The Relationship Between the Public and Private Investment in Alegria : An ARDL Co-integration approch

العلاقة بين الاستثمار العام والاستثمار الخاص في الجزائر

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الملخص: تهدف هذه الدراسة الى اختبار العلاقة ما بين الاستثمار العام والاستثمار الخاص في الجزائر خلال الفترة 1984-2017 باستخدام نموذج الانحدار الذاتي للفجوات الزمنية الموزعة المتباطئةARDL . بينت النتائج بوضوح أن الاستثمار الخاص يرتبط معنويا بكل من: سعر الصرف الحقيقي، والتغير في الناتج، ومعدل الفائدة الحقيقي، ومخاطر البلد، والانفتاح التجاري. أيضا، أظهرت النتائج أن معامل الاستثمار العام هو سلبي ومعنوي إحصائيا بقيمة -0.39. وهذا دليل واضح على وجود أثر المزاحمة في الاقتصاد الجزائري.

الكلمات المفتاحية : الاستثمار العام، الاستثمار الخاص، نموذج ARDL ، أثر المزاحمة ، الاقتصاد الجزائري.

Abstract : The present research aims to investigate the relationship between public and private investment in algeria during the period (1984-2017), using Autoregressive Distributed Lag (ARDL) modelling. The results clearly represented that private investment is considerbly correlated to : real exchange rate, economic growth, real interest rate, country risk and trade openness, and it s also showed that the coefficient of public investment is negative and statistically significant with a value of -0.39. This is a clear evidence of the crowding-out effect in the Algerian economy.

Key Words: Public investment, Private investment, ARDL model, Crowding out effect, Algerian economy.

JEL Classification: E62, C63.

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Introduction:

The investement plays an important role in the economic growth ; the increase of investement means an increase in the productive capacity which leads countries improve thier capacity to produce more of commodities and services, and raises community's real income.

Even if the economists agreed about this importance, the relationship between public investement and private investement still an issue of concern and the debats of economists and economy policy makers in the all countries (developed or developing countries) of the world. After many years of conviction about the increase in public investement that it serves to inhibt the private investement, the study which brought by ashauer (1989) about productivity of public spending in the american economy had shown that the relationship between public investement in the infrastructure and private investement was a complimentary relationship. Since then, the empirical studies continued to examinate and determinate nature of the relationship between public investement and private investement in many countries, but those empirical studies didnt determinate it categorically because it varies from a country to other, and affected by many factors.

- The Keynesian theorem « crowding in »: it Considers imployement and the interest rate sensitivity of investment is low. In this case, the increase in the public spending will lead to a low or non-existent interest rate, instead of leading to a high income, and motivate or attract the private investement, and increase its productivity.
- The neoclassical theorem « crowding out » : it view individuals planing their consumption over their entire life cycle by shifting taxes to future generation budget deficits increase current consumption by assuming full employment of resorces, neoclassical argue that increased consumption implies a decrease in saving **(**Emad M.A Abdullatif Alani 2006) and also assumes full employment and advocates Competitive markets against government intervention. Besides The neoclassical loanable funds theory explains that the balancing of savings and investment will be solved by the interest rate mechanism. The malfunctioning or slow operations of this mechanism are attributed to the short-term variations in employment and output In case of an increase in government spending, interest rates have to increase to bring the capital market into equilibrium, dampening private investment.(Yrd. Doç. Dr. Ye im KU TEPELI 2005).
- The Ricardian equivalence theorem "no crowding out or crowding in": advanced by barro (1989), it view government that for a given path of government consumption, the timing of taxes, or equivalently, the accumulation and decumulation of public debt, didnt affect private consumption. In a closed economy, therefore it also left the interest rate, investments and output unchanged. If this proposition holds, the scope of fiscal policy as a stabilization tool of the economy that will be very limited (ThankGod O. Apere (2014)) the increase in the budget deficits was expected to be accompanied by an increase in taxes in the future. That's why, individuals considering their future income will not change their consumption and/or savings leaving interest rates and private

investment also unchanged, which translates into no crowding out or crowding in effect of fiscal spending. (Yrd. Doç. Dr. Ye im KU TEPELI (2005).

Problematic: what is the nature of the relationship between the public and private investment in Algeria during the period (1984-2017)?

Hypothesis: In order to answer the problematic we have developed a null hypothesis, and its alternative hypothesis, which are as follows:

- H_0: there is a crowding in effect between the public and private investment in Algeria from 1984 to 2017.
- H_1: there is a crowding out effect between the public and private investment in Algeria from 1984 to 2017.

1.Investment policy in algeria (1985-2019) :

As other countries, Algeria faces several economic and social challenges, and seeks since indépendance to inclusive development, and to solve all social and economic problematics, and developing all its sectors. Algerian economy has undergone a spectacular evolution, led to changing investement structure. If we track this history, we find that Algeria has embraced socialism which deponds on the dominance of the public sector in achieving development goals, but that didn't permit to achieve desired goals, this has led to attach importance to the private sector and involve it with public sector in development process, which prove importance of relationship between public investement and private investement and the complementary roles in accelerating economic growth.

1.1 Periode from 1985 still 2000 :

The public investment program from 1985 to1989 represented a projection of expenditures of 550 billion of Algerian dinar AD (Figure1), it focused on the development of agriculture and irrigation sector,organisation of the national economy ,support and expand production and the expected economic growth Outside the hydrocarbon sector was 7% but in this period oil prices had been sharply declined in 1986 was estimated 9$ per barrel ,the algerian economy was heavily reliant on hydocarbons.wich account for about 30 percent of GDP and 60 percent of budget revunes As a result, it faced many internal and external imbalances, which necessitated reforms and recourse to external assistance.

However, starting from 1993, with the signing of the third credit agreement and the implementation of the structural adjustment plan, Algeria started to follow the policy of rationalizing public expenditure by lifting all forms of support provided by the state, following the policy of imported imports, liberalizing prices and prioritizing public investment projects. Thus, the ratio of government spending to gross domestic product (GDP) declined continuously during the structural adjustment period, to 26.60% in 1999, up from 38% in 1994.

In the context The rate of economic growth had registred only 2.1 on average during 1990-2000 this rate awed very low to absorb the hight unemployment rate this was result of serval factors was the ineffectiveness of the production system and the disappearance of a large part of public companies as a result of the

structural adjustment program (1994-1998) and the hostility of the environment of the company.

1.2 Period from 2000-2019 :

The periode between 2000 and 2014 was charcterized by the rise of oil prices in the world markets so Algeria had invested reavily to improve the business environment with the efforts aiming to increase the rate of economic growth. The first one program investment was the economic recovery program wich covered the period 2001-2004 at a cost of 7 us billion initiated to relaunch the rates of economic growth remained which had been weak for a decade, it focused on four sectors (Figure2).The second program (2005-2010) called complementary program to support growth (pcsc) and south and highlands programs for an mount of 200 billion U.S this program aims to continue the policy of expansion of spending especially with the continuued rise of oil price for an amount of 57$ per barrel in 2005 (Figure3) , it focused on improvment the living conditions, devlopment of basic facilities support economic, development of public services ,development of comunication technologies (Figure4) and the third public pinvestment program the algerian goverment had anonced the launching of a five year public investment plan starting in 2010 until 2014 the total financiel commitments represent an amount of 286 billion US dollar and This amount had been divided into two important programs :

Complete of projects under construction with a financial envelope of $ 130 billion and make new project for an amount of 155 billion and More than 20% of the public investments in this program it focused on improvment social conditions and in order to promote human development.

Forth program investment was complementary to other programs which covered the period (2015-2019) whose cost was expected to hit DZD 21,000 billion to build a competitive and diversified economy and improvment living conditions in the housing ; education and health sectors, also stimulate economic growth with expected economic growth in 2019 is to 7%.

2. Literature review :

- **Khalifa H .Ghali (1998)** invistegated the long run effects of public investment model on private capital formation he used multivariate cointegration techniques to develop a vector error-correction model over period 1963-1993 for tunisia the empirical finding showed that public investment had a negative impact on private investment in both short –run and long- run and a negative effect on economic growth in long- run.
- **Stephen M miller and Habib ahmed (2000)** examined the effects of disaggregated government expenditure on investment using fixed- and random-effect methods during the period (1975-1984) for 40 contries included developed and developing country the study finding showed that tax-financed government expenditure crowds out more investment than debt financed expenditure. Expenditure on social security and welfare reduces investment in all samples while expenditure on transport and communication induces private investment in developing countries.

- **Mamatzakis (2001)** investigated the link between disaggregated measures of government expenditures and private investment of the Greece. During the period 1950-1994 he used cointegration analysis of a multivariate system of equations and applied the impluse reponse function IRF and variance decomposition VDC the estimeted results showed that government investment had a positive effect on private investment while the government consumption had a negative impact on private investment.
- **Ahmed badwi (2006)** analysed the complementarity and substitutability of state capital to private sector investment using a co-integrated vector autoregressive model to account for potential endogeneity and nonstationarity problems. The Results clearly showed that both private and public capital spending had stimulated economic growth in Sudan during the period 1970–1998 and The impact of private investment on real growth had been more pronounced than that of public sector investment Public sector investment appears to have deleteriously impacted private sector physical capital expansion, implying that the impact of crowding-out categories of public sector investment had been large enough to offset any crowding-in effects. Such crowding out effect had weakened favourable positive effect that public sector's investment had exerted on growth by jeopardising private sector capital undertakings.
- **Bashier Al-abdulrazag (2009)** investigated the causal relationship between government investment and private investment in Jordan over the period 1976-2004 he employed the VECM model and applied the impulse response functions (IRF) and variance decomposition (VDC) to investigated the effect of government investment shocks on private investment. The empirical findings support the complementarity hypothesis between government investment and private investment, and that, government investment tends to crowd-in between government investment and private investment, and that, government investment tended to crowd-in private investment in Jordan. Thus, the government investment activities had a positive effect on private investment and the economic growth in Jordan.
- **Umakrishnan Kollamparambil and Michael Nicolaou** (2011) analysed the nature and relationship between public and private investment in South Africa using quarterly data from 1960 to 2005. The findings of the study had a strong policy implications and indicate that although public investment was not "crowding in/out" private investment, it exerted an indirect impact on private investment through the accelerator effect. Hence an increase in government spending on infrastructure and social sectors was likely to enhance private investment in the country. Therefore more proactive fiscal policy was suggested to increase the investment-GDP ratio which can stimulate higher growth rates.
- **Zahra Sharif and Mehdi Farahanin (2012)** Examined the impact of government investment on private investment for Iran over the period (1973 to 2005) using a standard investment model, Suggested that private sector investment depends on government investment, GDP, availability of bank credit, economic freedom and microeconomic uncertainty. A simple univariate model of GARCH (1,1) was specified to obtain uncertainty measures. The

estimeted results showed that government investment complements private investment. The results also indicated that private investment was constrained by the availability of bank credit. Economic freedom index had a positive and significant impact on private investment and microeconomic uncertainty has a negative impact on private investment.

- **Afia Malik (2013)** examined linear as well as non-linear impact of fiscal policy variables on private investment in Pakistan. During the period (1972-2009) The results showed that it's better to examine different aspects of fiscal policy instead of fiscal policy variables in aggregate form as the impact of fiscal policy variables in aggregate and disaggregate form do not comply with each other Different categories of expenditures and revenues had different impact on private investment. Secondly, in the most of cases there existed a non-linear relationship, which implied the significance of certain threshold level for the different fiscal policy instruments to encourage private investment.
- **Mohammad zayyanu and al (2014)** used the multiple regression analyses to investigated the extent for which government spending crowd in or crowd out private investment in Nigeria The analysis is conducted using 34 years of annual data for Nigeria. The paper emphasis on disaggregating the capital and recurrent spending of the federal government and examining their separate effect on private investment. The analysis suggested that effective macroeconomic management be ensued in order to cushion the adverse effect of rising inflation on private investment.
- **Samah Shetta and Ahmed Kamaly** (2014) tested the lazy banking hypothesis for Egypt. According to this hypothesis, government borrowing crowds out private investment through its dampening effect on private credit and estimated VAR model by using quarterly data spanning for almost four decades. The results showed that output growth positively impacts the willingness of the banking sector to extend more credit to both the government and the private sector. Finally, the consistent of the lazy bank, impulse functions response showed that the effect of a government borrowing shock was contractionary (as opposed to the effect of private credit shock which was slightly expansionary) with regard to the overall banking sector credit.
- **Hüseyin Şen and Ayşe Kaya (2014)** Analyzed the effects of government spending on private investment, evaluating the existence of crowding-out/-in effects, in Turkey over the period 1975-2011 The empirical findings showed that government current transfer spending, and government interest spending crowd out private investment, whereas government capital spending crowds-in private investment in Turkey.
- **Garikai Makuyana and Nicholas M. Odhiambo (2018)** investigated the impact of public and private investment on economic growth and the crowding effect between this two components of investment in South Africa. Using Autoregressive Distributed Lag (ARDL)-bounds testing approach to cointegration over the period 1970 to 2017. They found that private investment has a positive impact on economic growth both in the long run and short run, while public investment had a negative effect on economic growth in the long

run. Further than that, gross public investment was found to crowd out private investment, while its infrastructural component was found to crowd in private investment.

3. Data and Methodology :

3.1 Data :

The present reserch had carried out the relationship between public and private investment in Algeria during the period 1984-2017 our data were obtained from different sources. The private investment was considered a dependent variable whose behavior was explained implicitly as follows in equation (1) :

IP =f (IG, REER, RGDP, RINT, TRAD, ICRG)

The variable used in this study are **:**

- *IP* : private Investment.
- *IG* : public Investment.
- *REER* : real effective exchange rate.
- *RGDP* : real GDP growth.
- *RINT* : real interest rate.
- *TRAD* : trad opennes.
- *ICRG* : Index of country risk**.**

3.2 Econometric methodology :

The first step of our econometric methodology was to identify the most important statistical characteristics of the stability of time series, besides studing the most important standard tests that study these characteristics, determine the stability and extent of immobility, and determine the degree of integration and the nature of the relationship between the variables of these time series , the most important test (root unit) and one of the tests used by (Dickie Fuller) and (philips perron) . The purpose of our study was to use Autoregressive Distributed Lag (ARDL) modelling wich was developed by pesaran1997,shinand and sun 1998 peseran and al 2001, and This test does not require that the time series be integrated of the same order Where a combination of variables can be combined I(0) and I(1) in the form and We can separate short-term effects from the long-term where Through this methodology we can détermine the intégrative Relationship of the dependent variable and the independent variables in the long and short term in the same equation and Determine the size of the effect of each of the dependent variables on the independent variable and this by taking enough time lag to get better A set of data from the general frame model (laurenceson and chai 2003) And to ensure a cointgration relationship in a model vecm pesaran and narayan Provides a new approach to investigate the balance relationship between variables. This method was known as bounds test approch the test can be performered by using the (F) statistic or wald test to chek the significance of the lagged co efficient on unrestricted error correction model the ardl bounds test approch consists of Two critical values are given by Pesaran et al (2001) for the cointegration test The lower critical bound assumes all the variables are I (0) meaning that there is no cointegration relationship between the examined variables.

The upper bound assumes that all the variables are I (1) meaning that there was cointegration among the variables. When the computed F-statistic was greater than

the upper bound critical value, then the H_0 was rejected (the variables are cointegrated). If the F-statistic was below the lower bound critical value, then the (H_0) cannot be rejected (there was no cointegration among the variables). When the computed Fstatistics falls between the lower and upper bound, then the results are inconclusive.

$$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0.$$
$$H_1 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq 0.$$

4. Empirical results :

4.1. Stationarity /unit root :

The present study, testing the presence of unit root which was using the Augmented Dickey Fuller (ADF) test and philips perron(pp) where the null hypothesis test was that the series had a unit root

Table (01) : Unit root test

VARIABLE	ADF		Pp		dicision
	LEVEL	First différence	LEVEL	First différence	
RINT	-0.96	-4.60	-1.12	-4.58	I(1)
ICRG	-1.63	-5.09	-1.63	-5.08	I(1)
IG	-2.47	-6.16	-2.47	-6.24	I(1)
IP	-3.16	-7.54	-1.69	-7.78	I(1)
REER	-3.82	/	-1.65	-5.06	I(1)
RGDP	-4.47	/	-4.48	/	I(0)
TRAD	-0.59	-4.54	-0.77	-4.32	I(1)
	satistical	tΦj	.3.21=%10	،3.55- =%5	،4.27 - =%1

Source : computed by Authors using Eviews9.

When we comparing tΦj satistical With critical values were shown The first differences for each variable were stable time series. This was because the absolute values of the estimated statistic. This was superior to all critical levels of ADF and PP tests Except Real GDP growth variable Which settled at the level so The best way to study the integration relationship the autoregressive distributed lag model.

4.2. Cointegration Test using the Bounds test Approach :

Table (02). ARDL Bound testing for cointégration

Test statistic	**Value**	**K**
f-statistic	**4.86073**	**3**

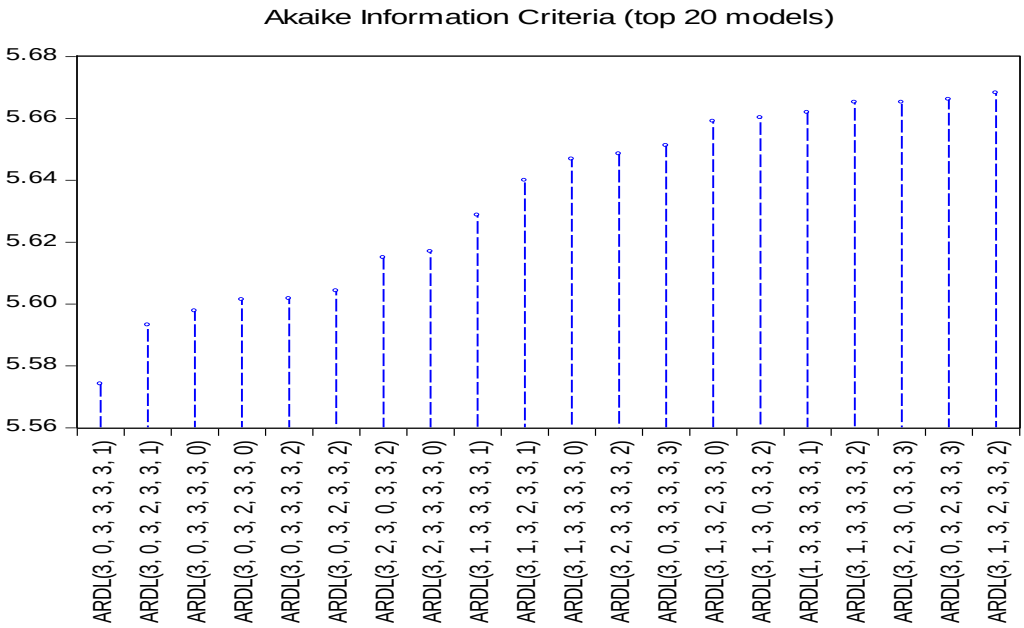
Critical value bounds :

Significance	**I0 Bound**	**I1 Bound**
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.23

Source : computed by Authors using Eviews9.

We noticed that the F-statistic for the Bounds Test was 4.38, and this clearly exceeds even the 1% critical value for the upper bound. Accordingly, we strongly rejected the hypothesis of "No Long-Run Relationship".

4.3. The Optimal Number of Lags :



Source : computed by Authors using Eviews9.

Through the figure above the ideal model which degrades the value scharws ARDL (3,0,3,3,3 ,1) Meaning three lag for private investment, No lag for public investment, Three lags for the real effective exchange rate, the rate of economic growth, the real interest rate, and the rate of Trade openness And one lag for the country risk index So we have the following model :

IP = C(1)*IP(-1) + C(2)*IP(-2) + C(3)*IP(-3) + C(4)*IG + C(5)*REER + C(6)*REER(-1) + C(7)*REER(-2) + C(8)*REER(-3) + C(9)*RGDP + C(10)*RGDP(-1) + C(11)*RGDP(-2) + C(12)*RGDP(-3) + C(13)*RINT + C(14)*RINT(-1) + C(15)*RINT(-2) + C(16)*RINT(-3) + C(17)*TRAD + C(18)*TRAD(-1) + C(19)*TRAD(-2) + C(20)*TRAD(-3) + C(21)*ICRG + C(22)*ICRG(-1) + C(23).

4.4. ARDL Error correction model :

The table that follows presents the long-run ARDL results :

Table 03 : long-run ARDL analysis

ARDL Cointegrating And Long Run Form Dependent Variable: IP Selected Model: ARDL(3, 0, 3, 3, 3, 3, 1) Included observations: 31				
Cointegrating Form				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(IP(-1))	0.436396	0.239218	1.824259	0.1056
D(IP(-2))	0.314184	0.185495	1.693761	0.1288
D(IG)	-0.714911	0.403973	-1.769700	*0.1047
D(REER)	0.016581	0.080130	0.206922	0.8412
D(REER(-1))	-0.253814	0.080279	-3.161639	**0.0134
D(REER(-2))	0.174781	0.048108	3.633109	***0.0067
D(RGDP)	0.419234	0.596011	0.703400	0.5018
D(RGDP(-1))	0.837109	0.506030	1.654266	0.1367
D(RGDP(-2))	0.457286	0.547617	0.835046	0.4279
D(RINT)	0.208479	0.141119	1.477328	0.1778
D(RINT(-1))	0.018226	0.148303	0.122901	0.9052
D(RINT(-2))	-0.357939	0.109862	-3.258081	**0.0116
D(TRAD)	-0.484370	0.262082	-1.848160	0.1018
D(TRAD(-1))	0.079406	0.356695	0.222616	0.8294
D(TRAD(-2))	0.619073	0.277747	2.228908	*0.0564
D(ICRG)	0.985195	0.236560	4.164666	***0.0031
CointEq(-1)	-0.823291	0.319669	-5.703689	***0.0005

*** significant at 1 % , **significant at 5% , * significant at 10

Source : computed by Authors using Eviews9.

The error-correction coefficient was negative (-0.82), as required, and was very significant at 1 % This indicates a long-term equilibrium relationship in terms of its value. This means that in case of shock in the form Requires (0.82) Period to return to stability.

4.5. Estimated the long-run coefficients:

Table (04) : the long –run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IG	-0.392099	0.204675	-1.915720	0.0917*
REER	-0.066437	0.012768	-5.203379	0.0008***
RGDP	0.805908	0.659947	1.221171	0.0256**
RINT	-0.166869	0.112894	-1.478101	0.1776
TRAD	0.193462	0.123459	7.236915	0.0001***
ICRG	0.403479	0.137999	2.923771	0.0192**
C	56.756904	9.445150	6.009106	0.0003***

*** significant at 1 %, **significant at 5% , * significant at 10 %

Source : computed by Authors using Eviews9.

The estimated long run coefficients show that private investment are directly related to public investment (IG) , real exchange (REER), economic growth

(RGDP) ,real intreast rate (RINT) , index of country risk (ICRG) ,rate of trade openness and cofficients of (IG) , (REER) , (TRAD) , (ICRG) had expected signs and were statistically significant .

The study shows that the cofficient of public investment was negative and statistically significant at 10% with a value of -0.39 so for algeria case crowding out effect was present, this implies that a one percentage increase in public investment would lead to about 0.39 percentage decrease in private investment in Algeria .

The cofficient of rate openness trade was positive and staticallly significant at 1% with value of 0.19 and the index's cofficient of country risk was positive sign and statically significant at 1% with value of 0.40.

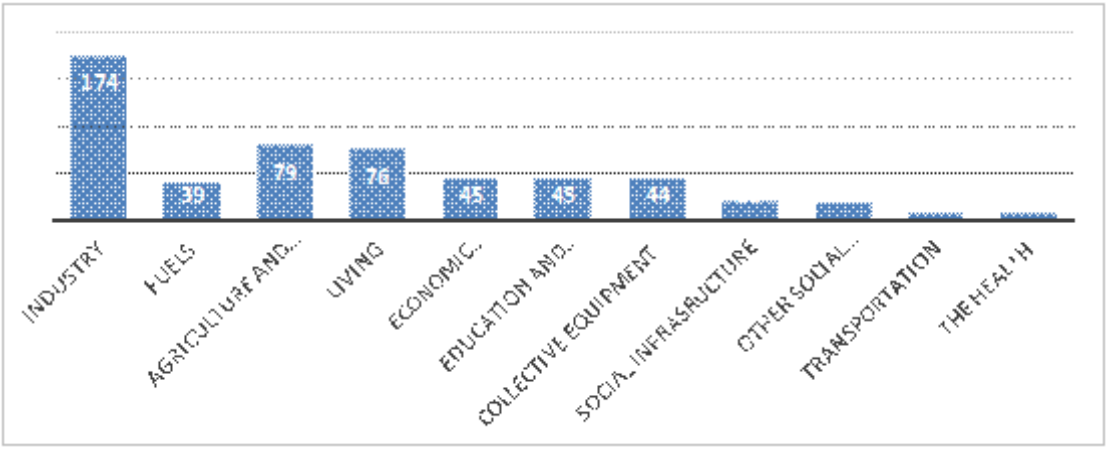
In other hand, cofficient of real effective exchange rate was negative statitically significant at 1% with value of -0.06 this implies real exchange negatively influences private investment in the long run in algeria, further the cofficient of RINT are statistically insignificant.

4.6. Cusum and cusum square :

The cumulative total test of the retrograde condensation was used (cusum) as well as the cumulative sum of the boxes of residues return (cusum of square) Proposed by both even (1975) dublin brown, to ensure that the data used in this study were empty of structural changes as well as the stability and harmony of cofficients, so that these two tests were the most important tests in this methodology(ARDL).

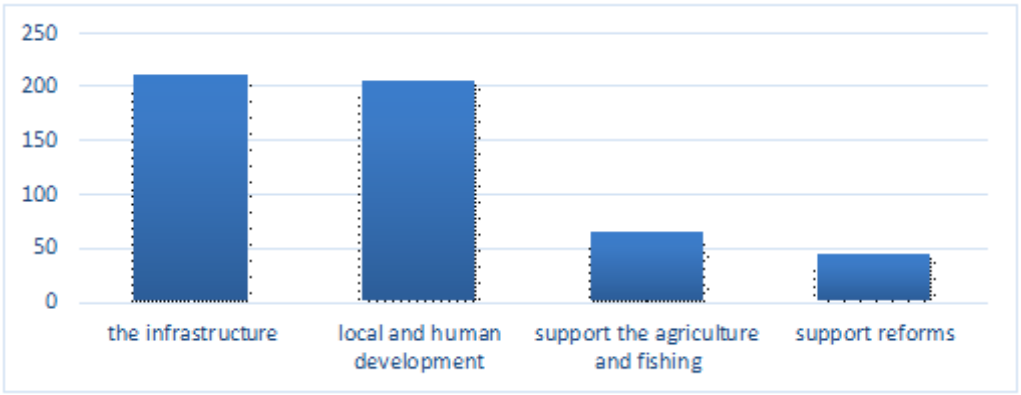
The structural stability of the estimated cofficients of the error correction for the autoregressive distributed lag model if the position of the graphic for the tests of cusum (figure5) and cusum square square (figure6), fall within critical limits at 5% In both tests curves did not emerge from interval's confidence, indicating long-term stability of cofficients.

Figure (01) : Public investment program from (1985-1989)
(in Billion Algerian Dinar)



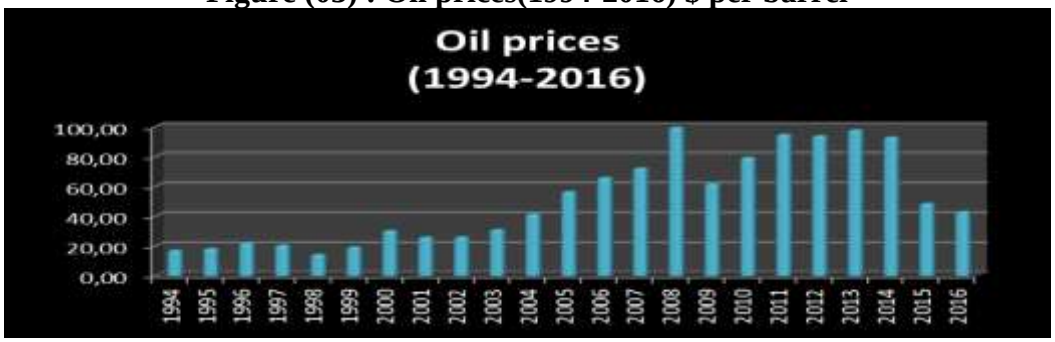
Source : Prepared by researchers

Figure (02) : The economic recovery program (2001-2004)
(in Billion Algerian Dinar)



Source : Prepared by researchers.

Figure (03) : Oil prices(1994-2016) $ per barrel



Source :world bank data .

Figure (04) : Complementary program to support growth(2005-2010)
(in Billion Algerian Dinar)

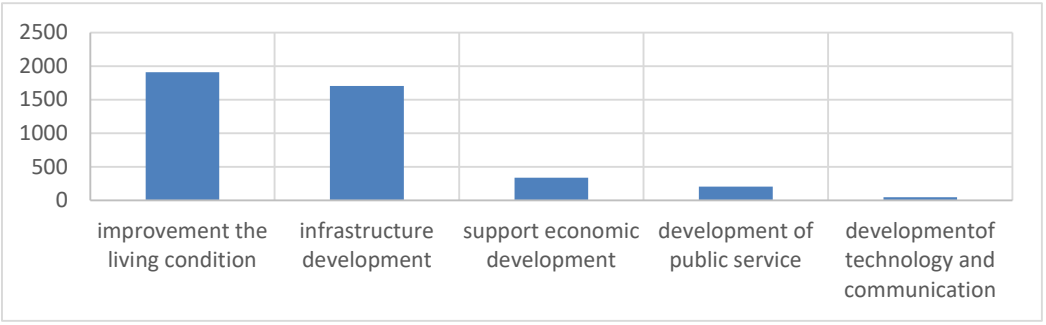


Figure (05) : Plot of cumulative sum of recursive residuals.

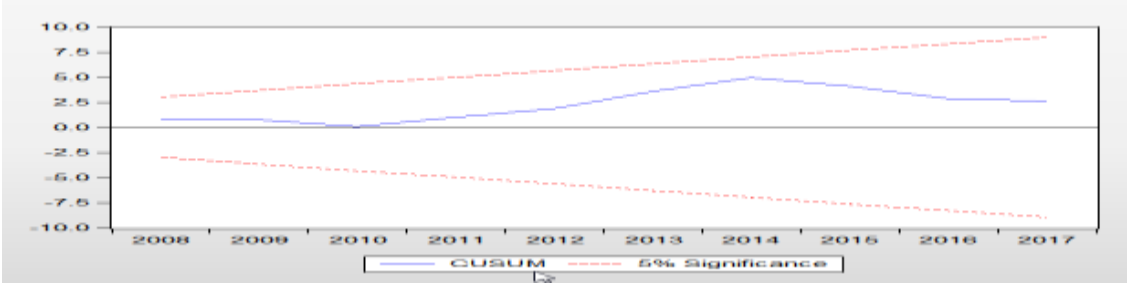
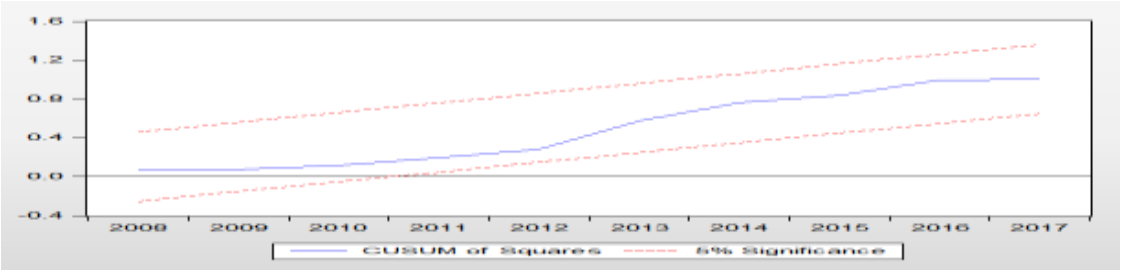


Figure (06) : Plot of cumulative sum of squares of recursive residuals.



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