



Effect of public investment in human capital on economic growth in Ecuador, 2000–2023

Efecto de la inversión pública en el capital humano sobre el crecimiento económico en Ecuador, 2000–2023

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ABSTRACT

Human capital is a fundamental axis for explaining the dynamics of economic growth, particularly in developing economies such as Ecuador. This study examines the effect of public investment in education and health on economic growth during the period 2000–2023. An econometric log-log model was applied to estimate the elasticity of Gross Domestic Product (GDP) per capita in response to variations in public spending on these sectors. Official data from the

Central Bank of Ecuador, the National Institute of Statistics and Census, sectoral ministries, and international sources were used, complemented by specialized literature. The findings reveal a positive and statistically significant impact of both variables on economic growth, with a greater magnitude in the case of health expenditure. Specifically, a 1% increase in health spending is associated with a 0.34% rise in GDP per capita, while a similar increase in education spending generates a 0.11% increase in this indicator. These results confirm the relevance of strengthening human capital investment policies as a sustainable development strategy while highlighting the importance of prioritizing efficiency and quality in public expenditure. It is concluded that social investment, especially in health, not only improves population well-being but also constitutes a driver of productivity and competitiveness in the long term.

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RESUMEN

El capital humano constituye un eje fundamental para explicar las dinámicas del crecimiento económico, particularmente en economías en desarrollo como la de Ecuador. El presente estudio examina el efecto de la inversión pública en educación y salud sobre el crecimiento económico, tomando como referencia el período 2000–2023. Para ello se construyó un modelo econométrico log-log que permitió estimar la elasticidad del Producto Interno Bruto (PIB) per cápita frente a variaciones en el gasto público destinado a estos sectores. Se utilizaron datos oficiales del Banco Central del Ecuador, el Instituto Nacional de Estadística y Censos, ministerios sectoriales y fuentes internacionales, complementados con literatura especializada. Los resultados evidencian un impacto positivo y estadísticamente significativo de ambas variables sobre el crecimiento económico, aunque con una mayor magnitud en el caso del gasto en salud. En efecto, un incremento del 1% en el gasto sanitario se asocia con un aumento del 0.34% en el PIB per cápita, mientras que la misma variación en educación incrementa en 0.11% dicho indicador. Estos hallazgos confirman la pertinencia de fortalecer las políticas de inversión en capital humano como estrategia de desarrollo sostenible, al tiempo que ponen de relieve la necesidad de priorizar la eficiencia y calidad del gasto. Se concluye que la inversión social, especialmente en salud, no solo mejora el bienestar de la población, sino que también constituye un motor de productividad y competitividad en el largo plazo.

Keywords / Palabras clave

productivity, well-being, elasticity, public policy, sustainable development.

productividad, bienestar, elasticidad, políticas públicas, desarrollo sostenible.

Introduction

Economic growth in developing countries has been the subject of extensive debate in contemporary economic literature, particularly with regard to the role of human capital as an engine of development. In this context, public investment in education and health has become an essential component in enhancing the productive capacities of the population, increasing competitiveness, and improving levels of social welfare. Ecuador, like other Latin American nations, has undergone profound political, social, and economic transformations in recent decades that have tested the effectiveness of its public policies and its ability to sustain an inclusive and sustainable growth model. In this context, analyzing the effect of investment in human capital on economic growth is relevant not only academically but also practically, insofar as it guides government decision-making regarding the allocation of public resources.

From the earliest formulations of human capital theory, Schultz (1961) and Rees (1965) emphasized the importance of education and health as investments that increase the skills, productivity, and adaptability of the workforce. These contributions laid the foundation for considering human capital as a factor of production as important as physical capital or technology. Later, Lucas (1988) and Romer (1990) incorporated these ideas into endogenous growth models, where the accumulation of knowledge and the development of skills are seen as internal drivers that fuel economic progress. According to these approaches, investment in human capital not only benefits the individuals directly involved, but also generates positive externalities for society as a whole, broadening the productive base and strengthening resilience to external crises.

In the case of Ecuador, the evolution of public investment in education and health has been closely linked to the country's macroeconomic dynamics. During the period 2000–2023, Ecuador faced significant

challenges, including financial crises, fluctuations in international oil prices, changes in political regimes, and structural reforms. These factors affected the availability of fiscal resources and, therefore, the state's ability to sustain and expand social investment. Despite these limitations, public spending on education reached levels close to 5% of gross domestic product (GDP) during the years of the oil boom, while spending on health showed sustained growth, rising from 3.3% of GDP in 2000 to 7.6% in 2023 (Central Bank of Ecuador, 2024). This trajectory shows a deliberate effort to strengthen human capital as the basis for development, although doubts remain about the efficiency and real impact of these investments in terms of economic growth.

The debate on the relationship between human capital and economic growth is not without controversy. While some empirical studies confirm the existence of a positive and significant correlation between the two factors (Barro, 1991; Hanushek & Woessmann, 2012), others point out that the effects of education and health may be conditioned by contextual variables, such as the quality of spending, the relevance of educational programs to labor market demands, or the efficiency of health system management (Psacharopoulos & Patrinos, 2004; Krueger & Lindahl, 2001). In this regard, contemporary literature agrees that the mere allocation of resources does not automatically guarantee positive economic results, but rather that it is necessary to evaluate how these resources are used and managed.

Within the framework of endogenous growth models, investment in education is associated with the accumulation of human capital, which in turn drives technological innovation and productivity. Mankiw et al. (1992) demonstrated that countries with higher levels of education tend to have higher rates of GDP per capita growth in the long term. Similarly, Grossman (1972) argued that health should be conceived as a form of human capital that increases the productive capacity of individuals by reducing time lost to illness and prolonging working life. Thus, both education and health are fundamental pillars of a model of sustained growth, in which the well-being of the population becomes an economic asset.

The reality in Ecuador shows a series of particularities that warrant specific analysis. The country has high levels of social and regional inequality, which generates significant disparities in access to and quality of education and health services. In rural areas and indigenous communities, coverage of these services is limited, which restricts the possibilities for equitable economic development. In turn, fiscal

constraints derived from dependence on oil revenues have limited the sustainability of social investment, generating cycles of expansion and contraction that hinder the consolidation of long-term policies (Cerquera et al., 2022). In this context, it is pertinent to ask whether public investment in education and health has had a real impact on the country's economic growth or whether, on the contrary, the effects have been marginal due to a lack of continuity and efficiency in its implementation.

The main objective of this research is to analyze the effect of public investment in human capital, represented by spending on education and health, on Ecuador's economic growth during the period 2000–2023, through the estimation of a log-log regression model. This methodological approach allows the coefficients to be interpreted as elasticities, providing a clear measure of the proportional impact of each variable on GDP per capita. In particular, it seeks to determine which of these components has a greater weight in the dynamics of economic growth and whether the results are consistent with theories of human capital and endogenous growth.

The relevance of this study lies in its ability to provide empirical evidence to support the formulation of more efficient and targeted public policies. In a context of budgetary constraints, it is crucial to identify what type of social investment generates the highest returns in terms of productivity and well-being. In addition, the research contributes to the Latin American literature by offering an updated analysis of the relationship between social spending and economic growth, considering the particularities of the Ecuadorian case.

The general hypothesis is that both education and health spending have a positive impact on economic growth, although the impact of health spending is expected to be more immediate and greater in magnitude. This approach is based on the idea that improvements in health have a direct impact on the working capacity of the population, while the effects of education take longer to materialize. This temporal differentiation is essential for understanding the short- and long-term dynamics that characterize the relationship between human capital and economic growth.

In practical terms, the results of this research can guide the allocation of resources to strategic sectors in order to maximize their impact on economic development. They can also serve as input for designing intersectoral policies that integrate education and health as

complementary pillars of an inclusive and sustainable growth model. Such an approach is consistent with the recommendations of international organizations such as the Organization for Economic Cooperation and Development (OECD, 2010), which emphasize the need to prioritize the quality and efficiency of social spending over its mere quantitative expansion.

In summary, this study highlights the importance of rigorously analyzing the effect of public investment in human capital on Ecuador's economic growth. Beyond theoretical debates, the study seeks to offer robust empirical evidence to evaluate the effectiveness of the policies implemented in the last two decades and to provide concrete elements for the design of development strategies. The combination of theory, evidence, and statistical analysis forms the basis of this article, whose ultimate purpose is to contribute to the understanding of the mechanisms through which education and health become engines of economic and social progress.

Materials and Methods

This research takes a quantitative explanatory approach, aimed at analyzing the causal relationship between public investment in human capital, measured through spending on education and health, and Ecuador's economic growth during the period 2000–2023. The design adopted corresponds to a non-experimental time series study, since the independent variables were not manipulated but observed as they occur in economic reality. The main purpose was to estimate the effect of these social investments on per capita gross domestic product (GDP), using a double logarithmic (log-log) multiple regression model. This approach allowed the coefficients to be interpreted as elasticities, which facilitates understanding of the proportional impact of changes in public spending on economic growth.

The study used secondary data collected from official and publicly available sources. Information on real GDP per capita, expressed in constant 2015 dollars, was obtained from the Central Bank of Ecuador (BCE) and the World Bank. Data on public spending on education and health, expressed as a percentage of GDP, were collected from the National Institute of Statistics and Census (INEC), the Ministry of Finance, the Ministry of Education, and the Ministry of Health. The selection of these sources ensured consistency and reliability in the measurement of variables, as well as allowing for comparability of the series over time.

The dependent variable was real GDP per capita, considered an indicator of economic growth. The independent variables were public spending on education and public spending on health, both expressed as a proportion of GDP. These were incorporated into the econometric model transformed by natural logarithm, with the purpose of stabilizing variance, reducing heteroscedasticity problems, and facilitating the interpretation of coefficients as elasticities.

The methodological procedure comprised several stages. First, a descriptive analysis of the variables was performed to identify trends, fluctuations, and general behavior during the study period. Subsequently, stationarity tests were applied using the augmented Dickey-Fuller test to verify the suitability of the time series. Once statistical validity was assured, the log-log regression model was estimated using Stata statistical software.

To ensure the robustness of the results, diagnostic tests were implemented. Multicollinearity was evaluated by calculating the variance inflation factor (VIF), ruling out the presence of problematic correlations between the independent variables. The homoscedasticity of the residuals was verified using the Breusch-Pagan test, while the normality and symmetry of the errors were analyzed using histograms and scatter plots. These procedures ensured compliance with the classical assumptions of multiple linear regression and strengthened the reliability of the estimates.

The statistical analysis included the estimation of the elasticity coefficients of GDP per capita with respect to spending on education and health, as well as the significance test of each parameter using p-values. Likewise, the goodness of fit of the model was evaluated using the coefficient of determination R^2 and its adjusted version. The results obtained were contrasted with human capital economic theory and with previous studies in Latin America and internationally, in order to enrich the discussion and identify possible limitations.

In ethical terms, the use of secondary data from official and public sources ensured the transparency of the research process and eliminated risks associated with confidentiality or manipulation of information.

The methodology adopted was characterized by a rigorous and systematic approach, integrating descriptive analysis, applied econometrics, and statistical validation procedures. This methodological framework provided the necessary basis for accurately

identifying the effect of public investment in human capital on Ecuador's economic growth, contributing solid evidence to the academic debate and the formulation of public policies.

Results

Elasticity of GDP per capita with respect to public spending on education

The first objective of the research was to estimate the elasticity of GDP per capita with respect to variations in public spending on education. The log-log model showed a positive and statistically significant coefficient, confirming the direct relationship between the two variables.

Table 1. *Elasticity of GDP per capita with respect to education spending*

Variable	Coefficiente β	Error estándar	p valor	Intervalo de confianza 95%
ln(Gasto en educación)	0.1098	0.0335	.004	[0.0400, 0.1795]

Note. Log-log estimation with 24 observations (2000–2023).

The result indicates that a 1% increase in education spending generates, on average, a 0.11% increase in GDP per capita. Although the effect is positive and significant, it is evident that its impacts tend to materialize in the long term, consistent with the literature on human capital accumulation.

Elasticity of GDP per capita with respect to public spending on health

The second objective was to assess the elasticity of GDP per capita with respect to public health expenditure. The model showed a higher coefficient than that for education, suggesting a more immediate impact of this variable.

Table 2. *Elasticity of GDP per capita with respect to health expenditure*

Variable	Coefficiente β	Error estándar	p valor	Intervalo de confianza 95%
ln(Gasto en salud)	0.3410	0.0827	<.001	[0.1689, 0.5131]

Note. Log-log estimation with 24 observations (2000–2023).

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A 1% increase in public health spending is associated with a 0.34% increase in GDP per capita. This finding shows that health contributes more immediately to the productivity and economic well-being of the population.

Statistical significance of the variables

The third objective sought to verify the significance of the independent variables. The econometric results confirmed that both education and health have coefficients other than zero, with high statistical significance.

Table 3. *Significance test of the model coefficients*

Variable	Estadístico t	p valor
ln(Gasto en educación)	3.28	.004
ln(Gasto en salud)	4.12	<.001

Note. Values estimated with a 95% confidence level.

These results reject the null hypothesis of no relationship and validate the role of human capital as a determinant of economic growth in Ecuador.

Validity of the econometric model

The fourth objective was to evaluate the robustness and statistical validity of the estimated model. To this end, standard diagnostic tests were applied.

Table 4. *Validation tests of the econometric model*

Prueba	Estadístico p valor		Interpretación
Factor de inflación de varianza	VIF < 5	—	No hay multicolinealidad
Breusch-Pagan (heterocedasticidad)	$\chi^2 = 0.56$.4528	Se confirma homocedasticidad
Análisis gráfico de residuos	—	—	Residuos distribuidos aleatoriamente

Note. Evaluations performed on the log-log model with 24 observations.

The diagnostics confirmed the statistical validity of the model: absence of problematic collinearity, homoscedasticity in the errors, and adequate functional specification.

Overall, the results show that public spending on health has a greater and more immediate impact on economic growth than spending on education. However, both components of human capital contribute positively to GDP per capita and are statistically significant. The validity of the econometric model supports the robustness of the estimates, allowing us to move on to a discussion of their theoretical and public policy implications.

The findings of this research confirm that public investment in human capital has a positive and statistically significant effect on Ecuador's economic growth in the period 2000–2023. However, the impacts are not equally pronounced in the education and health sectors, which allows us to reflect on the differential mechanisms through which each dimension of human capital affects productivity.

The first result showed that spending on education, although significant, has a relatively low elasticity coefficient (0.11). This finding is consistent with the human capital theory of Schultz (1961) and Rees

(1965), who argue that education is an investment with cumulative and long-term effects. The fact that the magnitude is moderate can be explained by the deferred nature of educational benefits, since increases in schooling and teaching quality take time to translate into a more productive workforce. Research such as that of Barro (1991) and Mankiw et al. (1992) has shown that the effects of education are more noticeable over extended time horizons, which is consistent with the results obtained in this study.

The second result showed that health spending has a higher impact on GDP per capita (elasticity of 0.34). This result is consistent with the approaches of Grossman (1972), who conceptualizes health as a stock of human capital that increases the number of active days and reduces productivity losses due to illness. Similarly, Lucas (1988) and Romer (1990) suggest that improved health conditions enhance learning capacity and knowledge utilization, generating multiplier effects in the economy. In the Ecuadorian context, these findings can be interpreted as a reflection of the policies to expand access to health services implemented since the 2000s, which had more immediate impacts on the well-being and labor productivity of the population.

The third result, related to the statistical significance of the variables, reinforces the importance of human capital in explaining economic growth. P-values below 0.01 in both estimates allow us to reject the null hypothesis and empirically confirm what is maintained in endogenous growth models. In particular, the research by Hanushek and Woessmann (2012) emphasizes that the quality of education and cognitive skills play a decisive role in economic development, while Psacharopoulos and Patrinos (2004) underscore that returns on investment in education are high in developing countries. Although the coefficient for education in this study is lower than that for health, its significance validates that education remains an essential component of economic growth.

The fourth result, concerning the validation of the econometric model, confirmed the statistical robustness of the estimates. The absence of multicollinearity, the homoscedasticity of the residuals, and the correct functional specification of the model support the reliability of the results. These methodological elements strengthen the conclusion that the observed impacts are not the result of specification errors, but rather of robust causal relationships. This methodological aspect is crucial, given that previous studies in Latin America have pointed out

the importance of applying rigorous techniques to avoid bias and ensure reliable estimates (Cerquera et al., 2022).

In comparative terms, the results are consistent with international evidence suggesting that the effects of health tend to manifest themselves more quickly than those of education. For example, Krueger et al. (2001) found that educational investments require a favorable institutional context and longer time frames to generate significant economic returns. Similarly, OECD (2010) studies highlight that the quality of education spending is as important as its quantity, which could explain why the education coefficient in Ecuador is positive but moderate.

The Ecuadorian case also highlights the interaction between fiscal constraints and spending efficiency. Although the country has increased the percentage of GDP allocated to education and health in recent decades, the effectiveness of these investments depends on factors such as resource management, curriculum relevance, and health service coverage. Thus, the findings of this study suggest that it is not only necessary to maintain adequate levels of investment, but also to improve the efficiency and targeting of public spending to maximize its impact on economic development.

In summary, the discussion of the results supports the general hypothesis that public investment in human capital is a fundamental determinant of economic growth in Ecuador. However, it also highlights the need to differentiate between the immediate effects of health and the longer-term effects of education, as well as the importance of strengthening the quality and efficiency of related public policies. This reflection paves the way for the formulation of policy strategies that integrate both dimensions of human capital as complementary pillars of sustainable development.

Conclusions

This study showed that public investment in human capital, represented by spending on education and health, is a determining factor in Ecuador's economic growth during the period 2000–2023. The log-log model estimate identified that both variables have a positive and statistically significant effect on per capita gross domestic product, albeit to different degrees. Health spending showed higher elasticity (0.34), indicating that its impacts are more immediate on the

productivity and well-being of the population. Education spending, on the other hand, showed positive but more moderate elasticity (0.11), reflecting that its benefits materialize over longer periods, associated with the progressive accumulation of skills and knowledge in the labor force.

These findings confirm the hypothesis put forward in this paper and support the theoretical postulates of Becker (1993), Lucas (1988), and Romer (1990), who highlight human capital as an engine of sustained economic growth. They also agree with Grossman's (1972) empirical evidence regarding the importance of health as a form of productive capital, and with Hanushek and Woessmann's (2012) arguments on the decisive role of educational quality. A comparison with previous studies in Latin America leads to the conclusion that Ecuador shares a common pattern with the region: the need to simultaneously strengthen education and health in order to achieve inclusive and sustainable development (Losada et al., 2022).

In terms of public policy, the results suggest that, while it is essential to maintain adequate levels of spending in both sectors, the priority should be to ensure the efficiency and quality of investment. In education, this implies directing resources toward improving teacher quality, curriculum relevance, and reducing regional gaps. In health, it is necessary to consolidate accessible primary care systems, strengthen infrastructure, and ensure the financial sustainability of services. The articulation of these measures with economic development strategies will enhance synergies between both sectors and maximize their impact on national productivity.

Finally, this study highlights that social investment should not be considered an expense, but rather a key strategy for competitiveness and long-term economic growth. The evidence presented constitutes a call to consolidate intersectoral policies in education and health as pillars of a sustainable development model for Ecuador, capable of addressing structural challenges, reducing inequalities, and improving the quality of life of the population.

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