

The Role of Infrastructure in Economic Growth: Analyzing Electricity Production and GDP Growth

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This study examines the relationship between electricity production and economic growth in Latin America from 2009 to 2014. Electricity production, measured in kilowatt-hours per capita, and GDP growth, recorded as annual percentage change, are analyzed using data integration, correlation, and trend analyses. The heatmap showed a very weak link between electricity production and GDP growth, meaning electricity alone doesn't have a big impact on economic growth. Over the years, electricity use steadily increased, showing better infrastructure, but GDP growth was unstable, affected by outside factors. Countries varied: Chile had the biggest rise in electricity use, while Bolivia's economy stayed steady. This shows that many things affect economic growth, and more detailed studies are needed to understand how specific factors and patterns contribute.

I. QUESTION

How does electricity production (kWh per capita) correlate with economic growth (GDP growth) in Latin American countries from 2009 to 2014?

II. DATA SOURCES

Datasource1: World bank (Electricity production (kWh per capita)) [1]

* Data Type: Zip->CSV

*Description: This dataset contains the electricity production per capita for Latin American countries, which is a direct indicator of energy infrastructure.

Datasource2: World bank (GDP Growth (annual %)) [2]

* Data Type: Zip->CSV

*Description: This dataset measures the annual GDP growth (in constant prices) for the same countries, which reflects the economic performance over time.

A. Data Structure

The Electricity Production dataset is structured with temporal variables (year), categorical variables (country name and country code), and continuous variables (electricity production (kWh per capita)).

Country Name	Country Code	Indicator Name	Indicator Code	Year	Value
Argentina	ARG	Electric power consumption (kWh per capita)	EG.USE.ELEC.KH.PC	2009	2705.26146589616
Bolivia	BOL	Electric power consumption (kWh per capita)	EG.USE.ELEC.KH.PC	2009	539.422090547634
Brazil	BRA	Electric power consumption (kWh per capita)	EG.USE.ELEC.KH.PC	2009	2217.79002848663
Chile	CHL	Electric power consumption (kWh per capita)	EG.USE.ELEC.KH.PC	2009	3272.59731503103
Colombia	COL	Electric power consumption (kWh per capita)	EG.USE.ELEC.KH.PC	2009	1077.12537044961
Costa Rica	CRI	Electric power consumption (kWh per capita)	EG.USE.ELEC.KH.PC	2009	1853.64164691205
Cuba	CUB	Electric power consumption (kWh per capita)	EG.USE.ELEC.KH.PC	2009	1326.72623373809
Dominican Republic	DOM	Electric power consumption (kWh per capita)	EG.USE.ELEC.KH.PC	2009	1309.50520692317
Ecuador	ECU	Electric power consumption (kWh per capita)	EG.USE.ELEC.KH.PC	2009	1101.10958121143

Fig. 1. The Electricity Production

The GDP Growth dataset is structured with temporal variables (year), categorical variables (country name and country code), and continuous variables (GDP growth (annual %)).

Country Name	Country Code	Indicator Name	Indicator Code	Year	Value
Argentina	ARG	GDP growth (annual %)	NY.GDP.MKTP.KD.ZG	2009	-5.91852507634947
Bolivia	BOL	GDP growth (annual %)	NY.GDP.MKTP.KD.ZG	2009	3.35699957430565
Brazil	BRA	GDP growth (annual %)	NY.GDP.MKTP.KD.ZG	2009	-0.125812002161169
Chile	CHL	GDP growth (annual %)	NY.GDP.MKTP.KD.ZG	2009	-1.1180372326977
Colombia	COL	GDP growth (annual %)	NY.GDP.MKTP.KD.ZG	2009	1.13964864548062
Costa Rica	CRI	GDP growth (annual %)	NY.GDP.MKTP.KD.ZG	2009	-0.873455942787785
Cuba	CUB	GDP growth (annual %)	NY.GDP.MKTP.KD.ZG	2009	1.4513054307407
Dominican Republic	DOM	GDP growth (annual %)	NY.GDP.MKTP.KD.ZG	2009	0.946155167790621

Fig. 2. The GDP Growth

B. License

Both datasets used in this project, Electricity Production (kWh per capita) and GDP Growth (annual %), are licensed under the World Bank Open Data License [3]. This license allows the data to be used, shared, and modified for any purpose as long as the World Bank is properly credited as the source.

III. ANALYSIS

A. Data Integration

The integration process involved merging two datasets: one measuring electricity consumption per capita and the other capturing GDP growth percentages. These datasets were aligned using common identifiers such as country codes and years, ensuring consistency across variables. This unified dataset allowed for comparative analysis of trends, correlations, and country-specific insights. By combining energy and economic data, the project provides a comprehensive view of how electricity production and economic performance interact, laying the groundwork for further exploration of infrastructure development and its impact on growth.

B. Trends Over Time

This chart shows how much electricity people in different countries used every year from 2009 to 2014:

- Chile is on top, using the most electricity. Its usage kept going up each year and reached the highest by 2014.
- Bolivia is near the bottom, using much less electricity than Chile, but it also slowly increased every year.

- Uruguay, Argentina, and Brazil are in the middle, using a lot of electricity, but not as much as Chile.

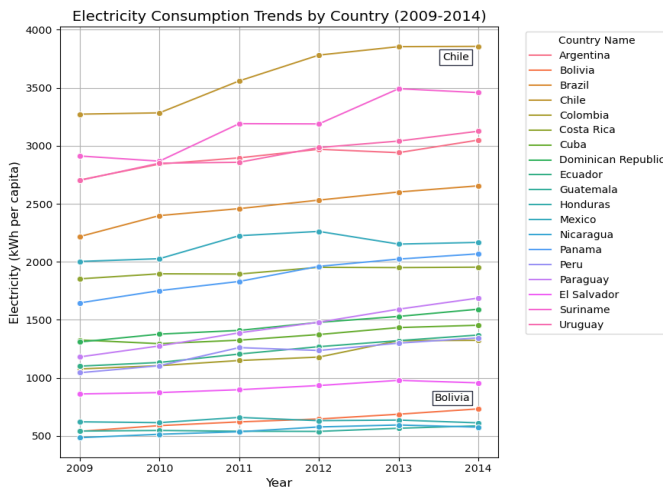


Fig. 3. Electricity Consumption Trends Over Time (2009–2014)

This chart shows how much the economies of different countries grew each year from 2009 to 2014.

- Panama grew the fastest and stayed on top most of the time, especially in 2010 when it grew the most.
- Argentina had big ups and downs. In 2009 and 2014, its economy shrank (went below 0).
- Many countries, like Peru and Uruguay, grew steadily, showing stable economies.

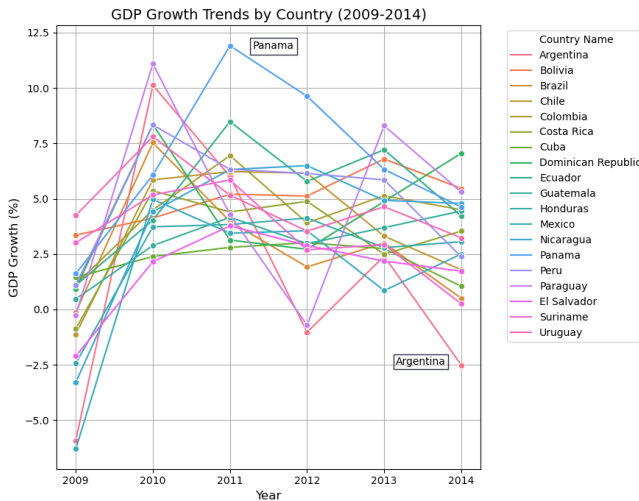


Fig. 4. GDP Growth Trends Over Time (2009–2014)

The electricity production in Latin America from 2009 to 2014 reveals a steady upward trend. Starting at approximately 1550 kWh per capita in 2009, the average production rose each year, reaching over 1800 kWh per capita by 2014. This upward trend highlights ongoing improvements in energy infrastructure and increasing access to electricity throughout the region, reflecting progress in development and modernization efforts.

Average Electricity Production Over Time

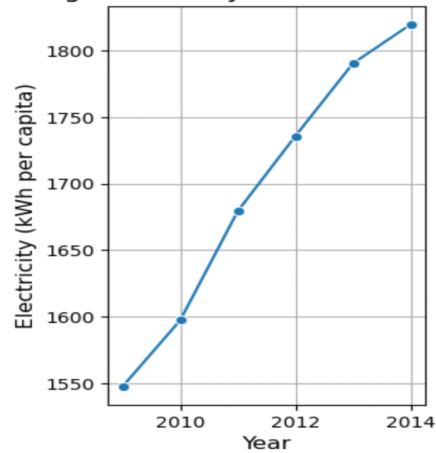


Fig. 5. Average Electricity Production Over Time

In contrast, the GDP growth over the same period shows significant variability. GDP growth rose sharply in 2010, reaching its highest point at approximately 5.7%, likely reflecting recovery from the global financial crisis. However, after 2010, GDP growth began to decline, dropping to around 4% in 2012, with slight fluctuations before falling further to about 3% in 2014. This pattern reflects the economic volatility during the period, influenced by global and regional economic factors.

Average GDP Growth Over Time

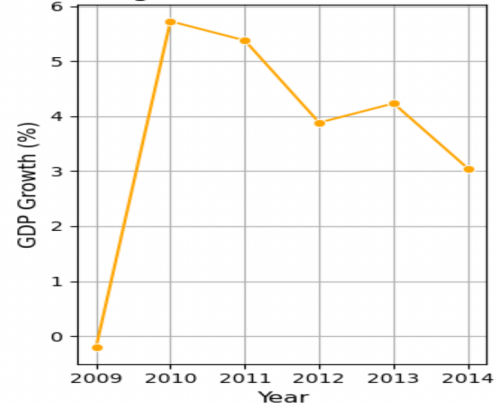


Fig. 6. Average GDP Growth Over Time

C. Country Comparisons

This analysis highlights a clear difference in patterns: electricity production showed a stable and predictable increase, while GDP growth experienced more unpredictable, influenced by broader economic forces.

The average electricity consumption per person across Latin American countries over six years.

- Chile has the highest electricity consumption, exceeding 3,000 kWh per capita, likely due to advanced energy infrastructure and high industrial demand.

- Nicaragua and Honduras display the lowest electricity consumption, indicative of limited energy access or smaller energy demands in the region.

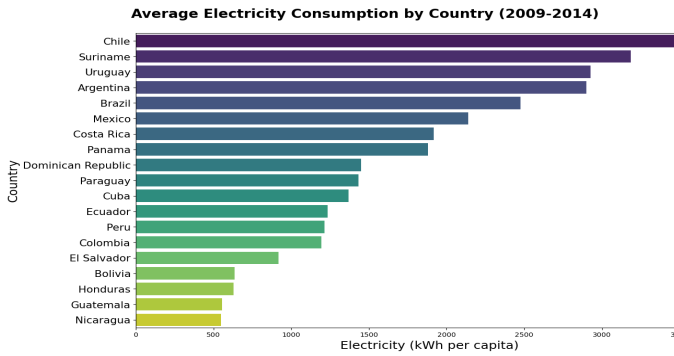


Fig. 7. Average Electricity Consumption by Country (2009-2014)

The graph shows the average GDP growth by country in Latin America from 2009 to 2014. It highlights significant variations in economic performance across countries:

- Panama grew the fastest, with its economy getting much bigger each year, mainly because of the Panama Canal and strong businesses.
- Ecuador and Peru also grew quickly because they sell lots of natural resources and built new things.
- At the bottom, Mexico, El Salvador, and Cuba grew the slowest, probably because of fewer jobs or money problems.

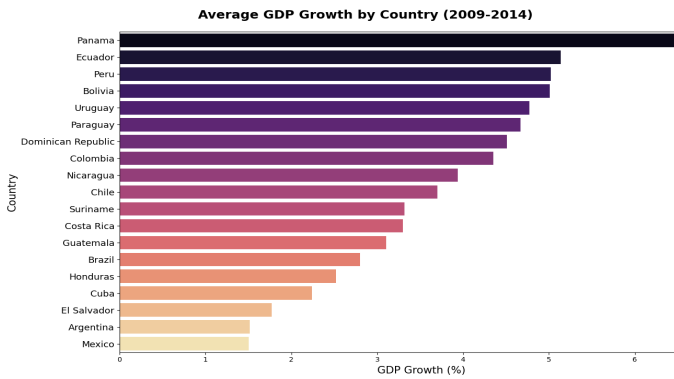


Fig. 8. Average GDP growth by country

D. Correlation

The Correlation Matrix of Electricity Production and GDP Growth shows the relationship between electricity production (measured in kWh per capita) and GDP growth (measured as a percentage). The diagonal values of 1.00 represent the perfect correlation of each variable with itself, which is standard. However, the off-diagonal value of -0.04, which represents the correlation between electricity production and GDP growth, indicates a very weak and insignificant negative relationship. This suggests that changes in electricity

production do not have a strong or direct impact on GDP growth in Latin America during the analyzed period (2009–2014). The findings highlight that while electricity production is essential for infrastructure development, other factors likely play a more significant role in influencing economic growth in the region.

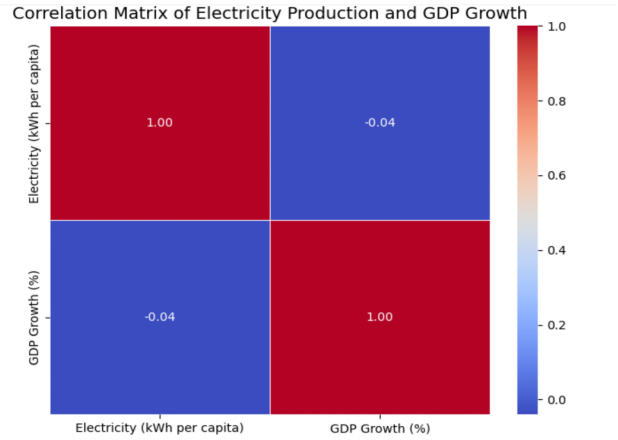


Fig. 9. Correlation Matrix of Electricity Production and GDP Growth

E. Limitations

This analysis has some limitations. It only focuses on electricity production and GDP growth, leaving out other important factors like industrial activity or population changes. Using averages may hide differences within countries, and the six-year period may not show long-term trends. The weak correlation found doesn't mean one causes the other, as other factors may be involved. External events like financial crises or natural disasters were also not considered, which could impact the results.

IV. CONCLUSION

In conclusion, the analysis shows no strong link between electricity production and GDP growth in Latin America from 2009 to 2014. While electricity production steadily increased, GDP growth was more volatile and influenced by other factors. This highlights the need to consider additional variables and longer-term trends to fully understand the relationship between energy use and economic growth.

REFERENCES

- [1] World Bank, "Electricity use (kWh per capita)," [Online]. Available: <https://api.worldbank.org/v2/en/indicator/EG.USE.ELEC.KH.PC?downloadformat=csv>. [Accessed: 28-Nov-2024].
- [2] World Bank, "GDP growth (annual %)," [Online]. Available: <https://api.worldbank.org/v2/en/indicator/NY.GDP.MKTP.KD.ZG?downloadformat=csv>. [Accessed: 28-Nov-2024].
- [3] World Bank, "Terms of Use for Datasets," World Bank Open Data Licensing, [Online]. [Accessed: 28-Nov-2024]