Self-Employment within the Firm

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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** $\Rightarrow$ low productivity & efficient scale
  - Barriers to labor specialization $\Rightarrow \begin{cases} \text{lower firm-level productivity} \\ \text{firm-level prod. declines in size} \end{cases} \Rightarrow$ small firms
  - Prevalent **business model** of traditional mfg in LIC is **not scalable**

Overview: Data, Model, Quantification

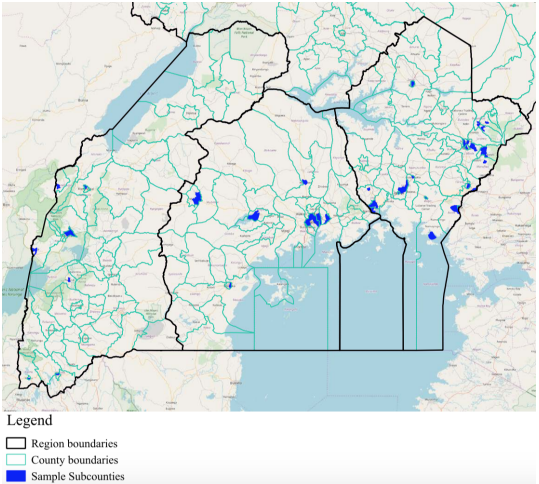
1. Novel **survey data on internal organization** of manufacturing firms in Uganda
   - Composition of tasks: larger firms $\approx$ replicas of smaller firms
   - Allocation of tasks: some – but **limited – specialization** in larger firms
   - Why? Customization makes it costly to **unbundle tasks** 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
    $\rightarrow$ 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	09	☐ 13:00 - 14:00
02	☐ 06:00 - 07:00	10	☐ 14:00 - 15:00
03	☐ 07:00 - 08:00	11	☐ 15:00 - 16:00
04	☐ 08:00 - 09:00	12	☐ 16:00 - 17:00
05	☐ 09:00 - 10:00	13	☐ 17:00 - 18:00
06	☐ 10:00 - 11:00	14	☐ 18:00 - 19:00
07	☐ 11:00 - 12:00	15	☐ 19:00 - 20:00
08	☐ 12:00 - 13:00	16	☐ 20:00 - 21:00

Question to Record the Main Activities Performed in Each Time Slot

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

MULTI-SELECT: ORDERED

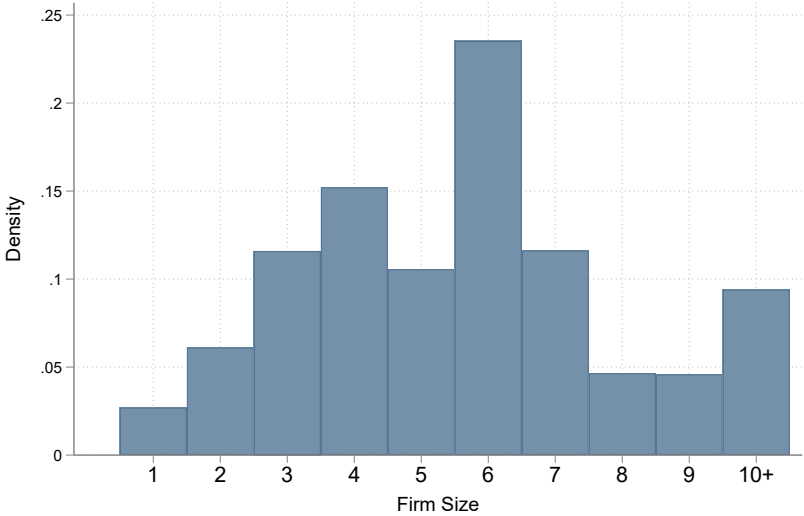
- 01 ☐ Away from business premises doing an activity not related to this business (e.g. going to the doctor, picking up kids, shopping etc.)
- 02 ☐ Book-keeping/business records
- 03 ☐ Eating or resting
- 04 ☐ Interact with customers
- 05 ☐ Look for new input suppliers for the production of any other 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

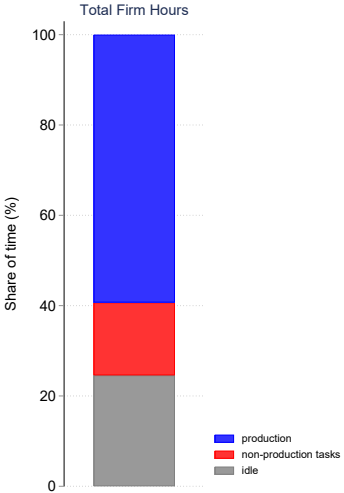
	All	Carpentry	Welding	Grain Milling
Firm Characteristics				
Employees	4.8	4.5	4.9	6.0
Monthly Revenues (USD)	1,437	1,222	1,548	1,916
Mechanization (relative to max machine utilization)	19%	23%	17%	19%
Formal License	83%	78%	88%	92%
Output Market and Demand				
Demand is crucial constraint	55%	55%	54%	57%
Any marketing expenditure	9%	7.7%	12%	7.8%
Sales done through walk-ins	80%	80%	75%	94%
Sales made to order	79%	75%	89%	69%
Talks to customers to communicate product quality	58%	61%	57%	54%

- Firms have **two core activities:** (1) **Production** and (2) **Finding customers**
  $\rightarrow$ Managing customer relationships key for revenue generation
- Very limited imports and exports

Why IKEA Does Not Enter UG?

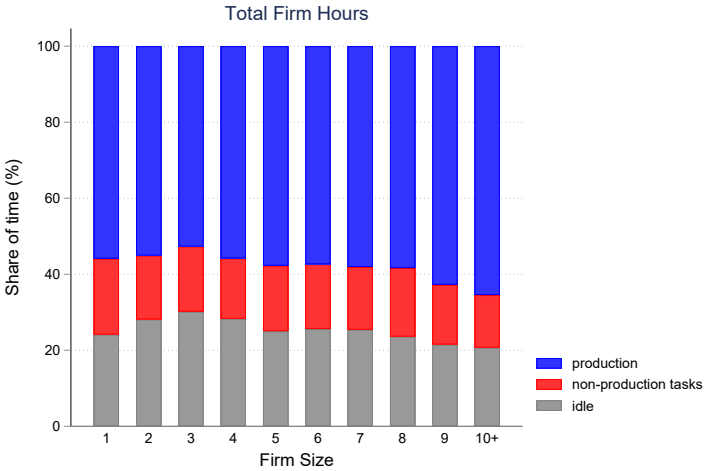
Task Composition: What Do Firms Do?

Task Composition: Which Tasks are Done Within the Firm?



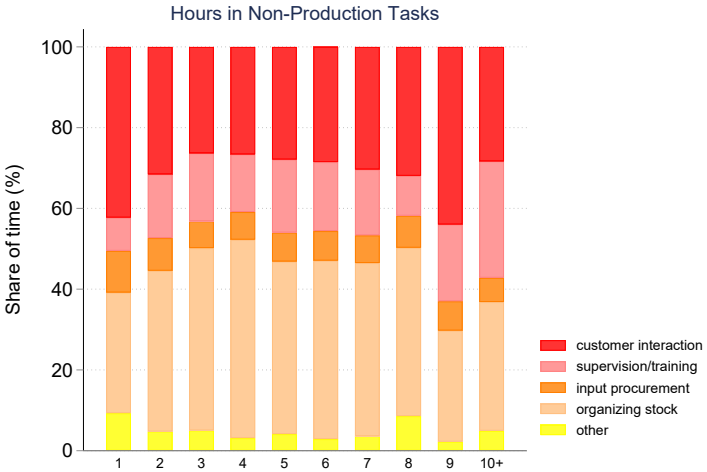
- Time spent on: **production, non-production, idle**
- Finer breakdown of each categories:
  - Production: production steps Go
  - Non-production: customer interaction, stock mgmt, input procurement, supervision/training, other Go
  - Idle: waiting, away, resting/eating Go

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?

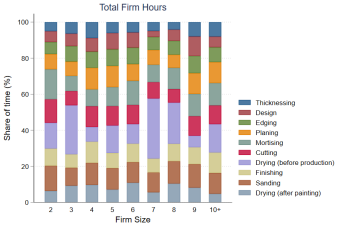


Figure 1: Carpentry

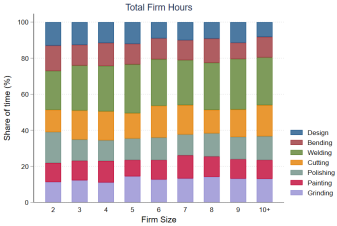


Figure 2: Welding

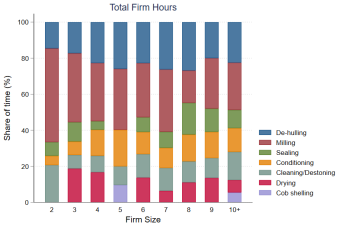


Figure 3: Grain Milling

- 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)

Idle by Size

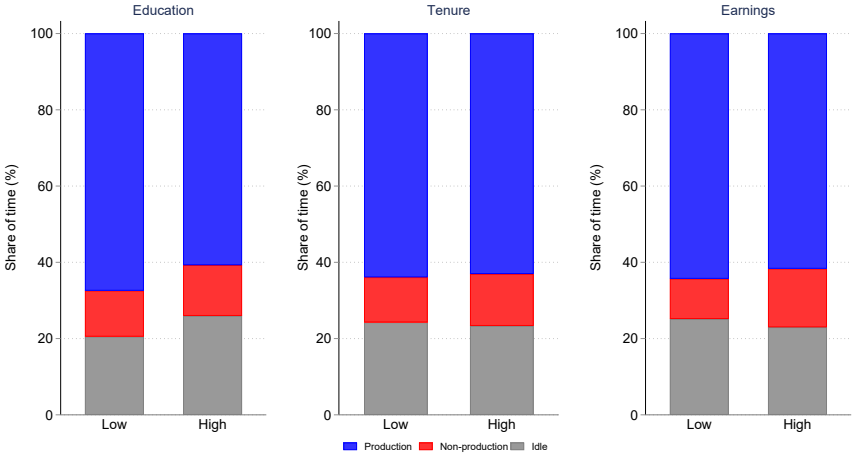
Task Allocation: Who Does What?

Task Allocation: Two Possible Dimensions of Labor Specialization

1. **Across employees:** more skilled workers could specialize on more complex tasks
2. **Employees vs entrepreneur:** entrepreneur could focus on managing/supervising

$\Rightarrow$ Next: study both dimensions of specialization and whether they vary by firm size

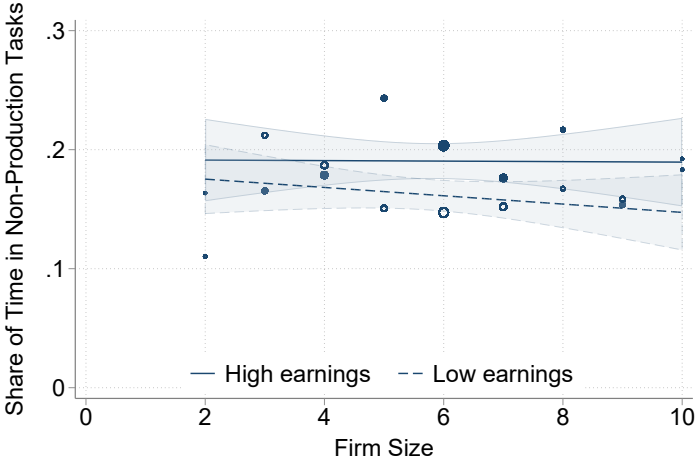
1. Specialization Across Employees: Do Skilled Employees do Less Production Tasks?



- **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

1. Specialization Across Employees: by Firm Size



- High skilled (earnings) employees spend (slightly) more time on non-production tasks
- Specialization is **similar in small and large firms**

By Time on Non-Prod

1. Specialization Across Employees: within Production and Non-Production Tasks

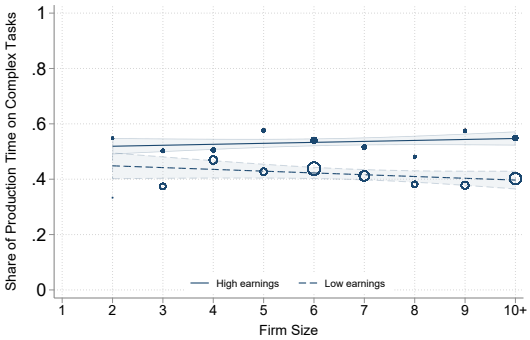


Figure 1: Production tasks

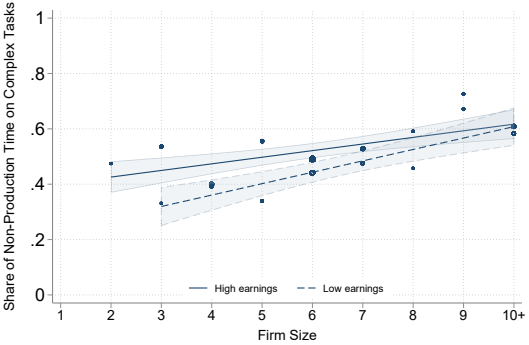
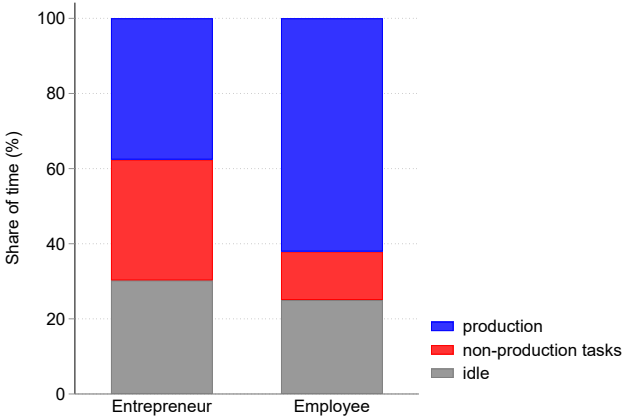


Figure 2: Non-Production Tasks

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

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

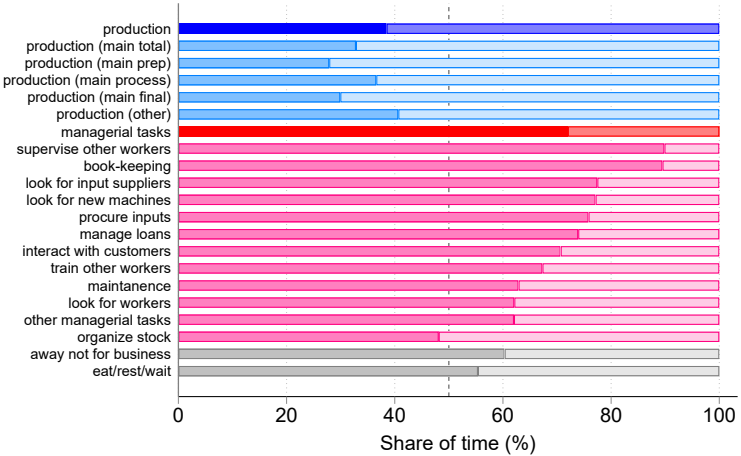


- **Some Specialization:** entrepreneurs do more non-production tasks, but **tasks overlap**

  → Entrepreneurs do 3 hrs/day of production; employees 1 hr/day non-production

Time

2. Employees vs Entrepreneur: Is there Overlap even within Task Types?

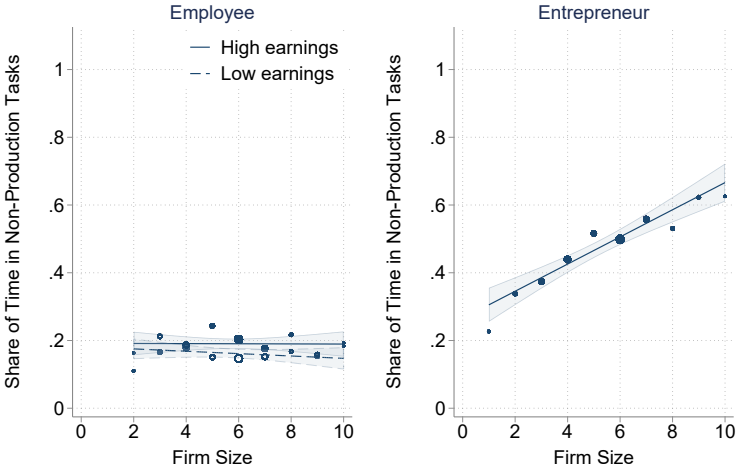


- Two results: 1. overlap in all tasks; 2. entrepreneur specialize in all non-prod tasks
- 1. + 2. **justify focus on production vs non-production** (or “managerial") tasks

Distribution

2. Employees vs Entrepreneur: by Firm Size

Detailed Demand



- **Larger firms are more specialized**: larger time allocation gap b/w empl. & entr.

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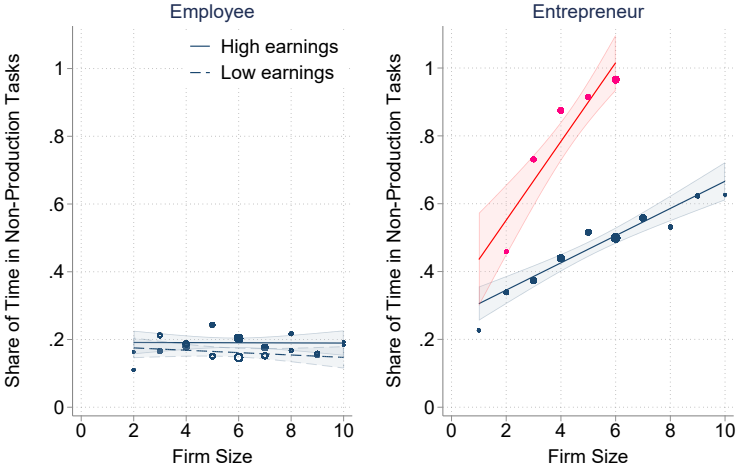

- Increase in non-prod. tasks of entr. is **smaller than a full-specialization benchmark**

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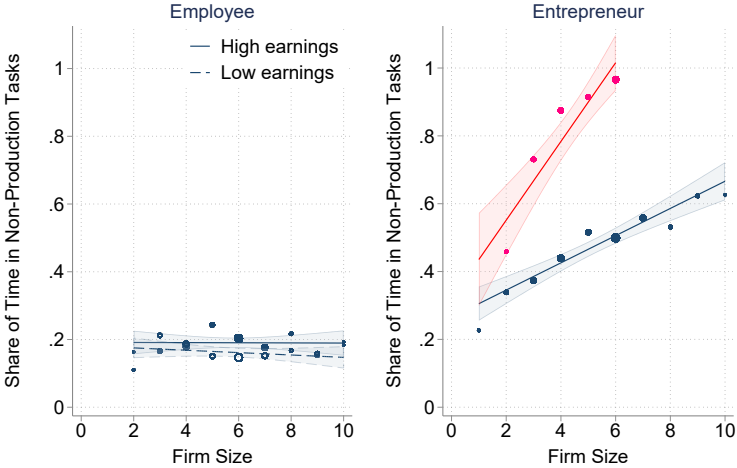
Detailed Demand



⇒ **Implication:** in large firms, **employees perform most "managerial tasks"**

Employee Reliance

Should We Have Expected More Specialization?

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- We should not expect to see much specialization in the data if:
  1. There is **no heterogeneity in skill intensity of tasks**
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- However, in the data we find:
  1. Employees assigned to non-prod. and complex production tasks earn more Go
  2. Skills heterogeneity: some among employees; a lot b/w employees and entrepreneurs Go

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

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⇒ ***Some sort of barrier likely prevents specialization***

One Possible Barrier to Specialization: Customization in Output Market

Figure 1: Carpentry

Figure 2: Welding

Figure 3: Grain Milling

- 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

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

- Customization $\rightarrow$ **communication, coordination** $\rightarrow$ hard to **unbundle** tasks

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Specialization			
Average specialization	**27%**	**29%**	**54%**

- 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 $\rightarrow$ 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**

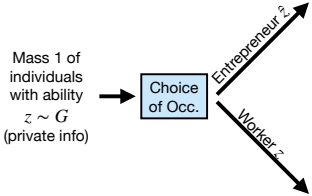
- Next: design a model suitable for and motivated by our setting. **Why a model?**
  1. **Theory:** show how limited specialization affects firm size, and firm & aggr. productivity
  2. **Measurement:** quantify role of internal barriers and interaction with external frictions

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



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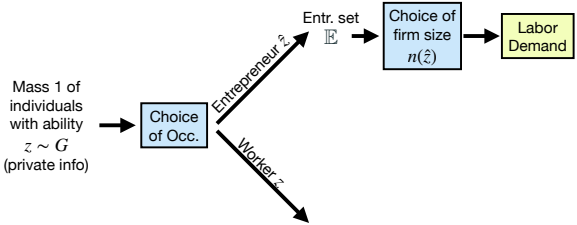

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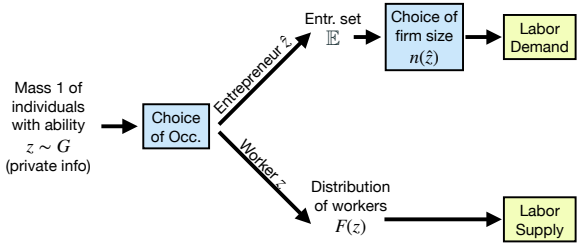

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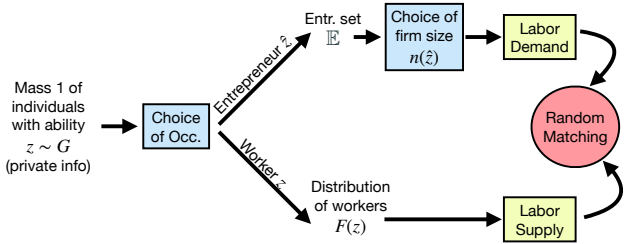

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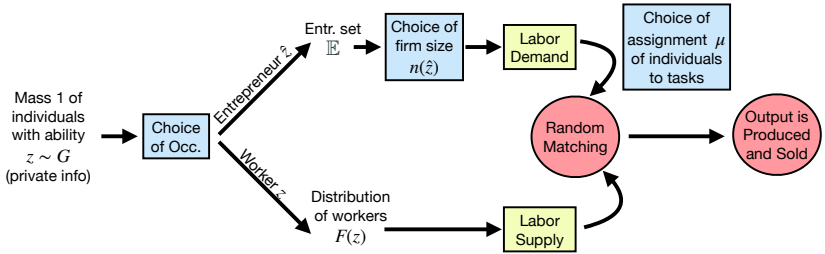

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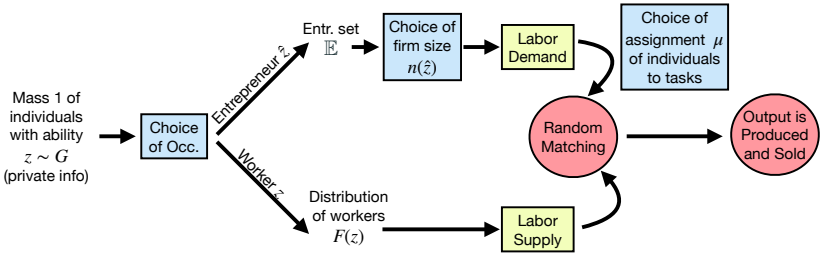

Output: $$Y(\hat{z}, n, \mu) = \underbrace{y(\hat{z}, \hat{z}, \mu)}_{\text{Entrepreneur}} + \underbrace{(n-1)\int y(z, \hat{z}, \mu)\, dF(z)}_{\text{Workers}}$$

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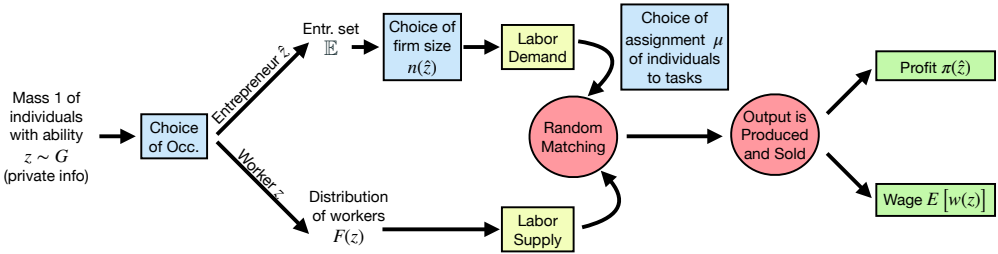

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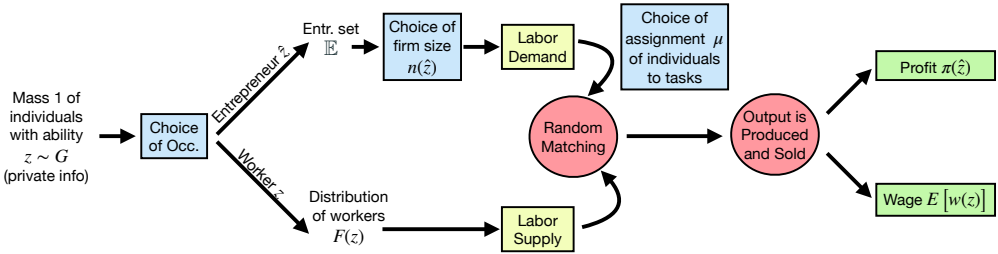

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Profits: $$\pi(\hat{z}) \equiv \max_{\{n \geqslant 1, \mu, p\}} \underbrace{(1-\tau)}_{\text{wedge}} \underbrace{p\, Y(\hat{z}, n, \mu)}_{\text{revenues}} - (n-1)\underbrace{\int w(z, \hat{z}, \mu, p)dF(z)}_{\text{avg wage}}$$

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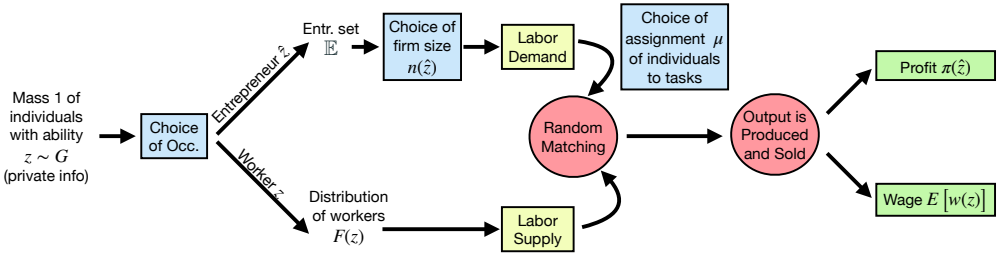

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External Frictions

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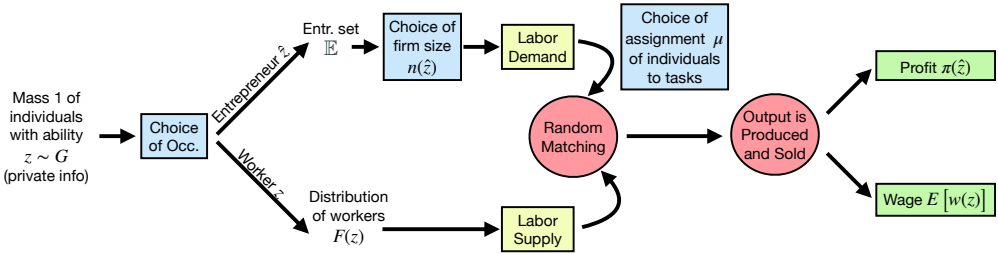

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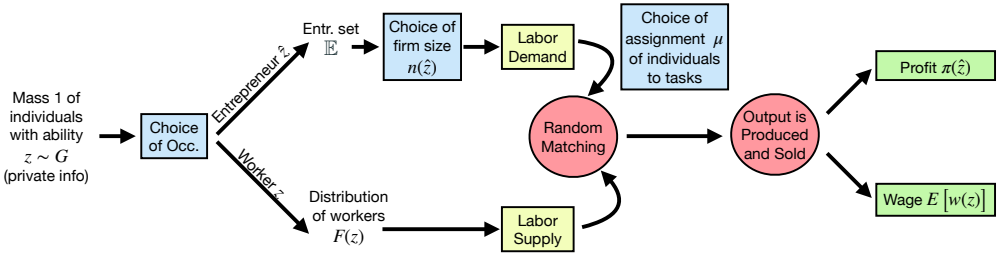
External Frictions

CES Demand → DRTS

Feasibility

Overview: Static Occupational Choice Model of Industry Equilibrium



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

Profits: $$\pi(\hat{z}) \equiv \max_{\{n \geqslant 1, \mu, p\}} \underbrace{(1-\tau)}_{\text{wedge}} \underbrace{p\, Y(\hat{z}, n, \mu)}_{\text{revenues}} - (n-1)\underbrace{\int w(z, \hat{z}, \mu, p)dF(z)}_{\text{avg wage}} \quad s.t. \quad \mu \in \mathbb{F} \quad p = Y(\hat{z}, n, \mu)^{-\frac{1}{\gamma}} P$$

External Frictions

CES Demand → DRTS

Feasibility

Wage: $$w(z, \hat{z}, \mu, p) = \underbrace{\overline{w}}_{\text{eq wage level}} + \underbrace{\omega}_{\text{piece rate}} \underbrace{p\, y(z, \hat{z}, \mu)}_{\text{worker revenues}}$$

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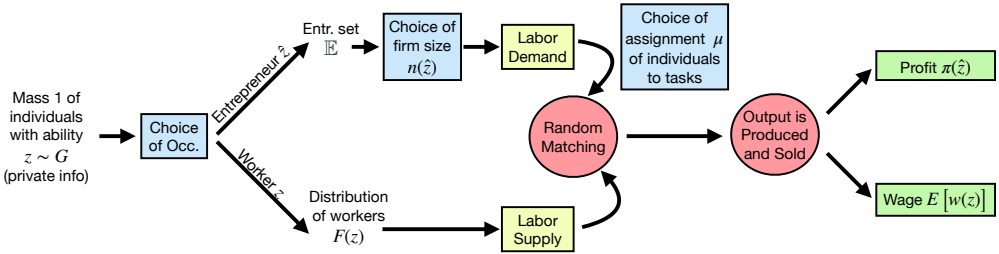

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Labor Mkt Clearing

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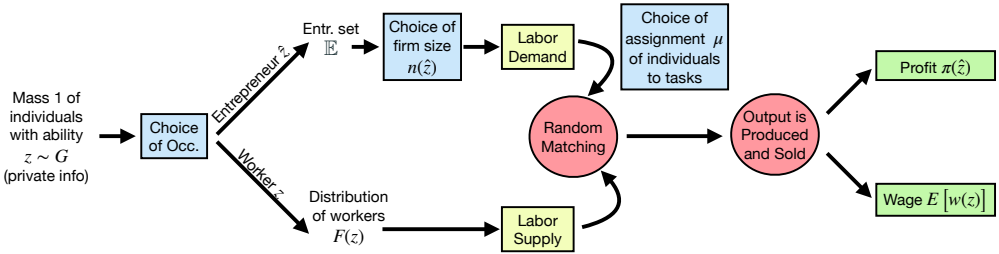

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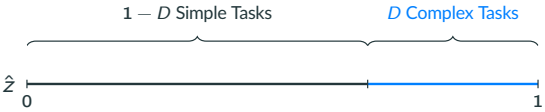
Labor Mkt Clearing

Set of Entrepreneurs

Line Production $y(z, \hat{z}, \mu)$: Without Labor Specialization



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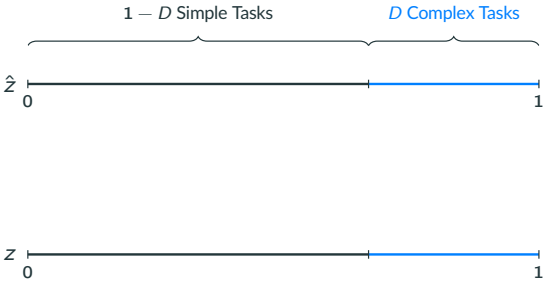

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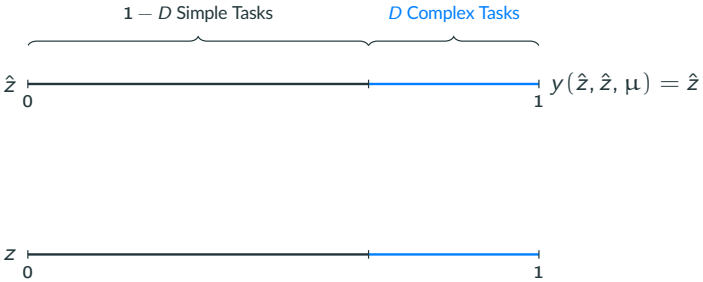

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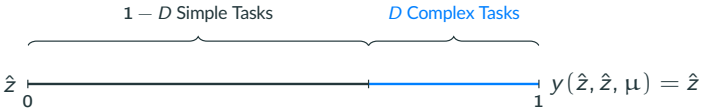
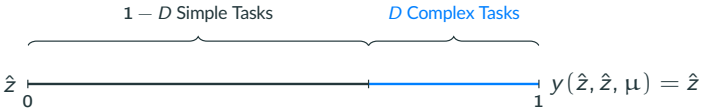


Idea: contribution of the entrepreneur's ability $\hat{z}$ to each line productivity (e.g. door design, firm reputation)

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

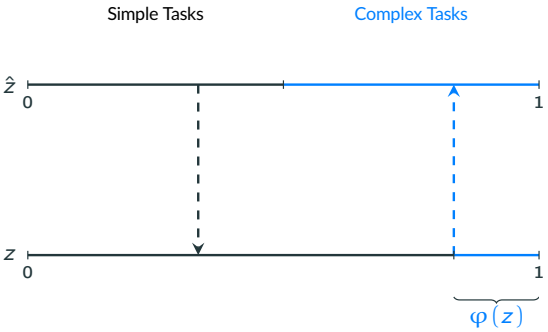


Idea: contribution of the entrepreneur's ability $\hat{z}$ to each line productivity (e.g. door design, firm reputation)

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 Sspecialization



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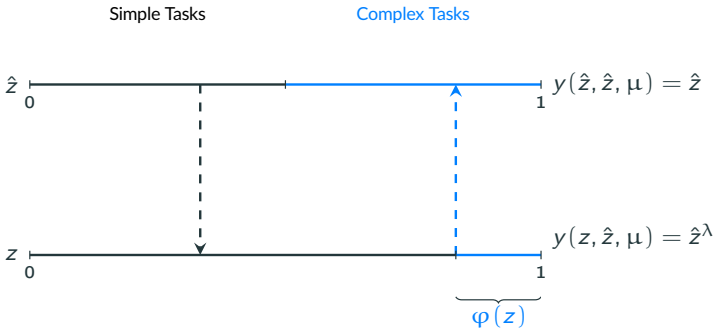

Avg Ability: rival term is a weighted average of the ability of individuals working on complex tasks $\longrightarrow$ $\tilde{z}(z, \hat{z}) = z^{\varphi(z)} \hat{z}^{1-\varphi(z)}$

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

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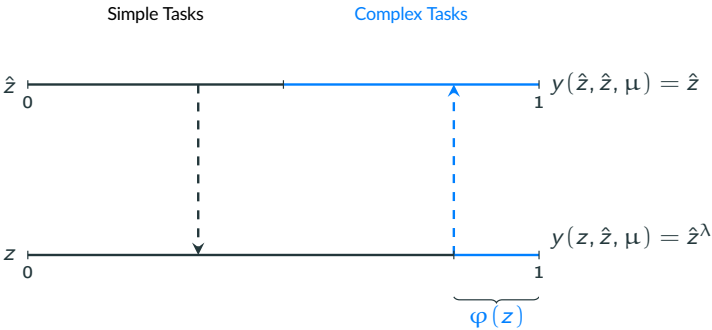

Key specialization trade-off:

+ it increases productivity if $\hat{z} > z$

- it entails a cost to unbundle tasks

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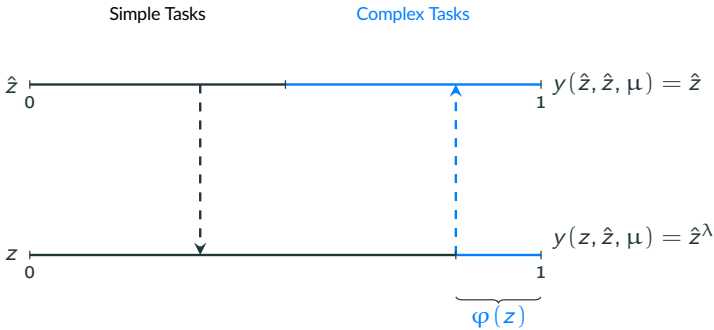

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Unbundling cost: cost to unbundle tasks and assign them to another person (e.g. communicate order details, coordinate production)

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' $\longrightarrow$ $\varphi(z) = D^{-1}\mu_C(z, z)$, $1 - \varphi(z) = D^{-1}\hat{\mu}_C(z, \hat{z})$.

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 $\overline{w}$
3. set of entrepreneurs $\mathbb{E}$ 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: $\pi(z) \geqslant E\left[w(z)\right] \quad \forall z \in \mathbb{E}$
3. labor market clears: $1 - \int_{\mathbb{E}} dG(z) = \int_{\mathbb{E}} (n(z) - 1) dG(z)$

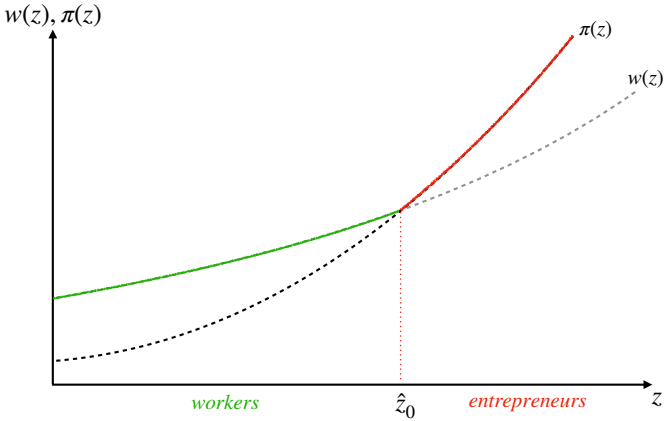
Characterization

Roadmap and Assumptions

- Two assumptions (for ease of exposition)
  1. $\kappa(\varphi) = 1 - \exp\{-\hat{\kappa}(\varphi)\}$, where $\hat{\kappa}(\varphi) = \kappa_0{}^{1/\kappa_1} \frac{\varphi^{1+1/\kappa_1}}{(1+1/\kappa_1)}$
  2. Entrepreneur spends **some time on simple tasks** (as in the data)

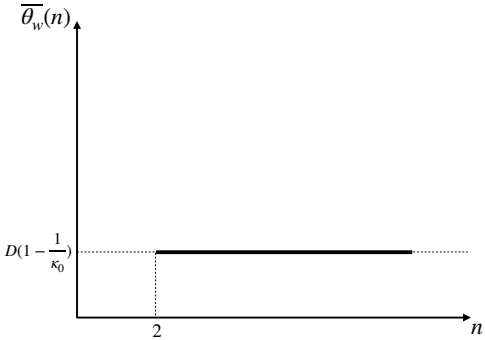
- Characterize
  1. Labor specialization within the firm (size & productivity)
  2. Optimal firm size (interaction of κ_0 & τ)
  3. Partial and general equilibrium effects of κ_0 (what's a firm?)

Lemma 0: Occupational Choice

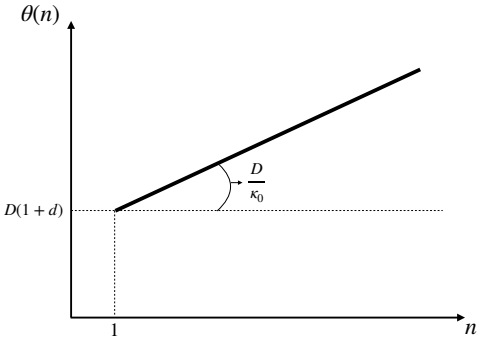


- Satisfy single crossing: $\frac{\partial E[w(z)]}{\partial z} \leqslant \frac{\partial \pi(z)}{\partial z} \; \forall z \quad \Rightarrow \quad \exists \, \hat{z}_0$ s.t. $z \in \mathbb{E}$ iff $z \geqslant \hat{z}_0$

Lemma 1: Labor Specialization, Firm Size and Cost κ_0 (illustrated for $\kappa_1 \to 0$)



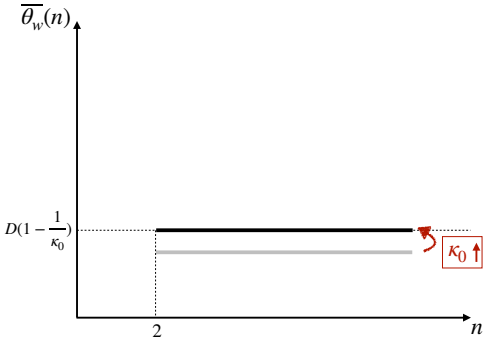
(a) Workers Time in Complex Tasks



(b) Entrepreneurs Time in Complex Tasks

- **More specialization in larger firms:** more 'low-hanging' complex tasks

Lemma 1: Labor Specialization, Firm Size and Cost κ_0 (illustrated for $\kappa_1 \to 0$)



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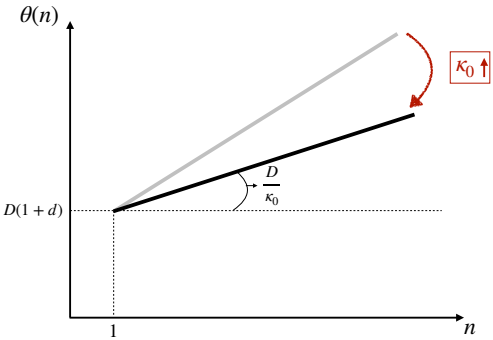

(b) Entrepreneurs Time in Complex Tasks

- **Higher unbundling cost $\to$ 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 $Y(\hat{z}, n) = \mathbb{Z}(\hat{z}, n, \mu)\, n$

$$\mathbb{Z}(\hat{z}, n, \mu) = \underbrace{\hat{z}^{\lambda}}_{\text{non-rival}} \quad \underbrace{\tilde{Z}(\hat{z}, n, \mu)^{1-\lambda}}_{\text{task-productivity}}$$

$$\tilde{Z}(\hat{z}, n, \mu) = \left(\frac{1}{n}\hat{z}^{1-\lambda} + \underbrace{\frac{n-1}{n}\int \tilde{z}(z, \hat{z}, \mu)^{1-\lambda} dF(z)}_{\text{dilution from firm size}} \right)^{\frac{1}{1-\lambda}}$$

  - $\tilde{z}(z, \hat{z}, \mu) \leqslant \hat{z}$, 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 $\tilde{z}(z, \hat{z}) < \hat{z} \quad \forall z$

Lemma 3: Optimal Firm Size & Frictions

- Optimal firm n size solves

$$\underbrace{\frac{\partial p(n)}{\partial n}\,\mathbb{Z}(\hat{z}, n, \mu)n + p(\hat{z})\mathbb{Z}(\hat{z}, n, \mu)}_{\text{change in revenues}} = \underbrace{\frac{\partial}{\partial n}\Big[(n-1)\overline{w}(\hat{z}, \mu, p(n))\Big]}_{\text{change in labor cost}}$$

Lemma 3: Optimal Firm Size & Frictions

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$$(1-\tau)\underbrace{\frac{\partial p(n)}{\partial n}\mathbb{Z}(\hat{z},n,\mu)n + p(\hat{z})\mathbb{Z}(\hat{z},n,\mu)}_{\text{change in revenues}} = \underbrace{\frac{\partial}{\partial n}\Big[(n-1)\overline{w}(\hat{z},\mu,p(n))\Big]}_{\text{change in labor cost}}$$

- Two kinds of frictions can keep firms small (complementary to one another)
  1. **External frictions ($\tau > 0$)**

Lemma 3: Optimal Firm Size & Frictions

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$$(1-\tau)\left[\underbrace{\frac{\partial p(n)}{\partial n}\mathbb{Z}(\hat{z},n,\mu)n + p(\hat{z})\mathbb{Z}(\hat{z},n,\mu)}_{\text{change in revenues}} + \underbrace{p(\hat{z})\frac{\partial \mathbb{Z}(\hat{z},n,\mu)}{\partial n}n}_{\text{prod. dilution}<0}\right] = \underbrace{\frac{\partial}{\partial n}\left[(n-1)\overline{w}(\hat{z},\mu,p(n))\right]}_{\text{change in labor cost}}$$

- 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 ($\mathbb{Z}(x,n) \leqslant x$)**
     - **firm-level productivity declining in size ($\partial\mathbb{Z}(x,n)/\partial n \leqslant 0$)**

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

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   $\Rightarrow$ Firms allow entrepreneurs to **leverage talent** and they have **larger** efficient scale

2. $\kappa \to \infty$ and $\lambda = 0$: **Self-Employment Within the Firm**
   - $Y(\hat{z}, n, \mu) = \overline{z}(\hat{z})\, n$
   - 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** κ_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**: $\overline{n} \equiv \int_{\hat{z}_0} n(z) dG$;
3. **average ability of firm owners**: $\hat{z}_0$ increases;
4. **aggregate productivity** $\overline{\mathbb{Z}} \equiv \int_{\hat{z}_0} \mathbb{Z}(z, n(z), \mu(z)) n(z) dG$;
5. **average wage** $E[w(z)]$ increases for all workers;
6. **returns to managerial ability**: $\frac{\partial \mathbb{Z}(z, n(z), \mu(z))}{\partial z}$ increases.

Testing the Model's Predictions

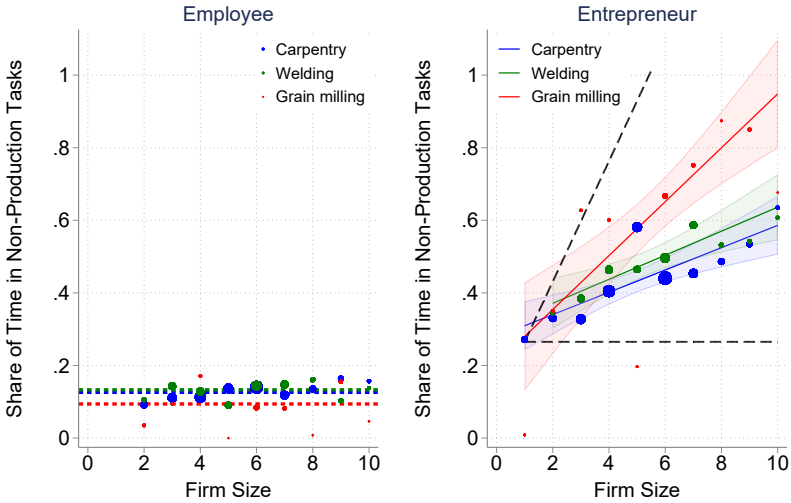
First test: Heterogeneity Across Sectors Helps Validate Proposition 1

- Predictions of Proposition 1 testable using variation in unbundling cost (κ_0)
  $\rightarrow$ use **heterogeneity across the three sectors as plausible sources of κ_0 variation**

- We argued that **grain milling has lower unbundling cost** $\rightarrow$ 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

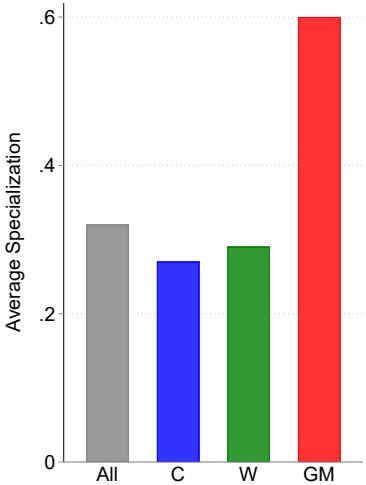
$\Rightarrow$ Next we show that these four predictions are satisfied in the data

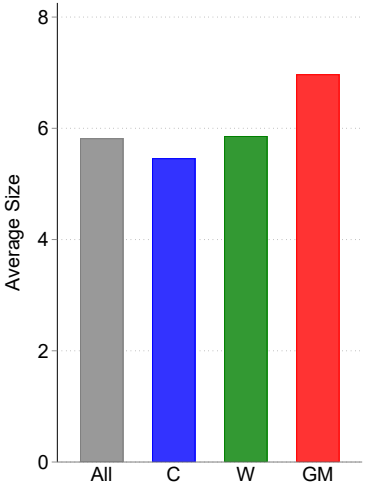
Intermediate Step: Measuring κ_0 Across Sectors using Lemma 1



- Lemma 1: low κ_0 in GM $\rightarrow$ steep relationship b/w specialization and size (✓)

First test ✓: Validating the Four Predictions of Proposition 1 for Grain Milling

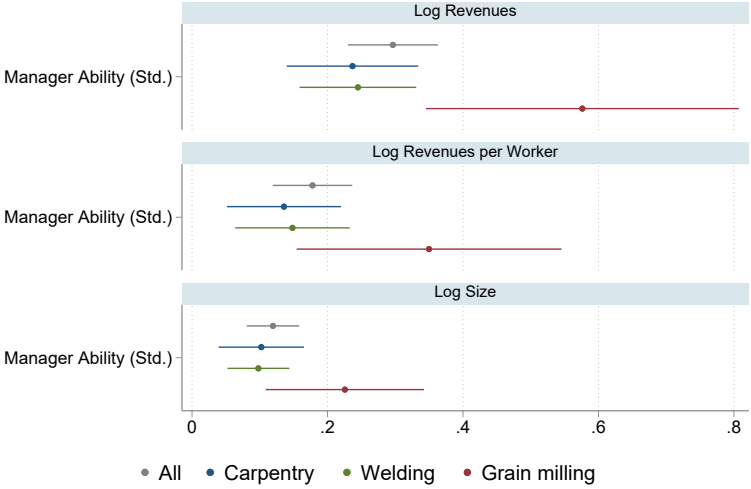




1. **More labor specialization**

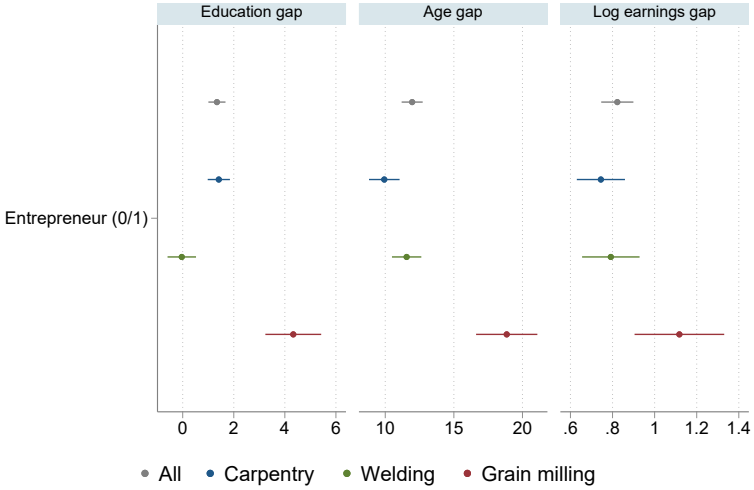
2. **Larger firms**

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)

Second Test

Quantification

Overview of Quantitative Approach

- Goal: **two main exercises**
  1. **Quantification:** what are the aggregate implications of the unbundling cost κ?
  2. **Policy Interventions:** returns from lowering external frictions (τ) depend on estimated κ_0

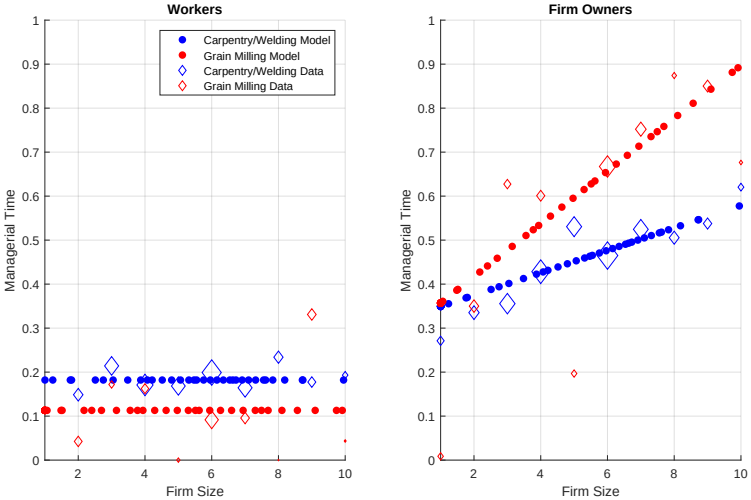
- Minor **model extensions for quantitative analysis**
  - Extreme value shocks: smooth out occupational choice
  - Outside sector: choice of entering manufacturing

- Calibration

Calibration Details

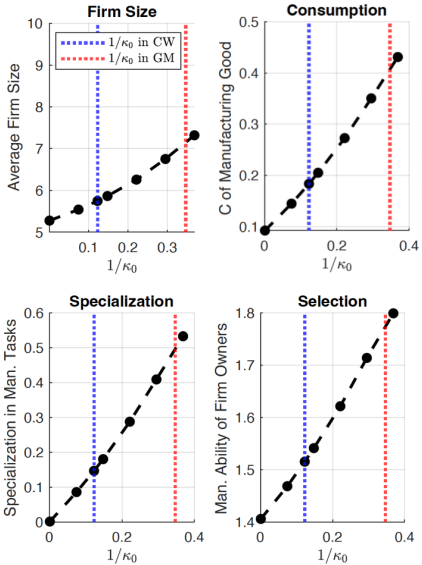
  - **Unbundling costs can be estimated separately:** C & W is benchmark; GM is alternative
  - Calibrate all other parameters to match rich set of moments for carpentry/welding

Estimating Unbundling Costs: Large in C & W; Smaller in GM



- Perfect match of within-firm organization (irrespective of equilibrium moments)

Quantification/Counterfactual: Vary the Unbundling Cost κ_0



Exercise

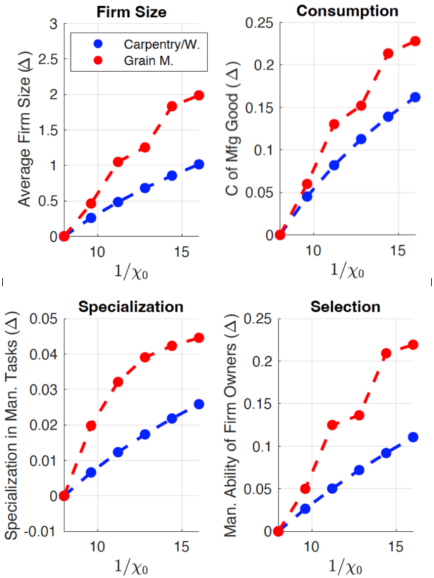
- Start from CW calibration
- Vary only the unbundling cost κ
  - red line = κ from GM calibration

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 τ with κ_0 of CW or GM



Exercise

- Start from CW or GM calibration
- Vary external frictions τ

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

Conclusion

- New evidence from Ugandan mfg firms + theory: **firms resemble SEWIF**
  - firms are **not vehicles to leverage talent** $\rightarrow$ low productivity, small efficient scale
- **Shift focus** from "who starts firms" to **"what people do w/i firms"**
  - if firms $\approx$ set of self-employed $\Rightarrow$ 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

	Morbylanga Table
IKEA prices around the world (USD)	
USA	699
India	563
Morocco	728
Egypt	733
Price for similar products in Uganda (USD)	
Our survey data (average)	134
Quote from high-end carpenter	414

Back

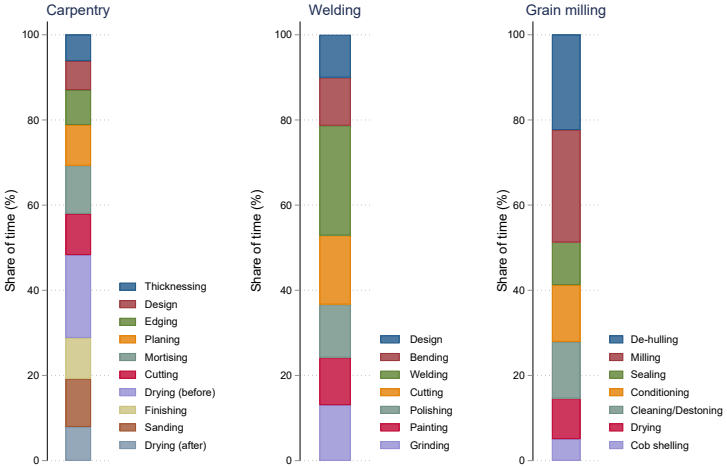
Comparison with IKEA: Products

Figure 4: Morbylanga IKEA Table

Figure 5: Ugandan Table with Chairs

Back

Task Composition: Production



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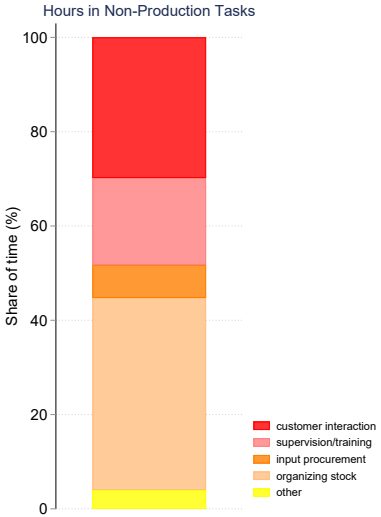
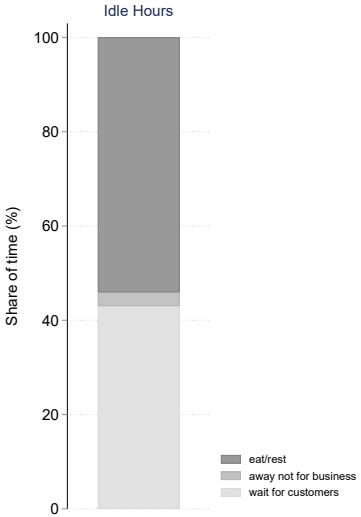
Task Composition: Non-Production



- Customer interaction important category
- Consistent with prevalence of customization/face-to-face demand

Back

Task Composition: Idle Time



- Resting and waiting at firm premises primary reasons for idle time

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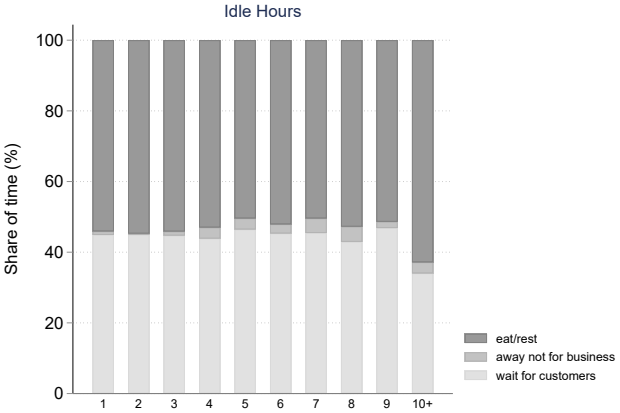
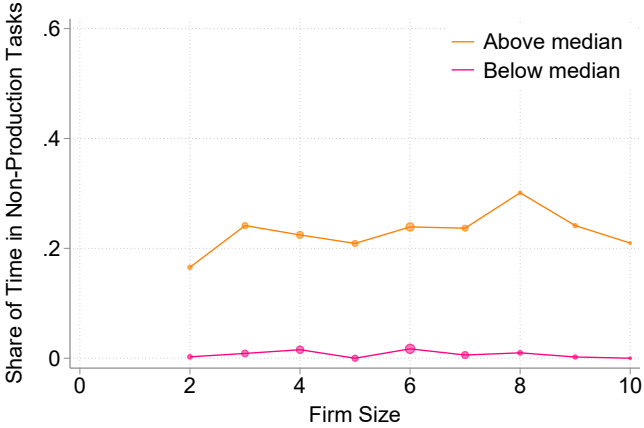
Does the Type of Idle Time Change Across the Firm Size Distribution?



- Broadly similar across size distribution

Back

Limited Increase in Specialization Across Employees with Firm Size



- Flat relationship for all employee types

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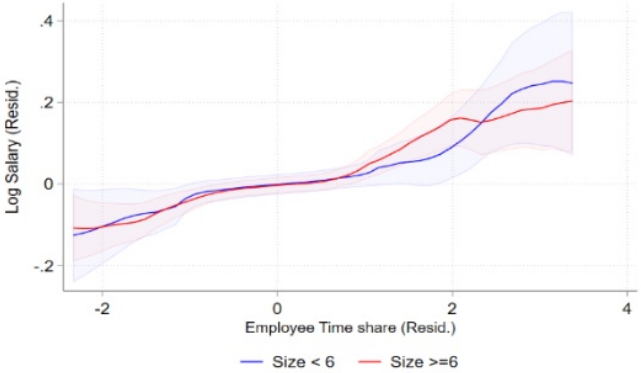
Is Our Measurement of Non-Production Tasks Consistent Across the Size Distribution?



Return to working on non-production tasks similar in smaller and larger firms

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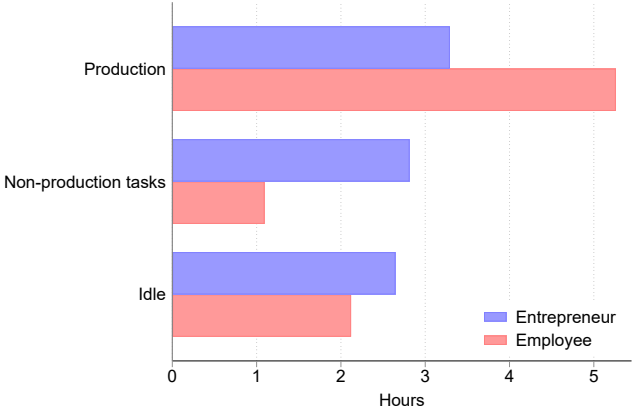
Task Allocation: Overlap Between Entrepreneurs and Employees



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Key Distinction in Time Allocation is Between Entrepreneurs and Employees

	Time Share in Non-production Tasks		
	(1)	(2)	(3)
Entrepreneur (0/1)	0.317***		
	(0.013)		
Yrs. Schooling above Median (0/1)		0.012	
		(0.010)	
Tenure above Median (0/1)			0.020*
			(0.010)
Firm Size	0.002	-0.001	-0.001
	(0.002)	(0.001)	(0.001)
Sample	Ent + Emp	Employee	Employee
Adjusted R^2	0.257	0.050	0.050
Observations	3,803	2,686	2,703

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Entrepreneur's involvement in production not driven by training motives

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Task Allocation Across the Size Distribution

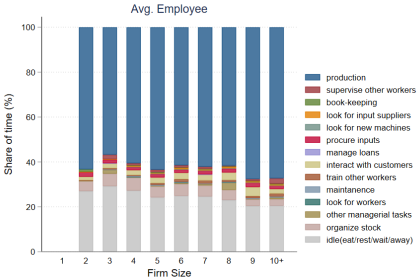

Figure 6: Employee

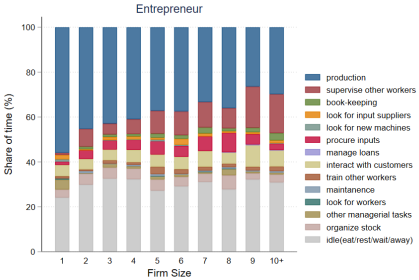

Figure 7: Entrepreneur

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Task Composition and Allocation Across the Size Distribution: Summary

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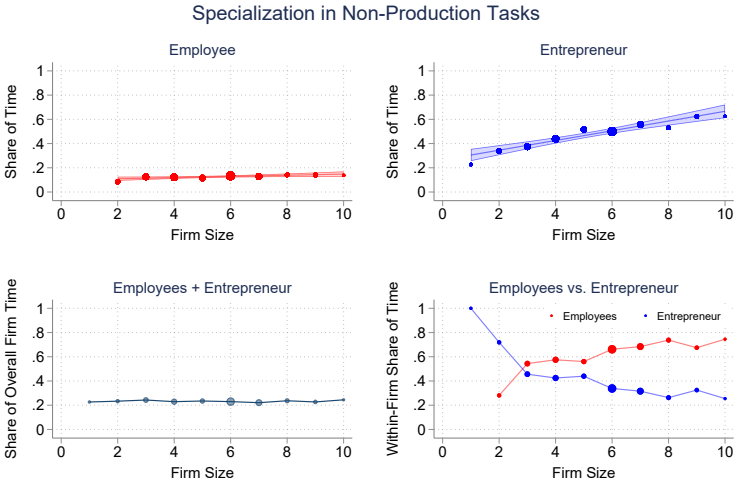

- Higher specialization in large firms, but non-prod. tasks done mostly by employees

Consequence of Limited Specialization: In Large Firms, Employees Are More Important in Demand Generation

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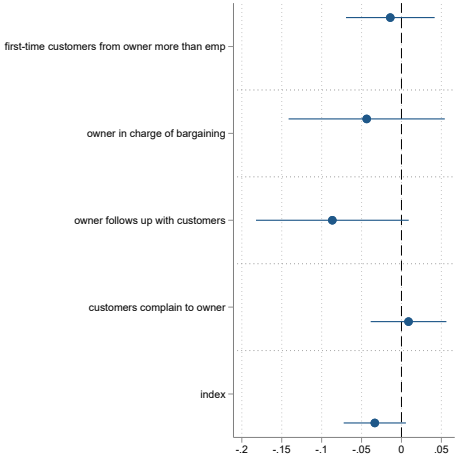

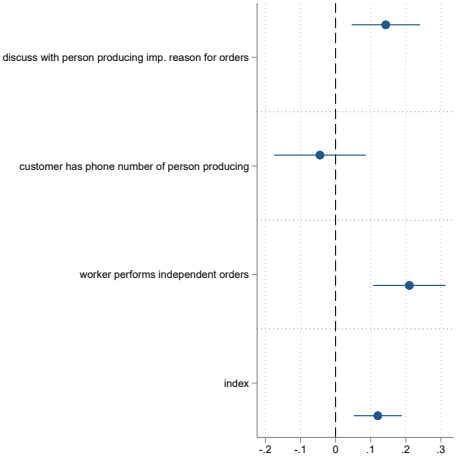

Heterogeneity in Skill Intensity of Tasks

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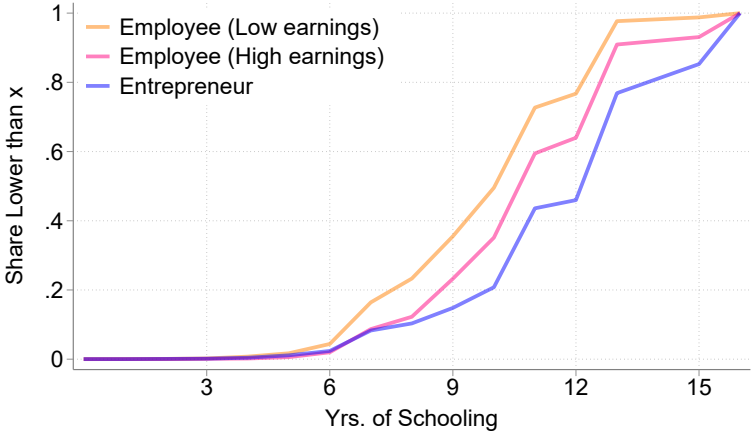
	(Log) Salary		
	(1)	(2)	(3)
Time Share Non-prod. Tasks	0.297***		0.293***
	(0.073)		(0.081)
Supervise/Train (0/1)		0.200***	
		(0.061)	
Customer Int. (0/1)		0.081**	
		(0.038)	
Input procurement (0/1)		0.106***	
		(0.040)	
Org. Stock (0/1)		-0.004	
		(0.036)	
Other Managerial Tasks (0/1)		-0.022**	
		(0.067)	
Avg. Complexity of Prod. Steps Performed			0.166***
			(0.031)
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

Back



Heterogeneity in Skills and Task Assignment

Back

	Time Share Non-prod. Tasks	Avg. Complexity of Prod. Steps Performed	Yrs. Schooling
	(1)	(2)	(3)
Yrs. Schooling	0.004*	0.013**	
	(0.002)	(0.006)	
Tenure (Yrs.)	0.005**	0.036***	
	(0.002)	(0.005)	
Entrepreneur (0/1)			0.900***
			(0.147)
Sample	Employee	Employee	Ent + Emp
Firm FE	Yes	Yes	Yes
Adjusted R^2	0.354	0.414	0.036
Observations	2,711	2,432	3,929

- 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* $\mathbb{I}_o(z, r, s)$*,* $\mathbb{I}_w(z, r, s)$*,* $\mathbb{I}_x(z, r, s)$*, and stationary distributions* $g_o(z, r, s)$*,* $g_w(z, r, s)$*, 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* $P_m = \left(\frac{\omega}{1-\omega}\right)\left(\frac{Y_m}{Y}\right)^{\frac{1}{\iota}}$*;*
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. $g_o(z, r, s)$*,* $g_w(z, r, s)$*, and* $g_x(z, r, s)$ *are stationary and consistent with the occupational choice and the laws of motion for* z *and* r *.*

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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 → $\kappa_1 = 0$
- $\theta(z', z'; \kappa_0, \chi_0) = D\left(1 + d + \frac{n(z'; \kappa_0, \chi_0) - 1}{\kappa_0} \underbrace{\int (z' - z)^{\kappa_1} f(z) dz}_{=1}\right)$
  - Data: regression of time owners spend on complex tasks on firm size → D/κ_0
- Average θ of workers $= D\left(1 - \frac{1}{\kappa_0}\right)$ → second equation for D, κ_0
- Average θ of firm owners $= D\left(1 + d + \frac{\bar{n} - 1}{\kappa_0}\right)$ → pins down d

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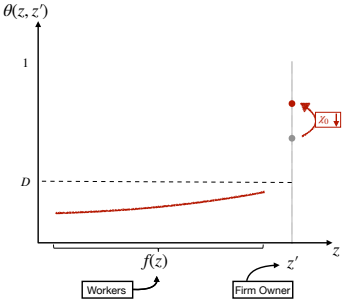
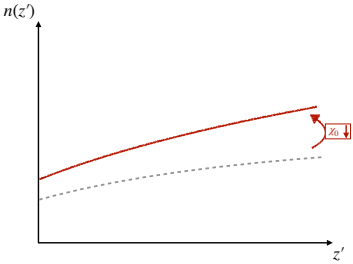
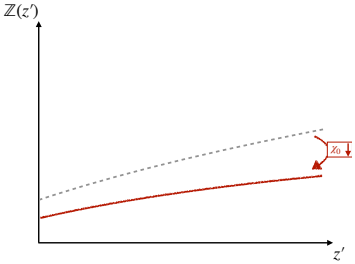
Lemma 1: Unbundling vs cost of firm size

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

- Lower χ_0
  - ➔ more specialization, larger firms, **lower productivity**







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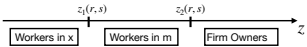
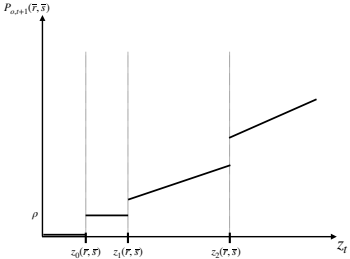
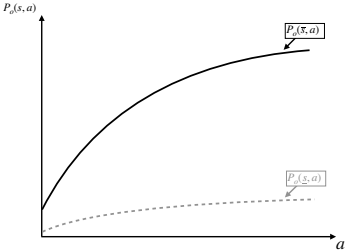
Lemma 2: Occupational Choice

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

- Occupational segregation at age 0
- $\mathbb{P}$(start firm) increases in z
- Occupational life-cycle: learning & capital cost







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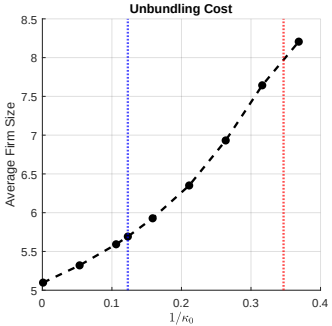
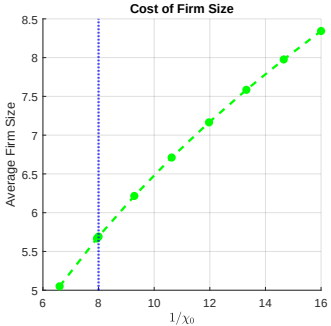
Comparable Changes in κ_0 and χ_0

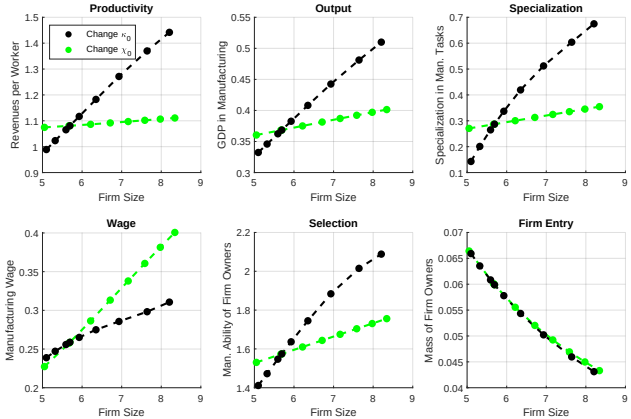
- Range for κ_0: from values estimated for CW to GM
- Range for χ_0: generate similar increase in firm size





κ_0 estimated in CW close to ∞ ➔ self-employment within the firm

Quantification: Compare Aggregate Effects of Changing κ_0 and χ_0



- Firms are both small due to low specialization and are not specialized because are small
- Reducing κ_0 **generates larger increases in specialization and productivity**

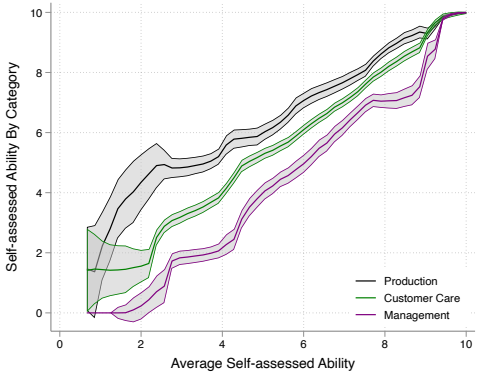
Calibration Strategy: Details

Identification of within-firm block

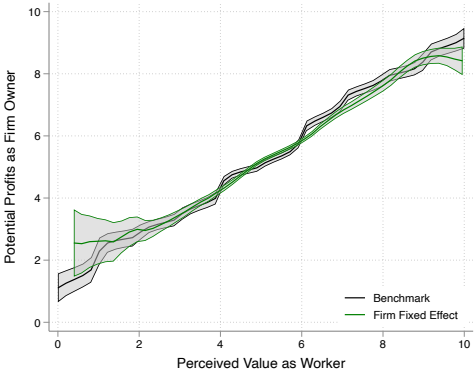
- $\theta(z, z'; \kappa_0, \chi_0) = D\left(1 - \frac{1}{\kappa_0}(z' - z)^{\kappa_1}\right)$
  - Data: workers' time spent on complex tasks independent of their/owner ability → $\kappa_1 = 0$
- $\theta(z', z'; \kappa_0, \chi_0) = D\left(1 + d + \frac{n(z'; \kappa_0, \chi_0) - 1}{\kappa_0} \underbrace{\int (z' - z)^{\kappa_1} f(z) dz}_{=1}\right)$
  - Data: regression of time owners spend on complex tasks on firm size → D/κ_0
- Average θ of workers $= D\left(1 - \frac{1}{\kappa_0}\right)$ → second equation for D, κ_0
- Average θ of firm owners $= D\left(1 + d + \frac{\bar{n} - 1}{\kappa_0}\right)$ → pins down d

back

Evidence on Absolute Advantage as Perceived by Workers and Entrepreneurs



(a) Workers



(b) Firm Entrepreneurs

- Workers: self-assessed abilities are strongly correlated across skill types
- Entrepeneurs: employees valuable as workers are also profitable at starting a firm

Validation: Managerial Tasks are More Skill-Intensive

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

Validation 1: Assign all managerial tasks to entrepreneur (Full-Specialization)

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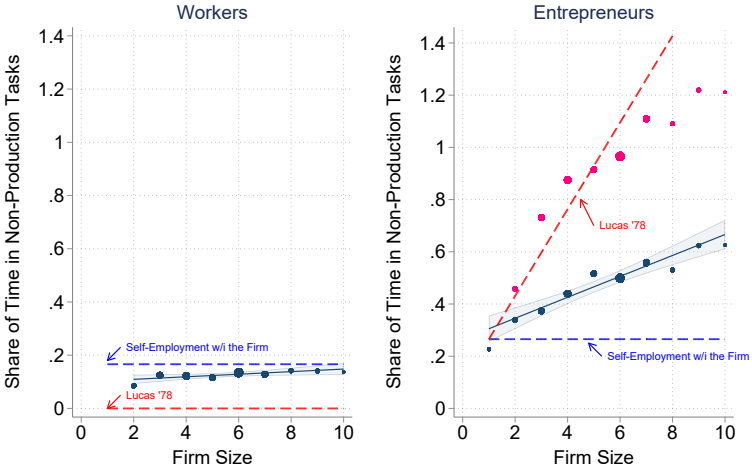

- Counterfactual follows closely Lucas '78 benchmark → **validates model's assumption**

Validation 2: Measure Total Hours Spent in Each Set of Tasks

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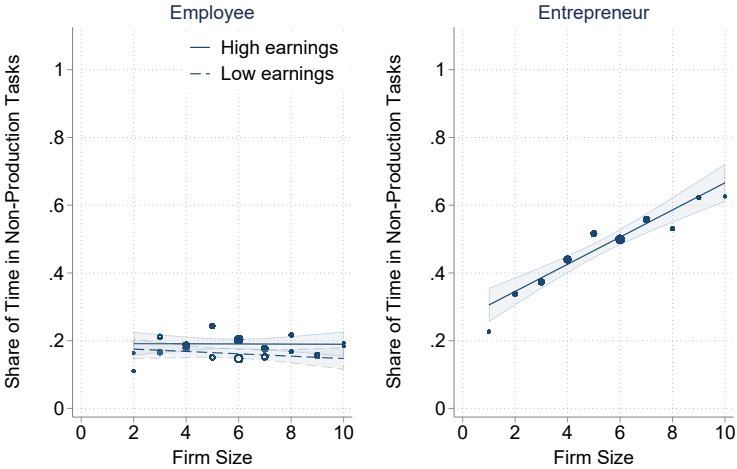
Labor Specialization for High and Low Skilled Workers

Back



- 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

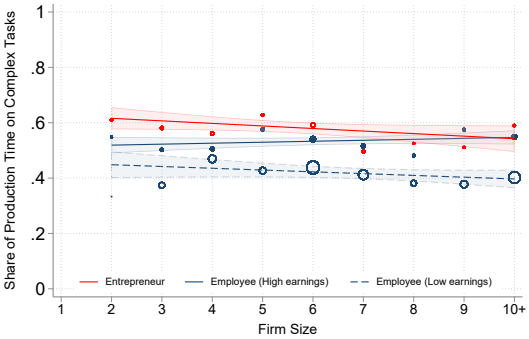


Figure 1: Production tasks

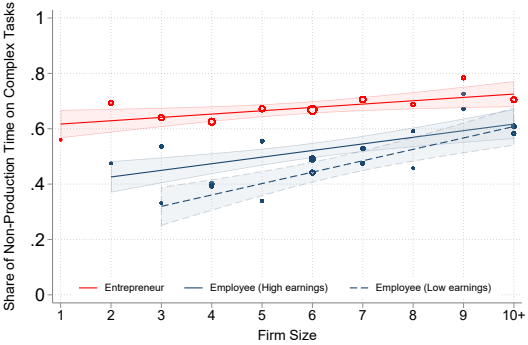


Figure 2: Non-Production Tasks

- Entrepreneurs spend more time on complex steps/tasks

Quantitative Validation: Comparing Carpentry/Welding with Grain Milling

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

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

$\Rightarrow$ 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

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

- Labor specialization changes the output of individual production lines

$$y(z', x, \mu) = \underbrace{x^{\lambda}}_{\text{Non-Rival}} \underbrace{\tilde{z}(z')^{1-\lambda}}_{\text{Rival}} \underbrace{\mathbb{I}_{n\int \mu_C(z',z)dF(z)+\hat{\mu}_C(z',x)\geqslant D}}_{\text{Complex Tasks}} \underbrace{\mathbb{I}_{n\int \mu_S(z',z)dF(z)+\hat{\mu}_S(z',x)\geqslant 1-D}}_{\text{Simple Task}}$$

$$\tilde{z}(z') = \exp\left\{\frac{1}{D}\left(\hat{\mu}(z', x)\log(x) + (n-1)\int \mu(z', z)\log(z)dF(z)\right)\right\} \underbrace{\left(1 - \kappa\left(\varphi(z')\right)\right)}_{\text{Delegation Cost}}$$

- $\varphi(z) = \frac{1}{D}\mu(z, z)$: share of z's complex tasks done by z

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Feasibility of Assignment (General Case)

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

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

$$\hat{\mu}_C(x, x) + \hat{\mu}_S(x, x) + (n-1) \int \left(\hat{\mu}_C(z, x) + \hat{\mu}_S(z, x)\right) dF(z) \leqslant 1 \qquad \text{(Entrepreneur)}$$

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Premise: Many Small Firms in Low Income Countries (no Agr)

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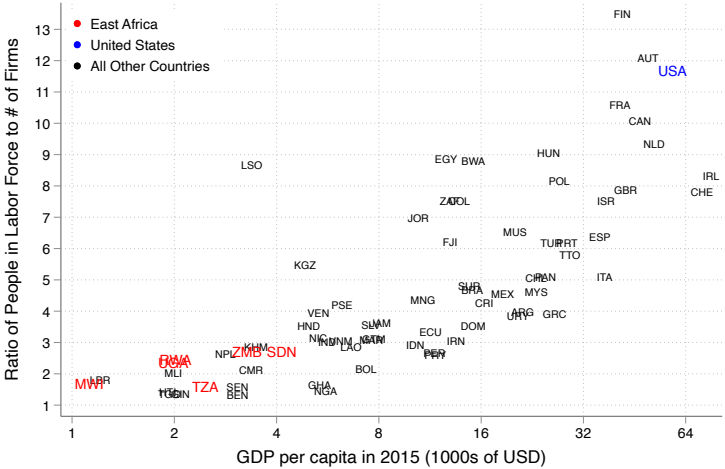
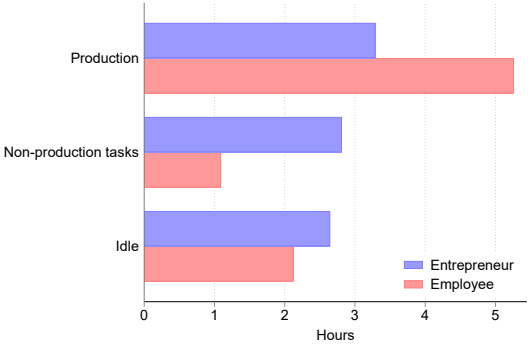


- Similar picture if we drop agriculture (with a small decrease in number of firms in LIC)

Number of Hours Spent on Each Activity



- Even entrepreneurs spend the majority of their time in production
- **Two takeaways**
  1. Limited specialization
  2. Managerial tasks are relatively few

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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** κ
- **Labor market**: entrepreneurs choose firm size & match with workers
  - z is private information $\Rightarrow$ random matching
  - Worker compensation adjusts to clear the labor market

Road map for model

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 $\Rightarrow$ residual demand curve $p(Y) = Y^{-1/\gamma}$
- Output of firm with entrepreneur $\hat{z}$, size n, and assignment μ

$$Y(\hat{z}, n, \mu) = \underbrace{y(\hat{z}, \hat{z}, \mu)}_{\text{Entrepreneur}} + \underbrace{(n-1)\int y(z, \hat{z}, \mu)dF(z)}_{\text{Workers}}$$

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

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 μ

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

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

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Production without Labor Specialization

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Production with Labor Specialization (Task-Swapping)

- Empirically relevant case: entrepreneur specializes in complex tasks

general case

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

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

$$
\begin{aligned}
y(z, \hat{z}, \mu) =& \hat{z}^{\lambda}\, \tilde{z}(z, \hat{z})^{1-\lambda} \\
\tilde{z}(z, \hat{z}, \mu) =& z^{\varphi(z)} \hat{z}^{1-\varphi(z)} \underbrace{(1 - \kappa(\varphi(z)))}_{\text{Unbundling Cost}}
\end{aligned}
$$

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Feasibility of Assignment

- Recall that each individual (owner and workers) has one unit of time
- An assignment μ is feasible $(\mu \in \mathbb{F})$ if and only if all time constraints are satisfied:

$$\underbrace{\mu_C(z,z) + \mu_S(z,z)}_{\text{own tasks}} + \underbrace{\hat{\mu}_S(\hat{z},z)}_{\text{entrepreneur's simple tasks}} \leqslant 1 \quad \forall z \qquad \text{(Workers)}$$

$$\underbrace{\hat{\mu}_C(\hat{z},\hat{z}) + \hat{\mu}_S(\hat{z},\hat{z})}_{\text{own tasks}} + \underbrace{(n-1)\int \hat{\mu}_C(z,\hat{z})dF(z)}_{\text{workers' complex tasks}} \leqslant 1 \qquad \text{(Entrepreneur)}$$

general case

Profit Maximization

- Entrepreneur with ability $\hat{z}$ chooses size (n) and a (feasible) assignment (μ)

$$\pi(\hat{z}) \equiv \max_{\{n \geqslant 1, \mu, p\}} \underbrace{(1-\tau)}_{\text{wedge}} \underbrace{p\, Y(\hat{z}, n, \mu)}_{\text{revenues}} - (n-1) \underbrace{\int w(z, \hat{z}, \mu, p) dF(z)}_{\text{avg wage}}$$

$$s.t. \quad \mu \in \mathbb{F}$$

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

  - Wedge τ 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

$$w(z, \hat{z}, \mu, p) = \underbrace{\overline{w}}_{\text{eq wage level}} + \underbrace{\omega}_{\text{piece rate}} \underbrace{p\, y(z, \hat{z}, \mu)}_{\text{worker revenues}}$$

- 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

$\Rightarrow$ $\bar{w} = (1 - \omega) \frac{\gamma}{\gamma - 1} o_w$

Occupational Choice

- Given a set of entrepreneurs $\mathbb{E}$, the expected wage for a worker z is

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

- Occupational choice: become entrepreneur iff $\pi(z) \geqslant E\left[w(z)\right]$

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 $\overline{w}$
3. set of entrepreneurs $\mathbb{E}$

such that

1. firm size and taskassignment $\{n(z), \mu(z)\}_{z \in G}$ maximize profits for all z
2. individuals pick occupation optimally: $\pi(z) \geqslant w(z) \quad \forall z \in \mathbb{E}$
3. labor market clears: $1 - \int_{\mathbb{E}} dG(z) = \int_{\mathbb{E}} (n(z) - 1) dG(z)$

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 $\rightarrow$ "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

$$\mathbb{Z}_w(x,\mu) = \underbrace{x^{\lambda}}_{\text{non-rival}} \quad \underbrace{\tilde{Z}_w(x,\mu)^{1-\lambda}}_{\text{task-productivity}}$$

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

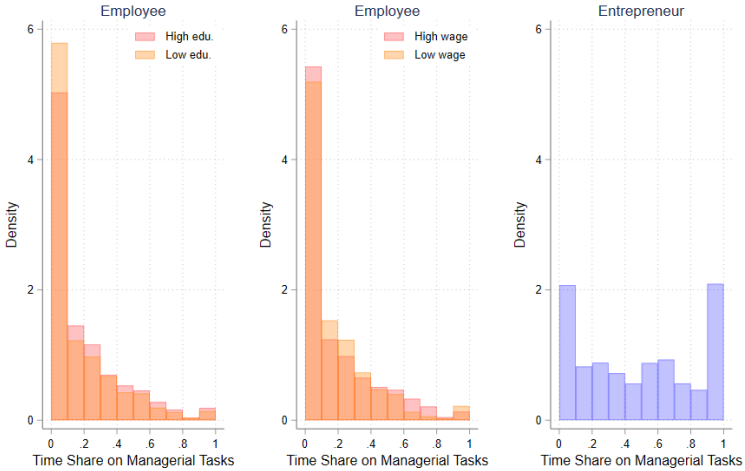
- The average wage is thus

$$\overline{w}(x,\mu,p) = w_0 + \omega p \mathbb{Z}_w(x,\mu)$$

where in the "benchmark" case $\mathbb{Z}_w(x,\mu) = x$

Key Distinction in Time Allocation Is Between Entrepreneurs and Employees

Return



Regression Training

Second Test: Returns to Managerial Score Across Locations

First Test

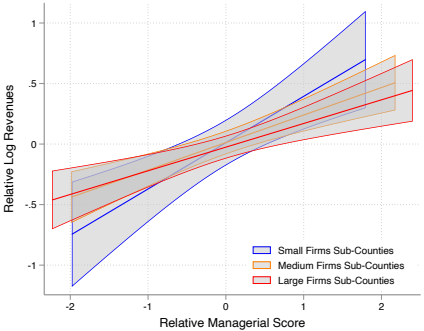
- Recall from the theory

$$\mathbb{Z}(\hat{z}, n, \mu) = \underbrace{\hat{z}^{\lambda}}_{\text{non-rival}} \underbrace{\left(\frac{1}{n}\hat{z}^{1-\lambda} + \underbrace{\frac{n-1}{n}\int \tilde{z}(z, \hat{z}, \mu)^{1-\lambda} dF(z)}_{\text{dilution from firm size}} \right)}_{\text{task-productivity}}$$

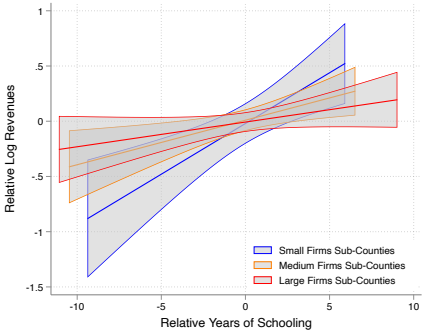
- The bigger the firm n, the less $\mathbb{Z}(\hat{z}, n, \mu)$ depends on $\hat{z}$, as long as
  1. $\lambda < 1$: entrepreneurial ability partially rival
  2. $\kappa_0 > 0$: workers perform managerial tasks
- Prediction: returns to managerial ability is larger in small firms
  - Variation in size? Split by sub-counties (three groups) (τ 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

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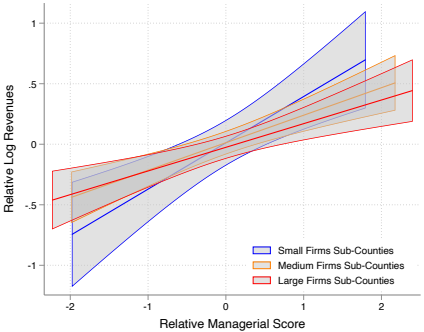

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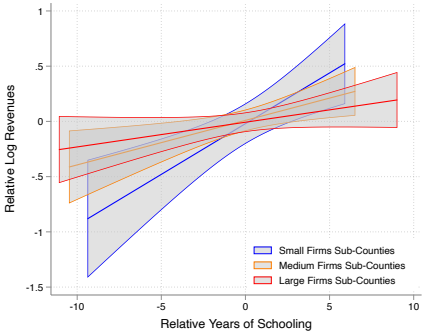

(b) Returns to Schooling

$\Rightarrow$ **Validates the Model + Provides Moments to Estimate λ**

Calibration Strategy (Note: for today, assume $\lambda = 0$)

return

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

2. Solve for κ_0, D, d **to match Facts 1 and 2** exactly

details

   - average **time spent on managerial activities** (owners & workers)
   - relationship between with time on managerial activities and firm size
   - can estimate κ_0, D, d separately by sector to match differences in within-firm organization

3. **External friction τ & heterogeneity $G(z)$** pinned down by firm revenues & size

   - large heterogeneity in revenues per worker $\rightarrow$ large σ_z
   - large firms $\rightarrow$ small τ

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