Analyzing the Relationship Between GDP, Public Education Expenditure, and Illiteracy Rates, Education Level, and Economic Activity Participation in Brazil, Colombia and Peru (2002–2020)

Methods of Advanced Data Engineering

Canberk ARICI – 23583949

1. Introduction

1.1 Question

How do GDP and public expenditure on education relate to selected educational outcomes in Brazil, Colombia and Peru from 2002 to 2020, specifically in terms of illiteracy rates, population with 13 years or more of education, and economic activity participation among the population with 13 years or more of education?

1.2 Motivation

Education is the backbone of development and economic growth, yet it remains unequal in access and outcomes in Latin America. This project examines how GDP and public expenditure on education correlate with key educational outcomes in Brazil, Colombia, and Peru between 2002 and 2020. Focusing on illiteracy rates, the population with 13 or more years of education, and their economic activity participation, to explore the effect of economic factors on educational opportunities and outcomes.

2. Used Data

This dataset is a detailed record from three South American countries: Brazil, Colombia, and Peru, ranging from the year 2002 to 2020. The data is first stored in the .db file and later transformed into this DataFrame format for analysis. It represents a wide range, has key indicators related to economic performance and education, and is good for deriving meaningful insights and conducting cross-country analyses. For the dataset for all genders, in each of these countries include:

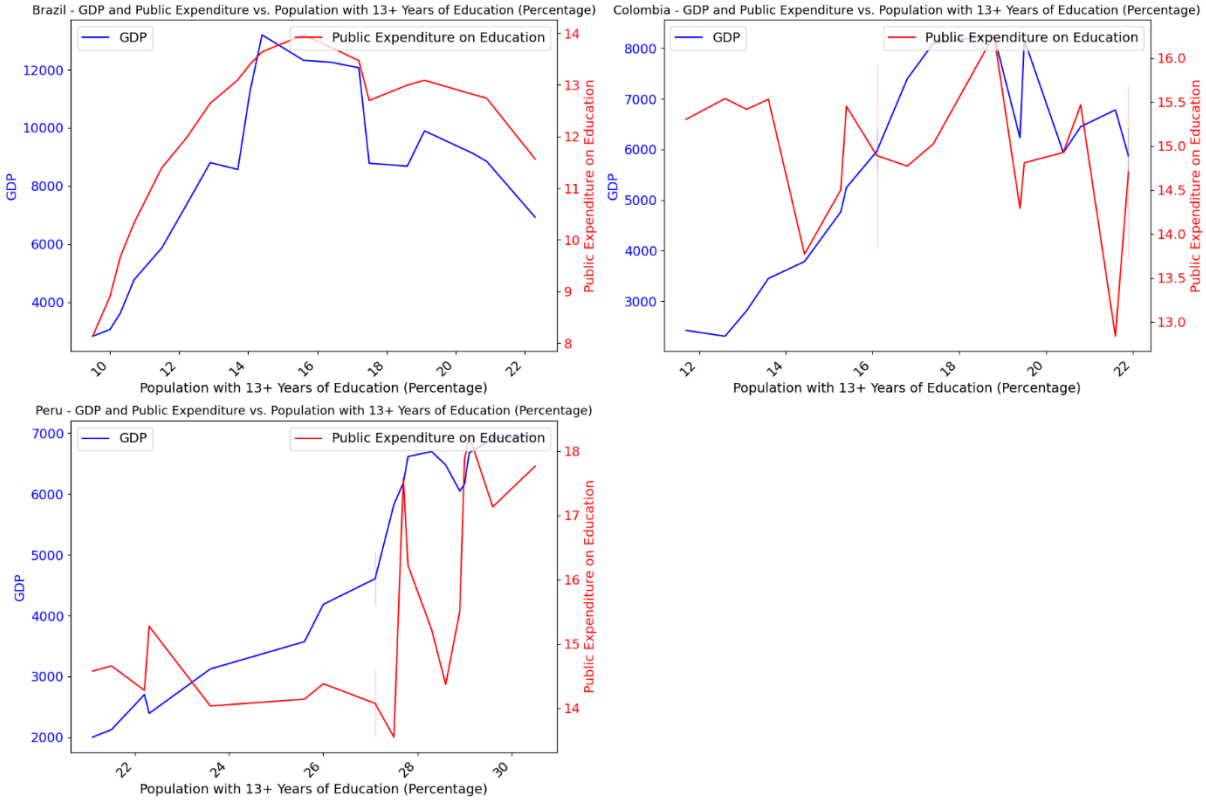
Population 15 years of age and older participating in economic activity, by years of education (*EconomicActivityParticipation*), GDP per capita (current US$) (*GDP*), Illiteracy rates (*IlliteracyRates*), Public expenditure on education (*PublicExpenditure*), and Population 15 years of age and older, by years of education (*YearsOfEducation*), along with a *Year* column representing the timeline. The *Year* column is of data type int64, while all other columns are of data type float64.

2.1 License

This analysis uses data from the World Bank Data Catalog [1] and CEPAL Statistics [2]. World Bank data is under the CC-BY 4.0 license, attributed as: *"The World Bank: The World Bank Data Catalog under the CC-BY 4.0 License."* CEPAL Statistics data is for educational and non-commercial use, attributed as: *"Economic Commission for Latin America and the Caribbean (ECLAC), CEPALSTAT."* Both sources comply with their licensing terms.

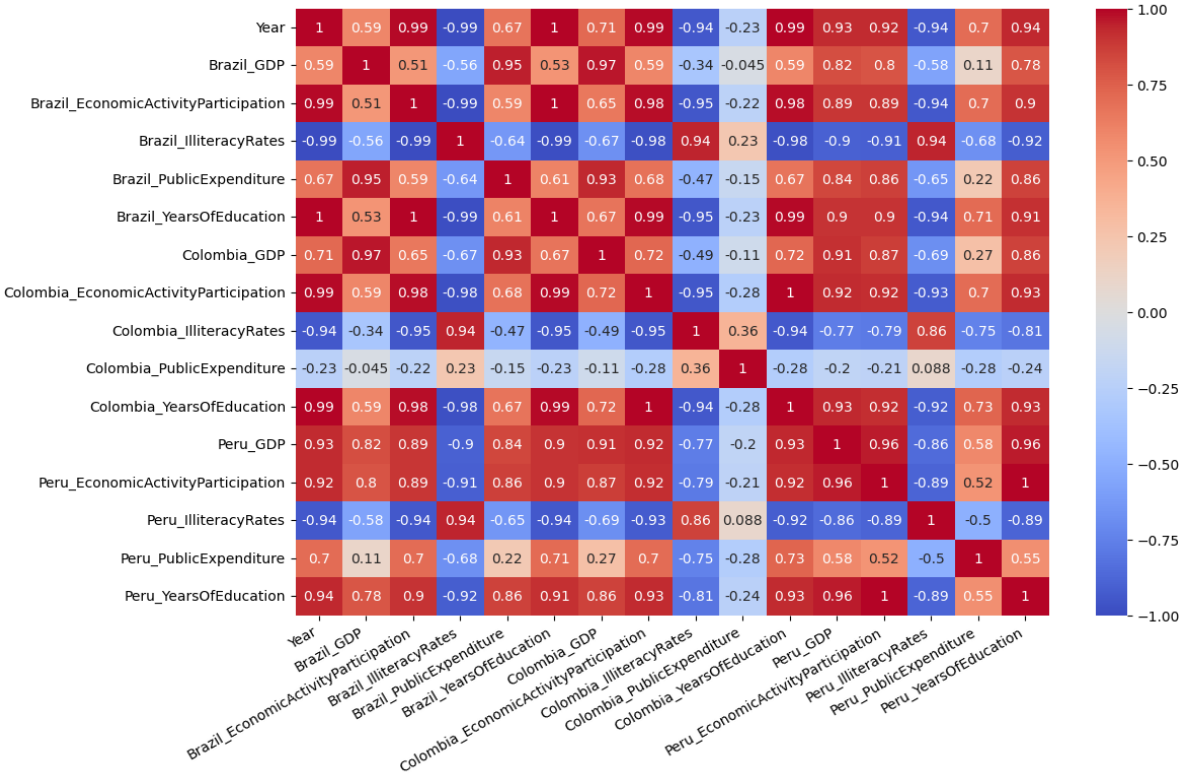
3. Analysis

Comparison of GDP and Public Expenditure vs. Percentage of Population with 13+ Years of Education in Brazil, Colombia, and Peru



The line plots highlight the relationship between GDP, Public Expenditure on Education, and the Population with 13+ Years of Education in Brazil, Colombia, and Peru between 2002 and 2020. For Brazil, there is a positive correlation. Both GDP and Public Expenditure on Education are generally increasing with a rise in Population with 13+ Years of Education, showing good relationship between GDP and investment in education. However, Colombia shows fluctuations. Public expenditure on education declines at certain higher education levels despite GDP growth, suggesting inefficiencies or external factors influencing educational funding. In Peru, public expenditure on education is highly volatile. Despite GDP increasing steadily, indicating challenges in maintaining consistent investment.

Correlation Matrix of Variables



3.1 Brazil

In Brazil, GDP is moderately positively correlated with both Population with 13+ Years of Education (0.53) and Economic Activity Participation (0.51), indicating that GDP has a positive though moderate influence on education and economic participation. The strong correlation between GDP and Public Expenditure on education (0.95) highlights how GDP facilitates increased funding for education. Public expenditure is positively correlated with Population with 13+ Years of Education (0.61) and Economic Activity Participation (0.59), suggesting that although effects may be gradual, education spending is related to better educational outcomes and higher economic participation. The perfect correlation (1.00) between Population with 13+ Years of Education and Economic Participation highlights the direct relationship between the two features. The strong negative correlation (-0.99) between Illiteracy rates and Economic Activity Participation highlights the importance of economic investment in decreasing illiteracy and increasing economic participation.

3.2 Colombia

In Colombia, GDP is positively correlated with both Population with 13+ Years of Education (0.72) and Economic Participation (0.72), indicating that GDP supports education and economic participation. However, the weak negative correlation between GDP and Public Expenditure on Education (-0.11) shows that GDP has a limited impact on education funding. The negative correlation between GDP and Illiteracy Rates (-0.49) shows that GDP helps reduce illiteracy.

Public Expenditure on Education has weak negative correlations with both Population with 13+ Years of Education (-0.28) and Economic Activity Participation (-0.28) suggesting that increased education spending does not necessarily lead to better educational or economic outcomes. The positive correlation with Illiteracy Rates (0.36) points to possible inefficiencies in how education funds are allocated. Strong negative correlation between Illiteracy Rates and Economic Activity Participation (-0.95) shows the role of education in improving economic participation. The perfect correlation (1.00) between Population with 13+ Years of Education and Economic Participation highlights their direct relationship.

3.3 Peru

In Peru, GDP shows a strong positive correlation with both Population with 13+ Years of Education (0.96) and Economic Activity Participation (0.96), suggesting that GDP significantly influences education and economic participation. The negative correlation between GDP and illiteracy rates (-0.86) suggests that GDP helps reduce illiteracy. Public Expenditure on Education is moderately positively correlated with GDP (0.58) and Population with 13+ Years of Education (0.55), indicating that although education spending is beneficial, it is not the only factor influencing these outcomes. The negative correlation with illiteracy rates (-0.50) suggests that public spending contributes to reducing illiteracy, but other factors also seem to play a significant role. Finally, the perfect correlation (1.00) between Population with 13+ Years of Education and Economic Participation highlights their direct relationship.

4. Conclusion

This study explores the relationship between GDP, public education spending, and educational outcomes in Brazil, Colombia, and Peru from 2002 to 2020.

In Brazil, strong correlation of GDP with education spending and educational outcomes indicates that GDP is key driver of educational progress. In Colombia, despite positive GDP growth, the weak negative correlation between GDP and education spending points to inefficiencies in resource allocation. Higher spending does not effectively reduce illiteracy. Peru shows a similar trend, with GDP improving educational outcomes, but public expenditure on education remains volatile. This presents challenges in sustaining investment.

While GDP contributes to reducing illiteracy in Brazil and Peru, the results for Colombia reflect the difficulties of managing education funding. These findings show the importance of resource allocation efficiently to improve the impact of education spending.

This study has limitations such as the absence of regional differences in education spending and other socio-economic factors that may influence educational outcomes. Further research is needed to better understand these complex relationships between GDP growth, public education spending, and educational outcomes, which will help in developing more targeted and effective educational policies.

5. References

[1] World Bank Group Data Catalog - The World Bank: The World Bank Data Catalog under the CC-BY 4.0 License (https://datacatalog.worldbank.org/home)

[2] Economic Commission for Latin America and the Caribbean (ECLAC), CEPALSTAT (https://statistics.cepal.org/portal/cepalstat/open-data.html)

6. Disclaimer

In this study, grammarly.com was used for grammar check. The final versions of the sentences were checked by me and I am responsible.