

Effects of public spending on human development in CEMAC member countries

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Abstract: The objective of this article is to analyze the effects of public spending on human development in CEMAC member countries over the period from 2009 to 2023. To do so, we used a fixed-effects model on panel data from the six CEMAC member countries. The estimation results show that public spending has a positive effect on human development in CEMAC member countries. From these results, two economic policy implications were formulated. The first is that CEMAC member countries should allocate more of their public spending to productive infrastructure in order to stimulate economic and social development. The second is that CEMAC member countries should increase public spending on education and health to ensure an adequate level of human development.

Key Word: public spending, human development, CEMAC.

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I. Introduction

Since the publication of the first Human Development Report (UNDP¹, 1990), human development has become a major concern for all countries of the world, especially developing countries in Sub-Saharan Africa (SSA). As Amartya Sen, 1998 Nobel Laureate in Economics, emphasized in the introduction to the 2010 Human Development Report: “In 1990, public understanding of development was galvanized by the publication of the first Human Development Report. Under the leadership of the visionary Mahbub ul Haq, this Report had a profound effect on the way policymakers, civil servants, and the media, as well as economists and other social scientists, view societal progress” (UNDP, 2010; Bendaoud, 2011).

Furthermore, it is recognized that human development depends on numerous macroeconomic factors, particularly public spending, which aims not only to meet the basic needs of populations but also to increase the level of economic and social development (Mesplé-Somps, 1991). In Central Africa, public spending plays a crucial role in the provision of public services. According to the International Monetary Fund (IMF, 2016), it finances productive and social infrastructure (ports, electricity, water, schools, and hospitals). Specifically, it acts as a catalyst for achieving the Sustainable Development Goals (SDGs, particularly SDGs 3 to 9) adopted by the United Nations (UN, 2015) as a benchmark development agenda to be achieved by 2030.

However, in most Central African countries, and particularly those belonging to the CEMAC (Economic and Monetary Community of Central Africa), the level of human development remains low and stagnant. Indeed, the realities of different countries and periods have shown that public spending can have positive, negative, or neutral effects on various aspects of human development, insofar as a problem arises in categorization based on the Human Development Index (HDI) (UNDP, 1991). This index is a comparative indicator that allows for the evaluation of progress made by countries in economic and social terms. Based on this index, UNDP classifies countries into four human development categories: very high ($HDI \geq 0.800$), high ($0.700 \leq HDI \leq 0.799$), medium ($0.550 \leq HDI \leq 0.699$) and low ($HDI < 0.550$) (UNDP, 2018).

At the level of the CEMAC member countries, the HDI statistics confirm that most of these countries are affected by this problem. Therefore, the table below shows that, with the exception of Gabon, whose level of human development falls between high and medium, almost all the other CEMAC member countries still represent a group of poor, weak, and stagnant countries in terms of human development.

¹- United Nations Development Programme

Table 1: Distribution of the HDI by country

Pays	2010	2012	2015	2017	2019	2020	2021	2022	2023
Gabon	0,648	0,683	0,697	0,702	0,703	0,71	0,706	0,693	0,733
Congo	0,489	0,534	0,592	0,606	0,72	0,574	0,571	0,593	0,649
Equatorial Guinea	0,538	0,554	0,592	0,591	0,592	0,599	0,596	0,650	0,674
Cameroon	0,46	0,495	0,518	0,556	0,563	0,578	0,576	0,587	0,588
Chad	0,295	0,34	0,396	0,404	0,398	0,397	0,394	0,394	0,416
Central Africa	0,315	0,352	0,352	0,367	0,397	0,407	0,404	0,387	0,414

Source: *author based on UNDP data (2018, 2022 and 2025)*

Yet, in Central Africa, and more specifically in the CEMAC member countries, populations live alongside abundant natural resources. Indeed, the forests of the Congo Basin constitute the second largest tropical rainforest reserve in the world, representing 70% of the dense forest cover of the African continent. In addition to these forest resources, the sub-region also boasts significant hydroelectric potential capable of supplying the entire continent with electricity, and numerous opportunities remain untapped, particularly in the agri-food sector. As a reminder, in 2007, oil accounted for 79% of CEMAC exports (UNDP Central Africa, 2017).

Notwithstanding the efforts made by the authorities of the CEMAC member countries in initiating policies, projects, or development programs such as the CEMAC 2025 vision of an emerging integrated economic space, the Regional Economic Program (PER), the Economic and Financial Reform Program (PREF-CEMAC), the White Paper based on a common vision of the ECCAS and CEMAC (2014-2030), the level of human development in most of the CEMAC member countries remains weak.

This situation can be explained by several factors, some of which are natural, such as the public spending deficit, poor governance (corruption, control of national wealth by political actors, political favoritism, etc.), the acquisition of debt by each generation to meet current needs without being able to repay it (financial over-indebtedness, for example), terrorist attacks (Boko Haram, for example), armed group conflicts, and political instability (Nembot et al., 2021). Also contributing are fluctuations in economic cycles, such as the 2008-2009 financial crisis and the 2014-2015 oil price collapse, which caused a drop in public spending and all indicators of living standards, as well as the COVID-19 pandemic and the Russo-Ukrainian war, which negatively affected the economic and financial activities of the sub-region (UNDP Central Africa, 2017; BEAC, 2020).

In economics, the relationship between public spending and human development is the subject of controversial debates, both theoretical and empirical. Theoretically, two main schools of thought are in opposition: Keynesian and neoclassical.

According to Keynesian economics, public spending has a positive effect on human development. Indeed, Keynesian analysis (Keynes, 1936; Eisner, 1989) considers public spending as a driver of human development. This approach is also supported by Pigou's theory of externalities (1920), Barro's theory of endogenous growth (1990), and Sen's capability approach (1985).

In contrast to Keynesian analysis, the second approach, supported by the neoclassical school, argues that public spending has a negative or neutral effect on human development. According to this approach (Bailey, 1971; Buiter, 1977; Feldstein, 1982; Van de Walle, 1989), public spending crowds out private investment and consumption because economic agents anticipate the future consequences of fiscal policy and adjust their consumption and saving behaviors accordingly. This perspective is also supported by Arrow's impossibility theorem (1951), the public choice school (Buchanan and Tullock, 1962), and Ricardian equivalence theory (Barro, 1974).

On an empirical level, the observed theoretical controversy also gives rise to two groups of works: the works of authors whose results reveal that public spending has positive effects (Edeme, 2014; Raihanatou et al, 2023; Moussavou, 2019; Hamadou and Karim, 2024) and those of authors whose results show that public spending has negative or zero effects on human development (Elalaoui and Hefnaoui, 2018; Omodero, 2019; Okiemy, 2021).

In light of the foregoing, it is clear from this literature that the link between public spending and human development is not universally accepted. Therefore, our added value in this literature lies in providing both theoretical and empirical evidence on the link between public spending and human development in the case of CEMAC member countries. To our knowledge, this research is groundbreaking in our field of study, as some previous studies have addressed public spending specifically in relation to human development, economic growth, or other macroeconomic aggregates.

Thus, the choice of this topic can be justified for two main reasons. The first relates to the unstable level of human development in almost all CEMAC member countries. To illustrate this, some statistics (Table

1) and explanatory factors were presented above. Regarding the second reason, the table below displays some statistics on public expenditures and revenues recorded as a percentage (%) of GDP by CEMAC member country.

Table 2: Distribution of public spending and revenue by country

Pays	Public spending			Public revenue		
	2018	2019	2020	2018	2019	2020
Gabon	14,4	15,4	26,4	17,9	22,3	20,3
Congo	16,4	15,5	29,9	23,3	23,8	18,1
Equatorial Guinea	10,9	11,1	22,5	20,6	18,1	9,5
Cameroon	11,9	11,9	18,2	16,0	15,6	13,4
Chad	9,3	9,9	18,8	11,6	11,6	9,6
Central Africa	48,2	49,5	20,1	59,8	57,7	41,7

Source: author based on BEAC data (2020)

This table shows that in 2020, public spending in all CEMAC member countries exceeded revenue. Consequently, all countries recorded budget deficits: Gabon (-6.1), Congo (-11.3), Equatorial Guinea (-13.0), Cameroon (-4.4), Chad (-6.5), and Central African Republic (-0.8). It is important to note that these budget deficits result in recourse to public debt to finance public spending through public borrowing on financial markets. This is the case, for example, with the financial programs signed with the IMF for the consolidation of budgetary measures.

To this end, this work draws on the methodological strengths of the effects of public spending to answer the following question: what are the effects of public spending on human development in CEMAC member countries? Within this framework, the objective of this work is to analyze the effects of public spending on human development in CEMAC member countries. From this objective stems the following hypothesis: public spending has positive effects on human development in CEMAC member countries. Besides the introduction and conclusion, the remainder of this work is organized into three sections. The first is devoted to the literature review. The second presents the methodology. Finally, the third is dedicated to the presentation, discussion, and interpretation of the results.

II. Literature review

In this section, we first deal with the review of the theoretical literature and then with the review of the empirical literature.

II.1. Review of the theoretical literature

The debate on the relationship between public spending and human development pits two opposing analytical perspectives against each other.

The first perspective maintains that public spending is a driver of human development and contributes to the fight against poverty. Consequently, several arguments justify government intervention in human development spending. In Keynes's general theory (1936), Keynesian analysis recognizes the power of fiscal policy to influence the economy and the significant role that the public spending multiplier can play in achieving macroeconomic equilibrium. The core idea of this theory is that the government can stimulate human development by financing various development projects through revenues (taxes) levied on the private sector (households and businesses). In other words, increased public spending through expansionary fiscal policy stimulates aggregate demand, thereby generating a multiplier effect that fosters growth in production, employment, business profitability, and investment (Eisner, 1989). Specifically, this Keynesian approach places great emphasis on government intervention through the role of the public spending multiplier in achieving macroeconomic equilibrium. It is also supported by Pigou's theory of externalities (1920), insofar as government intervention to correct market failures (negative externalities) or promote positive externalities (such as those of public spending) is a suitable justification for investing in human development through public spending.

Furthermore, Barro (1990), in his theoretical model of endogenous growth with public spending, notes that public infrastructure facilitates the flow of information, people, and goods, thereby increasing productivity and generating multiplier effects. Moreover, government revenue (taxes and levies intended to finance these investments) plays an essential role in economic growth and does not merely discourage the private sector. Finally, public spending is therefore a key driver of human development through investments in strategic sectors such as education, health, social protection, and infrastructure.

Furthermore, the challenge of reducing public debt can be a significant and major asset for boosting human development and ensuring that the most vulnerable populations benefit from it in the fight against poverty. In the capabilities approach, Sen (1985) considers an individual's capacity to have varying means of functioning and to benefit from the corresponding well-being related to the human development process. Consequently, government efforts are seen as an opportunity to improve or influence individuals' capacity to acquire more opportunities in the human development process. In this regard, Edeme (2014) indicates that public spending represents a form of government intervention designed to stimulate the economy by correcting market failures in order to redistribute resources equitably, promote economic growth, and improve human well-being.

The second point of analysis, on the contrary, proves that government intervention in public spending hinders human development. To this end, numerous arguments against public spending on human development are invoked.

From the perspective of Arrow's impossibility theorem (1951), investment in government spending can be described as a "dictatorial decision," defined as the implementation of a collective choice by a single individual (the State: a legal entity) without considering the preferences of all individuals. This is particularly unsatisfactory given that some individuals seek genuine democracy in the use of state revenues intended to finance human development. Thus, any state intervention that does not respect individual choices constitutes a dictatorship, but respecting these individual choices in the management of public affairs is impossible according to Arrow's theorem.

According to proponents of the Public Choice School (Buchanan and Tullock, 1962), the state is considered a cheat. It is understood as the economic agent that sets the rules of the game and is both referee and player. Indeed, when the share of public spending sometimes exceeds half of GDP, it neglects and forgets the objective of the target population. Certainly, the market can experience failures, but this does not automatically necessitate state intervention, and its regulations are often more effective in improving living conditions and lifestyles than market self-regulation. In other words, civil servants, politicians, and bureaucrats are not economic agents above others, but rather individuals with their own particular interests who seek to maximize their satisfaction in terms of power, monetary gain, the number of offices they manage, and so on. This wastefulness results in an increased level of public debt, sometimes considered the "original sin."

Besides Arrow's impossibility theorem and the Public Choice School, neoclassical authors such as Feldstein (1982) and Van de Walle (1989) argue that government involvement in socioeconomic activities hinders economic development. Indeed, public spending crowds out private investment and consumption (Bailey, 1971; Buiter, 1977). According to these authors, government intervention in public spending is likely to reduce access to greater human development.

Furthermore, many countries frequently engage in issuing public debt (domestic or external) to finance their development projects or programs. However, this can have repercussions on all economic activities, given these states' inability to service their debt (Nembot et al., 2021). Based on this reason, the Ricardian equivalence theory developed by Barro (1974) stipulates that the public debts contracted today by public administrations will eventually, at some point in the near future, become equivalent to future taxes, to be repaid with interest. This theory also specifies that the increase in public spending financed by debt necessitates an increase in private savings, given that economic actors will anticipate tax increases. According to Barro (1974), this policy is not effective in promoting human development.

II.2. Review of the Empirical Literature

This literature review highlights two analytical trends: empirical studies showing a positive effect and results showing a negative effect.

In the first analytical trend, the work of Edeme (2014) on the relationship between sectoral public spending and human development in Nigeria, covering the period 1999–2012 using a panel least squares (PLS) regression model, showed that sectoral public spending has a positive functional relationship with human development. This indicates that public spending in these sectors promotes human development in Nigeria. Similarly, Adjovi and Codo (2019), using the dynamic sequential Computable General Equilibrium (CGE) model and data from the 2007 Integrated Modular Household Living Conditions Surveys (EMICOV), conducted research on the impacts of public infrastructure spending on economic growth and poverty reduction in Benin. Their findings indicate that the allocation of public spending positively influences economic growth and poverty reduction. More specifically, the authors specify that, beyond this positive relationship, road infrastructure spending contributes significantly more to growth and poverty reduction than social spending, suggesting that road development is the most effective channel for reducing poverty and inequality. Similar results illustrating a positive effect have been obtained by other authors such as (Tangara et al., 2019), on the relationship between public spending and poverty reduction in Mali from 1990-2016, using an error correction model (ECM); Moussavou (2019), on the impact of public spending on growth dynamics in Congo-Brazzaville from 1980-2014, through the use of the Dickey and Fuller technique; Fouopi et al (2014), on the "Threshold Effects of

Public Spending on Economic Growth in CEMAC Countries" from 1997-2011, using the Panel Smooth Threshold Regression (PSTR) method, via a smooth transition model.

Raihanatou et al. (2023) used World Bank data covering the period 1990–2018 in the CEMAC zone. Their estimation results reveal that public agricultural spending has a positive impact on economic growth and improves the population's standard of living. Therefore, to stimulate economic development, it would be wise to strengthen government effectiveness to ensure that support reaches key beneficiaries and motivates the various stakeholders involved in the agricultural sector's development process. Similarly, Hamadou and Karim (2024), after using quantitative methods, applied the ARDL model with a bounds-testing approach to time series data from 2000 to 2021. Their results indicate that public spending on education and health has a positive impact on the evolution of the Human Development Index (HDI). The authors also concluded that economic growth (GDP) positively influences the variation of the HDI.

Regarding the second analytical approach, Omodero (2019), using a multiple linear regression model, assessed the impact of general government spending on human development in Nigeria from 2003 to 2017. The results indicate that government capital expenditures and inflation have a negligible negative influence on the HDI. Indeed, according to this author, resources allocated to recurring expenditures should be reduced, and more money should be invested in human development projects in Nigeria.

Similarly, Elalaoui and Hefnaoui (2018), using the Autoregressive Distributed Lag (ARDL) model, studied the impact of public spending on economic growth in Morocco during the period from 1975 to 2016. The results confirm that the impact of total public spending on economic growth is negative, which can be explained by the unproductive nature of public spending financed by public debt. Phaneuf and Wasmer (2005) also highlight a relative negative impact of public spending and tax levies on economic activity in Quebec and Canada, using a semi-structural vector autoregressive (SVAR) econometric approach over the period from 1981 to 2004. Indeed, this negative link between these indicators can be justified by the inability of tax levies to predict economic growth.

Recently, Okiemy (2021) analyzed the impact of oil revenue shocks and fiscal policy cyclicalities on human development in CEMAC member countries from 1990 to 2018. Using the PVAR model, the results showed that oil revenues do not have a positive effect, meaning they do not improve human development in CEMAC member countries.

This literature review reveals that theoretical advances on the relationship between public spending and human development have been the subject of relatively few empirical analyses, compared to studies that have focused directly on the link between public spending and human development. Nevertheless, the results of both theoretical and empirical analyses have yielded both positive and negative effects of public spending on human development. In conclusion, this article reveals itself as a genuine contribution to the economic literature.

III. Methodology

The objective of this article is to analyze the effects of public spending on human development in CEMAC member countries. To this end, two sections are devoted to the methodology. The first presents the method of investigation, and the second reviews the modeling.

III.1. Method of investigation

In this article, the mode of investigation refers to the different steps taken to access all the information leading to its realization. Given that the problem addressed is analyzed from the angle of macroeconomic data, the mode of investigation consisted of the exploitation of various information on the relationship between public spending and human development. Access to the various data used in the estimates allowed us to inventory studies, research documents, articles, works, reports, etc., through different libraries, institutions and search engines (Google, Google Scholar, NBER, Science Directe, etc.).

III.2. Modeling the effects of public spending on human development

In this section, we present respectively the estimation model that underlies the study, the data sources, the choice and description of the variables, and the estimation procedure.

III.2.1. Model for estimation purposes

In this article, we draw inspiration from the work of Ngimanang (2025) and Edeme (2014), which is based on panel data models. However, econometric studies show that cross-sectional data generally contain specification errors. According to Bourbonnais (2015), these errors stem, among other things, from autocorrelation and heteroscedasticity, and can bias the results of estimators. To address this issue, it is important to account for these errors by including the error term in the equation to be estimated. After reviewing the literature on the relationship between public spending and human development, the explanatory variables for the vector X selected are: total investment (INT); imports of goods and services (IMP); the infrastructure development index (IDI); political stability and absence of violence (SPA); control of corruption (CCR); and

inflation (INF). Taking into account that the data are panel data which simultaneously include the time dimension t , and the individual dimension i , our equation for estimation purposes is as follows:

$$HDI_{it} = \alpha_0 + \alpha_1 DPU_{it} + \alpha_2 INT_{it} + \alpha_3 IMP_{it} + \alpha_4 IDI_{it} + \alpha_5 PSA_{it} + \alpha_6 CCR_{it} + \alpha_7 INF_{it} + \varepsilon_{it} \quad (1)$$

- HDI : human development index
- DPU : public spending
- INT : total investment
- IMP : imports of goods and services
- IDI : infrastructure development index
- PSA : political stability and absence of violence
- CCR : control of corruption
- INF : inflation
- α_0 : constant term
- α_1 - α_7 : coefficients of variables
- ε : error term
- i : country
- t : Period

III.2.2. Data sources, choice and description of variables

In this article, the data used comes from the databases of the United Nations Development Programme (UNDP); the African Development Bank (AfDB); the World Bank, particularly the World Development Indicators (WDI) and the World Governance Indicators (WGI); and the IMF's Africa Regional Economic Outlook (AFRREO). This data concerns the six CEMAC member countries (Cameroon, Central African Republic, Congo, Gabon, Equatorial Guinea, and Chad) and covers the period from 2009 to 2023. The choice of variables is based on the literature on the relationship between public spending and human development, and the study period was selected based on available data. The variables used are presented as follows:

Human Development Index (HDI): The Human Development Index is an indicator that measures human development based on three essential components of human life: longevity, measured by life expectancy at birth; knowledge, measured by the acquisition of knowledge; and standard of living, measured by access to necessary resources (UNDP, 1990). The HDI takes into account a broader definition of well-being beyond Gross Domestic Product (GDP) per capita or Gross National Product (GNP) per capita and other measures of human development, while providing a less biased distributional picture than that presented by GNP per capita. Its values range from 0 to 1, indicating low, medium, high, and very high levels of human development (Okiemy, 2021; Ngimanang, 2025).

Public expenditure (DPU): Public expenditure refers to goods and services purchased by federal, regional, and local governments (Mankiw, 2019). It primarily includes current operating expenses (salaries and wages, equipment and supplies, common charges, etc.), capital expenditure (or investment expenditure), and domestic and external debt servicing (Mampassi and Tendelet, 2015). The expected sign is positive (+).

Total Investment (INT): Total investment corresponds to expenditures on the acquisition of capital goods, construction, housing, and the accumulation of inventories necessary for economic activity (Frank and Bernanke, 2009; Mankiw, 2019). Investment contributes to human development by promoting capital accumulation, job creation, and improvements in productive capacity, which can increase income and access to essential goods and services (Romer, 1986; Lucas, 1988). The expected sign is positive (+).

Imports of goods and services (IMP): Imports of goods and services represent the value of goods and services acquired from the rest of the world. They can contribute to human development when they provide economies with access to goods, technologies, medical equipment and educational products that are not available locally (Grossman and Helpman, 1991). From this perspective, openness to trade can promote technological diffusion and improve consumption and production possibilities (Frankel and Romer, 1999). However, the effect depends on the structure of imports and the productive capacity of the country. The expected sign is positive (+).

Infrastructure Development Index (IDI): The Infrastructure Development Index measures the availability and quality of economic and social infrastructure, particularly in the areas of transport, energy, telecommunications, water, and sanitation. Infrastructure is a key determinant of human development because it facilitates access to essential services, reduces economic costs, and improves living conditions (Calderón and Servén, 2010; Fosu and Ankras, 2022). Its development thus fosters economic and social opportunities for populations. The expected sign is positive (+).

Political Stability and Absence of Violence (PSA): Political stability and absence of violence measure the perceived risk of political instability, violence, or terrorism. Greater stability fosters an environment conducive to investment, the provision of public services, and human development (North, 1990; Acemoglu, Johnson, and Robinson, 2005). The work of Ayessa and Hakizimana (2021) shows, in particular, that political instability can compromise economic performance. The indicator ranges from -2.5 to +2.5, with a higher value indicating greater stability. The expected sign is positive (+).

Control of Corruption (CCR): Control of corruption reflects the ability of institutions to limit the use of public power for private gain and to prevent the capture of the state by special interests (World Bank). Corruption can thus divert public resources and undermine human development (Hakizimana, 2021). The indicator ranges approximately from -2.5 to +2.5: a high value indicates better control of corruption. The expected sign is positive (+).

Inflation (INF): Inflation refers to a general and sustained increase in the price level, which reduces the purchasing power of money. High inflation affects human development by decreasing household purchasing power, increasing economic uncertainty, and reducing their ability to access essential goods and services (Friedman, 1963; Akerlof, Dickens, and Perry, 2000). In low-income economies, this pressure can be particularly severe for vulnerable households. The expected sign is negative (-).

Table 3: Summary of variables, their measurements and their sources

Variable	Abbreviation	Measure	Source
Human Development Index	HDI	Score from 0 to 1	PNUD
Public expenditure	DPU	% of GDP	AFRREO
Total Investment	INT	% of GDP	AFRREO
Imports of goods and services	IMP	% of GDP	AFRREO
Infrastructure Development Index	IDI	Score from 0 to 100	BAD
Political Stability and Absence of Violence	PSA	Score from -2.5 to +2.5	WGI
Control of Corruption	CCR	Score from -2.5 to +2.5	WGI
Inflation	INF	%	WDI

Source: *author*

III.2.3. Estimation procedure

This study analyzes the effects of public spending on human development in CEMAC member countries. Based on available data, the analysis covers the period from 2009 to 2023, focusing on the six CEMAC member countries: Cameroon, Central African Republic, Congo, Gabon, Equatorial Guinea, and Chad. In econometrics, when twenty years of data are available, unit root tests are generally not very powerful for distinguishing stationary from non-stationary series. An alternative approach is to increase the number of observations, that is, to extend the study period to include the necessary information for different countries (Hurlin and Mignon, 2005).

In the case of this article, T is less than 25 observations; in other words, both the individual (country, N) and temporal (time, T) dimensions are less than 25. In this situation where T is small (15 years), stationarity analysis is unnecessary, as all variables are automatically considered stationary (Znaidia and Hammami, 2017). Thus, linear regression models for panel data, such as the pooled ordinary least squares (OLS) model and individual effects models (fixed effects and random effects models), are appropriate (Baltagi et al., 2005).

IV. Presentation, discussion and interpretation of the results

In this section, we have, on the one hand, the presentation and discussion of the results, and on the other hand, the interpretation of the results.

IV.1. Presentation and discussion of the results

In this section, the results of the descriptive statistics; the correlation matrix; the Multi-collinearity test via the variance inflation factor (VIF); the estimation and those relating to the post-estimation tests (Hausman, heteroscedasticity and autocorrelation) are presented successively.

Table 4: Descriptive Statistics

Variables	Mean	Std. dev.	Minimum	Maximum	Observations
HDI	0,5264111	0,1200688	0,293	0,733	90
DPU	20,62166	7,787128	9,734043	48,56233	90
INT	28,20277	11,90383	8,518935	79,40108	90
IMP	34,46529	11,84382	17,63153	79,96546	90
IDI	16,16913	7,164656	3,930814	32,4598	90
PSA	-0,8054306	0,8042236	-2,699193	0,3848909	90
CCR	-1,225377	0,2343356	-1,645761	-0,6343055	90
INF	2,973818	2,644979	-2,077866	14,89868	90

Source: author based on Stata 17

Table 4 above presents the results of the descriptive statistics for the variables used in our estimation model for CEMAC member countries, covering the period 2009-2023. These results show that the average Human Development Index (HDI) and public expenditure (PE) are 0.5264111 and 20.62166, respectively, with maximum values of 0.733 and 48.56233. Over the same study period, the minimum levels of the Human Development Index and public expenditure in CEMAC member countries decreased by 0.293 and 9.734043, respectively.

Furthermore, the Human Development Index has a standard deviation of 0.1200688, which is relatively low and less than 0.5. This explains the small dispersion around its mean. However, public spending has a standard deviation of 7.787128, as do other variables such as total investment, import of goods and services and infrastructure development index, which are 11.90383, 11.84382 and 7.164656 respectively, which are very high and greater than 0.5. This suggests a strong dispersion around their means.

Table 5: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) HDI	1,000							
(2) DPU	0,417*	1,000						
(3) INT	0,333*	0,559*	1,000					
(4) IMP	0,125	0,630*	0,731*	1,000				
(5) IDI	0,881*	0,148	-0,023	-0,174	1,000			
(6) PSA	0,816*	0,494*	0,455*	0,320*	0,584*	1,000		
(7) CCR	0,322*	0,094	-0,056	-0,132	0,518*	0,154	1,000	
(8) INF	-0,188	0,008	-0,112	0,038	-0,113	-0,226*	-0,002	1,000

* $p < 0,05$

Source: author based on Stata 17

In Table 5, on one side, we have the Human Development Index (HDI), which is positively correlated with public spending, total investment, imports of goods and services, the infrastructure development index, political stability and absence of violence, and control of corruption. This means that these variables move in the same direction as the HDI. On the other side, only inflation moves in the opposite direction to the HDI, as it is negatively correlated with it.

Regarding the individual significance of the model, all coefficients associated with the dependent variable (HDI) are significant at the 5% level, with the exception of the variables (imports of goods and services and inflation), whose significant coefficients are associated with the independent variables.

Table 6: Multicollinearity test: variance inflation factor (VIF)

Variables	VIF	1/VIF
IMP	2,94	0,340598
PSA	2,74	0,365123
IDI	2,69	0,371856
INT	2,52	0,397033
DPU	2,05	0,488079
CCR	1,47	0,680385
INF	1,10	0,906200
Mean VIF	1,71	

Source: author based on Stata 17

Table 6 above presents the results of the multicollinearity test for the different variables used to estimate the model, via the variance inflation factor (VIF). These results show that all VIF values, including the mean VIF, are below the critical threshold of 5, indicating the absence of problematic multicollinearity. Therefore, all the variables used are valid, and the model is appropriate.

Table 7: Pooled, Fixed Effects, and Random Effects Models

VARIABLES	Pooled	Fixed Effects	Random Effects
HDI	variable endogène		
DPU	0,00171*** (3,452)	0,000513 (1,057)	0,00171*** (3,452)
INT	0,00211*** (5,879)	0,00142*** (3,198)	0,00211*** (5,879)
IMP	-0,000558 (-1,430)	-0,000329 (-0,861)	-0,000558 (-1,430)
IDI	0,0131*** (21,21)	0,0111*** (8,751)	0,0131*** (21,21)
PSA	0,0361*** (6,499)	-0,00643 (-0,561)	0,0361*** (6,499)
CCR	-0,0646*** (-4,630)	-0,00438 (-0,176)	-0,0646*** (-4,630)
INF	-0,000961 (-0,896)	-0,00140 (-1,532)	-0,000961 (-0,896)
Constant	0,192*** (6,110)	0,301*** (8,968)	0,192*** (6,110)
Observations	90	90	90
R-squared		0,649	
Number of ID_Pays	6	6	6
F		20,36	
chi2	1898		1898
chi2p	0,0000	0,0000	0,0000

z-statistics in parentheses

*** p<0,01 ; ** p<0,05 ; * p<0,1

Source: *author based on Stata 17*

Table 7 above describes the different results of the Pooled (OLS) model, the Fixed Effects (FE) model, and the Random Effects (RE) model. Since the probability associated with the Pooled model is below the 5% significance level, the null hypothesis (H0) of no individual effects is rejected in favor of the alternative hypothesis (H1) of the existence of individual effects. These individual effects include both fixed and random effects. Therefore, the choice between the fixed effects model and the random effects model relies on the Hausman discrimination test, considered a post-estimation test.

Table 8: Post-estimation tests

Types de tests	Null hypothesis	Results
Hausman	Random Effects	Chi2(7) = 35,35 Prob > chi2 = 0,0000
Heteroscedasticity	Variance consistency	Chi2 (6) = 19,72 Prob > chi2 = 0,0031
Autocorrelation	No autocorrelation	F (1, 5) = 0,024 Prob > F = 0,8841

Source: *author based on Stata 17*

Table 8 above summarizes the results of three (3) post-estimation tests to determine which of the two models to retain: the fixed effects model or the random effects model. In addition to choosing the appropriate model, it is also essential to correct for bias in cases of autocorrelation and/or heteroscedasticity of errors. Therefore, the Hausman test results show a probability (Prob > chi2 = 0.0000) below the 1% significance threshold; the fixed effects model is preferable and adopted over the random effects model.

Furthermore, the heteroscedasticity test indicates that the probability (Prob > chi2 = 0.0031) associated with the chi-square statistic (Chi2 (6) = 19.72) is less than the 1% threshold. Therefore, the null hypothesis of homoscedasticity of the errors is rejected in favor of the alternative hypothesis of heteroscedasticity, meaning that the variance of the errors is not constant. However, the results of the autocorrelation test of the errors show that the probability (Prob > F = 0.8841) is greater than the 10% threshold. The null hypothesis of no

autocorrelation is therefore verified and accepted. These results necessitate the use of a robust fixed-effects model to address the heteroscedasticity of the errors.

Table 9: Estimation results of the fixed-effects model corrected for heteroscedasticity bias

HDI	Coefficient	Std. err.	Statistic (z)	(P> z)	[95% conf. interval]	
DPU	0,0018811	0,0004058	4,64	0,000	0,0010856	0,0026765
INT	0,0022058	0,0002002	11,02	0,000	0,0018135	0,0025981
IMP	-0,0006188	0,0002629	-2,35	0,019	-0,001134	-0,0001036
IDI	0,0128502	0,0004174	30,79	0,000	0,0120322	0,0136683
PSA	0,0361563	0,0030739	11,76	0,000	0,0301316	0,0421811
CCR	-0,0484788	0,0122512	-3,96	0,000	-0,0724907	-0,0244669
INF	-0,0010879	0,0006137	-1,77	0,076	-0,0022907	0,0001148
cons	0,2095538	0,0216722	9,67	0,000	0,167077	0,2520306
Number of obs	=	90				
Number of groups	=	6				
Wald chi2(8)	=	10243,06				
Prob > chi2	=	0,0000				

Source: *author based on Stata 17*

IV.2. Interpretation of the results

The results in Table 9, derived from the estimation of the fixed-effects model corrected for heteroscedasticity bias, allow us to analyze the effects of public spending on the Human Development Index in CEMAC member countries.

The probability (Prob > chi2 = 0.0000) associated with the statistic [Wald chi2 (8) = 10243.06] being less than the 1% threshold, the corrected model is therefore statistically and globally significant at the 1% level. The coefficient of the variable of interest, i.e., the explanatory variable public spending, being positive (0.0018811) at the 5% significance level, this means that public spending has a positive effect on the Human Development Index in CEMAC member countries. Indeed, this positive sign reveals that public spending and the Human Development Index move in the same direction. Thus, an increase in public spending is accompanied by an improvement in the level of human development. Specifically, the results show that an increase of one unit in public spending leads to an increase of 0.009 units in the human development index in CEMAC member countries.

Thus, it is worth noting that, theoretically, these results obtained within the CEMAC member countries align with the Keynesian view of the state's economic role (Keynes, 1936; Eisner, 1989), which posits that increased public spending has positive effects on human development. Furthermore, empirically, these results corroborate those obtained by Oedème (2014) and Raihanatou et al. (2023) in Nigeria and the CEMAC zone, respectively, demonstrating a positive relationship between a series of public expenditures and macroeconomic aggregates.

Therefore, it is concluded that public spending is a favorable factor for human development in CEMAC member countries. Economically, this situation, inherent in these results, allows us to draw two conclusions:

- ❖ Public spending in CEMAC member countries contributes to economic development. Indeed, public spending on roads, electricity, transportation, and telecommunications generates externalities that improve business productivity and can thus support economic development (Nembot Ndeffo et al., 2021).
- ❖ Public spending in CEMAC member countries allows for an increase in the level of social development. It should be emphasized in this regard that public spending plays an essential role in financing social infrastructure such as education and health (Mesplé-Somps, 1991; IMF, 2016). This can, in turn, have a positive effect on human development.

V. Conclusion and economic policy implications

The objective of this article was to analyze the effects of public spending on human development in CEMAC member countries over the period 2009-2023. To achieve this objective, we used a fixed-effects model on panel data from the six CEMAC member countries. The estimation results show that public spending has a positive effect on human development in CEMAC member countries. Based on these results, we formulated two economic policy implications:

- CEMAC member countries should allocate more public spending to productive infrastructure to stimulate economic and social development;
- CEMAC member countries should increase public spending on education and health to ensure an adequate level of human development.

For our future research, we may conduct further investigations into various aspects of public spending to explore the topic in relation to other macroeconomic variables.

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