated offer as permanent shocks.

The retained model in this paper is equally bivariate. It includes industrial added value (% of GDP) and oil rents (% of GDP). The series of the eight countries under investigation are taken from the World Bank. Data are annual covering the 1975-2010 period for the UAE and the 1971-2010 period for the rest of the countries. Conducting unit root tests (Augmented Dickey-Fuller (ADF) and Phillips Perron (PP)), we conclude that the indt and rentt series are stationary at first difference for the eight countries under consideration (see table 1). Johansen test indicates the absence of cointegration between the two series for the entire sample. We retain then a VAR at first differences both for ind_t and $rent_t$ of p order with $Y_t = (\Delta ind_t \ \Delta rent_t)'$, $t = 1, \ldots, T$. The structural Vector Moving Average (VMA) is written as follows:

$$\begin{cases} \Delta ind_t = \sum\limits_{k=0}^{\infty} b_{11}^*(k) w_{1t-k} + \sum\limits_{k=0}^{\infty} b_{12}^*(k) w_{2t-k} \\ \Delta rent_t = \sum\limits_{k=0}^{\infty} b_{21}^*(k) w_{1t-k} + \sum\limits_{k=0}^{\infty} b_{22}^*(k) w_{2t-k} \end{cases} \quad (1)$$

Where w_{1t} and w_{2t} respectively denote a real shock and a nominal shock[6]. The system may be written as:

$$\begin{bmatrix} \Delta ind_t \\ \Delta rent_t \end{bmatrix} = \begin{bmatrix} B_{11}^*(L) & B_{12}^*(L) \\ B_{21}^*(L) & B_{22}^*(L) \end{bmatrix} \begin{bmatrix} w_{1t} \\ w_{2t} \end{bmatrix} \quad (2)$$

Which is equivalent to:

$$Y_t = B_0^* w_t + B_1^* w_{t-1} + B_2^* w_{t-2} + B_3^* w_{t-3} + \ldots = \sum_{i=0}^{\infty} B_i^* L^i w_t = B^*(L) w_t \quad (3)$$

Where $B^*(L) = \sum\limits_{i=0}^{\infty} B_i^* L^i$ a lag polynomial with all its roots outside the unit circle and $V(w_t) = \Omega = I$.This latter standardization hypothesis is generally used to facilitate identification of the structural form. Given that industrial

[5] Indeed, instead of associating each endogenous variable to a specific innovation, Blanchard and Quah consider the impact of shocks on the model's variables can be either transient or permanent. These shocks are then treated as exogenous variables.
[6] According to Quah and Vahey (1995) and Jacquinot (1998), offer shock is said real shock and demand shock is said nominal shock.

added value is stationary at first differences, $b^*_{12}(k)$ translates the effect of w_{2t} (nominal shock) on Δind_t after k periods. It would be logic after conducting some algebraic specifications, to consider that $\sum_{k=0}^{j} b^*_{12}(k)$ is the effect of w_{2t} on the level of indt after j periods. Then, $\sum_{k=0}^{j} b^*_{12}(k)$ translates the long-run effect of a nominal shock on production. Conventionally, we consider that only a real shock may have permanent effects on activity and that a nominal shock has no transient effects. Long-term neutrality of a nominal shock on production will then be the retained identification criterion.

The VAR model is estimated under the following reduced form:

$$Y_t = A(L)Y_{t-1} + \varepsilon_t \tag{4}$$

With ε_{1t} and ε_{2t} are canonical innovations associated to the reduced form of the model and where $V(\varepsilon_t) = \Sigma_\varepsilon$, $A(L) = \sum_{i=1}^{p} A_i L^i$ a lag polynomial with all its roots outside the unit circle. Equation (4) admits the following VMA form:

$$Y_t = \varepsilon_t + B_1\varepsilon_{t-1} + B_2\varepsilon_{t-2} + B_3\varepsilon_{t-3} + \ldots = B(L)\varepsilon_t \tag{5}$$

Where $B(L) = \sum_{i=0}^{\infty} B_i L^i$.

It follows that

:

$$\begin{cases} \varepsilon_t = B_0^{-1} w_t \\ \Sigma_\varepsilon = B_0^{-1}\Omega(B_0^{-1})' \\ \Sigma_\varepsilon = B_0^{-1}(B_0^{-1})' \end{cases} \tag{6}$$

Innovations ε_t are then linear combinations of shocks w_t. Equations (3) and (5) give:

$$B^*(L) = B(L)B_0^{-1} \tag{7}$$

It follows then that in order to determine $B^*(L)$, B_0 should be identified since $B(L)$ may be known through a standard VAR. Taking into account a standard VAR estimation, and the orthogonalization and standardization of the variance-covariance matrix Ω, identifying the structural parameters is about imposing at least $\frac{n(n-1)}{2}$ additional restrictions [7] on the coefficients matrix attached to the contemporaneous variables ($B^*(0) = B_0^{-1}$) and/or on long-term multipliers ($B^*(1) = B(1)B_0^{-1}$) [8] . In the bivariate case, like ours, only one additional restriction $\frac{n(n-1)}{2} = 1$ is imposed to identify the structural model. This restriction deduced from economic theory is meant in our model to restrict the long-run effect of a nominal shock on activity. Against this background, the right upper corner of the matrix of long-term multipliers $B^*(1)$ should be equal to zero. $B^*(L)$ will be then triangular inferior.

Table 1: Results of ADF and PP tests

Country/ Variable		AD		PP	
		level	First difference	level	First difference
Algeria	real	-2.080	-6.978	-2.057	-7.103
	nominal	-2.594	-7.134	-2.699	-7.144
China	real	-2.544	-5.454	-2.727	-5.463
	nominal	-1.626	-5.085	-1.875	-5.086
UAE	real	-2.603	-7.912	-2.640	-7.912
	nominal	-2.307	-6.425	-2.196	-7.838
Japan	real	-0.661	-5.431	-0.663	-5.361
	nominal	-1.625	-3.640	-2.329	-8.547
Norway	real	-2.066	-6.349	-2.022	-7.588
	nominal	-2.245	-6.491	-2.041	-10.47
SA	real	-1.818	-5.732	-1.632	-5.731
	nominal	-3.438	-7.868	-3.613	-8.255
Tunisia	real	-2.258	-5.299	-2.256	-5.239
	nominal	-1.943	-6.387	-1.994	-6.395
USA	real	-0.064	-5.406	-0.008	-5.298
	nominal	-1.797	-5.993	-1.929	-5.989

3 Impulse responses

Analysis of responses to shocks is done through the interpretation of impulse response functions. These functions are based on our SVAR model's identification scheme. Our model assumes, along the neo-classic theory, long-term neutrality of a nominal shock on production. The results of impulse response functions for the eight countries are all consistent with our model's scheme.

[7] Indeed, since the variance-covariance matrix Σ_ε is symmetric, $\frac{N(N+1)}{2}$ restrictions are provided by the mo.del However, B_0 contains N^2 unknown elements, we must impose at least $\frac{N(N-1)}{2}$ restrictions for the just identification of the structural form.
[8] Replacing L by the unit at equation (7) we obtain long term multipliers.

Graphs 1 to 8 respectively represent responses in the eight countries [9] in terms of industrial added value and oil rents (from top to bottom) following a real shock (on the left) and a nominal shock (on the right) [10] .

Concerning the real shock, we note that the difference of the long-term effect on industrial added value is proportional to that on oil rents in Algeria, Norway, Saudi Arabia and Tunisia. This difference is different from that in China, UAE, Japan and the US in which oil rents' reactions remain less significant. This observation could have an ultimate relationship with DD mainly that the first group of countries risks to face such a phenomenon.

As for the nominal shock, the graphs indicate that in the eight countries, consistent with the identification restriction, such a shock has no long-run effect on production. Indeed, production reaction to nominal shock for UAE, Tunisia and the US is almost null for the entire sample period and adjustment to long-term situation of the rest of the countries remains very short. This latter observation confirms pkilips's curve verticality hypothesis.

4 Forecast error variance decomposition

Forecast error variance decomposition (FEVD) consists of attributing each shock a portion in the model's variables variation. In our model, this is done through finding contribution of identified shocks, both the real and nominal shock, to industrial added value and oil rents fluctuation. FEVD analysis of the eight countries under consideration (Tables 2 and 3) [11] confirms also the results of impulse response functions and the adopted identification scheme.

FEVD of industrial added value indicates that the nominal shock does not contribute to production variation and that in the best cases its contribution is minimum. Indeed, at a horizon of 1 to 40, the contribution of the nominal shock in activity variation is null for UAE, Tunisia and the US and it reaches 16 % for the rest of the countries.

Concerning FEVD of oil rents, we note that almost the entire fluctuation of this variable is governed by a nominal shock in China, UAE, Japan and the US. This scheme is totally reversed in Norway and Saudi Arabia in which oil rents variations are explained in a large part by a real shock. Nevertheless, rents variations in Algeria and Tunisia are fairly divided between the real shock and the nominal shock. This confirms our previous doubts during the impulse

[9] The abscissa of 8 graphs of impulse responses indicate the time in years and the ordinates the variables responses.
[10] The confidence intervals of IRF are constructed from Hall's percentile method.
[11] The contribution of each shock is expressed as a percentage.

response functions analysis, which assumes that Algeria, Norway, Saudi Arabia and Tunisia risk to be the most affected countries by DD.

table2: **FEVD of "ind_t"** with relative **contribution of real shok and nominal shok**.

Horizon		1	2	3	4	5	10	20	40
Algeria	real	93	84	84	84	84	84	84	84
	nominal	7	16	16	16	16	16	16	16
China	real	96	95	94	94	94	94	94	94
	nominal	4	5	6	6	6	6	6	6
UAE	real	100	100	100	100	100	100	100	100
	nominal	0	0	0	0	0	0	0	0
Japan	real	94	86	87	87	87	87	87	87
	nominal	6	14	13	13	13	13	13	13
Norway	real	98	97	97	97	97	97	97	97
	nominal	2	3	3	3	3	3	3	3
SA	real	98	95	95	95	95	95	95	95
	nominal	2	5	5	5	5	5	5	5
Tunisia	real	100	100	100	100	100	100	100	100
	nominal	0	0	0	0	0	0	0	0
USA	real	100	100	100	100	100	100	100	100
	nominal	0	0	0	0	0	0	0	0

table3: **FEVD of "$rent_t$"** with relative **contribution of real shok and nominal shok**.

Horizon		1	2	3	4	5	10	20	40
Algeria	real	45	46	46	46	46	46	46	46
	nominal	55	54	54	54	54	54	54	54
China	real	2	6	7	7	7	7	7	7
	nominal	98	94	93	93	93	93	93	93
UAE	real	11	13	14	14	14	14	14	14
	nominal	89	87	86	86	86	86	86	86
Japan	real	10	24	24	24	24	24	24	24
	nominal	90	76	76	76	76	76	76	76
Norway	real	93	91	91	91	91	91	91	91
	nominal	7	9	9	9	9	9	9	9
SA	real	71	72	72	72	72	72	72	72
	nominal	29	28	28	28	28	28	28	28
Tunisia	real	48	48	48	48	48	48	48	48
	nominal	52	52	52	52	52	52	52	52
USA	real	3	4	4	4	4	4	4	4
	nominal	97	96	96	96	96	96	96	96

5 Analysis of the results

Before analysing the obtained results, we signal out that we chose eight countries with different development levels.This choice is based on three main criteria. The first one is that countries should have a developed or relatively developed industry, whereas the second is that these countries should be rentier. The third criterion is that the sample covers different industrial development levels (see table 4).

Likewise, the mentioned countries are among the three oil-producing groups: pure oil-exporting countries (Saudi Arabia, UAE, Norway and Algeria), oil-exporting countries (China, USA and Tunisia) and an oil-importing country (Japan). The choice of this heterogeneous specification of countries is explained by three main reasons. The first is that most previous studies highlighted one unique country, a fact which prevented them from moderating their theoretical and empirical results. The second is that the choice of a number of countries enables us to see the different reaction scenarios possible to a shock (real or nominal) and to detect then dynamicity of DD in each group. The third is that such a choice enables politicians to anticipate ultimate DD phenomena and know their direction. This would allow them to formulate the most efficient economic strategies and policies aiming at preventing these negative effects.

Table 4: Evolution of industrial added value (% of GDP) and oil rents (% of GDP) over 1971-2010

Country	Variable	1971	1980	1990	2000	2010
Algeria	ind	41	57	48	58	62
	rent	8	28	8	13	17
China	ind	42	48	41	45	46
	rent	0.4	14	5	2	1.4
Norway	ind	31	39	33	41	40
	rent	0.02	9	9	15	10
SA	ind	69	71	48	53	59
	rent	40	80	41	40	50
Tunisia	ind	23	35	33	30	32
	rent	2	16	5	2.98	4
UAE	ind	–	53	58	48	5
	rent	–	48	24	18	18
Tunisia	ind	43	39	37	31	27
	rent	0.00	0.010	0.0017	0.0012	0.0022
USA	ind	34	33	27	23	20
	rent	0.4	3	0.7	0.39	0.68

Source: World bank

5.1 *Effects of a real shock on industrial added value*

Examining impulse response functions (appendix), we note that long-run effects of positive real shocks on industrial added value for all countries are positive and whose behaviour displays four distinct categories. Indeed, in Algeria and Norway, we notice that during the two post-shock years the temporary positive effect on industrial added value knew a slight decrease to stabilize at a lower level than that recorded during the shock. In the UAE, temporary positive effect of the shock on industrial added value knew a strong decrease followed by a levelling off, without nevertheless reaching the initial level.

In China, Tunisia and the US, we may notice that the shock had first a positive and increasing effect on industrial added value before stagnating at a level higher than the initial one. In Japan and Saudi Arabia, the same positive effect is recorded except that stagnation reverted to the initial level.

Except Saudi Arabia, we may initially conclude here that industrial sectors of oil-importing countries are those which benefit the most from a positive real shock.

5.2 *Effects of a real shock on oil rents*

In all countries, we notice that a long-term positive shock had a positive effect on oil rents. Two main observations are signalled. First, in Japan, UAE, China, the US and Saudi Arabia, we notice that size of the positive effect of a real shock on oil rents is less important than that on industry. This logically implies that this group of countries is less related to oil and that real shocks in these countries rarely result from positive energy shocks. This is true for the Japanese case where the real shock had at first a negative effect on oil rents before stagnating gradually towards zero. This shows the reality of an industrialized country where oil resources are rare and where positive real shocks attract capital to be invested in the energy sector. In other words, resources reallocation will take place leading to a short-term decrease in oil rents. For the rest of the countries (China, UAE, and the US), we notice that the effect of a real shock on oil rents, despite being positive, is weaker than that of a real shock on IAV. Differently put, IAV has an effect less proportional on oil rents. This may be explained by the fact that reactions of these countries to real shocks is but partial and this is because new mechanisms are less and less economical (China and the US), whether to preserve interests of future generations or prevent ultimate over-exploitation of current oil reserves (UAE and Saudi Arabia).

Second, in Algeria, Tunisia and Norway, we notice that the effect of a real shock on oil rents is equal (in variation and extent) to that of a real shock on IAV. Two explanations are possible. The first is the great dependence of the industrial sector on the energy sector (Norway and Algeria). The second is that the positive effect of a real shock on IAV has an encouraging effect to look for new mechanisms to ultimately increase oil offer (Torvik 2002).

5.3 Effects of a nominal shock on industrial added value

Except in Japan and the USA, the effect of a nominal shock on industrial added value is positive in the short term and negative before vanishing in the long term. This confirms DD theory given that an oil rents supplement (from a price shock) negatively affects the industrial sector. The mechanisms underlying such a relationship are usually related to exchange rate appreciation and whose immediate effect would decrease the industry competitiveness. However, long-run effect of the shock vanishes which proves the transient nature of the DD phenomenon.

In Japan, we note that the nominal shock had a positive impact in the short term and zero in the long term. This means that as an oil-importing industrial country, the nominal shock leads to exchange rate depreciation and consequently to an increase in industry competitiveness. The American case is special given that the industry was insensitive to the nominal shock both in the short and in the long term. A possible explanation is that the exchange rate of the dollar against other currencies suffered during a nominal shock from two opposing movements, which probably cancelled each other out. The first is the appreciation of the dollar, after an increase in revenues while the second is a depreciation resulting from the fact that it pays more for the same level of imports. Thus, two important results are in order. The first is that the DD is confirmed, usually in a short-term time horizon and in countries where economic structures are dependent on oil rents. The second result is that the nullity of the nominal shock on industrial added value leads us to confirm the validity of the neoclassical theory.

5.4 Effects of a nominal shock on oil rents

The common observation raised is that the effect of a positive nominal shock on oil rents for all countries is positive and stagnates in the long-term. However, in the short term, countries do not exhibit the same behaviour. In the case of China, Norway, Saudi Arabia and the USA, we notice that the shock increases rents which stagnate after at a level higher than the initial one. The reverse phenomenon is recorded for the remaining countries (Japan, Algeria, Tunisia and the UAE).

However, at this stage of analysis, a relevant question deserves to be asked: As long as the nominal shock had a long-run positive effect on rents, why did not these latter have an effect on industrial added value? In our view, the answer to this question is not a straight one. However, we can involve reasons that are probably possible. The first is that a rents supplement is offset by the negative effect of DD. The second is that the positive variations in rents are likely sources of deficiency of the different markets given that they create wealth by increasing prices of goods and services as well as prices of inputs. From then on, the ultimate higher cost of wages and cost of capital will reduce corporate profits through increased cost functions, hence the decline in industry competitiveness.

5.5 Contribution of shoks to variables' fluctuations

Table 1 indicates that industrial added value is dominated, in both the short and the long term, by real shocks. Thus, two groups of countries are distinguished. A first group of countries (UAE, TUNISIA, USA) where industrial added value is exclusively influenced by real shocks and at all time horizons (ranging from the short to the long term) suggesting that in these countries the productive strategy is completely independent from collected rents.

However, in the second group (Algeria, Norway, SA, china, Japan) we note that industrial added value is explained by both nominal shocks and real shocks, although dominance of real shocks is undeniable. The cases of Algeria and Japan are those in which nominal shocks contribute most to industrial added value (16% years for Algeria and 13% in the case of Japan in the next 2-40 years). Otherwise, the other countries of the group are intermediate cases.

In terms of economic policy we have three models to present given their importance. The first model is that of Tunisia, a small net oil importer, where its production strategy is based exclusively on real innovations. This model is to be consolidated in developing countries because it allows the country to diversify its productive apparatus and not be at the mercy of scarce and fluctuating natural resources. As part of this strategy, Tunisia has for decades managed to strengthen its production capacity and diversify its sources of wealth that allows the country to plan sustainable development based on productive wealth creation and human capital promotion. The second model is that of the UAE, an oil and gas exporter, where the economic strategy is based on real shocks. This strategy, less confirmed in the case of oil -exporting countries, is a successful one that allows the country to develop a more competitive economy and less dependent on oil. The third model is that of Algeria where IAV is relatively dependent on nominal shocks. Such a model may hide failures in the production system (undiversified, uncompetitive, low-value etc.). Such a

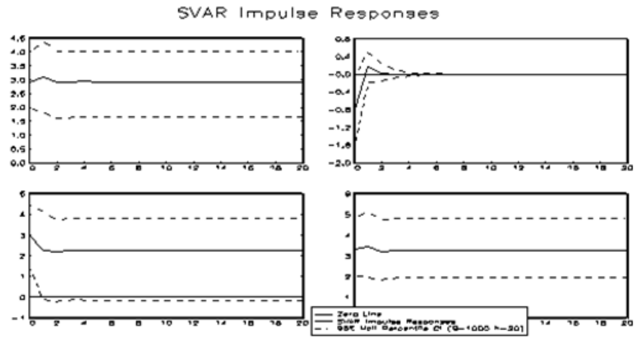

Fig. 1. **Responses of "ind" and "rent" (top to bottom) to real shock (left) and nominal shok (right) with 95% Hall percentile bootstrap confidence interval based on 1000 bootstrap replications(ALGERIA).**

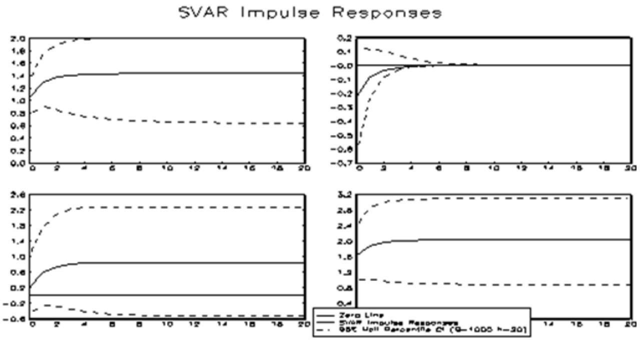

Fig. 2. **Responses of "ind" and "rent" (top to bottom) to real shock (left) and nominal shok (right) with 95% Hall percentile bootstrap confidence interval based on 1000 bootstrap replications(CHINA).**

model is to be avoided because sustainable development should be based on developing the real rather than the nominal sphere.

Table (2) indicates that oil rent is dominated, in both the short and long term, by real and nominal shocks. Thus, in the case of Algeria and Tunisia, oil rent is symmetrically explained by real and monetary shocks. This means that real and nominal shocks contribute to explaining about or almost 50% of rents. In the case of China, UAE, JAPAN, USA we note that rent is mostly explained by nominal shocks suggesting that rents significantly depend most on nominal fluctuations coming from sudden variations suffered by world energy market than from real innovations that may affect the real economy. In the case of NORWAY and Saudi Arabia, the opposite phenomenon is recorded suggesting that rents recorded in these countries may be mostly explained by real shocks. Two reasons may explain this trend. First, industry is highly dependent on energy sector. Second, the real recorded innovations in the productive sphere have a positive impact on energy production and therefore collection of rents (new technologies, new production processes, more incentives for energy use).

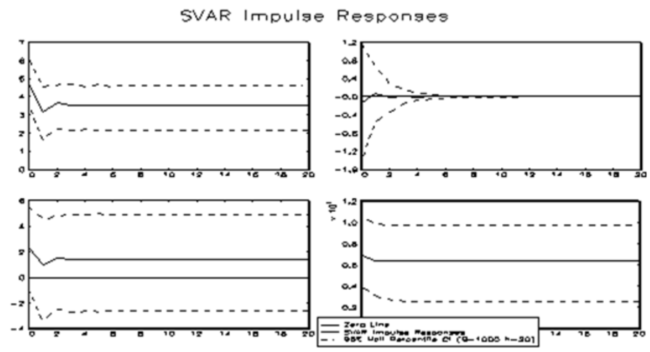

Fig. 3. **Responses of "ind" and "rent" (top to bottom) to real shock (left) and nominal shok (right) with 95% Hall percentile bootstrap confidence interval based on 1000 bootstrap replications(U.A.EMIRATES).**

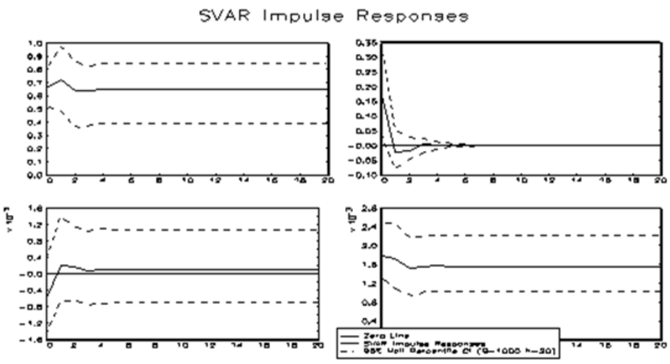

Fig. 4. **Responses of "ind" and "rent" (top to bottom) to real shock (left) and nominal shok (right) with 95% Hall percentile bootstrap confidence interval based on 1000 bootstrap replications(JAPAN).**

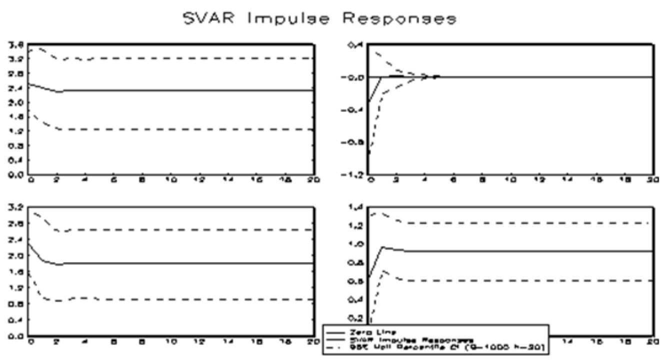

Fig. 5. **Responses of "ind" and "rent" (top to bottom) to real shock (left) and nominal shok (right) with 95% Hall percentile bootstrap confidence interval based on 1000 bootstrap replications(NORWAY).**

6 Conclusion

In conclusion, we can say that this paper enabled us to confirm that the DD problem is short-term phenomenon which recurs each time there is a shock on

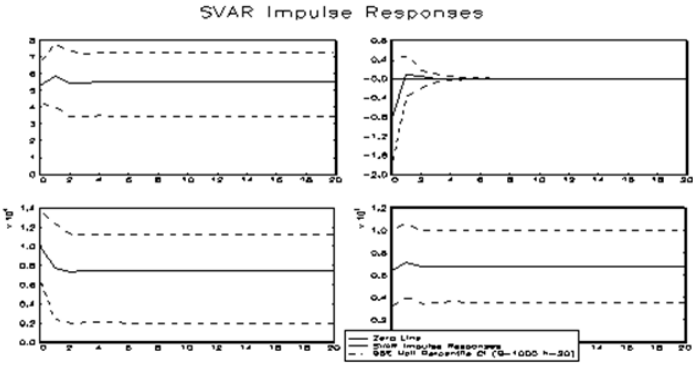

Fig. 6. **Responses of "ind" and "rent" (top to bottom) to real shock (left) and nominal shok (right) with 95% Hall percentile bootstrap confidence interval based on 1000 bootstrap replications(SAUDI ARABIA).**

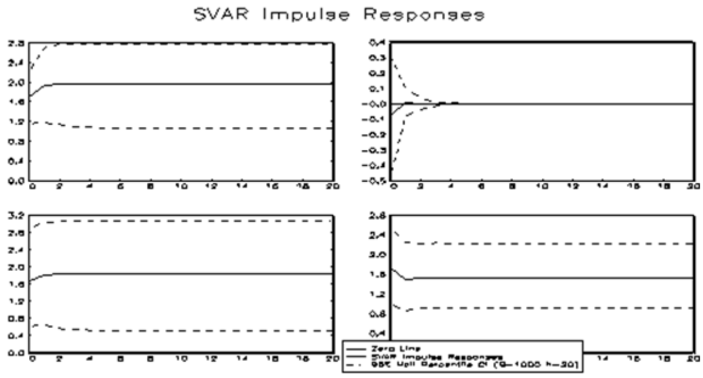

Fig. 7. **Responses of "ind" and "rent" (top to bottom) to real shock (left) and nominal shok (right) with 95% Hall percentile bootstrap confidence interval based on 1000 bootstrap replications (TUNISIA).**

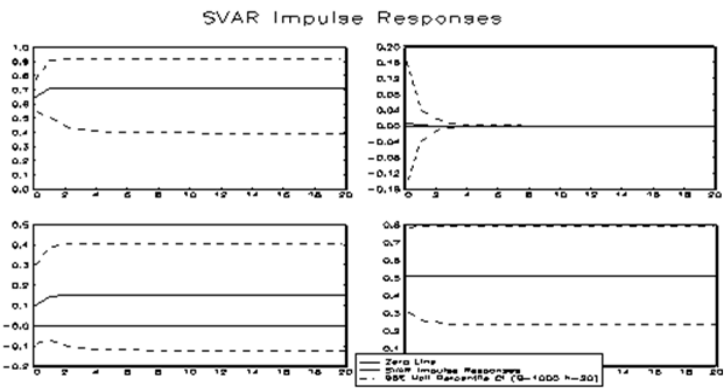

Fig. 8. **Responses of "ind" and "rent" (top to bottom) to real shock (left) and nominal shok (right) with 95% Hall percentile bootstrap confidence interval based on 1000 bootstrap replications (USA).**

oil rents. The ephemeral nature of the phenomenon confirms the neoclassical assumption stating that the effect of nominal shocks on real variables is only short term. Four results were discussed.

First, the effect of a real shock on industrial added value was positive in the long term and this for all countries of our sample. Indeed, this proves that shocks are structural innovations which enable productive systems to create, in the long term, more wealth.

Second, the long-term effect of a real shock on oil rents was positive for all countries with interdependence between industry on the one hand and oil rents on the other. Two possible reasons may explain this relationship. The first is that as industry grows thanks to a real structural shock it scores positive externalities on oil exploitation (better tools, technical skills, performed human capital etc..). The second possible reason is that industrial development can be a source of encouraging new oil discoveries and this to save volatility and fluctuation risk that characterizes the international energy market.

Third, the effect of a nominal shock on industrial added value seems, as already mentioned above, to confirm the DD phenomenon. Indeed, we noticed that during the two post shock periods, rents had a negative impact on industrial added value. Starting from the third period (the extreme case of Japan), the effect of rents is cancelled permanently.

Fourth, the effect of a nominal shock on oil rents is positive and stable which is explained by the fact that governments try to stabilize their income in the long term even if they resort to overusing resources.

The felt reaction of countries to each type of shock largely depends on their energetic-economic structures. For example, the USA was not a victim of DD phenomenon because the liberal structure of foreign exchange markets and currencies thwarted off the mechanisms by which DD is transmitted. Likewise, low level of DD in UAE is explained by the declared strategy of this country which is based on diversifying the economy and developing new sectors that create added value. In addition, in the case of Japan we noticed the low long-run effect of a real shock on rents, which proves that investment in oil does not appear, in the long term, neither an effective nor a profitable option.

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