STEG Lecture: The Agricultural Productivity Gap

Douglas Gollin  
Oxford  

David Lagakos  
BU & NBER  

Michael E. Waugh  
NYU & FRB Mpls  

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Agriculture Sector in Developing Countries

- Agriculture’s share of employment is large,

- Share of value added is lower than share of employment.
Agriculture Sector in Developing Countries

![Graph showing the relationship between VA share of Agriculture and Employment Share of Agriculture.]
Agriculture Sector in Developing Countries

- Agriculture’s share of employment is large,
- Share of value added is lower than share of employment.
- \( \frac{VA}{L} \) is lower in agriculture than in non-agriculture.
The Agricultural Productivity Gap in Developing Countries

We define the **Agricultural Productivity Gap** (APG) to be

\[
\text{APG} \equiv \frac{VA_n/L_n}{VA_a/L_a}.
\]

- Simple two-sector model says APG should be 1.
- Typical developing country has APG of around 4. Some have 8 or more!
The Agricultural Productivity Gap in Developing Countries

- Accounts for much of their low aggregate GDP per worker (Caselli, 2005; Restuccia et al, 2008; Vollrath, 2009)

- Taken at face value, gaps suggest **misallocation**

- Policy debate: encourage movement out of agriculture?

- This paper: do gaps reflect **measurement** issues?
What Do Agricultural Productivity Gaps Reflect?

• Sector differences in hours worked per worker?

Construct measures of hours worked by sector for 51 countries

• Sector differences in human capital per worker?

Construct measures of human capital by sector for 98 countries

• Measurement error in national accounts data?

Construct our own estimates using household survey data in 10 countries
What Do Agricultural Productivity Gaps Reflect?

- Sector differences in hours worked per worker?
  
  Construct measures of hours worked by sector for 51 countries

- Sector differences in human capital per worker?
  
  Construct measures of human capital by sector for 98 countries

- Measurement error in national accounts data?
  
  Construct our own estimates using household survey data in 10 countries
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  Construct our own estimates using household survey data in 10 countries
What we Conclude

• Our adjustments reduce gap from around 4 to around 2

• Large gaps also present in household survey data

• Needed: better understanding of why residual gaps so large
Simple Two-Sector Model

- Technologies
  
  \[ Y_a = A_a L_a^\theta K_a^{1-\theta} \quad \text{and} \quad Y_n = A_n L_n^\theta K_n^{1-\theta} \]

- Households can supply labor to either sector.

- Competitive labor markets, i.e. workers paid their marginal product.

- Equilibrium:
  
  \[ \text{APG} \equiv \frac{VA_n / L_n}{VA_a / L_a} = \frac{Y_n / L_n}{p_a Y_a / L_a} = 1. \]
Computing “Raw” Agricultural Productivity Gaps

Measures of $VA_a$ and $VA_n$

- Value added as defined in 1993 System of National Accounts (SNA)
- Source: World Bank, via country national accounts data

Measures of $L_a$ and $L_n$: "economically active population" by sector

- Employed or unemployed persons who are working (or seeking work) in the production of some good or service recognized by the 1993 SNA
- Source: World Bank, via population censuses or labor force surveys.
# Raw Agricultural Productivity Gaps

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<th>Unweighted</th>
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<td>Number of Countries</td>
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“Simple” Measurement Error in National Accounts Data?

1. Understate agricultural VA by excluding home production?
   • In principal: No, it is included as per SNA.
   • Accepted practice: output of particular crop = area planted × yield

2. Overstate agricultural employment, by including all rural persons?
   • In principal: No, only economically active persons included per SNA.
   • We find national accounts consistent with household surveys.
Our Adjustments

1. Measures of labor input by sector
   - Sector differences in hours worked per worker.
   - Sector differences in human capital per worker.

2. Measures of value added by sector
   - Reconstruct national accounts data from household survey data.
Sector Differences in Hours Worked

The graph illustrates the differences in hours worked between sectors for various countries. The x-axis represents hours worked in agriculture, while the y-axis shows hours worked in non-agriculture. Each country is represented by a point, indicating its position relative to the two sectors. The lines on the graph likely depict trends or average values for these countries.
Sector Differences in Human Capital

Average human capital per worker could differ across sectors

For frontier on this see: Porzio, Rossi and Santangelo, 2020; Hobijn, Schoellman, Vindas 2018

We construct human capital per worker by sector for 97 countries

- Years of schooling measured directly when available
- Impute years of schooling using educational attainment otherwise
- Baseline: Assume 10% rate of return on year of schooling

\[ h_{j,i} = \exp(s_{j,i} \cdot 0.10) \]
Sector Differences in Human Capital
## Adjusted Agricultural Productivity Gaps

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<th>Measure</th>
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Comparing Macro and Micro Data on Sector Value Added

The idea:

- Cross check “macro” value added data (from national accounts) with “micro” data from household income/expenditure surveys.

The data:

- Use World Bank’s Living Standards Measurement Surveys (LSMS)
- Explicit goal of LSMS: household income and expenditure measures
Measuring Value Added from Micro Data

Agriculture:

\[ \text{VA}_a = \sum_i y_{a,i}^{SE} + \sum_i y_{a,i}^L + \sum_i y_{a,i}^K, \]

\[ y_{a,i}^{SE} = \sum_{j=1}^J p_j \left( x_{i,j}^{\text{home}} + x_{i,j}^{\text{market}} + x_{i,j}^{\text{invest}} \right) - \text{COSTS}_{a,i}, \]

Non-agriculture:

\[ \text{VA}_n = \sum_i y_{n,i}^{SE} + \sum_i y_{n,i}^L + \sum_i y_{n,i}^K, \]

\[ y_{n,i}^{SE} = \text{REV}_{n,i} - \text{COSTS}_{n,i}. \]

\[ i = \text{household} \text{ and } j = \text{agriculture commodity}. \]
Comparison of Macro and Micro APG

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Conclusions of Gollin, Lagakos, Waugh (2014)

- Typical developing country has large agricultural productivity gap
- Better measurement reduces gap from around 4 to around 2
- Large gaps also present in household survey data
- Needed: better understanding of why residual gaps so large + whether there are productivity and welfare gains from moving workers out of subsistence agriculture
Why the Large Gaps? Some Recent Progress
Progress on Measurement Issues

- Gaps in wages (Herrendorf-Schoellman, AEJ:Macro, 2017)

- Undercounting farm inc. even in US (Herrendorf-Schoellman, RED, 2015)

- Hours decisions not likely independent of sector (Pulido-Swiecki, 2019)

- Higher labor shares in agriculture?

  - How to square with roughly constant labor share with GDP / capita? (Gollin, JPE, 2002; Humphries and Weisdorf, EJ, 2019)
Panel Returns to Migration: Some Recent Studies

- Returns to migration from panel data $\sim 0\%$ in Kenya, Indonesia and Brazil (Hamory et al, JEEA, 2020; Alvarez, AEJ:Macro, 2020)
  - Suggest no misallocation, just better workers outside of agriculture

- Higher returns ($\sim 20\%$) in Ghana, Malawi, South Africa, Tanzania (Lagakos, Marshall, Mobarak, Vernot, Waugh, JME, 2020);

- Even higher in China ($\sim 60\%$) using policy reform that induced migration (Gai, Guo, Li, Shi and Zhu, 2020)

- More evidence clearly needed here; exogenous push factors would be nice
  - Need not just numbers but insight about frictions that keep gaps large
Selection / Sorting: Some Recent Studies

• Old idea that more-productive workers sort into cities; recently, see Lagakos, Waugh AER 2013, Young QJE 2014; Alvarez-Cuadrado, Amodio, Poschke, 2020; Adamopoulos, Brandt, Leight, Restuccia (2017)

• The more important sorting is, the less room for “misallocation” (see e.g. Bryan-Morten, 2019)

• Quantitative importance of sorting hard to nail – identifying a Roy model is hard (e.g. Heckman-Honore, 1990)

• More in TA Lecture by Martin Shu
Some Open Issues for Future Research
Some Open Issues in this Literature

1. Spatial price differences

2. Seasonal migration out of agriculture

3. Intergenerational effects of migration

4. Imperfect information about size of gaps

5. Household migration decision making

6. Frictions in land markets
Spatial Price Differences

- APG > 1 could reflect lower cost of living in rural (agricultural) areas

- Chen, Ravaliion and Sangraula (2009): urban-rural COL differentials in developing countries

- Estimates of urban-rural COL “for household earning $1 per day”
Spatial Price Differences: Open Issues

• More goods available in U.S. cities – not simply a matter of the same basket costing more (Hanbury and Weinstein, RESTUD, 2014)

• True in low-income countries?
  • Seems likely but don’t know of evidence here
  • Appropriate spatial price index to use?
  • Can imagine taking Handbury and Weinstein to low-income setting

• Migration strategies complicated – can live on "ramen," later bring family
  • More on this later, but seems relevant for spatial price discussion
Seasonal Migration

• Bryan, Chowdhury, Mobarak, ECMA, 2014 – migration experiment
  • 30% consumption gains to migration in “lean season”
  • Most households don’t send migrant in subsequent year

• Lagakos, Mobarak, Waugh, 2020 – structural model of experiment
  • Seasonal migration acts as an insurance mechanism (see Morten, 2018)
  • If no opportunities in village and assets low, migration is valuable
  • Not about workers “stuck” in rural areas due to credit constraints

• Akram, Chowdhury, Mobarak, 2017 – larger migration experiment
  • More out-migration ⇒ higher rural wages
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Seasonal Migration: Open Issues

- Is temporary migration a gateway to more permanent moves?

- Negative effects on urban wages / urban areas?
  - Kleemans-Magruder, EJ, 2018: yes, in short run (in Indonesia)
  - In longer run cities can expand, but more evidence needed

- Role for policy unclear

  - India’s rural workfare policies reduce migration (Imbert and Papp, 2018)

  - Externalities through wages, other channels?

  - Social planner’s solutions vs market outcomes can offer insights
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Intergenerational Effects

- Nakamura-Sigurdsson-Steinsson (2020) – Volcanic migration shock
  - Migrant adults: similar to “control” adults that stayed back
  - Migrant kids: much more schooling + higher lifetime earnings

- Opportunities for interactions with literature on investments in children
  - Kids' schooling decisions linked to migration if urban schooling better
  - Seems like “better opportunities for kids” is central rationale for migration but direct evidence would be nice
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Imperfect Information

- Bryan, Chowdhury, Mobarak (2014) – precise zero effect of information treatment on migration in Bangladesh

- Baseler (2020) – large impacts of information treatments in Kenya
  - Rural Kenyans under-estimate non-agricultural city wages
  - Novel theory: migrants hide information from other villagers

- Obvious need for more evidence here!
Household Migration Issues

• Most (at least my own) models of migration have unitary household

• In practice, household may send a migrant, keep remaining members in village ... for a while

• Migration decisions linked to lifecycle choices like education, marriage, fertility

• Women much less likely to move than men; could well be gender-specific frictions to migrate

• Big picture: role of within-household economics in understanding why gaps persist
Frictions in Land Markets

- Important for understanding low productivity in agriculture (e.g. Adamopoulos-Restuccia, 2020; Chen-Restuccia-Santaeulalia-Llopis, 2021)

- Macro simulations show large potential gains from worker reallocations after land reforms (Gottlieb-Grobovsek, 2019, Chen 2017)

- Quasi-experimental evidence from Mexico: migration effects from land titling program (de Janvry, Emerick, Gonzalez-Navarro, Sadoulet, 2015)
Conclusions

• Large agricultural productivity gaps in most developing countries

• Much progress on understanding their determinants, taking both macro and micro perspectives

• Many open questions, but big-picture is: what are the frictions that keep people in low-productivity agriculture work?

• What (if anything) should policymakers do to get households out of subsistence farming?