Analysis and Measurement of the Relationship between Gross fixed capital formation and Economic growth in Algeria for the Period 1990-2018

تحليل وقياس العلاقة بين إجمالي تكوين رأس المال الثابت والنمو الاقتصادي في الجزائر للفترة 1990-2018

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Abstract: This study will analyze and measure the relationship between Gross fixed capital formation and Economic growth in Algeria, using the error correction model. We conclude that there is a causal relationship between GFCF and GDP in Algeria within the period under study, also we find there is a long run significant relationship that exists between the variables examined, The result as indicated that A positive shock in Gross fixed capital formation of 1% will have a negative impact on the Gross domestic product, and A positive shock in Gross domestic product of 1% will have a negative impact on the Gross fixed capital formation.

Keywords: Fixed Capital Formation, Gross domestic product, Economic Growth, error correction model.
Jel Classification Codes : E22; E25; C32; O49.

Abstract in Arabic:
تحاول الدراسة تحليل وقياس العلاقة بين إجمالي تكوين رأس المال الثابت والنمو الاقتصادي في الجزائر، وذلك باستخدام نموذج تصحيح الخطأ. وتوصلنا أن هناك علاقة سببية بين GFCF والنمو في الجزائر، كما أن هناك علاقة طويلة المدى بين المتغيرات ، كما أن حدوث صدمة إيجابية في تكوين رأس المال الثابت بـ 1 ٪ سيكون لها تأثير سلبي على GDP، وحدوث صدمة إيجابية في GDP بـ 1 ٪ سيكون لها تأثير سلبي على GFCF.

Keywords: تكوين رأس المال الثابت ، الناتج المحلي الإجمالي ، النمو الاقتصادي ، نموذج تصحيح الخطأ.
Jel Classification Codes : E22; E25; C32; O49.

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Introduction

Economic variables gaining their degree of importance from the role which play in the future of the country's economy, so the variable of gross fixed capital formation is a high importance in the national economy as it provides an investment plan for the country and is considered an indicator of the rational economic plan set for reaching the goal of the subject. Also, the gross fixed capital formation, which is one of the indicators of the success of any economy in attracting capital for investment, is the main component of investment in any economic entity and an addition to capital in the economy.

Hence the problem of study for research analysis and measurement the relationship between Gross fixed capital formation and Economic growth by answering the following question:

Is there a relationship between gross fixed capital and economic growth in Algeria for the Period 1990-2018?

The study is based on the following hypotheses:

- There is a positive correlation between gross fixed capital and economic growth in Algeria.
- There is no causality between gross fixed capital and economic growth in Algeria.
- There exists a long-run relationship between gross fixed capital and economic growth in Algeria.

Because of the above discussion, the objective of the study is to investigate the effect of gross fixed capital formation (GFCF) on economic growth (GDP) as well as causal connection between gross fixed capital formation and Economic growth and determine the direction and behavior of the relationship between gross fixed capital formation and Economic growth in Algeria for the period 1990-2018.

1. Literature Review

The fixed capital formation index is of great importance in the economic development process. It defines the level and rate of economic growth, characterized by high scalability through the start and continuation of investment and savings operations. The increase in capital will be reflected in the increase in the productivity of other elements of production such as land and labor, and thus a catalyst for the increase in productivity and economic growth.

Nurkse (1962) defines capital formation as a reluctance to use current productive activity in real-time consumption and to direct part of it

to the formation of capital goods such as equipment ... which in turn increases the productive efficiency of the country and raises growth. In other words, directing part of the current resources towards achieving balance for capital goods used in the future to develop and expand consumer products, and to raise economic growth (Nurkse, 1962, p. 62).

Gross fixed capital formation represents the value of the durable goods (tangible and intangible assets) for non-military purposes, purchased by the resident producing units to be used at least one year in the production process, as well as the value of services incorporated in fixed capital goods (Gibescu, 2010).

Gross fixed capital formation used within national accounts, which measures expenditure on non-financial assets from both the public and private sectors, and measures the acquisitions less disposals of assets such as land, buildings, equipment and transport used in the production process for more than a year.

Gross fixed capital formation consists of resident producers' acquisitions, less disposals, of fixed

Assets during a given period plus certain additions to the value of non - produced assets realized by the productive activity of producer or institutional units, fixed assets are tangible or intangible assets produced as outputs from processes of production that are themselves used repeatedly, or continuously, in processes of production for more than one year.

Economic literature and applied studies indicate that there is a mutual effect between GDP and gross fixed capital formation. There is specificity to this relationship. The changes in GDP are reflected in the total fixed capital formation in subsequent periods; GDP is not affected by investments of the same year, but by investments of previous years. Investments of the year do not show their effect on output in the same year, for years depending on the speed of introduction of new projects in the economy, this effect is investigated by identifying so-called time-lag periods; the structure of the economy contributes to determining the direction of the correlation between GDP and total capital formation.

The relationship between gross domestic product (GDP) and gross fixed capital formation shows that the first is clearly affected by the amount of investments accumulated in the national economy. The larger the amount of investments, the more positive it will affect the situation of GDP.

In the same context, there is a fundamental point that determines the nature of the relationship between GDP and fixed capital formation, which is clearly reflected in the extent of the effect of gross fixed capital formation on GDP. The effect may not be fully reflected in the same year in which

cumulative investment operations took place. The whole of which has implications for several years, depending on the speed at which new investment projects are introduced into the Investment Cycle (SAHLI, 2018).

Several studies have dealt with the relationship between gross fixed capital formation and Economic Growth, the following are some of these studies:

Kanu & Ozurumba,(2014), Addressed the impact of capital formation on Nigeria's economic growth using the VAR model, and found that in the short term, there was no significant impact on the overall gross fixed capital formation on economic growth; in the long run, there was a positive correlation with economic growth (Kanu & Ozurumba , 2014). Also, Gibescu(2013), examined the effect of gross fixed capital formation in supporting economic growth by showing an analysis of the relationship between gross fixed capital formation and economic growth in Romania, Bulgaria, Czech Republic, Poland, and Hungary for the period 2003-2009, and found a strong correlation between total capital formation Stability and economic growth in countries (SAHLI, 2018). proved the slow causal relationship between the total local production and the gross domestic product and the gross fixed capital formation in Algeria inside the prediction model about the study variables.

Bellatreche &Touiti(2018) reveals a lack of evidence of an equilibrium relationship in the long term between Gross Fixed Capital Formation and economic growth in Algeria during the period of the study. Moreover, the findings show that there is a trace of causality running from economic growth to Gross Fixed Capital Formation. They are confirmed by the tests of variance decompositions and impulse response functions (Bellatreche & Touiti, 2018).

2. Evolution of gross fixed capital formation and economic growth in Algeria

There are several periods showing the evolution of gross fixed capital formation and economic growth in Algeria during the period 1990-2018:

The period between 1990 and 1999 was characterized by a decrease in the share of gross fixed capital formation and a significant fluctuation in the rate of economic growth. The share of gross fixed capital formation as a percentage of GDP went from 26.97% in 1990 to 24.39% in 1999, The economic growth rate moved from 0.8% in 1990 to 3.2% in 1999, with years of negative growth in 1993 and 1994 at 2.1% and -0.9%, respectively, This is due to the economic crisis experienced by the Algerian economy due

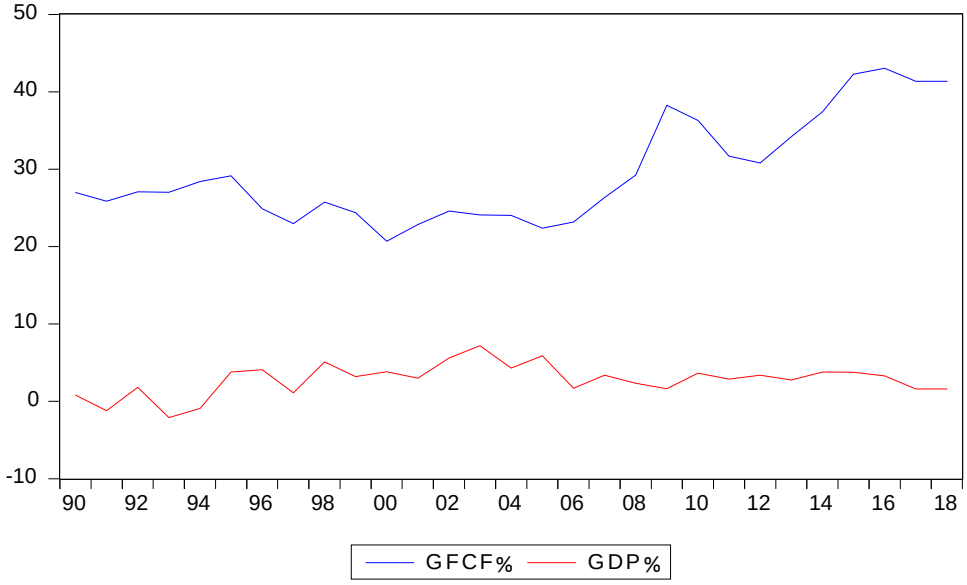
to the decline in oil prices in the international markets and the inability of most public institutions, in addition to privatizations.

The period between 2000 and 2014 was characterized by high oil prices in the international markets with a significant improvement in economic growth rates which were on average more than 3.5% and reached a maximum of 2003 at a growth rate of 7.2%. The period was also characterized by a continuous increase in the share of gross fixed capital formation from 20.67% in 2000 to 37.41% in 2014, due to the embodiment of several investment projects and raising the volume of investment within several development programs.

The period between 2015 and 2018 was characterized by declined Economic growth due to the decline in oil prices and moved from 3.7% in 2015 to 1.6% in 2017. The share of gross fixed capital formation declined in spite of the improvement in 2015 (42%), 2016 (43%), moving from 42.25% in 2015 to 41.3% in 2018.

In general, despite the improvement in the macroeconomic indicators after 2000 due to the improvement and the rise in oil prices, this growth recorded that the economy is fragile and the growth achieved is distorted growth (Bouyacoub, 2012).

Figure number (1): Gross fixed capital formation and Economic growth in Algeria 1990-2018



Source: Prepared by researchers based on EViews 7

3. Methodology

The data were obtained from the World Bank Database (WDI). The data span from 1990 to 2018.

We study the relationship between Gross fixed capital formation and Economic growth in Algeria for the period 1990-2018. The variables are defined as below:

GFCF: Gross fixed capital formation

GDP: Gross domestic product

3.1 Time Series Stability Test (Unit Root Test)

The stability of the time series for the variables of the study was conducted in terms of Gross fixed capital formation (GFCF), Gross domestic product (GDP). It is a problem not to take into account the absence of variation problem and the normal distribution test in a given time series, so another additional test is used to test the unit root, the Philips Perron test, which makes a nonverbal correction of Dickey Fuller's taking into account associated errors, because the Philips Perron test has a better and more accurate testing capacity than the ADF test, especially when the sample size is small. In the case of inconsistent DF test results; this test is performed in four stages (Patterson, 2002, p265). The results are shown in the following table:

Table number (1): Testing the root of the unit by applying the first difference filter

ADF *test*						
Differences			***Levels***			***Variables***
No Intercept and trend	*Intercept and trend*	*Intercept*	*No Intercept and trend*	*Intercept and trend*	*Intercept*	
-4.645902	-4.730211	-4.847326	0.679555	-1.956022	-0.583503	**GDP**
3.366486-	*3.804615-*	*3.908122-*	*1.920540*	*3.921448-*	*0.303414*	**GFCF**
P-P test						
Differences			***Levels***			***Variables***
No Intercept and trend	*Intercept and trend*	*Intercept*	*No Intercept and trend*	*Intercept and trend*	*Intercept*	
-4.645902	-4.729940	-4.847358	0.558980	-2.141546	-0.658301	**GDP**
3.345265-	3.808380-	3.905608-	1.187545	2.094774-	0.023828-	**GFCF**

Source: Prepared by researchers based on EViews 7

By applying the ADF and PP tests, this table indicates that the results of the two tests were consistent and that the time series of the economic variables are unstable at all levels. All estimated values are less than the critical values in their absolute value, which means that they are statistically

insignificant. The null hypothesis that the variables were not kept constant was accepted.

As for the first difference, the variables of the study were stable at a significant level of 5%, and that each of the variables, GFCF, GDP are integrated to the same degree. To confirm this, we test the degree of integration of residues and results in the following table:

Table number (2): Root unit test ADF

	ADF		
ET	intercept	Trend and intercept	none
	-2.383118	-3.647399	-2.431969

Source: Prepared by researchers based on EViews 7

3.2 Granger Causality Tests

table 3 shows that there is a causal relationship in one direction only between Gross fixed capital formation and GDP, i.e., the change in Gross fixed capital formation causes a change in the GDP, while in the other cases we find that the probability corresponding to the Fisher F statistic is greater than 5%, meaning that is no causality between them.

Table number (3): Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
GFCF does not Granger Cause GDP	27	0.47462	0.6283
GDP does not Granger Cause GFCF		**4.84493**	**0.0181**

Source: Prepared by researchers based on EViews 7

3.3 Johansen co-integration test

After the results of the root of the unit showed that all the time series are stable at the first difference, Johansen said that the non-existence of time series at the level does not negate the long-term linear relationship between the variables. Hence the co-integration test can be conducted according to the method used for table 4.

Where the results indicate rejection of the null hypothesis, which means that there is no vector of co-integration, and acceptance of the alternative hypothesis with one common integration vector, which means that the variables should be represented by the error correction model to estimate the short- and long-term effects, it is clear that the calculated value of Eigenvalue Max and Statistic Trace is greater than Critical Value at 5% (Cherakrak, Gaham, & Al-Mihyawi , 2019).

The table shows that the calculated value of the maximum probability (20.68) is greater than the critical value (15.49) of the same test at the probabilistic level (5%), thus rejecting the null hypothesis that there is no vector of co integration.

(20.21) is greater than the critical value of the impact test at a significant level (5%); this means that there is a long-term equilibrium relationship of

co-integration. This accepts the null hypothesis, where the number of vectors for integration is 1 at a significant level (5%), this means the possibility of a long-term balance relationship at least between some variables, despite the existence of imbalance in the short term.

Table number (4): Johansen co-integration test

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.527000	20.68835	15.49471	0.0075
At most 1	0.017422	0.474529	3.841466	0.4909
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.527000	20.21383	14.26460	0.0051
At most 1	0.017422	0.474529	3.841466	0.4909

Source: Prepared by researchers based on EViews 7

It is clear from the table that the optimal delay period according to four standards, SC, FPE, and HQ, AIC is equal to 1. Therefore, the optimal delay period used in VECM is equal to 1.

Table number (5): Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-110.3656	NA	14.12143	8.323380	8.419368	8.351922
1	-59.04053	91.24463*	0.424818*	4.817817*	5.105781*	4.903444*
2	-56.33306	4.412177	0.470694	4.913560	5.393499	5.056271

Source: Prepared by researchers based on EViews 7

To determine the direction of the causal relationship and the analysis of behavior in the short and long term between the variables requires estimation of the model error correction products where we reached the following:

The error correction rate in the Gross fixed capital formation equation was significant and negative (-0.078995), meaning that 7.89% of the long-term imbalance in Gross fixed capital formation is corrected per year. The rate of correcting the error in the GDP equation was significant and negative (-0.499916), meaning that 50% of the long-term imbalance in GDP is corrected in the year.

The parameters of the first differences of the dependent variable of a single period can be illustrated by the following table:

Table number (6):Results of the short - term error correction test

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.078995	0.055015	-1.435874	0.0465
C(2)	0.230169	0.210606	1.092889	0.0274
C(3)	0.045941	0.205641	0.223406	0.0355
C(4)	0.060591	0.084686	0.715478	0.4826
C(5)	0.004489	0.072437	0.061969	0.9512

C(6)	0.160980	0.105511	1.525720	0.0027
R-squared	0.227173	Mean dependent var		0.212692
Adjusted R-squared	0.033966	S.D. dependent var		0.450054
S.E. of regression	0.442344	Akaike info criterion		1.405718
Sum squared resid	3.913372	Schwarz criterion		1.696048
Log likelihood	-12.27434	Hannan-Quinn criter.		1.489323
F-statistic	1.175804	Durbin-Watson stat		2.000161
Prob(F-statistic)	0.355565			

Source: Prepared by researchers based on EViews 7

Also the effect of the gross fixed capital formation on the GDP during the 1-year slowdown is estimated at -0.615001%. This indicates that there is a significant negative effect at a significant 5% gross fixed capital formation on GDP in the short term. The rise in gross fixed capital formation leads to a drop in GDP; this can be explained by weak local production capacity and inefficient device Productive, As well as the weak absorptive capacity of the national economy.

As well the effect of the GDP on the gross fixed capital formation during the 1-year slowdown is estimated at 0.060591%. This indicates that there is a significant positive effect at a significant 5% GDP on gross fixed capital formation in the short term. The rise in GDP leads to a rise in gross fixed capital formation.

3.4 Test Validity of the Model:

- VEC Residual Serial Correlation LM Tests

We note from table 7 that most possibilities are not significant, and therefore accept the hypothesis of nothingness and that there is no subjective correlation between the errors.

Table number (7): Results of Autocorrelation Correlation Test

Lags	LM-Stat	Prob
1	5.555699	0.2349
2	2.922456	0.5709
3	3.837589	0.4284
4	5.700373	0.2227
5	1.575186	0.8132
6	4.540207	0.3378
7	4.812462	0.3071
8	2.003755	0.7351
9	0.781900	0.9409
10	10.97338	0.0269
11	12.96689	0.0114
12	4.774412	0.3112

Source: Prepared by researchers based on EViews 7

- VEC Residual Heteroskedasticity Test

Table number (8): Results of the heterogeneity test

Chi-sq	df	Prob.

75.28506	60	0.0883

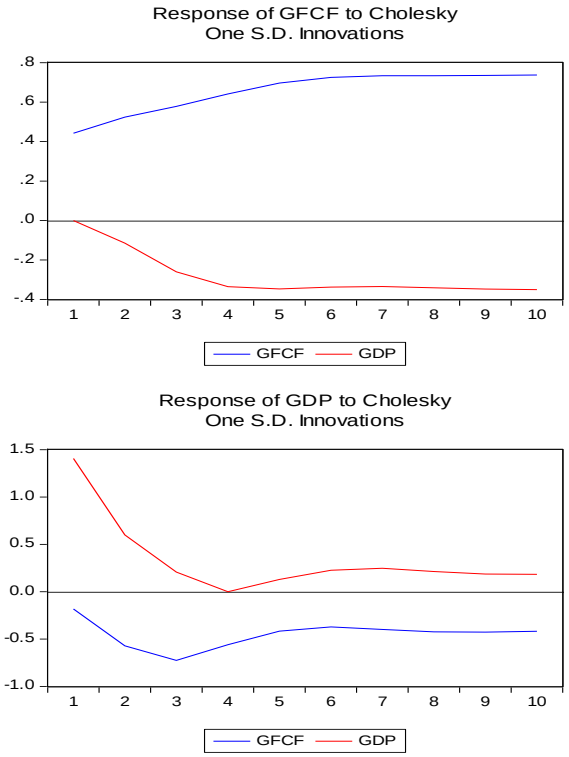
Source: Prepared by researchers based on EViews 7

The table shows that the statistical probability (8.83%) is greater than 5%. We accept the null hypothesis and that the series of residues have a homogeneous variation, so the model does not suffer from the problem of heterogeneity or the problem of self-correlation.

4. Test Results for Pulse Response and Fractionation

The use of pulse response functions allows determining the behavior of dynamic model variables and determining the direction of the relationship. Figure 2 shows the following results:

Figure number (2): Results of the Pulse Response Test



Source: Prepared by researchers based on EViews 7

A positive shock in Gross domestic product of 1% will have a negative impact on the Gross fixed capital formation. A sudden change in Gross domestic product by 1% leads to a response to the Gross fixed capital formation with a decrease of -0.114751% in second year. The negative effect to the year 10 continues with a decrease of -0.350122%, the sudden

change in Gross domestic product by one standard deviation negatively affects the short and long term in the Gross fixed capital formation.

A positive shock in Gross fixed capital formation of 1% will have a negative impact on the Gross domestic product. Any change in Gross fixed capital formation by 1% leads to a decrease in the Gross domestic product directly and by -0.181631% in the first year to reach in the tenth year -0.417219%, and this indicates that any sudden change in Gross fixed capital formation by one standard deviation negatively affects the Gross domestic product in the short and long ranges.

The following table shows the result of the fragmentation of the variance of the Gross fixed capital formation forecast error for 10 forward periods. Each column displays the variable contribution ratio Gross fixed capital formation, and we note that the standard error for the prediction of the price of oil for one year is 0.44% and then increases with time to reach 2.29% in the tenth year.

From the table it is clear that the Gross fixed capital formation shocks contribute to the interpretation of the variance in the line of forecasting the Gross fixed capital formation itself by 100% in the short term and then by 83% in the forecast period for 10 years in the future.

While the contribution of Gross domestic product is nil in first years, but increased during the period to 17 % in the tenth year.

Table number (9): Results of the Test of Fragmentation of Variance for the GFCF

GFCF	S.E.	GFCF	GDP
1	0.442344	100.0000	0.000000
2	0.695306	97.27631	2.723688
3	0.941121	90.88452	9.115480
4	1.187002	86.30616	13.69384
5	1.419185	84.45048	15.54952
6	1.629114	83.91893	16.08107
7	1.817684	83.69398	16.30602
8	1.989640	83.45779	16.54221
9	2.149319	83.21138	16.78862
10	2.299182	83.00969	16.99031

Source: Prepared by researchers based on EViews 7

The following table shows the result of the fragmentation of the variance of the Gross domestic product forecast error for 10 periods forward. Each column presents the variable contribution ratio in the interpretation of the variance of the Gross domestic product forecast line. The standard amount of the forecast error for one year is 1.41% and increases with time to 2.19% in the tenth year.

From the table it is clear that the shocks in the Gross domestic product contribute to the interpretation of variance in the line of forecasting the Gross domestic product itself 98.35% in the short term and then fall to 54.36% in the forecast period of ten years in the future.

While the contribution of Gross fixed capital formation is limit in first years (1.64%), but increased during the period to 45.63 % in the tenth year.

Table number (10): Results of the Test of the Fragmentation of Variance Relative to the GDP

GDP	S.E.	GFCF	GDP
1	1.417903	1.640911	98.35909
2	1.641931	13.30296	86.69704
3	1.806950	27.09989	72.90011
4	1.891610	33.47920	66.52080
5	1.941126	36.37969	63.62031
6	1.989217	38.11415	61.88585
7	2.043807	39.90018	60.09982
8	2.098157	41.94526	58.05474
9	2.149329	43.91985	56.08015
10	2.197139	45.63516	54.36484

Source: Prepared by researchers based on EViews 7

Conclusion:

By studying the relationship between Gross fixed capital formation and Gross domestic product, we conclude:

- There is a long-term relationship between gross fixed capita formation and economic growth.
- There is causal relationship between, gross fixed capital formation and economic growth within the period under study.
- A positive shock in Gross fixed capital formation of 1% will have a negative impact on the Gross domestic product.
- A positive shock in Gross domestic product of 1% will have a negative impact on the Gross fixed capital formation

Based on our findings, we can make a number of suggestions as follows:

- We suggest that focusing on investment in Gross fixed capital formation.
- Moreover, Reliance on foreign direct investment to support economic growth.

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