Self-Employment within the Firm

Vittorio Bassi  
USC

J. H. Lee  
USC

Alessandra Peter  
NYU

Tommaso Porzio  
Columbia

Ritwika Sen  
Kellogg

Esau Tugume  
BRAC

January 2023
How Are Firms in Developing Countries Internally Organized? Does It Matter?

- Premise: firms in low-income countries are **small & have low productivity**

- Usual interpretation: symptom of **external frictions** or **limited resources**
  - Credit markets, labor markets, transportation costs, ...
  - Less availability of modern technology, human capital, managerial talent, ...

- This paper: **production organization w/i the firm** ⇒ low productivity & efficient scale
  - Barriers to labor specialization ⇒ \[
    \begin{align*}
      & \text{lower firm-level productivity} \\
      & \text{firm-level prod. declines in size} \\
    \end{align*}
  \] ⇒ small firms
  - Prevalent **business model** of traditional mfg in LIC is **not scalable**
Overview: Data, Model, Quantification

1. Novel **survey data on internal organization** of manufacturing firms in Uganda
   - Composition of tasks: larger firms \( \approx \) replicas of smaller firms
   - Allocation of tasks: some – but **limited** – specialization in larger firms
   - Why? Customization makes it costly to **unbundle tasks** in the production process

2. **Model:** allocation of talent *b/w and w/i* firms \( \Rightarrow \) firm size & firm + aggr. productivity
   - Span different orgs: self-employment within the firm to scalable entrepreneurial talent
   - Result: unbundling costs lower labor specialization, firm size, firm & aggr. productivity

3. Bring model to data: **quantify the aggregate effects of limited specialization**
   - Large unbundling cost: observed equilibrium close to self-employment within the firm
   - Policy: smaller returns to removing other (“external”) frictions facing the firm
The Survey
Representative Survey of 3 Manufacturing Sectors in Urban Uganda

- Carpentry, Welding, Grain milling
  - Cover 35% of mfg employment (BIG!)
  - Not just micro-enterprises
    → organization of labor could matter

- Sample:
  - 1,115 firms, 2,883 employees
  - Baseline in 2019 + 2 follow-ups

- + Ongoing Panel

Thanks STEG, IGC, & PEDL!
Key Innovation: Measuring Time Use Within the Firm

- **Aim:** study variation in task composition (what’s done) and allocation (who does it)
- **Method:** we ask everyone in the firm what they have done in the last work day

Exact wording:

*Now, I would like to ask some questions about daily time management. More precisely, I would like to know which activities you have done during the last day worked*

- At what time did you start working for this business in the last day worked?
- At what time did you stop working for this business in the last day worked?
Question to Record the Time Slots in Which Individuals Are at the Firm

**Question**

9.0d Enumerator, please select all the time slots between %Q9_0b% and %Q9_0c%. Please include all of those time slots, even if the respondent was temporarily not at the firm premises.

**Answer Options**

| Multi-Select | 01 | 05:00 - 06:00 | 02 | 06:00 - 07:00 | 03 | 07:00 - 08:00 | 04 | 08:00 - 09:00 | 05 | 09:00 - 10:00 | 06 | 10:00 - 11:00 | 07 | 11:00 - 12:00 | 08 | 12:00 - 13:00 | 09 | 13:00 - 14:00 | 10 | 14:00 - 15:00 | 11 | 15:00 - 16:00 | 12 | 16:00 - 17:00 | 13 | 17:00 - 18:00 | 14 | 18:00 - 19:00 | 15 | 19:00 - 20:00 | 16 | 20:00 - 21:00 |
### Question

9.1 Please select all the activities you have done during the %rostertitle% Do NOT read answer options - Max 3 options - Record answers order

### Answer Options

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 01: Away from business premises doing an activity not related to this business (e.g. going to the doctor, picking up kids, shopping etc.)
- 02: Book-keeping/business records
- 03: Eating or resting
- 04: Interact with customers
- 05: Look for new input suppliers for the production of any other product
- 06: Look for new input suppliers for the production of MAIN PRODUCT
- 07: Look for/apply for new loans
- 08: Look for/buy new machines for the production of any other product
- 09: Look for/buy new machines for the production of MAIN PRODUCT
- 10: Look for/interview potential workers
- 11: Maintenance of machines or equipment for the production of any other product
- 12: Maintenance of machines or equipment for the production of MAIN PRODUCT
- 13: Manage existing loans
- 14: Organizing the stock, cleaning, tidying up
- 15: Procure inputs for the production of any other product from suppliers
- 16: Procure inputs for the production of MAIN PRODUCT
Overall Survey Design: Rich Information on How Firms Produce

- Rich information on production process and each step completed
- Time spent on each production step for main product
- Detailed data on output market and product characteristics
- Data on organizational practices within the firm (e.g. how wages are set)
- Standard index of managerial practices (McKenzie and Woodruff 2017)
Basic Descriptives
Firm Size Distribution

- Average size is 5 employees → potential for labor specialization in "large firms"
Descriptives on Firm Characteristics and Output Market

<table>
<thead>
<tr>
<th>Firm Characteristics</th>
<th>All</th>
<th>Carpentry</th>
<th>Welding</th>
<th>Grain Milling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employees</td>
<td>4.8</td>
<td>4.5</td>
<td>4.9</td>
<td>6.0</td>
</tr>
<tr>
<td>Monthly Revenues (USD)</td>
<td>1,437</td>
<td>1,222</td>
<td>1,548</td>
<td>1,916</td>
</tr>
<tr>
<td>Mechanization (relative to max machine utilization)</td>
<td>19%</td>
<td>23%</td>
<td>17%</td>
<td>19%</td>
</tr>
<tr>
<td>Formal License</td>
<td>83%</td>
<td>78%</td>
<td>88%</td>
<td>92%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output Market and Demand</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand is crucial constraint</td>
<td>55%</td>
<td>55%</td>
<td>54%</td>
<td>57%</td>
</tr>
<tr>
<td>Any marketing expenditure</td>
<td>9%</td>
<td>7.7%</td>
<td>12%</td>
<td>7.8%</td>
</tr>
<tr>
<td>Sales done through walk-ins</td>
<td>80%</td>
<td>80%</td>
<td>75%</td>
<td>94%</td>
</tr>
<tr>
<td>Sales made to order</td>
<td>79%</td>
<td>75%</td>
<td>89%</td>
<td>69%</td>
</tr>
<tr>
<td>Talks to customers to communicate product quality</td>
<td>58%</td>
<td>61%</td>
<td>57%</td>
<td>54%</td>
</tr>
</tbody>
</table>

- Firms have **two core activities**: (1) **Production** and (2) **Finding customers** → Managing customer relationships key for revenue generation
- Very limited imports and exports
Task Composition: What Do Firms Do?
Task Composition: Which Tasks are Done Within the Firm?

- Time spent on: production, non-production, idle
- Finer breakdown of each categories:
  - Production: production steps
  - Non-production: customer interaction, stock mgmt, input procurement, supervision/training, other
  - Idle: waiting, away, resting/eating
Does the Task Composition Change Across the Firm Size Distribution?

- Task composition is very similar → Is this true even within each category?
Does the Type of **Non-Production Tasks** Change Across the Firm Size Distribution?

- Broadly similar across size distribution:
  - Slightly more supervision/training in large firms; almost none in size 1 firm (reassuring)
Does the Type of Production Tasks Change Across the Firm Size Distribution?

- **Figure 1**: Carpentry
- **Figure 2**: Welding
- **Figure 3**: Grain Milling

- Focus on time spent on each production steps for the main product

⇒ Overall takeaway: **large firms do more of the same type of task** (CRTS)
Task Allocation: Who Does What?
1. **Across employees:** more skilled workers could specialize on more complex tasks

2. **Employees vs entrepreneur:** entrepreneur could focus on managing/supervising

⇒ Next: study both dimensions of specialization and whether they vary by firm size
1. Specialization Across Employees: Do Skilled Employees do Less Production Tasks?

- **Very limited specialization**: skilled employees do slightly less production tasks
  → individual earnings is the stronger predictor of share of time spent in non-prod tasks
• High skilled (earnings) employees spend (slightly) more time on non-production tasks
• Specialization is similar in small and large firms
1. Specialization Across Employees: within Production and Non-Production Tasks

**Figure 1: Production tasks**

- High skilled employees spend (slightly) more time on complex steps/tasks
- Specialization is similar in small and large firms ⇒ No organizational change

**Figure 2: Non-Production Tasks**
2. Employees vs Entrepreneur: Do Entrepreneurs Focus on Non-Production Tasks?

- **Some Specialization:** entrepreneurs do more non-production tasks, but **tasks overlap**
  
  → Entrepreneurs do 3 hrs/day of production; employees 1 hr/day non-production
2. Employees vs Entrepreneur: Is there Overlap even within Task Types?

- Two results: 1. overlap in all tasks; 2. entrepreneur specialize in all non-prod tasks
- 1. + 2. justify focus on production vs non-production (or "managerial") tasks
2. Employees vs Entrepreneur: by Firm Size

- Larger firms are more specialized: larger time allocation gap b/w empl. & entr.
2. Employees vs Entrepreneur: by Firm Size

- Increase in non-prod. tasks of entr. is smaller than a full-specialization benchmark
⇒ Implication: in large firms, employees perform most "managerial tasks"
Should We Have Expected More Specialization?
Should We Have Expected More Specialization?

• We should not expect to see much specialization in the data if:
  1. There is no heterogeneity in skill intensity of tasks
  2. There is no heterogeneity in skills within the firm
Should We Have Expected More Specialization?

• We should not expect to see much specialization in the data if:
  1. There is no heterogeneity in skill intensity of tasks
  2. There is no heterogeneity in skills within the firm

• However, in the data we find:
  1. Employees assigned to non-prod. and complex production tasks earn more
  2. Skills heterogeneity: some among employees; a lot b/w employees and entrepreneurs

→ Should expect specialization on complex (non-prod) tasks, especially by entrepreneurs
Should We Have Expected More Specialization?

- We should not expect to see much specialization in the data if:
  1. There is no heterogeneity in skill intensity of tasks
  2. There is no heterogeneity in skills within the firm

- However, in the data we find:
  1. Employees assigned to non-prod. and complex production tasks earn more
  2. Skills heterogeneity: some among employees; a lot b/w employees and entrepreneurs

→ Should expect specialization on complex (non-prod) tasks, especially by entrepreneurs

⇒ Some sort of barrier likely prevents specialization
One Possible Barrier to Specialization: Customization in Output Market

- In C & W: products are customized → **plausible source of cost of specialization**
- In GM: more standardization → we should expect more specialization
### One Possible Barrier to Specialization: Customization in Output Market

<table>
<thead>
<tr>
<th></th>
<th>Carpentry</th>
<th>Welding</th>
<th>Grain Milling</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product Characteristics:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80-20 price dispersion for main product (Std.)</td>
<td>1.46</td>
<td>1.61</td>
<td>1.15</td>
</tr>
<tr>
<td>Charges different prices due to customization</td>
<td>42%</td>
<td>52%</td>
<td>17%</td>
</tr>
<tr>
<td><strong>Customers buy on order to customize products</strong></td>
<td>65%</td>
<td>65%</td>
<td>26%</td>
</tr>
<tr>
<td>Customers buy on order to bring own inputs</td>
<td>5%</td>
<td>5%</td>
<td>52%</td>
</tr>
<tr>
<td><strong>Process Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days to complete typical order</td>
<td>4.0</td>
<td>4.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Customer pays fully upfront (quality uncertainty)</td>
<td>26%</td>
<td>30%</td>
<td>54%</td>
</tr>
<tr>
<td>Potential # of machine types for main product</td>
<td>24</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td><strong>Worker-Customer Interaction</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customers buy on order to discuss details with person producing</td>
<td>52%</td>
<td>48%</td>
<td>22%</td>
</tr>
<tr>
<td>Workers perform independent orders</td>
<td>47%</td>
<td>49%</td>
<td>30%</td>
</tr>
</tbody>
</table>

- Customization → **communication, coordination** → hard to **unbundle** tasks
### One Possible Barrier to Specialization: Customization in Output Market

<table>
<thead>
<tr>
<th></th>
<th>Carpentry</th>
<th>Welding</th>
<th>Grain Milling</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product Characteristics:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80-20 price dispersion for main product (Std.)</td>
<td>1.46</td>
<td>1.61</td>
<td>1.15</td>
</tr>
<tr>
<td>Charges different prices due to customization</td>
<td>42%</td>
<td>52%</td>
<td>17%</td>
</tr>
<tr>
<td>Customers buy on order to customize products</td>
<td>65%</td>
<td>65%</td>
<td>26%</td>
</tr>
<tr>
<td>Customers buy on order to bring own inputs</td>
<td>5%</td>
<td>5%</td>
<td>52%</td>
</tr>
<tr>
<td><strong>Process Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days to complete typical order</td>
<td>4.0</td>
<td>4.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Customer pays fully upfront (quality uncertainty)</td>
<td>26%</td>
<td>30%</td>
<td>54%</td>
</tr>
<tr>
<td>Potential # of machine types for main product</td>
<td>24</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td><strong>Worker-Customer Interaction</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customers buy on order to discuss details with person producing</td>
<td>52%</td>
<td>48%</td>
<td>22%</td>
</tr>
<tr>
<td>Workers perform independent orders</td>
<td>47%</td>
<td>49%</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Specialization</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average specialization</td>
<td>27%</td>
<td>29%</td>
<td>54%</td>
</tr>
</tbody>
</table>

- Customization → **communication, coordination** → hard to **unbundle** tasks
- More customization in Carp./Weld. → less specialization (Piore-Sabel '84; Holmes-Stevens '04)
Motivating the Model

• We have shown **three main results so far**
  1. **Task-Composition:** Large firms are replicas of small firms → perform similar set of tasks
  2. **Task-allocation:** limited specialization of entrepreneurs, especially in large firms
  3. Plausible evidence that limited specialization is due to **costs to unbundle production**

• Next: design a model suitable for and motivated by our setting. **Why a model?**
  1. **Theory:** show how limited specialization affects firm size, and firm & aggr. productivity
  2. **Measurement:** quantify role of internal barriers and interaction with external frictions
Model
Overview: Static Occupational Choice Model of Industry Equilibrium

Mass 1 of individuals with ability
\[ z \sim G \]
(private info)
Overview: Static Occupational Choice Model of Industry Equilibrium

Mass 1 of individuals with ability $z \sim G$ (private info)
Overview: Static Occupational Choice Model of Industry Equilibrium

Mass 1 of individuals with ability $\tilde{z} \sim G$ (private info)

- Choice of Occ.
- Entrepreneur $\tilde{z}$
- Worker $\tilde{z}$

Choice of firm size $n(\tilde{z})$

Labor Demand

Definition of Competitive Equilibrium

1. Firm size and assignment to tasks
2. Wage level $w$
3. Set of entrepreneurs $E$ and distribution of workers $F(\tilde{z})$

such that

1. Firm size and task assignment
2. Individuals pick their occupation optimally: $\pi(\tilde{z}) > E[w(\tilde{z})]$
3. Labor market clears: $1 \cdot REdG(z) = RE(n(z) - 1) dG(z)$
Overview: Static Occupational Choice Model of Industry Equilibrium

Mass 1 of individuals with ability $z \sim G$ (private info)

Entrepreneur $\mathbb{E}$

Choice of Occ. $\mathbb{E}$

Worker $z$

Distribution of workers $F(z)$

Choice of firm size $n(z)$

Labor Demand

Labor Supply

Definition of Competitive Equilibrium

1. Firm size and assignment to tasks
2. Wage level
3. Set of entrepreneurs $\mathbb{E}$ and distribution of workers $F(z)$ such that
   1. Firm size and task assignment
   2. Individuals pick their occupation optimally: $\check{\mu}(z) > \mathbb{E}[w(z)]$ $\forall z \in \mathbb{E}$
   3. Labor market clears: $1 - R_E dG(z) = R_E (n(z) - 1) dG(z)$
Overview: Static Occupational Choice Model of Industry Equilibrium

Mass 1 of individuals with ability \( z \sim G \) (private info)

Choice of Occ.

Entrepreneur \( \varepsilon \)

Worker \( \zeta \)

Distribution of workers \( F(\zeta) \)

Choice of firm size \( n(\zeta) \)

Labor Demand

Random Matching

Labor Supply

Definition of Competitive Equilibrium

1. firm size and task assignment \( \{ n(\zeta), \mu(\zeta) \} \),

2. wage level \( w \),

3. set of entrepreneurs \( E \) and distribution of workers \( F(\zeta) \)

such that

1. firm size and task assignment \( \{ n(\zeta), \mu(\zeta) \} \),

2. individuals pick their occupation optimally: \( \pi(\zeta) > E[ w(\zeta) ] \),

3. labor market clears: \( 1 - RE dG(\zeta) = RE (n(\zeta) - 1) dG(\zeta) \)
Overview: Static Occupational Choice Model of Industry Equilibrium

Mass 1 of individuals with ability $z \sim G$ (private info)

Choice of Occ. of entrepreneur $E$

Choice of firm size $n(z)$

Labor Demand

Choice of assignment $\mu$ of individuals to tasks

Random Matching

Distribution of workers $F(z)$

Labor Supply

Output is Produced and Sold

1. Firm size and task assignment $\{n(z), \mu(z)\}$
2. Wage level $w$
3. Set of entrepreneurs $E$ and distribution of workers $F(z)$ such that
   - Firm size and task assignment $\{n(z), \mu(z)\}$ maximize profits for all $z$
   - Individuals pick their occupation optimally: $\bar{\pi}(z) > E[w(z)]$
   - Labor market clears: $REdG(z) = RE(n(z) - 1)dG(z)$

Output is Produced and Sold
Overview: Static Occupational Choice Model of Industry Equilibrium

Production without Labor Specialization

- Each firm produces a variety of goods.
- Residual demand curve: $p(Y) = Y - \frac{1}{n}$

Output of firm with entrepreneur $\hat{z}$, size $n$, and assignment $\mu$:

$$y(\hat{z}, \hat{z}, \mu) = \left. Y(\hat{z}, n, \mu) \right|_{\{z\}} + (n - 1) \int y(z, \hat{z}, \mu) dF(z)$$

Entrepreneur
Worker

Output: $Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z)$
Overview: Static Occupational Choice Model of Industry Equilibrium

Production without Labor Specialization

• Each firm produces a variety of tasks.

Output of firm with entrepreneur $\hat{z}$, size $n$, and assignment $\mu$:

$$ Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z) $$

Entrepreneur

Workers

Output:

$$ Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z) $$
Overview: Static Occupational Choice Model of Industry Equilibrium

Mass 1 of individuals with ability $z \sim G$ (private info)

Choice of Occ. -> Entr. set $E$ -> Labor Demand

Choice of firm size $n(z)$ -> Random Matching

Labor Supply -> Output is Produced and Sold

Profit $\pi(\hat{z})$

Wage $E[\omega(z)]$

Output: $Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z)$

Profits: $\pi(\hat{z}) = \max_{\{n \geq 1, \mu, p\}} (1 - \tau) \cdot p \cdot Y(\hat{z}, n, \mu) - (n - 1) \int w(z, \hat{z}, \mu, p) dF(z)$
Overview: Static Occupational Choice Model of Industry Equilibrium

Output: \( Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z) \)

Profits: \( \pi(\hat{z}) = \max_{(n \geq 1, \mu, p)} (1 - \tau) \int p Y(\hat{z}, n, \mu) - (n - 1) \int w(z, \hat{z}, \mu, p) dF(z) \)

External Frictions

Entrepreneur

Workers

Distribution of workers \( F(z) \)

Labor Supply

Labor Demand

Choice of firm size \( n(\hat{z}) \)

Choice of assignment \( \mu \) of individuals to tasks

Random Matching

Output is Produced and Sold

Profit \( \pi(\hat{z}) \)

Wage \( E [w(z)] \)

Mass 1 of individuals with ability \( z \sim G \) (private info)
Overview: Static Occupational Choice Model of Industry Equilibrium

- Mass 1 of individuals with ability $z \sim G$ (private info)
- Entrepreneur $z$ chooses size $(n)$ and assignment $(\mu)$ as feasible
- Labor demand
- Labor supply
- Random matching
- Output is produced and sold
- Wage $E[w(z)]$
- Profit $\pi(z)$

Output: $Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z)$

Profits: $\pi(\hat{z}) = \max_{\{n \geq 1, \mu, p\}} \left[ (1 - \tau) \ p \ Y(\hat{z}, n, \mu) - (n - 1) \int w(z, \hat{z}, \mu, p) dF(z) \right]$

External Frictions

CES Demand $\rightarrow$ DRTS

Feasibility

Productivity depends on entrepreneur's & worker's ability $y(z, \hat{z}, \mu)$, where $\hat{z}$'s time spent on simple tasks $D$ is complex and $y(z, \hat{z}, \mu)$, $z$'s time spent on complex tasks $D$.
Overview: Static Occupational Choice Model of Industry Equilibrium

Mass 1 of individuals with ability \( z \sim G \) (private info)

Choice of Occ. \( \hat{z} \)

Entrepreneur \( \hat{z} \)

Distribution of workers \( F(z) \)

Worker \( \hat{z} \)

Choice of firm size \( n(\hat{z}) \)

Labor Demand

Choice of assignment \( \mu \) of individuals to tasks

Random Matching

Output is Produced and Sold

Profit \( \pi(\hat{z}) \)

Wage \( E[w(z)] \)

\[ \text{Output: } Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z) \]

\[ \text{Profits: } \pi(\hat{z}) = \max_{(n \geq 1, \mu, p)} \left( 1 - \tau \right) p Y(\hat{z}, n, \mu) - (n - 1) \int w(z, \hat{z}, \mu, p) dF(z) \]

\[ \text{Wage: } w(z, \hat{z}, \mu, p) = \omega + \frac{p y(z, \hat{z}, \mu)}{\text{eq wage level}} \]

External Frictions

CES Demand \( \rightarrow \) DRTS

\[ p = Y(\hat{z}, n, \mu)^{-\frac{\tau}{\tau - 1}} \] Feasibility

Entrepreneur

Workers

\( \hat{z} \)

\( \hat{z} \)

\( F(z) \)

\( n(\hat{z}) \)

\( y(z, \hat{z}, \mu) \)

\( dF(z) \)

\( w(z, \hat{z}, \mu, p) \)

\( \int \)

\( \int \)

\( \pi(\hat{z}) \)

\( E[w(z)] \)

\( Y(\hat{z}, n, \mu) \)

\( p Y(\hat{z}, n, \mu) \)

\( \int \)

\( w(z, \hat{z}, \mu, p) \)

\( dF(z) \)

\( \omega \)

\( \frac{p y(z, \hat{z}, \mu)}{\text{eq wage level}} \)

\( \text{piece rate} \)

\( \text{worker revenues} \)
Overview: Static Occupational Choice Model of Industry Equilibrium

**Mass 1 of individuals with ability \( z \sim G \) (private info)**

**Entrepreneur**

1. **Choice of Occ.**
   - Entr. set \( \mathcal{E} \)
2. Distribution of workers \( F(z) \)
3. Labor Demand
4. Random Matching
5. Labor Supply
6. Output is Produced and Sold
7. Profit \( \pi(\hat{z}) \)
8. Wage \( E[w(z)] \)

**Output:**
\[
Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z)
\]

**Profits:**
\[
\pi(\hat{z}) = \max_{(n \geq 1, \mu, \rho)} \left[ (1 - \tau) \rho Y(\hat{z}, n, \mu) - (n - 1) \int w(z, \hat{z}, \mu, \rho) dF(z) \right]
\]

**Wage:**
\[
w(z, \hat{z}, \mu, \rho) = \frac{\text{eq wage level}}{\text{worker revenues}} + \omega
\]

**External Frictions:**
- **CES Demand → DRTS**

**Feasibility:**
- \( \mu \in [\mathcal{F}] \)
- \( \rho = Y(\hat{z}, n, \mu)^{-\frac{1}{\tau}} \)
Overview: Static Occupational Choice Model of Industry Equilibrium

Output:

\[ Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z) \]

Profits:

\[ \pi(\hat{z}) = \max_{(n \geq 1, \mu, p)} \left\{ \left(1 - \frac{1}{\mu} \right) p Y(\hat{z}, n, \mu) - (n - 1) \int w(z, \hat{z}, \mu, p) dF(z) \right\} \]

Wage:

\[ w(z, \hat{z}, \mu, p) = \frac{\text{eq wage level}}{\omega} + \frac{\text{piece rate}}{\omega} p y(z, \hat{z}, \mu) \]

\[ E[w(z)] = \int w(z, \hat{z}, \mu(\hat{z}), p(\hat{z})) dG(\hat{z}) \]
Line Production $y(z, \hat{z}, \mu)$: Without Labor Specialization

- $1 - D$ Simple Tasks
- $D$ Complex Tasks

Note: Only Complex Tasks Impact Line Productivity
Line Production $y(z, \hat{z}, \mu)$: Without Labor Specialization

- $y(z, \hat{z}, \mu) = \hat{z}$
- Without Labor Specialization

\[
D_{\text{Complex Tasks}} - D_{\text{Simple Tasks}}
\]

\[
\hat{z} = y(\hat{z}, \hat{z}, \mu) = \hat{z}
\]

\[
\hat{z} = y(z, \hat{z}, \mu) = \hat{z}
\]

• Note: Only Complex Tasks Impact Line Productivity
Line Production $y(z, \hat{z}, \mu)$: Without Labor Specialization

\[ y(z, \hat{z}, \mu) = \hat{z} \]

• Note: Only Complex Tasks Impact Line Productivity
Line Production $y(z, \hat{z}, \mu)$: Without Labor Specialization

Idea: contribution of the entrepreneur’s ability $\hat{z}$ to each line productivity (e.g. door design, firm reputation)

Rival: contribution of the ability of individual performing the complex task (e.g. convince customers of high product quality)
Line Production $y(z, \hat{z}, \mu)$: Without Labor Specialization

$y(z, \hat{z}, \mu) = \hat{z}$

$y(z, \hat{z}, \mu) = z^\lambda \hat{z}^{1-\lambda}$

**Idea:** contribution of the entrepreneur’s ability $\hat{z}$ to each line productivity (e.g. door design, firm reputation)

**Rival:** contribution of the ability of individual performing the complex task (e.g. convince customers of high product quality)

**Note:** entrepreneurs have also to spend an additional of time $dD$ to perform “overhead” complex tasks
Line Production $y(z, \hat{z}, \mu)$: With Labor Specialization

Simple Tasks

Complex Tasks

$\hat{z} \quad 0 \quad \quad 1$

$z \quad 0 \quad \quad 1$

$\varphi(z)$

Unbundling Cost

Avg Ability

$\| \{z \} \|

Rival

$Idea$
Line Production $y(z, \hat{z}, \mu)$: With Labor Specialization

**Simple Tasks**

$y(z, \hat{z}, \mu) = \hat{z}$

**Complex Tasks**

$y(z, \hat{z}, \mu) = \hat{z}^\lambda \cdot \tilde{z}(z, \hat{z})^{1-\lambda} \cdot [1 - \kappa(\varphi(z))]$

- **Avg Ability**: rival term is a weighted average of the ability of individuals working on complex tasks $\tilde{z}(z, \hat{z}) = z^{\varphi(z)} \hat{z}^{1-\varphi(z)}$
- **Unbundling cost**: cost to unbundle tasks and assign them to another person (e.g. communicate order details, coordinate production)
Line Production $y(z, \hat{z}, \mu)$: With Labor Specialization

**Key specialization trade-off:**
- It increases productivity if $\hat{z} > z$
- It entails a cost to unbundle tasks

**Avg Ability:** rival term is a weighted average of the ability of individuals working on complex tasks $\tilde{z}(z, \hat{z}) = z^\varphi(z) \hat{z}^{1-\varphi(z)}$

**Unbundling cost:** cost to unbundle tasks and assign them to another person (e.g. communicate order details, coordinate production)
Line Production $y(z, \hat{z}, \mu)$: With Labor Specialization

**Key specialization trade-off:**
- It increases productivity if $\hat{z} > z$.
- It entails a cost to unbundle tasks.

**Avg Ability:** rival term is a weighted average of the ability of individuals working on complex tasks.

**Unbundling cost:** cost to unbundle tasks and assign them to another person (e.g. communicate order details, coordinate production).

**Note:** we focus on entrepreneurs specializing on complex tasks. In the paper, we consider assignment $\mu \equiv \{\mu_T(z', z), \hat{\mu}_T(z', \hat{z})\}$ for the time spent by each worker $z$ and entrepreneur $x$ on tasks $T$ for $z'$.

$\tilde{z}(z, \hat{z}) = z^{\varphi(z)} \hat{z}^{1-\varphi(z)}$

$\varphi(z) = D^{-1} \mu_c(z, z)$, $1 - \varphi(z) = D^{-1} \hat{\mu}_c(z, \hat{z})$.
Definition of Competitive Equilibrium

A competitive equilibrium is given by

1. firm size and assignment to tasks \( \{n(z), \mu(z)\}_{z \in G} \forall z \),
2. wage level \( \bar{w} \)
3. set of entrepreneurs \( E \) and distribution of workers \( F(z) \)

such that

1. firm size and task assignment \( \{n(z), \mu(z)\}_{z \in G} \) maximize profits for all \( z \)
2. individuals pick their occupation optimally: \( \pi(z) \geq E[w(z)] \quad \forall z \in E \)
3. labor market clears: \( 1 - \int_{E} dG(z) = \int_{E} (n(z) - 1) dG(z) \)
Characterization
Roadmap and Assumptions

• Two assumptions (for ease of exposition)

1. \( \kappa(\varphi) = 1 - \exp\{-\hat{\kappa}(\varphi)\} \), where \( \hat{\kappa}(\varphi) = \frac{\kappa_0^{1/\kappa_1} \varphi^{1+1/\kappa_1}}{(1+1/\kappa_1)} \)

2. Entrepreneur spends some time on simple tasks (as in the data)

• Characterize

1. Labor specialization within the firm (size & productivity)
2. Optimal firm size (interaction of \( \kappa_0 \) & \( \tau \))
3. Partial and general equilibrium effects of \( \kappa_0 \) (what’s a firm?)
Lemma 0: Occupational Choice

- Satisfy single crossing: \( \frac{\partial E[w(z)]}{\partial z} \leq \frac{\partial \pi(z)}{\partial z} \forall z \implies \exists \hat{z}_0 \text{ s.t. } z \in E \iff z \geq \hat{z}_0 \)
Lemma 1: Labor Specialization, Firm Size and Cost $\kappa_0$ (illustrated for $\kappa_1 \to 0$)

(a) Workers Time in Complex Tasks

(b) Entrepreneurs Time in Complex Tasks

More specialization in larger firms: more ‘low-hanging’ complex tasks
Lemma 1: Labor Specialization, Firm Size and Cost $\kappa_0$ (illustrated for $\kappa_1 \to 0$)

- **Workers Time in Complex Tasks**
  \[ \bar{\theta}_w(n) = D(1 - \frac{1}{\kappa_0}) \]

- **Entrepreneurs Time in Complex Tasks**
  \[ \theta(n) = D(1 + d) \]

- **Higher unbundling cost $\rightarrow$ lower specialization and relationship with firm size**
  Entrepreneur takes over fewer complex task for each additional worker
Lemma 2: Labor Specialization and Firm Productivity

• Total firm output is $Y(\hat{z}, n) = \mathbb{Z}(\hat{z}, n, \mu) \cdot n$

\[
\mathbb{Z}(\hat{z}, n, \mu) = \begin{cases} \hat{z}^\lambda & \text{non-rival} \\ \tilde{Z}(\hat{z}, n, \mu)^{1-\lambda} & \text{task-productivity} \end{cases}
\]

\[
\tilde{Z}(\hat{z}, n, \mu) = \left( \frac{1}{n} \hat{z}^{1-\lambda} + \frac{n-1}{n} \int \tilde{z}(z, \hat{z}, \mu)^{1-\lambda} dF(z) \right)^{\frac{1}{1-\lambda}}
\]

\[\tilde{z}(z, \hat{z}, \mu) \leq \hat{z}, \text{ since workers less skilled than entrepreneur}\]

• Larger firms $\rightarrow$ workers have more weight $\rightarrow$ lower productivity as long as
  
  i. entrepreneurial ability somewhat rival ($\lambda < 1$)
  
  ii. less than full specialization ($\kappa_0 > 0$), so that $\tilde{z}(z, \hat{z}) < \hat{z} \ \forall z$
Lemma 3: Optimal Firm Size & Frictions

• Optimal firm \( n \) size solves

\[
\frac{\partial p(n)}{\partial n} \mathbb{Z}(\hat{z}, n, \mu)n + p(\hat{z})\mathbb{Z}(\hat{z}, n, \mu) = \frac{\partial}{\partial n} \left[(n - 1)\overline{w}(\hat{z}, \mu, p(n))\right]
\]

change in revenues

change in labor cost
Lemma 3: Optimal Firm Size & Frictions

- Optimal firm $n$ size solves

\[
(1 - \tau) \left[ \frac{\partial p(n)}{\partial n} \right] \mathbb{Z}(\hat{z}, n, \mu)n + p(\hat{z})\mathbb{Z}(\hat{z}, n, \mu) = \left[ \frac{\partial}{\partial n} \left( (n - 1)\mathbb{w}(\hat{z}, \mu, p(n)) \right) \right]
\]

change in revenues

change in labor cost

- Two kinds of frictions can keep firms small (complementary to one another)
  1. **External frictions** ($\tau > 0$)
Lemma 3: Optimal Firm Size & Frictions

- Optimal firm $n$ size solves

$$(1 - \tau) \left[ \frac{\partial p(n)}{\partial n} z(\hat{z}, n, \mu)n + p(\hat{z}) z(\hat{z}, n, \mu) + p(\hat{z}) \frac{\partial z(\hat{z}, n, \mu)}{\partial n} n \right] = \frac{\partial}{\partial n} \left[ (n - 1) w(\hat{z}, \mu, p(n)) \right]$$

- change in revenues
- change in labor cost
- prod. dilution $< 0$

- Two kinds of frictions can keep firms small (complementary to one another)

1. **External frictions ($\tau > 0$)**
2. **Unbundling costs ($\kappa_0 > 0$) leading to limited specialization (as long as $\lambda < 1$)**
   - **lower firm-level productivity ($z(x, n) \leq x$)**
   - **firm-level productivity declining in size ($\partial z(x, n)/\partial n \leq 0$)**
Corollary 1: Two Polar Cases Span Different Notions of the Firm

1. \( \kappa \to 0 \) or \( \lambda = 1 \): **Scalable Entrepreneurial Talent**
   
   - \( Y(\hat{z}, n, \mu) = \hat{z} n \)
   
   - firm productivity = entrepreneur’s ability (due to full specialization or non-rivalry)

   \( \Rightarrow \) Firms allow entrepreneurs to **leverage talent** and they have **larger** efficient scale
Corollary 1: Two Polar Cases Span Different Notions of the Firm

1. $\kappa \to 0$ or $\lambda = 1$: Scalable Entrepreneurial Talent
   - $Y(\hat{z}, n, \mu) = \hat{z} \cdot n$
   - firm productivity = entrepreneur’s ability (due to full specialization or non-rivalry)
   $\Rightarrow$ Firms allow entrepreneurs to leverage talent and they have larger efficient scale

2. $\kappa \to \infty$ and $\lambda = 0$: Self-Employment Within the Firm
   - $Y(\hat{z}, n, \mu) = \overline{z}(\hat{z}) \cdot n$
   - firm productivity = average ability $\overline{z}(\hat{z}) = \frac{1}{n} \left( \hat{z} + (n - 1) \int z dF(z) \right)$
   $\Rightarrow$ Firms are purely a vehicle to share fixed costs and they have smaller efficient scale
Proposition 1: Equilibrium Effect of Lower Delegation Costs

Suppose $\lambda < 1$. Then, a decline in $\kappa_0$ yields an increase in:

1. **labor specialization**: $\theta(\hat{z}) - \theta_w(z)$ for all owner/worker pairs $\{\hat{z}, z\}$;
2. **average firm size**: $\bar{n} \equiv \int_{\hat{z}_0} n(z) dG$;
3. **average ability of firm owners**: $\hat{z}_0$ increases;
4. **aggregate productivity**: $\bar{Z} \equiv \int_{\hat{z}_0} Z(z, n(z), \mu(z)) n(z) dG$;
5. **average wage**: $E[w(z)]$ increases for all workers;
6. **returns to managerial ability**: $\frac{\partial Z(z, n(z), \mu(z))}{\partial z}$ increases.
Testing the Model’s Predictions
First test: Heterogeneity Across Sectors Helps Validate Proposition 1

• Predictions of Proposition 1 testable using variation in unbundling cost ($\kappa_0$)
  → use heterogeneity across the three sectors as plausible sources of $\kappa_0$ variation

• We argued that grain milling has lower unbundling cost → we thus expect
  1. higher labor specialization
  2. larger firm size
  3. larger returns to entrepreneurial talent
  4. larger skill gap between entrepreneur and workers

⇒ Next we show that these four predictions are satisfied in the data
Intermediate Step: Measuring $\kappa_0$ Across Sectors using Lemma 1

- Lemma 1: low $\kappa_0$ in GM $\rightarrow$ steep relationship b/w specialization and size (✓)
First test ✓: Validating the Four Predictions of Proposition 1 for Grain Milling

1. More labor specialization
2. Larger firms
First test ✓: Validating the Four Predictions of Proposition 1 for Grain Milling

3. Higher returns to managerial ability (From running regressions on managerial score)
First test ✓: Validating the Four Predictions of Proposition 1 for Grain Milling

4. **Stronger selection into entrepreneurship** (holds with and w/o firm FE)
Quantification
Overview of Quantitative Approach

• Goal: two main exercises
  1. **Quantification:** what are the aggregate implications of the unbundling cost $\kappa$?
  2. **Policy Interventions:** returns from lowering external frictions ($\tau$) depend on estimated $\kappa_0$

• Minor *model extensions for quantitative analysis*
  ▶ Extreme value shocks: smooth out occupational choice
  ▶ Outside sector: choice of entering manufacturing

• Calibration
  ▶ *Unbundling costs can be estimated separately:* C & W is benchmark; GM is alternative
  ▶ Calibrate all other parameters to match rich set of moments for carpentry/welding
• Perfect match of within-firm organization (irrespective of equilibrium moments)
Quantification/Counterfactual: Vary the Unbundling Cost $\kappa_0$

**Exercise**

- Start from CW calibration
- Vary only the unbundling cost $\kappa$
  - red line = $\kappa$ from GM calibration

**Take-away**

1. Economy is close to $\kappa_0 \to \infty$:
   - **Self-Employment w/i the Firm**
   - Firm = vehicle to share fixed cost

2. Firms are small b/c of low specialization

**Validation:** Quantitative Comparison of GM and CW
Policy Interventions: Effect of Reducing $\tau$ with $\kappa_0$ of CW or GM

Exercise

- Start from CW or GM calibration
- Vary external frictions $\tau$

Take-away

- Effect from relaxing "external" DRTS
  - smaller in CW than in GM
  - CW: “internal” DRTS are binding

$\Rightarrow$ low returns to growth policies if owners cannot leverage talent
Conclusion
• New evidence from Ugandan mfg firms + theory: firms resemble SEWIF
  ▶ firms are not vehicles to leverage talent → low productivity, small efficient scale

• Shift focus from "who starts firms" to "what people do w/i firms"
  ▶ if firms ≈ set of self-employed ⇒ firm size distr. less relevant for the allocation of talent

• Implications for policy: need large & internally specialized firms
  ▶ Lower returns from “classic” growth interventions if firm organizations are not scalable
Appendix
### Comparison with IKEA: Prices

#### IKEA prices around the world (USD)

<table>
<thead>
<tr>
<th>Country</th>
<th>Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>699</td>
</tr>
<tr>
<td>India</td>
<td>563</td>
</tr>
<tr>
<td>Morocco</td>
<td>728</td>
</tr>
<tr>
<td>Egypt</td>
<td>733</td>
</tr>
</tbody>
</table>

#### Price for similar products in Uganda (USD)

<table>
<thead>
<tr>
<th>Description</th>
<th>Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our survey data (average)</td>
<td>134</td>
</tr>
<tr>
<td>Quote from high-end carpenter</td>
<td>414</td>
</tr>
</tbody>
</table>
Comparison with IKEA: Products

Figure 4: Morbylanga IKEA Table

Figure 5: Ugandan Table with Chairs
Task Composition: Production

Carpentry
- Thicknessing
- Design
- Edging
- Planing
- Mortising
- Cutting
- Drying (before)
- Finishing
- Drying (after)

Welding
- Design
- Bending
- Welding
- Cutting
- Polishing
- Painting
- Grinding

Grain milling
- De-hulling
- Milling
- Sealing
- Conditioning
- Cleaning/Destoning
- Drying
- Cob shelling
- Customer interaction important category
- Consistent with prevalence of customization/face-to-face demand
Task Composition: Idle Time

- Resting and waiting at firm premises: primary reasons for idle time
Does the Type of Idle Time Change Across the Firm Size Distribution?

- Broadly similar across size distribution
Limited Increase in Specialization Across Employees with Firm Size

- Flat relationship for all employee types
Is Our Measurement of Non-Production Tasks Consistent Across the Size Distribution?

Return to working on non-production tasks similar in smaller and larger firms
Task Allocation: Overlap Between Entrepreneurs and Employees

- **Production**
  - Entrepreneur: 3 hours
  - Employee: 5 hours

- **Non-production tasks**
  - Entrepreneur: 3 hours
  - Employee: 1 hour

- **Idle**
  - Entrepreneur: 2 hours
  - Employee: 2 hours

Legend:
- Blue: Entrepreneur
- Red: Employee
<table>
<thead>
<tr>
<th></th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Share in Non-production Tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entrepreneur (0/1)</td>
<td>0.317***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yrs. Schooling above Median (0/1)</td>
<td></td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.010)</td>
<td></td>
</tr>
<tr>
<td>Tenure above Median (0/1)</td>
<td></td>
<td></td>
<td>0.020*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.010)</td>
</tr>
<tr>
<td>Firm Size</td>
<td>0.002</td>
<td>-0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Sample</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.257</td>
<td>0.050</td>
<td>0.050</td>
</tr>
<tr>
<td>Observations</td>
<td>3,803</td>
<td>2,686</td>
<td>2,703</td>
</tr>
</tbody>
</table>
Entrepreneur’s involvement in production not driven by training motives
Figure 6: Employee

Figure 7: Entrepreneur
• Higher specialization in large firms, but non-prod. tasks done mostly by employees
Consequence of Limited Specialization: In Large Firms, Employees Are More Important in Demand Generation

- first-time customers from owner more than emp
- owner in charge of bargaining
- owner follows up with customers
- customers complain to owner
- discuss with person producing imp. reason for orders
- worker performs independent orders
- customer has phone number of person producing
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Share Non-prod. Tasks</td>
<td>0.297***</td>
<td>0.293***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.073)</td>
<td>(0.081)</td>
<td></td>
</tr>
<tr>
<td>Supervise/Train (0/1)</td>
<td>0.200***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.061)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer Int. (0/1)</td>
<td>0.081**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.038)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input procurement (0/1)</td>
<td>0.106***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Org. Stock (0/1)</td>
<td>-0.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.036)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Managerial Tasks (0/1)</td>
<td>-0.022**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.067)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. Complexity of Prod. Steps Performed</td>
<td>0.166***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Firm FE: Yes, Yes, Yes
Demographic Ctrl.: Yes, Yes, Yes
Adjusted $R^2$: 0.540, 0.545, 0.551
Observations: 2,350, 2,350, 2,022

- Employees assigned to non-production tasks have higher earnings ($\sim 35\%$
  $\rightarrow$ non-prod. tasks more skill intensive
Heterogeneity in Skills

- Share Lower than x
- Yrs. of Schooling
- Employee (Low earnings)
- Employee (High earnings)
- Entrepreneur

Graph showing the share of employees with different earnings and a line for entrepreneurs as a function of years of schooling.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Yrs. Schooling</td>
<td>0.004*</td>
<td>0.013**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.006)</td>
<td></td>
</tr>
<tr>
<td>Tenure (Yrs.)</td>
<td>0.005**</td>
<td>0.036***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.005)</td>
<td></td>
</tr>
<tr>
<td>Entrepreneur (0/1)</td>
<td></td>
<td></td>
<td>0.900***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.147)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample</th>
<th>Employee</th>
<th>Employee</th>
<th>Ent + Emp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.354</td>
<td>0.414</td>
<td>0.036</td>
</tr>
<tr>
<td>Observations</td>
<td>2,711</td>
<td>2,432</td>
<td>3,929</td>
</tr>
</tbody>
</table>

- Higher skilled individuals are more likely to be assigned to non-production tasks
- Entrepreneurs have almost 1 more year of education than employees

→ We would expect specialization on complex (non-prod.) tasks, mostly by entrepreneurs
Equilibrium

The competitive equilibrium is a set of prices \( \{P_m, w\} \), firm sizes \( n(z') \forall z' \), task assignment for each pair \( (z, z'') \) of individuals in the firm (including the manager herself) \( \{\mu(z, z''; z')\}_\forall(z,z',z'') \), occupational choices \( \Pi_o(z, r, s), \Pi_w(z, r, s), \Pi_x(z, r, s) \), and stationary distributions \( g_o(z, r, s), g_w(z, r, s), \text{ and } g_x(z, r, s) \) such that:

1. firm owners choose firm size and task assignment to maximize profits
2. individuals choose their occupation to maximize their value
3. the producer of the aggregate output \( Y \) maximizes profits;
4. output price is \( P_m = \left( \omega \frac{Y_m}{1-\omega} \right) \left( \frac{Y_m}{Y} \right) \frac{1}{i} \);
5. the labor market clears: \( \sum_r \sum_s \int n(z) g_o(z, r, s) dz = \sum_r \sum_s \int g_w(z, r, s) dz \);
6. \( g_o(z, r, s), g_w(z, r, s), \text{ and } g_x(z, r, s) \) are stationary and consistent with the occupational choice and the laws of motion for \( z \) and \( r \).
Identification of within-firm block

• \( \theta(z, z'; \kappa_0, \chi_0) = D \left( 1 - \frac{1}{\kappa_0} (z' - z)^{K_1} \right) \)
  ▶ Data: workers’ time spent on complex tasks independent of their/owner ability \( \Rightarrow \kappa_1 = 0 \)

• \( \theta(z', z'; \kappa_0, \chi_0) = D \left( 1 + d + \frac{n(z'; \kappa_0, \chi_0) - 1}{\kappa_0} \int (z' - z)^{K_1} f(z) \, dz \right) \)
  ▶ Data: regression of time owners spend on complex tasks on firm size \( \Rightarrow D / \kappa_0 \)

• Average \( \theta \) of workers = \( D \left( 1 - \frac{1}{\kappa_0} \right) \) \( \Rightarrow \) second equation for \( D, \kappa_0 \)

• Average \( \theta \) of firm owners = \( D \left( 1 + d + \frac{n-1}{\kappa_0} \right) \) \( \Rightarrow \) pins down \( d \)
Lemma 1: Unbundling vs cost of firm size

• Suppose

1. \( \kappa(\varphi) = \kappa_0 \varphi^{1/\kappa_1} \)
2. \( \chi(n) = \chi_0 n^{1/\chi_1} \)

• Lower \( \chi_0 \)
  \( \rightarrow \) more specialization, larger firms, lower productivity
Lemma 2: Occupational Choice

- Suppose
  1. no learning from owner
  2. \( w(z) = w \ \forall z \)

- Occupational segregation at age 0
- \( P(\text{start firm}) \) increases in \( z \)
- Occupational life-cycle: learning & capital cost
Comparable Changes in \( \kappa_0 \) and \( \chi_0 \)

- Range for \( \kappa_0 \): from values estimated for CW to GM
- Range for \( \chi_0 \): generate similar increase in firm size

\[ \kappa_0 \text{ estimated in CW close to } \infty \rightarrow \text{self-employment within the firm} \]
• Firms are both small due to low specialization and are not specialized because are small
• Reducing $\kappa_0$ generates larger increases in specialization and productivity
Calibration Strategy: Details

Identification of within-firm block

• \( \theta(z, z'; \kappa_0, \chi_0) = D \left( 1 - \frac{1}{\kappa_0} (z' - z)^{\kappa_1} \right) \)
  
  ▶ Data: workers’ time spent on complex tasks independent of their/owner ability \( \rightarrow \kappa_1 = 0 \)

• \( \theta(z', z'; \kappa_0, \chi_0) = D \left( 1 + d + \frac{n(z'; \kappa_0, \chi_0) - 1}{\kappa_0} \int (z' - z)^{\kappa_1} f(z) \, dz \right) \)
  
  ▶ Data: regression of time owners spend on complex tasks on firm size \( \rightarrow D/\kappa_0 \)

• Average \( \theta \) of workers = \( D \left( 1 - \frac{1}{\kappa_0} \right) \) \( \rightarrow \) second equation for \( D, \kappa_0 \)

• Average \( \theta \) of firm owners = \( D \left( 1 + d + \frac{\bar{n} - 1}{\kappa_0} \right) \) \( \rightarrow \) pins down \( d \)
Evidence on Absolute Advantage as Perceived by Workers and Entrepreneurs

(a) Workers

- Workers: self-assessed abilities are strongly correlated across skill types
- Entrepreneurs: employees valuable as workers are also profitable at starting a firm
**Validation: Managerial Tasks are More Skill-Intensive**

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Salary</th>
<th>(2) Salary</th>
<th>(3) Time share on Managerial Act.</th>
<th>(4) Time share on Managerial Act.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time share on Managerial Act.</td>
<td>0.395***</td>
<td>0.297***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.083)</td>
<td>(0.073)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.009***</td>
<td>-0.000</td>
<td>-0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td></td>
</tr>
<tr>
<td>Years of Schooling</td>
<td>0.026***</td>
<td>0.004*</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td></td>
</tr>
<tr>
<td>Tenure at the Firm (Yrs)</td>
<td>0.029***</td>
<td>0.006**</td>
<td>0.005**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td></td>
</tr>
<tr>
<td>Vocational Training (0/1)</td>
<td>0.125**</td>
<td>0.007</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.056)</td>
<td>(0.019)</td>
<td>(0.019)</td>
<td></td>
</tr>
<tr>
<td>(Log) Salary</td>
<td></td>
<td></td>
<td></td>
<td>0.034***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.011)</td>
</tr>
</tbody>
</table>

| Observations                     | 2,350      | 2,350      | 2,711                             | 2,711                             |
| Adjusted $R^2$                   | 0.495      | 0.540      | 0.353                             | 0.357                             |
| Sectors                          | All        | All        | All                               | All                               |
| Firm FE                          | Yes        | Yes        | Yes                               | Yes                               |
| Joint p-value                    | -          | 0.000      | 0.063                             | 0.021                             |

- Two measures of skill-intensity provide similar results
  1. **returns**: workers that spend more time in managerial task have higher earnings
  2. **sorting**: more skilled workers spend more time in managerial tasks
• Counterfactual follows closely Lucas ’78 benchmark → validates model’s assumption
Validation 2: Measure Total Hours Spent in Each Set of Tasks
• More skilled employees (as measured by salary) spend a bit more time in complex tasks
Specialization Within the Firm: by Production and Non-Production Tasks

Figure 1: Production tasks

Figure 2: Non-Production Tasks

- Entrepreneurs spend more time on complex steps/tasks
### Quantitative Validation: Comparing Carpentry/Welding with Grain Milling

<table>
<thead>
<tr>
<th>Moments</th>
<th>CW Data</th>
<th>CW Model</th>
<th>GM Data</th>
<th>GM Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Specialization</td>
<td>0.28</td>
<td>0.29</td>
<td>0.53</td>
<td>0.62</td>
</tr>
<tr>
<td>Firm Size</td>
<td>5.5</td>
<td>5.7</td>
<td>7</td>
<td>7.8</td>
</tr>
<tr>
<td>Regression of Log(Rev) on Manscore</td>
<td>0.24</td>
<td>0.33</td>
<td>0.58</td>
<td>0.60</td>
</tr>
<tr>
<td>Wage as a Share of Revenues pw</td>
<td>0.26</td>
<td>0.26</td>
<td>0.17</td>
<td>0.25</td>
</tr>
</tbody>
</table>

- Changing only within-firm organization: over-shoot differences in firm size
- Qualitatively replicate larger returns to managerial ability in GM (also per worker)

⇒ Insights: **firms are smaller due to low labor specialization**, and not vice-versa (In this context)
Production with Labor Specialization (General Case)

- Focus on empirically relevant case: entrepreneur specializes in complex tasks
  In the paper, general case in which everyone can specialize in each task [Add link]
- Net output of the firm is identical to the case without specialization
  \[ Y(x, n, \mu) = \hat{y}(x, \mu) + (n - 1) \int y(z, x, \mu) dF(z) - \chi(n) \]
- Labor specialization changes the output of individual production lines
  \[ y(z', x, \mu) = x^{\lambda} \left[ \frac{\tilde{z}(z')^{1-\lambda}}{\lambda} \right] \begin{cases} \Pi_n \int_{\mu_C(z',z)dF(z)+\hat{\mu}_C(z',x) \geq D} & \text{Complex Tasks} \\ \Pi_n \int_{\mu_S(z',z)dF(z)+\hat{\mu}_S(z',x) \geq 1-D} & \text{Simple Task} \end{cases} \]
  \[ \tilde{z}(z') = \exp \left\{ \frac{1}{D} \left( \hat{\mu}(z', x) \log(x) + (n - 1) \int \mu(z', z) \log(z) dF(z) \right) \right\} \left( 1 - \kappa \left( \phi(z') \right) \right) \]
- \( \phi(z) = \frac{1}{D} \mu(z, z) \): share of \( z \)'s complex tasks done by \( z \)
Feasibility of Assignment (General Case)

- An assignment $\mu$ is feasible ($\mu \in \mathbb{F}$) if and only if time constraints are satisfied:

  $\hat{\mu}_C(x, z') + \hat{\mu}_S(x, z') + (n - 1) \int (\mu_C(z, z') + \mu_S(z, z')) \, dF(z) \leq 1 \quad \forall z'$  \quad \text{(Workers)}

  $\hat{\mu}_C(x, x) + \hat{\mu}_S(x, x) + (n - 1) \int (\hat{\mu}_C(z, x) + \hat{\mu}_S(z, x)) \, dF(z) \leq 1$  \quad \text{(Entrepreneur)}
Premise: Many Small Firms in Low Income Countries (no Agr)

- Similar picture if we drop agriculture (with a small decrease in number of firms in LIC)
Even entrepreneurs spend the majority of their time in production.

**Two takeaways**
1. Limited specialization
2. Managerial tasks are relatively few
Environment: static model of industry equilibrium

- **Mass 1 of agents with ability** $z \sim G$
  - Choose to be entrepreneurs or workers

- **Production technology**: monopolistically competitive firms with CRTS
  - Production requires complex & simple tasks
  - **firm productivity is endogenous** and depends on
    1. entrepreneurial ability (**non-rival** "idea")
    2. ability of individuals assigned to complex tasks (**rival** input) - s.t. delegation cost $\kappa$

- **Labor market**: entrepreneurs choose firm size & match with workers
  - $z$ is private information $\Rightarrow$ random matching
  - Worker compensation adjusts to clear the labor market
1. Production function (w/o and w labor specialization) + feasibility of assignment
2. Agents’ optimization: profit maximization and occupational choice
3. Equilibrium
4. Discussion of assumptions
5. Characterization
Production without Labor Specialization

- Each firm produces a variety ⇒ residual demand curve $p(Y) = Y^{-1/\gamma}$
- Output of firm with entrepreneur $\hat{z}$, size $n$, and assignment $\mu$
  \[ Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z) \]
  \[ \text{Entrepreneur} \quad \text{Workers} \]
  - one worker = one production line ⇒ $y(z, \cdot)$: output from $z$’s line
Production without Labor Specialization

- Each firm produces a variety ⇒ residual demand curve $p(Y) = Y^{-1/\gamma}$
- Output of firm with entrepreneur $\hat{z}$, size $n$, and assignment $\mu$

$$Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z)$$

  - **one worker = one production line** $\rightarrow y(z, \cdot)$: output from $z$'s line

- Production requires $D$ complex and $1 - D$ simple tasks

$$y(z, \hat{z}, \mu) = \begin{cases} \mathbb{1}_{\mu_C(z,z) \geq D} & \text{Complex Tasks} \\ \mathbb{1}_{\mu_S(z,z) \geq 1 - D} & \text{Simple Task} \end{cases}$$

  - where $\mu_S(z, z)$: amount of $z$'s time spent on simple tasks
Production without Labor Specialization

- Each firm produces a variety $\Rightarrow$ residual demand curve $p(Y) = Y^{-1/\gamma}$
- Output of firm with entrepreneur $\hat{z}$, size $n$, and assignment $\mu$
  
  $$Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z)$$

  > one worker = one production line $\Rightarrow y(z, \cdot)$: output from $z$'s line

- Production requires $D$ complex and $1 - D$ simple tasks
  
  $$y(z, \hat{z}, \mu) = \begin{cases} I_{\mu_C(z,z) \geq D} & \text{Complex Tasks} \\ I_{\mu_S(z,z) \geq 1-D} & \text{Simple Task} \end{cases}$$

  > where $\mu_S(z,z)$: amount of $z$'s time spent on simple tasks
  
  > Productivity depends on entrepreneur's & worker's ability
Production without Labor Specialization

• Each firm produces a variety ⇒ residual demand curve \( p(Y) = Y^{-1/\gamma} \)

• Output of firm with entrepreneur \( \hat{z} \), size \( n \), and assignment \( \mu \)

\[
Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n-1) \int y(z, \hat{z}, \mu) dF(z)
\]

\[\text{Entrepreneur} \hspace{1cm} \text{Workers}\]

▶ one worker = one production line ⇒ \( y(z, \cdot) \): output from \( z \)'s line

• Production requires \( D \) complex and \( 1 - D \) simple tasks

\[
y(z, \hat{z}, \mu) = \hat{z}^\lambda z^{1-\lambda} \quad \begin{cases} \geq D & \text{Complex Tasks} \\ \geq 1-D & \text{Simple Task} \end{cases}
\]

▶ where \( \mu_S(z, z) \): amount of \( z \)'s time spent on simple tasks

▶ Productivity depends on entrepreneur's & worker's ability
Production with Labor Specialization (Task-Swapping)

- Empirically relevant case: entrepreneur specializes in complex tasks

- Output identical to before \( Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z) \)
Production with Labor Specialization (Task-Swapping)

- **Empirically relevant case**: entrepreneur specializes in complex tasks

- **Output identical to before** \( Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z) \)

- **Labor specialization → productivity** of individual production lines
  
  > "Rival" part: composite of **ability of who performs complex tasks**

  \[
  y(z, \hat{z}, \mu) = \hat{z}^\lambda \tilde{z}(z, \hat{z})^{1-\lambda}
  \]

  \[
  \tilde{z}(z, \hat{z}, \mu) = z^{\varphi(z)} \hat{z}^{1-\varphi(z)} \left(1 - \kappa(\varphi(z))\right)
  \]

  > where \( \varphi(z) = \frac{1}{D} \mu_C(z, z) \): share of \( z \)'s complex tasks done by \( z \)
Production with Labor Specialization (Task-Swapping)

- Empirically relevant case: entrepreneur specializes in complex tasks

- Output identical to before $Y(\hat{z}, n, \mu) = y(\hat{z}, \hat{z}, \mu) + (n - 1) \int y(z, \hat{z}, \mu) dF(z)$

- Labor specialization $\rightarrow$ productivity of individual production lines
  - "Rival" part: composite of ability of who performs complex tasks

\[
y(z, \hat{z}, \mu) = \hat{z}^{\lambda} \tilde{z}(z, \hat{z})^{1-\lambda} \quad \underbrace{\mu_C(z, z) + \mu_C(z, x) \geq D}_{\text{Complex Tasks}} \quad \underbrace{\mu_S(z, z) \geq 1-D}_{\text{Simple Task}}
\]

\[
\tilde{z}(z, \hat{z}, \mu) = z^{\varphi(z)} \hat{z}^{1-\varphi(z)} \quad \underbrace{(1 - \kappa(\varphi(z)))}_{\text{Unbundling Cost}}
\]

- where $\varphi(z) = \frac{1}{D} \mu_C(z, z)$: share of $z$'s complex tasks done by $z$
Recall that each individual (owner and workers) has one unit of time.

An assignment $\mu$ is feasible ($\mu \in F$) if and only if all time constraints are satisfied:

$$\mu_C(z, z) + \mu_S(z, z) + \hat{\mu}_S(\hat{z}, z) \leq 1 \quad \forall z$$  \hspace{1cm} \text{(Workers)}$$

$$\hat{\mu}_C(\hat{z}, \hat{z}) + (n - 1) \int \hat{\mu}_C(z, \hat{z})dF(z) \leq 1$$  \hspace{1cm} \text{(Entrepreneur)}$$
• Entrepreneur with ability \( \hat{z} \) chooses size \((n)\) and a (feasible) assignment \((\mu)\)

\[
\pi(\hat{z}) \equiv \max_{\{n \geq 1, \mu, p\}} \left( 1 - \tau \right) \quad \text{wedge} \quad p \ Y(\hat{z}, n, \mu) - (n - 1) \int w(z, \hat{z}, \mu, p) dF(z) \quad \text{revenues} \quad \text{avg wage}
\]

\[
s.t. \quad \mu \in F
\]

\[
p = Y(\hat{z}, n, \mu)^{-\frac{1}{\gamma}} P
\]

- Wedge \( \tau \) captures all other frictions (credit, transportation costs,...)
- \( F \): equilibrium distribution of workers in the economy
- Recall: random matching \( \rightarrow \) choose \( n - 1 \), not individual workers’ ability
Wage Determination

• Wage of worker \( z \) matches with entrepreneur \( x \) is given by

\[
    w(z, \hat{z}, \mu, p) = \bar{w} + \omega p y(z, \hat{z}, \mu)
\]

- \( \bar{w} \): eq wage level
- \( \omega \): piece rate
- \( p y(z, \hat{z}, \mu) \): worker revenues

• Interpretation of wage function: bargaining over marginal match surplus
  
  - \( \omega \frac{\gamma}{\gamma - 1} \): workers’ bargaining weight
  - Owner outside option: produce without marginal worker
  - Worker’s outside option \( o_w \) is endogenous to labor market equilibrium

\[
    \bar{w} = (1 - \omega) \frac{\gamma}{\gamma - 1} o_w
\]
• Given a set of entrepreneurs $E$, the expected wage for a worker $z$ is

$$E \left[ w(z) \right] = \int_E w(z, \hat{z}, \mu(\hat{z}), p(\hat{z}))dG(\hat{z})$$

• Occupational choice: become entrepreneur iff $\pi(z) \geq E \left[ w(z) \right]$
Definition of Competitive Equilibrium

A competitive equilibrium is given by

1. firm size and assignment to tasks \( \{n(z), \mu(z)\}_{z \in G} \forall z \),
2. wage level \( \bar{w} \)
3. set of entrepreneurs \( E \)

such that

1. firm size and task assignment \( \{n(z), \mu(z)\}_{z \in G} \) maximize profits for all \( z \)
2. individuals pick occupation optimally: \( \pi(z) \geq w(z) \quad \forall z \in E \)
3. labor market clears: \( 1 - \int_{E} dG(z) = \int_{E} (n(z) - 1) dG(z) \)
Discussion of Some Key Assumptions

1. **Identical piece rate**: institutional feature with strong empirical support
   - evidence: piece rate prevalent and no w/i firm dispersion
   - relevance: irrelevant for theoretical results as long as single-crossing is satisfied

2. **Random matching**: directly implied by restriction on piece rate
   - evidence: weak PAM; labor frictions; hard to observe ability
   - focus: occupational choice & w/i firm assignment (limit for counterfactual)

3. **Task-swapping view of labor specialization**: Each production line requires same tasks (CRTS)
   - evidence: task composition does not vary with firm size
   - focus: good model of UG, but limits external validity → "local counterfactuals"

4. **Theory of absolute advantages**: good managers are also good workers
   - evidence: different skills (technical, customer, managerial) are reported to be strongly correlated
   - focus: cannot speak of specialization w/i complex/simple tasks (due to comparative advantages)
Details on the Wage Function

• Define the average workers’ productivity (which does not depend on firm size \( n \)) as

\[
\tilde{Z}_w(x, \mu) = \left( \int \tilde{z}(z, x, \mu)^{1-\lambda} dF(z) \right)^{\frac{1}{1-\lambda}}
\]

• The average wage is thus

\[
\bar{w}(x, \mu, p) = w_0 + \omega p \tilde{Z}_w(x, \mu)
\]

where in the "benchmark" case \( \tilde{Z}_w(x, \mu) = x \)
Key Distinction in Time Allocation Is Between Entrepreneurs and Employees

- **Employee**
  - High edu.
  - Low edu.

- **Employee**
  - High wage
  - Low wage

- **Entrepreneur**

![Density plots for time share on managerial tasks for different groups.](image)
Second Test: Returns to Managerial Score Across Locations

• Recall from the theory

\[
\mathcal{Z}(\hat{z}, n, \mu) = \hat{z}^\lambda \\
\text{non-rival}
\]

\[
\left( \frac{1}{n} \hat{z}^{1-\lambda} + \frac{n-1}{n} \int \hat{z}(z, \hat{z}, \mu)^{1-\lambda} dF(z) \right)
\]

\[
\text{dilution from firm size} \text{ task-productivity}
\]

• The bigger the firm \( n \), the less \( \mathcal{Z}(\hat{z}, n, \mu) \) depends on \( \hat{z} \), as long as

1. \( \lambda < 1 \): entrepreneurial ability partially rival
2. \( \kappa_0 > 0 \): workers perform managerial tasks

• Prediction: returns to managerial ability is larger in small firms
  ▶ Variation in size? Split by sub-counties (three groups) (\( \tau \) variation)
Second Test ✓: Larger Returns to Managerial Score in Locations with Small Firms

- **Hypothesis**: if firms are smaller, returns to entrepreneurial ability is larger

(a) Returns to Managerial Score

(b) Returns to Schooling
Second Test ✓: Larger Returns to Managerial Score in Locations with Small Firms

- **Hypothesis:** if firms are smaller, returns to entrepreneurial ability is larger

(a) Returns to Managerial Score

(b) Returns to Schooling

⇒ Validates the Model + Provides Moments to Estimate $\lambda$
Calibration Strategy (Note: for today, assume $\lambda = 0$)

1. **Data:** $\kappa_1 = 0 \rightarrow$ within-firm problem can be estimated separately

2. Solve for $\kappa_0, D, d$ to match Facts 1 and 2 exactly
   - average time spent on managerial activities (owners & workers)
   - relationship between with time on managerial activities and firm size
   - can estimate $\kappa_0, D, d$ separately by sector to match differences in within-firm organization

3. **External friction $\tau$ & heterogeneity $G(z)$** pinned down by firm revenues & size
   - large heterogeneity in revenues per worker $\rightarrow$ large $\sigma_z$
   - large firms $\rightarrow$ small $\tau$

Note: estimation is still work in progress, today we show a rough **numerical exploration**