Wages, Human Capital, and Structural Transformation

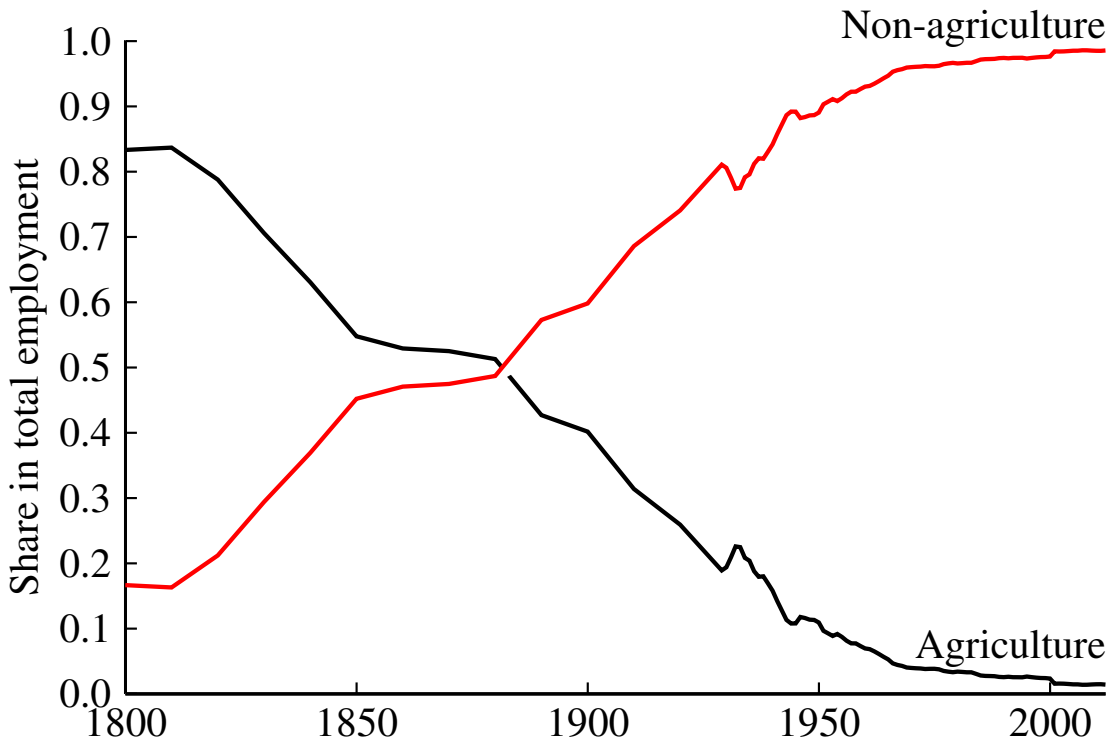
Berthold Herrendorf and Todd Schoellman
Arizona State University

July 12, 2014

Motivation

Structural transformation: reallocation of labor across broad sectors

US structural transformation during 1800–2000



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

Gaps in average	U.S. Census	CPS
raw wages per hour	1.72	1.75
wages per hour controlling of geography and gender	1.80	1.85

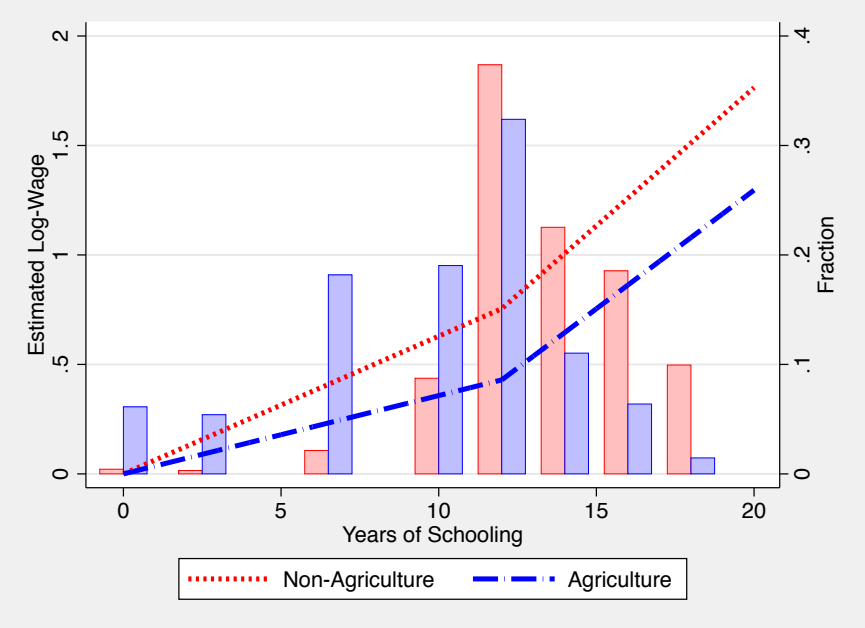
Fact 2: Gaps in average years of schooling

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

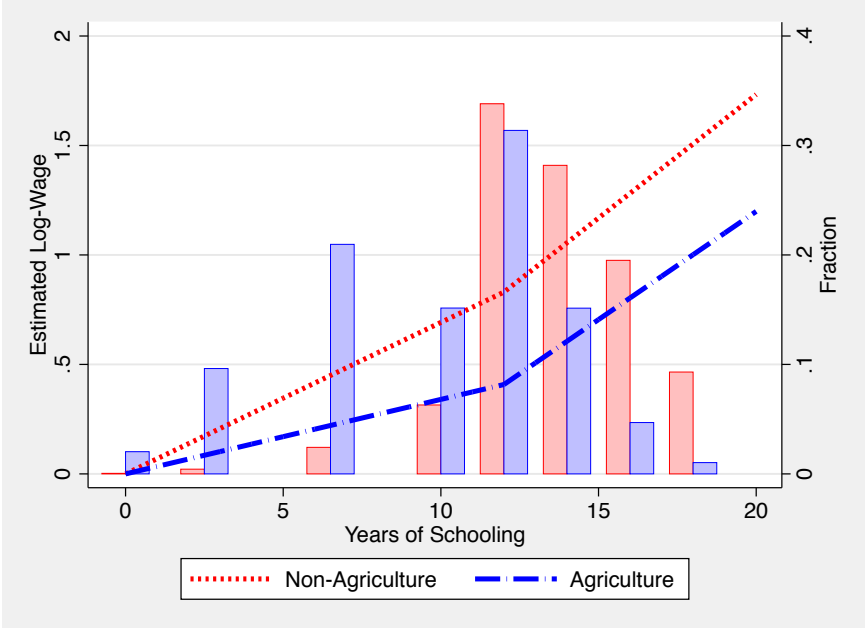
Gaps in average	U.S. Census	CPS
years of schooling	3.50	3.33
wages per efficiency unit with 10% returns	1.21	1.25

Fact 3: Large gaps between Mincer returns

Sector–specific Mincer returns are higher in non–ag



(a) U.S. Census



(b) Monthly CPS

Back

Using sector–specific Mincer returns, difference in average human capital accounts for entire wage gaps

	U.S. Census	CPS
gaps in average wages per efficiency unit with sector–specific returns	1.03	0.98

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

$$y_j(x, s) = \exp(\gamma_j xs + \beta c)$$

  - 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 χ:
    $xs < \chi$ 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:

$$W_a = W_n \quad \Longleftrightarrow \quad \gamma_a = \gamma_n$$

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

$$W_a = (1 - \tau) W_n$$

Evidence from Switchers

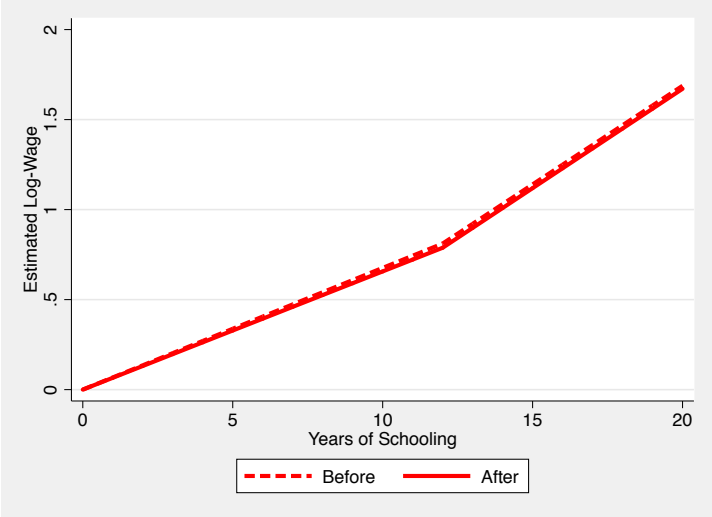
CPS has information on individuals who switch job

- 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

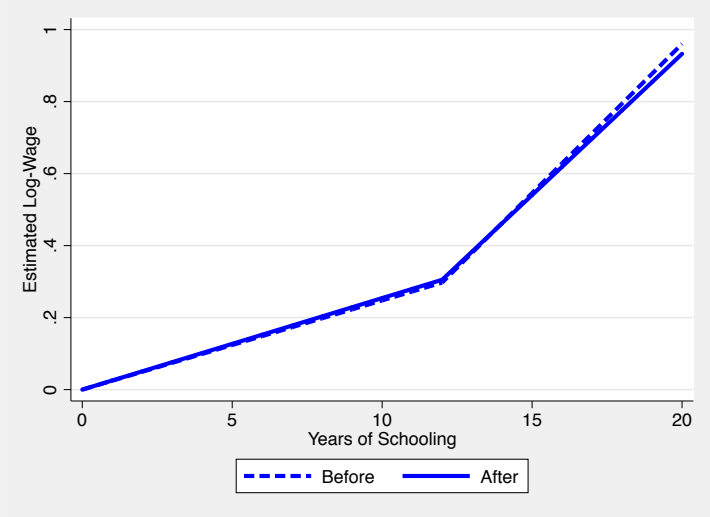
Switchers and the two hypotheses

- **Selection hypothesis**: Mincer returns of switchers do not change
- **Sectoral hypothesis**: Mincer returns of switchers do change

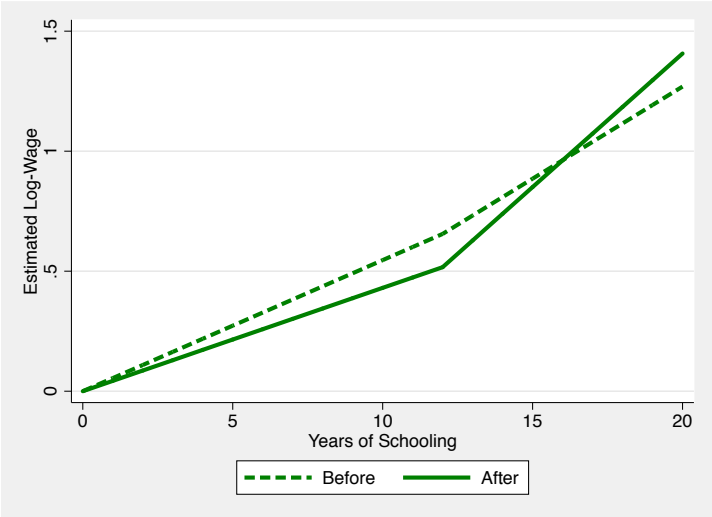
Wages as a Function of Schooling, Before and After Switching



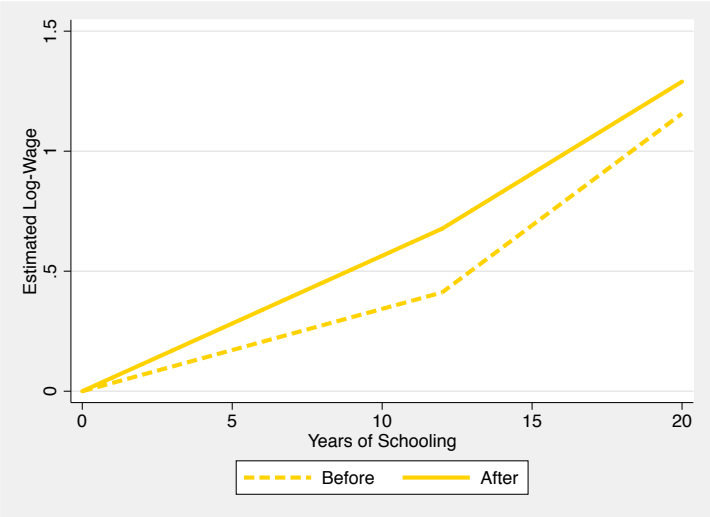
(c) Non-Ag Stayers



(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

Brazil (1980,1991,2000,2010)
West Germany (1970)
Indonesia (1976,1995)
Jamaica (1982,1991,2001)
Panama (1970,1990,2000,2010)
US (1970,1980,1990,2000,2005,2010)
Venezuela (1981,1990,2001)
Canada (1971,1981,1991,2001)
India (1983,1987,1993,1999,2004)
Israel (1995)
Mexico (1990,2000,2010)
Puerto Rico (1990,2000)
Uruguay (2006)

Descriptive Statistics

Population

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

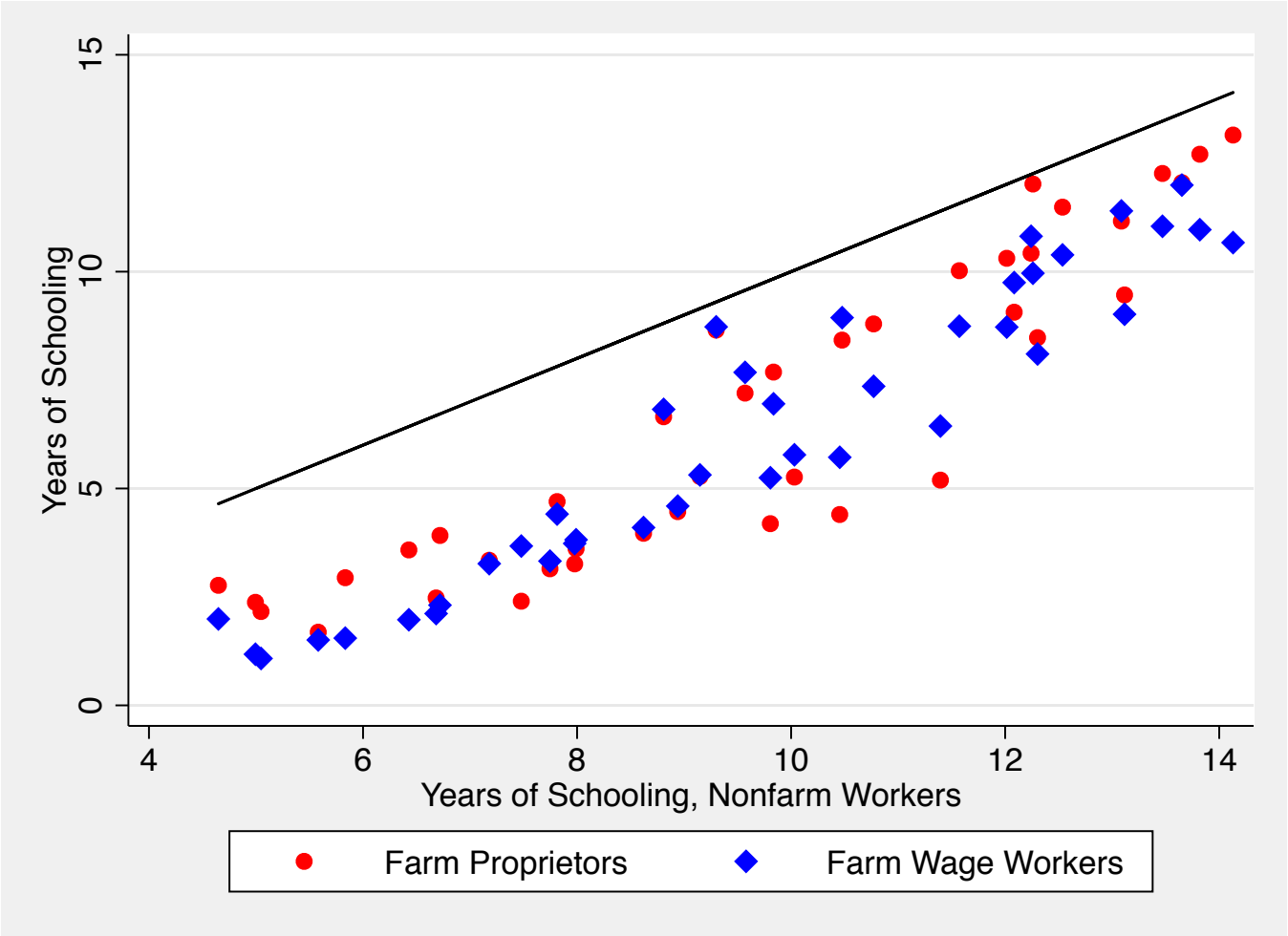
Development statistics

- 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

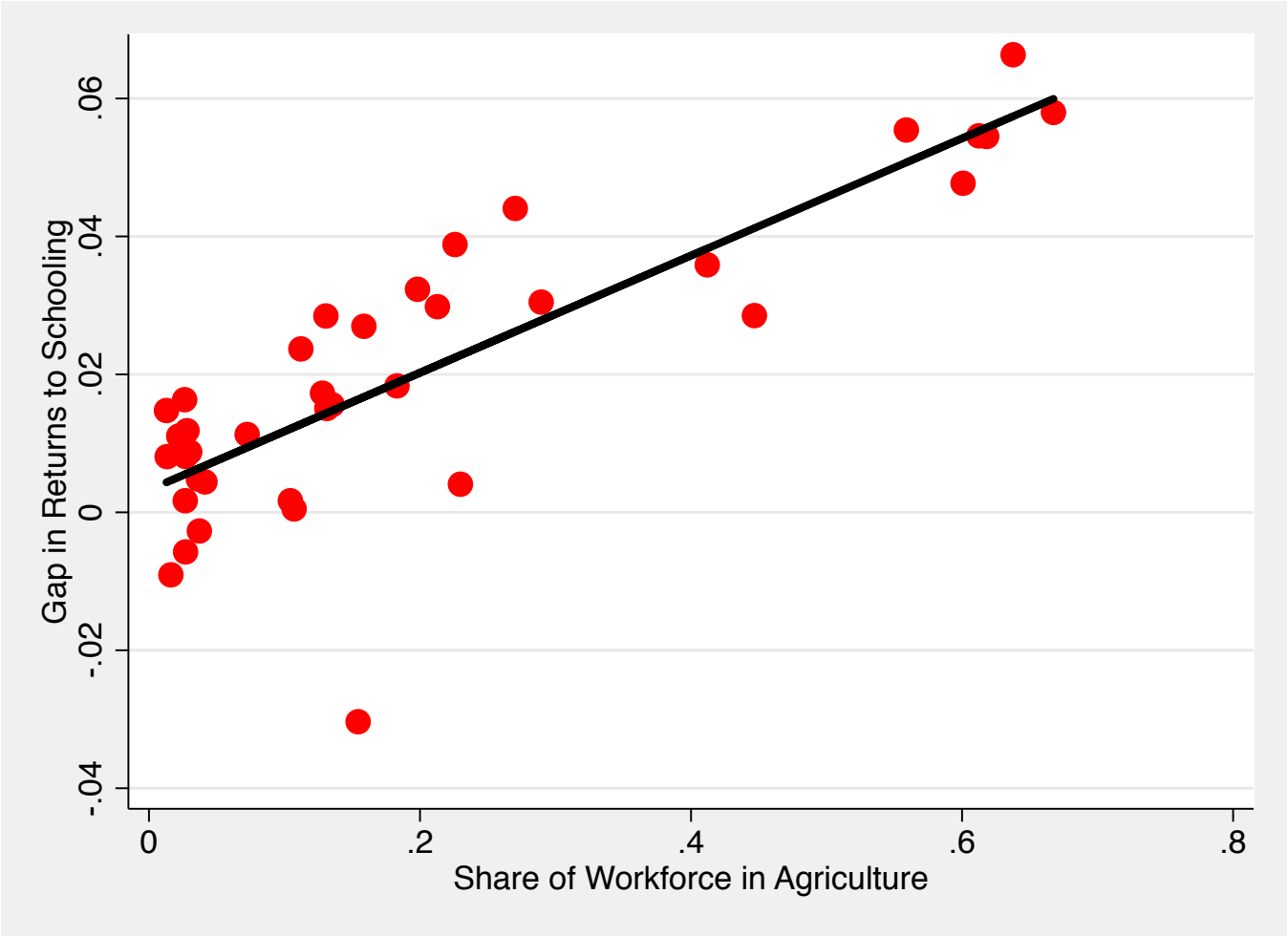
Share of wage workers in agricultural labor

Indonesia 1995	0.16	Indonesia 1976	0.17
Jamaica 2001	0.19	Panama 1970	0.21
Jamaica 1980	0.25	Jamaica 1991	0.26
Panama 1990	0.27	Panama 2000	0.29
Canada 1971	0.33	Canada 1981	0.34
Brazil 2000	0.35	W Germany 1970	0.36
Brazil 1980	0.37	Brazil 1991	0.37
Panama 2010	0.39	India 1987	0.40
India 1983	0.40	India 2004	0.44
Venezuela 1981	0.45	United States 1970	0.46
Mexico 1990	0.47	India 1993	0.47
Venezuela 1990	0.47	Mexico 2000	0.47
Mexico 2010	0.49	United States 1980	0.49
India 1999	0.49	Brazil 2010	0.49
Canada 2001	0.50	Canada 1991	0.51
Israel 1995	0.51	Venezuela 2001	0.54
United States 1990	0.57	Uruguay 2006	0.57
United States 2005	0.60	United States 2000	0.60
United States 2010	0.67	Puerto Rico 1990	0.72
Puerto Rico 2000	0.73		

Schooling of agricultural workers compared to non–agricultural workers



Share of labor in agriculture vs. gaps in Mincer returns

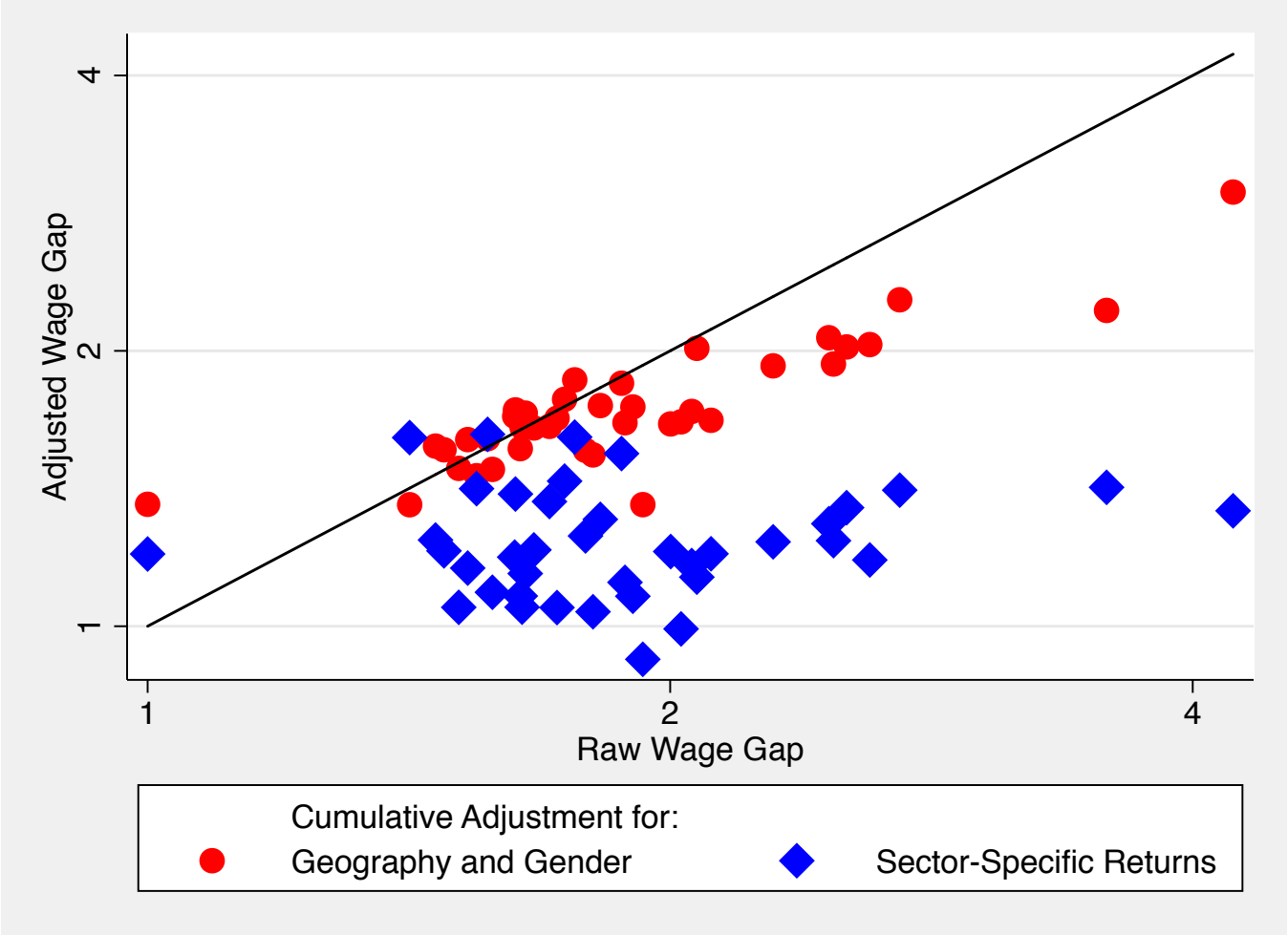


Cross–country Results

Large wage gaps

Sectoral differences in human capital account for most of them

Gaps in average wages per	Min	Median	Max
hour	1.42	1.79	4.22
hour controlling for geography and gender	1.36	1.68	2.98
efficiency unit with sector–specific returns	0.92	1.21	1.62


Adjusted Wage Gap
1
2
4
1
2
4
Raw Wage Gap
Cumulative Adjustment for:
Geography and Gender
Sector-Specific Returns

Implied values of τ under the assumption that $\gamma_a = \gamma_n$

Min	Median	Max
-0.08	0.21	0.62

- Small compared to what the literature has found (e.g., Restuccia etal, 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
  - ε_{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**

$$\log(w_{ijt}) = \beta_t d_t + \beta_z Z_{ijt} + (\beta_j + \beta_{sj} s_{ijt} + \beta_{cj} c_{ijt}) \cdot d_j + \varepsilon_{ijt}$$

  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

Gaps in average wages per	Min	Median	Max
hour	1.42	1.79	4.22
efficiency unit with 10% returns	0.96	1.29	2.00