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Public Investment and Economic Growth in Morocco: An Econometric Analysis Using the ARDL Model

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Abstract

The following research aims to contribute to the empirical literature on the efficiency of public investment in Morocco. We use the Auto Regressive Distributed Lag (ARDL) model to jointly capture the long-run relationship and the short-run dynamics between public investment and economic growth. Other variables such as the capital stock and the size of the employed labor force are also included in the model. The results indicate the absence of any correlation between public investment and economic growth in the short term. However, the impact of public investment on economic growth becomes negative in the long term.

Keywords: ARDL, cointegration public, economic growth, investment, Morocco

1. Introduction

The relationship between public investment and economic growth has been analyzed theoretically since the 1980s, and since then, many studies have attempted to address this relationship with heterogeneous results and methods depending on the period as well as the country in which this analysis was performed. In general, these studies have met very complicated technical constraints related to the difficulty of measuring public capital. These constraints manifest in the following question: why was the aggregate approach the most widely used in these models?

Historically, public investment was regarded as an essential tool for stimulating economic growth in the post-war years of the 1920s and 1940s. While the early 1980s has known a very difficult macro-economic context in many countries, making recourse to public finance negligible, the importance of public capital has grown even more in recent years, with several global economic bodies such as the IMF and OECD starting to recommend that the countries around the world should increase their public investment expenses in times of crisis to stimulate growth Developing countries rely heavily on public capital to stimulate economic growth and achieve development, which explains the predominance of public investment in overall investment in these countries, but the nature of the public and the lack of governance in these countries have limited their impact on economic growth.

Since independence, public investment in Morocco has gone through several phases with different trends. But in our study, we will focus more on the period 1980-2020.

In recent years, public investment efforts have accelerated sharply. A this level, the amount of our size has risen from 167.30 MM dhs in 2011 to 245 MM DH in 2022. This upward trend is the result of proactive action by the executive branch, eager to put into practice the Royal High Lines and the coherent, sector-based strategies and infrastructure projects.

In addition, the role of public investment in economic growth was analyzed by a number of theorists. Indeed, Keynes attributed to the public authority an indispensable role in the economic sphere through public investment. Thus, public action must intervene in economic to intervene in the economy by making additional expenditures when activity declines, as well as private spending. These additional costs will revive demand, which in turn will influence production and, consequently, employment. The emergence of new theories to explain growth during the thirty glorious years brought a new vision to the problem in question.

The neoclassicals show that growth is achieved through technical progress, considering it as an exogenous element. The founders of endogenous growth theory, on the other hand, saw technical progress as an endogenous

element, and even as a generator of positive externalities.

This article contributes to the debate on the relationship between public investment and economic growth. The question that emerges from this research is what is the effect of public investment on economic growth in Morocco?

To answer this question, we will use an econometric study based on the Auto Regressive Distributed Lag (ARDL) model.

The rest of the article is structures as follows:

Section 1 reviews the theoretical and empirical literature on the link between public investment and economic growth. Section 2 then describes the methodology used and presents the data used. Section 3 is devoted to estimating the model and presenting the results. And finally, we close with section 4, which looks at interpretations and discussions of the said results, as well as a general conclusion.

2. Literature Review

The literature review describes the theoretical and empirical debates on the impact of public investment on economic growth. Firstly, we outline the theoretical advances on the nature of the link between these two macroeconomic aggregates, and secondly, we present the empirical results.

2.1 Theoretical Literature

The debate on the impact of public investment on economic growth has been remarkably adressed among different economic currents.

According to the classics, public intervention is harmful to the economy, with the exception of its regalian role. To this end, Smith (1776) identified the fundamental duties of the state, which must also adapt to economic conditions, rather than being active.

For liberals, public investment can have a crowding-out effect on private investment, which can lead to economic growth. This depends on the availability of funds to undertake the investments and the sectors to which the funds are devoted.

In Keynes's general theory, the emphasis is on the role the state budget can play in achieving economic equilibrium. Keynes (1936) contradicted the neoclassicists, who favored automatic self-regulation. He argued that state intervention to stimulate demand could boost GDP growth.

Unlike the Keynesian approach, the "public choice" school starts from a microeconomic logic to justify state intervention. This makes it difficult to agree on the financing of goods that provide a usefulness that is difficult to quantify for both sides. Musgrave (1959) asserts that state investment in infrastructure is growing at a faster rate than per capita income. For him, merit goods contribute to rational state action for the betterment of society. Since the market cannot efficiently provide collective goods characterized as non-excludable and non-rivalrous, state intervention becomes necessary.

Moreover, public power must construct a genuine collective utility function integrating everyone's preferences. Endogenous growth theorists see public expenses as playing a productive role.According to Romer (1986), public investment in infrastructure increases the productivity of the private sector. Thus, a positive externality produced by the existence of state-provided infrastructure. Barro (1991) and Aschauer (1989) consider that public expenses can enter either the production function of entrepreneurs, or consumers' utility function.

In addition, Barro's model, completed by Sala-I-Martin (1992), specifies that public investment contributes to private productivity.

2.2 Empirical Literature

Empirical studies on the relationship between public investment and economic growth are extensive. Some of this work has endorsed the positive relationship between these two macroeconomic aggregates. Others, however, contradict the above result.

In the case of Morocco, there is a research that has studied the relationship between public investment and economic growth. We quote Tahtah (2013), who tried to study the causal links between public expenses and economic growth for the period 1970-2008, by measuring the 'spillover' effects on the private sector, the model being in the form of an error correction (MCE). The results of his work led to the conclusion that public investment spending, especially in human capital formation and in the transport and communications sector, has no impact on growth through the promotion of the private sector. Moreover, the effects of public consumption spending on growth have proved negative in the long term, and the author recommended its reduction.

Obad and Jamal (2016), in turn, studied in aggregate the impact of public expenses on economic growth for the period 1980-2014, using the ARDL method to capture both short- and long-term effects. The estimation results showed that the unproductive nature of debt-financed public expenses is detrimental to economic growth in Morocco, and that the decline in investment spending during the period of SAP implementation was not conducive to economic growth.

Azeroual and Oumansour (2019) studied the impact of public investment spending on economic growth empirically in the short and long term over the period 1990-2015 using a model (ARDL), the results showed that the spillover effect on the private sector is significant in the short term but starts to weaken in the long term, due to public investment inefficiency and poor mobilization. They pointed to the importance of human capital in this respect.

Iaich and Bouraouane (2020) attempted to measure the impact of public investment on economic growth for the period 1991-2017 using an ARDL model, the econometric results showed that in the short term the effect of public investment varies between positive and negative and is marked by weakness, while in the long term the effect is not significant.

Other empirical research conducted out outside Morocco was examined in this regard.

Aschauer (1989) empirically studied the relationship between productivity and public expenses in a disaggregated way. He found that military spending has a negative impact on overall productivity,

while non-military spending has a significant impact. This empirical study covered the period from 1949 to 1985, using annual time-series data and a linearized Cobb-Douglas equation, estimated by the OLS method.

BARRO (1990) completed empirically the theoretical arguments he concluded in the articles (Barro, 1989, 1990). The results he obtained partially confirmed his theoretical arguments, he found a negative regression between public expenditure and the growth rate, on the other hand the results showed a positive relationship between public investment expenditure and growth but not significantly different from 0. As a result, he concluded that this spending plays no role in growth, paradoxically to what he had already theoretically asserted.

J. N. Ntita, J. D. Ntita, and F. K. Ntita (2017) have attempted to analyze the impact of public investment on growth in the Congo over the period 1981-2015, using the Hanson method, the empirical results of the work have shown that the optimal threshold for public investment is of 22%, above which public investment must be mobilized to have a positive and significant impact on economic growth in the Pays du Congo.

Devarajan, Swaroop, and Zouheng-Fu (1996) using data from 43 developing countries over a 20-year period 1970-1990, have shown that an increase in the share of public expenses has positive and statistically significant effects on growth. On the other hand, they found that public over-investment could have a negative and significant effect on the rate of growth in developing countries, making it imperative for governments in these countries to re-transfer public resources from marginal investment goods to current consumption.

Nubukpo (2007) evaluates the impact of public expenses on growth in the UEMOA economies from 1965 to 2000 (Note 2). Using an error-correction model, he shows that public expenses has no significant impact on economic growth in most majority of the Union's economies. In the long term, the impact of public expenses is differentiated by country. On the basis of these results, he put forward the hypothesis that there was a non-linear relationship between the size of government (public expenses as a percentage of GDP) and economic growth.

Afonso and Furceri (2010) explain that social contributions and operating expenses have a negative effect on growth for European countries, whereas public investment volume of public investment expenditure has a positive effect on growth. But the more volatile their level, the lower the level of growth. They also show that a one-percentage-point increase in public expenses in terms of GDP would reduce growth by 0.13 percentage points.

Fouopi, Nsi, Mbomon, and Epo (2014), sought to assess the influence of public expenses on economic growth CEMAC countries from 2000 to 2011 (Note 3). They analyzed this non-linear relationship using a smooth transition model, the PSTR (Panel Smooth Threshold Regression) method.

The results have shown that the positive effect of public expenses on growth is only apparent when the ratio of public expenses on education and health reaches the thresholds of 8.70% and 10.80% respectively. As for public consumption expenditure, public investment expenditure and military expenditure, they positively affect the sensitivity of economic growth to public expenses, up to a threshold of 33% for public consumption spending a threshold of 48.5% for capital expenditure and 7.2% for military spending.

Zakane (2009) investigates the effect of public infrastructure spending on economic growth in Algeria for the

period 1975-2005. Using a VAR model, the research results show that public investment spending has a positive but weak effect on economic growth in Algeria. The VAR modeling applied in this work also shows the existence of a two-way causal relationship between public investment spending and economic growth in Algeria.

Nazmi and Ramirez (1997) have analyzed the impact of public and private capital expenditure on economic growth. They concluded that public investment spending had a positive and significant effect on output growth. At the same time, the impact of public investment on economic growth was statistically identical to the impact of private capital expenditure. The contribution of public investment to increased production had, however, a significant crowding-out effect on private investment spending.

3. Methodology

3.1 Model Specification

Our econometric estimation of the impact of public investment on economic growth is based on Barro's (1990) model and the basic equation used in Kako Nubukpo's (2007) work.

The general form of the equation for the model to be estimated is:

$$Y = f(C, P, E) \tag{1}$$

With:

Y: Gross Domestic Product (GDP)

C: represents conventional variables, in particular Capital.

P: includes variables linked to public activity, in particular Public expenses.

E: contains all variables related to the rest of the world, in particular the term-of-trade index.

The present study for Morocco introduces the following variables:

GDP: Moroccan Real GDP

SK: Capital Stock

EMP: Number of People in Work

IVP: Public Investment

The Cobb-Douglas equation is therefore:

$$GDP = A\, SK^{\alpha} EMP^{\beta}\, IVP^{\gamma} \tag{2}$$

By introducing the log, the equation to be estimated will be as follows:

$$log(GDP) = \beta 0 + \beta 1\ log\ (SK) + \beta 2\ log\ (EMP) + \beta 3\ log\ (IVP) + \varepsilon \tag{3}$$

ε: represents the error term

With the expected signs of the coefficients $\beta 1 > 0$, $\beta 2 > 0$, $\beta 3 > 0$

3.2 Data Source

The data used in this econometric study come from the database of the World Bank, the High Commission for Planning (HCP) and the public finance dashboards of the Ministry of Economy and Finance. They have an annual dimension and cover the period 1980-2020.

4. Results

We begin by analyzing the stationarity of the series in question. The results of the stationarity tests enable us to specify the most reliable model for estimating the effect of the explanatory variables on the dependent variable.

4.1 Results of Stationarity Tests

To study the stationarity of the time series used in this section of the econometric section, we first use the Augmented Dickey Fuller (ADF) test. We then validate its results using the non-parametric KPSS test. The results are summarized in the table below.

Table 1. Variable stationarity tests

Variable	Test ADF Level	Test ADF First Difference	Test ADF Second Difference	Order of Integration
Log_GDP	-0.689 219 **	-8.955 753 **	-8.624 976**	I (1)
	0.8377	0.0000	0.0000	
Log_SK	0.298 749 **	-2.159 180**	-5.352 676 **	I (2)
	0.9753	0.2238	0.0001	
Log_EMP	-5.814 289 **	-4.156 100 ***	-5.549 907 **	I (0)
	0.0000	0.0115	0.0000	
Log_IVP	-0.103 297 **	-5.678 744**	-7.858 564 **	I (1)
	0.9421	0.0000	0.0000	

*** indicates that the model is with trend and constant; ** indicates model with constant only (Note1);

Source: authors from tests on Eviews 10 software

It seems that the Log_EMP series is stationary in level. In contrast, the Log_GDP and Log_IVP series became stationary after the first difference, while the Log_SK series became stationary only after the second difference.

We then analyze the degree of integration of the Log_SK variable using the non-parametric KPSS test, and the results are as follows:

Table 2. KPSS test results for the Log_SK variable

Variable	Test KPSS Level	Test KPSS First Difference
Log_SK	0.792 304 > 0.463 000	0.204 827 < 0.463 000

Source: authors based on tests with Eviews 10 software.

For the Log_SK series, the KPSS test gives a different result from that of the ADF. However, since we trust non-parametric tests, we'll consider the Log_SK series to be an I (1) series.

The results of stationarity tests show that there are series of order I (0) and others of order I (1). For this reason, we adopt the AutoRegressive Distributed Lag (ARDL) model.

Our model formula takes the following form:

$$\Delta Y_t = \lambda 0 + \lambda 1\, Y_{t-1} + \lambda 2 X_{t-1} + \sum_{i=1}^{p} \alpha i\, \Delta Y_{t-i} + \sum_{j=0}^{q} \beta j\, \Delta X_{t-j} + \varepsilon t \quad (4)$$

With:

Yt: the variable to be explained;

Xt: the vector of explanatory variables;

Δ: the first difference;

λ0: the constant;

λ1 and λ2: the long-term effects;

αi and βj: the short-term effects;

εt: the error term.

By introducing the variables of our model, the previous equation will be reformulated as follows:

$$\Delta \log(GDP_t) = \lambda_0 + \lambda_1 \log(GDP_{t-1}) + \lambda_2 \log(SK_{t-1}) + \lambda_3 \log(EMP_{t-1}) + \lambda_4 \log(IVP_{t-1}) + \sum_{i=1}^{p} \alpha_i\, \Delta \log(GDP_{t-i}) + \sum \beta_{1j}\, \Delta \log(SK_{t-j}) + \sum \beta_{2j}\, \Delta \log(EMP_{t-j}) + \sum \beta_{3j} \Delta \log(IVP_{t-j}) + \varepsilon t \quad (5)$$

4.2 Estimation of the ARDL Model

The optimal ARDL model selected on the basis of the Akaike information criterion (AIC) is ARDL (2, 0, 1, 0). This result is given by the Eviews software after automatic estimation of the various possible models by setting the maximum delay (500 models).

In addition, the coefficient of determination R2 associated with the model is 0.995340, meaning that the variance of the GDP growth rate is 99.53% explained by the exogenous variables.

The complete results of this estimation are summarized in the following two tables:

Table 3. ARDL model estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob
LOG_GDP (-1)	0.248 682	0.161 360	1.541 161	0.1331
LOG_GDP (-2)	0.274 263	0.155 107	1.768 220	0.0866
LOG_SK	0.426 532	0.129 140	3.302 870	0.0024
LOG_EMP	1.652 657	0.675 872	2.445 221	0.0202
LOG_EMP (-1)	-1.664 568	0.666 584	-2.497 163	0.0179
LOG_IVP	-0.012 189	0.037 143	-0.328 155	0.7449
C	7.130 178	2.487 855	2.865 994	0.0073

Source: authors, based on estimates using Eviews 10 software.

Table 4. ARDL model estimation

Variable	Coefficient
R-Squared	0.995 340
Adjusted R-Squared	0.994 467
F-statistic	1139.246
Prob (F-statistic)	0.000 000
Durbin-Watson stat	1.820 491
Log likelihood	-3.523 657
Akaike info Criterion	-3.630 788
Schwarz Criterion	-3.332 200

Source: authors, based on estimates using Eviews 10 software.

4.3 Cointegration Test

We now apply the cointegration test developed by Pesaran et al. (2001), to determine the existence (or not) of a long-term relationship between the variables. The results of the cointegration test are reported in the following table:

Table 5. Cointegration Bounds test

F-statistic	K	Signif.	Lower Bound	F-statistic
7.005 933	3	10%	2.37	3.2
		5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

Source: Authors based on Eviews 10 software test.

The F-stat calculated for the null hypothesis that there is no long-term relationship between the variables is 7.005933, which is above the upper bound of the Bound of the interval for the different significance levels. This implies rejection of the null hypothesis that there is no long-term relationship between the variables, we therefore conclude that there is evidence of cointegration between the variables in our model.

As a result, we can estimate the short-term and long-term relationship.

4.4 Short-Term Relationship

The results of the short-term dynamics are summarized in the following table:

Table 6. Estimated short-term relationship

Variable	Coefficient	Std. Error	t-Statistic	Prob
D (LOG_GDP (-1))	-0.274 263	0.111 477	-2.460 271	0.0195
D(LOG_EMP)	1.652 657	0.363 361	4.548 247	0.0866
CointEq (-1)	-0.477 055	0.075 993	-6.277 609	0.0000

Source: authors, based on estimates using Eviews 10 software.

The results of the estimation of the short-term relationship show that the error correction coefficient is negative (-0.47) and significant (P=0.0001). This indicates the convergence of the series trajectories towards long-term equilibrium. Thus, a shock to economic growth in Morocco is corrected at 47.7% per year.

In the short term, the values of one year's GDP growth rate have a significant negative impact on the following year's economic growth. A 1% increase in GDP results in a 0.27% reduction in next year's GDP.

In the case of the employed labour force, its short-term effect on GDP for the same year is positive and significant. A 1% increase in the labor input leads to a 1.65% increase in GDP for the same year. Furthermore, the capital stock and public investment have no short-term effect on GDP.

4.5 Long-Term Relationship

The results of the long-term dynamics are presented in the following table:

Table 7. Estimated long-term relationship

Variable	Coefficient	Std. Error	t-Statistic	Prob
LOG_SK	0.894 094	0.129 508	6.903 758	0.0000
LOG_EMP	-0.024 967	0.250 296	-0.099 751	0.9212
LOG_IVP	-0.025 550	0.078 407	-0.325 860	0.7467
C	14.946 23	2.958 408	5.052 120	0.0000

Source: authors, based on estimates using Eviews 10 software.

Estimation of the long-run relationship, presented in Table 6, shows that the coefficients for public investment and the employed labour force are negative but not significant. On the other hand, the coefficient for the capital stock is positive and significant.

The long-run relationship is given by the equation below:

$$log(GDP) = 0.8941 * log(SK) - 0.0250 * log(EMP) - 0.0255 * log(IVP) + 14.9462 \quad (6)$$

It is clear that the working population has a negative long-term impact on GDP.

An increase in the employed population of 1% leads to a small decrease in GDP by 0.0249%. What's more, public investment has a negative but small effect on GDP over the long term. A 1% increase in public investment leads to a 0.0255% decrease in GDP.

4.6 Model Robustness Tests

Diagnostic tests were carried out to assess the robustness of the chosen model. These include tests for error normality, residual homoscedasticity and residual autocorrelation. In addition, specification and coefficient stability tests will be carried out.

4.6.1 Normality Test

Table 8. Normality test

Hypothesis verified	Applied test	Statistic	Probability
Normality	Jarque-Bera	2.163 268	0.339 041

Source: authors from tests on Eviews 10 software.

According to the Jarque Bera test, the null hypothesis of residual normality is accepted at the 5% threshold, since the probability of the test statistic is greater than 5%.

4.6.2 Heteroskedasticity Test

Table 9. Homoskedasticity test

Hypothesis verified	Applied test	F-Statistic	Probability
Heteroskedasticity	ARCH	1.725 225	0.1973

Source: authors from tests on Eviews 10 software.

The ARCH heteroskedasticity test indicates that the model is homoscedastic, as the probability of the calculated statistic is greater than 5%.

4.6.3 Error Autocorrelation Test

Table 10. Error autocorrelation test

Hypothesis verified	Applied test	F-Statistic	probability
Autocorrelation of errors	Breusch-Godfrey	0.510 992	0.6050

Source: authors based on tests with Eviews 10 software.

According to the results of the Breush-Godfrey Lagrange multiplier test for autocorrelation of variances, the residuals are not autocorrelated at the 5% threshold, since the critical probability (0.60) is greater than 5%.

4.6.4 Specification Test

Table 11. Specification test

Hypothesis verified	Applied test	t-Statistic	Probability
Specification	Ramsey RESET	0.472 136	0.6401

Source: authors based on tests with Eviews 10 software.

The Ramsey (RESET) functional form test tells us that the critical probability is equal to 0.6401, which is greater than 5%. The model is therefore well structured.

Validation of our estimated model and of the results obtained from the short- and long-term relationship requires verification of a set of hypotheses, namely error correlation, heteroscedasticity, normality, specification and coefficient stability. Indeed, the four tests presented in the table below show that the probability of the statistic for each test is greater than 5%. This means that the H0 hypothesis is accepted in all these tests. The errors are therefore not self-correlated, are homoscedastic, their distribution follows a normal distribution and our model is well specified. In addition, the stability of the coefficients of our ARDL model (2, 0, 1, 0) is validated through the CUSUM and CUSUMSQ tests, as the curve does not leave the corridor in these two tests (Figures 1 and 2). Finally, based on the results of the five tests performed, we can confirm the robustness of our estimated ARDL (2, 0, 1, 0) model.

4.6.5 Model Stability

In order to study the stability of the model's coefficients, we also studied the Cusum and Cusum square tests represented respectively by the Figures below:

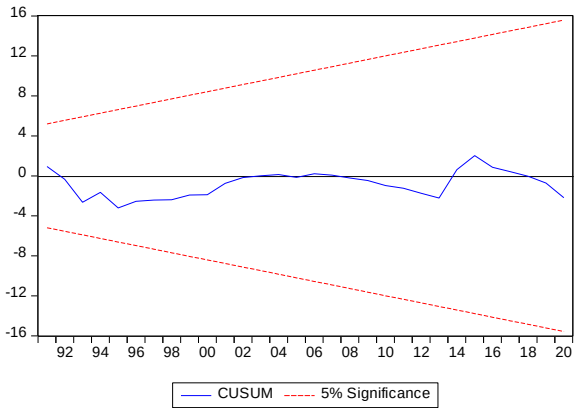

Figure 1. Cusum tests

Source: authors based on tests with Eviews 10 software.

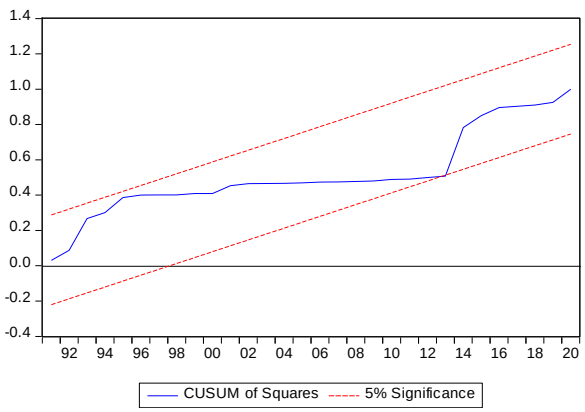

Figure 2. Cusum square tests

Source: authors based on tests with Eviews 10 software.

Both Figures remain within the corridor. This attests to the stability of the regression coefficients.

5. Discussion

The main question in this article is to know whether the hypothesis of the positive impact of economic growth is experimentally verified in the case of Morocco.

Using appropriate estimation techniques, this study highlights some important results.

The short-term estimate indicates that there is a significantly negative impact of the one-year lagged variation in GDP on Moroccan economic growth. Quantitatively, we note that a relative increase of one percent in a given year leads to a small decline in economic growth of 0.27% in the following year.

We also found that the variable representing economic growth has a positive and significant response to an increase in the labor factor. Indeed, any 1% increase in the employed working population translates into a 1.65% increase in GDP.

Furthermore, our results show that the capital stock and public investment have no effect on economic growth.

On the other hand, the estimation of the long-term relationship highlights that public investment has a negative impact on economic growth. But this effect is not significant. This result is consistent with the research work of Jaouad OBAD, Youssef JAMAL, Mohamed Azeroual and Nor-Eddine Oumansour. The negative effect of public investment on economic growth is an empirical test of neoclassical growth theory. Similarly, the labor factor has a negative effect on economic growth. This long-term result is the opposite of the short-term one. So an increase in the employed labour force is not always a growth factor.

On the other hand, accumulated capital has a positive and significant effect on growth.

6. Conclusion

The aim of this study is to shed light the nature of public investment effect on economic growth in Morocco. We propose a dynamic regression approach, taking into account the problem of variable stationarity, and consequently incorporating an Auto Regressive Distributed Lag (ARDL) model. It should be noted that increasing the level of public investment has no effect on economic growth in the short term, but this impact becomes negative in the long term. In addition, cumulative capital has a positive impact on economic growth. In the light of these results, we believe that the State should continue to promote public investment.Public authorities will have to take economic criteria into account when selecting sectors, and address the issue of governance when executing public investment.

We could always assume that investment in education and health would probably play a role in channelling the effectiveness of public investment through human capital.

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Notes

Note 1. The coefficient is significant at 5% probability level.

Note 2. UEMOA: Ivory Coast, Benign, Burkina Faso, Guina Bissau, Mali, Niger, Senegal and Togo.

Note 3. CEMAC: The Central African Republic, Cameroon, Republic of Congo, Gabon, Equatorial Guinea, Chad.