Firms and Workers I

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Acknowledgement

For the material taught in weeks 5-7, I relied extensively on materials developed by Muhammad Meki, Doug Gollin and Simon Quinn.

What is a firm?

- What is a firm?
- Usually defined as a production technology.
- Production technologies are typically given as constant returns to scale (CRS).
- But if CRS holds, then firm size is indeterminate: unclear whether we will have one large firm or many small ones.
- So, what determines firm size? Early theories:
  - Coase (1937): transaction costs.
  - Alchian and Demsetz (1972): moral hazard.

Plan for this topic

- The Lucas model: what determines firm size?
- The Roy model: how do firms and workers choose a sector?
- The O-Ring model: how to match different workers in the same firm?

Plan for today

- Basic descriptives on firms in low and middle income countries (LMIC)
- A foundational model of supply-side frictions
- Evidence
- A frontier model of supply-side frictions
- Demand-side frictions

Roadmap

Basic facts

Supply-side constraints: the model of Lucas 1978

Evidence on the Lucas model

A frontier model

Demand-side constraints

References

A firm as a technology

$$Y = AK^{\beta}L^{1-\beta} \tag{1}$$

Do firms in LMICs differ in their L, K, β, and A?

Four key facts about firms in LIMCs

1. Firms are small (L)
2. They use less capital (K)
3. Have lower labor shares ($1 - \beta$)
4. Productivity is low and dispersed (A)

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The average firm in LMICs is small

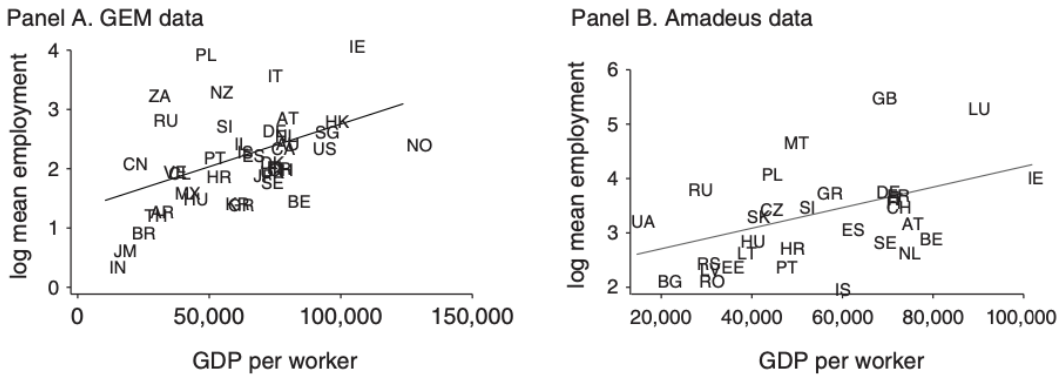


FIGURE 3. AVERAGE EMPLOYMENT AND INCOME PER WORKER

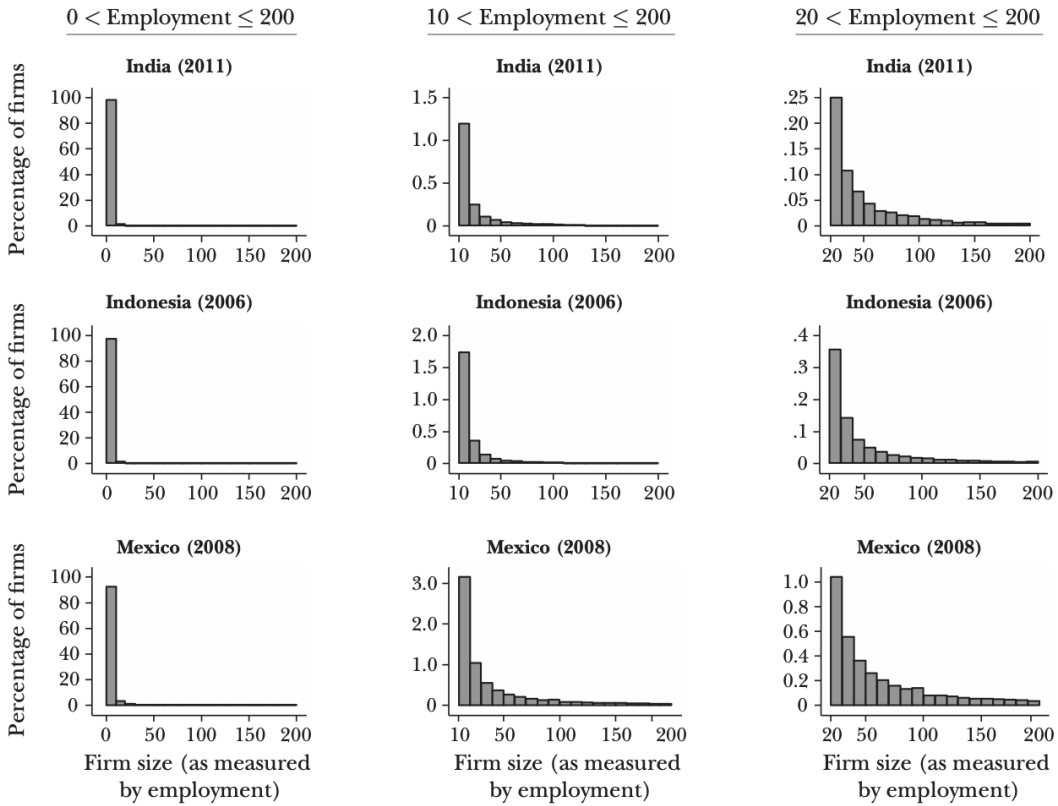
Notes: GDP per worker outside agriculture is computed as real GPD for 2005 at purchasing power parity from the Penn World Tables 8 (Summers and Heston 1991; Heston, Summers, and Aten 2009) minus value added in agriculture, forestry, and fishing (from FAO macro indicators), divided by total persons engaged minus persons engaged in agriculture, also from the FAO. Firm employment data from the GEM for panel A and from Amadeus for panel B. The vertical axis shows log average employment. The lines represent the best linear fits. Regression results are reported in Table 2.

From Poschke 2018

The firm size distribution is highly skewed. The modal firm has no employees.

Figure 1

Distribution of Firm Size as Measured by Number of Workers



Source: We use microdata from the manufacturing sector in the Mexican Economic Census, the Indonesian Econ
Sample Survey (Schedule 2). See footnote 1.
Notes: The figure shows distribution of firm size measured by the number of workers. The bin size is 10 workers, a
For all graphs, the y-axis indicates the share of all firms in the specified size. The different columns truncate the

From Hsieh and Olken 2014

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Capital per worker is highly correlated with GDP per worker

APPENDIX 2: Additional Figures and Tables

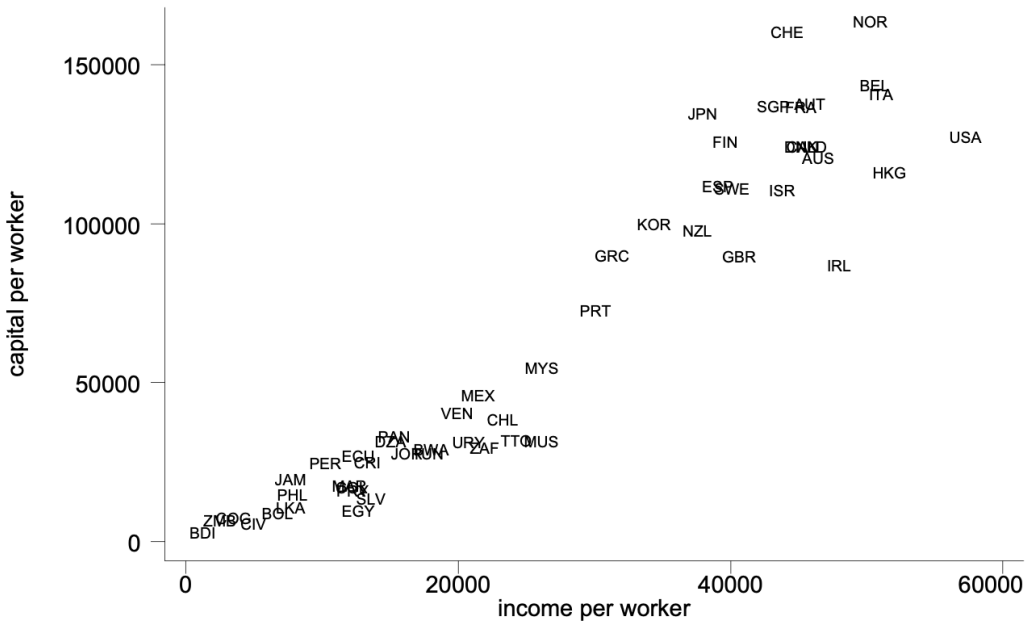


Figure 8: Capital Stocks

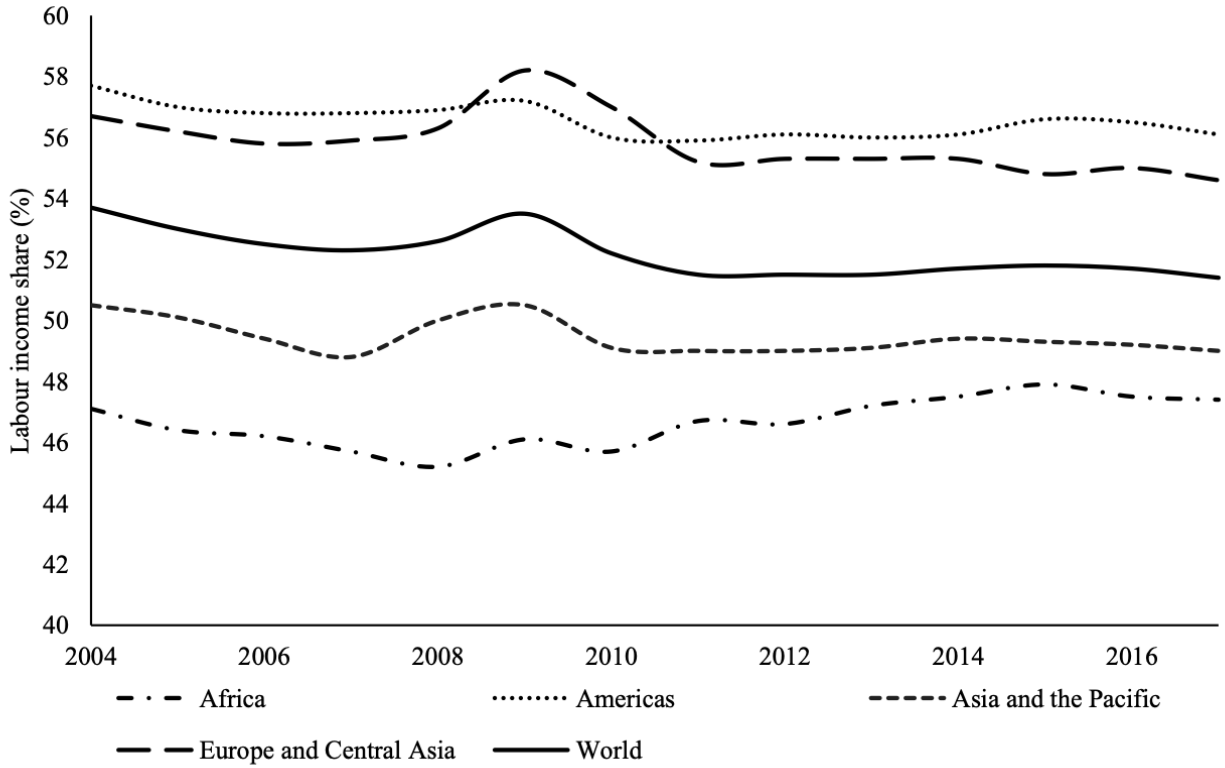
Source: Caselli Feyer 2005.

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Labour shares are lower in LMICs

Figure 5. Global and regional adjusted labour income shares, 2004-2017



Source: ILO 2019.

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Across firms, there is wide dispersion in productivity

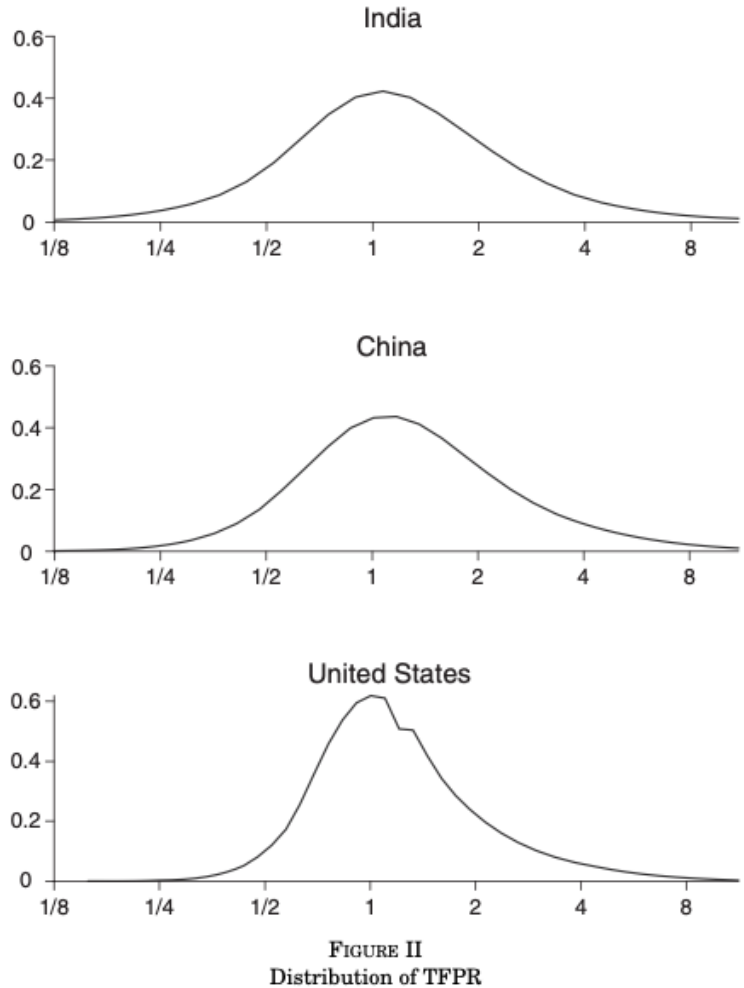
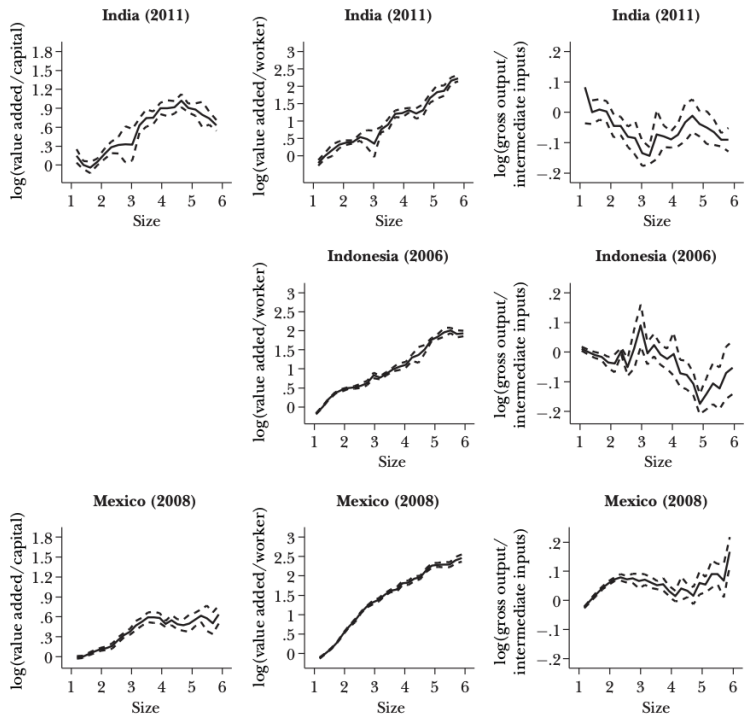


FIGURE II
Distribution of TFPR

Distribution of $ln(TFPR_s/\overline{TFPR_s})$ from Hsieh and Klenow 2008

Productivity tends to be higher in larger firms

Figure 3
Average Product and Firm Size
(size measured as log(employment))



Source: See Figure 1 for sources.
Notes: Figure shows local linear regressions of log average product on log employment. We normalize the y-axis by taking the value of the function at log(employment) = 1.4 to be zero. Dashed lines represent 95 percent confidence bounds. Size is measured as log (employment).

From Hsieh and Olken 2014

Theories of firms in LMICs

One way of organising different theories of the firm is on the basis of the core constraint to firm growth. These can be:

- Supply-side constraints (e.g. Lucas 1978).
- Demand-side constraints (e.g., Melitz 2003).

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Lucas (1978) model

Lucas 1978 proposes a “span of control” model of firm size:

- The term originates from engineering and reflects the idea that a manager can only exercise control over a limited range of supervisory activities.
- Beyond that, the manager loses effectiveness (embodies ideas from Alchian and Demsetz, Williamson)
- Lucas treats managerial ability as a skill – separable from raw labour ability – that differs across individuals and that determines the extent of an individual’s span of control.
- A similar model structure can work with other fixed factors that are inelastically supplied and vary across individuals.

Two technologies: the production technology

- A firm consists of two technologies: a production technology and a managerial technology.

- Production technology is standard concave CRS:

$$y = F(k, n) = nf\left(\frac{k}{n}\right) \tag{2}$$

where k is capital, n is labour.

Two technologies: the managerial technology

- Individuals differ in entrepreneurial ability, x. Ability cannot be traded and is a fixed input.
- An individual with ability x who manages a firm produces: $xg(y)$.
- The managerial technology $g(\cdot)$ is strictly increasing and strictly concave $\rightarrow$ the span of control

Lucas on the Description of Management

"This description of management is a shallow one, in at least two respects. First, it does not say anything about the nature of the tasks performed by managers, other than that whatever managers do, some do it better than others. Given this assumption, however, one is led immediately to the question: why does the best manager not run everything? Therefore, I assume concavity of the function g. Second, this technology precludes pyramidal managerial structures: managers managing other managers. One could postulate a technology for such organizations without any difficulty in a mathematical sense, but without a clear idea of where one is going, this is likely to lead to an uninformative taxonomy."

– Lucas (1978, p. 512)

The production function

Putting the two technologies together gives:

$$q = x\, g\big(f(\kappa)\, n\big), \quad \text{where } \kappa \equiv \frac{k}{n} \tag{3}$$

Firm's optimisation

Consider the problem of a firm that faces factor prices w and r.

- The firm is managed by an entrepreneur with ability x.
- The firm's optimization problem is given by:

$$\pi(x \mid w, r) = \max_{\kappa, n} \left[x\, g\big(f(\kappa)\, n\big) - r\kappa n - wn \right] \tag{4}$$

First-order conditions (using the notation $y = f(\kappa)n$):

$$xg'(y)f'(\kappa) = r, \quad \text{by the chain rule} \tag{5}$$

$$xg'(y)f(\kappa) = r\kappa + w \tag{6}$$

Towards solving the model...

From (5) and (6), we can derive:

$$\frac{f(\kappa) - f'(\kappa)\,\kappa}{f'(\kappa)} = \frac{w}{r} \tag{7}$$

This holds for any value of x, so all firms choose the same κ.

But different entrepreneurs will use different quantities k and n.

The firm's scale can be found from solving for the value of y.

An example: the relationship between the ability distribution and the size distribution

Suppose we take a very simple production function with one input, given by $y = n$. The managerial technology is xy^{α}.

- The first-order condition from the firm's problem gives:

$$x\alpha y^{\alpha-1} = w \tag{8}$$

- We then have:

$$n(x) = \left(\frac{\alpha x}{w}\right)^{\frac{1}{1-\alpha}} \tag{9}$$

- Firm size is a function of firm ability $\rightarrow$ The ability distribution pins down the firm size distribution.

(Note that x is often assumed to have a skewed ▸ Pareto distribution.)

Two additional features of the model

- Occupational choice: individuals can choose whether to be workers or managers.
- General equilibrium: letting w and r vary to clear markets.

Occupational choice

- An individual with ability x can either manage a firm and make profit $\pi(x)$ or work for a wage w.
- All individuals are equally productive as workers.
- Managing a firm is a full-time job; i.e., it takes a full unit of time, so that the entrepreneur forgoes the wage w.

- Because profits are monotonic in x, there will be a threshold value of x (call it z) such that:
  - individuals with ability above z will choose to be managers.
  - individuals with ability below z will choose to be workers.

Finding the threshold

Our goal is to solve for this threshold value z such that people are indifferent between being workers and managers.

Key condition: an individual with managerial ability z earns profits that are identical to the wage rate:

$$\pi(z) = zg\big(f(\kappa)n(z)\big) - r\kappa n(z) - wn(z) = w \tag{10}$$

Easy to write down, but analytic solutions are not always possible.

This is particularly true if we switch from partial equilibrium to general equilibrium, where the wage rate itself becomes endogenous. In that case, we typically need to solve this problem computationally.

General equilibrium

Now allow for w and r to be endogenous, with given economy-wide stocks of labour and capital.

- For instance, suppose that the aggregate capital stock is fixed at K. Suppose further that the labour force is fixed at one unit.
- We need to solve for wages and the rental rate such that the market clears for labour and for capital.
- For heuristic convenience, forget the Pareto distribution, and think of the people in the labour force having a uniform distribution of entrepreneurial ability indexed on $[0, 1]$.

A strategy for finding the equilibrium prices

Our strategy for solving the model – finding an equilibrium wage rate and rental rate – is as follows:

1. First, take a particular value of the wage rate. For that wage rate, we can solve the partial equilibrium problem above; i.e., we can again find a threshold value of $z \in [0, 1]$ such that everyone above z will be an entrepreneur and everyone below z will be a worker.
2. From this, we can derive the total labour demand in the economy and we can compare it to the total labour supply (which will in fact be given by z)
3. If there is excess demand in the market, the wage needs to rise to reach equilibrium. If there is excess supply, the wage needs to fall.

We can formalize this...

A more formal discussion of this strategy

- Total labour supply in this economy is given by z (due to uniform distribution assumption).
- Labour demand is given by $\left[\int_z^1 n(x)\,dx\right]$.
- In equilibrium, labour supply must equal labour demand.
- That means that wage will adjust to w^* such that $\left[\int_{z^*}^1 n(x)\,dx\right] = z^*$.
- The rental rate will also adjust. In equilibrium, the rental rate r^* will equate capital demand with the aggregate capital stock.
- All firms will have the same capital-labour ratio, which will be $\kappa = K/z^*$.

A concluding thought: efficiency

- In Lucas 1978, the size distribution is efficient.
- However, in other models occupational choice and firm size are driven by frictions such as borrowing constraints (Banerjee and Newman (1993), Buera et al. (2015)).
  - In these models, the size distribution will not be efficient.
- Also, we can think of managerial ability as the result of imperfect human capital investment decisions.
  - Again, another source of inefficiency.

Two empirical predictions

- If firm size is optimally chosen on the basis of management ability, then we would expect returns to additional labor to be low.

- If managerial ability can be improved, we would expect firms to expand.

Roadmap

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Evidence on the Lucas model

- The returns to additional labor
- The empirics of management

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Demand-side constraints

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De Mel, McKenzie, Woodruff (2019)

An RCT to measure marginal returns to labor among small firms

- 1533 firms in urban Sri Lanka.
  - 81 percent do not have paid or unpaid workers at baseline.
- Offered a monthly wage subsidy, for 8 months, if firm hired an additional employee.
  - Subsidy is about $1/2$ average unskilled worker earnings.
  - 21 check-up visits per firm
- Wage subsidy cross-randomized with:
  - matched savings account
  - training.

A simple framework

In a simple, canonical model:

$$f'(L) = w \tag{11}$$

- In the absence of frictions, hiring should increase while wages are subsidised, and quickly fall thereafter.
- If there is learning or binding one-off hiring costs, impact on hiring should be permanent.
- If hiring costs are persistent, impact on hiring should decline gradually over time.

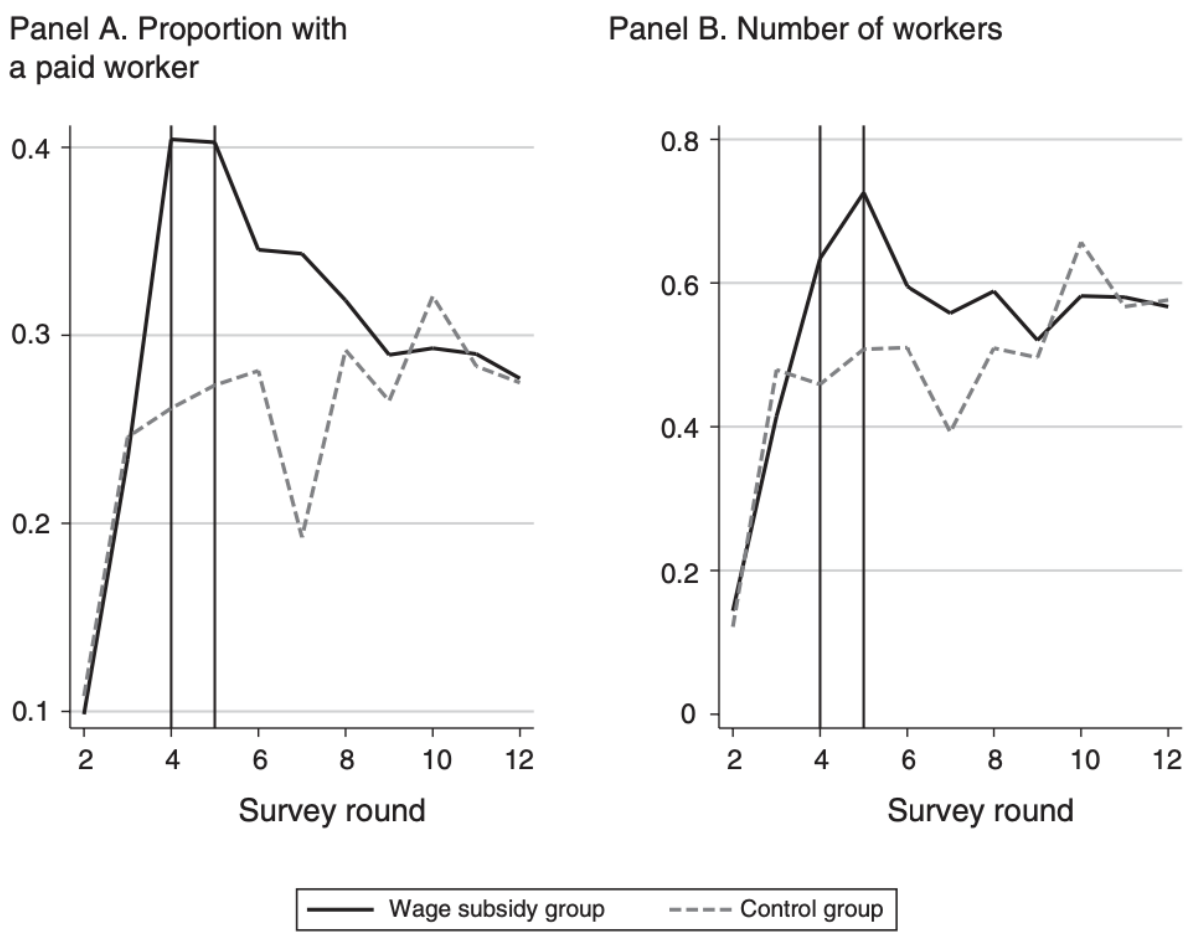


FIGURE 2. IMPACT ON EMPLOYMENT

TABLE 6—IMPACT ON PROFITS AND SALES

	Sample size	Before subsidy	During subsidy	After subsidy			*p*-value equality	*p*-value all zero
				Year 1	Year 2	Year 3+		
Panel A. Unconditional profits (truncated at ninety-ninth percentile)								
Assigned to treatment	4,692	873	6,786	1,906	2,110	1,431	0.727	0.478
		(1,479)	(1,235)	(1,150)	(1,445)	(1,175)		
Control mean		14,572	16,603	16,492	18,534	17,808		

TABLE 4—IMPACT ON FIRM SURVIVAL

	Sample size	Before subsidy	During subsidy	After subsidy			p-value equality	p-value all zero
				Year 1	Year 2	Year 3+		
Panel A. Self-employed in survey round								
Assigned to treatment	5,055	−0.006	−0.009	0.058	0.082	0.054	0.001	0.002
		(0.023)	(0.018)	(0.021)	(0.025)	(0.027)		
Control mean		0.927	0.958	0.885	0.850	0.831		

$$(6) \qquad Profits_{i,t} = \alpha + \beta_1 \times L_{i,t} + \sum_{s=3}^{12} \delta_s 1\left(t = s\right) + \theta' X_i + \varepsilon_{i,t},$$

TABLE 7—RETURN ON LABOR

	Level of profits				log of profits		
	Associations in control group		Treatment IV estimates		Associations in control group		
	Cross section	Panel data	Unconditional profits	Conditional profits	Cross section	Panel data	IV treatment effect
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Number of paid workers	6,214	4,903	2,586	3,270	0.198	0.127	0.131
	(748)	(696)	(6,358)	(5,974)	(0.021)	(0.023)	(0.295)
Sample size	2,670	2,670	959	913	2,320	2,320	892

Notes: Robust standard errors are in parentheses, clustered at the firm level. Regressions control for time fixed effects, randomization strata, and controls used in re-randomization. Columns 1, 2, 5, and 6 use control group only. Columns 3, 4, and 7 use wage subsidy only and control groups. The IV estimates instrument the number of paid workers with assignment to the wage subsidy treatment.

(The 4000 per-month subsidy is not included in the definition of profits. Columns (3) and (4) thus imply that the total return to an extra worker is negative)

Appendix Table 3.3: Treatment Effects on Having any Paid Worker by Treatment Arm

	(1a) Wage Subsidy Only Treatment Effect	(1b) Wage Subsidy + Savings Treatment Effect	(1c) Wage Subsidy + Training Treatment Effect	(1d) Savings Only Treatment Effect	(1e) Training Only Treatment Effect	(1f) Savings + Training Treatment Effect		(2) Any Wage Subsidy Effect
Before Subsidy	-0.020	0.027	0.035	0.025	0.023	-0.007		0.015
	(0.036)	(0.036)	(0.037)	(0.048)	(0.045)	(0.044)		(0.030)
During Subsidy	0.129***	0.184***	0.156***	0.018	0.039	0.040		0.158***
	(0.035)	(0.033)	(0.034)	(0.044)	(0.039)	(0.040)		(0.027)
Year 1 After	0.102***	0.152***	0.113***	0.070	0.073*	0.099**		0.124***
	(0.034)	(0.034)	(0.033)	(0.044)	(0.040)	(0.041)		(0.026)
Year 2 After	0.018	0.056	0.089***	0.015	-0.026	0.026		0.057**
	(0.035)	(0.035)	(0.034)	(0.045)	(0.038)	(0.040)		(0.028)
Year 3-4 After	-0.012	0.055*	0.050	-0.016	-0.003	0.003		0.034
	(0.032)	(0.033)	(0.032)	(0.043)	(0.037)	(0.039)		(0.026)
Pooled Impact After	0.029	0.083***	0.079***	0.017	0.012	0.037		0.066***
	(0.029)	(0.030)	(0.029)	(0.038)	(0.034)	(0.035)		(0.024)
Sample Size							13887	10,259
P-value: all three wage treatments equal during subsidy period							0.334	
P-value: wage only treatment = savings only treatment during subsidy period							0.018	
P-value: wage+savings=wage only + savings only, wage+training = wage only + training only, during subsidy							0.714	
P-value: all three wage treatments equal one another by round after intervention							0.050	
P-value: wage only treatment = savings only treatment by round after intervention							0.871	
P-value: wage+savings=wage only + savings only, wage+training = wage only + training only, by round after							0.003	
P-value: pooled impact after equal for all three wage treatments							0.152	
P-value: pooled impact after for wage only treatment = savings only treatment							0.760	
P-value: pooled impact after of wage+saving = wage only + savings only, wage+training=wage only + training only							0.637	

Notes:

Robust standard errors in parentheses, clustered at the firm level. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Columns 1a-1f are all from the same regression, which uses the full sample of 14,227 observations and estimates separate treatment impacts by treatment group and time period.

The Pooled impact after row shows the impact of pooling the 1 Year, 2 Years, and 3-4 Year after results.

Column 2 shows impacts from a separate regression which pools together the treatments in 1a, 1b, and 1c, and drops the other treatments.

All regressions control for randomization strata, variables used for re-randomization, and survey round dummies.

Implications

- Return to labor in the absence of complementary capital and training seems to be limited.
  - Consistent with the idea of diminishing returns to labor central to the Lucas model.

- Results are more nuanced after boosting capital and training.

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The measurement of management

Table 1
The Management Practice Dimensions

Categories	*Score from 1–5 based on:*
1) Introduction of modern manufacturing techniques	What aspects of manufacturing have been formally introduced, including just-in-time delivery from suppliers, autonomation, flexible manpower, support systems, attitudes, and behavior?
2) Rationale for introduction of modern manufacturing techniques	Were modern manufacturing techniques adopted just because others were using them, or are they linked to meeting business objectives like reducing costs and improving quality?
3) Process problem documentation	Are process improvements made only when problems arise, or are they actively sought out for continuous improvement as part of a normal business process?
4) Performance tracking	Is tracking ad hoc and incomplete, or is performance continually tracked and communicated to all staff?
5) Performance review	Is performance reviewed infrequently and only on a success/failure scale, or is performance reviewed continually with an expectation of continuous improvement?
6) Performance dialogue	In review/performance conversations, to what extent is the purpose, data, agenda, and follow-up steps (like coaching) clear to all parties?
7) Consequence management	To what extent does failure to achieve agreed objectives carry consequences, which can include retraining or reassignment to other jobs?
8) Target balance	Are the goals exclusively financial, or is there a balance of financial and nonfinancial targets?
9) Target interconnection	Are goals based on accounting value, or are they based on shareholder value in a way that works through business units and ultimately is connected to individual performance expectations?
10) Target time horizon	Does top management focus mainly on the short term, or does it visualize short-term targets as a "staircase" toward the main focus on long-term goals?
11) Targets are stretching	Are goals too easy to achieve, especially for some "sacred cows" areas of the firm, or are goals demanding but attainable for all parts of the firm?
12) Performance clarity	Are performance measures ill-defined, poorly understood, and private, or are they well-defined, clearly communicated, and made public?
13) Managing human capital	To what extent are senior managers evaluated and held accountable for attracting, retaining, and developing talent throughout the organization?
14) Rewarding high performance	To what extent are people in the firm rewarded equally irrespective of performance level, or are rewards related to performance and effort?
15) Removing poor performers	Are poor performers rarely removed, or are they retrained and/or moved into different roles or out of the company as soon as the weakness is identified?
16) Promoting high performers	Are people promoted mainly on the basis of tenure, or does the firm actively identify, develop, and promote its top performers?
17) Attracting human capital	Do competitors offer stronger reasons for talented people to join their companies, or does a firm provide a wide range of reasons to encourage talented people to join?
18) Retaining human capital	Does the firm do relatively little to retain top talent or do whatever it takes to retain top talent when they look likely to leave?

Note: The full set of questions that are asked to score each dimension are included in Bloom and Van Reenen (2006).

From Bloom Van Reenen 2010



Garbage outside a factory



Garbage inside a factory



Garbage inside a factory



Shelves overfilled and disorganized

FIGURE II

Many Parts of These Factories Were Dirty and Unsafe

From Bloom et al 2013

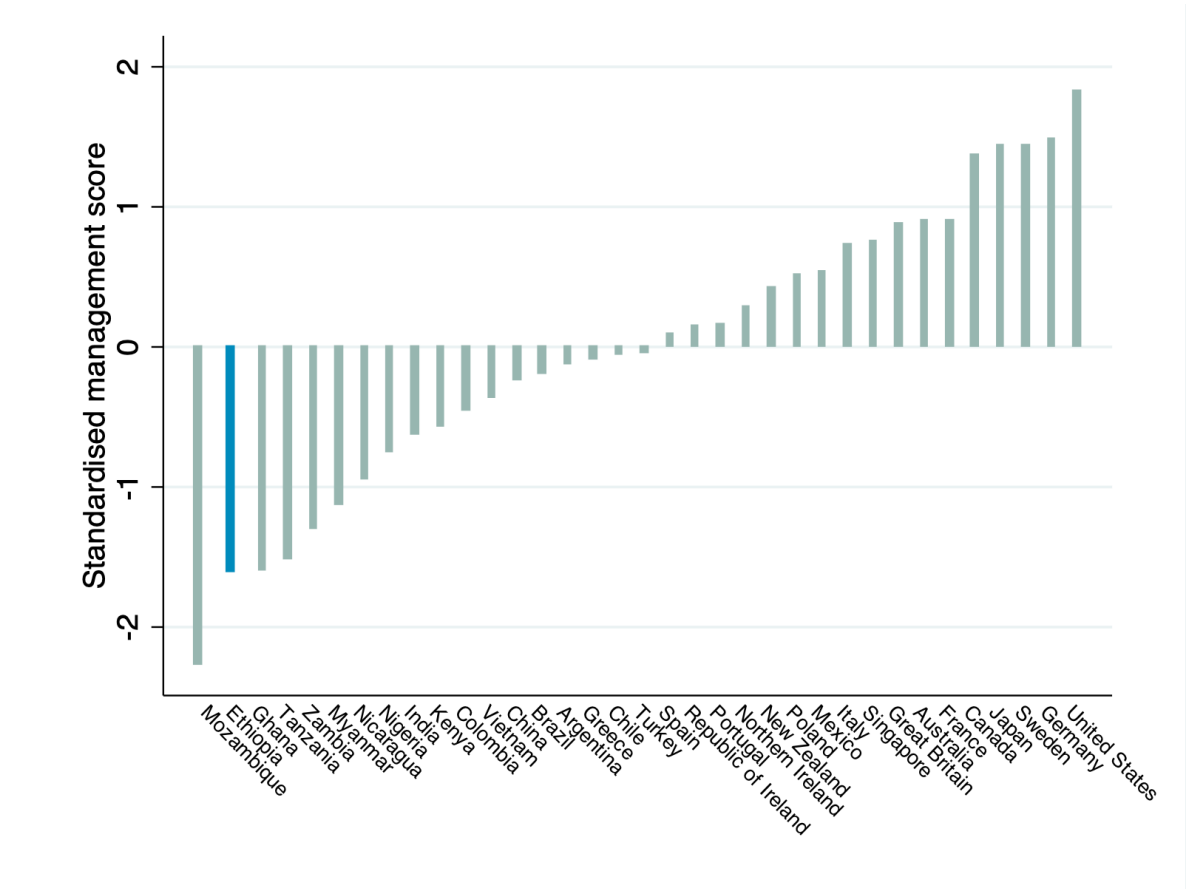


FIGURE III

The Factory Floors Were Frequently Disorganized

From Bloom et al 2013

Management quality correlates tightly with GDP per capita



Data from the World Management Survey.

Iacovone et al 2022 study two management consulting interventions

- 159 firms in the auto-part industry in Colombia (average size 58 employees).
- Low management practice scores at baseline.
- Randomly assign firms to one of two interventions:
  - Individual consulting ($ 30k per firm)
  - Group consulting ($ 10k per firm)

(see also earlier paper by Bloom et al 2013)

Large impacts on profits of group consulting

Table 5: Impacts on Firm Performance

	EAM Data (Annual Outcomes 2010-2018)									
	Sales		Profits		Value-Added		Production		Aggregate Index	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Winsorized Levels										
Individual Treatment*During Intervention	69	398	5	16	152	184	-208	116	0.020	0.035
	(437)	(605)	(236)	(257)	(263)	(285)	(517)	(564)	(0.115)	(0.125)
Individual Treatment*Post Intervention	697	818	42	85	92	125	380	474	0.066	0.082
	(623)	(1012)	(252)	(262)	(976)	(289)	(658)	(694)	(0.206)	(0.216)
Group Treatment*During Intervention	1088**	1354**	695***	749***	681***	727***	1210**	1295***	0.278***	0.298***
	(459)	(534)	(241)	(250)	(258)	(259)	(467)	(481)	(0.103)	(0.107)
Group Treatment*Post Intervention	1705**	1969**	647**	696**	753**	800**	1696**	1861**	0.300**	0.327**
	(676)	(766)	(309)	(331)	(326)	(349)	(684)	(737)	(0.135)	(0.145)
Balanced Panel	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Sample Size (N*T)	1008	900	1008	900	1008	900	1008	900	1008	900
Number of Firms	120	100	120	100	120	100	120	100	120	100
P-value: Individual=Group During	0.047	0.060	0.035	0.039	0.126	0.133	0.017	0.026	0.049	0.058
P-value: Individual=Group Post	0.182	0.183	0.059	0.077	0.042	0.053	0.093	0.098	0.287	0.292
Control Mean in 2017	4762	4821	1972	1998	2588	2627	4877	4946	-0.087	-0.087

And on employment

Table 4: Impact on Employment

	Firm Survey Data Jan 2013-Dec 2017		PILA Data Jan 2012-Dec 2018				EAM Data Annual 2010-2018			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			Conditional		Unconditional		Unbalanced		Balanced	
	Level	I.H.S.	Level	I.H.S.	Level	I.H.S.	Level	Log	Level	Log
Individual Treatment*During Intervention	-3.012	-0.018	-1.375	-0.063	-0.201	-0.001	2.133	-0.001	2.259	0.047
	(2.912)	(0.040)	(2.819)	(0.043)	(2.767)	(0.049)	(5.330)	(0.061)	(5.741)	(0.055)
Individual Treatment*Post Intervention	-2.150	0.040	2.174	0.025	3.725	0.136	6.929	0.079	7.120	0.111
	(3.741)	(0.052)	(4.475)	(0.078)	(4.332)	(0.109)	(7.705)	(0.090)	(8.110)	(0.088)
Group Treatment*During Intervention	3.837*	0.101**	5.213	0.117*	3.349	0.113	5.519	0.125	7.341	0.145**
	(2.268)	(0.039)	(3.178)	(0.061)	(3.651)	(0.107)	(5.173)	(0.079)	(4.710)	(0.070)
Group Treatment*Post Intervention	5.874**	0.121**	6.937*	0.184**	4.369	0.145	13.492**	0.227**	15.053**	0.260***
	(2.848)	(0.049)	(4.014)	(0.079)	(4.449)	(0.152)	(5.830)	(0.097)	(6.171)	(0.099)
Sample Size (N*T)	7299	7299	11807	11807	12537	12537	1008	1008	900	900
Number of Firms	145	145	147	147	157	157	120	120	100	100
P-value: Individual=Group During	0.058	0.033	0.087	0.016	0.423	0.315	0.622	0.199	0.440	0.259
P-value: Individual=Group Post	0.072	0.190	0.247	0.038	0.894	0.949	0.390	0.112	0.321	0.117
Control Mean in 2013	56.08	4.36	57.66	4.42	56.22	4.34	63.41	3.82	67.5	3.89
Control S.D. in 2013	51.33	0.86	45.95	0.89	51.19	0.93	57.69	0.837	59.80	0.821

Notes:

Fixed effects regressions with firm and time fixed effects. Standard errors clustered at the firm level are in parentheses.

*, **, *** denote significance at the 10, 5, and 1 percent levels respectively.

Firm data survey is monthly employment from our firm survey; PILA data are monthly formal employment data from administrative records; EAM is annual data on total employment from the Colombian manufacturing survey.

Level denotes monthly level of employment; I.H.S. is inverse hyperbolic sine transformation.

Conditional denotes the analysis is for the group of surviving firms; unconditional codes employment as zero once a firm dies. Unbalanced is for the full set of firms matched in the EAM, balanced is for the set of 100 firms with data in all nine years from 2010 to 2018.

Implications

- Improving management increases firm size.
  - Consistent with the idea that better managers have a greater span of control and larger optimal firm size.

Roadmap

Basic facts

Supply-side constraints: the model of Lucas 1978

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A frontier model

Demand-side constraints

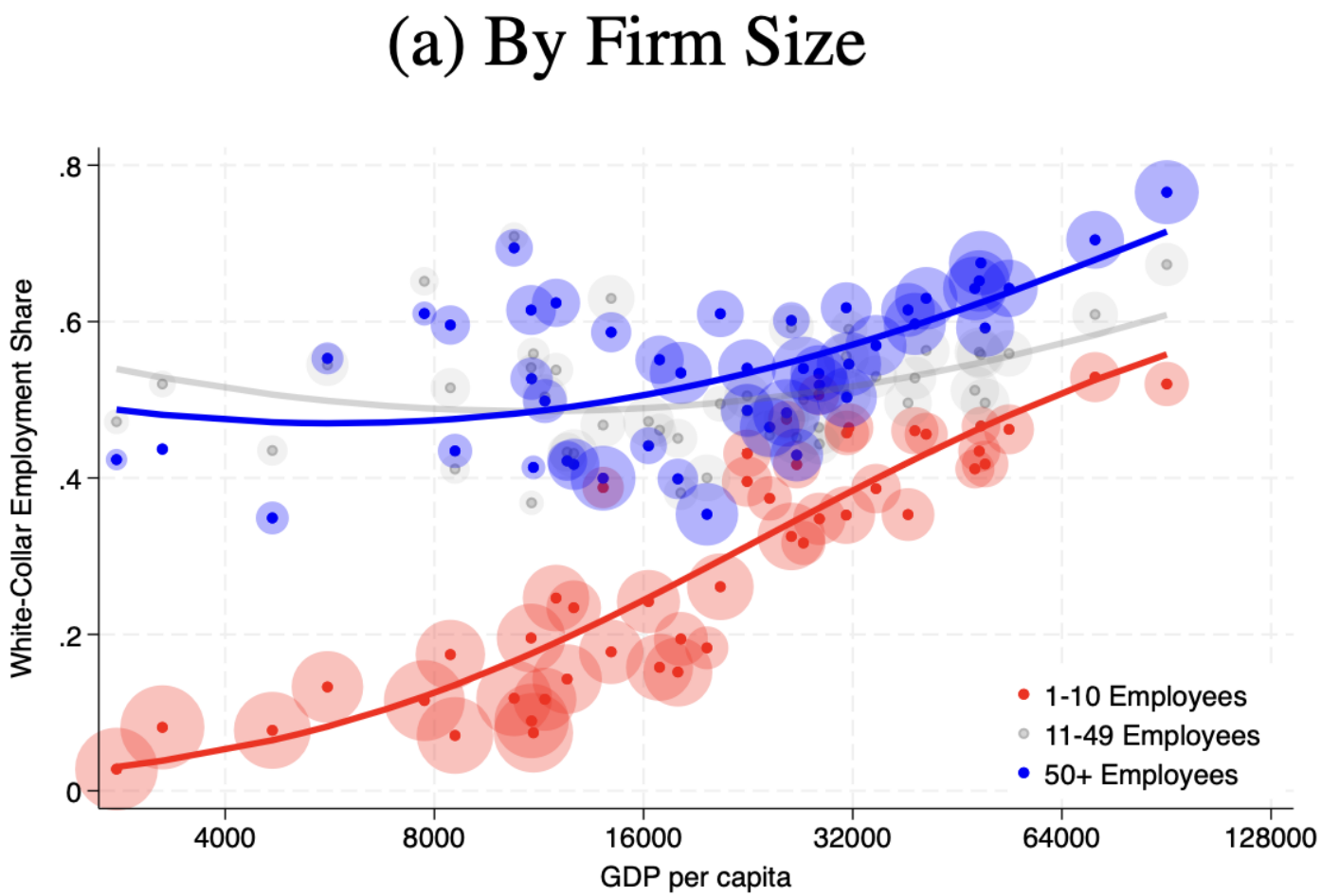
References

We will now look at the recent paper by Engbom et al. (2025).

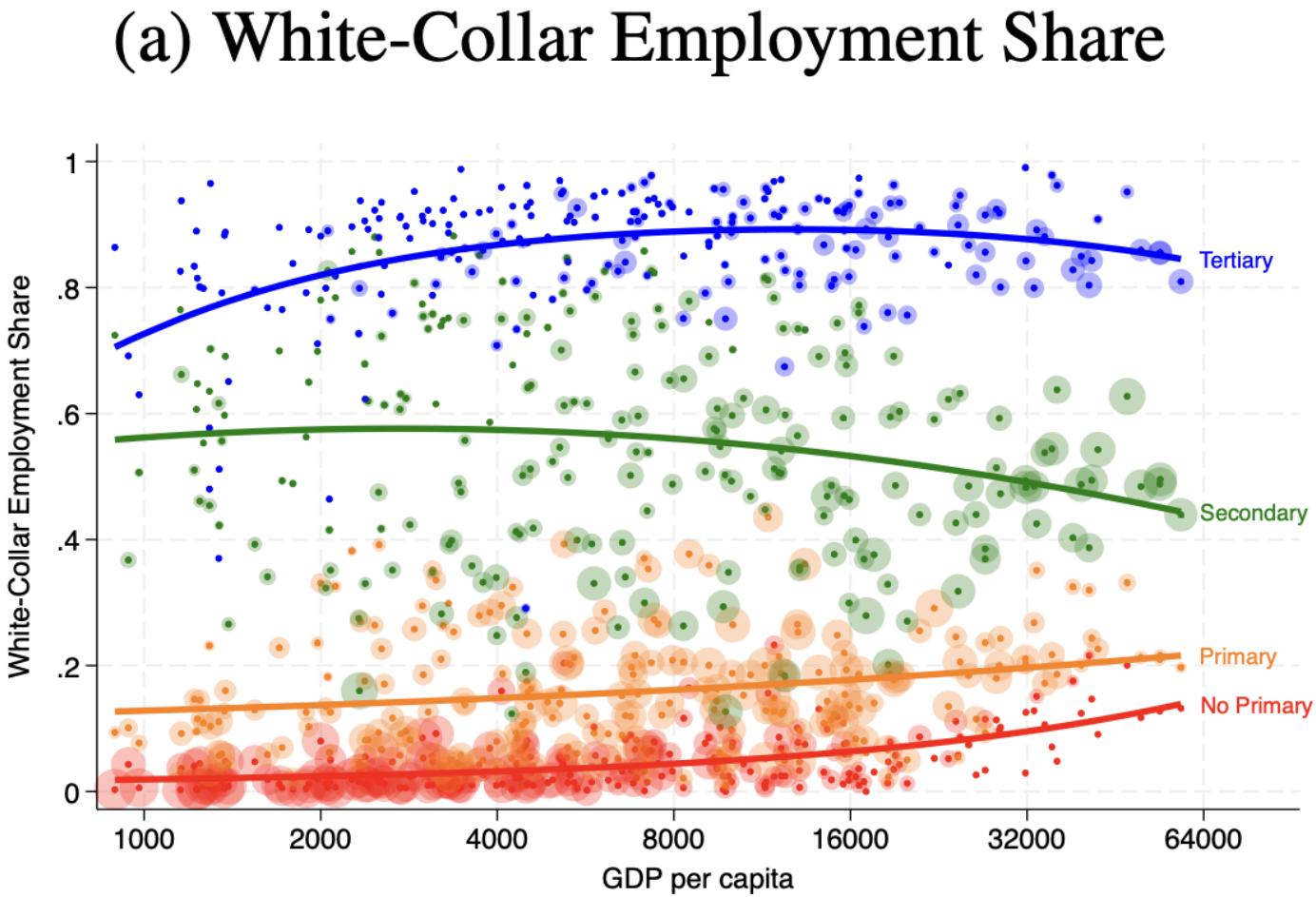
Key idea (consistent with Chandler 1977): the span of control problems is mitigated by recruiting and organising a hierarchy of white-collar workers.

The paper starts from some motivating facts, and then builds and estimates a model.

Fact 1: Large firms and firms in richer countries employ more white collar workers



Fact 2: More educated workers are more likely to be white collar, irrespective of development



The model: the structure of production

- A unit-mass of individual with ability z, drawn from $G(z)$, with support $(0, \infty)$.
- An individual can start a firm and be an entrepreneur, or work for somebody else's firm as a laborer, or as a professional.

- Production involves a single production task produced by laborers (firm hires n_l efficiency units of laborers)

- Production also involves a continuum of admin tasks:
  - Admin tasks be be professionalised or not.
  - If professionalised, the firm sets $n_p(i)$ – the efficiency units of professional labor assigned to each task i.
  - Output for a professionalised admin task is $a(i)n_p(i)$.
  - Output for a non-professionalised admin task is 1.

  $\rightarrow$ The output of each task i is $\tilde{n}(i) = \max\{1, a(i)n_p(i)\}$.

The model: aggregating admin and production tasks

- The admin tasks are aggregated through an unweighted Cobb-Douglas aggregator.
- The production and admin tasks are aggregated through a Cobb-Douglas aggregator with parameters γ_p and γ_n.
- The skill z of the entrepreneur increases the productivity of the enterprise.

- Total output is thus:

$$zA\, exp\left(\int_0^1 \log \tilde{n}(i)^{\gamma_p} di\right) n_l^{\gamma_l} \tag{12}$$

The model: relation to Lucas 1978

- Suppose the entrepreneur does not professionalise any task. The production function boils down to

$$zAn_l^{\gamma_l}$$

- This is essentially the production function of Lucas 1978: returns to scale are decreasing (assuming $\gamma_l < 1$).

- Adding professionalisation extends the span of control and essentially moderates decreasing returns to scale.

The problem of the entrepreneur: maximise profits

- Each efficiency unit of laborers' work costs w_l
- Each efficiency unit of professionals' work costs w_p

- Entrepreneur chooses: (i) the share of tasks to professionalise q, (ii) n_l, and (iii) average professional labor per admin task n_p.

Occupational choice

An individual with skills z earns:

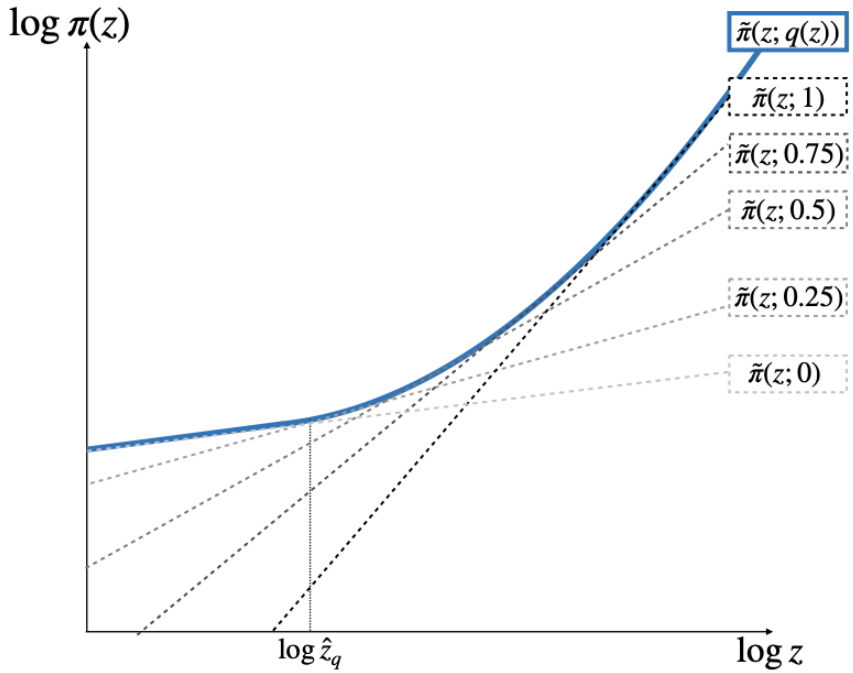
- $\pi(z)$ as an entrepreneur
- $w_l z^{\chi}$ as a laborer
- $w_p z^{\rho}$ as a professional

Individuals maximise earnings and so earnings are given by:

$$\phi(z) = \max \left\{ \underbrace{w_\ell z^{\chi}}_{\text{Laborer}}, \underbrace{w_p z^{\rho}}_{\text{Professional}}, \underbrace{\pi(z)}_{\text{Entrepreneur}} \right\}. \tag{3}$$

The choice of professionalization as a function of skills

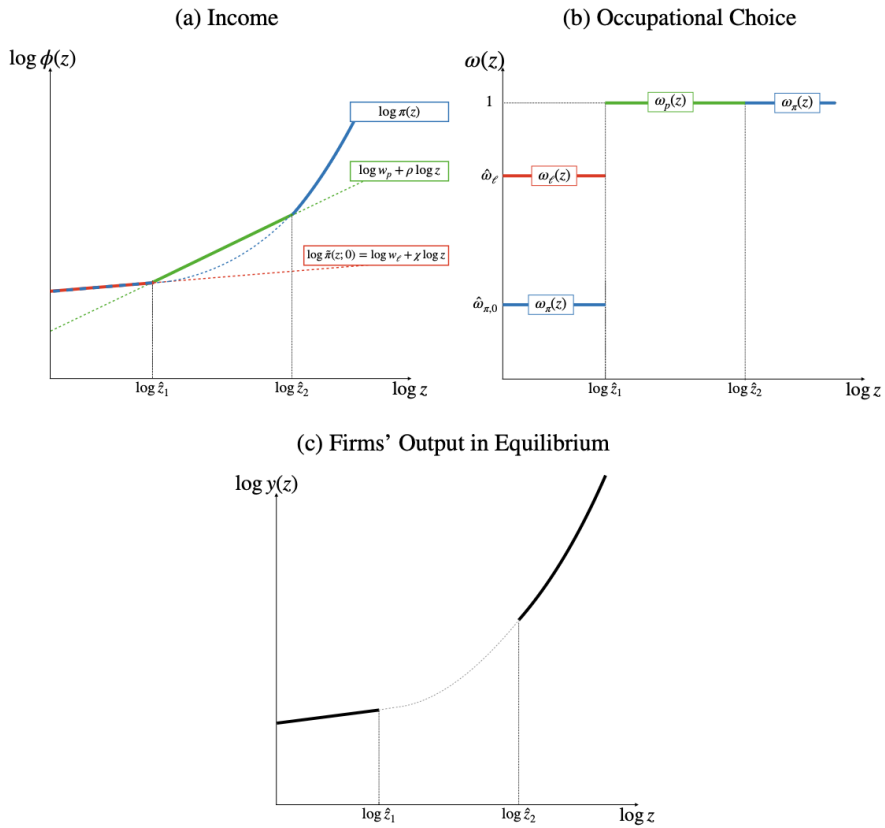
FIGURE 3: ORGANIZATION OF PRODUCTION AND FIRM PROFITS



There is a cutoff level of skills $\hat{z}_q$ at which the entrepreneur finds it optimal to professionalise some tasks. Call entrepreneurs with $z < \hat{z}_q$ traditional and entrepreneurs with $z \geq \hat{z}_q$ modern.

Occupational choice is also a function of skills

FIGURE 4: OCCUPATIONAL CHOICE AND ENDOGENOUS DUALITY



Low z individuals become laborers or traditional entrepreneurs; medium z professionals; high z modern entrepreneurs.

(Under assumption 3 on relative elasticity of income w.r.t. skills)

Key proposition: an increase in skills raises firm size and the share of professional workers

PROPOSITION 1 (Impact of an Increased Skill Supply)**.** *Start from an equilibrium featuring duality. Consider a uniform increase in the supply of skills that shifts up each individual by a factor of* $\kappa > 1$*, implying a new distribution function,* $\tilde{G}(z) = G(z/\kappa)$*.*

There exists a threshold $\hat{\kappa}$ *such that for any* $\kappa < \hat{\kappa}$*, an increase in* κ *yields:*

1. ***Constant wages and cutoff rules.*** *Wages per efficiency unit for both types of workers and the occupational cutoff* $\hat{z}$ *remain constant. Consequently, there is no change in the set of optimal occupational choices conditional on skill level* z*.*

2. ***Reorganization of production.*** *The share of white-collar workers and average firm size rise, while the share of traditional entrepreneurs falls.*

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A parallel tradition: demand-side limits to firm size

A separate literature limits firm size on the *demand* side rather than through a managerial fixed factor.

- Krugman (1980). Monopolistic competition with love of variety: each firm makes its own differentiated variety and faces a *downward-sloping* residual demand curve.
- Melitz (2003). Firms with heterogeneous productivity + fixed costs of serving markets. Only productive enough firms sell (and export).
- Hsieh & Klenow (2009). Output/price wedges cap how large a firm becomes; resulting misallocation of demand across varieties lowers aggregate TFP.

Key mechanism. Even a highly productive firm cannot grow forever: raising output pushes down the price of *its* variety. Size is constrained by the demand for what the firm sells.

Interventions that extend markets

If demand (market access) is the binding constraint, a natural policy lever is to *extend the market* a firm can reach. A growing body of RCTs finds this often works:

- **Connect firms to buyers.** Egyptian rug makers given export orders raised profits 16–26% and learned to make higher-quality rugs (Atkin, Khandelwal & Osman 2017).
- **Firm-to-firm links.** Buyer–supplier networks (Cai & Szeidl 2026) raise sales and productivity.
- **Bid/marketing skills.** Training Liberian SMEs to bid for contracts won them larger, new buyers (Hjort et al. 2024).

See this J-PAL Policy Insight for a more comprehensive review.

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References

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Key datasets

- World Bank Enterprise Survey
- Global entrepreneurship monitor
- World Management Survey
- Jobs of the World

Aside: The Pareto distribution

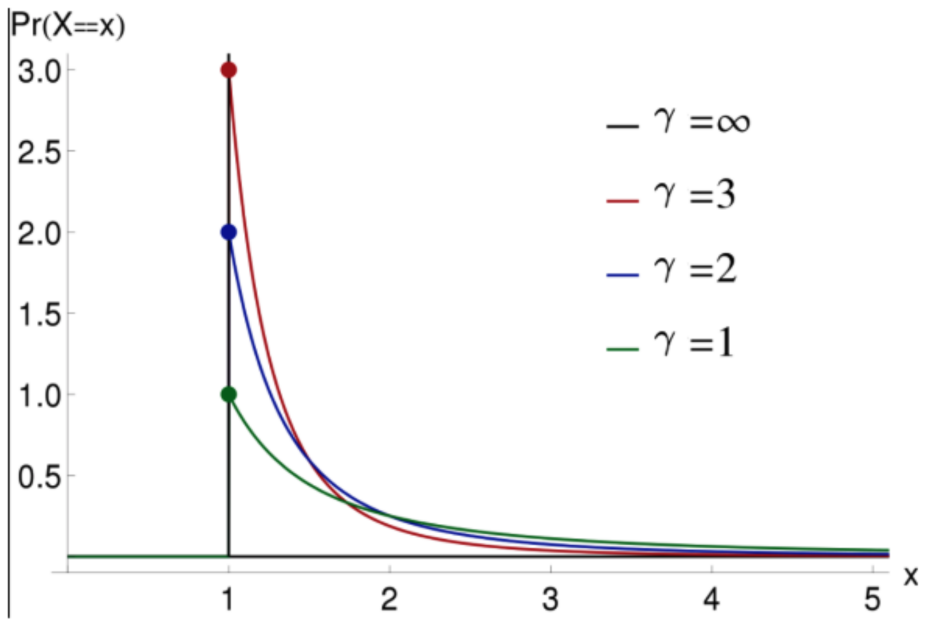
Back

A common assumption is that x is drawn from a Pareto distribution $\triangle(x)$.

- This is a skewed distribution often used to model the distribution of wealth.
- In general, the firm size distribution in rich countries is consistent with a Pareto distribution.
- Not quite so clear in poor countries, because of data limitations, but possibly also true.

PDF of Pareto distribution

Back



Aside: The Pareto distribution

Back

The random variable Z has a Pareto distribution with shape parameter $\gamma \in (0, \infty)$ on the interval $[1, \infty)$ with CDF G given by:

$$G(z) = 1 - \frac{1}{z^\gamma}, \quad z \in [1, \infty) \tag{13}$$

With $\gamma = 1$, this is the standard Pareto distribution.

The PDF is:

$$g(z) = \frac{\gamma}{z^{\gamma+1}}, \quad z \in [1, \infty) \tag{14}$$