Public Investments and Economic Growth in Algeria: A VAR Approach

الاستثمارات العامة والنمو الاقتصادي في الجزائر: دراسة قياسية باستخدام نماذج ال VAR

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Abstract:This study aims to analyze the relationship between public, private investments and economic growth in Algeria during the period 1998 -2020, using the VAR model. GDP growth is used as a proxy for the economic growth. Empirical results granger causality test, Impulse Response Functions (IFR) and Variance decomposition (VRC), show that while, both public and private investments are not determinants of the economic growth in the short term, public investments have a positive impact on economic growth at the long term.
Keyword: Economic Growth; Public Investments; Private Investments; Gross Domestic Product (GDP); Vector Autoregressive Model (VAR).
JEL classification code: F43, H5, E2, B23.

الملخص:هدفت الدراسة إلى تحديد أثر الاستثمارات العامة والخاصة على النمو الاقتصادي، بالنسبة للجزائر خلال الفترة الممتدة من 1998 إلى 2020. ولتحقيق ذلك تم استخدام معدلات نمو الناتج المحلي الاجمالي كممثل للنمو الاقتصادي، ولتحليل البيانات تم تطبيق نموذج الانحدار الذاتي المتجه(VAR). أظهرت نتائج اختبار السببية وكل من اختباري دالة الاستجابة الفورية (IRF) وتحليل مكونات التباين(VCR) عدم وجدود علاقة معنوية بين كل من الاستثمارات العامة والخاصة والنمو الاقتصادي في المدى القصير، بينما على المدى الطويل تبين وجود أثر ايجابي للاستثمارات العامة على النمو الاقتصادي.
الكلمات المفتاحية: النمو الاقتصادي، الاستثمارات العامة، الاستثمارات الخاصة، الناتج المحلي الاجمالي، نموذج الانحدار الذاتي المتجه.
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1. Introduction

In recent years, there has been an increasing discussion in policymaking, academic papers and circles of the relevant roles of public and private investment in the growth process of developing countries. These two kinds of investment can have a differential impact on the economic growth. It is argued that government spending can bolster economic growth by putting money in the hands of the public. This is as public investment may lead to an increase in employment which should multiply throughout the economy. Public investment in infrastructure development may provide an incentive for further investment by the private sector.

Algeria as one of these developing countries has invested heavily to improve the business environment and continuous improvement now characterized the Algerian economy. Mainly that, financial crisis in 2008 brought a heavy blow to the global economy. How to resist this crisis and improve economy growth was an important question faced by the governments of many countries. The last decade, Algeria has been recorded a balance of trade surplus, a low inflation rate and stable currency, beside a greater stability and a derive for economic diversification, in a year that saw many countries in the Middle East and North Africa Region rocked by revolution, government changes and political reforms, Algeria has largely been spared large-scale unrest.

The country today has an economy that, having gone through the long, tortuous and painful path of economic reform and restructuring, now stands on the threshold of economic revival. Not only have the elements of a liberal, free market economy been put in place, but Algeria's access to oil and gas revenues, together with the improvements in its external account, should mean that positive development and an appropriate environment for foreign investors has been created.

In the context of the theoretical and econometric problems raised by the estimation of economic growth, and the lack of consensus in the rising and modeling the effects of public investment, models that require as little restrictions to the relationship between the variables as possible become more important. Given this a Vector Autoregressive (VAR) model is used and given its characteristics, the effects of public and private investments on economic growth are also estimated. It is

within this framework that the following question is introduced: what is the impact of public investment and private investment on economic growth, in a VAR model framework for the Algerian economy? The issue is very important for the Algerian public authorities in order to base their financial decisions, and to evaluate the results of the public investment plans.

1.1 Study Objectives

In this paper the following objectives are addressed and highlighted:
- To deal with the effects of public investments on economic growth .
- To determine the impact of private investment on economic growth .
- To evaluate the efficiency of the public investment plans lunching by the Algerian government .

The rest of this paper is organized as follows. Section 2 presents a brief study of previous empirical studies and gives a theoretical background for the study variables. Section 3 provides data and methodology. Empirical findings are discussed in Section 4, and the main conclusions are stated in Section 5.

1.2 Letirature Review

A large body of previous empirical literature examines whether public investment (or some component of it) makes a distinct contribution to economic growth. (Barro, 1990) was among the first to examine the effect of public investment and public consumption expenditures on cross-country growth rates, after controlling for a number of variables, it was found that public investment has no significant effect on growth rates, whereas the rate of economic growth is negatively related to the share of government consumption expenditure. (Caselli, Esquivel, & Lefort, 1996) find a negative correlation between public expenses for education and economic growth. (Dessus, 2000) considers that this is the effect of the inefficiency of public education systems .

(Mittnik & Neumann, 2017) estimate a VAR with GDP, private investment, public investment and public consumption for six industrialized economies. Their results indicate that public investment tends to exert positive effects on GDP, and that there is no evidence of dominant crowding-out effects. Some related studies have addressed the effects of public investment on GDP, and the crowding-in hypothesis in the context of VAR analysis. For instance, (Voss, 2002) estimates a VAR model with GDP, public investment, private

investment, the real interest rate, and price deflators of private and public investment, for the US and Canada, for the period 1947-1996. According to the reported results, innovations to public investment crowd out private investment.

(Bukhari, Ali, & Saddaqat, 2007) Make a novel attempt to study the interactions among the macroeconomic variables with the help of 1971-2000 heterogeneous dynamic panel data from Korea, Singapore, and Taiwan. The premise of this study is that public spending may contribute to economic growth in different ways. The analysis found that both public and private investment and public consumption have a long-term dynamic impact on economic growth in all the countries of the sample and in a panel of sample countries. Moreover, (Swaby, 2007) seeks to uncover the relationship between public investment and growth in Jamaica. The relationship is established through the use of a VECM. It was found that although public investment had a positive impact on GDP, it was not significant. Public investment also crowed-out net private investment as it resulted in higher domestic private investment but lower foreign domestic investment, with the latter effect being much more substantial.

The following studies conclude a positive effect of the public investment on economic growth. These studies find that public investments generate economic growth, also leading to the increase of the productivity of private investments (Chatterjee, Sakoulis, & Turnovsky, 2003); (Everaert, 2003); (Del Mar Salinas-Jimenez, 2004); (Pina & M, 2015)). Other studies in the financial literature analyze the efficiency of the public investments ((Esteller & Sole, 2005) and (Alfonso, Schuknecht, & Tanzi, 2018)) .

Recently, (Bédia, 2018) investigates the impact of public and private investment on Côte d'Ivoire's economic performance (GDP growth) over the period 1969-2001, using an autoregressive-distributed lag (ARDL) Error Correction Model (ECM). The results show that in the short run an increase in private investment by 100% enhances economic growth by 28%, while 100% increase in public investment led to only 7% increase in real GDP. In the long run nevertheless the impact of public investment on GDP growth has been higher than private investment, 100% increase in private investment led to 25% increase in GDP, while public investment impacts growth by 37%. The main findings indicate that while the short run efficiency of public

capital can be further improved in Côte d'Ivoire, in the same time the efficiency of private investment can be improved in the long run.

What distinguishes the current study from the previous litertatures, is that it is performed on a developing country which is Algeria depending on recent data. Accordingly, the researcher in this paper tries to integrate different strands of the literature and focus on the effects of public and private investment on economic growth in Algeria during the time period 1998 to 2020.

1.3 Research Hypotheses

Based on the theoretical framework and previous studies, aiming for achieving the study objectives, the following alternative hypotheses are developed and empirically tested :

H_1: There is a significant statistical effect of public investment on economic growth in the short term .

H_2: There is a significant statistical effect of private investment on economic growth in the short term.

H_3: There is a significant statistical effect of public investment on economic growth in the long term.

H_4: There is a significant statistical effect of private investment on economic growth in the long term.

2 .Theoretical Frame Work

In this section the researcher gives an overview of the Economic Growth and government policies in Algeria.

2.1 Overview of The Economic Growth and Government Policies in Algeria

Algeria is a particular case in the MENA region. Whereas this country is vast and very rich in natural resources, it has not managed to benefit from its potential to secure a better living standard of its population and an economic takeoff.

- **Period From 1995 till 2000: The New Departure of Economic Growth in Algeria**

 The reform program that was supported by the World Bank and IMF and lunched in Algeria in 1994 has been highly successful in bringing about macro-economic stability. Inflation dropped from 39% in 1994 to around 5% by the end of the 1990's. The fiscal deficit, at 8.7% of GDP in 1993, was initially halved and subsequently kept at low levels, and

turned into surpluses of around 2.5% by 1997 (see figure 1). The oil price drop of 1998 weakened the fiscal performance as the decline in oil revenues prompted a deficit of 4% of GDP, but the fiscal stance was reversed following the oil price recovery and expenditure curtailments in 1999, yielding a close-to balanced budget. However, the supply response failed to materialize, and the economy remains vulnerable to oil price and climatic changes.

The reform program succeeded in reversing the long past decline in GDP growth, but the recovery is still slow and subject to large fluctuations provoked by weather and oil price variability. Real GDP growth rate in 1995-1996 averaged 4% (mostly driven by the hydrocarbons sector), followed by a sharp slowdown in 1997 to around 1%m (see figure 1), reflecting the drought induced drop in agricultural production and a continued decline in the State-owned industrial sector. Manufacturing value added fell continuously by 2% in 1995, 13% in 1996, and 7% in 1997, implying a cumulative loss between 1990-1997 of around 40% in real terms and prompted some industrial restructuring.

Economic performance in 1998, with a real GDP growth rate of 5.1%, was exceptionally high despite the oil price shock, principally due to an exceptionally good harvesting year by good rainfalls, and some recovery in manufacturing resulting from the restructuring efforts of the previous 4 years. In 1999, real GDP growth dropped again to 3.5%, mainly due to a substantial slow-down of the non-hydrocarbon sector, which grew at only 2.7% in real terms due to the budgetary impact of the sharp drop in oil prices. This was due to the deceleration of the construction and services sectors, compounded by a severe slow-down in agriculture due to an important late-season drought that mostly affected the cereal sector. Prompted by the oil price recovery in the second part of the year, the hydrocarbon sector grew at 6%, once again compensating for the slowdown in the non-hydrocarbon sectors.

Fiscal imbalances with prudent monetary and fiscal policies reprogramming of external debt, and introduction of structural reforms, these included trade liberalization, a two-step devaluation of the Algerian dinar (in total 70 percent) between April and September 1994; a managed float regime in 1995 supported by an interbank foreign exchange market; and the restructuring of public enterprises (Social and Economic Development Group , 2007).

The adjustment program achieved significant success in price stability, but with dramatic social impact. Macroeconomic performance did indeed improve. Between 1994 and 2000, inflation fell from 29 to 0.3 percent; the fiscal deficit went from -4.4 percent of GDP to a surplus of 7.8 percent of GDP (see figure 1); the spread between the parallel market and official exchange rates fell by about 100 percent; and growth recovered to a modest rate of 3.2 percent. Yet the unavoidable closing of more than 900 nonviable public enterprises slashed the public labor force by 320,000 (about 40 percent)—a significant social cost. Unemployment increased from 24 percent in 1994 to 30 percent in 2000 (World Bank, 2013).

- **Period from 2001-2010, Public Spending Plan, (2001-2004), Complementary Growth Support Plan(2009-2005)**

Algeria has invested heavily to improve the business environment with the efforts aiming to consolidating the result of the 2001-2004 public Spending Plan through the \$55 bn Complementary Growth Support Plan lunched by President Abdelaziz Bouteflika for developing spending between 2005 and 2009, a plan aimed at improving living conditions, upgrading the country's infrastructure, improving the business environment and rebalancing the regional development.

At this period, Algeria has recorded remarkable economic performance, resulting in the consolidation of the macroeconomic framework. That notwithstanding, the economy remains highly dependent on the oil and gas sector and therefore very sensitive to external shocks from 2004 to 2010, the country's GDP growth rate averaged 3.4%, driven by the performance of the oil and gas sector, as well as the contribution of the services, construction and public works sectors (BTP) and, to a lesser extent, the agricultural sector, which recorded a bumper cereal harvest in 2009. The vitality of the services and construction sectors stems mainly from the huge volume of public investments. The vitality of these sectors is reflected in the relatively high non-oil GDP growth rate, which stood at 6.3% per annum during the period 2004-2010 (see figure 1). However, its contribution to GDP is still low; it's a real constraint facing the challenge of diversification of income sources of the country (World Bank, 2013).

- **Period after 2010, Public Investment Plan(2014-2010)**

The Algerian government has announced the launching of a five-year public investment plan starting in 2010 until 2014. This program is

the continuation of previous economic plans covering the period from 2004 to 2009 and the general dynamic of national reconstruction through economic growth revival launched in 2001. The total financial commitments represent an amount of 21.214 billion of Algerian Dinars (286 billion, US Dollars). This five-year public investment plan' stretching from 20 I 0 until 2014 focused on both the completion of previous projects for an investment amounting 9.700 billion of AD (130 billion US Dollars) and the launching of new projects for the amount of 11.534 billion of AD (156 billion US dollars) .

Algeria continues to support the development and the financing of SMEs in the country in an effort to spur additional employment generation and private sector growth. An amount of 150 billion AD is to be allotted to the promotion of small and medium-sized enterprises. According to official data, unemployment has been declining; reaching 10% in 2010, down from 10.2% in 2009, but youth unemployment remains high at 21% (2010). The medium-term growth is favorable, at 3.9% in 2011 and 3.6% in 2012 (**see figure 1**).

- **Period fror (2015-2020)**

In 2019, Algeria's economic growth rate slowed for the fifth consecutive year amid prolonged social mobilization and political transition, denting consumer and business confidence and spending. At the sector level, the structural deterioration in the hydrocarbon industry continued, with a decline of 4.9% in the industry, while the non-hydrocarbon sector grew by a modest 2.4% in real terms.

In 2020, the Algerian economy is expected to show a significant contraction in real GDP in 2020 due to the dual shock of containment measures and the decline in hydrocarbon export revenues due to the COVID-19 pandemic. In this context, the authorities have taken several measures to provide immediate relief to families and businesses and announced far-reaching structural reforms to shift to a model of economic development led by the private sector, while maintaining support for the weakest and most vulnerable segments of the population. 1079/5000 Translation results in 2019, Algiers' economic growth rate is the fifth in a row in terms of social and political transformation, which weakened consumer confidence at a depth level, the structural deterioration in the hydrocarbons industry continued, with a decline of 4.9% in the industry, while the public sector grew by a modest 2.4% in real terms. In 2020, the Algerian economy showed a

significant contraction in real GDP in 2020 due to the shock to containment measures and the decline in hydrocarbon export revenues due to the COVID-19 pandemic crisis. This is the economic growth of economic units (The World BanK, 2021).

From the following figure, we note that the GDP growth rates are constantly declining, as they recorded a rate of 0.8 and -5.48 in 2019 and 2020 respectively, this is due to the epidemic's economic crisis which also comes after five consecutive years of underdevelopment in GDP growth (2015-2019) in Algeria, driven by a shrinking hydrocarbon sector, a public-sector-led growth model and mazes, and a private sector struggling to become the new engine of economic growth. The hydrocarbon industry, which interpreted 20% of GDP, 41% of tax revenues and 94% of export revenues in 2019, is experiencing a structural decline.

Fig.1: GDP - growth rates (%) form 1995-2020
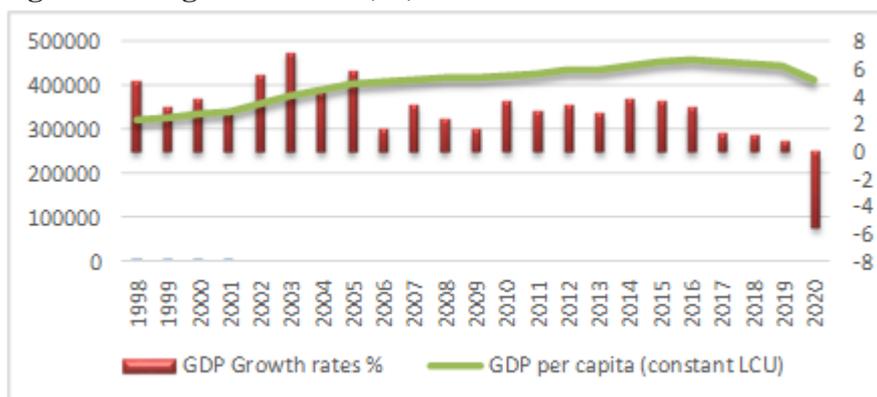
Source: prepared by the researcher based on the world bank data.

2.2.2. Operational Definitions of Study Variables

Economic Growth: is the growth at the level of national income. There are various measures of national income, but the one used is the Gross Domestic Product (GDP). We measure growth as the percentage change in GDP. However, it is very important that we only take the percentage change of the real GDP. Economic growth tends to follow a cyclical pattern. There is may be boom periods when economic growth is faster, but these may well be followed later by periods when the economy slows soon down. This pattern is known as the trade cycle. So, in the current paper the growth rate of the domestic product is considered as an estimator for the economic growth .

Public investment (PUB): public investment encompasses money that a government spends on physical infrastructure and public services, such as health, education and, research and development support, human capital formation and human development; this later can improve the "employability" of people at risk of becoming long-term unemployed, mostly by training but also by other measures that promote their social and economic inclusion. In general, the main role of the public investment is to boost the economic growth. In this paper public investment to GDP ratios are used as estimators for PUB.

Private investment (PRV): can be defined as the investment by businesses and financial institutions rather than by a government. In this paper private investment to GDP are used as estimators for PRV.

3 .Methodology and Data

The methodology used in this paper and the data descriptions are illustrated below:

3.1 Data Description

All relevant data have been obtained from the International Statistic data bases (World Bank and IMF). The researcher chose the period 1998-2020 for the analysis in this paper; this allows considering the Algerian economic growth and investment trends over last few decades. The primary variable of interest is the economic growth, the researcher takes GDP growth rate as a measure of economic growth, but expresses public investment and private investment as ratios of GDP. This choice of variables allows him to focus on the effects of public and private spending on economic growth .

3.2 Vector Autoregression (VAR) Methodology

The VAR system is based on empirical regularities embedded in the data. The VAR model may be viewed as a system of reduced form equations in which each of the endogenous variables is regressed on its own lagged values and the legged values of all other variables in the system (Gujarati N. D., 2004).

An n variable VAR system can be written as :

A (l) Y_t = A +U_t (1)

and   A (l) = l – A_1 l - A_2 l 1^2 - …A_m 1^m (2)

Where Yt is a nxl vector of macroeconomic variables, A is a nxl vector of constraints, and Ut is a nxl vector of random variables, each of which is serially uncorrelated with constant variance and zero mean. Equation (2) is a nxn matrix of normalized polynomials in the lag

operator l (l k $Y_t = Y_t$ – k) with the first entry of each polynomial on A's being unity. Since the error terms (Ut) in the above model are serially uncorrelated, an ordinary least squares (OLS) technique would be appropriate to estimate this model. (Gujarati, 2004) .

In order to analyze the impact of unanticipated policy shocks on the macro variables in a more convenient and comprehensive way, (Sims, Stock, & Watson, 1990) proposed the use of Impulse Response Functions (IRFs) and Forecast Error Variance Decompositions (FEVDs). IRFs and FEVDs are obtained from a moving average representation of the VAR model [equations (1) and (2)] as shown below :

$$Y_t = \text{Constant} + H_t \text{ (l) U} \quad \ldots\ldots \quad (3)$$
$$\text{and H (l)} = I + H_t^1 l + H_2^1 + \ldots\ldots \quad (4)$$

Where, H is the coefficient matrix of the moving average representation, which can be obtained by successive substitution in equations (1) and (2). The elements of the H matrix trace the response over time of a variable i due to a unit shock given to variable j. In fact, these impulse response functions will provide the means to analyze the dynamic behavior of the target variables due to unanticipated shocks in the policy variables. This is because the IRFs trace the reaction of all the variables in the VAR system to innovations in one of the variables and therefore can be used to analyze the effects of structural innovations (Saeed, Hyder, & Ali, 2007).

In this paper a (VAR) methodology is utilized for two reasons. First, previous studies imply that the variables of interest are simultaneously related. We need to treat each variable symmetrically and allow feedback among them. Second, VAR analysis is superior to a single equation approach for capturing the long-run dynamics of variables. An n-equation VAR is an n-variable linear system in which each variable is in turn explained by its own lagged values and past values of the remaining n-1 variables (Enders, 1995, p. 112).

3.3. Stationarity Test (Unit Root Test)

The unit root test examines the stationarity of the data, the data series are stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or lags between the two time periods (Gujarati & Porter,

2010, p. 205). To single time series the early work that used the unit root is backed to (Dickey & Fuller, 1979, p. 79.

3.4 The Granger Causality Test:

The third step is the Granger causality test to determine the causal relationship between the variables A Granger-causality test examines whether the variable to be tested adds explanatory power to an existing relationship between one (or more) other variable(s) and its (their) lags. For example, if Z_t is a dependent variable and Z_{t-1} is the variable lagged one period, then $Z_t = f(Z_{t-1}, v_t)$ would represent a statistical relation between the two, when v_t is some unknown source of variation in the functional relation between them. For the Granger test, a known variable would be put into the functional relation of Z_t and Z_{t-1} with various lags and leads to determine whether it helped to reduce v_t (for more details see (Gujarati, 2004)).

3.5 Variance Decompositions and Impulse Response Functions

based on the estimated VAR models, impulse response's function (IRF) and variance decomposition analyses (VDC) are computed in order to address the question of causality between private, public investment and economic growth. Impulse response is the time paths of one or more variables as a function of a one-time shock to a given variable or set of variables. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables through the dynamic lag structure of the VAR (Aziakpono, 2005, p. 11).

4. Empirical Results

The following test and analyzes have been used to reach the study objectives :

4.1 Stationarity Test

From table (1) it is evident that all time series are compatible with the hypothesis that stationarity characterizes the variables in this study. Since, (the ADF absolute computed values, are greater than the absolute critical values, at the level for PRV and at the first difference for GDP and PUB variables, where all the statistics are significant), that allows for applying the VAR methodology.

Table (1): Unit Root Test Results

Variables	ADF	
	Level	1st Difference
GDP	-2.674731 (0.0942)*	-7.056556 (0.0000)***

PUB	-1.673293	-4.900697
	(0.4302)	(0.0009)***
PRV	-3.886499	-6.816749
	(0.0081)***	(0.0000)***

Source: prepared by the researcher based on the Eviews outputs.
Probabilities of rejection of null hypothesis are presented in parenthesis. ***, ** and * denotes significance at p<1%, 5% and 10%

4.2 The Optimal Lag Length Selection

The next step is to formulate and estimate the appropriate VAR model. The variables in the VAR models are used on their stationary level. The initial task in estimating the VAR model is to determine the optimum order of lag length. This is important since under parametrization would tend to bias the results and over-parametrization would diminish the power of tests. The optimal lag length of the lagged differences of the tested variable is determined by minimizing the Akaike Information Criteria (AIC) and Schwarz Bastian Criteria (SBIC). Table (2) shows the selected lag length by criteria, all the criteria (LR, FPF, AIC, SC and HQ) recommended a joint lag 1.

Table (2): the Optimal Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-119.92	NA	158.37*	13.570*	14.01*	13.64*
2	-116.85	4.20	313.62	14.194	15.08	14.346
3	-108.25	9.04	391.69	14.237	15.57	14.46

 * Indicates lag order selected by the criterion
Source: prepared by the researcher based on the Eviews outputs.

4.3 The Granger Causality Test

The Granger-causality tests and the VAR simulations reported in this article are consistent in using only one lagged value of the relevant variables. The tests are restricted to one lagged value because the short span of the available annual data necessitates economizing on degrees of freedom, the shortage of degrees of freedom being especially acute for the VAR analysis and this is consistent with precedent lag length selection test.

The test results are presented in Table (3). Obviously, neither public nor private investments had statistically significant effects on the economic growth (both H1 and H2 are rejected at 5% significant level) for the Algerian economy in the short term. It is interesting that there isn't any granger causality between the private investments and economic growth. Whereas, public investment was significantly caused

by economic growth. Since, Algeria is seeking to diversify its economy, which is now heavily dependent on hydrocarbons, by developing the traditional sectors such as agriculture, business services, ICT, tourism, etc. finally, the results show that private investment was caused by economic growth .

Table (3): Granger Causality Results

Null Hypotheses:	F-Statistic	Probability
PRV does not Granger Cause GDP	1.22807	0.3044
GDP does not Granger Cause PRV	3.74584	0.0942*
PUBL does not Granger Cause GDP	0.05726	0.8144
GDP does not Granger Cause PUBL	3.12044	0.0991*

* Denotes significance at $p < 10\%$.

Source: prepared by the researcher based on the Eviews outputs

4.3 Vector Autoregression Estimation

The lag order of 1 is selected by minimised AIC statistics for our dynamic VAR specification. The estimated VAR is reported in table (4) below. The impact of public and private investment on economic growth is shown from the respective coefficient. In general, the explanatory power of all the equations of the VAR model as reflected in their R^2 and F statistic is fairly well .

Table (4): Vector Autoregression Estimates

Variables	GDP
GDP(-1)	0.538562
	(0.26577)
	[2.02642]
PUBL(-1)	0.151016
	(0.10265)
	[1.47120]
PRV(-1)	-0.132918
	(0.13139)
	[-1.01160]
R-squared	0.581638
Adj. R-squared	0.462106
F-statistic	4.865956
Log likelihood	-10.34800
Akaike AIC	2.669599
Schwarz SC	2.760375

Source: prepared by the researcher based on the Eviews outputs

4.4 Impulse Responses Analysis

Impulse responses are presented in Figure (2). It is shown for 1 to 16 lags/quarters. A shock in public investments has a positive and significant impact on GDP which mean that H3 is accepted. And this impact increase with time. Besides, a shock in private investment affects GDP positively starting from the fourth quarter however; its impact is negligible and both long and short run (H4 is rejected) .

Fig.2: Impulse Responses Analysis
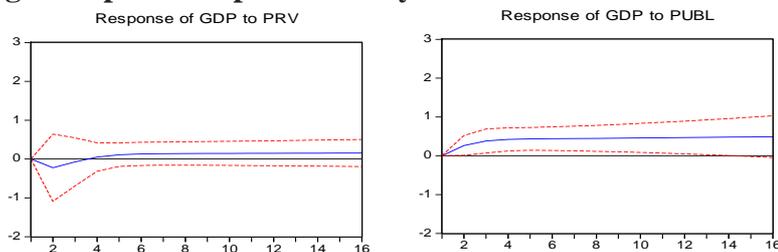
Source: prepared by the researcher based on the Eviews outputs

4.5 Variance Decomposition Analysis

Variance decomposition measures the percentage of the forecast error variances at various forecast horizons that are attributable to each of individual shocks or group of shocks. Such procedure allows one to see the long-run (after 15 periods) percentage variation in GDP as a result of shocks to public and private investments. If the share of variation of a variable would be 0%, then that variable would be completely exogenous in the model as in (Enders, 1995).

The results in table (5) and figure (3) indicate that at second quarter a shock in GDP is largely explained by its own innovations (about 98%), but its explanatory power declines over time. The forecast error variance decomposition shows that only 1.257474 % of total variation of GDP is directly accountable to the shock in public investment and 0.90% is explained by the chock in private investment at the same period (both hypotheses H_1 and H_2 are rejected) .

However, in the long-run the explanatory power of public investment increases, for example at the 9th quarter 19.17 % of total variation of GDP is explained by the chock in public investment. While, the explanatory power of private investment remains negligible at the same period, the forecast error variance decomposition shows that only 2.28 % of total variation of GDP is explained by the chock in private investment .

Moreover, in the long-run the explanatory power of public investment chows a considerable increase, and about 33% of total variation of GDP is directly accountable to the shock in public investment. However, the forecast error variance decomposition shows that only 3.42 % of total variation of GDP is explained by the chock in private investment. Hence, private investment can be considered as an exogenous variable in this study in both short and long run .

Table (5): Variance Decompositions (VD)

Period	S.E.	GDP	PRV	PUBL	Period	S.E.	GDP	PRV	PUBL
1	2.07	100.	0.00	0.00	9	2.67	78.7	2.06	19.1
2	2.35	97.8	0.90	1.25	10	2.72	76.30	2.28	21.4
3	2.42	95.4	0.94	3.63	11	2.76	73.9	2.49	23.5
4	2.46	92.6	0.95	6.42	12	2.80	71.6	2.69	25.6
5	2.50	89.6	1.12	9.20	13	2.85	69.5	2.88	27.5
6	2.55	86.7	1.35	11.8	14	2.89	67.4	3.07	29.4
7	2.59	83.9	1.60	14.41	15	2.94	65.42	3.24	31.32
8	2.63	81.3	1.84	16.84	16	2.98	63.4	3.42	33.09

Source: prepared by the researcher based on the Eviews outputs

Fig.1: Variance Decomposition
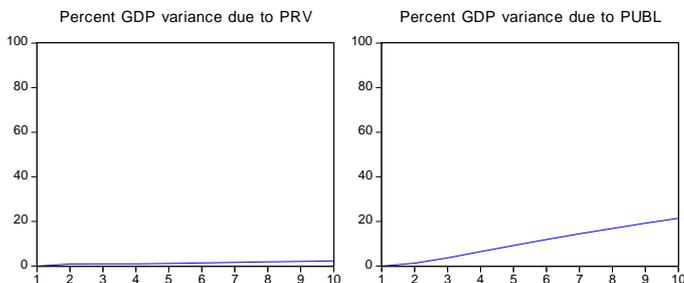
Source: prepared by the researcher based on the Eviews outputs

In the case of public investments this may be explained by: first, the corruption as well as the inefficient public projects with low control and supervision. Second, before establishing any policy to boost the national economy, the Government has chosen to give priority to the upgrading of the country's infrastructure. In 2005, it launched a Complementary Plan for Growth Support (PCSC) aiming at improving the services and facilities available to economic actors as well as the whole population. Supplemented by two special programs for the Highlands and the South, it provided more than 180 billion dollars in investments by 2009. 70% have been spent on basic infrastructure,

housing and public facilities. Most of these guidelines are translated into the 2005-2025 Land Master Plan and declined per sector in 19 dedicated master plans. The five-year plan for funding of basic infrastructure and utilities is introduced from 2010-2012. Therefore, the results of these projects will be seen at the long term and this is consistent with the results that indicate a positive effect of these investments on economic growth at the long term (after 2020). Finally, most of these projects are launched for upgrading of the country's infrastructure, so they are not productive projects. So, evidently their impact on the economic growth is long term and indirect impact .

To date, the participation of the private sector in investment has been relatively low and concentrated in some sectors; consequently, its impact on the Algerian economic growth is very low and this may due to many reasons, one of these reasons is that the Algerian business climate is not conducive to private sector development.

Steps were taken during 2011 in the framework of the tripartite meeting of the social partners to improve the business climate and investment. New methods of payment were introduced for inputs and raw materials imported by production enterprises. Investment loans to SMEs were enhanced and a procedure for dealing with the bank debts of SMEs in difficulty was introduced. Moreover, In the repport of the (World Bank, 2013) on the business climate it ranks Algeria 148th out of 183 countries. It emphasises the constraints that weigh on the business climate, in particular in respect of creating businesses and transferring property. These procedures entail major delays and costs. In addition, it remains difficult for SMEs to get access to bank financing. Furthermore, a survey into trends carried out by the forum of business leaders.

More over the results of the study can be explained by the sever impact of economic crisis caused by the pandemic follows six consecutive years of slowdown in GDP growth (2015-2020) in Algeria, driven by a shrinking hydrocarbon sector, a labyrinthine and public-led model of growth, and a private sector struggling to become the new engine of economic growth. The hydrocarbon industry, which accounted for 20% of GDP, 41% of fiscal revenues, and 94% of export earnings in 2019, is experiencing structural decline.

5. Conclusion

The effects of public investment on economic growth have received a great deal of attention in the recent economic literature. While, the casual connection between public and private investments and economic growth in Algeria has not yet been fully explored, this paper makes a novel attempt to study the interactions among these macroeconomic variables. Within the approaches that have been applied to assess the impact of public infrastructures, this paper estimates the dynamic domestic effects of innovations in public and private investments using a vector autoregressive (VAR) methodology for the Algerian economy.

The Algerian government has recently announced the launching of a five-years public investment plan starting in 2010 until 2014. This program is the continuation of previous economic plans covering the period from 2004 to 2009 and the general dynamic of national reconstruction through economic growth revival launched in 2001. This motivates the researcher to investigate the impact of both private and public investments on the Algerian economic growth.

Empirical results derived from granger causality test, Impulse Response Functions (IFR) and Variance decomposition (VRC) show that both public and private investments are not determinants of the economic growth in the short term, On the other hand, a positive shock in public investments generates a rise in the level of economic growth in the long term. This reaction shows that, in the case of Algeria, there are a lot of other factors that can stimulate economic growth, which have higher trend multiplier effects.

Based on the findings in this paper the researcher recommended the following:

- Set high technical standards for public investment managemen and drawing lessons from the on-going budget modernization reform in order to support the overall implementation, monitoring, and evaluation of projects; support the preparation of a medium-term expenditure framework and improve the efficiency and cost-benefit of investments in four key sectors, transport and public works, water, education, and health.
- Algerian policy makers would have to implement efficient measures where the increases of public capital must be accompanied with efficient implementation, and continuous control and supervision .

- Invest more capital in productive projects by allocating more resources to the agricultural and industrial sectors that will flourish the Algerian economy and minimize the high importation cost .
- To enhance the business climate in order to encourage the private sector creation and development.

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