# The Effects of Female Land Inheritance on Economic Productivity in Ghana

Nathan Barker

University of Chicago

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# Motivating Ideas

- This paper asks: what are the effects of female land inheritance on occupational choice and productivity in Ghana?
- Three big ideas in context of this conference
  - Idea 1: Consequences of land institutions will depend on individual's outside option relative to farming
  - Idea 2: "Customary Land Tenure" is not a monolith; different "customary" rules will have different consequences
  - Idea 3: Frictions in different markets can amplify each other

# Land Inheritance Customs and Occupational Choice

- In Ghana: two land inheritance regimes
  - Patrilineal descent: land passes from fathers to sons
  - Matrilineal descent: interplay with colonial institutions facilitates "ambiguous rules" in which men and women can both inherit
- Study these differences in combination with selection into and returns to different sectors

# Core Insight: Male and Female Inheritance produce Asymmetric Outcomes

- Male and female inheritance produce asymmetric outcomes, because of differences in outside option for men and women
- Female inheritance:
  - Women: Manage farms, supply labor to their agricultural plots
  - Men: Exit agriculture, work in labor market
- Male Inheritance:
  - Men: manage farms supply labor to their agricultural plots
  - Women: face barriers to labor market participation, supply labor to male-owned plots, work less

# Result: Female Inheritance Improves *Male* Productivity

- Female inheritance: associated with higher per capita consumption, driven by higher *male* labor productivity, via two mechanisms
  1. Cognitive skill rewarded in wage labor but not farming: increased flexibility $\rightarrow$ men better capture the returns to their skill
  2. Level effect: wage labor associated with higher earnings relative to most levels of landholding
- Agricultural productivity: equal across both inheritance regimes
  - Reflects three offsetting effects: (1) female-managed farms have lower observed TFP, and (2) more matrilineal female farmers, but (3) male-female gap smaller under matriliny
  - Differences plausibly in part reflect unobserved input differences
- Suggests male-only inheritance regimes negatively affect economic productivity

# Why this happens: three frictions

- My pattern of results driven by three frictions:
- Friction 1: Patriliny imposes male-only inheritance constraint
- Friction 2: Inheritance does not extend to financial market
- Friction(s) 3: Other inequities mean women face worse opportunities in labor market
- Frictions in land markets can be amplified by the presence of frictions in other markets

# Steps Today

- Show: Differences in customs affect: inheritance, land management, schooling
- Observe differences across in consumption (beyond schooling differences), motivates unpacking differences in selection and productivity
- Intuition: parents trade off schooling and land transfers
- Unpacking effect depends on characterizing economic environment, in particular:
  - Estimating farmer total factor productivity, with endogenous input use
  - Estimating returns to skill in farm, non-farm sectors
- Question to consider: can other hypotheses explain these patterns?
  - General female empowerment effect?
  - Other non-labor allocation reasons (*within district*)?

▸ Related Literature

# Inheritance and Kinship in Ghana

- Ethnic groups in Ghana practice *unilineal* descent: kinship and inheritance determined through one parent only
- 52% practice patrilineal descent: kinship through male relatives, inheritance passes from fathers to sons, rarely to daughters
  - Passing land to daughters risks land being lost to other lineages (Duncan 2010)
- Largest meta-ethnicity (Akan) practices matrilineal descent: kinship is determined through female relatives ▸ Map of Matriliny
  - Not symmetric to patriliny: still patriarchal, *historically* from men to maternal nephews (Rattray 1923, Fortes 1987)
- Descent rules have long history: evidence of matriliny among the Akan at least as early as 15th century (Wilks 1989)

# Evolving institutions and Female Inheritance

- Key trajectory: tension between matriliny (but not patriliny) and colonial institutions pushes towards (a) more ambiguous rules, (b) potential for female inheritance
- Colonial rule and Christianity/Islam emphasize importance of nuclear families, not in tension with patriliny, but leads to competing claims in matrilineal households:
  - Kinship rules: obligations to lineage; Colonial rules: obligations to children (Fortes 1987)
  - Leads to "open texture" of inheritance among matrilineal households (Douglas 1969, Hill 1997)
- Amanor 2005: increased flexibility + kinship rules: possibility of female inheritance

# Dataset: Ghana Socioeconomic Panel Survey

- 5,009 households and split-offs: 6,337 households observed at least once
- Nationally representative: 334 enumeration areas (villages, neighborhoods) selected from 2000 census
- Three waves: 2009/10 - 2013 - 2018
- Information on core economic outcomes: consumption, income, wealth, place of birth, education
- Measures of cognition (Raven's Progressive Matrices, Digit Span Forward and Backwards)
- Imposed sample restriction: prime age (25-54), born rural

# Empirical Comparison

For a given outcome (inheritance, farm management, education), for individual $i$, born in district $d$, observed at time $t$, I estimate:

$$y_{idt} = \alpha + \beta matri_i + \gamma female_i + \delta female_i \times matri_i + \mu_t + \nu_d + \epsilon_{idt}$$

Where:

- $y_{itd}$ is the outcome of interest
- $matri_i$ is an indicator variable for matrilineal descent
- $female_i$ is an indicator for female
- $\mu_t$ are wave fixed effects
- $\nu_d$ are district of birth fixed effects

# Land Acquisition, by Gender, Descent

**Land Inheritance, by Gender and Descent**

| | (1) Inherited any Land | (2) Allocated any land | (3) Acres inherited | (4) Acres allocated |
|---|---|---|---|---|
| Female | -0.305*** | -0.173*** | -1.885*** | -1.043*** |
| | (0.0114) | (0.0085) | (0.0892) | (0.0596) |
| Matrilineal Tribe | -0.0281 | -0.0367** | -0.300** | -0.451*** |
| | (0.0199) | (0.0148) | (0.1520) | (0.0806) |
| Female * Matrilineal | 0.109*** | 0.0816*** | 0.658*** | 0.717*** |
| | (0.0181) | (0.0129) | (0.1400) | (0.0765) |
| Sample Mean | 0.203 | 0.114 | 0.928 | 0.440 |
| Patrilineal Male Mean | 0.373 | 0.216 | 2.054 | 1.134 |
| Observations | 12,172 | 12,172 | 12,172 | 12,172 |
| F-Test: Female * Matri=0 | 36.52 | 39.93 | 22.08 | 88.04 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| F-Test: Matri + Fem*Matri=0 | 28.50 | 15.78 | 13.42 | 19.37 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| F-Test: Female + Fem*Matri=0 | 192.80 | 88.33 | 130.90 | 47.76 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |

▸ Descent-Level Comparison

# Land Management, by Gender, Descent

**Plot Management, by Gender and Descent**

| | (1) | (2) |
|---|---|---|
| | Manages agricultural Plot | Acres cultivated |
| Female | -0.540*** | -3.618*** |
| | (0.0125) | (0.1220) |
| Matrilineal Tribe | -0.153*** | -1.213*** |
| | (0.0232) | (0.2090) |
| Female * Matrilineal | 0.203*** | 1.345*** |
| | (0.0207) | (0.1840) |
| Sample Mean | 0.367 | 1.750 |
| Patrilineal Male Mean | 0.677 | 3.965 |
| Observations | 12,175 | 12,175 |
| F-Test: Female * Matri=0 | 96.33 | 53.40 |
| p-value | 0.000 | 0.000 |
| F-Test: Matri + Fem*Matri=0 | 6.74 | 0.90 |
| p-value | 0.009 | 0.344 |
| F-Test: Female + Fem*Matri=0 | 413.40 | 272.60 |
| p-value | 0.000 | 0.000 |

- Managers supply their own labor $>$ 90% of time

# Education

**Human Capital, by Gender, Descent**

| | (1) Years, Education |
|---|---|
| Female | -2.108*** |
| | (0.1530) |
| Matrilineal Tribe | 1.911*** |
| | (0.2470) |
| Female * Matrilineal | -0.378* |
| | (0.2190) |
| Sample Mean | 5.796 |
| Patrilineal Male Mean | 5.863 |
| Observations | 6,137 |
| F-Test: Female * Matri=0 | 2.96 |
| p-value | 0.085 |
| F-Test: Matri + Fem*Matri=0 | 41.70 |
| p-value | 0.000 |
| F-Test: Female + Fem*Matri=0 | 247.80 |
| p-value | 0.000 |

# Log Per Capita Consumption: by Descent

**Household-Level Per Capita Log Consumption**

| | (1) | (2) |
|---|---|---|
| | Log Consumption per Capita, Adult Equivalent | Log Consumption per Capita, Adult Equivalent |
| Matrilineal Tribe | 0.216*** | 0.0994** |
| | (0.0445) | (0.0394) |
| Average Male Years of Education | | 0.0225*** |
| | | (0.0026) |
| Average Female Years of Education | | 0.0261*** |
| | | (0.0031) |
| Mean Male Cognition | | 0.0208 |
| | | (0.0157) |
| Mean Female Cognition | | 0.0572*** |
| | | (0.0157) |
| Observations | 4,290 | 4,290 |

# Framework

- Parents have goal of maximizing children's future income
- Can facilitate this through transfers of land, investment in human capital
- Parents aware of:
  - Differences in skill-intensity of sectors
  - Further barriers women face
- Matriliny: relaxes constraint only men can inherit

# Additional Features of Economic Environment

1. Women face additional barriers to participating in the labor market
   - 7% of women work for a wage, compared to 22% of men
2. Land markets are thin
   - 4% of plots purchased; 4% of households earning income from renting out/sharecropping land (3% sharecrop, 1% cash rent)
   - Additionally: plausible concerns of tenure insecurity if owner $\neq$ manager (dissociation for just 4% of owners)
3. Decomposing drivers of net effect–I show:
   - *Cognitive skill is rewarded in the labor market, but not in farming*
   - *Female-managed plots: lower observed TFP* - calculate using Levinsohn-Petrin - style inversion

# Multinomial Logit: Selection into Occupations

For $occup_{irt} \in \{farming, business, wage, no\ individual\ income\}$, I estimate (separately for men and women):

$$Pr(occup_{irt} = j) = \frac{e^{\beta^j \cdot X_{irt}}}{\sum_{m=1}^{M} e^{\beta^m \cdot X_{irt}}}$$

- $X_{irt}$: Cognition Index, Years of Education, Region of Birth, Matrilineal Indicator
- Idea: female inheritance induces more matrilineal men to select into wage labor
- Calculate Inverse Mills Ratios from estimates (following Dubin McFadden 1984)

▸ Selection Eqn: Males ▸ Selection Eqn: Females

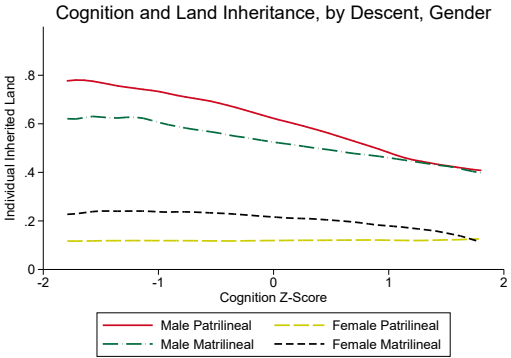
# Male Returns to Skill and Selection

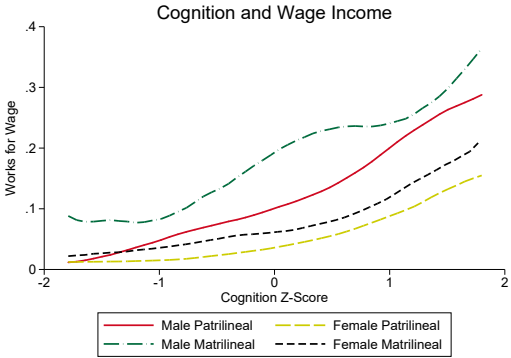
**Male Returns to Skill with Matriliny-Induced Selection**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | ln(Total Annual Wage Income) | ln(Wages per Day) | ln(TFP), land quality adjusted | ln(Agricultural Profits per Acre) | Agricultural profits per Acre (levels) |
| Years Education | 0.204*** | 0.215*** | -0.0051 | -0.0030 | -20.5800 |
| | (0.0526) | (0.0447) | (0.0188) | (0.0254) | (24.5900) |
| Cognition Index | 0.222** | 0.249*** | -0.0475 | -0.0356 | 7.4840 |
| | (0.1040) | (0.0840) | (0.0449) | (0.0609) | (46.4900) |
| Inverse Mills - Selection into Wage Labor | -0.203** | -0.244*** | | | |
| | (0.0791) | (0.0690) | | | |
| Inverse Mills - Selection into Agriculture | | | -0.048 | -0.063 | -61.380 |
| | | | (0.066) | (0.083) | (78.790) |
| Sample Mean | 8.58 | 3.32 | 0.12 | 6.33 | 616.10 |
| Observations | 772 | 771 | 2,249 | 1,767 | 2,480 |

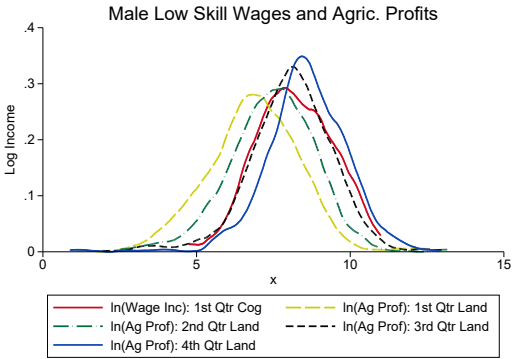
▸ Female Returns Similar

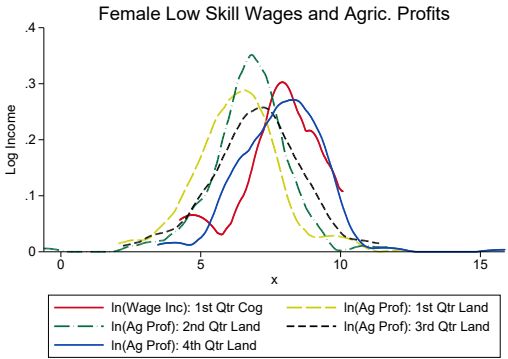
# Cognition and Selection: Inheritance



# Low-Skill Wages vs Agric. Land



# Estimated Farmer TFP

**Farmer Total Factor Productivity by Gender and Descent**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Log TFP, Unadjusted | Log TFP, Unadjusted | Log TFP, with Land Quality Adjustments | Log TFP, with Land Quality Adjustments | Log TFP, with Land Quality Adjustments |
| Female | -0.268*** | -0.336*** | -0.280*** | -0.337*** | |
| | (0.0326) | (0.0459) | (0.0348) | (0.0493) | |
| Matrilineal Tribe | | 0.0954 | | 0.0264 | 0.0282 |
| | | (0.0583) | | (0.0609) | (0.0591) |
| Female * Matrilineal | | 0.154** | | 0.144** | |
| | | (0.0663) | | (0.0708) | |
| Omitted Group Mean | 0.050 | -0.124 | 0.076 | 0.060 | -0.010 |
| Observations | 3,742 | 3,488 | 3,742 | 3,489 | 3,489 |
| F-Test: Female * Matri=0 | | 5.38 | | 4.14 | |
| p-value | | 0.021 | | 0.042 | |
| F-Test: Matri + Fem*Matri=0 | | 11.12 | | 4.69 | |
| p-value | | 0.001 | | 0.030 | |
| F-Test: Female + Fem*Matri=0 | | 14.10 | | 13.99 | |
| p-value | | 0.000 | | 0.000 | |

▸ Explanations of offsetting effects

# Implications

- Female inheritance need not come at expense of male productivity
- Result here: depends on no dissociation between inheritance and management
  - Suggests benefits to improved tenure: men working for wages while women manage
- Bigger picture: speaks to consequences (and importance of studying) additional female barriers
  - Results would look different if male and female inheritance produced symmetric impacts on opposite gender
- Finally: importance of getting into black box of "traditional institutions"

# Appendix Slides

# Anthropological Differences

***Ethnographic Atlas: Inheritance Rules for Land Acquisition***

| | *Share* | |
|---|---|---|
| *Custom* | Gender-specified only | All |
| Matrilineal: Sister's Sons | 0.066 | 0.050 |
| Children, daughters receive less | 0.092 | 0.070 |
| **Children, both sexes equally** | **0.117** | **0.089** |
| Patrilineal: Sons | 0.725 | 0.549 |
| **Other Matrilineal Heirs** | | **0.097** |
| Other Patrilineal Heirs | | 0.145 |
| | | |
| **Upper Bound Female** | | **0.186** |

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# Laws on Inheritance

***World Bank Law Database - Sons and Daughters Inherit Equally***

| | *1971* | *2020* |
|---|---|---|
| Lower and Lower Middle Income Countries, Weighted Equally | 0.545 | 0.688 |
| Lower and Lower Middle Income Countries, Weighted by Population | 0.225 | 0.696 |

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# Sources of Differences

Example: current customary law in Tanzania (Ezer 2006):

- Widows: explicitly excluded from inheritance ("shall be cared for by her children")
- Hierarchical scheme of child inheritance: three classes (decreasing shares)
  - Oldest sons: class one
  - Other sons: class two
  - Daughters: class three

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# PNDC Law 111

Law passed in 1985, on inheritance for those who die intestate (ie with no will)

1. On the commencement of this Law, the devolution of the estate of any person who dies intestate on or after such commencement shall be determined in accordance with the provisions of this Law subject to subsection (2) of this section and the rules of private international law.
2. This Law **shall not apply to any stool, skin or family property**.

$\Rightarrow$ Lineage ("skin," "stool") and family land continue to be legally governed by customary rules

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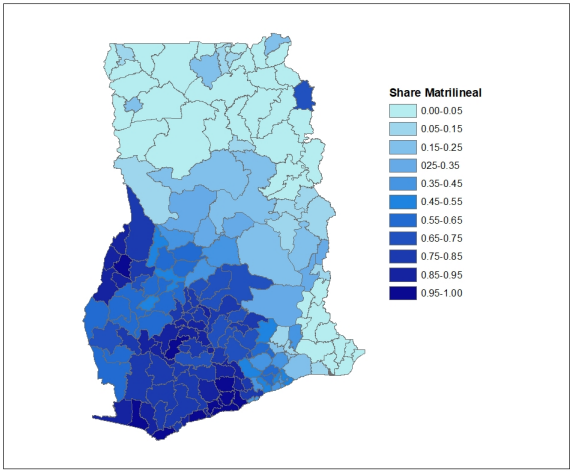
# Matrilineal Population by District (IPUMS)

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# Contribution to Literature

- Key contribution: the nature of structural transformation in Ghana (developing countries):
  - Depends on specific nature of customary land regimes
  - Offers different opportunities and constraints to men and women

Relevant related literatures:

- Nature of rural gender inequality
  - Kilic et al (2015), Field et al (2021), Heath and Tan (2020), Goldstein and Udry (2008), Udry (1996)
- Culture and its impact on economic decision-making
  - Ashraf et al (2020), Bau (2021), Fernando (2020), La Ferrara (2007), Munshi and Rosenzweig (2006, 2015), Lowes (2017)
- Agricultural wage gap: selection vs constraints
  - Gollin Lagakos Waugh (2014), Lagakos and Waugh (2013), Young (2013), Herrendorf and Schoellman (2018), Adamopoulos et al (2021)

# "Allocation" of Land

From Amanor (2001):
In place of giving land as a gift to a family member land may be **allocated to a relative or close friend to "eat from" or to cultivate freely. [....] Gaining user rights in land is often the first stage which children pass through before they are given a gift of the plot**. If children cannot afford to make the aseda ["thank you payment"] to seal the granting of land as a gift, they will hold land on a user right basis. Frequently children start off working with their father or mother on their farms, and then are given a plot of their own on which to make a farm, before this plot is later formally presented to them as a gift.

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# Descent-Level Comparison

**Comparison of Inherited Land by Descent**

| | (1) | (2) |
|---|---|---|
| | Obtained land via inheritance or allocation | Acres Received via Allocation or Inheritance |
| Matrilineal Tribe | 0.0018 | -0.162 |
| | (0.0192) | (0.123) |
| Patrilineal Mean | 0.31 | 1.55 |
| Observations | 12,175 | 12,175 |

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# Tenure Security

**Land Tenure Security, by Gender and Descent**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Has land that could be left empty | Has land that could be left empty indefinitely | Has land that could be sold | Has land that could be used as collateral | Has land that was left fallow |
| Female | -0.0361* | -0.0545** | -0.0922*** | -0.0807*** | -0.190*** |
| | (0.0196) | (0.0233) | (0.0232) | (0.0228) | (0.0095) |
| Matrilineal Tribe | 0.102*** | 0.127*** | 0.107*** | 0.138*** | -0.0393** |
| | (0.0282) | (0.0344) | (0.0335) | (0.0340) | (0.0189) |
| Female * Matrilineal | 0.0356 | 0.0897*** | 0.0927*** | 0.0542 | 0.0351** |
| | (0.0269) | (0.0330) | (0.0341) | (0.0339) | (0.0161) |
| Waves with Data | 1, 2, 3 | 2, 3 | 2, 3 | 2, 3 | 2, 3 |
| Patrilineal Male Mean | 5,958.00 | 4,002.00 | 4,002.00 | 4,002.00 | 10,063.00 |
| Observations | (0) | (0) | (0) | (0) | (0) |
| F-Test: Female * Matri=0 | 0.74 | 0.67 | 0.39 | 0.36 | 0.24 |
| p-value | 0.719 | 0.669 | 0.399 | 0.413 | 0.144 |
| F-Test: Matri + Fem*Matri=0 | 1.75 | 7.36 | 7.40 | 2.56 | 4.74 |
| p-value | 0.186 | 0.007 | 0.007 | 0.110 | 0.030 |
| F-Test: Female + Fem*Matri=0 | 17.46 | 30.24 | 26.06 | 23.37 | 0.09 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.769 |

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# Reshaping Labor Data: Manager-Gendered Labor Level

- To formally test *gender of manager* $\times$ *gendered labor* interaction , I reshape data to "gendered-labor - manager - wave" level

| HHID | Manager_ID | Manager_Gender | Fem_Labor_Qty | Male_Labor_Qty |
|---|---|---|---|---|
| 101 | 101-01 | Female | 40 | 17 |
| 203 | 203-01 | Male | 20 | 55 |
| 203 | 203-02 | Female | 35 | 30 |

| HHID | Manager_ID | Manager_Gender | Labor_Type | Labor_Qty |
|---|---|---|---|---|
| 101 | 101-01 | Female | Female | 40 |
| 101 | 101-01 | Female | Male | 17 |
| 203 | 203-01 | Male | Female | 20 |
| 203 | 203-01 | Male | Male | 55 |
| 203 | 203-02 | Female | Female | 35 |
| 203 | 203-02 | Female | Male | 30 |

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# Agricultural Labor by Gender

**Agricultural Labor Supply, Reported at Gendered Labor - Manager - Wave Level**

| | *Household Labor* | | | *All Labor* | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Any Gendered Labor | Days Gendered Household Agricultural Labor | Days Gendered Household Agricultural Labor per Acre | Any Gendered Labor | Days Gendered Agricultural Labor | Days Gendered Agricultural Labor per Acre |
| Female Labor * Male Manager | -0.186*** | -60.62*** | -17.11*** | -0.162*** | -108.2*** | -28.24*** |
| | (0.0059) | (2.0220) | (0.6020) | (0.0054) | (3.5840) | (1.1300) |
| Male Labor * Female Manager | -0.320*** | -78.38*** | -13.79*** | -0.114*** | -108.3*** | -11.92*** |
| | (0.0107) | (2.8640) | (1.7730) | (0.0088) | (4.5520) | (2.3750) |
| Female Labor * Female Manager | -0.0282*** | -42.85*** | 18.70*** | -0.0518*** | -92.07*** | 17.10*** |
| | (0.0085) | (3.3050) | (2.4450) | (0.0076) | (4.6100) | (3.3820) |
| Wave Fixed Effects? | Yes | Yes | Yes | Yes | Yes | Yes |
| Omitted Group: Male Labor - Male Manager Mean | 0.88 | 128.1 | 33.8 | 0.94 | 196.2 | 50.3 |
| Observations | 17,906 | 17,906 | 16,506 | 17,906 | 17,906 | 16,506 |
| F-Test: Fem Labor*Male Mgr = Male Labor*Fem Mgr | 138.0 | 52.3 | 3.7 | 23.6 | 0.0005 | 52.5 |
| p-value | 0.000 | 0.000 | 0.055 | 0.000 | 0.983 | 0.000 |
| F-Test: Fem Labor*Fem Mgr + Fem Labor*Male Mgr = 0 | 378.5 | 501.7 | 0.4 | 483.2 | 718.1 | 8.29 |
| p-value | 0.000 | 0.000 | 0.547 | 0.000 | 0.000 | 0.004 |
| F-Test: Male Labor*Fem Mgr + Fem Labor*Fem Mgr = 0 | 451.3 | 447.20 | 2.0 | 126.8 | 523.50 | 1.05 |
| p-value | 0.000 | 0.000 | 0.152 | 0.000 | 0.000 | 0.305 |

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# Agricultural Labor by Gender, Descent

**Labor-Manager-Descent Triple Difference, Agricultural Labor Supply**

| | *Household Labor* | | | *All Labor* | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Any Gendered Labor | Days Gendered Household Agricultural Labor | Days Gendered Household Agricultural Labor per Acre | Days Gendered Household Agricultural Labor per Acre | Days Gendered Household Agricultural Labor per Acre | Days Gendered Household Agricultural Labor per Acre |
| Female Labor * Male Manager | -0.141*** | -64.65*** | -16.58*** | -0.113*** | -103.8*** | -27.45*** |
| | (0.0068) | (2.7950) | (0.7800) | (0.0059) | (4.1870) | (1.6980) |
| Male Labor * Female Manager | -0.257*** | -81.98*** | -8.122** | -0.107*** | -111.5*** | -8.528** |
| | (0.0148) | (4.7110) | (3.2810) | (0.0119) | (6.1470) | (4.3090) |
| Female Labor * Female Manager | -0.0280** | -54.93*** | 13.88*** | -0.0352*** | -92.19*** | 15.35*** |
| | (0.0116) | (4.6790) | (2.6780) | (0.0098) | (6.1040) | (4.6250) |
| Matri * Male Labor * Male Mgr | 0.0177 | -16.36** | 0.0344 | 0.0483*** | 4.1300 | 1.5560 |
| | (0.0158) | (7.7040) | (2.4120) | (0.0132) | (11.4100) | (3.7550) |
| Matri * Female Labor * Male Manager | -0.0996*** | -0.8480 | -0.7400 | -0.0816*** | -3.2290 | -0.4240 |
| | (0.0189) | (6.8670) | (2.2360) | (0.0169) | (9.0640) | (3.3700) |
| Matri * Male Labor * Female Manager | -0.109*** | -3.4940 | -9.793** | 0.0173 | 11.5400 | -4.8010 |
| | (0.0233) | (8.2280) | (4.0800) | (0.0196) | (10.4900) | (5.1540) |
| Matri * Female Labor * Female Manager | -0.0033 | 11.1700 | 9.141* | -0.0002 | 5.8680 | 5.3660 |
| | (0.0197) | (8.3450) | (4.9880) | (0.0176) | (10.1800) | (7.3460) |
| Omited group: Male Labor - Male Mgr - Patrilineal Mean | 0.90 | 142.20 | 33.98 | 0.95 | 206.80 | 51.78 |
| Observations | 16,850 | 16,850 | 15,512 | 16,850 | 16,850 | 15,512 |
| F-Test: Fem Labor*Fem Mgr*Matri =0 | 0.03 | 1.79 | 3.36 | 0.00 | 0.33 | 0.53 |
| p-value | 0.869 | 0.181 | 0.067 | 0.992 | 0.565 | 0.465 |

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# Two-Stage Estimation Procedure

With equation of:

$$y_{it} = \beta_0 + \beta_1 l_{it} + \beta_2 n_{it} + \beta_3 m_{it} + \omega_{it} + \epsilon_{it}$$

- In first stage, estimate $\widehat{\beta}_2$ and composite term, $\phi_{it}(l_{it}, m_{it}) = \beta_0 + \beta_1 l_{it} + \beta_3 m_{it} + \omega_{it}(l_{it}, m_{it})$
- Additionally, assume that: $\omega_{it+1} = g(\omega_{it}) + \xi_{it+1}$

Use GMM, with additional moment conditions of:

$$E[(\xi_{it} + \epsilon_{it}) l_{it}] = E[\xi_{it} l_{it}] = 0$$

$$E[(\xi_{it} + \epsilon_{it}) m_{it-1}] = E[\xi_{it} m_{it-1}] = 0$$

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# Additional Factor Share Estimation Methods

- Two other methods: (1) Ackerberg-Caves-Frazer and (2) Dynamic Panel Data have sufficiently demanding data requirements that estimates with them are very imprecise

**Farm Factor Share Production Estimation - All Methods**

| | (1) Levinsohn Petri ("LP") | (2) OLS | (3) OLS-FE | (4) Ackerberg-Caves-Frazer | (5) Dynamic Panel Data |
|---|---|---|---|---|---|
| Labor | 0.085*** | 0.097*** | 0.178*** | 0.090 | 0.655 |
| | (0.014) | (0.018) | (0.025) | (0.905) | (0.609) |
| Land | 0.320*** | 0.409*** | 0.359*** | 0.543*** | 0.061 |
| | (0.044) | (0.018) | (0.028) | (0.192) | (0.533) |
| Agricultural Inputs | 0.290*** | 0.351*** | 0.263*** | 0.125 | 0.112 |
| | (0.040) | (0.013) | (0.018) | (0.574) | (0.337) |

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# Additional Factor Share Estimation Methods

- Regardless of method used, very similar TFP estimates

| | LP | OLS | OLS-FE | ACF | DPD |
|---|---|---|---|---|---|
| LP | 1.000 | | | | |
| OLS | 0.989 | 1.000 | | | |
| OLS-FE | 0.996 | 0.993 | 1.000 | | |
| ACF | 0.984 | 0.971 | 0.986 | 1.000 | |
| DPD | 0.901 | 0.894 | 0.920 | 0.887 | 1.000 |

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# Matriliny-Induced Selection Equation: Men

**Sector of Labor - Average Marginal Treatment Effects**

| | (1) | (2) |
|---|---|---|
| | *Males* | |
| | Among Sample engaged in any occupation | All Prime-Age Men |
| *Manages Business* | | |
| Matrilineal | -0.0225 | -0.0184 |
| | (0.0215) | (0.0187) |
| Years Education | -0.0010 | -0.0009 |
| | (0.0017) | (0.0015) |
| Cognition | 0.0115 | 0.0056 |
| | (0.0102) | (0.0090) |
| *Employed in Wage Labor* | | |
| Matrilineal | 0.0570** | 0.0471** |
| | (0.0255) | (0.0228) |
| Years Education | 0.0297*** | 0.0265*** |
| | (0.0021) | (0.0020) |
| Cognition | 0.0426*** | 0.0315*** |
| | (0.0106) | (0.0094) |
| *Not Earning Individual Income* | | |
| Matrilineal | | 0.0020 |
| | | (0.0205) |
| Years Education | | 0.0012 |
| | | (0.0013) |
| Cognition | | 0.0229*** |
| | | (0.0080) |
| Omitted Group: Managing Agricultural Plot | | |
| Observations | 3,550 | 4,063 |

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# Matriliny-Induced Selection Equation: Women

**Female Sector of Labor - Average Marginal Treatment Effects**

| | (1) Among Sample engaged in any occupation | (2) All Prime-Age Women |
|---|---|---|
| *Manages Business* | | |
| Matrilineal | -0.0998*** | -0.0132 |
| | (0.0331) | (0.0224) |
| Years Education | 0.0022 | 0.0078*** |
| | (0.0027) | (0.0018) |
| Cognition | -0.0045 | 0.0049 |
| | (0.0136) | (0.0097) |
| *Employed in Wage Labor* | | |
| Matrilineal | -0.0203 | -0.0070 |
| | (0.0197) | (0.0104) |
| Years Education | 0.0197*** | 0.0122*** |
| | (0.0019) | (0.0012) |
| Cognition | 0.0358*** | 0.0194*** |
| | (0.0086) | (0.0045) |
| *Not Earning Individual Income* | | |
| Matrilineal | | -0.0643*** |
| | | (0.0238) |
| Years Education | | -0.0108*** |
| | | (0.0018) |
| Cognition | | -0.0125 |
| | | (0.0096) |
| Omitted Group: Managing Agricultural Plot | | |
| Observations | 2,921 | 5,731 |

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# Female Returns to Skill and Selection

**Female Returns to Skill with Matriliny-Induced Endogenous Entry**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | ln(Total Annual Wage Income) | ln(Wages per Day) | ln(TFP), land quality adjusted | ln(Agricultural Profits per Acre) | Agricultural profits per Acre (levels) |
| Years Education | 0.528*** | 0.507*** | -0.0052 | 0.0277 | 0.7560 |
| | (0.1570) | (0.1400) | (0.0216) | (0.0373) | (49.9000) |
| Cognition Index | 0.935*** | 0.698*** | 0.0816 | 0.0538 | -4.9110 |
| | (0.2580) | (0.2260) | (0.0641) | (0.1020) | (145.8000) |
| Inverse Mills - Selection into Wage Labor | -0.515*** | -0.474*** | | | |
| | (0.1790) | (0.1580) | | | |
| Inverse Mills - Selection into Agriculture | | | 0.039 | 0.106 | 70.740 |
| | | | (0.055) | (0.091) | (143.400) |
| Sample Mean | 8.28 | 3.11 | -0.21 | 6.37 | 447.30 |
| Observations | 326 | 326 | 800 | 618 | 933 |

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# Male Sensitivity to Functional Form

**Robustness: Female Sector of Labor - Average Marginal Treatment Effects**

| | *Region of Birth Indicators* | | | |
|---|---|---|---|---|
| | *Logit* | | *Probit* | |
| | (1) | (2) | (3) | (4) |
| | Among Sample engaged in any occupation | All Prime-Age Women | Among Sample engaged in any occupation | All Prime-Age Women |
| *Manages Business* | | | | |
| Matrilineal | -0.0998*** | -0.0132 | -0.0921*** | -0.0108 |
| | (0.0331) | (0.0224) | (0.0331) | (0.0228) |
| Years Education | 0.0022 | 0.0078*** | 0.0033 | 0.0089*** |
| | (0.0027) | (0.0018) | (0.0027) | (0.0018) |
| Cognition | -0.0045 | 0.0049 | -0.0074 | 0.0046 |
| | (0.0136) | (0.0097) | (0.0137) | (0.0096) |
| *Employed in Wage Labor* | | | | |
| Matrilineal | -0.0203 | -0.0070 | -0.0202 | -0.0066 |
| | (0.0197) | (0.0104) | (0.0208) | (0.0109) |
| Years Education | 0.0197*** | 0.0122*** | 0.0170*** | 0.0102*** |
| | (0.0019) | (0.0012) | (0.0018) | (0.0011) |
| Cognition | 0.0358*** | 0.0194*** | 0.0382*** | 0.0207*** |
| | (0.0086) | (0.0045) | (0.0087) | (0.0045) |
| *Not Earning Individual Income* | | | | |
| Matrilineal | | -0.0643*** | | -0.0628*** |
| | | (0.0238) | | (0.0239) |
| Years Education | | -0.0108*** | | -0.0105*** |
| | | (0.0018) | | (0.0018) |
| Cognition | | -0.0125 | | -0.0130 |
| | | (0.0096) | | (0.0096) |
| Omitted Group: Managing Agricultural Plot | | | | |
| Observations | 2,921 | 5,731 | 2,921 | 5,731 |

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# Female Sensitivity to Functional Form

**Robustness: Female Sector of Labor - Average Marginal Treatment Effects**

| | *Region of Birth Indicators* | | | |
|---|---|---|---|---|
| | *Logit* | | *Probit* | |
| | (1) | (2) | (3) | (4) |
| | Among Sample engaged in any occupation | All Prime-Age Women | Among Sample engaged in any occupation | All Prime-Age Women |
| *Manages Business* | | | | |
| Matrilineal | -0.0998*** | -0.0132 | -0.0921*** | -0.0108 |
| | (0.0331) | (0.0224) | (0.0331) | (0.0228) |
| Years Education | 0.0022 | 0.0078*** | 0.0033 | 0.0089*** |
| | (0.0027) | (0.0018) | (0.0027) | (0.0018) |
| Cognition | -0.0045 | 0.0049 | -0.0074 | 0.0046 |
| | (0.0136) | (0.0097) | (0.0137) | (0.0096) |
| *Employed in Wage Labor* | | | | |
| Matrilineal | -0.0203 | -0.0070 | -0.0202 | -0.0066 |
| | (0.0197) | (0.0104) | (0.0208) | (0.0109) |
| Years Education | 0.0197*** | 0.0122*** | 0.0170*** | 0.0102*** |
| | (0.0019) | (0.0012) | (0.0018) | (0.0011) |
| Cognition | 0.0358*** | 0.0194*** | 0.0382*** | 0.0207*** |
| | (0.0086) | (0.0045) | (0.0087) | (0.0045) |
| *Not Earning Individual Income* | | | | |
| Matrilineal | | -0.0643*** | | -0.0628*** |
| | | (0.0238) | | (0.0239) |
| Years Education | | -0.0108*** | | -0.0105*** |
| | | (0.0018) | | (0.0018) |
| Cognition | | -0.0125 | | -0.0130 |
| | | (0.0096) | | (0.0096) |
| Omitted Group: Managing Agricultural Plot | | | | |
| Observations | 2,921 | 5,731 | 2,921 | 5,731 |

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# Effects driving equal TFP across inheritance regimes

- Lack of farm productivity differences driven by three effects:
  1. On average, women have lower farmer TFP, AND
  2. Matriliny induces more women to be farmers, BUT
  3. The male-female farm gap is smaller in matriliny
- What *isn't* driving gap: differences in (a) hours, (b) crop selection, or (c) human capital
- Candidate hypothesis: differences in unmeasured inputs, information-sharing