

Assessing the effects of education investment policies in Brazil: Evidence from a CGE model with endogenous human capital

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The economic literature characterizes human capital as a set of knowledge and skills that enhance individuals'™ productive capacity, generating positive systemic effects on both production and demand for goods and services in the economy (Schultz, 1959, 1960, 1961; Becker, 1962). Such effects may stem from policies aimed at expanding the education sector, an economic activity that plays a strategic role in human capital formation as well as in the production of research and development (R&D) within a country.

Based on this hypothesis, this study examines the role of education in human capital formation and knowledge production in Brazil by evaluating the economic effects of educational investments on the country's™ production system, labor market, and R&D activities. To this end, we employ a national recursive dynamic Computable General Equilibrium (CGE) model with endogenous labor supply, developed specifically for this research. The model builds upon an existing CGE framework that incorporates a stock–flow relationship between R&D investment and knowledge capital. We extend this framework by introducing a module that determines workers'™ qualifications based on years of schooling and relative wages across educational levels.

From a methodological perspective, the model specifies the channels through which public spending on education influences human capital formation, assuming that such investments increase average years of schooling and, consequently, expand the stock of human capital and the supply of skilled labor. Labor is disaggregated by skill level according to workers'™ educational attainment (low, medium, and high). Drawing on Yeo and Lee (2020) and Jung and Thorbecke (2003), the stock of human capital, represented by skilled labor, is treated as endogenous and determined by two components: educational investment and relative wages, reflecting the expected returns to qualification. In addition, wage differentials associated with each additional year of schooling are calibrated using parameters estimated from an econometric model, following the frameworks of Mincer (1974) and Heckman (1977, 1979). These parameters are then used to update labor supply wage vectors by skill level.

The CGE model is calibrated using a Social Accounting Matrix (SAM) constructed from the 2015 national Input–Output Tables provided by the Brazilian System of National Accounts (IBGE, 2024). The original database includes 127 products and 67 economic sectors, which are aggregated into 28 productive activities responsible for the production of 126 products. In addition to production sectors, the SAM includes households, government, and the rest of the world, with households grouped into four income classes. Behavioral parameters and elasticities estimated in the literature, such as Armington elasticities, export demand elasticities, and the Frisch parameter, are also incorporated into the calibration.

Inspired by the Brazilian National Education Plan (PNE), which targets public education investment equivalent to 10% of GDP over a ten-year horizon, we simulate four hypothetical education expansion scenarios. The first two scenarios involve increases in public spending on education aimed at raising its share of GDP: (i) a 10% increase over 10 years and (ii) a 10% increase over 20 years. The remaining two scenarios simulate equivalent government expenditures in the form of subsidies to private education.

The results indicate that expanding public investment in education generates positive impacts on GDP, human capital accumulation, R&D activity, and knowledge capital stocks in the medium and long run. In contrast, subsidies to private education produce negative effects on economic growth. Nevertheless, all scenarios lead to an increase in the number of skilled workers, supporting human capital accumulation in Brazil. While policies subsidizing private education are more efficient in expanding the human capital stock, public education investments are more effective in promoting R&D and knowledge capital accumulation, underscoring their relevance for the country's technological development. Finally, our study highlights the importance of coordinated policies that promote education investment by both the public and private sectors and are more evenly distributed over time.

Ultimately, the main contributions of this research are: (i) the modeling of Brazilian labor supply within a CGE framework explicitly linked to educational attainment, allowing workers' decisions to reflect not only relative wages but also government-provided institutional conditions in the education system; and (ii) the extension of the policy debate, through simulations, on the role of public investment in both public and private education in shaping key dimensions of the Brazilian economy, including human capital formation, labor market performance, and R&D production.