Economic Growth and the Agricultural Productivity Gap

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Introduction

This project aims to understand the vast income differences across countries through the lens of agricultural productivity. Rich countries often outperform poor countries across all sectors of the economy; when looking at *value added per worker*, a measure of labor productivity, the top 5 countries average around 40 times higher than the bottom 5. However, a productivity gap is especially present in the agricultural sector across countries, where in *real* terms, this factor is around 80 [1].

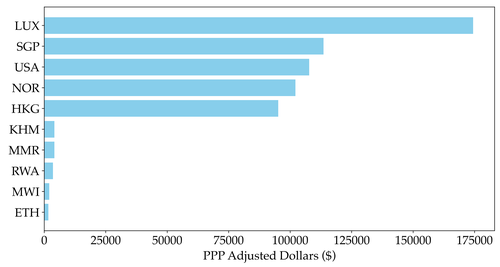

Figure 1: Value Added per Worker, Top 5 and Bottom 5 Countries

Poorer countries tend to also have a large *nominal* APG, within the sectors of its own economy, yet focus a much larger share of their workforce on agriculture, leading to the question of what the aggregate impact of these sectoral allocations and productivity gaps are.

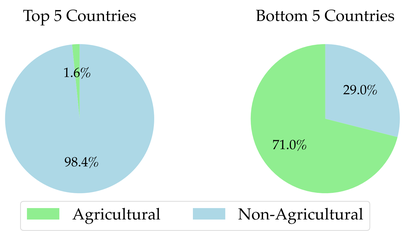

Figure 2: Average Employment Shares of Top 5 and Bottom 5 Countries, Ranked by Value Added per Worker

Cross-Sectional Data

Figure 3: Countries Included in the Dataset

In Figure 4, we summarize the real APG, i.e. the productivity differences across countries. In particular, the richest 5 countries are 60 times more productive in agriculture, but only 13 times more in other sectors.

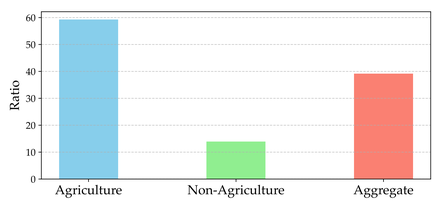

Figure 4: Ratio of Average Real Sectoral Productivity of Top 5 and Bottom 5 Countries, Ranked by Value Added per Worker

We combined data from the GGDC PLD [2] and UNSD AMA to get a sectoral breakdown of value added across countries in nominal terms. However, to make cross-country comparisons, expressed in a common currency (PPP index) to make comparisons, but we only had data for the aggregate and agriculture sectors, so our work lay in generating a PPP index for non-agriculture.

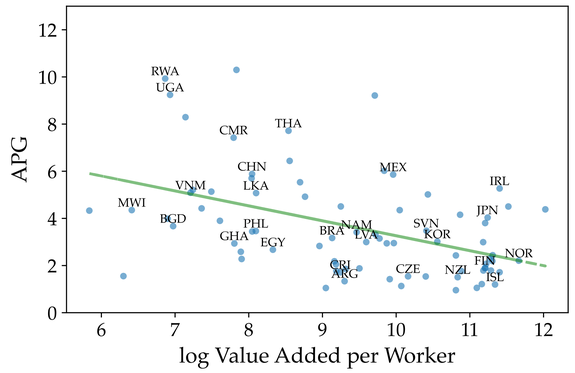

Figure 5: APG and VA per Worker Across Countries

Figure 5 shows the link between the APG and aggregate income of the countries. Richer countries tend to have lower APGs, seen by the trend line.

Time-Series Data

We took our index from the cross sectional case and extended it to all the years in our database, obtaining PPP adjusted sectoral value added from 1970-2023. Many countries, like the case of Brazil, showed comovement between the APG and lower agriculture sector employment shares over time. As countries develop, their productivity gap decreases and workers allocate out of agriculture.

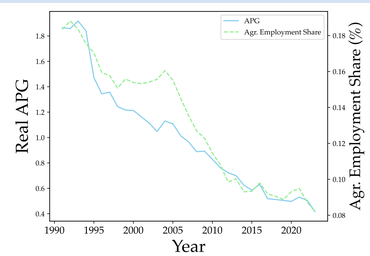

Figure 6: Real APG and Agr. Employment Share in Brazil, 1990-2023

Appendix: Math

A Purchasing Power Parity (PPP) adjustment is required to make any comparisons of goods across economies, but what actually is it? Exchange rates simply express one country's currency in another's, but that doesn't ensure the underlying values are equal [a]. Following the method of PWT [3], we first take the ratio of nominal and real value added to get the nominal price:

$$p_i^x = \frac{VA_i^{x,nom}}{VA_i^{x,real}}$$

where i is a sector, and $x \in C$ is a country. We use a composite index to convert prices into a PPP index for our *VA*s. We then use the Geary-Khamis Method to make the PPP sectoral *VA*s additive. It obtains a vector PPP_{all} by first calculating a reference price

$$\pi_i = \frac{\sum_{j \in C} VA_i^{j,nom} / PPP_{all}^j}{\sum_{j \in C} VA_i^{j,nom} / PPP_i^j}$$

which are weighted to represent the whole economy, and minimizing the difference between it and the observed price:

$$PPP_{all}^{x,obs} = \frac{VA_i^{x,nom}}{\pi_i \cdot VA_i^{j,nom} / PPP_i^j} \text{ for } x \in C$$

Using this PPP, we can use nominal prices for any year and multiply to extend our PPPs to all years in the data

$$PPP_{i,t}^x = PPP_{all,BY}^x \cdot \frac{p_{i,t}^x}{p_{i,BY}^x}$$

where BY is the base year.

[a] e.g., $1 USD = $1.38 CAD, but $1 USD buys 1 apple in the US whereas $1.38 CAD buys 2 in Canada

References

[1] Diego Restuccia, Dennis Tao Yang, and Xiaodong Zhu. Agriculture and aggregate productivity: A quantitative cross-country analysis. *Journal of monetary economics*, 55(2):234–250, 2008.

[2] Robert Inklaar, Ryan Marapin, and Kaira Gräler. Tradability and sectoral productivity differences across countries. *IMF Economic Review*, pages 1–53, 2024.

[3] Robert C Feenstra, Robert Inklaar, and Marcel P Timmer. The next generation of the penn world table. *American economic review*, 105(10):3150–3182, 2015.

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Resources

- Email: `nikhil.raman@mail.mcgill.ca`
- GitHub: `github.com/nraman-gz`

All files for reproducing the data, figures and poster are available on GitHub.