Gender, Work and Structural Transformation

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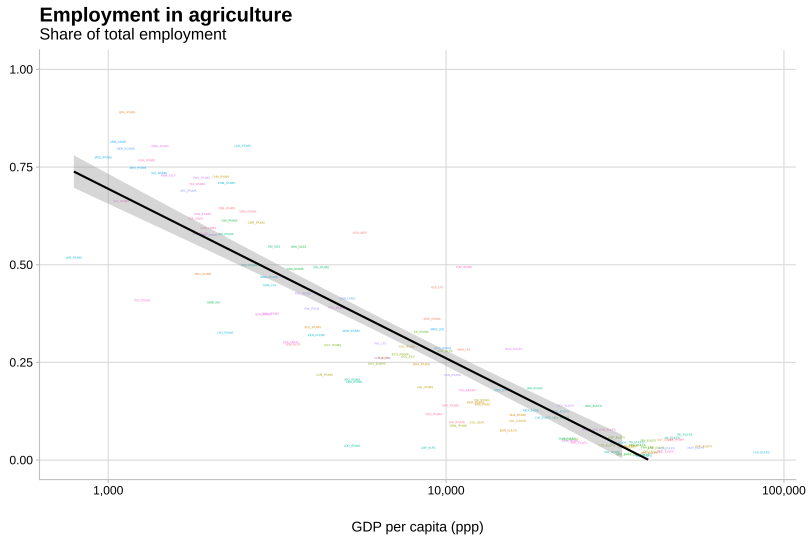
June 23, 2022

Development is accompanied by structural change out of agriculture.



Own computations. Nationally representative surveys w/ industry info for all workers. Each observation is a cty survey. Equal weights for each cty surveys.

Bringing families into the picture

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  1. Number of households in agriculture remains constant, agricultural workers per household down by half
  2. Number of households in agriculture down by half, agricultural workers per household constant

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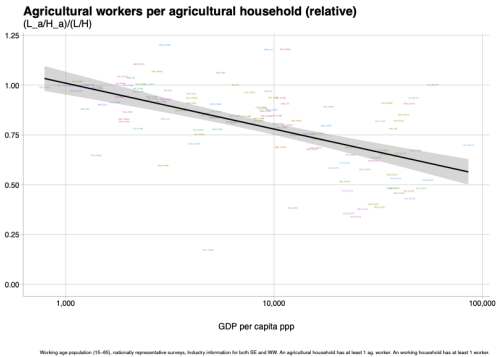
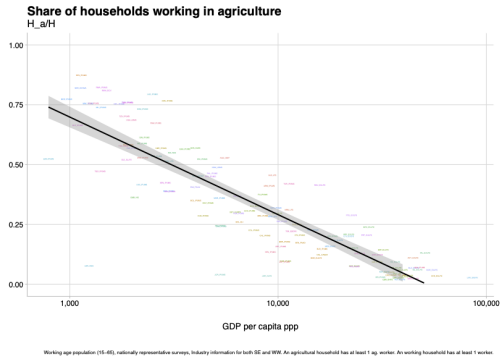
- Suppose agricultural employment declines from 80% to 40%.
- Two polar scenarios:
  1. Number of households in agriculture remains constant, agricultural workers per household down by half
  2. Number of households in agriculture down by half, agricultural workers per household constant
- Decomposition of the agricultural employment share

$$\frac{L_a}{L} = \underbrace{\left(\frac{L_a}{H_a} \Big/ \frac{L}{H}\right)}_{\text{Ag.workers per ag. HH (rel.)}} \times \underbrace{\frac{H_a}{H}}_{\text{Share of ag. HH}}$$

Bringing families into the picture





▸ Decomposition: Hours worked ▸ Within household employment

New Fact: Structural change out of agriculture driven by entire families

- What declines with development is the share of households in agriculture.

- Drop in agricultural employment share from LIC to HIC $\approx$ factor 28
  - Drop in agricultural household share $\approx$ factor 14.
  - Drop in (rel.) agricultural worker per ag. household $\approx$ factor 2.

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- Drop in share of hours worked in agricultural from LIC to HIC $\approx$ factor 17.2
  - Drop in (rel.) agricultural hours per ag. household $\approx$ factor 1.2.

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New fact: Structural change out of agriculture driven by families.

This paper: A family perspective on work and structural change

1. Document choices of market and home work by sex $\times$ marital status $\times$ location across the development spectrum.
   - Group that stands out in LIC: urban married women.

2. Use a model to estimate determinants of differences across groups and countries.
   - Determinants: Bargaining, Home production, Income, Wedges, Disutility of work.
   - **New:** work and sector choices by families.

3. Counterfactual simulations: determinants of work affect structural change.
   $\rightarrow$ New channel: opportunities for married women affect family location choice.

Female urban employment $\rightarrow$ family location choices $\rightarrow$ structural change.

Literature

- **Gender and structural transformation in the context of middle/high-income countries.** Olivetti (2013), Moro et al. (2017), Cuberes and Teignier (2016), Ngai and Petrongolo (2017), Rendall (2018).
- **Female labour force participation.** Sinha (1965), Goldin (1994), Boserup (1970), Ngai, Olivetti, and Petrongolo (2021).
- **Measurement of time use, leisure, and home production.** Aguiar and Hurst (2007), Ramey and Francis (2009), Bick et al. (2018), Bridgman et al. (2018), Boerma and Karabarbounis (2021).
- **Family economics.** Greenwood et al. (2017)
- **Gender, talent allocation and structural change.** Hsieh and Hurst (2019), Kleineberg and Chiplunkar (2021)
- **Social norms, safety, and female work choices.** Alesina and Giuliano (2010), Jayachandran (2021), Kondylis et al. (2020).

Data

We harmonize micro data from countries across the income distribution and build two unique datasets:

- Harmonized World Labour Force Survey (HWLFS)
- Harmonized World Time Use Survey (HWTUS)

$\rightarrow$ Measurement of labor supply and time allocation for subgroups of population.

Dataset 1: Harmonized World Labour Force Survey

- Harmonize demographic, education, household and labour market information.
- Household, labour force surveys and censi from 117 countries.
- Nests IPUMS Intl., IPUMS-US historical and EU-LFS.
- 1'526 country-year surveys.
- Observations: $\approx$ 200 mio. individuals.
- Coverage: \$500 - \$115,000.

This paper

- Survey sample: Nationally representative.
- Individual sample: working-age population aged 15-65.
- Demographics : sex, marital status.
- Sector/location (urban/rural).
- Hourly wages.

Dataset 2: Harmonized World Time Use Data

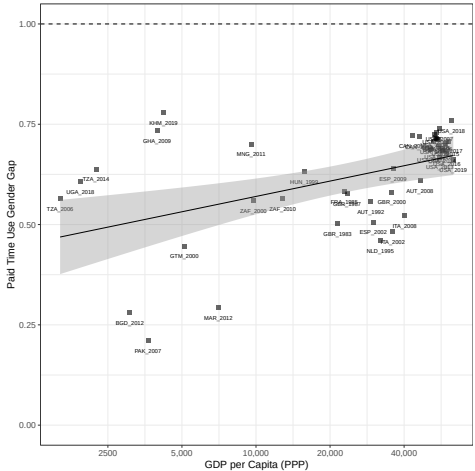
- Starting point: Multinational Time Use Study (MTUS)
- Augmented with TUS from low-income and middle-income countries.
- Requirement: full 24h diary data, nationally representative.
- Coverage: currently 82 surveys from 30 countries.
- Measure time spent on 7 activities. ▸ Classification

This paper

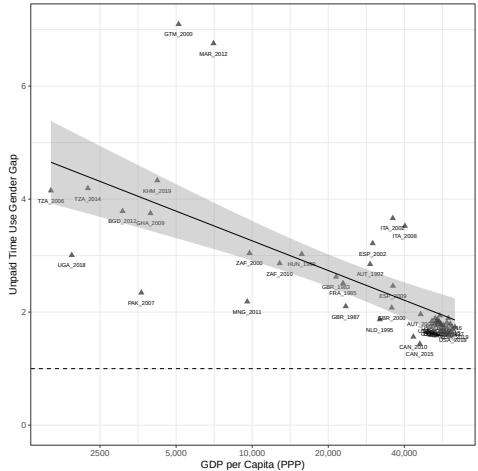
- Individual sample: working-age population aged 15-65.
- Demographics : sex, marital status.
- Sector/location (urban/rural).
- Market and home hours.

In progress: Distinguish types of home (unpaid) labor: domestic services and care.

Fact 2: Low market work of LIC women rel. to men...

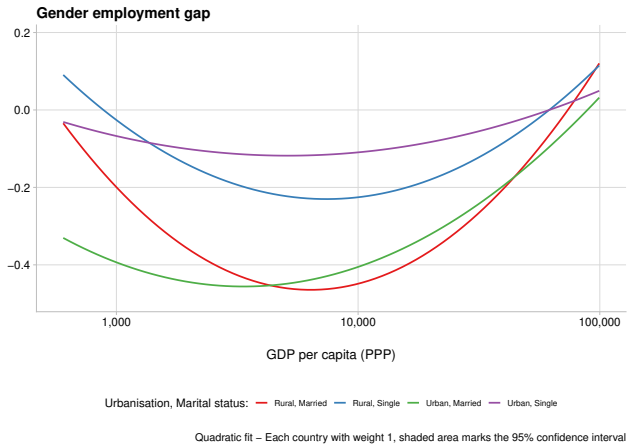


market work



home work

Fact 2: Low rel. market work of LIC women due to urban married women



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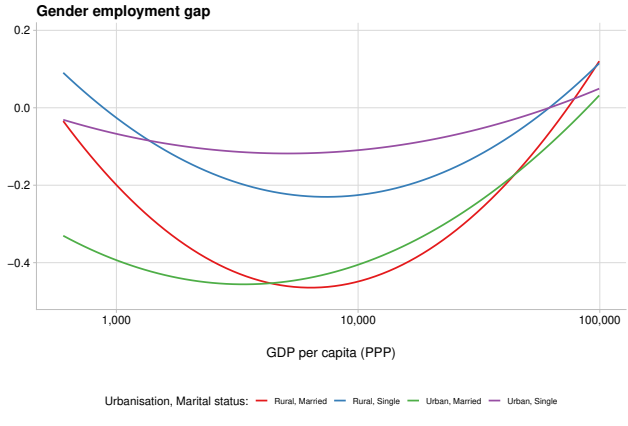
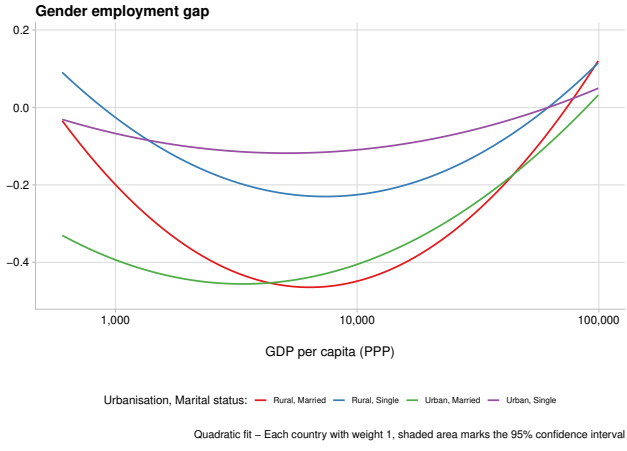


- Large employment gap for urban married women in LICs.
- Also for all married women in MICs. Robust to age, education.

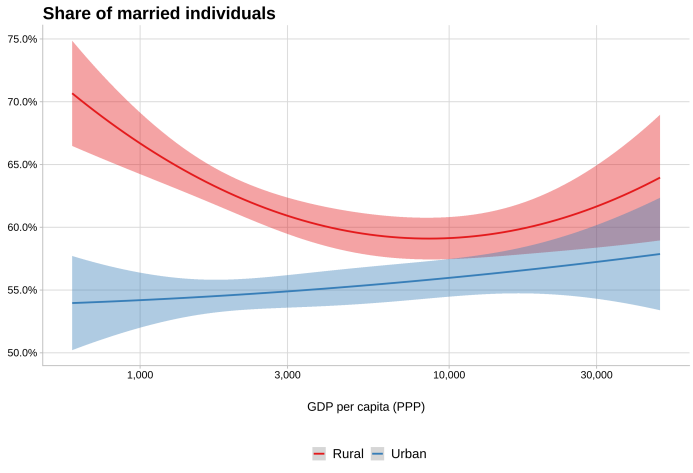
Fact 2: Low rel. market work of LIC women due to urban married women



⇒ Does this affect location choices of married couples?

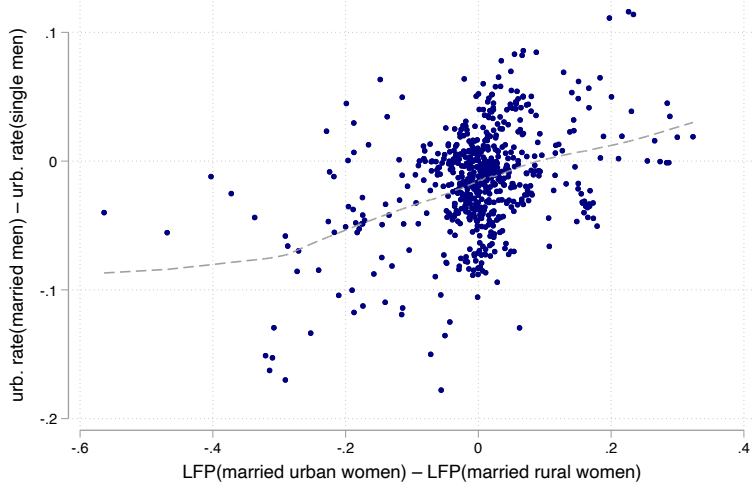
Fact 3: Female employment related to family/male location choices

1. In LICs, the share of married individuals is much higher in rural areas.



Fact 3: Female employment related to family/male location choices

2. Where urban married women work less, married men are less urban.



▸ regression

Three new facts

1. Structural change out of agriculture driven by entire families.
   $\Rightarrow$ Sectoral choices are family choices.

2. Low market labour supply for some groups of women:
   - Married urban women in LICs
   - All married women in MICs

   $\Rightarrow$ Incentives to participate differ by marital status and sector/location.

3. Female employment rates related to male location choices.
   $\Rightarrow$ Barriers to female employment can act as a barrier for the entire family.

$\Rightarrow$ Write down a model of family labour supply.

Model structure

1. A model of family labour supply
   - Choice of market and home labour supply
   - Choice of location/sector
2. Production in firms
3. Goods and labor market clearing general equilibrium

A model of family labour supply

- Three types of households: married, female single, male single.
- Two sectors/locations: agriculture (rural) and non-agriculture (urban).

A model of family labour supply

- Three types of households: married, female single, male single.
- Two sectors/locations: agriculture (rural) and non-agriculture (urban).

- Determinants of labour supply:
  - Wages w and gender gaps (h).
  - Preferences:
    - home produced goods vs market goods (B)
    - market work vs home work (C)
  - Bargaining power (λ)
  - Income effect on labour supply ($\sigma > 1$)

- Households maximize utility by choosing
  1. sector of work/location and
  2. market hours (L_m) and home hours (L_h)

A model of family labour supply

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1. Combine model and data to transparently infer these parameters for all types.
2. Simulate their effect on labour supply, sectoral structure, and output.

Model: Households

Individual utility (Boerma and Karabarbounis, *ECMA* fc.):

$$u = \frac{\left[c_m^{\frac{\varepsilon-1}{\varepsilon}} + \boldsymbol{B} c_h^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}(1-\sigma)}}{1-\sigma} - \boldsymbol{C}\frac{{L_m}^{1+1/\phi}}{1+1/\phi} - \frac{{L_h}^{1+1/\phi}}{1+1/\phi} + \boldsymbol{\nu}$$

Utility of a couple:

$$u^u = \boldsymbol{\lambda} u^{mu} + (1-\boldsymbol{\lambda}) u^{fu}$$

$\boldsymbol{B}, \boldsymbol{C}, \boldsymbol{\nu}, \boldsymbol{\lambda}$ vary by household/individual type and sector (subscripts suppressed.)

Model: Households

Individual utility (Boerma and Karabarbounis, *ECMA* fc.):

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Market goods:

$$c_m = \left[\theta {c_a}^{\frac{\psi-1}{\psi}} + (1-\theta) {c_n}^{\frac{\psi-1}{\psi}} \right]^{\frac{\psi}{\psi-1}}$$

Model: Households

Individual utility (Boerma and Karabarbounis, *ECMA* fc.):

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Budget constraint:

$$\begin{aligned} \text{single:} \quad & P c_m = w \boldsymbol{h} L_m \\ \text{couple:} \quad & P(c_m^m + c_m^f) = w^m \boldsymbol{h^m} L_m^m + w^f \boldsymbol{h^f} L_m^f \\ & p_a c_a^j + c_n^j = P c_m^j, \quad j = m, f \end{aligned}$$

Home production:

$$c_h^m + c_h^f = z(L_h^f + L_h^m)$$

What explains observed labour supply choices?

Many factors: we allow for full variation of $\boldsymbol{B}, \boldsymbol{C}, \boldsymbol{\lambda}, \boldsymbol{w}, \boldsymbol{h}$ across household/individual types and sector/location.

Identification:

- Rich data allow us to measure $\boldsymbol{L_m}, \boldsymbol{L_h}, \boldsymbol{w}, \boldsymbol{h}$ directly.
- Model allows for transparent identification of $\boldsymbol{B}, \boldsymbol{C}, \boldsymbol{\lambda}$ directly off optimality conditions.

For counterfactuals:

- Measure $\boldsymbol{\nu}$ using utility function.
- Measure $\boldsymbol{\mu}$ using firm module of model.

Calibrate: elasticities $\sigma, \phi, \varepsilon, \psi, \rho$

Labour supply choices and identification: Singles

– First order conditions for labour supply:

$$L_m: \quad \frac{wh}{P} c^{\frac{1-\sigma\varepsilon}{\varepsilon}} c_m^{-\frac{1}{\varepsilon}} = C L_m^{\frac{1}{\phi}}$$

$$L_h: \quad zBc^{\frac{1-\sigma\varepsilon}{\varepsilon}} c_h^{-\frac{1}{\varepsilon}} = L_h^{\frac{1}{\phi}}$$

– **Market vs home work:**

$$\left(\frac{L_m}{L_h}\right)^{\frac{1}{\phi}+\frac{1}{\varepsilon}} = \frac{1}{\boldsymbol{BC}} \left(\frac{wh}{Pz}\right)^{1-\frac{1}{\varepsilon}}$$

High home hours relative to market could be due to high $\boldsymbol{B}$ or high $\boldsymbol{C}$.
Let $\Theta \equiv L_h/L_m$.

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High home hours relative to market could be due to high $\boldsymbol{B}$ or high $\boldsymbol{C}$.
Let $\Theta \equiv L_h/L_m$.

– **Optimal home hours:**

$$L_h^{\sigma+\frac{1}{\phi}} = \boldsymbol{B}z^{-\sigma}\left[\left(\frac{wh}{Pz\Theta}\right)^{\frac{\varepsilon-1}{\varepsilon}} + \boldsymbol{B}\right]^{\frac{1-\sigma\varepsilon}{\varepsilon-1}}$$

Level of home hours reveals level of $\boldsymbol{B}$.

Labour supply choices and identification: Married

– First order conditions for labour supply:

$$
\begin{aligned}
L_m^m: &\quad C^m \lambda {L_m^m}^{\frac{1}{\phi}} = w^m h^m \mu_m \\
L_h^m: &\quad \lambda {L_h^m}^{\frac{1}{\phi}} = z\mu_h \\
L_m^f: &\quad C^f(1-\lambda) {L_m^f}^{\frac{1}{\phi}} = w^f h^f \mu_m \\
L_h^f: &\quad (1-\lambda) {L_h^f}^{\frac{1}{\phi}} = z\mu_h
\end{aligned}
$$

Labour supply choices and identification: Married

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– **Home hours, male vs female:**

$$\frac{L_h^f}{L_h^m} = \left(\frac{\lambda}{1-\lambda}\right)^{\phi}$$

Given equal productivity and disutility, relative L_h reveals bargaining power λ.

Labour supply choices and identification: Married

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$$

– **Market hours, male vs female:**

$$
\frac{L_m^f}{L_m^m} = \left(\frac{w^f h^f}{w^m h^m} \frac{\lambda}{1-\lambda} \frac{C^m}{C^f} \right)^{\phi}
$$

Labour supply choices and identification: Married

– **Home hours, male vs female:**

$$\frac{L_h^f}{L_h^m} = \left(\frac{\boldsymbol{\lambda}}{1-\boldsymbol{\lambda}}\right)^{\phi}$$

Given equal productivity and disutility, relative L_h reveals bargaining power $\boldsymbol{\lambda}$.

– **Market hours, male vs female:**

$$\frac{L_m^f}{L_m^m} = \left(\frac{w^f h^f}{w^m h^m}\frac{\lambda}{1-\lambda}\frac{\boldsymbol{C^m}}{\boldsymbol{C^f}}\right)^{\phi}$$

Given relative effective wages, relative market vs home hours reveal relative disutility of market work, $\boldsymbol{C^m/C^f}$.

Labour supply choices and identification: Married – cont.

Using all equations implies levels of market and home work:

$$L_m^{f\,\sigma+\frac{1}{\phi}} = \frac{1}{C^f}(1-\Lambda)^{-\sigma}(\Theta^f\Omega)^{\frac{1-\sigma\varepsilon}{\varepsilon}}\left(\frac{w^m h^m \Delta_m + w^f h^f}{P}\right)^{-\frac{1}{\varepsilon}}\frac{w^f h^f}{P}$$

$$L_h^{f\sigma+\frac{1}{\phi}} = B(1-\Lambda)^{-\sigma}\Omega^{\frac{1-\sigma\varepsilon}{\varepsilon}}(\Delta_h+1)^{-\frac{1}{\varepsilon}}$$

where

$$\frac{\Lambda}{1-\Lambda} = \left(\frac{\lambda}{1-\lambda}\right)^{\frac{1}{\sigma}}$$

$$\Delta_m = \frac{L_m^m}{L_m^f} \quad \text{and} \quad \Delta_h = \frac{L_h^m}{L_h^f}$$

$$\Theta^f = \frac{L_h^f}{L_m^f} \quad \text{and} \quad \omega = Bz^{1-\frac{1}{\varepsilon}}$$

$$\Omega = \Omega(w^m h^m, w^f h^f, \Delta_m, \Delta_h, P, \text{parameters})$$

Calibration: Elasticities

We externally calibrate the elasticities $\sigma, \phi, \varepsilon, \psi, \rho$.

σ, ϕ The model elasticity of market work wrt w is

$$\frac{1-\sigma}{\sigma + 1/\phi}.$$

In long-run data, this is around -0.2 (Boppart and Krusell 2020).

$\Rightarrow$ σ=1.4, ϕ=1.5.

ε = 2 (Aguiar, Hurst and Karabarbounis 2012)

ρ = 0.6, following estimates of the elasticity of substitution between men and women (Hamermesh, 1993; Johnson and Keane, 2013; Acemoglu et al., 2004; Olivetti and Petrongolo, 2014).

ψ 3.6 based on Storesletten, Zhao and Zilibotti (2019). Also consider lower values.

Results

Warning: Preliminary!

Inferred parameters: bargaining power

Home hours, male vs female:

$$\frac{L_h^f}{L_h^m} = \left(\frac{\lambda}{1-\lambda}\right)^{\phi}$$

	LIC		HIC	
	rural	urban	rural	urban
L_h^f/L_h^m	2.68	**3.97**	2.24	2.13
λ	0.66	**0.72**	0.63	0.62

Inferred parameters: relative disutility of market work

Market hours, male vs female:

$$\frac{L_m^f}{L_m^m} = \left(\frac{w^f h^f}{w^m h^m} \frac{\lambda}{1-\lambda} \frac{C^m}{C^f} \right)^{\phi}$$

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L_m^f / L_m^m	0.79	**0.43**	0.54	0.55
$w^f h^f / (w^m h^m)$	0.8	0.8	0.88	0.93
C^f / C^m	1.81	**3.51**	2.28	2.29

Inferred parameters: B vs C

Market vs home work, female:

$$\left(\frac{L_m^f}{L_h^f}\right)^{\frac{1}{\varepsilon}+\frac{1}{\phi}} = \frac{1}{\boldsymbol{BC^f}}\left(\frac{w^m h^m \Delta_m + w^f h^f}{Pz(\Delta_h+1)}\right)^{-\frac{1}{\varepsilon}} \frac{w^f h^f}{Pz}$$

Level of home work:

$$L_h^{f\,\sigma+\frac{1}{\phi}} = \boldsymbol{B} z^{1-\frac{1}{\varepsilon}}(1-\Lambda)^{-\sigma}\Omega^{\frac{1-\sigma\varepsilon}{\varepsilon}}(\Delta_h+1)^{-\frac{1}{\varepsilon}}$$

			LIC	urban	rural				
$L_{h,\text{urban}}$	/	$L_{h,\text{rural}}$	1.45			$\boldsymbol{B}_{\text{urban}}$	/	$\boldsymbol{B}_{\text{rural}}$	1.5
L_m^f	/	L_h^f		0.6	1.4	$\boldsymbol{C}^f_{\text{urban}}$	/	$\boldsymbol{C}^f_{\text{rural}}$	1.75
w^f_{urban}	/	w^f_{rural}	1.8						

Inferred parameters: Summary

- Much greater disutility of market work C for urban married women in LICs, both compared to rural and to HICs.

- This reflects lower observed market work than differences in w and B would lead us to expect.

Counterfactuals: Female vs male market work

Market hours, male vs female:

$$\frac{L_m^f}{L_m^m} = \left(\frac{w^f h^f}{w^m h^m} \frac{\lambda}{1-\lambda} \frac{C^m}{C^f} \right)^{\phi}$$

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Counterfactual: replace LIC values by HIC values in the equation.

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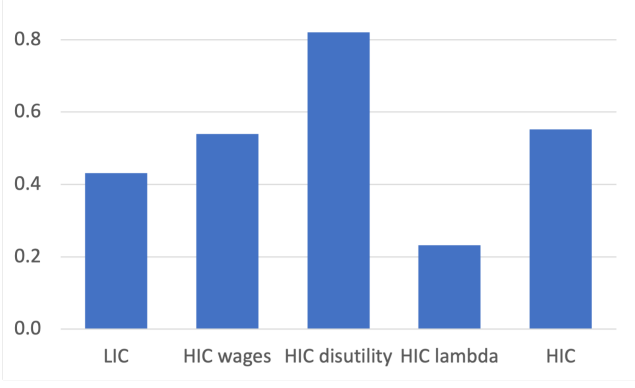

Counterfactuals: Structural change

Counterfactual: change C^f/C^m (LIC) to the HIC value: 2.3 (2) instead of 3.5 (2.8) for married (singles).

- More attractive urban work attracts single women and couples to urban locations.
- Similar (but weak) effect for single males due to higher w in GE.

Share of urban households:

	benchmark	lower C^f/C^m (married only)	lower C^f/C^m (all urban women)
single men	0.33	0.34	0.35
single women	0.33	0.34	0.42
couples	0.20	0.23	0.23
total	0.25	0.27	0.29

Barriers to female urban market work affect the structural composition of the economy.

Counterfactuals: Structural change: output and productivity

	benchmark	lower C^f/C^m (married only)	lower C^f/C^m (all urban women)
non-ag pop share	0.25	0.27	0.29
non-ag VA share	0.28	0.30	0.31
aggr. output	1	1.016	1.025
Y/hour	1	1.006	1.009

Barriers to female urban market work affect the structural composition of the economy.

Productivity gain, as non-ag more productive.

Counterfactuals: The composition of cities

Share of married individuals:

	benchmark	lower C^f/C^m (married only)	lower C^f/C^m (all urban women)
rural	0.67	0.66	0.68
urban	0.5	0.52	0.5

Barriers to female urban market work affect the population composition of cities.

Conclusion

- Gender and the family matter for location and sectoral choices.
- Low market work of urban women in LICs reflects higher disutility of market work, compared to rural or HIC women.
  - It is too low to be explained by differences in w and B.
- Disutility of female urban market work in LICs affects structural change, as it increases agricultural employment.

Appendix

TUS: Activity classification

Activity	Work type	Unpaid type	Definition
Work			Activities that can be delegated to a third party for the production of goods and services.
-	paid (market)		Activities to produce goods and services destined to the market as well as all goods (but not services) produced for own final use.
-	unpaid (home)		Activities to produce services for own final use.
-	-	service	Domestic services
-	-	household care	Care of household and family members.
-	-	non-household care	Care for others (incl. volunteering and community work).
Leisure			Leisure activities
Education			Time spent in education and related activities.
Self-care			Activities for self-care (sleep, food, cleaning).

Table: Activity classification

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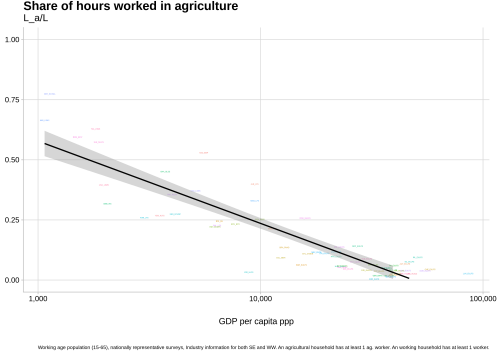
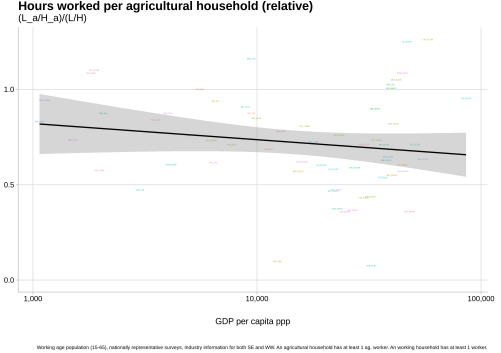
Bringing families into the picture

- Decomposition of hours worked in agriculture:

$$\frac{L_a}{L} = \underbrace{\left(\frac{L_a}{H_a} \;/\; \frac{L}{H}\right)}_{\text{Ag.hours per ag. HH (rel.)}} \times \underbrace{\frac{H_a}{H}}_{\text{Share of ag. HH}}$$





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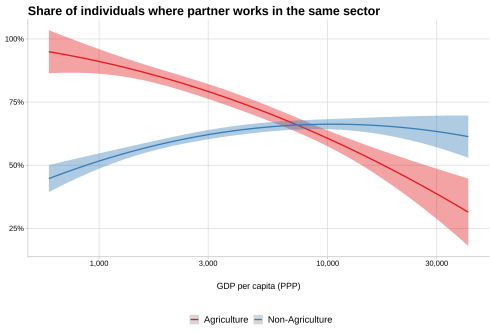
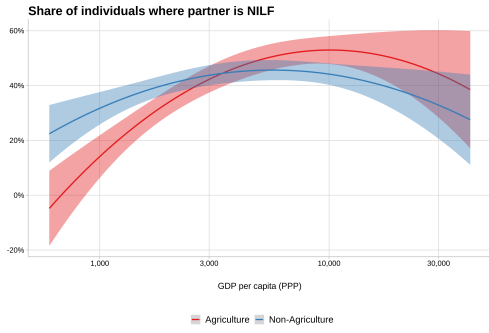
Bringing families into the picture





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Fact 3: Female employment related to family/male location choices

Regression: Where urban married women work less, married men are less urban.

	Urbanization rate of married males	
	(1)	(2)
Urbanization rate of single males	0.98^{***}	0.97^{***}
	(0.01)	(0.01)
ER of female-married-urban	0.17^{***}	0.16^{***}
	(0.01)	(0.02)
ER of female-married-rural	-0.18^{***}	-0.18^{***}
	(0.01)	(0.01)
Log GDP per capita		0.01^{***}
		(0.002)
Constant	-0.0001	-0.04^{***}
	(0.01)	(0.01)
Observations	790	786
R^2	0.96	0.96
Note:		*p<0.1; **p<0.05; ***p<0.01

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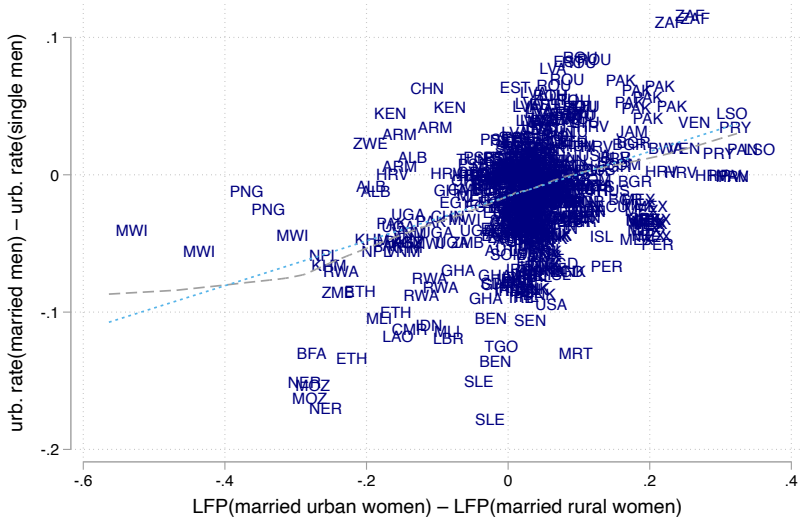
Fact 3: Female employment related to family/male location choices



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Appendix: Firms

Sectoral production function using four types of labour inputs:

$$Y = A\left[\sum_j \mu^j N^{j\rho}\right]^{\frac{1}{\rho}}, \quad j \in \{fu, fs, mu, ms\}$$

Elasticity of substitution: $1/(1-\rho)$.

Firms take as given a sector $\times$ type-specific wage and sectoral price.

Appendix: Equilibrium

An equilibrium consists of $p_a, \pi^j, w_k^j, L_{mk}^j, L_{hk}^j, k = a, n, j = fs, ms, fu, mu$, such that

1. households choose their location optimally,
2. households choose market and home labour supply optimally,
3. firms choose inputs optimally, and
4. goods and labour markets clear.

Labour supply choices and identification: Utility and location choice

Indirect utility for singles:

$$u = \left(\frac{wh}{P}\right)^{(1-\sigma)\frac{1+\frac{1}{\phi}}{\sigma+\frac{1}{\phi}}} K(B, C, wh, z) + \boldsymbol{\nu}$$

Data + parameters allow us to infer $\boldsymbol{\nu}$.

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Labour supply choices and identification: Wages, technology and wedges

Observe: $wh \equiv \hat{w}$ for each group j and sector k.
Want: $\boldsymbol{h}$

Labour supply choices and identification: Wages, technology and wedges

Observe: $wh \equiv \hat{w}$ for each group j and sector k.
Want: $\boldsymbol{h}$

Firm FOC:

$$w_k^j = p_k \mu_k^j \frac{A_k^\rho Y_k^{1-\rho}}{N_k^{j\,1-\gamma}}$$

$$w_k^j h_k^j = h_k^j p_k \mu_k^j \frac{A_k^\rho Y_k^{1-\rho}}{N_k^{j\,1-\gamma}}$$

$$\ln \hat{w}_k^j = \ln(w_k^j h_k^j) = \ln \boldsymbol{h_k^j} + \ln \mu_k^j + \ln(p_k A_k^\rho Y_k^{1-\rho}) + (1-\rho) \ln N_k^j$$

Labour supply choices and identification: Wages, technology and wedges

Observe: $wh \equiv \hat{w}$ for each group j and sector k.
Want: $\boldsymbol{h}$

Firm FOC:

$$\ln \hat{w}_k^j = \ln \boldsymbol{h_k^j} + \ln \mu_k^j + \ln(p_k A_k^{\rho} Y_k^{1-\rho}) + (1-\rho) \ln N_k^j$$

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Regression:

$$\ln \hat{w}_{ikt}^j = \hat{\boldsymbol{h}}_{\boldsymbol{k}}^{\boldsymbol{j}} + \beta \boldsymbol{X_{it}} + \gamma_{kt} + (1-\rho) \ln N_{kt}^j + \epsilon_{it}$$

Labour supply choices and identification: Wages, technology and wedges

Observe: $wh \equiv \hat{w}$ for each group j and sector k.
Want: $\boldsymbol{h}$

Firm FOC:

$$\ln \hat{w}_k^j = \ln \boldsymbol{h}_k^j + \ln \mu_k^j + \ln(p_k A_k^{\rho} Y_k^{1-\rho}) + (1-\rho) \ln N_k^j$$

Regression:

$$\ln \hat{w}_{ikt}^j = \hat{\boldsymbol{h}}_k^j + \beta \boldsymbol{X_{it}} + \gamma_{kt} + (1-\rho) \ln N_{kt}^j + \epsilon_{it}$$

Regress $\ln \hat{w}_i$ on observable characteristics + sector $\times$ time + sector $\times$ group FEs.

- Assumption: differences in μ across groups are only due to differences in observable characteristics, like age, education and occupation.

$\Rightarrow$ coefficients on observable characteristics capture μ_k^j differences, group FEs capture $\boldsymbol{h}$ differences relative to single men.

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Labour supply choices and identification: Technology: μ

Given estimates for $\boldsymbol{h}$, can compute $w = \hat{w}/h$.
Then infer $\boldsymbol{\mu_k^j}$ from firm FOCs and $\sum_j \mu_k^j = 1$:
Firm FOC:

$$w_k^j = p_k \mu_k^j \frac{A_k^\rho Y_k^{1-\rho}}{N_k^{j\,1-\rho}}$$

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Labour supply choices and identification: Technology: μ

Given estimates for h, can compute $w = \hat{w}/h$.

Then infer μ^j_k from firm FOCs and $\sum_j \mu^j_k = 1$:

Firm FOC:

$$w^j_k = p_k \mu^j_k \frac{A^\rho_k Y^{1-\rho}_k}{N^j_k{}^{1-\rho}}$$

So

$$\mu^j = \mu^1 \frac{w^1}{w^j} \left(\frac{N^1}{N^j} \right)^{1-\rho}$$

Because $\sum_j \mu^j_k = 1$,

$$\frac{1}{\mu^1} = 1 + \sum_{j=2}^{4} \frac{w^j}{w^1} \left(\frac{N^j}{N^1} \right)^{1-\rho}$$

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Labour supply choices and identification: Technology: A_k

Normalize A_a to 1. Y_a follows.

Using the non-agricultural good as the numéraire, the firm FOC implies A_n:

$$w_n^j = \mu_n^j \frac{A_n{}^\rho Y_n^{1-\rho}}{N_n^j{}^{1-\rho}}$$

Y_n follows.

The firm FOC in agriculture then implies p_a:

$$w_a^j = p_a \mu_a^j \frac{A_a^\rho Y_a^{1-\rho}}{N_a^j{}^{1-\rho}}$$

back

Labour supply choices and identification: Demand

Consumption demand and market clearing imply $\boldsymbol{\theta}$:

$$\frac{Y_a}{Y_n} = \left(\frac{\boldsymbol{\theta}}{1-\boldsymbol{\theta}} \frac{1}{p_a} \right)^{\psi}.$$

The price index of the aggregate market good follows as

$$P = \left(\theta^{\psi} p_a^{1-\psi} + (1-\theta)^{\psi} \right)^{\frac{1}{1-\psi}}.$$

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