Algeria's Economic Diversification and Economic Growth: An ARDL Bound Approach Testing

Maliki Samir B.
Professor
MECAS laboratory, University of Tlemcen, Algeria
samir.maliki@univ-tlemcen.dz
Si Mohammed Kamel
Associate Professor
MECAS laboratory, University of Ain Temouchent, Algeria
simohammed_k@yahoo.fr
Hassaine Amal
Professor
MECAS laboratory, University of Tlemcen, Algeria
amal.hassaine@univ-tlemcen.dz
Hartani Abdelmadjid[1]
PHD Candidate
MECAS laboratory, University of Tlemcen, Algeria
abdelmadjid.hartani@univ-tlemcen.dz

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Abstract

Through the implementation of the variables Capital (K) and Human Factor (L), defined respectively by the gross value of fixed capital creation of the gross production and enrollment ratio, in addition to government consumption expenditure. The variable of the oil sector that dominates GDP, this study aims to measure economic diversification's effects on growth in Algeria. The Herfindahl-Hirshman index is the main economic diversification component. Data sources are provided by the IMF and the National Statistics Office of Algeria (ONS) and cover the period 1980-2015. Our findings indicate a long-term association between growth and economic diversification following the ARDL model's implementation, followed by a negative sign suggesting the inverse relationship between economic growth and low economic diversification in Algeria and confirming its dominance the hydrocarbon industry.

The model also shows a 1 percent rise in the Herfindahl-Hirshman index produces a 0.8 percent negative effect similar to the elasticity standard.

Keywords: Economic growth, Economic diversification, Autoregressive Distributed Lag (ARDL), Algeria.

JEL Classifications: F43, C33

[1] **Corresponding Author** . Hartani Abdelmadjid **.E.mail:** abdelmadjid.hartani@univ-tlemcen.dz

Introduction

The drop-in oil prices in the second half of 2014 showed the weakness of the Algerian model of development based on a hydrocarbon sector (based on a single sector -the hydrocarbon one-) and showed above all its structural fragility. The immediate consequences of this situation are falling revenues, stopping public projects, reducing imports, and rising inflation. The Algerian economy is highly dependent on hydrocarbon sector exports. It is estimated that hydrocarbons account for roughly 60% of budget revenues, 30% of GDP, and over 95% of export earnings.

Awareness is beginning to be felt as to the rationalization of budgetary choices, but especially to the imperative of economic diversification in a context of strong competitiveness.

This diversification is targeted, by 2030, with a proposal for a new model of economic growth released in July 2016, which was preceded by the CNES (Social and Economic National Council, 2015) report on the economy, which is in line with those already drawn up by scientists and researchers, Think Tank group (Nabni, 2012) and international organizations (IMF report, 2016).

Algeria remains weakly integrated into the global economy despite its massive hydrocarbon exports. In fact, as measured by the ratio of non-oil exports and imports of goods and services to GDP (21%), Algeria's trade openness is the lowest in the Maghreb region (Nabli, 2007).

For the number of exported products, Algeria is among the lowest in the world at 184 (according to the World Bank estimations. The figures are 1,120 in Morocco, 2,849 in Indonesia and 3,266 in Mexico (World Bank Staff estimation). To date, economic growth continues to be at the mercy of unpredictable changes in international oil prices. In July 2016, the government adopted a new economic growth plan (2016-30) focusing on the private sector and a three-year budget stabilization strategy. The non-oil and gas industry accounted for no more than 5% of GDP in 2016, compared with 35% at the end of the 1980s, so the authorities are looking towards a re-industrialization of the country.

The research results (Stijns, 2005; Brunnschweiler, 2006) suggest that natural resources do not necessarily negatively impact a country's economy. Instead, it is supposed to add a significant contribution to a country's well-being. During the period (1960-2009), only Mexico and Indonesia have succeeded in diversifying their exports.

(Brunnschweiler and Bulte, 2008) strongly criticized the theory of the curse of natural resources by stating that this was a false trail designed to divert attention away from the real development problems. They confirm that indicators used to measure natural resources' abundance measure natural resource dependence more than development.

To ask the questions of diversification and accelerated economic growth naturally supposes that the State is first engaged in building the institutional capacities prerequisites for growth (Rodrik *et al.*, 2004). Thus, the process of diversification seems to be rather the exception than the rule testifying, the difficulty for countries dependent on abundant natural resources to initiate a process of structural transformation.

There are not many publications on the Algerian case, nevertheless, a study by Bouklia-Hassane (2013) before the fall in oil prices in 2014 showed by using a simulation of growth trajectories and using the World Bank RMSM-X model on the 2010 data of the Algerian economy, that the economy will not be able to sustain an accelerated growth sustainably.

That said, the dependent economy on hydrocarbons must indeed face in the course of its diversification to three major obstacles: a) the scale of the transformations of its productive structure requiring double-digit sectoral growth, b) the evolution of the indebtedness internal context in a context of relative decline of the hydrocarbon sector, and finally, c) the external solvency due to growth of imports required to support the accelerated growth of the economy, more important than that of the export sector, where new activities still emerging cannot take over from hydrocarbon exports only gradually.

In terms of GDP, figure 1 shows a decline of Algeria GDP growth from 2014 until now. The decrease was from 3.8 in 2014 to 1.6 in 2017 (see figure 1).

The study is different from the studies outline above in both respects: First, to our knowledge, this is the first time that we use the ARDL model with the HHI diversification index for a series from 1980 to 2015 in the new context of Algeria. Second, the study uses cointegration techniques to examine the long-run relationship between the growth variable and the different independent variables.

In Section 2, we present a brief review of economic diversification and theoretical arguments. In section 3, the model definition and variables are outlined. The estimating results are presented in section 4. The final section summarizes the conclusions.

1.Literature review on economic diversification and theoretical arguments

Several studies indicate that diversification and wealth formation have an inverted U-connection (Hesse, 2009; Cadot et al., 2011; Agosin et al., 2012; Naudé and Rossouw, 2011). Indeed, (Ng, 2006) analyzes the correlation between natural resource abundance and growth and finds evidence for a negative relationship. This finding means that development is kept back not by the availability of capital, but by the concentration of exports on primary products.

The key sources of export diversification in some MENA countries are also investigated in Dogruel and Tekce (2011). The findings show an inverse relationship between economic growth and export concentration and highlight the dual effect of trade liberalization on diversification; multilateral liberalization through the WTO, on the one hand, and the large regional trade agreement GAFTA, on the other hand, promote the efforts of those countries towards export diversification; (Clark et al., 2017) research the evolution of the manufacturing industry structure for eight performing Asian economies over the economic development road. They conclude that industrial policy has not disrupted industrial diversification followed by specialization to support economic growth, and may have facilitated it.

Two papers to illustrate how to determine economic diversification have been published by UNCTAD, including the well-known Finger-Kreinin export diversification index (Finger and Kreinin, 1979) Herfindahl-Hirschman business concentration index. The index ranges from 1 (non-diversified) to 0 (full diversified), with values closer to 1 suggesting a greater divergence from the world average and a comparatively less diversified export structure. The index covers merchandise exports only, i.e., product exports, not services.

Based on the Theil index, a common measure of inequality and diversity, the IMF established an Export Diversification Index (EDI) when the fall in oil prices in 2014.

The Theil Index represents the number of measurements of diversity across sectors and diversity within sectors. The more a country's exports diversify, the lower the EDI is (see figure 2). Generated by elaborate modeling (IMF, 2014), the Product Quality Index (PQI) ranges from 0 (low quality) to 1.2 (high quality). The higher quality of exports is, therefore, expressed in the greater value of the PQI. Figure 2 shows the EDI and the PQI for ten nations, including seven net oil exporters, side by side.

The export structure of country diversity and complexity is regarded as an instrument developed by (Hidalgo and Hausmann, 2009) as the Economic Complexity Index (ECI) for comparison. The most complex products are sophisticated chemicals and equipment, while the least complex products are raw materials and basic agricultural products, as presented in (Figure 3).

Well-diversified economies tend to be more efficient as well as more open to trade,
and thus to have a greater capacity for rapid long-run economic growth (Gylfason, 2016).

But a lot of multinational studies demonstrate the heterogeneity of the impact of resources on growth; it depends on the existence of two types of capital: human capital and "governance capital" or "institutional capital". A country deprived of such capital risks being subjected to the "curse of natural resources". It would also seem that, in the absence of this additional capital, a country would have a harder time diversifying its economy and climbing the technological scale (Gelb, 2010)

(Brunnschweiler and Bulte, 2008), after many estimates, arrive at two main conclusions: first, an abundance of resources and institutions determine resource dependence and this dependence does not affect growth. Second, the abundance of natural resources positively affects growth and institutional quality. (Gelb and Grasmann, 2008) further argue that countries with strong human capital and strong institutions will take advantage of their natural wealth and cite Australia's case.

We must note that data limitations often plague the literature on diversification. Both exports and employment data used to compute diversification measures lack both spatial and time-series coverage. Furthermore, some of the diversification measures are contaminated by price movements reflecting pseudo diversification rather than a genuine change in the economy's structure (Alsharif *et al.*, 2017).

Globally, Algeria stands at 178 in 190 economies on the ease of trading across borders (as shown in the figure 4).

Algeria has also struggled to maintain international investors interested. The country ranks 166th on the Ease of Doing Business (See figure 5).

In 2006, Algeria implemented a new hydrocarbon law that levied a new windfall tax of up to 50 percent on income when oil prices top $30 a barrel and set Sonatrach's participation (National Algerian company) to a minimum rate of 51 percent. Moreover, new foreign investment laws were introduced in 2009 and 2010, further limiting imports and foreign investment.

Algeria revises its hydrocarbon legislation again in 2013 to include additional tax incentives to promote activities related to unconventional oil and gas, as well as to those including small fields; reserves in underexplored areas, including offshore fields; and fields with complex geology and/or those lacking infrastructure (Nakhle, 2017).

2. Model definition and variables

We use the ARDL model proposed by (Pesaran et al., 1999, 2001) if the result obtained at the unit root test indicates the homogeneity of the time series stability at both I (1) and I (0), and not the second order I (2). In other words, the time series of the model would contain stable variables of order 0 and 1. In contrast, if we get variables incorporated in the first-class, we resort to the application of cointegration (Johanson Approch, 1988; Johansen-Juselius, 1990; Engle and Granger, 1987).

The ARDL model considers the time delay of lag. The explanatory variables are distributed overtime cycles, integrated by the ARDL model in several decomposers distributed within the corresponding parameters and the number of explanatory variables. The explanatory economic factors under research affect the dependent variable distributed between the short-term and long-term.

The second stage in results estimating is to evaluate the number of model time gaps by using the Akaike Information Criterion (AIC) or Schwartz Bayesian Criterion (SBC). After detecting the duration of the differences, the next stage is to analyze the long-term integration relationship.

The ARDL model's consistency needs the absence of collinearity problems that the Durban-Watson DW coefficient does not detect. The literature requires using the Lagrange Multiplier (LM version). The no significance of the F value measured in the Breusch-Godfrey Serial Correlation LM Test confirm the no collinearity.

After that, we use the Wald test to examine the combined integration by comparing the F value measured against the critical F value. We reject the null hypothesis H0 and accept the alternative hypothesis H1 when the value of F is not significant, i.e., the F value is less than the critical F value.

$$H_0 : \delta_{11} = \delta_{21} = \delta_{31} = \delta_{41} = \delta_{51} \quad (1)$$

$$H_1 : \delta_{11} \neq \delta_{21} \neq \delta_{31} \neq \delta_{41} \neq \delta_{51} \quad (2)$$

2.1. Index of Economic Diversification

Herfindahl-Hirshman index is the most widely used indicator of economic diversification. This index was used by US courts in 1982 to measure market concentration for antitrust. The index is also used extensively in foreign trade to measure the concentration of industries or a branch of a sector or measure the concentration of foreign trade markets used in global development systems and TRAINS and WITS indicators.

The HHI is computed as the sum of the squares of each sector of production's shares in total output (or sometimes as the square root of the sum of squares) (UNCTAD, 2012).

$$HHI = \frac{\sqrt{\sum_{i=0}^{n}\left(\frac{xi}{\bar{x}}\right)^{2}} - \sqrt{\frac{1}{N}}}{1-\sqrt{\frac{1}{N}}}$$

(3)

Where xi is the total output of sector i, X is the total gross output, while N is the number of sectors. The value of the index is between zero and 1. If the index is close to 0, it indicates a presence of economic diversification; otherwise, if the index is close to 1, this indicates that the resource is abundant and this is confirmed by the theory of Dutch disease which states the dominance of the raw materials sector in a given economy and a contribution very low in other sectors in the added value of the economy.

The curve (figure 6) shows the degree of economic diversification in Algeria from 1974 to 2014. It shows that the index was in the range of 0.24, which is a large rate compared to other countries such as the European Union, which rates are less than 5%. This indicator is also rising over time, where it is more than 40% in the middle of the first decade of the first millennium.

2.2. Variables and source of data

The study period is from 1980 to 2015 using annual economic growth data and the accepted growth variables in the classical, neoclassical and new generation models, namely: capital (K) and the human factor (L) defined respectively by the gross value of gross fixed capital formation and enrollment rate (see Mankiw et al., 1992; Romer, 1986; Barro, 1991; Schultz, 1980; Charle R. Hulten, 2001), and public consumption expenditure (the Barro Model, 1990; Karras, 1996).

We use the oil sector as a vector that dominates the GDP and the key cause of the periodic fluctuation of Algeria's economic growth. Finally, the study uses the Herfindahl-Hirshman economic diversification variable as the key variable in this study.

The source of the data is from the Algerian National Statistics Office and the International Monetary Fund.

The general model of the analysis then takes the following mathematical formula:

$$Y_t = \alpha + b_1K_t + L_t + b_3G_t + b_3HHi + b_4Yoil + \mu$$

(4)

3.Estimation results

Our analysis starts with a presentation of descriptive statistics of the six variables. In the table below, we can see the mean, median, standard deviation and Jarque-Bera statistics. The HHI mean is 0.28, with a standard deviation of 0.075 (See table 1).

3.1. Unit Root Tests

Before estimating the ARDL model, the unit root of the time series should be examined using the Expanded Dickey-Fuller test and the Phillips-Perron test proposed in 1988.

Tables 2 and 3 show that the growth variable is stable at the level I (0). The other variables are stable after taking the first differences I (1) at a significant level of 5% in both tests. In this case, we cannot apply a cointegration test and require integrating the ARDL model (see Table 2 and Table 3).

3.2. Cointegration tests

To ensure a long-term relationship in the study design, we examine the F test by comparing the computed F value against the ARDL Bounds test's critical F-value. The results revealed that the F 2.81 statistic is significant at 5% and is greater than the high critical value, which leads to rejecting the null hypothesis H_0 and confirming the existence of a long-term cointegration relationship. Between the growth variables and the explanatory determinants studied.

The long-term ARDL model equation will be:

$$Y = 0.9526 * Yoil + 0.3952 * K + 0.4314 * L - 0.8029 * HHi - 0.1400 * G / Y - 12.7346 \quad (5)$$

Capital and labor are statistically significant and contribute to growth, even with non-elasticity (0.4 for capital and 0.43 for the human factor) during the study period and in line with empirical research of growth, which simulated the different models of first- and second-generation neoclassical school.

This result can also be explained by the presence of a long-term convergence relationship between the two variables and economic growth. The 1 percent rise in capital and labor indicates a long-term relationship of 0.4 percent and 0.43 percent respectively. In parallel, if we can have the same 1 percent rise in the hydrocarbon market, this will lead to an almost elastic increase of 0.95 percent in economic growth. The energy sector's predominance can also explain this finding in Algeria's economic growth and the degree to which the resource abundance principle is realized. It uses a lot of capital and few factors of labor. Hence, its relative returns are lower than the relative volumes of production, unlike some productive sectors in other countries such as the textile and manufacturing industries.

The negative sign of the percentage of public consumption expenditure on economic growth is explained by the rise in expenditure of 1 percent contributes to a recession of 0.14 percent, which clearly shows the inefficiency of public expenditure in Algeria. That way, it would be easier for the decision-maker to prioritize a particular sector for public spending to achieve growth and avoid unnecessary expenses.

In terms of economic diversification, the findings suggest long-term cointegration between growth and economic diversification. The relationship's value is followed by a negative sign indicating the inverse relationship between economic growth and the low level of economic diversification in Algeria, defined by the hydrocarbon sector's predominance as demonstrated by equation (5). A 1% increasing trend in the Herfindahl-Hirshman index over the study period means that 0.8% is negative.

Concerning the quality of the estimated test, the LM series correlation test of Breusch-Godfrey (Table 4) was insignificant at 5%, indicating lack of collinearity issues in the series. In the same picture, R2 has reached an appropriate explanatory standard (0.82) and the statistical F of the 0.005 models, suggesting the significance and consistency of the calculation (see Table 4).

4. Conclusion

The contribution of this study was to test if economic diversification boost growth in the case of Algeria. Since Algeria is a country with a very low non-hydrocarbon export rate and with a further drop in oil prices, the effect of diversification on economic growth for this period has long been tested (1980-2015).

Our findings indicate a long-term association between growth and economic diversification following the implementation of the ARDL model, followed by a negative sign suggesting the inverse relationship between economic growth and low economic diversification in Algeria and confirming the dominance of the hydrocarbon industry.

The results motivate us to develop research in the future by measuring the Algerian productive sectors' productivity and analyzing investment efforts during the same time.

One of the most important investments a country rich in natural resources can make is developing and keeping certain ability of high-level managers in both the public and private sectors (Arezki and Nabli, 2012).

It is to be mentioned that the private sector in Algeria is predominant in leather and footwear (90 percent); textiles (87 percent); agri-food (87 percent); chemicals, rubber and plastics (78 percent including pharmaceuticals); and construction materials (52 percent); They could become potential sectors for economic diversification in Algeria.

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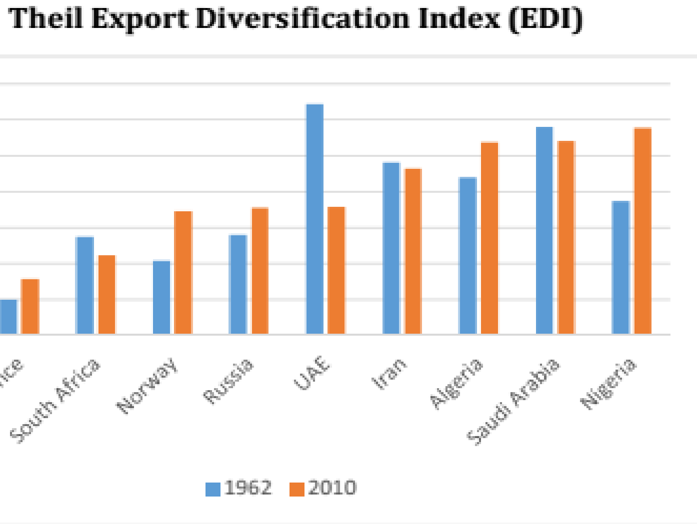
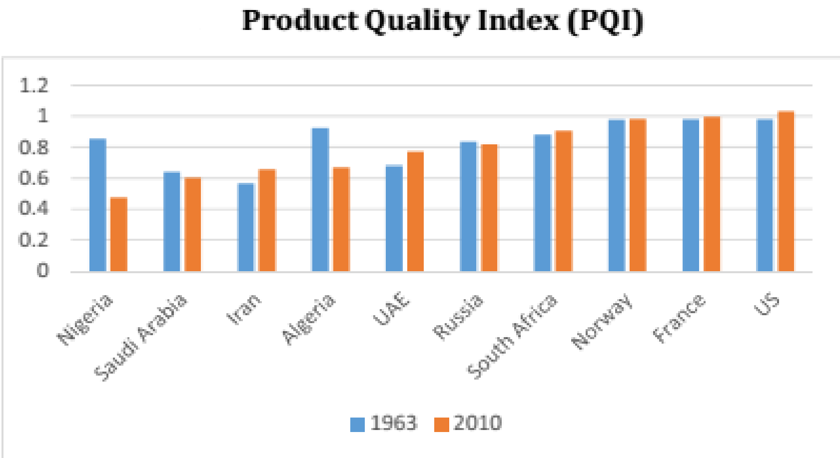
Appendices

Figure 1: Algeria GDP Growth Rate (2008-2017)

Source: ONS (Algerian National Statistical Office), 2017

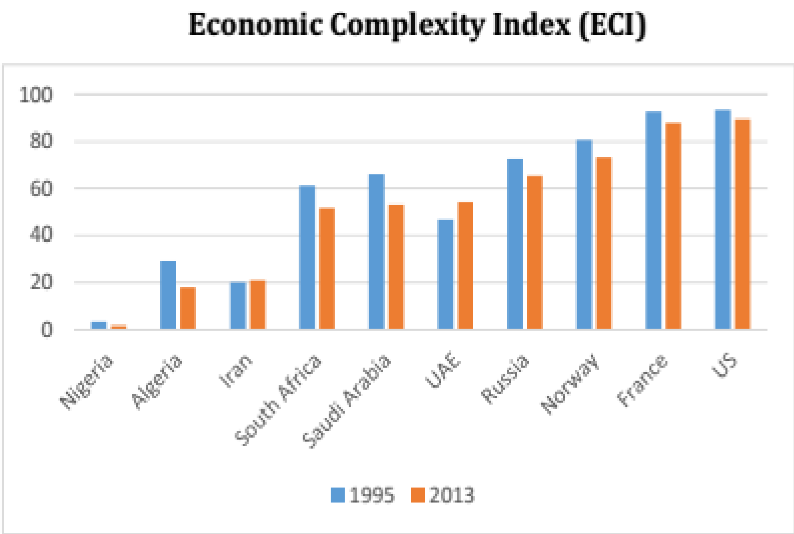
Figure 2: EDI & PQI measures of Economic Diversification





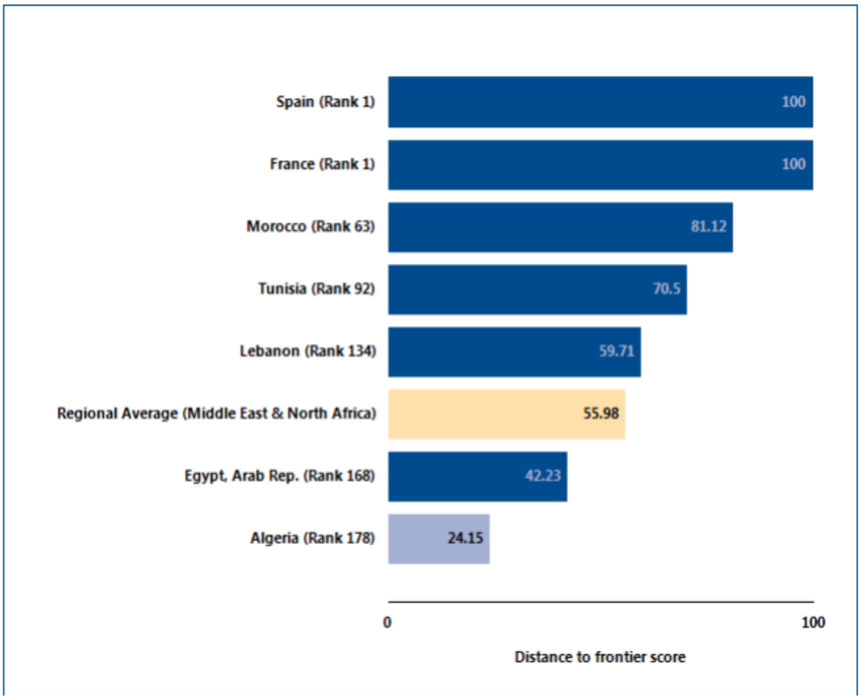
Source: Gylfason, 2016

Figure 3: ECI measure of Economic Diversification



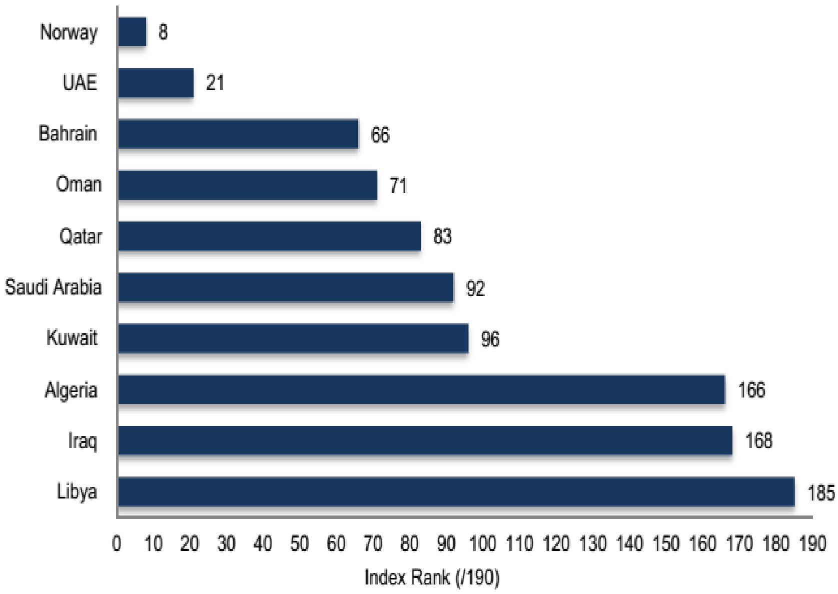
Source: Gylfason, 2016

Figure 4: How Algeria and comparator economies rank on the ease of trading across borders



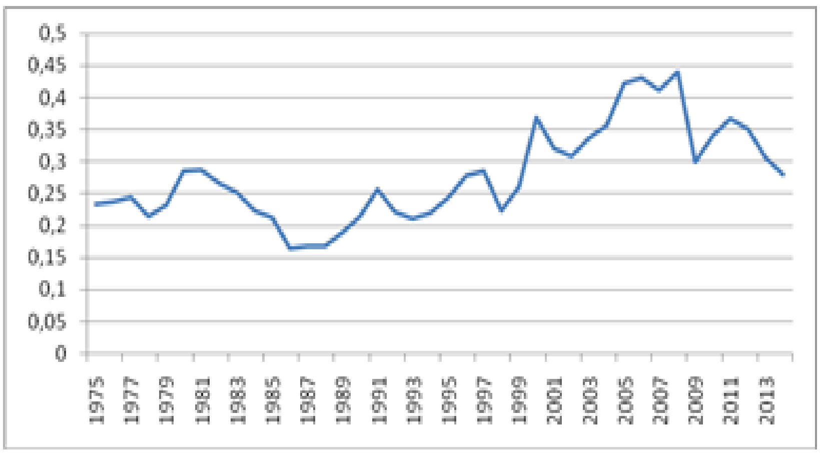
Source: World Bank, Doing business database,2017

Figure 5: Ease of doing business



Source: The World Bank,2016

Figure 6: Herfindahl-Hirshman index in Algeria (1974-2014)



Source: author's calculation

Table 1: Descriptive statistics of variables

	Y	K	G	YOIL	L	HHI
Mean	2.841667	28.98624	32.82436	3.490279	16.60187	0.283858
Median	3.250000	27.76059	31.62150	3.347412	11.68103	0.278752
Maximum	7.200000	38.23645	44.44400	4.715190	35.00000	0.439989
Minimum	-2.100000	20.67661	25.50000	2.546315	6.000000	0.163733
Std. Dev.	2.307526	4.890468	5.068502	0.670620	9.394277	0.075878
Skewness	-0.324184	0.238740	0.680258	0.557487	0.782418	0.398300
Kurtosis	2.425051	1.838194	2.666309	2.035390	2.166678	2.381711
Jarque-Bera	1.126422	2.366670	2.943526	3.260456	4.714709	1.525276
Probability	0.569378	0.306256	0.229520	0.195885	0.094670	0.466434
Sum	102.3000	1043.505	1181.677	125.6501	597.6672	10.21888
Sum Sq. Dev.	186.3637	837.0837	899.1400	15.74061	3088.836	0.201509

Table 2: Unit root test at the levels

Time series	Levels PP		Levels ADF	
	Intercept only	Intercept only	Intercept and trend	Intercept only

G/Y	-2.28 (0.42)	-1.62 (0.45)	-2.17 (0.48)	-1.55 (0.49)
Y	-3.73* (0.03)	-3.75* (0.00)	-4.64* (0.00)	-3.64* (0.00)
K	-0.94 (0.93)	-1.47 (0.56)	-1.27 (0.87)	-1.39 (0.57)
L	-0.99 (0.93)	1.78 (0.99)	-0.99 (0.93)	1.78 (0.99)
Yoil	-2.40 (0.37)	-1.73 (0.40)	-2.40 (0.73)	-1.7 (0.42)
HHI	-2.40 (0.51)	-1.7 (0.44)	-2.40 (0.51)	-1.7 (0.44)

Table 3: Unit root test at the first difference

Time series	First differences PP		First differences ADF	
	Intercept only		Intercept and trend	Intercept only
G/Y	-5.61* (0.0.0)	-5.69* (0.00)	-5.61* (0.00)	-5.68* (0.00)
Y	- * 8.20 (0.00)	-8.25* (0.00)	-6.03* (0.03)	-6.11* (0.00)
K	-8.88* (0.00)	-4.85* (0.00)	-5.84* (0.00)	-4.85* (0.00)
L	-4.92* (0.00)	-4.51* (0.00)	-4.96* (0.00)	-4.53* (0.00)
Yoil	-5.82* (0.00)	-5.93* (0.00)	-4.88* (0.00)	-4.96* (0.00)
HHI	6.15- (0.00)	6.25- (0.00)	6.08- (0.00)	6.17- (0.00)

*MacKinnon (1996) one-sided p-values at 5%.