STEG Lecture: The Agricultural Productivity Gap

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Agriculture Sector in Developing Countries

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- Share of value added is **lower** than share of employment.

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- Share of value added is **lower** than share of employment.

- $\Rightarrow VA/L$ is lower in agriculture than in non-agriculture.

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!

- 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?

- 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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What Do Agricultural Productivity Gaps Reflect?

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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:

$$\text{APG} \equiv \frac{VA_n/L_n}{VA_a/L_a} = \frac{Y_n/L_n}{p_a Y_a/L_a} = 1.$$

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

Measure	Weighted	Unweighted
5th Percentile	1.7	1.1
Median	3.7	3.0
Mean	4.0	3.6
95th Percentile	5.4	8.8
Number of Countries	113	113

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 X yield

2. Overstate agricultural employment, by including all rural persons?

- In principal: No, only economically active persons included per SNA.

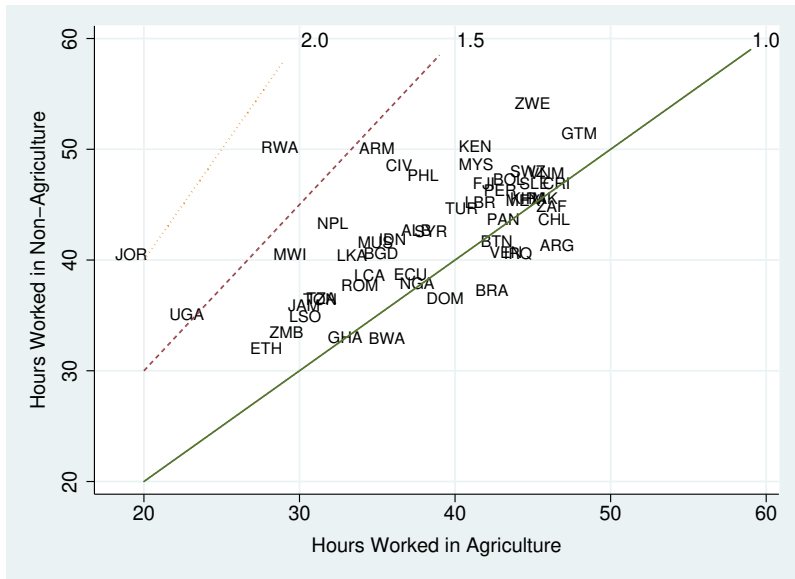- We find national accounts consistent with household surveys.

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

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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

Measure	Complete Data	All Countries
5th Percentile	0.8	0.7
Median	2.2	1.9
Mean	2.1	2.1
95th Percentile	3.9	3.9
Number of Countries	50	113

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:

$$VA_a = \sum_i y_{a,i}^{SE} + \sum_i y_{a,i}^L + \sum_i y_{a,i}^K,$$

$$y_{a,i}^{SE} = \sum_{j=1}^{J} p_j \left(x_{i,j}^{home} + x_{i,j}^{market} + x_{i,j}^{invest} \right) - COSTS_{a,i},$$

Non-agriculture:

$$VA_n = \sum_i y_{n,i}^{SE} + \sum_i y_{n,i}^L + \sum_i y_{n,i}^K,$$

$$y_{n,i}^{SE} = REV_{n,i} - COSTS_{n,i}.$$

$$i = \text{household} \quad \text{and} \quad j = \text{agriculture commodity.}$$

Comparison of Macro and Micro APG

Country	Agriculture Share of			APG	
	Employment	Value Added			
	Micro	Macro	Micro	Macro	Micro
Armenia (1996)	34.2	36.8	32.8	0.9	1.1
Bulgaria (2003)	14.1	11.7	18.4	1.2	0.7
Cote d'Ivoire (1988)	74.3	32.0	42.1	4.7	4.0
Guatemala (2000)	40.2	15.1	18.7	3.8	2.9
Ghana (1998)	53.9	36.0	33.3	2.2	2.3
Kyrgyz Republic (1998)	56.9	39.5	39.3	2.0	2.0
Pakistan (2001)	46.9	25.8	22.6	2.5	3.0
Panama (2003)	27.0	7.8	11.8	4.4	2.7
South Africa (1993)	11.0	5.0	7.0	2.3	1.7
Tajikistan (2009)	41.0	24.7	30.1	2.1	1.6

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- 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

- 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)

- 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

- 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
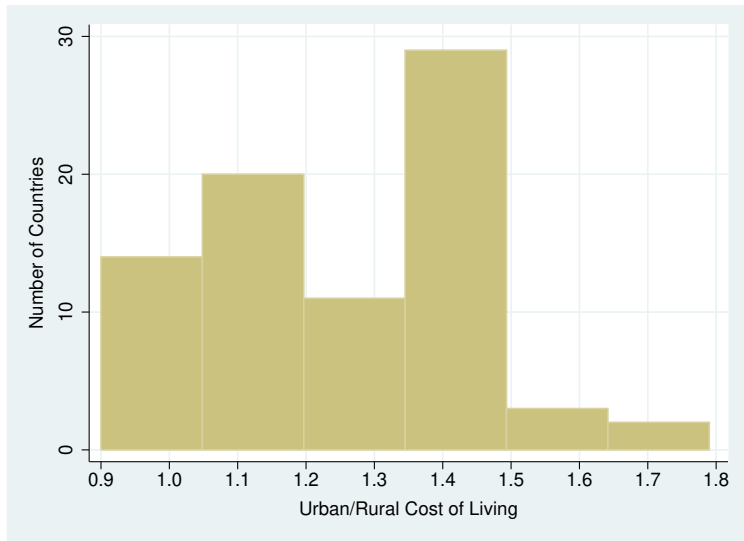
Some Open Issues for Future Research

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

- 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"

Chen et al (2009) Cost-of-Living Differences

- 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 $\Rightarrow$ higher rural wages

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- 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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- Nakamura-Sigurdsson-Steinsson (2020) – Volcanic migration shock

  - Migrant adults: similar to "control" adults that stayed back

  - Migrant <u>kids</u>: 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

Intergenerational Effects

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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!

- 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

- 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)

- 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?