



Colombia's metropolitan areas: engines of economic development and crucial sources of employment opportunities

Las áreas metropolitanas de Colombia: motores del Desarrollo económico y fuentes cruciales de oportunidades de empleo



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ABSTRACT

The general objective of this study is to conduct a comprehensive analysis of education returns in the metropolitan areas of Colombia. The aim is to understand the relationship between investment in academic training and the outcomes in terms of income, labor mobility, and professional development of individuals. Additionally, the study seeks to assess the impact of these factors on the competitiveness, innovation, and sustainable development of these urban areas. The methodology employed adopts a quantitative approach. A micro econometric model was implemented using Mincerian equations, utilizing data from the Integrated Household Survey (GEIH) provided by DANE for the period between 2018 and 2022. This analysis focuses on the metropolitan areas of Colombia, with Bogotá as the reference point. As the main conclusion, the data reveal the presence of a gender gap in the metropolitan areas. It is noteworthy that the highest education returns are primarily observed in Bogotá, followed by Medellín and Manizales in the second and third positions, respectively, for both the female and male subsamples. This finding contributes to a deeper understanding of the educational and labor dynamics in these urban areas.

Palabras clave: Colombia, Market economy, Transitioning economies, Employment, labor.

RESUMEN

El objetivo general de este estudio es realizar un análisis integral de los retornos de la educación en las áreas metropolitanas de Colombia. El objetivo es comprender la relación entre la inversión en formación académica y los resultados en términos de ingresos, movilidad laboral y desarrollo profesional de las personas. Además, el estudio busca evaluar el impacto de estos factores en la competitividad, la innovación y el desarrollo sostenible de estas áreas urbanas. La metodología empleada adopta un enfoque cuantitativo. Se implementó un modelo micro econométrico mediante ecuaciones mincerianas, utilizando datos de la Encuesta Integrada de Hogares (GEIH) proporcionada por el DANE para el período 2018-2022. Este análisis se centra en las áreas metropolitanas de Colombia, teniendo a Bogotá como punto de referencia. Como principal conclusión, los datos revelan la presencia de una brecha de género en las áreas metropolitanas. Es de destacar que los retornos educativos más altos se observan principalmente en Bogotá, seguida de Medellín y Manizales en la segunda y tercera posición, respectivamente, tanto para la submuestra femenina como para la masculina. Este hallazgo contribuye a una comprensión más profunda de la dinámica educativa y laboral en estas áreas urbanas.

Keywords: Colombia, Economía de mercado, Economías en transición, Empleo, trabajo.

1. INTRODUCTION

Metropolitan areas in Colombia play a central role in the country's economic development, serving as genuine hubs of employment opportunities. This analysis aims to examine the impacts of education in these areas, specifically those most relevant to the Gross Domestic Product (GDP) of the State of Colombia (National Administrative Department of Statistics - DANE, 2022). The goal is to understand how investment in academic training affects individuals' professional trajectories and economic indicators. "Returns to education," from the perspective of human capital theory, refer to the economic and non-economic benefits derived from educational investment (Becker, 1983; Schultz, 1960), especially in the context of Colombia's metropolitan areas, where these returns can be significant and vary based on educational levels and employment sectors (Becker, 2003; Gómez et al., 2015).

In these urban areas, a diversity of educational institutions is identified, ranging from local schools to prestigious universities (Gómez, 2013; Yamada, 2007). Although access to higher education is generally more accessible than in rural areas, challenges related to equity and educational quality persist. This context establishes the necessary framework for understanding returns on education investment in the metropolitan labor market (Álvarez et al., 2021; Basten & Haamann, 2018).

Individuals who invest in education in metropolitan areas experience substantial economic returns, especially in high-demand sectors such as technology, finance, and health (Salcedo, 2013; Galvis, 2010). The connection between higher education levels and higher salaries is palpable, standing out in a highly competitive metropolitan labor market that favors those with specialized skills and advanced academic training (Vera & Blanco, 2019; Escobar & Paternina, 2017). Higher education not only expands job opportunities but also facilitates access to roles of greater responsibility. Professionals with university degrees have greater chances of leading and participating in innovative sectors, contributing to dynamism and innovation in these urban areas (Rodríguez, 2016; Salas 2004).

The central hypothesis of this article asserts that investment in education in Colombia's metropolitan areas generates significant returns in terms of income, labor mobility, and

professional development. It is anticipated that this relationship between education and career success will be more pronounced compared to non-metropolitan areas, given the greater competitiveness and diversity of opportunities present in these urban environments.

Finally, the guiding question for this research is as follows: How is the relationship configured between investment in education and economic returns, labor mobility, and the impact on competitiveness, innovation, and sustainable development in Colombia's metropolitan areas, ¿considering the dynamics of these urban environments and their influence on the construction of professional trajectories and the socio-economic development of individuals?

2. METHODOLOGY

The primary database utilized in this study is derived from microdata of the Integrated Household Survey (GEIH) for the years 2018-2019-2021-2022. From a scientific perspective, surveys stand out as a vital tool for understanding social phenomena and, in this context, are widely employed in Labor Economics research (Barbosa et al., 2020; Freire & Terjeiro, 2010).

Within the framework of this analysis, the estimation of the income function is adopted, following the approach proposed by Mincer (1974). This methodology enables the calculation of returns on variables related to Human Capital in the wage incomes of metropolitan areas during the study period (Rincón et al., 2017; Isaza, 2013). Mincer Equation 1, used in this analysis, offers a deeper perspective by estimating the reciprocity that Human Capital variables have on the logarithm of labor income. This approach proves to be a valuable tool for understanding income dynamics in these specific urban areas (Riascos & Erazo 2010; Mincer, 1970).

$$\ln(y)=\beta_0+\beta_1S+\beta_2\text{exp}+\beta_3\text{exp}^2+\epsilon \quad (1)$$

Where: Y: income of the individual. S: number of years of formal education. Exp: number of years of work experience. ϵ : random term that cannot explain the model.

2.1. Microeconometric Model

$$\ln Y_i = \beta_0 + \beta_1 \text{expi} + \beta_2 \text{expi}^2 + \beta_3 \text{Edu1} + \beta_4 \text{Edu2} + \beta_5 \text{Disciplina} + \beta_6 \text{Disciplina1}_i + \beta_7 \text{Disciplina2}_i + \beta_8 \text{f1} + \epsilon \quad (2)$$

Within the econometric model used in this study (2), the methodology proposed by Heckman (1979) is implemented to correct the selection bias present when the analyzed individuals do not represent a random sample of the target population. Empirical evidence from global labor markets suggests that those participating in the labor market possess unobservable characteristics, such as motivation and ability, strongly associated with wages (Isaza & Reilly, 2011). The omission of these unobserved variables can result in the well-known omitted variable problem, distorting the coefficients of income equations (Heckman et al., 2003).

Heckman's procedure (3 and 4) addresses this issue by incorporating a selection term derived from the pseudo-residues of a probit model of labor participation. These pseudo-residues contain information about the unobservable variables associated with wages. Although the effect of each of these variables cannot be precisely determined, Heckman's procedure corrects the estimated betas of the other variables included in the model. This method introduces the variable λ , known as the correction term or the inverse of the Mills ratio (Isaza, 2003; 2002).

Additionally, differentiated wage equations will be estimated for men and women to identify the gender wage gap. The equations to be estimated are presented below.

$$\ln y_i = X_i \beta_i + \sigma_i \lambda_i + U_i \pi \tau^2 \quad (3)$$

$$\ln(W_m) = X_m \sigma_m \lambda_m + U_m \quad (4)$$

Where: W_i : Column vector of the logarithm of the hourly wage of the individual of sex i . X_i : Matrix containing the observed characteristics of the individuals. β_i : Vector of coefficients to be estimated. λ : Correction term. σ : Covariance between the unobservable factors affecting labor participation and those affecting wages. U_i : Random disturbance term, where $E(u) = 0$ (Gómez et al., 2015).

3. RESULTS

The results derived from the application of the Heckman procedure (1979) for the male subsample reveal patterns similar to those obtained for the female subsample (Gómez, 2014). Firstly, the lambda coefficients (3) indicate an absence of selection bias. Additionally, a statistically significant negative correlation at the 1% level is observed in the selected variables, suggesting that unobserved characteristics such as motivation, skills, and other attributes associated with productivity play a crucial role in determining individual incomes (Gómez & Barbosa, 2014; Schultz, 1961).

The variables linked to the Human Capital theory follow the trend described in the literature for this type of estimation. In particular, returns to potential work experience are significant at the 1% level in most cases, indicating that labor incomes tend to follow an upward trajectory that gradually slows down over the course of most occupational lifespans (Gómez & Rojas, 2015; Isaza, 2003). Moreover, education coefficients reflect the returns associated with each additional year of education, highlighting the importance of academic training in income determination (Gaspar, 2021; Becker et al., 1990).

To conclude, data from the year 2022 provided by DANE were used to delimit the analysis of education returns in the metropolitan areas of the Colombian State. This choice is based on the observation that three departments contribute significantly, representing 60% of the Gross Domestic Product (CEPAL, 2019). It is also noteworthy that data from the year 2020 were not used due to the presence of the pandemic, as substantial errors were identified that could distort the results (Martínez et al., 2020; UNICEF, 2020). It is important to note that the estimation results, both for the female and male subsamples, are presented in detail in Tables 1 and 2. These tables focus on Bogotá, which serves as the base within the 13 metropolitan areas of Colombia and represents the highest contributor to the GDP.

Table 1.*Male subsample*

Metropolitan areas	Year			
	2018	2019	2021	2022
Medellin	0,0712***	0,0718***	0,0747***	0,0801***
Barranquilla	-0,2157***	0.2294***	0.2241***	0.2163***
Cartagena	-0,1516***	-0,1556***	-0,1563***	-0,1544***
Manizales	-0,1221***	-0,1224***	-0,1235***	-0,1201***
Monteria	-0,3219***	-0,3258***	-0,3205***	-0,3268***
Villavicencio	-0,0708***	-0,0711***	-0,0729***	-0,0741***
Pasto	-0,4601***	-0,4618***	-0,4635***	-0,4643***
Cucuta	0,1115***	-0,1148***	0,1152***	0,1174***
Pereira	-0,1549***	-0,1571***	-0,1583***	-0,1564***
Bucaramanga	0,0546***	0,0568***	0,0574***	0,0539***
Ibague	-0,1625**	-0,1648**	-0,1612**	-0,1626**
Cali	-0,1870***	-0,1878***	-0,18783***	-0,1901***

Table 2.*Female subsample*

Metropolitan areas	Year			
	2018	2019	2021	2022
Medellin	-0,0517***	-0,0525***	-0,0545***	-0,0533***
Barranquilla	-0,3312***	-0,3319***	-0,3324***	-0,3381***
Cartagena	-0.2301***	-0.2344***	-0.2351***	-0.2384***

Manizales	-0,0981***	-0,0988***	-0,0101***	-0,0984***
Monteria	-0,3561***	-0,3568***	-0,3573***	-0,3577***
Villavicencio	-0,1051***	-0,1087***	-0,1048***	-0,1064***
Pasto	-0,4139***	-0,4162***	-0,4113***	-0,4132***
Cucuta	-0,1032***	-0,1041***	-0,1056***	-0,1072***
Pereira	-0,1027***	-0,1033***	-0,1018***	-0,1044***
Bucaramanga	-0,0459***	-0,0451***	-0,0474***	-0,0489***
Ibague	-0,3068**	-0,3087**	-0,3095**	-0,3101**
Cali	-0,1456***	-0,1435***	-0,1477***	-0,1498***

Source: of both tables, Dane DATA

Robust standard errors in brackets. *** denotes significance at 1%, ** denotes significance at 5%, * denotes significance at 10%. denotes significance at 10%. Base category is Salesperson, Shop Assistant. The names of the trades, occupations and professions are taken from the page http://www.ilo.org/public/libdoc/ilo/1969/69B09_35_span.pdf. Last accessed 30/11/2023

The results obtained for both the male and female subsamples reflect consistency with the specialized literature on human capital (Zambrano, 2019; Psacharopoulos & Patrinos, 2002). Firstly, the data indicate the existence of a gender gap. Although women, on average, exhibit superior both soft and hard skills and have a lower school dropout rate, their educational outcomes, with similar job characteristics, are inferior to those of men (Mosquera, 2013; Callejas et al., 2003). Secondly, it is observed that the higher returns to education in metropolitan areas, compared to Bogotá, the capital, align with territories that have higher business activity.

In particular, the metropolitan areas of Medellín, Manizales, and Bucaramanga stand out, obtaining the highest educational returns for both the female and male subsamples. These findings coincide with the data from the year 2022, where Bogotá and the departments of

Valle and Antioquia contribute 50% to Colombia's GDP, reflecting an amount of 1,465.52 billion Colombian pesos at current prices (DANE, 2020; 2022; Gaviria, 2015).

Moreover, the data indicate that, in general, metropolitan areas that are more competitively and, in some cases, geographically distant from Bogotá, show lower returns to education (Ministry of Commerce, Industry, and Tourism, 2020; Romashkina et al., 2020). For example, both in the Caribbean Region with the metropolitan areas of Cartagena, Barranquilla, and Montería, and in the Pacific Region with Pasto, and in the Andean Region with Cúcuta, lower educational returns are evident in both subsamples

4. DISCUSSION

Investment in education in metropolitan areas plays a fundamental role in facilitating both social mobility and professional development of individuals (Gómez & Rojas, 2014; Becker, 1964). Those with a solid academic background are better prepared to adapt to changing work environments and seize growth opportunities within their careers. Additionally, the association between education and employability allows professionals to successfully overcome emerging labor challenges (Maldonado, 2021; Hernández et al., 2010).

In a metropolitan environment characterized by competition and constant economic dynamics, education becomes a determining factor for labor productivity and competitiveness (Aburto & Bonales, 2011; Laverde et al., 2020). Individuals with advanced technical skills and specialized knowledge contribute significantly to the economic development of metropolitan areas (Téllez et al., 2022; Hinojo et al., 2020). The ability to innovate and adapt to changing demands of the labor market improves significantly with continuous education (Rincón & Gómez, 2023; Maturana & Andrade, 2019).

The influence of education in metropolitan areas goes beyond purely economic aspects, extending to the realm of sustainable development (Becker, 2002; Suarez, 2018). Educated professionals are more inclined to participate in civic initiatives, promote responsible business practices, and advocate for sustainable development (Vera & Blanco, 2019; Angulo,

2017). The intrinsic connection between education and social responsibility strengthens the foundation for sustainable and equitable growth in these metropolitan areas (Álvarez et al., 2018; Ibagón & Gómez, 2018).

5. CONCLUSIONS

The data suggests the presence of a gender gap in metropolitan areas, where the highest returns to education are observed, firstly in Bogotá, followed by Medellín and Manizales in second and third place, respectively, for both the female and male subsamples.

Returns to education in the metropolitan areas of Colombia are evident across various dimensions, ranging from economic to social aspects. Investment in education emerges as a key catalyst for individual and collective progress in these dynamic environments. To fully harness these returns and ensure inclusive development, it is essential to continue strengthening education policies that promote equity and quality in the country's metropolitan areas.

It is crucial to note that returns to education in Colombia can be significant and vary depending on the educational level and employment sector. However, it is important to recognize that these returns may also be influenced by diverse factors, such as the individual's socioeconomic level and government policies regarding education and employment. In this regard, the continuous improvement of these policies emerges as an essential element to maximize the benefits of educational investment in the country.

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CONFLICTO DE INTERÉS

No existe conflicto de interés por parte de los autores

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DECLARACIÓN DE RESPONSABILIDAD AUTORAL

Dustin Tahisin Gómez Rodríguez: conceptualización, metodología, análisis formal, desarrollo de resultados, redacción – borrador inicial.

Ehyder Mario Barbosa Pérez: metodología, análisis formal, desarrollo de resultados, visualización, redacción – revisión y edición.

Carlos David Martínez Ramírez: supervisión, validación, revisión del documento final.