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].

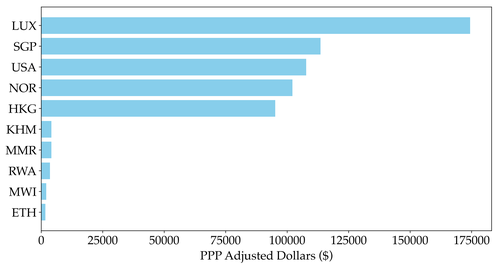

Figure 1: Value Added per Worker, Top 5 and Bottom 5 Countries

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.

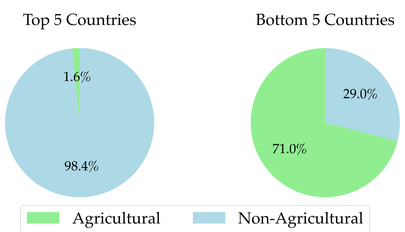

Figure 2: Average Employment Shares of Top 5 and Bottom 5 Countries, Ranked by Value Added per Worker

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.

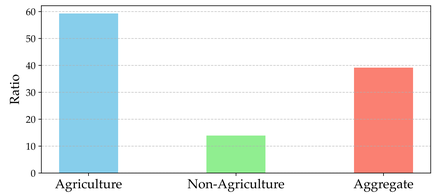

Figure 4: Ratio of Average Real Sectoral Productivity of Top 5 and Bottom 5 Countries, Ranked by Value Added per Worker

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.

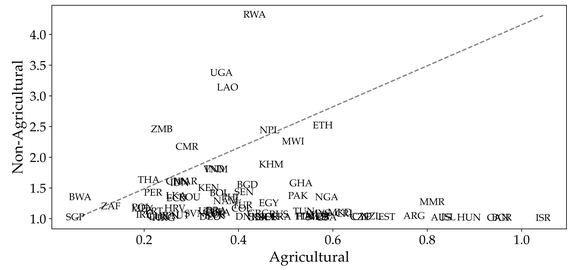

Figure 5: Nominal Value Added Shares in Agriculture and Non-Agriculture

Figure 5 shows the nominal APG of the data by comparing non-agricultural productivity to its agricultural counterpart within each country.

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 showed an increasing APG and lower agriculture sectoral employment shares over time, following the trend of their development.

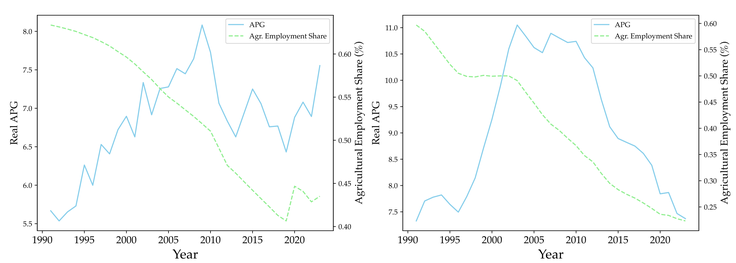

Figure 6: Real APG and Agricultural Employment Share in India (left) and China (right), 1990-2023

Appendix: Math

A Purchasing Power Parity (PPP) adjustment is required to make any comparisons of goods across economies, but what actually is it? Exchange simply rates express one country's currency in another's, but that doesn't ensure the 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 VAs. We then use the Geary-Khamis Method to make the PPP sectoral VAs additive. It obtains a vector PPP_{all} by first calculating a reference price

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

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.