

Threshold Effect of Public Investment on Economic Growth in The Democratic Republic of Congo: Regime Change Approach.



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ABSTRACT: This study analyzes the threshold effect of public investment on economic growth in the Democratic Republic of Congo (DRC), over the period from 1985 to 2022. Based on the threshold regression model of Hansen (1999, 2000) and the work of Barro (1990) and Aschauer (1989), it aims to identify a critical level of public investment beyond which its impact on economic growth changes in nature. The results show that when the public investment ratio is below 2.12%, it has a negative effect on growth, unlike private investment, which remains favorable. For a ratio between 2.12 and 4.1, both public and private investment stimulate growth. Above 4.1%, public investment continues to have a positive effect, while private investment loses statistical significance. The study highlights the importance of strategic management of public resources, in line with Barro's (1991) recommendations, to maximize the impact of investments on growth. Poor allocation of public funds can significantly reduce their economic return. Thus, strengthening the institutional framework and governance appears essential to improve the effectiveness of public investments and promote sustained and inclusive longterm growth in the DRC.

KEYWORDS: Public investment, economic growth, Threshold Regression Models

I. INTRODUCTION

Public investment has long been considered a fundamental driver of economic growth, particularly in developing countries where physical and social infrastructure remains insufficient to support sustainable growth. By playing a critical role in capital formation, public investment facilitates the production of goods and services, thereby contributing to economic expansion. However, the optimal size of public investment is a question that arises, as too low a level can limit its impact on growth, while excessive and misallocated investment can generate economic inefficiencies and unsustainable debt, necessitating a rigorous assessment of the optimal threshold beyond which public investment becomes counterproductive.

Since the time of Adam Smith, the role of public policies in economic growth has been analyzed through various lenses, ranging from Keynesian approaches to the structuralist perspectives that shaped economic policies in the 1950s and 1960s. However, the economic crises of the 1970s and 1980s, coupled with the Washington Consensus, led to a reduction in state intervention, limiting its role to the provision of essential public goods in the infrastructure, education, and health sectors. With the emergence of endogenous growth theories, public investment has gained renewed interest. These theories posit that public spending, particularly in strategic areas such as infrastructure and human capital, generates multiplier effects that boost both productivity and economic growth. The relevance of public investment has recently been revived by economic contexts characterized by historically low interest rates, an increased need for productivity gains and moderate economic growth, but the question of the optimal investment threshold remains essential to maximize these multiplier effects while minimizing the risks of crowding out private investment and budgetary inefficiency.

Empirical studies show that investments in basic infrastructure (roads, energy, education, and health) improve productivity and the business climate. However, inefficiencies in resource allocation and governance problems, such as corruption and mismanagement, often limit their impact, particularly in developing countries (Aschauer, 1989; Barro, 1990). Bom and Lightart (2015), using a meta-regression analysis, demonstrate that the elasticity of output with respect to public investment averages between 0.08 and 0.17, depending on whether overall public capital or infrastructure is considered. Quantitative studies estimate values between 0.05 and 0.101. Although these figures may seem modest, they have significant long-term effects. Other research, such as that of Calderón and Servén (2010), highlights the importance of investment quality rather than mere volume, noting that poorly planned

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infrastructure projects can even hinder economic growth. Thus, determining an optimal level of public investment becomes a necessity to avoid wasting resources while ensuring maximum returns on economic growth.

However, some authors have also highlighted negative effects. Crowding-out theories argue that public investment can compete with private investment, particularly in the context of budget constraints and debt-financed spending, thus limiting the overall effectiveness of economic policies. Furthermore, studies show that poor governance, corruption, and institutional inefficiency significantly reduce the impact of public investment, particularly in developing economies such as the Democratic Republic of Congo (DRC). In this context, determining the optimal threshold for public investment is essential to maximize its benefits while minimizing negative effects on the economy.

In the Democratic Republic of Congo, public investment has fluctuated significantly in recent decades, driven by political crises, armed conflicts, and inefficient resource management. Between 1985 and 2022, the DRC experienced a period of economic recession characterized by negative growth rates, hyperinflation exceeding 2,000%, and inefficient resource management. Following the end of conflict and the implementation of economic reforms in 2002, a moderate recovery led to GDP growth of 6.74% in 2004, although this growth remained fragile and heavily dependent on extractive industries. Public investment fluctuated significantly, falling from 9.2% of GDP in 1985 to only 1.8% in 2000, before increasing slightly to 2.13% in 2022, which remains insufficient to address the infrastructure gap. Despite an increase in capital expenditures, these remain low compared to recurrent expenditures, limiting their impact on growth. In 2022, economic growth reached 8.9%, driven by the extractive sector, but poor governance, low prioritization of productive investments, and dependence on external financing continue to hamper sustainable development. In this context, it is becoming crucial to determine the optimal level of public investment for the DRC in order to maximize its impact on growth and ensure sustainable development without compromising fiscal balance.

These observations raise important questions: Do public investments in the DRC contribute effectively to economic growth, and what is their optimal level? To answer this question, we hypothesize that public investment has a positive and significant effect on economic growth in both the short and long term, but that this effect depends on a critical threshold beyond which its effectiveness decreases.

The methodological approach of this study begins with a review of the existing literature on the subject, identifying the different theories and established empirical results. Empirically, the study uses the threshold regression approach to estimate the threshold effect of public investment, thus making it possible to identify the level of investment beyond which its impact on growth becomes marginal or negative, thus providing more precise policy recommendations for the management of public investments in the DRC.

II. EMPIRICAL REVIEW

The question of the optimal size of public investment and its impact on economic growth has been the subject of numerous empirical studies, each adopting different methodologies to assess the relationship between these two variables. Barro (1990) was one of the first to formalize this relationship in an endogenous growth model, suggesting that there is an optimal level of public investment beyond which its effect becomes negative due to an excessive increase in compulsory levies and inefficiency in the allocation of public resources. This model has served as a framework for many subsequent studies exploring the non-linear nature of this relationship.

Aschauer (1989) analyzed the effect of public investment on productivity in the United States using a time series approach, highlighting a significant elasticity between public investment in infrastructure and economic growth. His results influenced several subsequent studies that sought to identify the optimal level of this investment. Démurger (2001) applied an econometric approach to Chinese provinces to examine how public investment influences regional growth, emphasizing that the positive effect is conditioned by good governance and efficient resource allocation.

Tanzi and Davoodi (1997) explored the effect of corruption on the efficiency of public investment in developing countries, demonstrating that high levels of public spending do not necessarily guarantee high growth due to institutional distortions and poor management of public funds. Devarajan, Swaroop, and Zou (1996) used panel data to analyze the composition of public spending in developing countries, showing that excess public investment in certain sectors could have a negative effect on growth when marginal efficiency decreases.

Easterly and Rebelo (1993) studied the relationship between fiscal policies and economic growth using a large sample of countries, finding that public investment in infrastructure had a significant positive impact on growth, but that this relationship was non-linear and dependent on the level of institutional development of the countries studied. Bose, Haque, and Osborn (2007) applied a dynamic panel model to analyze the relationship between public spending and growth in 30 developing countries, confirming that optimal public investment should not exceed a certain threshold beyond which its effect becomes negative.

Calderón and Servén (2010) used a panel data approach to examine the impact of public infrastructure on growth in Latin America and demonstrated that the quality of public investment is as important as its volume, confirming that poor governance can reduce

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investment efficiency. Pritchett (2000) developed an analysis on the efficiency of public investment, highlighting a phenomenon of "phantom capital" in developing countries, where a large part of public investment does not translate into productive gains.

Bom and Ligthart (2014) conducted a meta-analysis of empirical studies on public investment and growth, finding that the average elasticity of output with respect to public investment was between 0.08 and 0.17, but with variations depending on the level of development of countries. Égert, Kozluk, and Sutherland (2009) analyzed the long-run effects of public investment on productivity using an econometric model based on OECD countries, highlighting that growth gains depended heavily on institutional efficiency and the regulatory framework in place.

Kneller, Bleaney, and Gemmell (1999) assessed the effect of fiscal policies on growth using a panel model, demonstrating that productive public spending had a significant positive effect, while unproductive spending could hinder growth. Dabla-Norris et al. (2012) demonstrated, through a panel analysis, that the impact of public investment on growth is conditioned by the institutional capacity of countries to effectively manage infrastructure projects.

Mourougane and Roma (2013) examined the relationship between public investment and growth in the euro area using a panel regression model, finding that a level of public investment between 3% and 5% of GDP was optimal for maximizing growth without generating excessive fiscal distortions. Ghazanchyan and Stotsky (2013) studied the effects of the composition of public spending on growth in low-income countries and found that the positive effects of public investment were stronger when spending was well targeted and executed with greater transparency.

Ilzetzki, Mendoza, and Végh (2013) examined the fiscal multipliers of public investment and found that the effectiveness of these investments depended on the level of development of public institutions and the ability of governments to avoid fiscal waste. Gupta et al. (2005) explored the relationship between public investment, growth, and governance, highlighting the central role of transparency and anti-corruption in enhancing the positive effects of public investment on growth.

Kraay and Servén (2013) studied the relationship between public investment, public debt, and growth, finding that the beneficial effects of public investment were reduced when financed by excessive debt. Fournier (2016) used a semi-structural growth model to analyze optimal public investment and estimated that an increase in investment of 1% of GDP could increase growth by 0.4% in the long run, provided it was well managed.

Ghosh and Gregoriou (2008) used an ARDL model to examine the short- and long-term effects of public investment on economic growth in emerging countries, highlighting the need for a balance between public investment and fiscal discipline. Blanchard and Leigh (2013), in a study on the effects of fiscal policies, showed that public investment was particularly effective during recessions, with a fiscal multiplier greater than one.

Cavalcanti et al. (2018) examined the relationship between public investment and productivity in Latin America and concluded that returns on public investment were higher when these expenditures were accompanied by institutional reforms that improved project efficiency. Finally, Hulten (1996) highlighted the critical role of public infrastructure maintenance, showing that poorly maintained public investment could see its economic impact drastically diminish in the long term.

These various studies highlight the existence of an optimal threshold for public investment, beyond which marginal efficiency decreases due to institutional, budgetary, or economic constraints. Identifying this threshold is a fundamental challenge for decision-makers in order to maximize the benefits of public investment without suffering negative effects on debt and private sector competitiveness.

III. ESTIMATE OF THE THRESHOLD EFFECT OF PUBLIC INVESTMENT ON ECONOMIC GROWTH IN THE DRC

The effectiveness of public investment in promoting economic growth is not uniform and can vary depending on various factors, including the level of investment itself. It is in this perspective that the question of the threshold effects of public investment on economic growth in the DRC arises.

This section aims to analyze the existence and nature of these threshold effects in the DRC. By examining empirical data and specific case studies, the study seeks to identify the critical levels of public investment that are necessary to generate sustained economic growth. Furthermore, we will explore the conditions under which these threshold effects manifest themselves, as well as the policy implications for maximizing the effectiveness of public spending in a country with immense development needs.

1. Model Specification

From a theoretical perspective, the relationship between public investment and economic growth is not necessarily linear. It is subject to crowding-out effects and diminishing returns, suggesting the existence of a threshold beyond which the effectiveness of public investment diminishes. According to Barro's (1990) endogenous growth model, an optimal level of public investment promotes capital accumulation and improves factor productivity. However, when this investment exceeds a certain threshold, it can generate inefficiencies, lead to misallocation of resources, and ultimately limit economic growth. This phenomenon has been highlighted by Tanzi and Davoodi (1997), who show that excessive public investment, particularly in the presence of weak governance, can lead to unsustainable debt and crowd out private investment. To empirically model this threshold effect, we rely on the threshold regression methodology developed by Hansen (1999, 2000), which identifies a critical threshold beyond which the impact of public

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investment on growth changes regime. Concretely, when public investment is below this threshold, its effect on growth remains positive and significant. However, beyond this threshold, its impact can become marginal or even negative. This approach is particularly relevant for developing economies such as the Democratic Republic of Congo, where the quality of institutions and the effectiveness of public spending significantly influence the impact of investment on economic growth.

Drawing on Hansen's (1999, 2000) work on Threshold Regression Models (TRM) and the empirical research of Barro (1990) and Aschauer (1989) on the relationship between public investment and economic growth, the analytical framework of this study uses a Threshold Autoregressive Model (TAR). These are widely used in various fields, including modeling economic phenomena such as multiple equilibria, sample splits, and are the basis for popular models such as Threshold Autoregressive Regression (TAR) and Self-Exciting Threshold Autoregressive Regression (SETAR). These models can effectively represent nonlinear relationships between economic variables, providing a structured approach to modeling abrupt transitions or asymmetries in economic data.

The basic equation can be formulated as follows:

$$y_t = \{\beta_1 x_t + \varepsilon_t \text{ si } q_t \leq \gamma \beta_2 x_t + \varepsilon_t \text{ si } q_t > \gamma$$

Or :

- β_1 et β_2 are vectors of coefficients to be estimated for the two regimes
- q_t is the observed threshold variable
- γ is the (unknown) threshold value that determines the regime change.
- ε_t is the error term, assumed to have zero expectation and constant variance, i.e. $\varepsilon_t \sim N(0, \sigma^2)$

This model assumes that the regression coefficients change when q_t crosses the γ threshold. It is Therefore a non-linear model by regimes, where the non-linearity is induced by the presence of the γ threshold.

2. Variable selection and stationarity test

Our study uses annual data for the period 1985-2022 and is drawn from various BCC reports and the World Bank database (WDI). For this reason, before establishing the estimate, a series of tests will have to be developed to specify the optimal form of the equation.

Table 1. Correlation Matrix Between Variables

Correlation				
t-Statistic				
Probability	TCR	INVES PUB	INVES PR	MM
TCR	1,000,000			

INVES PUB	0.397090	1,000,000		
	2.595983	-----		
	0.0136	-----		
INVES PR	0.548171	0.077680	1,000,000	
	3.932514	0.467492	-----	
	0.0004	0.6430	-----	
MM	-0.425251	-0.129787	0.001382	1,000,000
	-2.819106	-0.785367	0.008294	-----
	0.0078	0.4374	0.9934	-----

Source: Author based on Eviews10 results

Analysis of the correlation matrix between the variables clearly shows that the economic growth rate is positively correlated with the public investment rate and the private investment rate, but negatively correlated with the money supply in circulation. It should be noted that the threshold model is only compatible with stationary series. Verification of the "stationarity" of the variables is required.

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Table 2. Series Stationarity Test Results

Variables	In level			In difference			Model	Order of integration
	ADF	VCM (5%)	Decision	ADF	VCM (5%)	Decision		
TCR	-1.66	-1.95	NS of the DS type	-5.65	-1.95	S	1	I (1)
INVPUB	-2.58	-1.95	S				1	I(0)
INVPR	-5.01	-3.54	S				3	I(0)
MM	-7.51	-3.57	S				3	I(0)

Source: Author based on Eviews10 results NB: S= Stationary, NS= Non-stationary.

From reading Table 2, the ADF test shows that in general the null hypothesis of unit root cannot be rejected at the 5% threshold. We deduce that some chronicles are non-stationary and others are stationary at level. Given that our study is carried out according to the regime of the public investment rate (normal or critical regime), we therefore resort to Threshold Estimation or threshold regression.

3. Result of the Estimates

After studying the stationarity of the variables, we can now determine the most relevant threshold variable and determine the different regimes for the selected threshold variable.

3.1. Results of threshold modeling

Before moving on to the estimation of the threshold model, it is necessary to test for the presence of a threshold effect and to specify the threshold variable for which linearity is most strongly rejected.

The candidate threshold variable in this model is the public investment ratio. Thus, we distinguish two regimes: a normal regime when the threshold variable is less than or equal to the threshold, and a critical regime when the threshold variable exceeds the threshold.

To test the existence of "threshold variables", the value of which changes the behavior of economic growth in the DRC, we use the "Sum of Squares of Residuals" (SSR) test.

a) Selection of the threshold variable

Among the candidate threshold variables, we retain the one that represents a greater non-linearity effect. Therefore, the variable that presents a maximum number of regimes in our model. This is equivalent to retaining the variable that minimizes the Sum of Squares of the Residuals (SSR).

Table 3. Selection of the Threshold Variable

Model Selection Criteria Table

Dependent Variable: TCR

Date: 08/28/24 Time: 17:12

Sample: 1985-2022

Included observations: 38

Threshold Variable	SSR	Diets
INVES PUB	179.074158	3

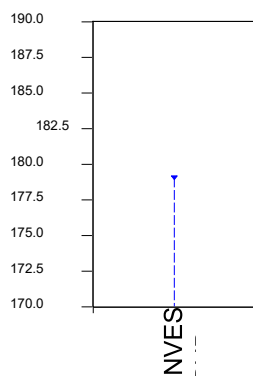
Source: Eviews software release

The threshold variable of this model is the public investment rate with an SSR of 179.074. This threshold divides the model into three regimes.

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Figure Sum of Squares of Residuals

Sum of Squared Residuals



As in Table 3 above, in this figure the threshold variable whose model has the lowest AIC is clearly the public investment ratio variable.

b) Results of the estimations of two models

Table 4. Results Of the Threshold Regression for the Variable Key Rate

TCR			
VARIABLES	REGIME 1: INVEPUB < 2.123938	REGIME 2: 2.123938 <= INVEPUB < 4.0989999	REGIME 3: 4.0989999 <= INVEPUB
C	-5.4	-3.898869	-9.756294
INVEPUB	-1.52	1.371886	0.036472
INVEPR	0.59	1.063352	0.123169
MM	-0.2	-1.031608	1,317773

Source: Author based on Eviews10 results

Table 4 represents the estimated threshold model. It is a representation of three distinct GDP growth rate scenarios according to the public investment ratio.

3.2. Interpretation of results

1. 1st Regime: $INVEPUB < 2.123938$

According to the above estimate, for a public investment ratio lower than 2.12, the economic growth rate is positively correlated with the level of private investment (0.59) but negatively correlated with the money supply and public investment.

2. II nd Regime: $2.123938 \leq INVEPUB < 4.0989999$

For a level of public investment less than or equal to 2.12 and less than 4.1, the economic growth rate is positively correlated with public and private investments but it is negatively correlated with the money supply (-1.03).

3. III rd Regime: $4.0989999 \leq INVEPUB$

For a public investment ratio greater than or equal to 4.1, the economic growth rate is positively correlated with public and private investment, but also with the money supply. In this regime, current expenditure and private investment are statistically insignificant at the 5% threshold, despite the expected sign for private investment.

Overall, we find that for the period under analysis, when the public investment ratio is lower than 2.12, the latter has a negative effect on economic growth but when it is higher than 4%, there is a revival of economic growth.

The results of this study corroborate some findings found in the literature, notably those of Tanzi and Zee (1997), who showed that public investments, particularly those in infrastructure and social services, can be an engine of economic growth when well designed and managed, but they also warn of the risks associated with mismanagement and inefficient allocation of public resources. They also suggest that the effects of public investments on economic growth should not be considered in isolation. They interact with other aspects of economic policy, such as monetary and fiscal policy, and these interactions can influence the magnitude of the positive or negative effects of public investments.

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Similarly, Barro (1991), in his work, particularly in the study entitled "Government Spending in a Simple Model of Endogenous Growth", demonstrates that public investments can have positive effects on economic growth, but that these effects depend heavily on how the investments are managed and allocated. When public investments are poorly targeted or inefficient, they can lead to diminishing or even negative returns, highlighting the importance of appropriate management and allocation of public resources.

3.3. Model validation

To ensure the reliability and robustness of the threshold effect model of public investment on economic growth in the DRC, several diagnostic tests were conducted. The Lagrange multiplier test confirmed the absence of autocorrelation in the residuals, ensuring that the model does not suffer from serial correlation problems that could bias the estimates. The Ramsey RESET test validated the functional form of the model, indicating that it is correctly specified without omitting nonlinear relationships. Furthermore, the Jarque-Bera test confirmed that the residuals follow a normal distribution, a key assumption for valid statistical inference. The homoscedasticity test further demonstrated that the residuals exhibit constant variance, excluding heteroscedasticity that could distort standard errors and significance levels. Given these results, the model meets the essential econometric assumptions, strengthening the credibility of its conclusions regarding the threshold effects of public investment on economic growth.

IV. CONCLUSION

This article analyzes the threshold effect of public investment on economic growth in the Democratic Republic of Congo (DRC). The main objective was to identify a critical threshold beyond which the impact of public investment on growth changes regime. The study also proposed strategic directions to optimize the effectiveness of public policies related to public investment.

To achieve the objectives and test the hypotheses, the study was inspired by the work of Hansen (1999, 2000) on Threshold Regression Models (TRM) as well as the empirical research of Barro (1990) and Aschauer (1989) on the relationship between public investment and economic growth. The analytical framework of this study uses a Threshold Autoregressive Model (TAR)..

From a descriptive point of view, the analysis clearly showed that the economic growth rate is positively correlated with the public investment rate and the private investment rate but negatively with the money supply in circulation.

Empirically, the estimation results show a variation in the impact of public investment on economic growth according to three distinct regimes. When the public investment ratio is below 2.12, economic growth is positively influenced by private investment but negatively by the money supply and public investment. For a ratio between 2.12 and 4.1, both public and private investment stimulate growth while the money supply has a negative effect. Above 4.1, economic growth becomes positively correlated with both public and private investment as well as the money supply, although current expenditure and private investment are not significant at the 5% level.

These findings highlight the critical role of public investment in the DRC's economic development while demonstrating its dependence on various macroeconomic and institutional factors. They underscore the importance of strategic and efficient allocation of public resources, in line with Barro's (1991) findings. Poor investment management can reduce returns and even lead to negative impacts. Finally, the study recommends strengthening the institutional framework to optimize the effectiveness of public investments and support sustainable economic growth.

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