Wages, Human Capital, and Structural Transformation

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Motivation

Structural transformation: reallocation of labor across broad sectors

US structural transformation during 1800–2000

[Diagram showing the share in total employment of Agriculture and Non-agriculture from 1800 to 2000]
Two different views of structural transformation in the literature

- **Efficient allocation view**
  - Assumes the allocation of labor across broad sectors is efficient
  - Argues structural transformation is a consequence of growth

- **Misallocation view**
  - Observes labor productivity is much higher outside of ag
  - Postulates barriers prevent structural transformation out of unproductive ag
  - Argues growth is a consequence of structural transformation

- **Opposite directions of causality and rather different policy implications**
Our contribution

- We provide evidence on the two views
  - Average sectoral wages
    - wages equal marginal value products of labor if there is competition
  - 39 population censuses of 13 countries 1970–2010
    - 30% of the world population
    - four of the five most populous countries (Brazil, India, Indonesia, US)

- We find the following results
  - wage workers in non–ag earn higher average wages than in ag
  - human capital broadly constructed accounts for most of the wage gaps
  - these results are consistent with efficient allocation view of structural transformation
Three Facts from the U.S.

Fact 1: Gaps in average wages

Average wages per hour considerably higher in non-ag than in ag

<table>
<thead>
<tr>
<th>Gaps in average</th>
<th>U.S. Census</th>
<th>CPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>raw wages per hour</td>
<td>1.72</td>
<td>1.75</td>
</tr>
<tr>
<td>wages per hour controlling of geography and gender</td>
<td>1.80</td>
<td>1.85</td>
</tr>
</tbody>
</table>
Fact 2: Gaps in average years of schooling

Using 10% Mincer returns per year of schooling, difference in average human capital accounts for sizeable part of wage gaps

<table>
<thead>
<tr>
<th>Gaps in average</th>
<th>U.S. Census</th>
<th>CPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>years of schooling</td>
<td>3.50</td>
<td>3.33</td>
</tr>
<tr>
<td>wages per efficiency unit with 10% returns</td>
<td>1.21</td>
<td>1.25</td>
</tr>
</tbody>
</table>
Fact 3: Large gaps between Mincer returns

Sector-specific Mincer returns are higher in non-ag

(a) U.S. Census

(b) Monthly CPS
Using sector-specific Mincer returns, difference in average human capital accounts for entire wage gaps

<table>
<thead>
<tr>
<th></th>
<th>U.S. Census</th>
<th>CPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>gaps in average wages per efficiency unit with sector-specific returns</td>
<td>1.03</td>
<td>0.98</td>
</tr>
</tbody>
</table>
Possible interpretations of sector–specific Mincer returns

- **Sectoral hypothesis**
  - Technology is more human–capital intensive in non–ag
  - Differences in Mincer returns reflect differences in sectoral technologies

- **Selection hypothesis**
  - Workers in non–ag have more valuable unobserved characteristics
  - Differences in Mincer returns reflect differences in unobserved characteristics

- **Ways of telling them apart**
  - Different theoretical implications – build a model
  - Different empirical implications – study switchers
Model

Environment

- One period and large number of individuals

- Utility

  \[ \alpha \log(y_a) + (1 - \alpha) \log(y_n) \]

- Endowments
  - One unit of time, which is supplied inelastically
  - Innate ability \( x \) and years of schooling \( s \)
• **Technology in sector** \( j \):

\[
Y_j = \sum_{(x,s) \in \Omega_j} y_j(x, s)
\]

where

\[
y_j(x, s) = \exp(\gamma_jxs + \beta c)
\]

○ sectoral hypothesis: \( \gamma_n > \gamma_a \)

○ selection hypothesis: average \( x \) is higher in non–ag

• **Stylized form of barriers**

○ tax \( \tau \geq 0 \) on wages in non–agriculture

○ tax revenue lump sum rebated

Estimated Mincer Returns
Proposition 1: sorting equilibrium

- If $\gamma_a \leq \gamma_n$, there is a competitive equilibrium with the following features:
  - individuals sort according to a threshold $\chi$:
    - $xs < \chi$ in ag, $xs = \chi$ indifferent, $xs > \chi$ non-ag
  - average wages per worker are higher in non-ag than in ag
- If $\gamma_a < \gamma_n$, then this is the unique competitive equilibrium
Proposition 2: wages and the selection hypothesis

- Suppose $\tau = 0$
- The following is true in the sorting equilibrium of Proposition 1:
  \[ W_a = W_n \iff \gamma_a = \gamma_n \]
- Proof: for individual $x_S = \chi$ the indifference condition becomes
  \[ W_a \exp(\gamma_a \chi) = W_n \exp(\gamma_n \chi) \]
Proposition 3: barriers and wage gaps

- Suppose that $\gamma_a = \gamma_n$
- The following is true in the sorting equilibrium of Proposition 1:

$$\tau = \frac{W_n - W_a}{W_n}$$

- Proof: for individual $x_s = \chi$ the indifference condition becomes

$$W_a = (1 - \tau)W_n$$
Evidence from Switchers

CPS has information on individuals who switch job

- Households are in the CPS for 4 months, out for 8 months, in for 4 months
- In the fourth month of each spell extra data are collected (“outgoing rotation groups”)
- These observations are separated by one year

Switchers and the two hypotheses

- **Selection hypothesis**: Mincer returns of switchers do not change
- **Sectoral hypothesis**: Mincer returns of switchers do change
Wages as a Function of Schooling, Before and After Switching

(c) Non-Ag Stayers

(d) Ag Stayers

(e) Non-Ag to Ag

(f) Ag to Non-Ag
Cross–country Analysis

39 country–year pairs have IPUMS data on wages and employment

Descriptive Statistics

Population

- 30% of world population
- Four of the five most populous countries

Development statistics

- Maximum gap in GDP per capita: factor 20
- Maximum gap in productivity between non–ag and ag: factor 4
- Maximum share of employment in ag: 2/3
## Share of wage workers in agricultural labor

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Share</th>
<th>Country</th>
<th>Year</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>1995</td>
<td>0.16</td>
<td>Indonesia</td>
<td>1976</td>
<td>0.17</td>
</tr>
<tr>
<td>Jamaica</td>
<td>2001</td>
<td>0.19</td>
<td>Panama</td>
<td>1970</td>
<td>0.21</td>
</tr>
<tr>
<td>Jamaica</td>
<td>1980</td>
<td>0.25</td>
<td>Jamaica</td>
<td>1991</td>
<td>0.26</td>
</tr>
<tr>
<td>Panama</td>
<td>1990</td>
<td>0.27</td>
<td>Panama</td>
<td>2000</td>
<td>0.29</td>
</tr>
<tr>
<td>Canada</td>
<td>1971</td>
<td>0.33</td>
<td>Canada</td>
<td>1981</td>
<td>0.34</td>
</tr>
<tr>
<td>Brazil</td>
<td>2000</td>
<td>0.35</td>
<td>W Germany</td>
<td>1970</td>
<td>0.36</td>
</tr>
<tr>
<td>Brazil</td>
<td>1980</td>
<td>0.37</td>
<td>Brazil</td>
<td>1991</td>
<td>0.37</td>
</tr>
<tr>
<td>Panama</td>
<td>2010</td>
<td>0.39</td>
<td>India</td>
<td>1987</td>
<td>0.40</td>
</tr>
<tr>
<td>India</td>
<td>1983</td>
<td>0.40</td>
<td>India</td>
<td>2004</td>
<td>0.44</td>
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<tr>
<td>Venezuela</td>
<td>1981</td>
<td>0.45</td>
<td>United States</td>
<td>1970</td>
<td>0.46</td>
</tr>
<tr>
<td>Mexico</td>
<td>1990</td>
<td>0.47</td>
<td>India</td>
<td>1993</td>
<td>0.47</td>
</tr>
<tr>
<td>Venezuela</td>
<td>1990</td>
<td>0.47</td>
<td>Mexico</td>
<td>2000</td>
<td>0.47</td>
</tr>
<tr>
<td>Mexico</td>
<td>2010</td>
<td>0.49</td>
<td>United States</td>
<td>1980</td>
<td>0.49</td>
</tr>
<tr>
<td>India</td>
<td>1999</td>
<td>0.49</td>
<td>Brazil</td>
<td>2010</td>
<td>0.49</td>
</tr>
<tr>
<td>Canada</td>
<td>2001</td>
<td>0.50</td>
<td>Canada</td>
<td>1991</td>
<td>0.51</td>
</tr>
<tr>
<td>Israel</td>
<td>1995</td>
<td>0.51</td>
<td>Venezuela</td>
<td>2001</td>
<td>0.54</td>
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<tr>
<td>United States</td>
<td>1990</td>
<td>0.57</td>
<td>Uruguay</td>
<td>2006</td>
<td>0.57</td>
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<tr>
<td>United States</td>
<td>2005</td>
<td>0.60</td>
<td>United States</td>
<td>2000</td>
<td>0.60</td>
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<tr>
<td>United States</td>
<td>2010</td>
<td>0.67</td>
<td>Puerto Rico</td>
<td>1990</td>
<td>0.72</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>2000</td>
<td>0.73</td>
<td></td>
<td></td>
<td></td>
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Schooling of agricultural workers compared to non–agricultural workers

![Graph showing the comparison of years of schooling between farm proprietors and farm wage workers. The graph illustrates a positive correlation between years of schooling and wages, with farm wage workers generally having less education compared to farm proprietors.](image-url)
Share of labor in agriculture vs. gaps in Mincer returns
Cross–country Results

Large wage gaps

Sectoral differences in human capital account for most of them

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<th>Min</th>
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<tr>
<td>hour</td>
<td>1.42</td>
<td>1.79</td>
<td>4.22</td>
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<td>hour controlling for geography and gender</td>
<td>1.36</td>
<td>1.68</td>
<td>2.98</td>
</tr>
<tr>
<td>efficiency unit with sector–specific returns</td>
<td>0.92</td>
<td>1.21</td>
<td>1.62</td>
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### Implied values of $\tau$ under the assumption that $\gamma_a = \gamma_n$

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<tr>
<td></td>
<td>-0.08</td>
<td>0.21</td>
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- Small compared to what the literature has found (e.g., Restuccia et al, JME, 2008)
What About Productivity Gaps?

- **Maximum productivity gaps in our sample are a factor 4**

- **We have shown that there is not much room for misallocation of wage workers**

- **What may account for the sizeable productivity gaps?**
  - Mismeasurement of agricultural value added (our previous paper)
  - Misallocation of land and/or proprietors (Adamopoulos–Restuccia)
Conclusion

- Evidence favors efficient allocation view of structural transformation
- Sector-specific Mincer returns capture selection according to innate ability
Defensive Slides

Construction of Wages

- Census and March CPS: last year’s income divided by product of hours usually worked in a week times weeks worked in the year

- Outgoing rotation groups of monthly CPS files: hourly wage or weekly earnings divided by hours worked for the prior week
Regression for Stylized Fact 1

- Estimate

\[
\log(w_{ijt}) = \beta_t d_t + \beta_j d_j + \beta_z Z_{ijt} + \varepsilon_{ijt}
\]

- \( i \) indexes workers and \( j \) sectors
- \( d_t \) and \( d_j \) are time and sector dummies
- \( Z_{ijt} \) are controls for state and gender
- \( \varepsilon_{ijt} \) is an iid error with zero mean

- Choosing non-ag as the omitted group, wage gap equals \( \exp(\beta_a) \)
Regression for Stylized Fact 3

- **Estimate**

\[
\log(w_{ijt}) = \beta_t d_t + \beta_z Z_{ijt} + (\beta_j + \beta_s s_{ijt} + \beta_c c_{ijt}) \cdot d_j + \epsilon_{ijt}
\]

where \( s \) are total years of schooling and \( c \) are years of college

- **Findings**
  - \( \beta_{sa} << \beta_{sn} \) and \( \beta_{ca} \leq \beta_{cn} \)
  - This can be illustrated by the estimated log–wage function \( \log(w_{ij}(.)) \)
Related literature

Young (QJE, 2013)

- Micro data for poor and middle-income countries

- Migration flows go in both directions
  - One in five individuals born in rural area moves to urban area as an adult
  - One in four individuals born in urban area moves to rural area as an adult
Gollin, Lagakos, Waugh (2012)

- Micro data for poor countries including African ones
- Construct human capital with aggregate Mincer returns from Hall and Jones
- Find sizeable residual productivity gaps after controlling for human capital
Exercise of Gollin, Lagakos, and Waugh with our data

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