Barriers to Mobility or Sorting? Sources and Aggregate Implications of Income Gaps across Sectors in Indonesia

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Motivation

- Large income gaps between agricultural and non-agricultural workers in developing countries are well known, but their origin is still debated
- Two main hypotheses:
  - Barriers to labor mobility across sectors
  - Sorting of workers based on unobserved productivity
- Those hypothesis have different predictions for allocative efficiency

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- Those hypothesis have different predictions for allocative efficiency

This paper:

- Assess what income gaps tell us about the presence and importance of mobility barriers and sorting
- Quantify the aggregate losses from any uncovered worker misallocation

Preview

- We document robust reduced-form premia for working in non-agriculture in Indonesia
  1. Workers in non-agriculture earn on average nearly 80% more than workers in agriculture
  2. Worker switching from agriculture to non-agriculture sees an average income gain of over 20%
  3. Workers switch in both directions (gross flows much larger than net flows)

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- We document robust reduced-form premia for working in non-agriculture in Indonesia
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  2. Worker switching from agriculture to non-agriculture sees an average income gain of over 20%
  3. Workers switch in both directions (gross flows much larger than net flows)
- These patterns are hard to reconcile with a canonical Roy model, but can be generated by an extended Roy model model that features:
  - Idiosyncratic productivity shocks
  - Compensating differentials
  - Barriers to mobility

Preview

- We show that the reduced-form sectoral premia *by themselves* have little empirical content
  - Not informative on whether there is misallocation
- Using a richer set of moments of the joint sector-income distribution allows us to identify sorting and barriers in our structural model

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  - Not informative on whether there is misallocation
- Using a richer set of moments of the joint sector-income distribution allows us to identify sorting and barriers in our structural model
- Findings
  - Sorting clearly occurs
  - Evidence of barriers significantly misallocating workers across sectors
    - Removing barriers would lead 35% of workers to switch sectors and increase aggregate output by as much as 21%

Related Literature

- Income/consumption/productivity gaps in developing countries:
  - Herrendorf and Schoellman (2018), Young (2013), Gollin et al. (2014)
- Identification using longitudinal surveys:
  - Beegle et al. (2011), Hicks et al. (2017), Alvarez (2018)
  - Katz and Summers (1989), Abowd et al. (1999), Taber and Vejlin (2016)
- Sorting:
  - Roy (1951), Heckman and Honore (1990), Lagakos and Waugh (2013)
- Misallocation across sectors/space:
  - Restuccia et al. (2008), Bryan et al. (2014), Adamopoulos et al. (2017), Sarvimaki et al. (2018)

Data

- Indonesia Family Life Surveys (IFLS) is uniquely well fitted for our goals:
  - Long period of time: 1993-2014, 5 waves
  - Exerts particular effort to track individuals who migrate (re-contact rate of 90% for first-wave target households in the fifth wave)
  - Large sample (>20000), representative of more than 80% of Indonesian population
  - Agriculture in Indonesia is very important (40% of workforce).
  - Detailed information on work history, migration history, demographics, etc.
- Main outcome variable is annual income
- Main sample consists of adults (15+) who answer the employment module

Descriptive Statistics

	IFLS 1: 1993	IFLS 2: 1997	IFLS 3: 2000	IFLS 4: 2007	IFLS 5: 2014
Joint distribution over sectors and locations					
Total Agriculture	0.45	0.35	0.36	0.36	0.29
Rural Agriculture	0.42	0.31	0.32	0.31	0.24
Urban Agriculture	0.03	0.03	0.04	0.05	0.05
Total Non-Agriculture	0.55	0.65	0.64	0.64	0.71
Rural Non-Agriculture	0.27	0.30	0.27	0.25	0.27
Urban Non-Agriculture	0.28	0.35	0.37	0.39	0.44
Total Rural	0.69	0.62	0.59	0.56	0.50
Total Urban	0.31	0.38	0.41	0.44	0.50
Share of male	0.60	0.62	0.59	0.58	0.57
Mean age	41.4	38.1	39.0	40.7	41.2
Mean years of schooling	5.4	6.1	7.1	7.8	8.7
No. observations	9714	12875	17931	20874	24475
Main sample: panel of workers with 2+ observations					
No. observations			70586		
No. individuals			22829		

▸ Occupations

Estimating Reduced-Form Sectoral Premia

- Let y_{islt} denote income of an individual i working in sector s, living in location type l in year t
- Estimating equation

$$\ln y_{islt} = X_{it}\beta + D_N + D_U + D_i + \varepsilon_{islt}$$

  - X_{it} collects standard individual covariates such as sex, years of education, experience and experience squared, as well as year and province dummies
  - D_N and D_U capture the non-agriculture and urban premia of interest
  - D_i captures the time-invariant component individual heterogeneity

Cross-Sectional Premium

Fact 1

Workers in non-agriculture earn significantly more than observationally similar workers in agriculture.

	(1) Log Income	(2) Log Income	(3) Log Income	(4) Log Income	(5) Log Income
Non-Agriculture	0.839***		0.686***	**0.574*** **	0.332***
	(0.041)		(0.040)	(0.036)	(0.033)
Urban		0.647***	0.405***	0.207***	0.084**
		(0.045)	(0.042)	(0.036)	(0.032)
Year FE	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes
Indiv. cont.				Yes	Yes
Individual FE					Yes
Observations	48299	48308	48299	44494	44497
R^2	0.412	0.394	0.424	0.503	0.518

Notes: Individual controls: education, experience, experience sq., and sex. Observations weighted by longitudinal survey weights. Standard errors clustered by enumeration areas (primary sampling units of the survey) in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

▸ Interactions ▸ Distributions

Transitions across Sectors

Fact 2

Gross flows between agriculture and non-agriculture are significantly larger than net flows.

Sector transitions	No. of cases	Share of total
AA	13214	27.68
AN	3886	8.14
NA	3546	7.43
NN	27098	56.76
Total	47744	100.00
Indiv. who switch at least once		23.89

Spatial Unit	Ratio Gross/Net Flows
Country	9.65
Province	5.97
District	3.24

Notes: XY indicates a transition from sector X to Y between two consecutive observations for an individual (A - Agr., N - Non-Agr.).

▸ Probabilities ▸ Locations

Premium by Direction of Switch

Fact 3

Workers switching from agr. to non-agr. see significant income increases, while workers switching in the opposite direction see significant cuts.

	(1) Δ Log Income		(2) Δ Log Income
Sector transitions		Sector trans. × Migration	
AN	**0.220*** **	AA × Migrate	-0.108
	(0.050)		(0.092)
NA	**-0.392*** **	AN × Stay	**0.196*** **
	(0.049)		(0.053)
NN	-0.066***	AN × Migrate	0.275**
	(0.023)		(0.108)
Location transitions		NA × Stay	**-0.379*** **
RU	0.091*		(0.054)
	(0.047)	NA × Migrate	-0.472***
UR	-0.199***		(0.110)
	(0.058)	NN × Stay	-0.117***
UU	-0.040*		(0.021)
	(0.023)	NN × Migrate	-0.008
			(0.039)
Δ Year FE	Yes		Yes
Δ Province FE	Yes		Yes
Δ Indiv. cont.	Yes		Yes
Observations	27697	Observations	24858
R^2	0.075	R^2	0.075

Notes: XY indicates a transition from sector (or location) X to Y between two consecutive observations for an individual (A - Agr., N - Non-Agr., R - Rural, U - Urban). Migrate indicates movement outside of the village boundary. Omitted categories: AA in (1) and AA×Stay in (2). Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Robustness

- Existence of within-worker non-agricultural premium is robust to a series of concerns:
  - Job type ▸ Job-type
  - Measurement of income (restricting only to wages ▸ Wages, or measuring standard of living through consumption ▸ Consumption)
  - Heterogeneity in Mincerian returns ▸ Mincerian
  - Additional jobs and home production ▸ Jobs-Home
  - Hours worked ▸ Hours
  - Over time ▸ Over-time
  - Long-run outcomes ▸ Long-run

Reduced Form Results: Recap and Interpretation

- Three empirical regularities:
  - Workers in non-agriculture earn on average much more than workers in agriculture
  - Workers switch in both directions (gross flows much larger than net flows)
  - Workers switching from agriculture to non-agriculture see a substantial (but smaller than in cross-section) income gain, workers switching to non-agriculture see a substantial income loss

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  - Workers switch in both directions (gross flows much larger than net flows)
  - Workers switching from agriculture to non-agriculture see a substantial (but smaller than in cross-section) income gain, workers switching to non-agriculture see a substantial income loss
- These patterns are hard to reconcile with a canonical Roy model (with fixed comparative advantage for a worker)
- But can be rationalized by an extended Roy model with:
  1. More dispersion of income shocks in agriculture
  2. Utility compensation for working in agriculture
  3. Random/involuntary switches
- We specify and estimate a structural model to quantify the relevance of these explanations

Model

- Worker in sector $s = A, N$ at time t receives income

$$y_t^s(\Omega_{it}) = R_t^s h^s(\Omega_{it})$$

  - R_t^s is exogenous price of human capital
  - $h^s(\Omega_{it})$ is worker's supply of human capital

$$h^s(\Omega_{it}) = \exp(\theta_i^s + \varepsilon_{it}^s)$$

    - θ_i^s is the permanent component of productivity, i.i.d. across individuals $N(0, \Sigma_\theta)$
    - ε_{it}^s is the productivity shock, i.i.d. across individuals and time $N\left(0, \sigma_{\varepsilon^s}^2\right)$

- Worker maximizes contemporaneous utility

$$V(\Omega_{it}) = \max_s \{V^s(\Omega_{it})\}$$

Sector Choice

- Basic frictionless case

$$V^s\left(\Omega_{it}\right) = \ln y_t^s\left(\Omega_{it}\right)$$

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- Preferences: utility compensation for working in agriculture

$$V_{cd}^s\left(\Omega_{it}\right) = \ln y_t^s\left(\Omega_{it}\right) + \ln C^s$$

$$C^s = \begin{cases} cd & \text{if } s = A \\ 1 & \text{if } s = N \end{cases}$$

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$$C^s = \begin{cases} cd & \text{if } s = A \\ 1 & \text{if } s = N \end{cases}$$

- Mobility barriers: due to random life events/search frictions worker forced into sector other than desired with probability

$$p^{s_{t-1}s_t}\left(\Omega_{it}\right) = p^{s's} = \begin{cases} p^T & \text{if } s \neq s' \\ p^S & \text{if } s = s' \end{cases}$$

Structural Estimation and Identification

- To identify sorting, compensating differentials, and barriers we need to discipline the model with additional moments
- Estimation is by Indirect Inference:
  - 7 auxiliary regression models that describe cross-sectional and within-worker premia, sector shares and transition probabilities, and variances of residual income (29 coefficients) ▸ Models
  - Estimated on the balanced panel of workers (those with information available in all waves)
- Given the log-normality assumptions we establish identification by extending the results from Heckman and Honore (1990) to a setting with frictions
  - Main complication: sectoral choice depends on worker's history

Empirical Content of the Within-Worker Premium

Proposition 1

Consider the frictionless model with two periods and human capital prices equal across sectors and over time. Then the average growth of log income of workers switching from agriculture to non-agriculture is positive if and only if $\sigma^2_{\varepsilon N} > \sigma^2_{\varepsilon A}$. *Furthermore, the average growth of log income of workers switching from non-agriculture to agriculture has the same magnitude but is of the opposite sign.*

Corollary 1

Under the same conditions as in Proposition 1, the non-agriculture premium identified from a regression with worker fixed effects is positive if and only if $\sigma^2_{\varepsilon N} > \sigma^2_{\varepsilon A}$.

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Under the same conditions as in Proposition 1, the non-agriculture premium identified from a regression with worker fixed effects is positive if and only if $\sigma^2_{\varepsilon N} > \sigma^2_{\varepsilon A}$.

- Whether the within-worker premium is zero or not by itself does not contain information on the presence or absence of frictions
  - Hicks et al. (2017) and Alvarez (2018) recently argue that there is no evidence of misallocation upon finding modest within-worker premia

Estimation Results: Basic Frictionless Model

- Can qualitatively match the premia but by **reversing** the pattern of residual variances

Parameter	Basic frictionless
Variance of permanent comparative advantage in sector s ($\sigma^2_{\theta^s}$) and covariance ($\sigma_{\theta^{AN}}$)	
$\sigma^2_{\theta^A}$	0.29
	(0.03)
$\sigma^2_{\theta^N}$	0.63
	(0.04)
$\sigma_{\theta^{AN}}$	0.26
	(0.04)
Variance of transitory productivity shocks in sector s ($\sigma^2_{\varepsilon^s}$)	
$\sigma^2_{\varepsilon^A}$	0.00
	(0.00)
$\sigma^2_{\varepsilon^N}$	0.06
	(0.01)

Coefficient δ_i	Data ($\hat{\hat{\delta}}_i$)	Standard error in the data	Basic frictionless
Non-agriculture premia: cross-sectional (δ_1) and within-individual (δ_2)			
δ_1	0.57	(0.03)	0.56
δ_2	0.40	(0.05)	0.21
Premia for switchers to non-agriculture (δ_5) and to agriculture (δ_6)			
δ_5	0.15	(0.07)	0.21
δ_6	-0.42	(0.06)	-0.21
Residual variance of workers in agriculture (δ_{24}) and non-agriculture (δ_{25})			
δ_{24}	**1.24**	(0.04)	**1.01**
δ_{25}	**0.95**	(0.03)	**1.19**
Residual variance of non-switching workers in agriculture (δ_{26}) and non-agriculture (δ_{27})			
δ_{26}	**1.43**	(0.06)	**1.44**
δ_{27}	**1.08**	(0.04)	**1.56**
Overall fit (loss function)			2.013

Estimation Results: Compensating Differential

- Requires a **large** preference for working in agriculture

Parameter	Compensating differential
Variance of permanent comparative advantage in sector s ($\sigma^2_{\theta^s}$) and covariance ($\sigma_{\theta^{AN}}$)	
$\sigma^2_{\theta^A}$	0.52
	(0.05)
$\sigma^2_{\theta^N}$	0.48
	(0.04)
$\sigma_{\theta^{AN}}$	0.18
	(0.05)
Variance of transitory productivity shocks in sector s ($\sigma^2_{\varepsilon^s}$)	
$\sigma^2_{\varepsilon^A}$	0.12
	(0.03)
$\sigma^2_{\varepsilon^N}$	0.01
	(0.01)
Compensating differential	
ln *cd*	**0.61**
	(0.04)

Coefficient δ_i	Data ($\hat{\delta}_i$)	Standard error in the data	Compensating differential
Non-agriculture premia: cross-sectional (δ_1) and within-individual (δ_2)			
δ_1	0.57	(0.03)	0.60
δ_2	0.40	(0.05)	0.35
Premia for switchers to non-agriculture (δ_5) and to agriculture (δ_6)			
δ_5	0.15	(0.07)	0.31
δ_6	-0.42	(0.06)	-0.33
Residual variance of workers in agriculture (δ_{24}) and non-agriculture (δ_{25})			
δ_{24}	1.24	(0.04)	1.14
δ_{25}	0.95	(0.03)	1.12
Residual variance of non-switching workers in agriculture (δ_{26}) and non-agriculture (δ_{27})			
δ_{26}	1.43	(0.06)	1.57
δ_{27}	1.08	(0.04)	1.44
Overall fit (loss function)			1.462

Self-Reported Job Satisfaction

- Preference for agriculture at odds with survey evidence on job satisfaction

	(1) Satisfied	(2) Satisfied	(3) Satisfied	(4) Satisfied
Non-Agriculture	0.019**	-0.009	0.034**	0.026
	(0.009)	(0.009)	(0.016)	(0.021)
Log Income		0.045***		0.028***
		(0.003)		(0.005)
Year FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Indiv. cont.	Yes	Yes	Yes	Yes
Individual FE			Yes	Yes
Observations	23275	19695	23279	19698
R^2	0.026	0.043	0.015	0.021

Notes: Dependent variable is equal to one if worker reports being Very Satisfied or Satisfied with the job and zero if Unsatisfied or Very Unsatisfied.Individual controls: education, experience, experience sq., and sex. Observations weighted by longitudinal survey weights. Standard errors clustered by enumeration areas (primary sampling units of the survey) in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Estimation Results: Mobility Barriers

- Our preferred explanation that fits the data best: **not all** sector choices are voluntary and once "trapped" switching to a preferred sector is **hard**
  - 63% of transitions from non-agr. and 32% from agr. driven by chance

Parameter	Barriers to mobility
Variance of permanent comparative advantage in sector s ($\sigma^2_{\theta^s}$) and covariance ($\sigma_{\theta^{AN}}$)	
$\sigma^2_{\theta^A}$	0.41
	(0.02)
$\sigma^2_{\theta^N}$	0.64
	(0.03)
$\sigma_{\theta^{AN}}$	0.26
	(0.02)
Variance of transitory productivity shocks in sector s ($\sigma^2_{\varepsilon^s}$)	
$\sigma^2_{\varepsilon^A}$	0.25
	(0.02)
$\sigma^2_{\varepsilon^N}$	0.03
	(0.02)
Probabilities of involuntary choices	
p^S	**0.11**
	(0.01)
p^T	**0.81**
	(0.02)

Coefficient δ_i	Data ($\hat{\delta}_i$)	Standard error in the data	Barriers to mobility
Non-agriculture premia: cross-sectional (δ_1) and within-individual (δ_2)			
δ_1	0.57	(0.03)	0.48
δ_2	0.40	(0.05)	0.40
Premia for switchers to non-agriculture (δ_5) and to agriculture (δ_6)			
δ_5	0.15	(0.07)	0.24
δ_6	-0.42	(0.06)	-0.40
Residual variance of workers in agriculture (δ_{24}) and non-agriculture (δ_{25})			
δ_{24}	1.24	(0.04)	1.13
δ_{25}	0.95	(0.03)	1.09
Residual variance of non-switching workers in agriculture (δ_{26}) and non-agriculture (δ_{27})			
δ_{26}	1.43	(0.06)	1.44
δ_{27}	1.08	(0.04)	1.01
Overall fit (loss function)			0.414

Reason for Job Separation

	Reason for separation				
Dep. variable	Voluntary	Forced	Family/Health	Other	Observations
Δ Log Wage	-	-0.393***	-0.447***	-0.241***	1410
	-	(0.071)	(0.072)	(0.057)	

Job transitions	Reason for separation (share of total)				
	Voluntary	Forced	Family/Health	Other	No. of cases
AA	22.90	17.56	23.66	35.88	131
AN	**37.18**	**10.26**	23.08	29.49	78
NA	**20.86**	**22.46**	28.34	28.34	187
NN	30.62	19.41	20.07	29.90	1669
Total	29.49	19.23	21.16	30.12	2065

Notes: Data for wage workers in IFLS wave 4 and 5 who were fired or quit in the preceding 5 years. The reported reason for separation from the previous job: voluntary: *Wage/salary was too low, Not conducive working environment;* forced: *Fired by the company because business was closed down/relocated/restructured, Fired for other reason, Refused being relocated;* family/health*: Marriage, Childbirth, Other family reason, Prolonged sickness;* other: *Other.* Panel A: Dependent variable is change in log wage between the last job and current job. *Voluntary* transitions are the omitted category. Controls: Year FE for current and last job, Province FE, Urban dummy, dummy for migrating outside of the village boundary. Observations weighted by longitudinal survey weights. Standard errors clustered by enumeration areas (primary sampling units of the survey) in parentheses. Significance levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$. Panel B: Fraction of job transitions occurring within and across sectors, broken down by reason for separation.

Barriers Quantified: Aggregate Impact

- Counterfactual: eliminate barriers to mobility in our baseline model by setting $p^S = p^T = 0$
- 35% of workers switch sectors
- Aggregate output increases by 21.5%

Variable	Notation	Counterfactual
Growth rate (%) in total income: (1) $*$ (2) $*$ (3)	$\Delta\%Y_i$	21.5
		(2.3)
(1) Fraction of the population reallocated	m	0.35
		(0.02)
(2) Ratio of average income of reallocated workers to average income	ψ_m	0.57
		(0.02)
(3) Growth rate (%) in total income of reallocated workers	$\Delta\%Y_m$	106.5
		(8.5)

Barriers Quantified: Sectoral Impact

- Counterfactual: eliminate barriers to mobility in our baseline model by setting $p^S = p^T = 0$
- Agricultural employment shrinks by 8.1 p.p.
- Labor productivity and output increases in both sectors

Variable	Agriculture	Non-Agriculture
Baseline employment share	0.39	0.61
Counterfactual employment share	0.30	0.70
Counterfactual employment growth (%)	-21.0	13.1
Counterfactual output growth (%)	14.2	24.6
Counterfactual productivity growth (%)	44.4	10.1

Industry Premia Revisited

- Without frictions, non-agricultural within-worker premium would be negative (not zero)
  - Zero premium does not imply efficient allocation
- Without sorting, cross-sectional and within-worker premia would be approximately equal
  - Difference b/w the two premia indicates presence of sorting

Coef.	Baseline model	No frictions	No sorting
Non-agriculture premia: cross-sectional (δ_1) and within-worker (δ_2)			
δ_1	0.48	0.18	0.46
δ_2	0.40	-0.31	0.44

Notes: No frictions imposes $p^T = p^S = 0$. No sorting imposes $\sigma^2_{\theta A}$, $\sigma^2_{\theta N}$, $\sigma^2_{\varepsilon A}$, $\sigma^2_{\varepsilon N}$ all equal to zero.

Conclusions

- We present extensive reduced-form evidence of a substantial premium for working in non-agriculture along with two-way worker flows in Indonesia
- We show that these premia are hard to interpret in isolation, but are informative when combined with other moments of the joint distribution of worker's observed income and sector
- Our estimates imply that a significant fraction of workers is misallocated, resulting in sizable efficiency losses
- Looking forward: what are the root causes of barriers to sectoral mobility and what policies can be used as a remedy?
  - Agriculture as a fallback option in developing countries
  - Joint household decisions due to social norms or missing markets

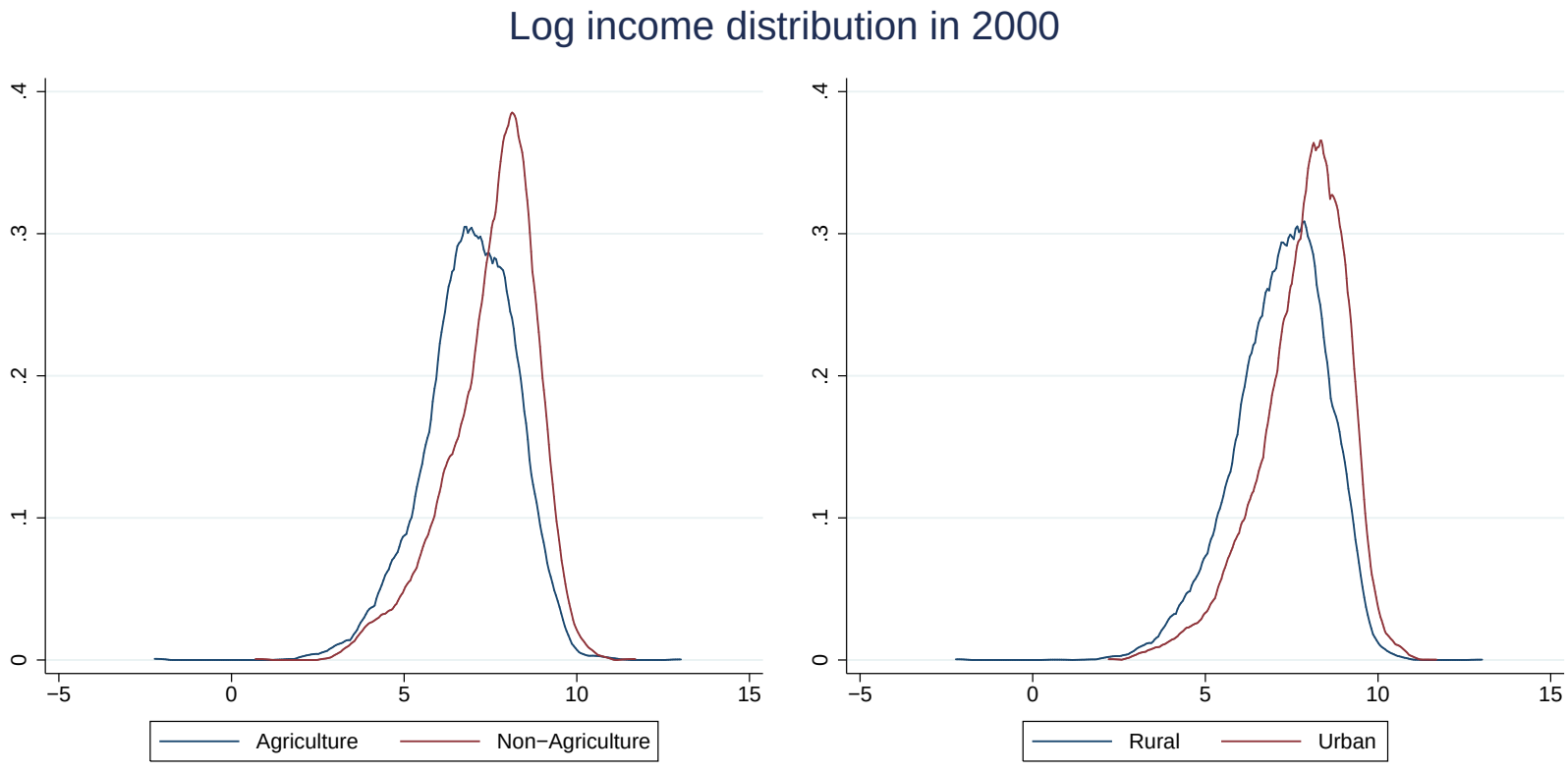
Occupations

Top 10 Occupations	Empl. share
Agricultural and animal husbandry workers	0.352
Salesmen, shop assistants and related workers	0.136
Bricklayers, carpenters and other construction workers	0.038
Maids and related housekeeping service workers NEC	0.038
Working proprietors (catering and lodging services)	0.034
Transport equipment operators	0.032
Teachers	0.031
Food and beverage processors	0.027
Working proprietors (wholesale and retail trade)	0.026
Service workers NEC	0.025
Cumulative	0.739

Notes: Notes: Employment shares reported for IFLS 4 (2007).

▸ Back

Within Dispersion is Large



Back

Sectoral Premia

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	(0.041)		(0.040)	(0.036)	(0.033)	
Urban		0.647***	0.405***	0.207***	0.084**	
		(0.045)	(0.042)	(0.036)	(0.032)	
Agr.×Urban						0.062
						(0.055)
Non-Agr.×Urban						0.416***
						(0.046)
Non-Agr.×Rural						0.326***
						(0.039)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Indiv. cont.				Yes	Yes	Yes
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▸ Back

Transitions Probabilities

		Sector in T+1	
		Agricult.	Non-Agr.
Sector in T	Agricult.	0.78	0.22
	Non-Agr.	0.12	0.88

		Location in T+1	
		Rural	Urban
Location in T	Rural	0.90	0.10
	Urban	0.05	0.95

Back

Transitions across Locations

Location transitions	No. of cases	Share of total
RR	23299	48.79
RU	3171	6.64
UR	1166	2.44
UU	20121	42.13
Total	47757	100.00
Indiv. who switch at least once		16.91

Spatial Unit	Ratio Gross/Net Flows
Country	2.12
Province	1.76
District	1.26

Back

Premia for Switchers and Stayers by Job Type

	(1) Self-employed	(2) Private Worker	(3) Government	(4) Unpaid Family
AN-AA	0.259***	0.245***	0.111	0.335
	18.31	11.98	0.43	1.21
NA-NN	-0.309***	-0.274***	-0.225	-0.871*
	33.61	17.89	1.02	3.79

Notes: Table presents tests based on results of a first-difference regression with direction of sectoral switch interacted with job type. Reported are the difference in coefficients of interest and the value of an *F(1,296)* test that the difference is zero. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

▸ Back

Wage Premia

	(1) Log Income	(2) Log Income	(3) Log Wage	(4) Log Wage
Non-Agriculture	0.574***	0.332***	0.490***	0.231***
	(0.036)	(0.033)	(0.051)	(0.050)
Urban	0.207***	0.084**	0.193***	0.119***
	(0.036)	(0.032)	(0.042)	(0.035)
Year FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Indiv. cont.	Yes	Yes	Yes	Yes
Individual FE		Yes		Yes
Observations	44494	44497	23139	23140
R^2	0.503	0.518	0.556	0.601

Notes: Individual controls: education, experience, experience sq., and sex. Observations weighted by longitudinal survey weights. Standard errors clustered by enumeration areas (primary sampling units of the survey) in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

▸ Back

Consumption Premia

	(1) Log PCE	(2) Log PCE	(3) Log PCE	(4) Log PCI	(5) Log PCI	(6) Log PCI
NA sh. in HH income	0.305***			0.702***		
	(0.017)			(0.040)		
Non-Agr.		0.214***	0.075***		0.492***	0.197***
		(0.014)	(0.013)		(0.030)	(0.024)
Urban	0.315***	0.161***	0.095***	0.416***	0.225***	0.063*
	(0.029)	(0.024)	(0.026)	(0.043)	(0.034)	(0.037)
Non-Agr./$\overline{Y_{ih}/Y_h}$		0.382	0.134		0.884	0.352
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Indiv. cont.		Yes	Yes		Yes	Yes
Individual FE			Yes			Yes
Observations	40168	53546	53550	38365	51690	51693
R^2	0.707	0.742	0.784	0.504	0.520	0.541

Notes: Specifications (1) and (4) estimated at a household level with observations weighted by longitudinal household survey weights. (1) also includes the number of household members (level and squared) as controls. *NA sh. in HH Income* is a continuous variable measuring the share of non-agriculture in household's income. Specifications (2)-(3) and (5)-(6) estimated at an individual level. Individual controls: education, experience, experience sq., and sex. Observations weighted by longitudinal survey weights. Standard errors clustered by enumeration areas (primary sampling units of the survey) in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Back

Premia with Heterogeneity in Mincerian Returns

	(1) Log Income	(2) Log Income	(3) Log Income	(4) Log Income
Non-Agriculture	0.574***	0.332***	0.625***	0.314***
	(0.036)	(0.033)	(0.039)	(0.034)
Urban	0.207***	0.084**	0.200***	0.074**
	(0.036)	(0.032)	(0.034)	(0.032)
Year FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Indiv. controls	Yes	Yes	Yes	Yes
Individual FE		Yes		Yes
Het. in Mincer			Yes	Yes
Observations	44494	44497	44494	44497
R^2	0.503	0.518	0.506	0.520

Notes: Columns (3) and (4) allow for differences in Mincerian returns across sectors and locations. Average marginal effect for the population reported. Average effects for switchers are similar. Individual Mincerian controls: education, experience, experience sq., and sex. Observations weighted by longitudinal survey weights. Standard errors clustered by enumeration areas (primary sampling units of the survey) in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

▸ Back

Premia with Additional Jobs and Home Production

	Base (1) Log Income	Base (2) Log Income	Add. Job (3) Log Income	Add. Job (4) Log Income	Add+HH TC (5) Log Income	Add+HH TC (6) Log Income	Add+HH FC (7) Log Income	Add+HH FC (8) Log Income
Non-Agr.	0.574***	0.332***	0.501***	0.264***	0.462***	0.251***	0.447***	0.245***
	(0.036)	(0.033)	(0.034)	(0.032)	(0.033)	(0.032)	(0.032)	(0.032)
Urban	0.207***	0.084**	0.171***	0.063*	0.141***	0.057*	0.124***	0.051
	(0.036)	(0.032)	(0.034)	(0.034)	(0.033)	(0.034)	(0.033)	(0.034)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indiv. cont.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE		Yes		Yes		Yes		Yes
Observations	44494	44497	44489	44492	44489	44492	44489	44492
R^2	0.503	0.518	0.514	0.538	0.513	0.540	0.515	0.545

Notes: *Base* is the baseline specification involving primary job only. *Add. Job* also includes secondary job. *HH TC* scales income by the inverse of the share of self-produced consumption in household's overall consumption. *HH FC* scales income by the inverse of the share of self-produced food in household's food consumption. Individual controls: education, experience, experience sq., and sex. Observations weighted by longitudinal survey weights. Standard errors clustered by enumeration areas (primary sampling units of the survey) in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

▸ Back

Premia with Hours Worked

	(1) Log Income	(2) Log Income	(3) Log Income	(4) Log Income	(5) Log Inc./Hour	(6) Log Inc./Hour
Non-Agriculture	0.574***	0.332***	0.441***	0.271***	0.297***	0.185***
	(0.036)	(0.033)	(0.034)	(0.032)	(0.036)	(0.036)
Urban	0.207***	0.084**	0.160***	0.084***	0.109***	0.076***
	(0.036)	(0.032)	(0.031)	(0.026)	(0.029)	(0.028)
Log Hours/Year			0.496***	0.432***		
			(0.011)	(0.011)		
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Indiv. cont.	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE		Yes		Yes		Yes
Observations	44494	44497	43841	43843	43841	43843
R^2	0.503	0.518	0.592	0.595	0.478	0.493

Notes: Individual controls: education, experience, experience sq., and sex. Observations weighted by longitudinal survey weights. Standard errors clustered by enumeration areas (primary sampling units of the survey) in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

▸ Back

Premia over Time: Cross-Section

	Pooled	1993	1997	2000	2007	2014
	(1)	(2)	(3)	(4)	(5)	(6)
	Log Income	Log Income	Log Income	Log Income	Log Income	Log Income
Non-Agriculture	0.574***	0.792***	0.721***	0.547***	0.461***	0.449***
	(0.036)	(0.070)	(0.052)	(0.051)	(0.048)	(0.058)
Urban	0.207***	0.388***	0.271***	0.227***	0.204***	0.097
	(0.036)	(0.057)	(0.051)	(0.051)	(0.049)	(0.062)
Year FE	Yes					
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Indiv. cont.	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE						
Observations	44494	5296	8548	10293	10619	9738
R^2	0.503	0.382	0.333	0.244	0.267	0.249

Notes: *Pooled* is the baseline sample with observations from IFLS 1-5. Cross-sectional regressions in columns (2)-(6) run separately for each survey wave. Individual controls: education, experience, experience sq., and sex. Observations weighted by longitudinal survey weights. Standard errors clustered by enumeration areas (primary sampling units of the survey) in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

▸ Back

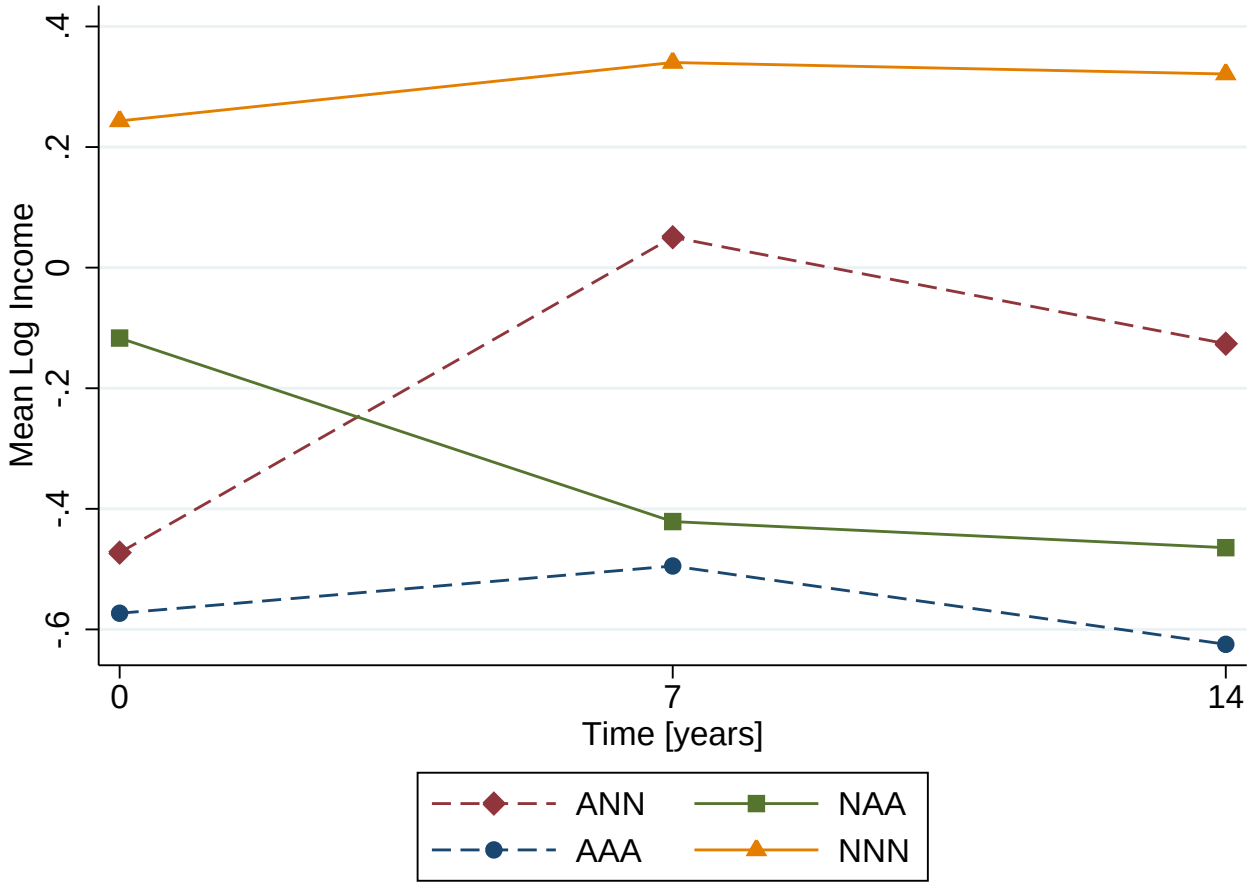
Premia over Time: Within-Workrer

	Pooled	1993-97	1997-00	2000-07	2007-14
	(1)	(2)	(3)	(4)	(5)
	Log Income	Log Income	Log Income	Log Income	Log Income
Non-Agriculture	0.332***	0.339***	0.292***	0.303***	0.217***
	(0.033)	(0.071)	(0.052)	(0.056)	(0.059)
Urban	0.084**	0.210***	0.097	0.156***	0.144**
	(0.032)	(0.068)	(0.087)	(0.058)	(0.058)
Year FE	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes
Indiv. cont.	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes
Observations	44497	13844	18841	20912	20360
R^2	0.518	0.242	0.205	0.396	0.282

Notes: *Pooled* is the baseline sample with observations from IFLS 1-5. Panel regressions in columns (2)-(6) run separately for each two consecutive survey waves. Individual controls: education, experience, experience sq., and sex. Observations weighted by longitudinal survey weights. Standard errors clustered by enumeration areas (primary sampling units of the survey) in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

▸ Back

Long-Run



Notes: Figure plots mean log income (after controlling for year and province fixed effects) by employment history spanned by three observations at 7-year intervals. XYZ indicates that worker was in sector X during the first observation (in 1993 or 2000), in sector Y during the second observation 7 years later (in 2000 or 2007), and in sector Z during the third observation 14 years later (in 2007 or 2014). A - Agriculture, N - Non-Agriculture. For clarity only histories of switchers who stick to their new sector and of always stayers are reported.

Long-Run Premia

	1993-2014 (1) Δ Log Income	93-07/00-14 (2) Δ Log Income
AN-AA	0.172	
	1.38	
NA-NN	-0.369***	
	9.10	
ANN-AAA		0.147*
		2.79
NAA-NNN		-0.186**
		4.62
Observations	2567	7857
R^2	0.105	0.098

Notes: Column 1 presents tests based on results of a first-difference regression, where the difference is over the period 1993-2014. Reported are the difference in coefficients of interest and the value of an *F(1,288)* test that the difference is zero. Column 2 presents tests based on a first-difference specification over 14 years (1993-2007 or 2000-2014) controlling for direction of switch during the first and second 7-year period. Reported are the difference in coefficients of interest and the value of an *F(1,292)* test that the difference is zero. Individual controls: education, experience, experience sq., and sex. Observations weighted by longitudinal survey weights. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Back

Recall Bias

	Contemporaneous			Retrospective		
	(1) Log Inc.	(2) Log Inc.	(3) Log Inc./Hr	(4) Log Inc.	(5) Log Inc.	(6) Log Inc./Hr
Non-Agriculture	0.707***	0.245***	0.192***	0.525***	0.110***	-0.038
	(0.013)	(0.022)	(0.024)	(0.020)	(0.039)	(0.052)
Log Hours	0.604***	0.462***		0.140***	-0.012	
	(0.039)	(0.046)		(0.051)	(0.045)	
Log Hours Squared	0.000	-0.002		0.018***	0.016***	
	(0.005)	(0.005)		(0.006)	(0.005)	
Age squared		-0.000***	-0.000***		-0.001***	-0.000***
		(0.000)	(0.000)		(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE		Yes	Yes		Yes	Yes
Observations	48626	48626	48626	63498	63498	63498
R-sq	0.423	0.540	0.433	0.161	0.192	0.158

Back

Recall Bias (II)

	Pooled Data			Hicks et al. (2017)		
	(1) Log Inc.	(2) Log Inc.	(3) Log Inc./Hr	(4) Log Inc.	(5) Log Inc.	(6) Log Inc./Hr
Non-Agriculture	0.588***	0.173***	0.076***	0.514***	0.171***	0.047
	(0.015)	(0.019)	(0.021)	(0.016)	(0.025)	(0.031)
Log Hours	0.385***	0.206***		0.531**	0.323***	
	(0.040)	(0.037)		(0.025)	(0.034)	
Log Hours Squared	0.006	0.009**		-0.021***	-0.014**	
	(0.005)	(0.004)		(0.005)	(0.006)	
Age squared		-0.000***	-0.000***		-0.001***	-0.000***
		(0.000)	(0.000)		(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE		Yes	Yes		Yes	Yes
Observations	107933	107933	107933	115897	115897	115897
R-sq	0.303	0.353	0.263			

Back

Auxiliary Regression Models for Indirect Inference

Auxiliary model	Selected coefficients	Coefficient description
i) Log-residual income linear regression on the sector choice: $\ln \tilde{y}_{its} = c + 1\{d_{it} = N\}\delta_1 + D_t + \varepsilon_{ist}$	δ_1	Non-agriculture premium (cross-sectional)
ii) Log-residual income linear regression on the sector choice: $\ln \tilde{y}_{its} = c + 1\{d_{it} = N\}\delta_2 + D_t + D_i + \varepsilon_{ist}$	δ_2	Non-agriculture premium (within-individual)
iii) Log-residual income linear regression on the direction of sector switching: $\ln \tilde{y}_{its} = c + 1\{d_{it-1} = s, d_{it} = s'\}\gamma_{ss'} + D_t + \varepsilon_{ist}$	$\delta_3 = \gamma_{NA}$ $\delta_4 = \gamma_{AN} - \gamma_{NN}$	Premia for switchers to each sector relative to their peers post-switch
iv) Log-residual income linear regression in first differences on the direction of sector switching: $\Delta \ln \tilde{y}_{its} = 1\{d_{it-1} = s, d_{it} = s'\}\gamma_{ss'} + \Delta D_t + \varepsilon_{ist}$	$\delta_5 = \delta_{AN}$ $\delta_6 = \delta_{NA} - \delta_{NN}$	Premia for switchers to each sector relative to non-switching workers

Notes: LPM stands for linear probability model. $\tilde{y}_{its}$ is the residual income of individual i in time t working in sector s, that satisfies $\ln \tilde{y}_{its} = \ln y_{its} - X'_{it}\hat{\beta}$, where y_{its} is the observed income, X'_{it} is the set of observables. D_t corresponds to year fixed-effects and D_i to individual fixed-effects. Δx is the first difference of variable x. $1\{d_{it} = N\}$ is a dummy indicating whether individual i works in non-agriculture in period t, $1\left\{d_{it-1} = s, d_{it} = s'\right\}$ is a set of dummies indicating whether individual i in period $t-1$ worked in sector s and in period $t$worked in sector s', and $1\{d_{it} = t\}$ is a set of dummies indicating whether the observation of worker i corresponds to period t. The omitted category in models iii) and iv) is AA, in model v) is $A \times 1$ and in model vi) is $t = 1$.

Auxiliary Regression Models for Indirect Inference

Auxiliary model	Selected coefficients	Coefficient description
v) Log-residual income linear regression on the interaction between sector choice and year: $\ln \tilde{y}_{its} = \delta_7 + \{1\{d_{it} = N\} \times 1\{d_{it} = t\}\} \gamma_{s \times t} + \varepsilon_{ist}$	δ_7 $\delta_8 = \gamma_{A \times 2} \ldots$ $\ldots \delta_{16} = \gamma_{N \times 5}$	Constant Interactions sector and year
vi) LPM of sector choice on time dummy variables: $1\{d_{it} = N\} = \delta_{22} + 1\{d_{it} = t\} \gamma_t + \varepsilon_{ist}$	δ_{17} $\delta_{18} = \gamma_2 \ldots \delta_{21} = \gamma_5$	Constant Year dummies
vii) LPM of sector choice on previous sector choice: $1\{d_{it} = N\} = \delta_{27} + 1\{d_{it-1} = N\} \delta_{28} + \varepsilon_{ist}$	δ_{22},δ_{23}	Constant and lagged sector choice
viii) Residual variances:	δ_{24}, δ_{25} δ_{26}, δ_{27} δ_{28}, δ_{29}	For workers in each sector from model v) For non-switching workers in each sector from model iv) For switching workers to each sector from model iv)

Notes: LPM stands for linear probability model. $\tilde{y}_{its}$ is the residual income of individual i in time t working in sector s, that satisfies $\ln \tilde{y}_{its} = \ln y_{its} - X'_{it}\hat{\beta}$, where y_{its} is the observed income, X'_{it} is the set of observables. D_t corresponds to year fixed-effects and D_i to individual fixed-effects. Δx is the first difference of variable x. $1\{d_{it} = N\}$ is a dummy indicating whether individual i works in non-agriculture in period t, $1\left\{d_{it-1} = s, d_{it} = s'\right\}$ is a set of dummies indicating whether individual i in period $t-1$ worked in sector s and in period $t$worked in sector s', and $1\{d_{it} = t\}$ is a set of dummies indicating whether the observation of worker i corresponds to period t. The omitted category in models iii) and iv) is AA, in model v) is $A \times 1$ and in model vi) is $t = 1$.

▸ Back

Estimation Results: Switching Costs

- With voluntary choices switching costs need to be of an **opposite signs** (giving utility compensation for switching to agriculture)

Parameter	Switching Costs
Variance of permanent comparative advantage in sector s ($\sigma^2_{\theta^s}$) and covariance ($\sigma_{\theta^{AN}}$)	
$\sigma^2_{\theta^A}$	0.50
	(0.05)
$\sigma^2_{\theta^N}$	0.45
	(0.04)
$\sigma_{\theta^{AN}}$	0.16
	(0.04)
Variance of transitory productivity shocks in sector s ($\sigma^2_{\varepsilon^s}$)	
$\sigma^2_{\varepsilon^A}$	0.12
	(0.03)
$\sigma^2_{\varepsilon^N}$	0.00
	(0.01)
Cost of moving from sector s to sector s' ($\phi^{ss'}$)	
$\ln \phi^{AN}$	**0.64**
	(0.04)
$\ln \phi^{NA}$	**-0.63**
	(0.03)

Coefficient δ_i	Data ($\hat{\delta}_i$)	Standard error in the data	Switching costs
Non-agriculture premia: cross-sectional (δ_1) and within-individual (δ_2)			
δ_1	0.57	(0.03)	0.60
δ_2	0.40	(0.05)	0.35
Premia for switchers to non-agriculture (δ_5) and to agriculture (δ_6)			
δ_5	0.15	(0.07)	0.29
δ_6	-0.42	(0.06)	-0.34
Residual variance of workers in agriculture (δ_{24}) and non-agriculture (δ_{25})			
δ_{24}	1.24	(0.04)	1.13
δ_{25}	0.95	(0.03)	1.10
Residual variance of non-switching workers in agriculture (δ_{26}) and non-agriculture (δ_{27})			
δ_{26}	1.43	(0.06)	1.59
δ_{27}	1.08	(0.04)	1.45
Overall fit			1.439

Back

Results for All Auxiliary Regression Models

(1) Coefficient δ_i (weight Ω_i)	(2) Data ($\hat{\delta}_i$)	(3) Standard error in the data	(4) Basic frictionless	(5) Compensating differential	(6) Barriers to mobility	(7) Barriers to mobility + compensating differential
Non-agriculture premia: cross-sectional (δ_1) and within-individual (δ_2)						
δ_1 (1)	0.57	(0.03)	0.56	0.60	0.48	0.49
δ_2 (1)	0.40	(0.05)	0.21	0.35	0.40	0.41
Premia for switchers to agriculture (δ_3, δ_6) and non-agriculture. (δ_4, δ_5). The first element in (a, b) is relative to peers post-switch; the second to non-switching workers						
δ_3 (5)	-0.05	(0.06)	-0.05	-0.10	-0.04	-0.05
δ_4 (5)	-0.31	(0.05)	-0.41	-0.37	-0.24	-0.25
δ_5 (5)	0.15	(0.07)	0.21	0.31	0.24	0.24
δ_6 (5)	-0.42	(0.06)	-0.21	-0.33	-0.40	-0.40
Constant (δ_7) and coefficients on interaction sector and year ($\delta_8 : A \times 2,\ \delta_9 : A \times 3, \ldots \delta_{16} : N \times 5$)						
δ_7 (5)	-0.17	(0.10)	-0.18	-0.18	-0.18	-0.16
δ_8 (1)	0.38	(0.07)	0.47	0.45	0.41	0.43
δ_9 (1)	0.34	(0.07)	0.38	0.27	0.38	0.35
δ_{10} (1)	0.63	(0.07)	0.56	0.55	0.67	0.72
δ_{11} (1)	0.85	(0.08)	0.78	0.78	0.94	0.89
δ_{12} (5)	0.76	(0.06)	0.60	0.64	0.70	0.74
δ_{13} (1)	1.10	(0.06)	1.06	1.03	1.07	1.04
δ_{14} (1)	0.89	(0.06)	0.91	0.88	0.85	0.88
δ_{15} (1)	1.05	(0.06)	1.12	1.16	1.03	0.97
δ_{16} (1)	1.27	(0.07)	1.33	1.33	1.19	1.23
Constant (δ_{17}) and coefficients on year dummies ($\delta_{18} : t = 2,\ \delta_{19} : t = 3$...)						
δ_{17} (10)	0.70	(0.01)	0.67	0.68	0.67	0.66
δ_{18} (10)	0.01	(0.02)	0.00	-0.03	-0.03	-0.03
δ_{19} (10)	-0.02	(0.02)	-0.09	-0.02	-0.05	-0.05
δ_{20} (10)	-0.03	(0.02)	-0.04	-0.05	-0.07	-0.08
δ_{21} (10)	-0.04	(0.02)	-0.05	-0.09	-0.09	-0.09
Constant (δ_{22}) and lagged sector choice (δ_{23})						
δ_{22} (10)	0.21	(0.01)	0.20	0.22	0.16	0.15
δ_{23} (10)	0.68	(0.01)	0.66	0.62	0.71	0.72
Residual variance of workers in agriculture (δ_{24}) and non-agriculture (δ_{25})						
δ_{24} (3)	1.24	(0.04)	1.01	1.14	1.13	1.14
δ_{25} (3)	0.95	(0.03)	1.19	1.12	1.09	1.06
Residual variance of non-switching workers in agriculture (δ_{26}) and non-agriculture (δ_{27}), switching to non-agriculture (δ_{28}) and to agriculture (δ_{29})						
δ_{26} (3)	1.43	(0.06)	1.44	1.57	1.44	1.47
δ_{27} (3)	1.08	(0.04)	1.56	1.44	1.01	1.01
δ_{28} (3)	1.73	(0.14)	1.58	1.54	1.80	1.80
δ_{29} (3)	1.86	(0.14)	1.51	1.51	1.83	1.81
Overall fit (loss function)			2.013	1.462	0.414	0.380

▸ Back

Results for All Structural Parameters

(1) Parameter	(2) Basic frictionless	(3) Compensating differential	(4) Barriers to mobility	(5) Barriers to mobility + compensating differential
Variance of permanent comparative advantage in sector s ($\sigma^2_{\theta^s}$) and covariance ($\sigma_{\theta^{AN}}$)				
$\sigma^2_{\theta^A}$	0.29	0.52	0.41	0.40
	(0.03)	(0.05)	(0.02)	(0.02)
$\sigma^2_{\theta^N}$	0.63	0.48	0.64	0.61
	(0.04)	(0.04)	(0.03)	(0.02)
$\sigma_{\theta^{AN}}$	0.26	0.18	0.26	0.25
	(0.04)	(0.05)	(0.02)	(0.02)
Variance of transitory productivity shocks in sector s ($\sigma^2_{\varepsilon^s}$)				
$\sigma^2_{\varepsilon^A}$	0.00	0.12	0.25	0.25
	(0.00)	(0.03)	(0.02)	(0.02)
$\sigma^2_{\varepsilon^N}$	0.06	0.01	0.03	0.00
	(0.01)	(0.01)	(0.02)	(0.00)
Variance of measurement error (σ^2_ν)				
σ^2_ν	0.73	0.71	0.47	0.50
	(0.01)	(0.01)	(0.02)	(0.01)
Price of human capital in sector s at time t (R^s_t)				
R^A_1	0.80	0.47	0.77	0.77
R^A_2	1.29	0.75	1.15	1.20
R^A_3	1.18	0.62	1.10	1.10
R^A_4	1.41	0.88	1.51	1.60
R^A_5	1.74	1.12	2.00	1.94
R^N_1	1.08	1.31	1.48	1.56
R^N_2	1.74	1.94	2.20	2.18
R^N_3	1.36	1.66	1.79	1.86
R^N_4	1.77	2.16	2.15	2.09
R^N_5	2.16	2.50	2.52	2.66
Compensating differential				
ln cd	–	0.61	–	0.11
		(0.04)		(0.04)
Probabilities of involuntary choices				
p^S	–	–	0.11	0.11
			(0.01)	(0.01)
p^T	–	–	0.81	0.81
			(0.02)	(0.02)

▸ Back

Index of Appendix Slides