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The relationship between natural resources rents, trade openness and economic growth in Algeria

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Abstract

The aim of this paper is to investigate the dynamic relationship between natural resources rents and Algerian economic growth within a trivariate framework by adding trade openness as a third variable. By using cointegration and error correction model techniques, Granger causality tests reveal a bidirectional causal relationship between natural resources rents and economic growth in the short-run and the long-run as well. Moreover, we found a unidirectional causality running from trade to economic growth without any feedback effect.

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1.Introduction

Since the seventies, the relationship between natural resource abundance and economic growth has been a controversial question among scholars and the extensive literature provided conflicting answers (Myrdal 1974; Hirschman, 1978; Solow, 1993; Sachs, 1993, Gylfason 2011). Broadly, there are two different axes that analyzed the resources-led growth hypothesis. The first body of the literature establishes a negative relationship between resource abundance and poor economic performance (Auty 1993, 1994, 2001), Bulmer- Thomas (1994), Gelb (1988), Lal and Myint (1996), Ranis (1991), Sachs and Warner (1995, 1997, 1999)). Tornell and Lane (1998) argue that natural resource booms may generate political tensions among powerful interest groups which may intensify current account deficits and affect growth. Collier and Hoeffler (1998) demonstrate how natural resources increase the risk of civil war by providing the example of some Africa's diamond wars which not only divert factors of production from socially productive uses but also destroy societal institutions and the rule of law (Gylfason and Zoega 2001). Sierra Leone is a good example of Africa's conflict as it produces huge quantity of Diamond for export but the country remained mired in poverty, ravaged by crippling internal warfare as local warlords have continued to fight for control over the diamond trade (Gylfason and Zoega 2006). The results of the first axe appear to support the resource curse hypothesis. The second range of literature called "resource blessing" show the positive side of natural resources and demonstrate their role in economic development and progress. It is argued that huge natural resource rents may promote investment activities and improve the infrastructure of the country. This would in turn boost economic activities and promote economic growth (Hamdi and Sbia, 2013a). The countries of the Gulf Cooperation Council[1] (GCC) are the good example. Thanks to natural resources rents which were invested in their economies GCC countries have made impressive progress and outstanding economic performance during the past decade (Hamdi and Sbia, 2013b).

Generally, in oil exporting countries, natural resources rents are mainly based on hydrocarbons, especially revenues from oil and gas and they are the backbone of their economies. This sector contributes significantly to government revenues and it is the principal actor of economic growth. Thanks to high oil prices during the recent period, oil exporting countries have achieved a buoyant economic growth and their balances of payments are looking very healthy. Algeria is one of the oil exporting countries and it is also an OPEP member. Recently, it achieved a fiscal surplus of 7.5%, and the economic growth during the period of crisis was around 3.4% (African development Bank 2011). Like other oil exporting countries, especially Arab countries, Algerian economy is characterized by poor diversification of growth sources and its economy remains highly dependent on the hydrocarbons sector (Belaid and Abderrahmani 2013). Non-oil exports remain insignificant and the dynamic of the economic activity is strongly dependent on changes in oil demand and prices. The aim of this paper is to investigate whether natural resources are blessing or curse to Algeria economic growth. Algeria is an interesting case study for several reasons. First of all, to the best of our knowledge, there is no article that examines the link between natural resources rents and economic growth neither for oil exporting countries neither for Algeria. Therefore this paper could be considered as a first attempt. Secondly; Algeria has the 10^{th} largest reserves of natural gas in the world and it is the sixth-largest gas exporter. It is also the principal provider of gas to Europe. The hydrocarbon sector accounted for 98% of the

[1] Bahrain, Kuwait, Saudi Arabia, Oman, Qatar and United Arab Emirates

total volume of exports in 2011 and USD 71.4 billion (African development Bank 2012). Naural resources rents notably hydrocarbons revenues, have long been considered as the principal engine of economic activities. They account for approximately 70% of budget revenues, 30% of GDP. Thanks to strong hydrocarbon revenues; Algeria has a cushion of $173 billion in foreign currency reserves and a large hydrocarbon stabilization fund (African development Bank 2011). Therefore, it is important to examine whether natural resources contribute to economic growth or not. Finally, when we compare Algeria's GDP per capita to other Arab oil exporting countries' GDP, Algeria appears to be far away. Between 2001 and 2009, GDP per capita for the GCC as a whole increased by 35%, with Bahrain and Qatar experiencing the strongest increases at 42% and 37%, respectively (in PPP terms) while Algerian GDP per capita increased by 20.8% only in the same period. In Algeria, the common believe is that natural resources rents did not improved neither the Algerian GDP per capita nor the overall country's GDP. In this paper, we will clarify this situation. We focus in particular on the role of trade openness since trade is crucial in the commercialization of mineral rents. With a restrictive trade policy and barriers on trade, the cost of trade increase and the mineral revenues fall. Without an adequate trade policy, exports of natural resources shrink and the revenues decline which in turn would hurt the economic growth.
To examine short-run, long-run and joint causality relationships we used a multivariate cointegration approach based on the advances in time series econometrics (cointegration test; Vector Error Correction Models (VECM). The empirical results show that there is evidence of a bi-directional relationship between natural resources rents and economic growth in the short run and the long run as well. Regarding trade openness, it contributes positively and significantly to economic growth (proxied by Gross Domestic Product per Capita) in the both short run and long run.
The remainder of the paper is as follows. In section 2 we present the econometric methodology and data, section 3 analyzes the empirical results and section 4 concludes

2. Econometric Methodology

2.1. Data

We consider the following three variables: real gross domestic product per capita, real natural resources rents[2] and trade openness[3]. The annual time series covers the period from 1971 to 2009. The main source of our data is the World Bank's World Development Indicators (WDI). The three variables are all transformed into log form

2.2. Unit Root test

The first step is to test whether the variables contain a unit root to confirm the stationarity of each variable. This is done by using the Augmented Dickey–Fuller (F-ADF) unit root tests. Considering the low power of the ADF tests we also use the Phillips-Perron (PP) test (1988), which takes account for possible correlation in the first differences of the time-series using a nonparametric correction and allows for the presence of a non-zero mean and a deterministic time trend.

2 Natural resources rents refer to revenues from hydrocarbon, notably oil and gas.
[3] Trade openness is measured by the sum of export and import divided by the gross domestic product. It is worth mentioning that the correlation matrix reveals a weak correlation between the variables which implies the absence of multicollinearity.

2.3. Cointegration and Error Correction Model

Johansen approach (1988) is used in this paper to test for cointegration between the variables of the series. This approach is basically based on two principal statistic tests: Trace test and Max-Eigen value. The likelihood Ratio (LR) test is based on the trace statistics (λ trace) which tests the H_0: $r \leq q$ against H_1: $q = r$ is calculated thus: $\lambda_{trace}(r) = -T\sum_{l+1}^{p}\ln(1-\hat{\lambda}i)$ where $\lambda r + i \ldots . \lambda n$, are the least value of eigenvectors $(p-r)$. The second test is the maximal eigenvalue test $(\lambda_{\max})$ which tests the H_0: there are *r* cointegrating vectors against the H_1: there are $r+1$cointegrating vectors and is calculated as follows:

$\lambda_{\max}(r, r+1) = -T\ln(1-\hat{\lambda}r+1)$

In this paper we use multivariate procedure by the mean of a VECM which is specified as follows:

$$\Delta LGDPpc_t = \alpha_1 + \sum_{i=1}^{p}\beta_{1i}\Delta LGDPpc_{t-i} + \sum_{i=1}^{q}\beta_{1i}\Delta L\,\mathrm{Re}nt_{t-i} + \sum_{i=1}^{r}\beta_{1i}\Delta LTO._{t-i} + \lambda_1 ect_{t-1} + \mu_{1t} \quad (1)$$

$$\Delta L\,\mathrm{Re}nt_t = \alpha_2 + \sum_{i=1}^{p}\beta_{1i}\Delta LGDPpc_{t-i} + \sum_{i=1}^{r}\beta_{1i}\Delta L\,\mathrm{Re}nt._{t-i} + \sum_{i=1}^{s}\beta_{1i}\Delta LTO_{t-i} + \lambda_1 ect_{t-1} + \mu_{2t} \quad (2)$$

$$\Delta LTO_t = \alpha_3 + \sum_{i=1}^{r}\beta_{1i}\Delta LGDPpc_{t-i} + \sum_{i=1}^{p}\beta_{1i}\Delta L\,\mathrm{Re}nt_{t-i} + \sum_{i=1}^{q}\beta_{1i}\Delta LTO_{t-i} + \lambda_1 ect_{t-1} + \mu_{3t} \quad (3)$$

Where ECT is expressed as follows:

$$ECT_t = LGDP_t - \alpha_1 - \beta_{1i}L\,\mathrm{Re}nt - \beta_2 LTO._{t-i} \quad (4)$$

Where *t=1...T*, denotes the time period.

3. Empirical Results

3.1.Unit root tests

First of all, we use the Augmented Dickey–Fuller (F-ADF) unit root tests to test the non-stationarity in our data series. Considering the low power of the ADF test we also use the Phillips-Perron (PP) test (1988), which takes account of the serial correlation and heteroscedasticity, as an alternative test.

Table 1 reveals the results of the unit root tests of the Augmented Dickey-Fuller (*ADF*) and Phillips-Perron (*PP*) for *LGDP*, *LRENT* and *LTO* for Algeria. The test statistics for the log levels of GDP, *LRENT* and *LTO* are statistically insignificant. When we apply the unit root tests to the first difference of all variables, both tests reject the joint null hypothesis for each variable at the 1 per cent level. Thus, from all of the tests, the unit roots tests indicate that each variable is integrated of order one.

Table 1. Results of the Unit Root Test.

	ADF		PP		Order of Integration
	Level	1st diff,	Level	1st diff,	
LGDP	-0.733	-8.104	1.733	-7.270	I(1)
LLRENT	-2.210	-5.875	-2.236	-5.873	I(1)
LTO	-2.762	-4.574	-1.938	-3.797	I(1)

Note: The regressions in first difference include intercept.
*** Denotes the rejection of the null hypothesis at 1%level of significance

After checking the integration of our four variables at order one, I(1), we selected the optimal lag length of underlying Vector Auto Regression (VAR henceforth) using the conventional model selection criteria. These criteria established that the optimal lag length is two.

3.2. Cointegration : Long run and short run

Results of the Johanson contegration tests are displayed in Table 2 below. The Trace test and Max-Eigen value) suggest the existence of one cointegrating vectors at 1% of significance.

Table 2. Johanson contegration tests

Hypothesized	Trace Statistic	Max-Eigen Statistic
None *	43.43873	28.03541
At most 1 *	15.40332	12.26256
At most 2	3.140755	3.140755

Trace and Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Basically, the existence of cointegration indicates the presence of at least one long-run equilibrium relationship among the variables. In this case, Granger causality exists among these variables in at least one way (Engle and Granger, 1987). The VECM is performed to restablish the disequilibrium in the cointegration relationship, as well as to test for long and short-run causality among cointegrated variables. The correction of the disequilibrium is done by the mean of the Error correction term (ECT).

The results of the long-run equilibrium relationship are presented in Table 3 below. They show that the coefficient of *LRENT* is 0.214 which is positive and significant at the level of 1%. It means that a 1% increase in resources rent will increase GDP per cap by 21.4% in the long- run. LTO is also positive and significant a level of 1% which indicates that it influences positively the level of growth.

Table 3. Long-run elasticities

Dependent Variable: LGDPpc

	Coef.	t-value
LRENT	0.214603	-1.18294***
LTO	0.504589	-1.10431***
C	4.835656	

*** Denotes the rejection of the null hypothesis at 1%level of significance

Table 4 shows the results of the short-run estimation. The variables were estimated with two lags as the optimal lag length criteria was two. These results seem interesting in the sense that all the coefficients are statistically significant at conventional level of significance This means that in short-run, all of these variables contribute significantly to per capita GDP.

Table 4. ECM results based on Johansen cointegration

Regressor	**coef**	**t-value**
Δ (LRENT(1))	-0.074748	-4.83622***
Δ (LRENT(2))	0.003029	0.16104
Δ (LTO(1))	0.145146	4.30337***
Δ (LTO(2))	-0.055663	-1.39244
C	0.007277	2.17984**
ECT	-0.072308	-3.16027***
Diagnostic tests	**t-stats**	**p-value**
White Test	0.824302	0.5757
Normality	1.38	0.507
Breusch-Pagan-Godfrey	1.263800	0.3035
ARCH	1.899001	0.1775
Breusch-Godfrey LM Test	1.616991	0.2178
Ramsey RESET	0.022312	0.8824
R2	0.709	

*** Denotes the rejection of the null hypothesis at 1% level of significance.

The robustness of the ECM model has been passes by the six most important diagnostic and stability tests i.e. White test, Jacque-Bera normality test, Breusch-Pagan-Godfrey, Breusch-Godfrey serial correlation LM test, ARCH test, and Ramsey RESET specification test. All the tests revealed that the model provides consistent results. Moreover R2 (0.709) shows that the model is a relatively good fit. Hence, the results reported are valid for consistent interpretation. Finally, the stability of model is also checked by applying Cumulative Sum of Recursive Residual (CUSUM) and Cumulative Sum of Squares of Recursive Residual (CUSUMQ) techniques based on equation (4) of the error correction model and they also show that the model is stable.

Fig. 1. Plot of cumulative sum of recursive residual

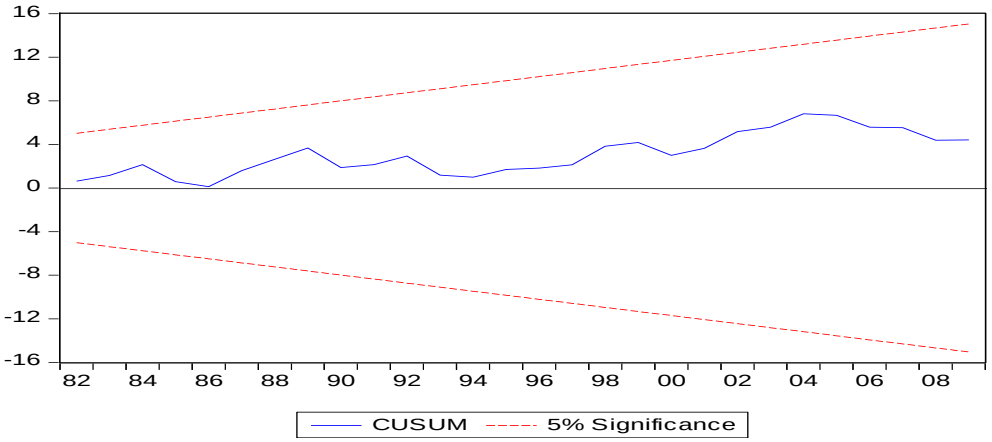
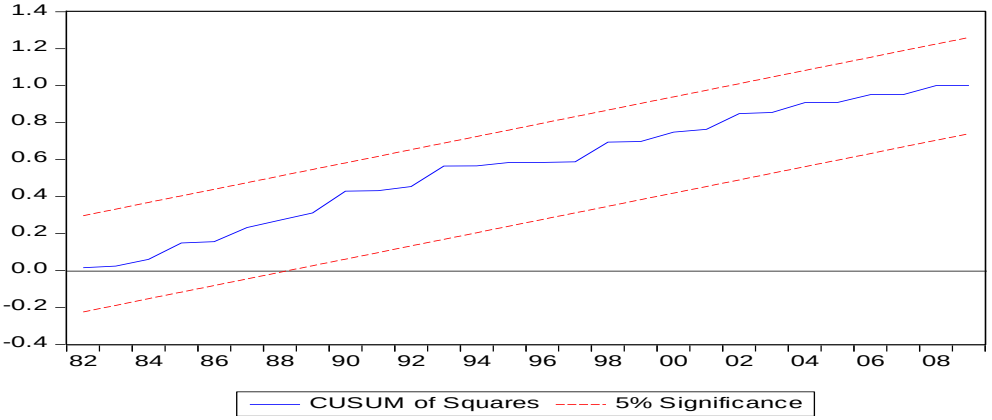


Fig. 2. Plot of cumulative sum of squares of recursive residual



After discussing long-and short-run dynamics, the next concern is to inspect the direction of causality amongst these variables. There results based on the VEC model are reported in Table 6 in which we have performed three Granger causality tests: short-run causality, long-run causality and the joint short and long-run. The first test indicates the significance of the sum of lagged terms of each explanatory variable by the mean of joint Fisher test; the second test indicates the significance of the error correction term by the mean of the t-test and finally the third test is the short-run adjustment to restore the long-run equilibrium.

Table 5: Results of the causality tests

Variable	*Short run (F-stats)*			***ECT*** *(t-stat)*	*Joint short and long run (F-stats)*		
	ΔLGDPpc	ΔLRENT	ΔLTO		ΔLGDPpc & ECT	ΔLRENT & ECT	ΔLTO& ECT
ΔLGDPpc	-	13.82***	9.97***	-3.16***	-	12.60 ***	11.28 ***
ΔLRENT	4.17**	-	4.27**	1.60	2.83 **	-	3.51**
ΔLTO	0.87	0.19	-	1.15	1.00	0.71	-

*** Denotes the rejection of the null hypothesis at 1%level of significance

The F-statistics for the short-run dynamic reveals a bi-directional causality between LGDPpc and LRent. This means that when revenues from natural resources increase, GDP per capita increase. Moreover, when GDP increases, thanks to natural resources rents, the government would invest further in mining[4] and would explore further natural resources and field tankers especially oil and gas which would in turn create employment opportunity and increase productivity. This strategy would promote GDP per capita and improve the Algerian living standards. This result support our findings reported in Table 4 in which natural resources rent are significant at the level of 1%. Table 5 also reveals a unidirectional causality running from LTO to GDP. This means that trade contributes significantly to GDP per capita and this conclusion also confirms the results found in table 4. The results further show that LRent is influenced by the degree of trade openness. This conclusion shows the crucial role of trade in economic growth and reflects the reality of the Algerian economy because when the trade volume increases, notably exports of natural resources, the rents would also increase which in turn would increase the Algerian GDP per capita. Based on these results, we may conclude that, in the short-run, there is unidirectional causality running from LTO to LRent.

Regarding error correction results, it is observed that deviation from the long-run equilibrium is only corrected by GDP per capita; the other variables appears to be weakly exogenous. This reveals the fact that any changes in LTrade and LRent that disturb long-run equilibrium are corrected by counter-balancing changes in the real GDP per capita. In this context, it may be concluded that GDP is caused by natural resources rent and trade and rent is caused by GDPpc and Trade but trade is not caused by any of both variables

Turning now to the right side of table 6, results of the significance of interactive terms of change in natural resources rents ($\Delta LRent$), along with the ECT in the GDP per capita equation are consistent with the presence of Granger-causality running from natural resources rents to GDP per capita. These indicate that whenever there is the presence of a shock to the system, LRent would make short-run adjustments to re-establish long-run equilibrium. Moreover, the joint Wald F-statistics results indicate in the GDP per capita equation, error correction term and natural LTo are jointly significant at a level of 1%.

Moreover, Results of the significance of interactive terms of change in gdp ($\Delta LGDP$), along with the ECT in the LRent are consistent with the presence of Granger-causality running from GDP per capita to LRent and similar results were found with LTrade. Hence, we confirm the presence of bidirectional Granger causality in the long run running between LRent and GDP per capita and a unidirectional causality running from LTrade to LRent.

4.Conclusion and Policy implications

The aim of this study was to investigate the causal relationship between natural resources rents and economic growth for Algeria, and to obtain policy implications of the results. To this end, causality tests have been performed using modern techniques in the time series literature and adapted in a framework where both traditional and additional channels of causality could be exposed. The data availability covers the period 1971–2009. In summary, time series properties of the data have been analyzed by way of unit root and co-integration tests before applying

[4] Almost 75% of Algerian territory is desert; hence investment in mining is the preferred strategy for Algerian government.

Granger's causality tests and several models were estimated to test for the direction of Granger-causality (long run, short run and jointly). To give more potency to the model, we added trade openness as a third variable as major natural resources revenues came from trade. These are interesting features of the paper.

Overall results reveal that trade openness and natural resources rents contribute positively and significantly to economic growth. The short run Granger causality tests reveal the presence of a bidirectional relationship between natural resources rents and economic growth and the presence of a unidirectional causal relationship running from trade openness to natural resources rents. The long run estimation indicates identical result as the short-run. These conclusions show on the one hand the importance of trade as a channel to increase the revenues from natural resources and on the other hand the importance of natural resources revenues as engine of economic growth in Algeria. These results could be interpreted as follows. First, trade is a crucial factor which contributes significantly to economic growth. However, trade is mostly based on export of oil and gas. It is worth to mention that Algeria is a very huge country; hence, it would be better to diversify its trade and to implement new strategy. In this sense, Algerian government should pursue implementation news reforms and negotiations for accession to the World Trade Organization (WTO) to strengthen the existing economic reforms and be better integrated into the global economy. Algeria should also improve its trade policy and should promote regional cooperation, especially with its neighbors; the Maghreb countries. As the model reveals that economic growth does not Granger causes trade, this could reflects the absence of effective trade strategy. Therefore, Algeria should promote the infrastructure of the industrial and manufactory sectors and should also promote proper policies to attract foreign direct investment.

Second, Algeria relies heavily on energy sector and energy resources rents are crucial for economic development. This means that the overall wealth of the economy depends on the availability of natural reserves as well as the prices of energy. However, given the uncertainly on the future reserves of oil and gas[5], alternative fuels and transportation technologies would face challenges that could impede their ability to mitigate the consequences of a peak and decline in oil production, unless sufficient time and effort are brought to bear (GAO 2007). Therefore, the government should promote alternative channels of revenues and should find key alternative technologies to oil and gas such as the green energy policy. Again, Algeria is a huge land equivalent to almost five times France and the shift toward green energy could represent an enormous opportunity to create renewable energy based on wind and solar energy which could be exported to Europe. This strategy would diversify trade, generate more resources and create employment.

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[5] Most studies estimate that oil production will peak sometime between now and 2040 (GAO 2007)

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