Lecture 2: Organization and Trade

Economics 552

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Week 2

Caliendo and Rossi-Hansberg (QJE, 2012)

- Production requires organization
  - Mom-and-pop shop is organized very differently than IBM, Microsoft, or GE
  - Large firms build complicated management hierarchies
- Most general equilibrium models (e.g. trade models) assume firms are just technologies
  - Emphasis on selection
  - No within-firm effects
- Does this matter?
  - Yes, if we are looking at within-firm outcomes, as in many recent empirical studies
    - ★ e.g. productivity, skill composition, wages, layers of management
  - Yes, because these within-firm effects can have aggregate consequences
- Here we aim to understand the impact of trade on within-firm outcomes as well as across firms
  - Not only focus on *who* does what, as with selection, but also *how* do they do it

Caliendo and Rossi-Hansberg (QJE, 2012)

- We introduce organization in a heterogeneous firm equilibrium framework with differentiated products
  - Exogenous demand heterogeneity rather than heterogeneity in productivity as in Melitz (2003)
- We use the model of organization in Garicano (2000) and Garicano and Rossi-Hansberg (2004, 2006, 2011)
  - Focus on trade not offshoring as Antras, et. al (2006)
- Much closer to the empirical literature and ready for calibration or structural estimation

Empirical Evidence

- Many studies have emphasized technology upgrading as a result of trade liberalization
  - Atkeson and Burstein (2010), Bustos (2011), Lileeva and Trefler (2010), Costantini and Melitz (2008)
- However, these studies cannot explain why the productivity of some firms declines as a result of a trade liberalization
  - Technology is not downgraded when a firm shrinks
  - Organization can be simplified, leading to lower productivity
- Our theory is consistent with empirical evidence on the effect of trade on productivity
  - De Locker (2007 and 2011), Baldwin and Gu (2003) and others
  - Distinction between productivity and revenue productivity
  - Heterogenous responses across firms as in Lileeva and Trefler (2010)
- Fewer studies on organizational change
  - Guadalupe and Wulf (2010) show delayering as a result of trade competition

The Model: Preferences

- $\tilde{N}$ identical agents with CES preferences with ES $\sigma > 1$

$$U\left(x\left(\cdot\right)\right) = \left(\int_{\Omega} \alpha^{\frac{1}{\sigma}} x\left(\alpha\right)^{\frac{\sigma-1}{\sigma}} M\mu\left(\alpha\right) d\alpha\right)^{\frac{\sigma}{\sigma-1}}$$

  - $x\left(\alpha\right)$ denotes the consumption of variety α
    - ★ Agents like varieties with higher α better
  - M is the mass of products available and $\mu\left(\cdot\right)$ the probability distribution over varieties in Ω
- Agents are endowed with one unit of time that they supply inelastically
  - Agents obtain an equilibrium wage w for their unit of time
  - If an agent learns an interval of knowledge of length z she has to pay wcz, which she receives back as part of her compensation

Technology

- An entrepreneur pays a fixed entry cost f^E in units of labor to design her product
  - It obtains a demand draw α from $G(\cdot)$ (later $G(\alpha) = 1 - \alpha^{-\gamma}$)
  - α determines the level of demand of the firm
- If entrepreneur decides to produce she pays a fixed cost f in units of labour
  - Needs to build an organization

Technology

- Production requires labor and knowledge
- Agents employed in a firm act as production workers or managers
- Workers:
  - Each worker uses her unit of time to generate a production possibility that can yield A units of output
  - For output to be realized the worker needs to solve a problem
  - Problems are drawn from $F(z) = 1 - e^{-\lambda z}$
    - ★ $\lambda > 0$ regulates how common are the problems faced in production
  - Workers learn how to solve an interval of knowledge $\left[0, z_L^0\right]$
    - ★ If the problem they face is in this interval production is realized
    - ★ Otherwise they could ask a manager one layer above

Technology

- Managers
  - Specialize in solving problems
  - Spend h units of time with each problem that gets to her
    - ★ So each manager can deal with $1/h$ problems
  - A manager of layer 1 tries to solve the problems workers could not solve
    - ★ So problems that require knowledge larger than z_L^0
    - ★ Learns how to solve problems in the interval $\left[z_L^0, z_L^0 + z_L^1\right]$
    - ★ So the firm needs $n_L^1 = hn_L^0\left(1 - F\left(z_L^0\right)\right)$ of these managers
    - ★ Unsolved problems can be sent to a manager one layer above
  - In general, managers in layer l learn $\left[Z_L^{l-1}, Z_L^l\right]$ and there are $n_L^l = hn_L^0(1 - F(Z_L^{l-1}))$ of them, where $Z_L^l = \sum_{\ell=0}^{l} z_L^\ell$

Cost Minimization

- Consider a firm that produces a quantity q. The *variable* cost function is given by

$$C(q; w) = \min_{L \geq 0} \{C_L(q; w)\}$$

where $C_L(q; w)$ is the minimum cost of producing q with an organization with $L+1$ layers, namely,

$$C_L(q; w) = \min_{\{n_L^l, z_L^l\}_{l=0}^L \geq 0} \sum_{l=0}^L n_L^l w \left(c z_L^l + 1\right)$$

subject to

$$\begin{aligned} q &\leq F(Z_L^L) A n_L^0, \\ n_L^l &= h n_L^0 (1 - F(Z_L^{l-1})) \text{ for } L \geq l > 0, \\ n_L^L &= 1 \end{aligned}$$

▸ z > 0

Marginal Costs

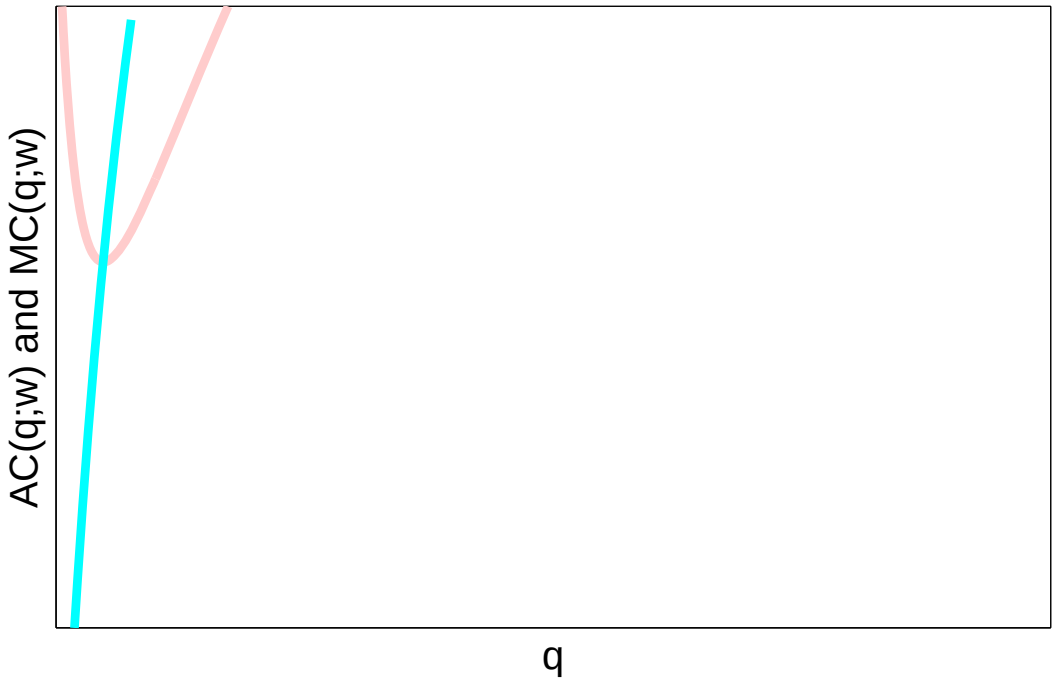
- The marginal cost curve given L is given by

$$MC_L(q;w) \equiv \frac{\partial C_L(q;w)}{\partial q} = \frac{wch}{\lambda A} e^{\lambda z_L^L(q)} = \phi$$

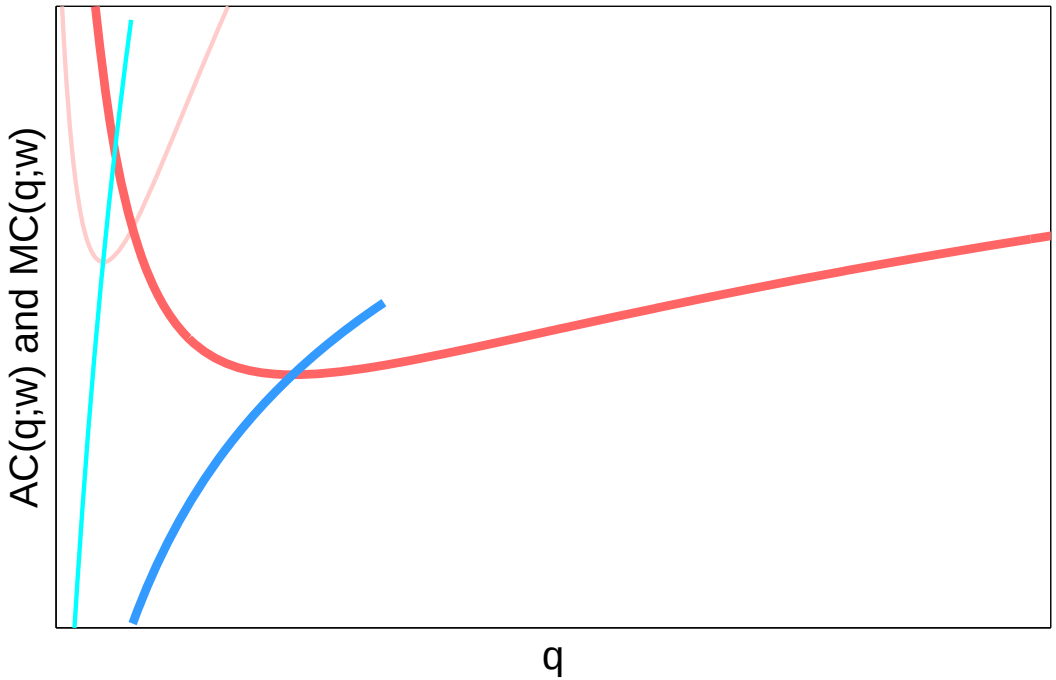
  where ϕ is the Lagrange multiplier associated with output constraint
  - So the higher the knowledge of the entrepreneur, $z_L^L(q)$, the higher $MC_L(q;w)$
  - $z_L^l(q)$ is increasing in q, since, given L, scale expanded by adding knowledge and spans of control at all layers

- **Propositions 1** to **6** characterize the cost function

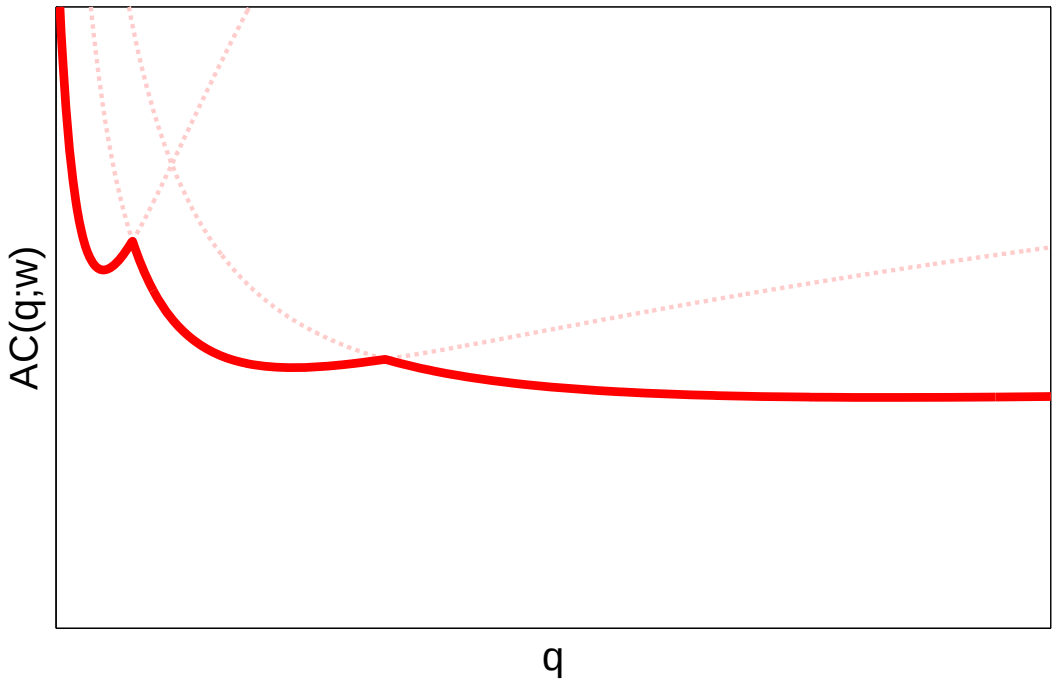
Marginal and Average Costs



Marginal and Average Costs

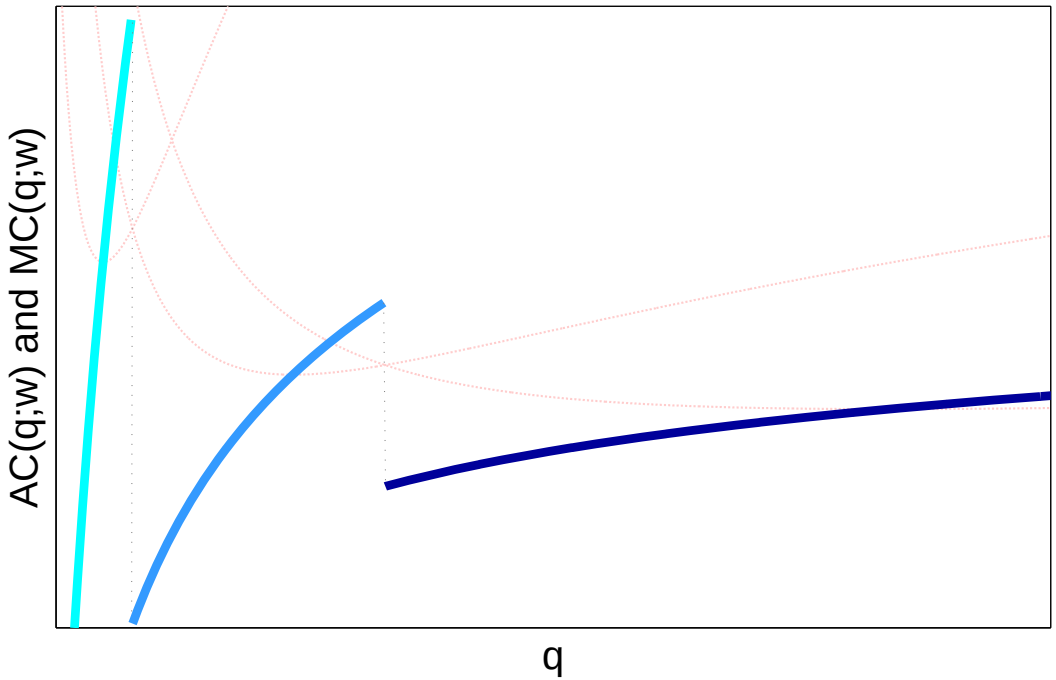


Average Costs: The Lower Envelope



▸ h and c

Marginal Costs



Eliminating Knowledge

- When $c/\lambda \longrightarrow 0$ knowledge is no longer an input in production
- In this case, marginal cost is constant and average cost is decreasing because of an added fixed cost
- As in Melitz (2003) but with demand heterogeneity

Proposition 7 *In the limit when* $c/\lambda \longrightarrow 0$ *and* $L \geq 1$*, the cost function is given by*

$$C(q; w) = w\left(\frac{q}{A} + 1\right)$$

and so

$$AC(q; w) = w\left(\frac{1}{A} + \frac{1}{q}\right) \qquad \text{and} \qquad MC(q; w) = \frac{w}{A}$$

Productivity

- Productivity is given by

$$a(q) = \frac{q}{C(q;1)} = \frac{1}{AC(q;1)}$$

  where the average cost is net of any fixed costs of production and is measured at constant factor prices $w = 1$
- When $c/\lambda \longrightarrow 0$ and $L \geq 1$ the model generates another fixed cost that we need to subtract from costs. Hence,

$$a(q) = \frac{q}{\lim_{c/\lambda \to 0} C(q;1) - 1} = A$$

- As in Melitz (2003) in this case productivity is fixed and given by A. This is not the case when $c/\lambda > 0$

Profit Maximization

- Given CES preferences demand is given by $p(\alpha) = q(\alpha)^{-\frac{1}{\sigma}} (\alpha R)^{\frac{1}{\sigma}}$ where R is total revenue and $P = 1$
- The problem of an entrepreneur with draw α is

$$\pi(\alpha) \equiv \max_{q(\alpha) \geq 0} p(\alpha) q(\alpha) - C(q(\alpha); w) - wf$$

- Hence,

$$p(\alpha) = \frac{\sigma}{\sigma - 1} MC(q(\alpha); w)$$

and

$$q(\alpha) = \alpha R \left(\frac{\sigma}{\sigma - 1} MC(q(\alpha); w) \right)^{-\sigma}$$

- $MC(q(\alpha); w)$ increasing in $q(\alpha)$ and jumps down with new layer
  - **Proposition 8**: $q(\alpha)$ and $p(\alpha)$ increase in α given L and jump (up for $q(\alpha)$ and down for $p(\alpha)$) across L's

▸ Profits

Equilibrium in the Closed Economy

- We consider a "stationary" equilibrium
  - So $[1 - G(\bar{\alpha})] M^E = \delta M$ where M^E is the mass of entrants, M is the mass of firms operating, and δ is the fraction of firm that exit in a period
- Entry threshold $\bar{\alpha}$ is given by $\pi(\bar{\alpha}) = 0$
- Free entry implies

$$\int_{\bar{\alpha}}^{\infty} \frac{\pi(\alpha)}{\delta} g(\alpha) \, d\alpha = w f^E$$

- Labor market clearing requires

$$\tilde{N} = \frac{M}{1 - G(\bar{\alpha})} \left(\delta f^E + \int_{\bar{\alpha}}^{\infty} (C(\alpha; 1) + f) g(\alpha) \, d\alpha \right)$$

- Good market clearing requires $R = w\tilde{N}$

Equilibrium Properties

- The general equilibrium is characterized by $\bar{\alpha}$, w, R, and M

Proposition 10 *There exists a unique equilibrium*

- Free entry implies that increases in population increase w and M, but not $q(\alpha)$
  - So changes in market size do not lead to changes in organization or productivity

Proposition 11 *In equilibrium a larger population size does not affect the entry threshold or the quantities produced, but increases wages, prices, revenues and operating profits of all active firms*

Open Economy

- Two countries: Domestic (D) and Foreign (F) with populations $\tilde{N}_i$
  - Same preferences so a draw α applies to both markets
  - Fixed cost of production given by f_{ii}, and fixed cost to export of f_{ij}
  - $x_{ij}(\alpha)$ is the demand of an agent in country j for goods α produced in country i, $q_{ij}(\alpha)$ the quantity produced, and $p_{ij}(\alpha)$ is the price
  - We normalize $P_D = 1$
- Trade is costly. Iceberg trade cost are given by $\tau_{ij} > 1$, for $i \neq j$

Prices and Quantities in the Open Economy

- Quantities produced for each market are then

$$q_{ii}(\alpha) = \alpha R_i P_i^{\sigma-1} \left(\frac{\sigma}{\sigma - 1} MC\left(q_i(\alpha); w_i\right) \right)^{-\sigma}$$

and

$$q_{ij}(\alpha) = \alpha R_j \left(\frac{P_j}{\tau_{ij}} \right)^{\sigma-1} \left(\frac{\sigma}{\sigma - 1} MC\left(q_i(\alpha); w_i\right) \right)^{-\sigma}$$

  - Note that domestic quantity now depends on total production, $q_i(\alpha)$
  - So exporting changes domestic production through within-firm reorganization
  - In contrast to standard model all firms might export even if $f_{ij} > f_{ii}$

- Price in each market is given by

$$p_{ij}(\alpha) = \tau_{ij} p_{ii}(\alpha) = \tau_{ij} \frac{\sigma}{\sigma - 1} MC\left(q_i(\alpha); w_i\right)$$

Equilibrium in the Open Economy

- Production threshold, $\bar{\alpha}_{ii}$, is determined by $\pi_i(\bar{\alpha}_{ii}) \geq 0$
- Export threshold, $\bar{\alpha}_{ij}$, is determined by $\pi_{ij}(\bar{\alpha}_{ij}) = \max\{0, \pi_{ii}(\bar{\alpha}_{ij})\}$
- Free entry condition is then given by

$$\int_{\bar{\alpha}_{ii}}^{\bar{\alpha}_{ij}} \frac{\pi_{ii}(\alpha)}{\delta} g(\alpha)\, d\alpha + \int_{\bar{\alpha}_{ij}}^{\infty} \frac{\pi_{ij}(\alpha)}{\delta} g(\alpha)\, d\alpha = w_i f_i^E$$

- Labor market clearing is guaranteed by

$$\tilde{N}_i = \frac{M_i}{1 - G(\bar{\alpha}_{ii})}\left(\delta f_i^E + \int_{\bar{\alpha}_{ii}}^{\infty} \left(C(q_i(\alpha); 1) + f_{ii}\right) g(\alpha)\, d\alpha + \int_{\bar{\alpha}_{ij}}^{\infty} f_{ij} g(\alpha)\, d\alpha\right)$$

- Goods market clearing is guaranteed by $R_i = w_i N_i$
- An equilibrium is a vector $(\bar{\alpha}_{DD}, \bar{\alpha}_{DF}, \bar{\alpha}_{FF}, \bar{\alpha}_{FD}, M_D, M_F, P_D, P_F, w_D, w_F, R_D, R_F)$

Equilibrium Properties in the Open Economy

Proposition 12.1 *In equilibrium a trade liberalization increases welfare in both countries*

Proposition 12.2 *The quantity produced of all non-exporters decreases and the quantity produced of all exporters increases*

Corollary: *The number of management layers of all non-exporters decreases weakly and of all exporters increases weakly*

- Non-exporters that do not change layers decrease the skill of all employees and exporters that do not change layers increase them
  - For firms that do change layers the skill of workers goes up for non-exporters and down for exporters
- If change in quantity large enough change in productivity positive for exporters and negative for non-exporters
  - Depends on where firms were producing relative to MES

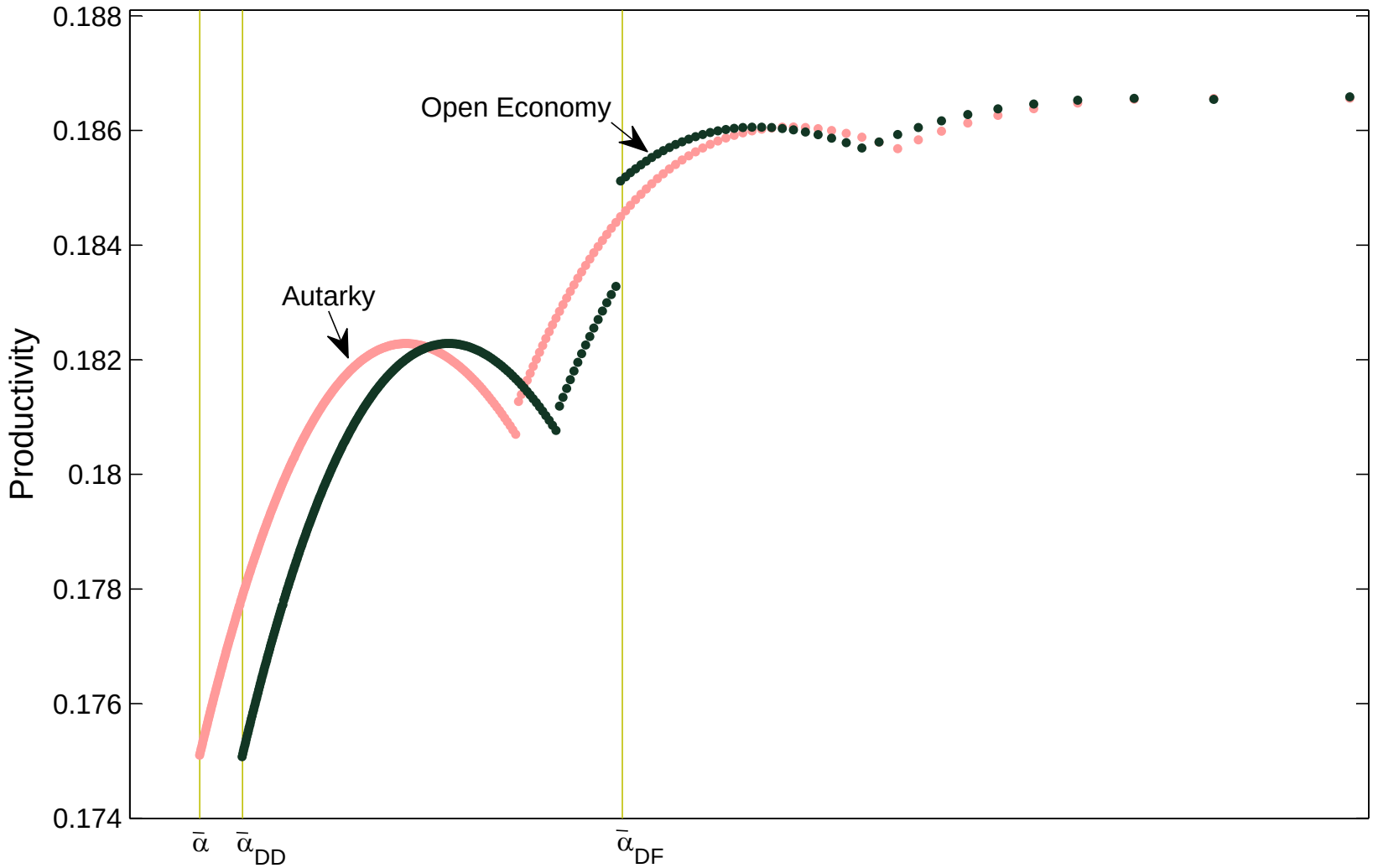
Calibration

- Consider a world with two symmetric countries like the U.S. in 2002
- Need values for f_i^E, f_{ii}, f_{ij}, h, c/λ, γ, σ, A, $\tilde{N}_i$, δ, τ_{ij}
- We set $\sigma = 3.8$ (Bernard, et al., 2003), $\tau = 1.3$, $\delta = 10\%$ (Ghironi and Melitz, 2005), and normalize $f_{ii} = 1.1$
- $\tilde{N}_i$ is the total number of employees in the manufacturing sector and proportional educational sector
- We calibrate the values of f_i^E, f_{ij}, h, c/λ, A and γ to match:

Moments	Data	Model
Share of firms that export	18.0	17.53
Average size of firms	45.2	45.44
Share of education employees	11.8	11.85
Share of expenditure on domestic goods	78.9	74.94
Total expenditure	5.1	5.10
Pareto coefficient	-1.095	-1.094

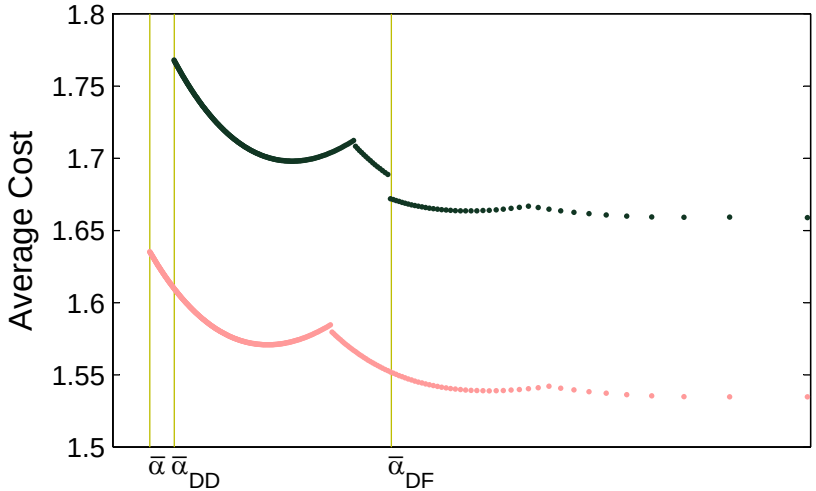
▸ Parameter Values ▸ Data

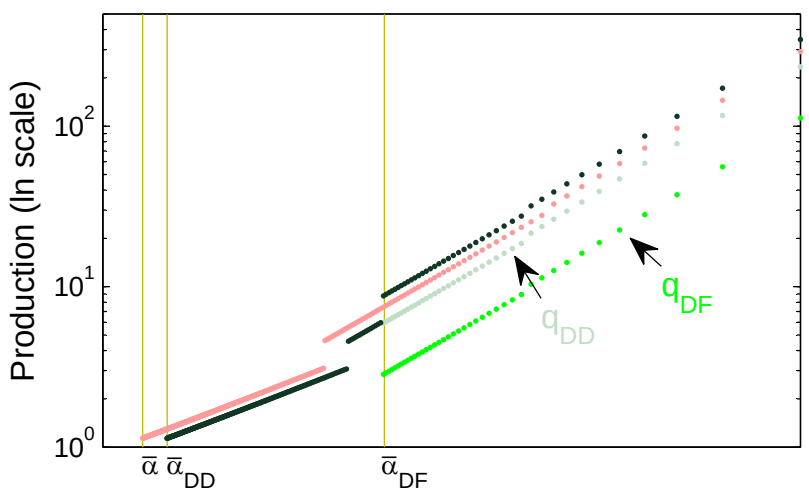
Productivity

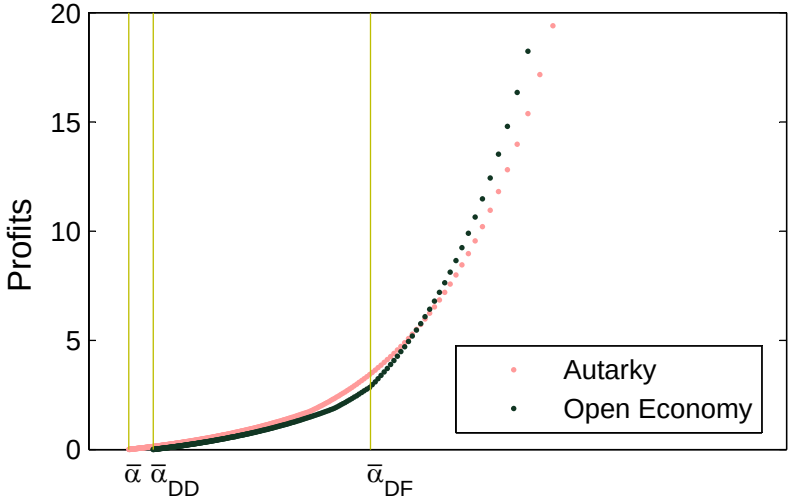


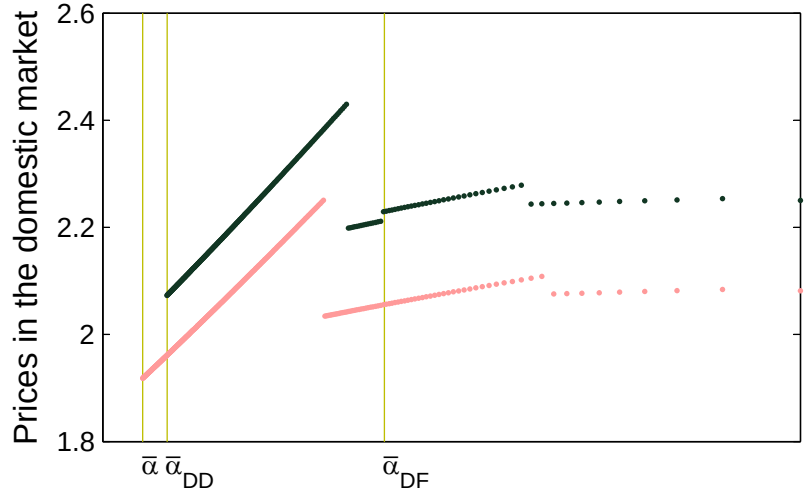
▸ Distributions

Costs, Profits, Quantities, and Prices

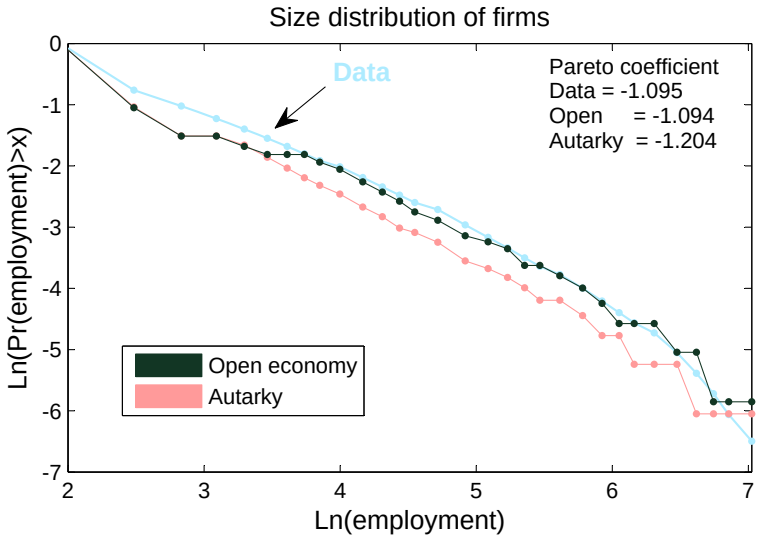


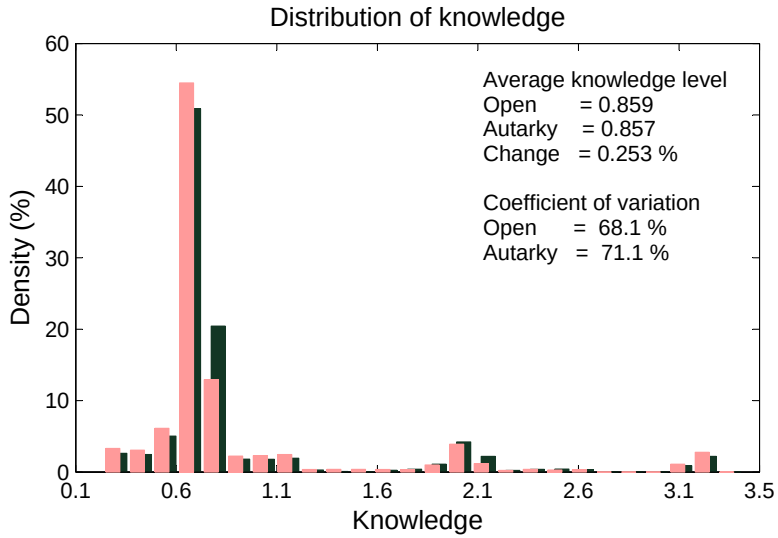


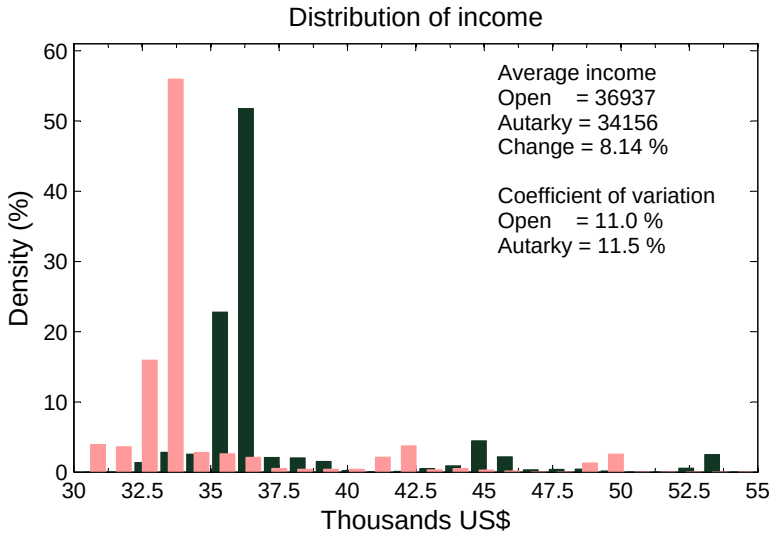


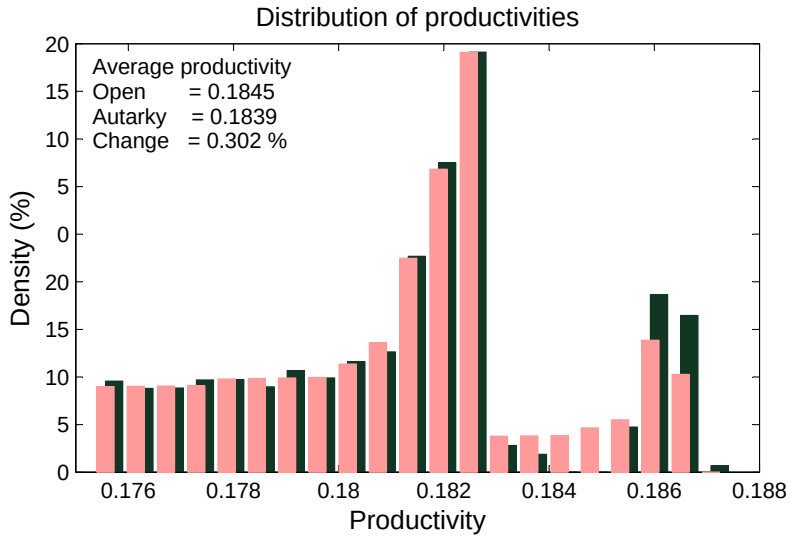


Distributions of Size, Knowledge, Income, and Productivity



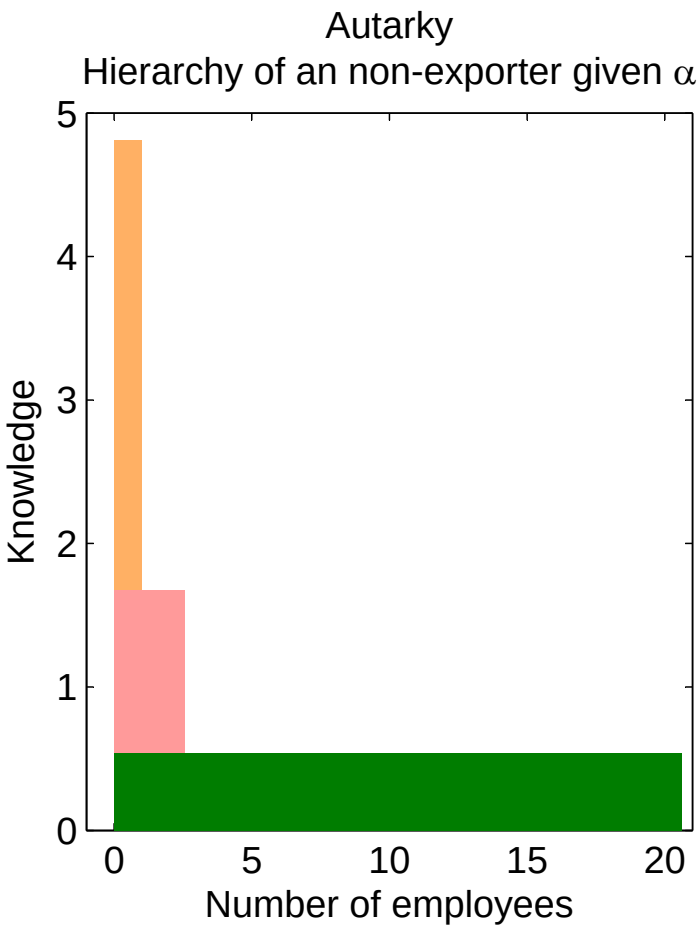


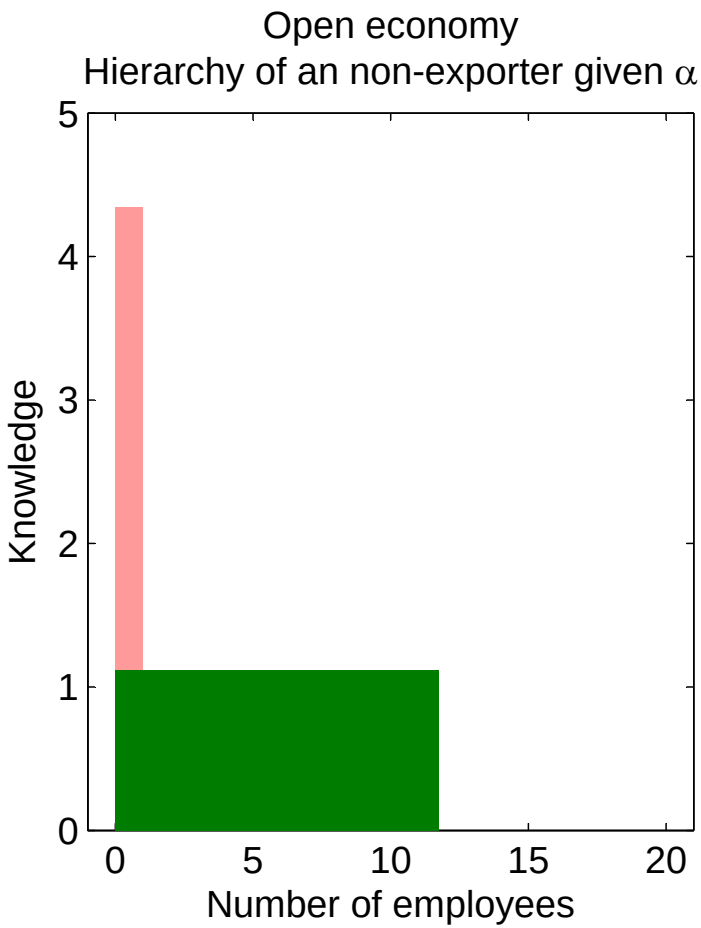




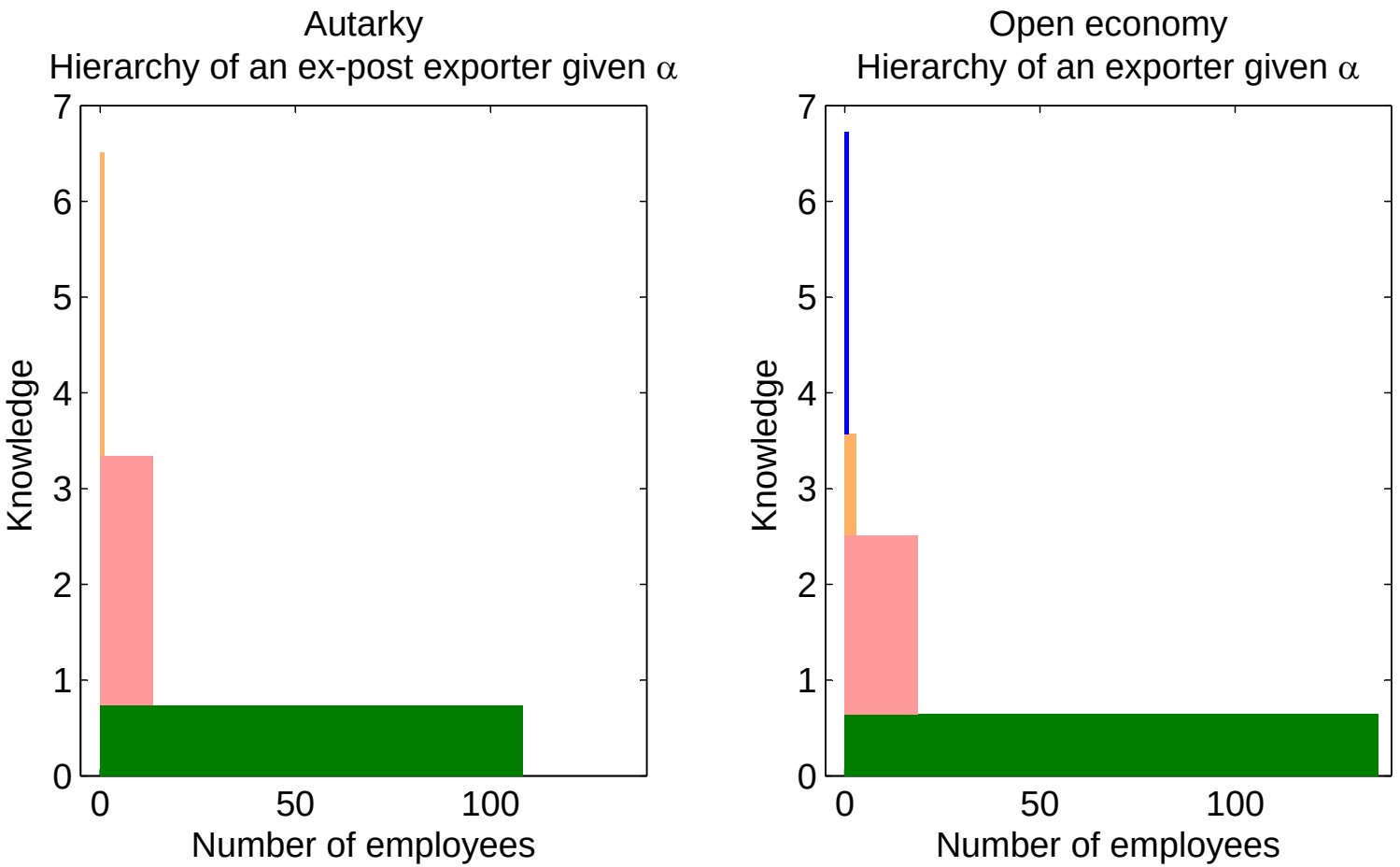
▸ Free Trade

Impact of Trade on Internal Organization: Non-exporters



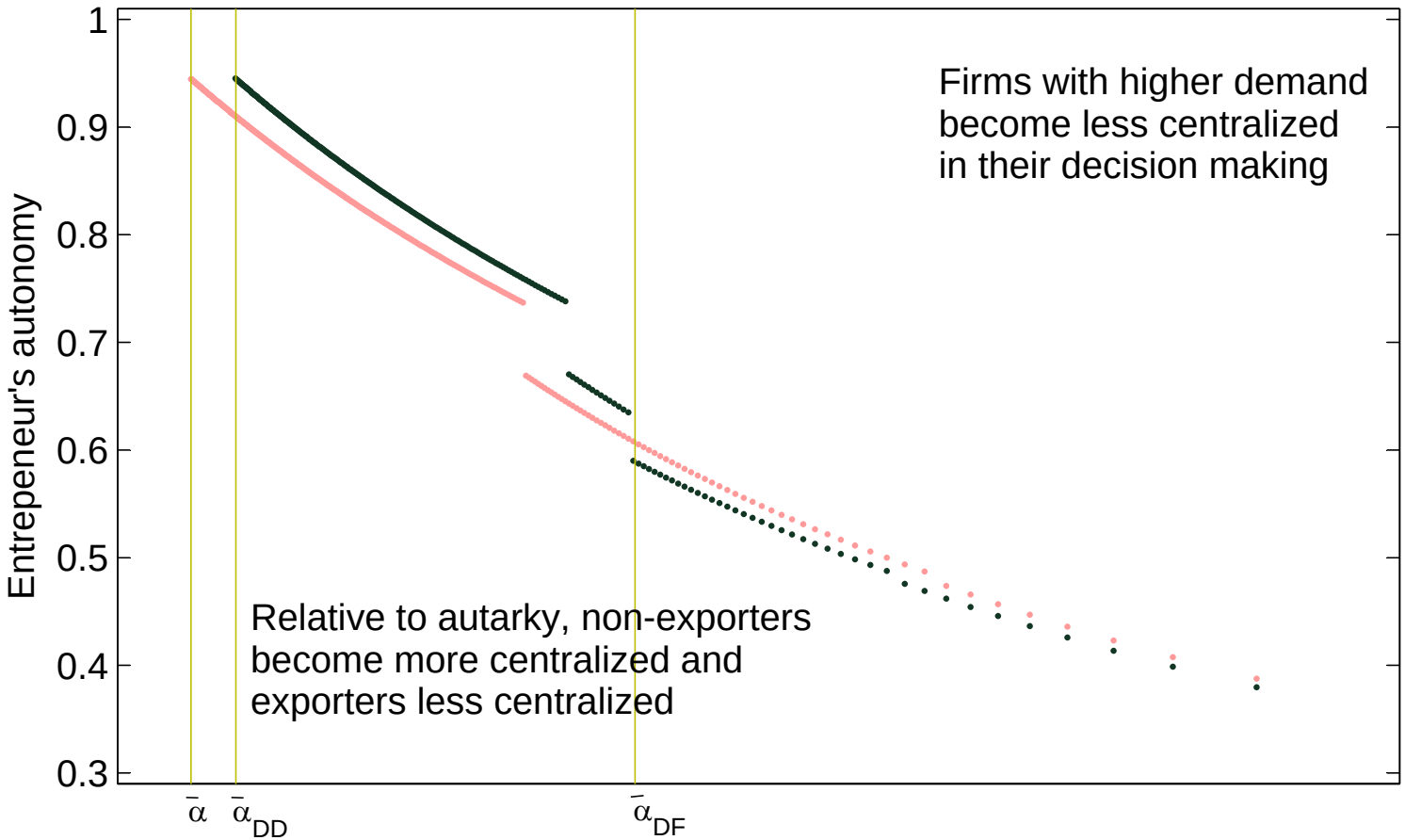


Impact of Trade on Internal Organization: Exporters



Autonomy

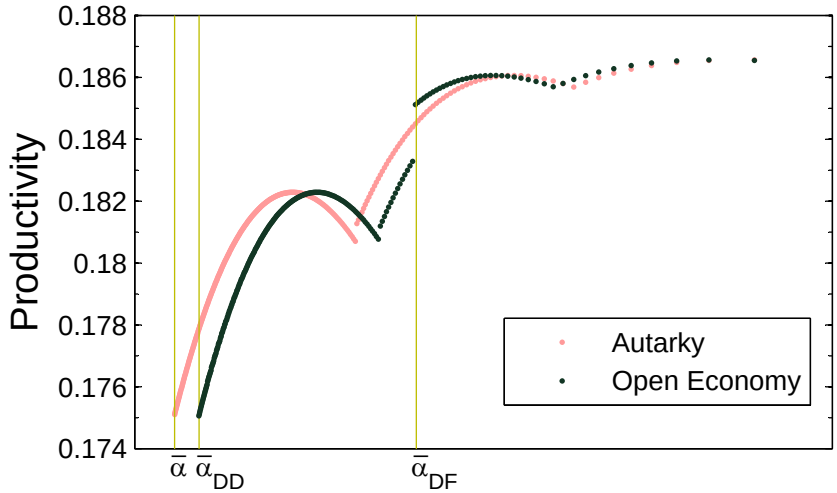
- Measure autonomy by the fraction of problems solved (or decisions made) by a given position, z_L^l / Z_L^L

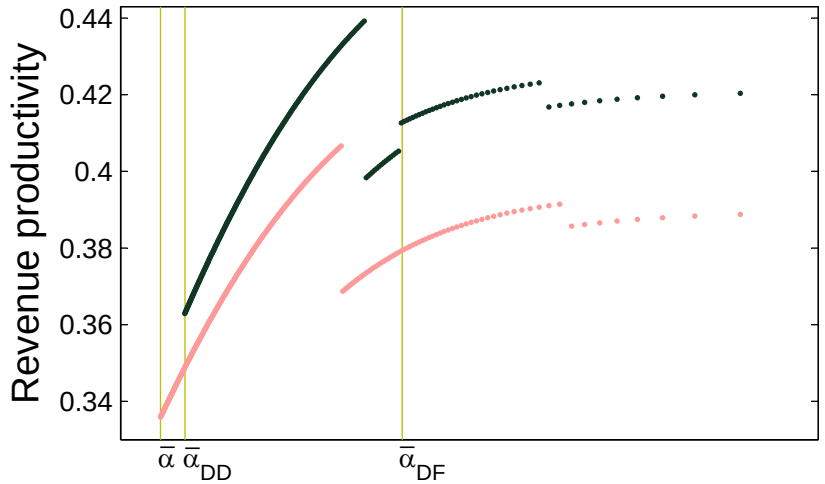


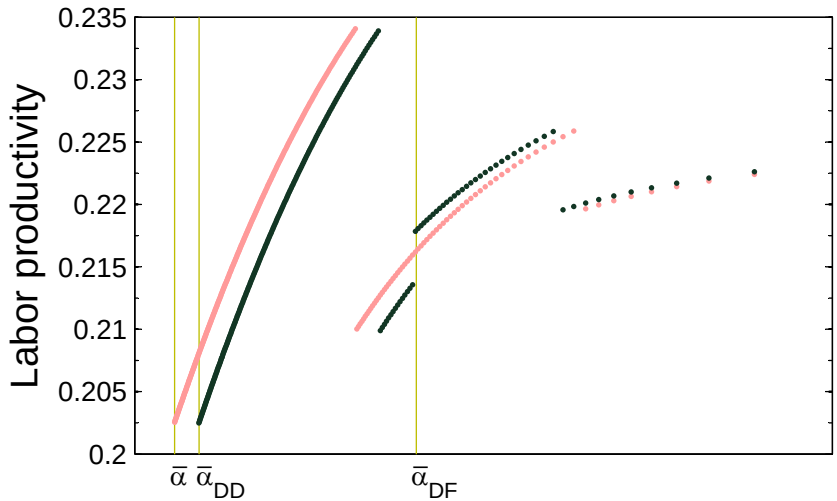
Other Measures of Productivity

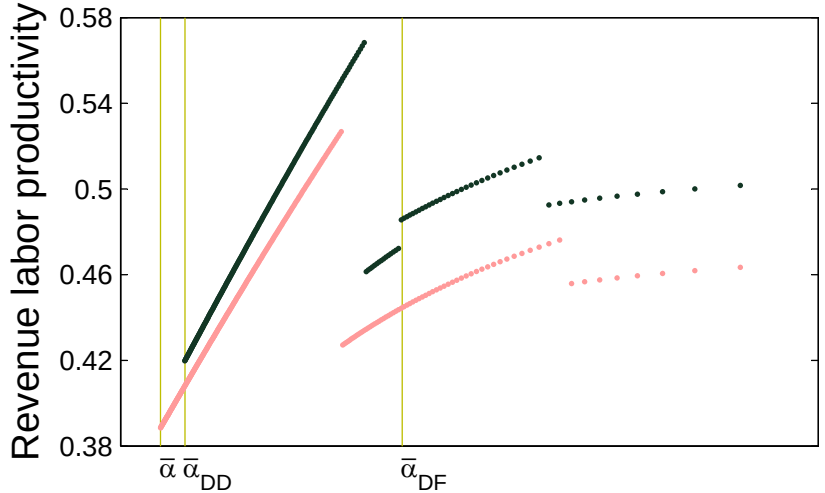
- We measure productivity by $q(\alpha) / C(\alpha; 1)$
- In many cases this is hard to do empirically, since neither the cost function nor prices are available
- So other measures are used in practice:
  - Revenue productivity: $r(\alpha) / C(\alpha; 1) = p(\alpha) q(\alpha) / C(\alpha; 1)$
  - Labor productivity: $q(\alpha) / n(\alpha)$ where $n(\alpha)$ is the total number of employees in the firm
    - ★ Does not include education or fixed costs
  - Revenue labor productivity: $r(\alpha) / n(\alpha)$
- These measures use progressively more easily available data

Other Measures of Productivity



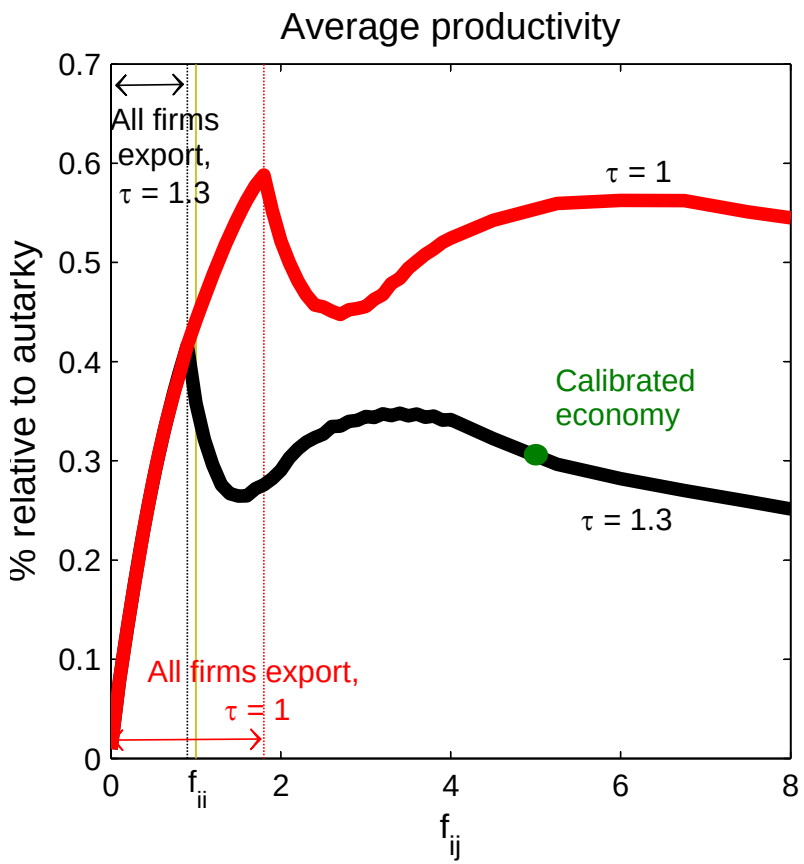


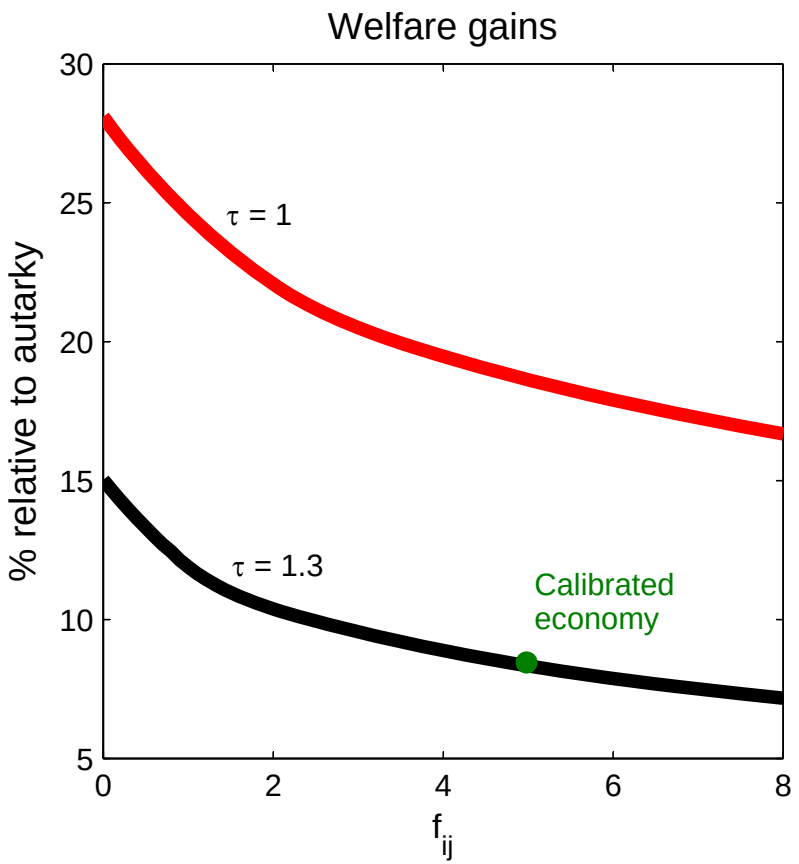




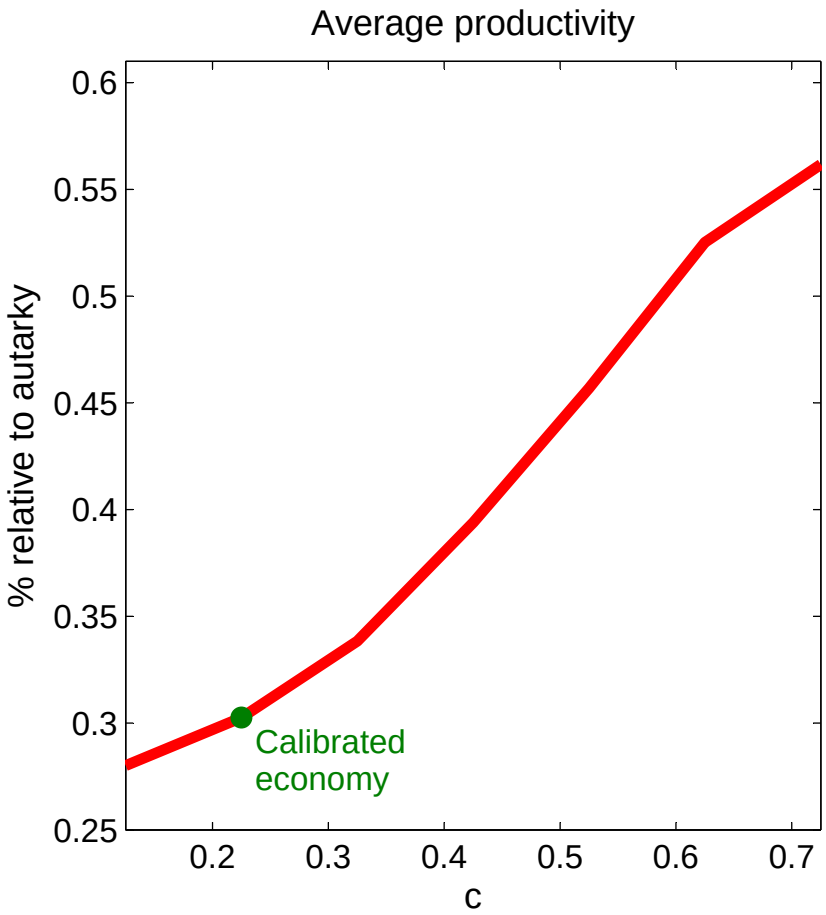
▶ Table ▶ P Dist. ▶ LP Dist.

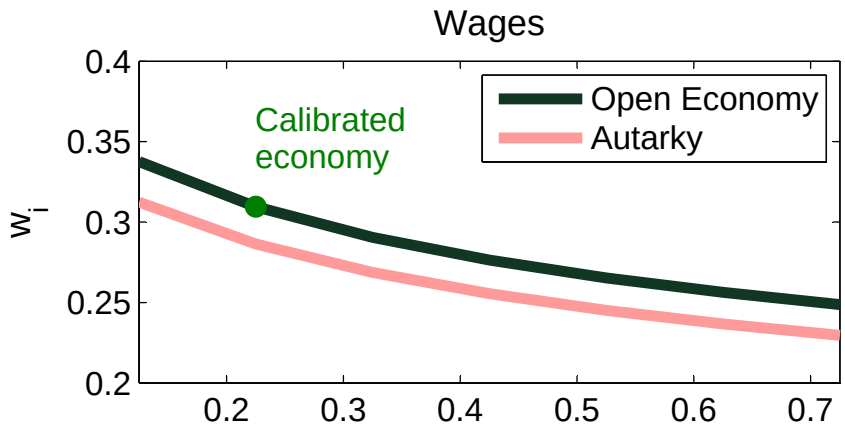
Changing Export Costs

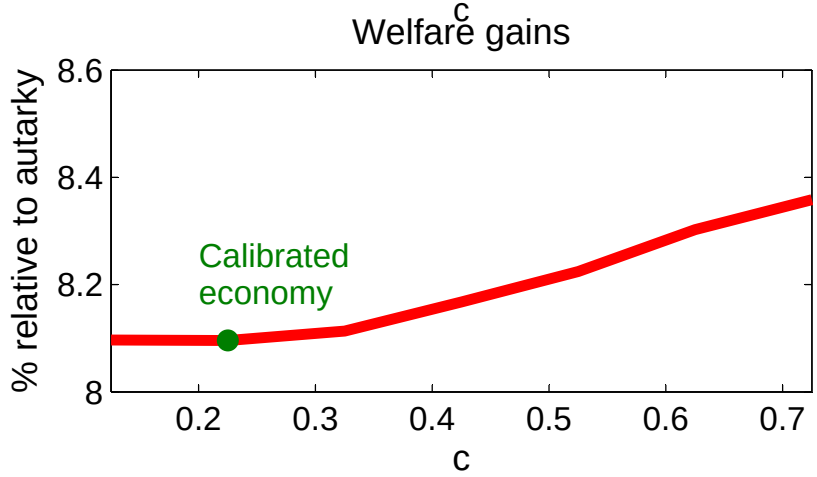




Changing the Cost of Knowledge

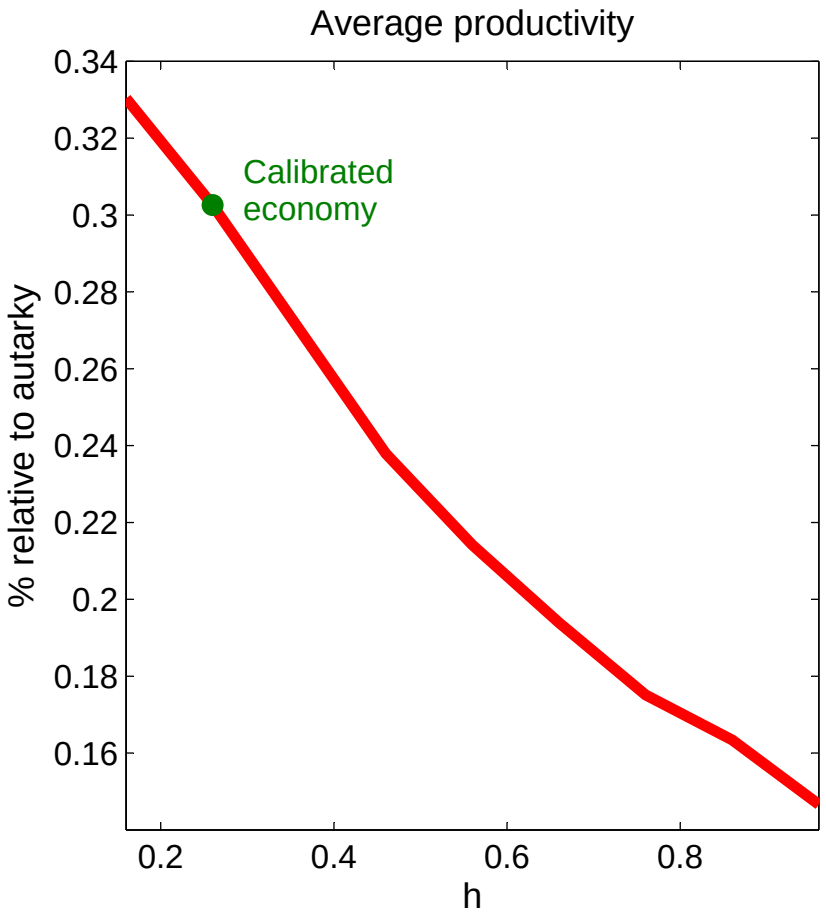


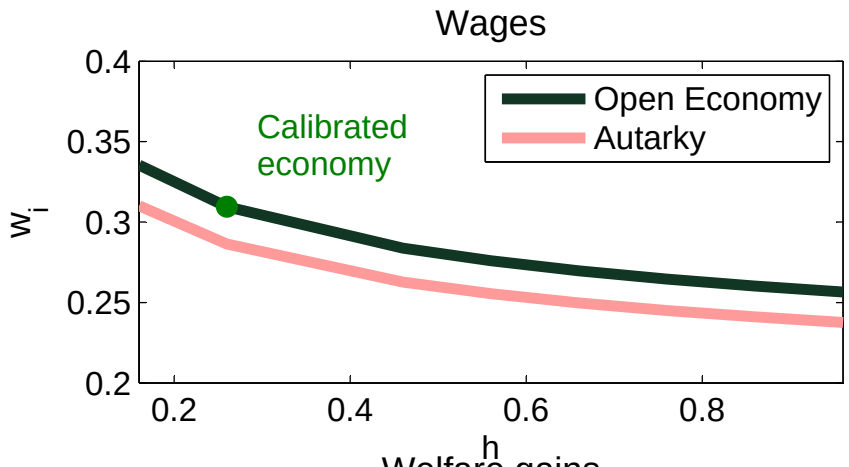


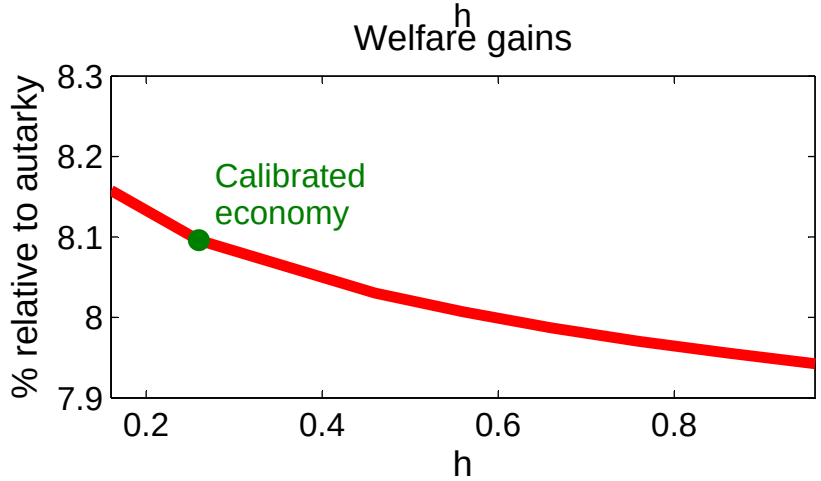


▸ h and c ▸ Welfare Gains vs. ACR

Changing Communication Costs







▸ h and c

Conclusions

- We propose a theory where production requires organization
  - Choosing the number of distinct functions, the number of employees in each of them, as well as their skill
- Then, heterogeneity in demand leads to heterogeneity in productivity and other within-firm characteristics
  - Organization allows the firm to economize on knowledge thereby increasing its productivity
  - Organizational choices are discrete: The number of functions or layers
- Theory allows us to study a rich set of within firm implication on trade
  - In particular on within-firm wages, skill composition and productivity
  - The model can be calibrated or structurally estimated
  - Findings are consistent with the empirical literature

Positive Knowledge

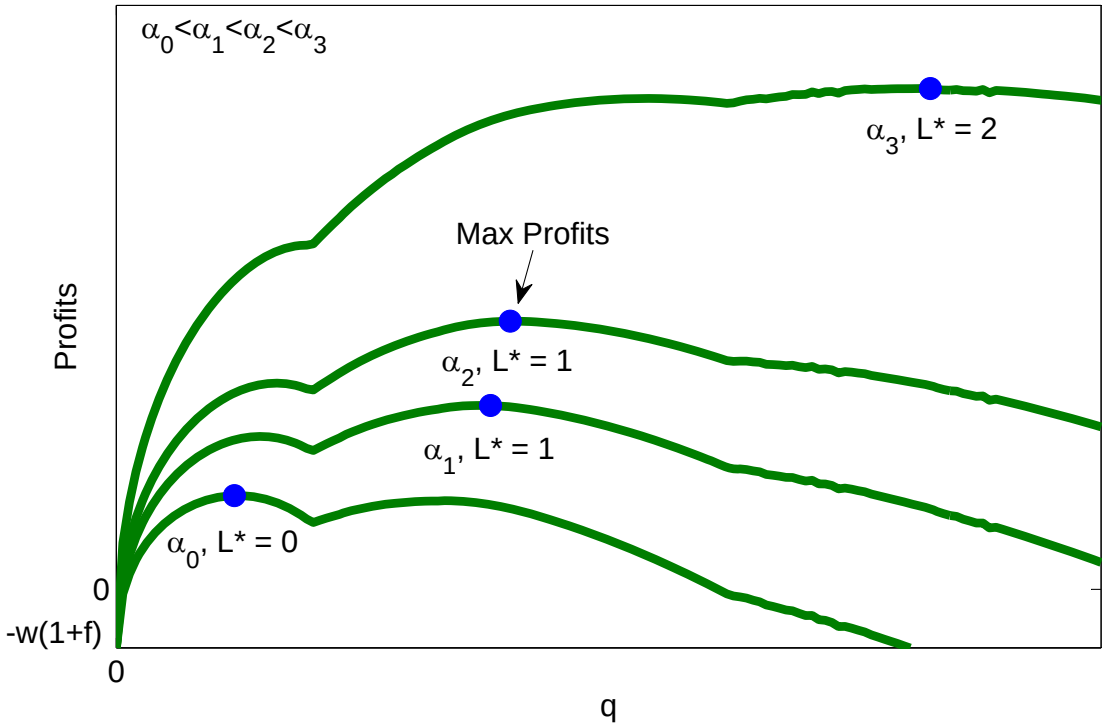
- In order to guarantee that $z_L^l(q) \geq 0$ for all q, l and L we need to impose a parameter restriction
  - If L is optimally chosen, $z_L^l(q) > 0$ for $l \neq \{0, L\}$ since there is no benefit of having that management layer
  - Still, without Assumption 1, it could be that $z_L^0(q) = 0$ for $L \geq 1$ and $z_L^L(q) = 0$ for $L \geq 2$, but $z_L^L(q) > 0$ if $z_L^0(q) > 0$
    - ★ In this case, results still apply but more cumbersome notation

Assumption 1 *The parameters* λ, c, *and* h *are such that* $\frac{c}{\lambda} \leq \frac{h}{1-h}$

Proposition 1 *Under Assumption 1, for all* $L \neq 1$ *and any output level* q, *the knowledge of agents at all layers is positive (*$z_L^l \geq 0$ *never binds)*

Back

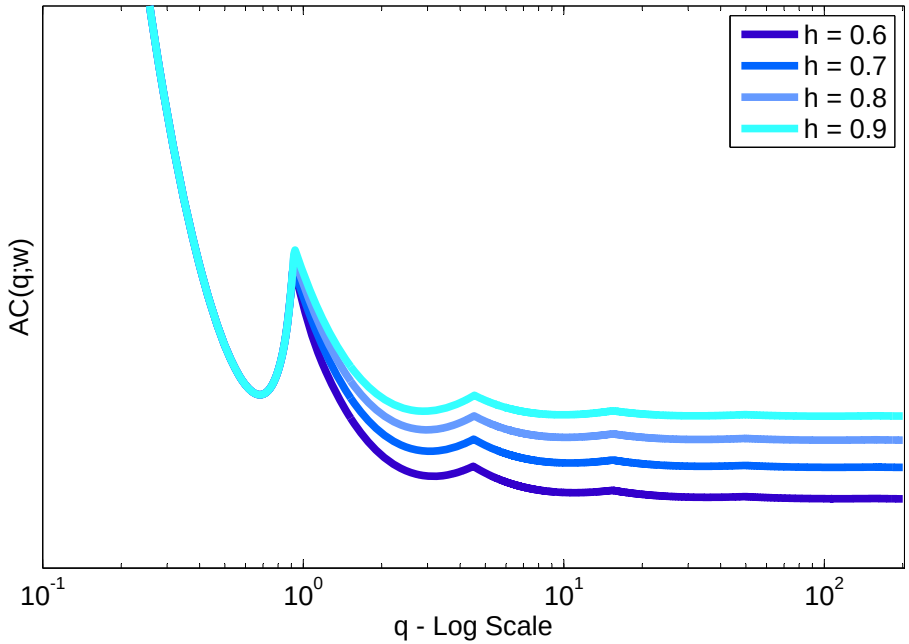
Profits

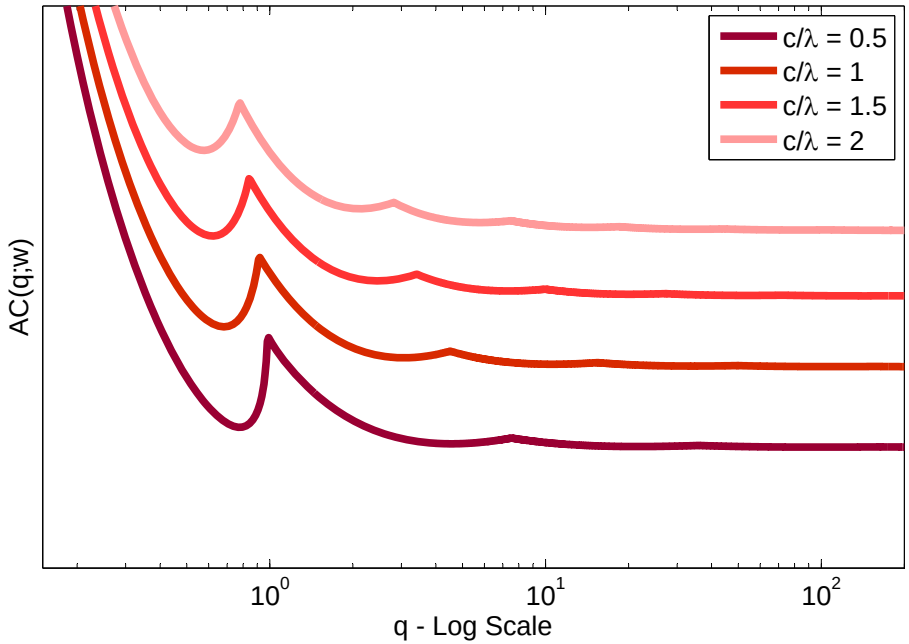


Proposition 9 *Given L, the profit function is strictly concave in q. Furthermore, $\pi(\alpha)$ is increasing and continuous in α*

▸ Back

Effect of Communication and Learning Cost on AC(q;w)





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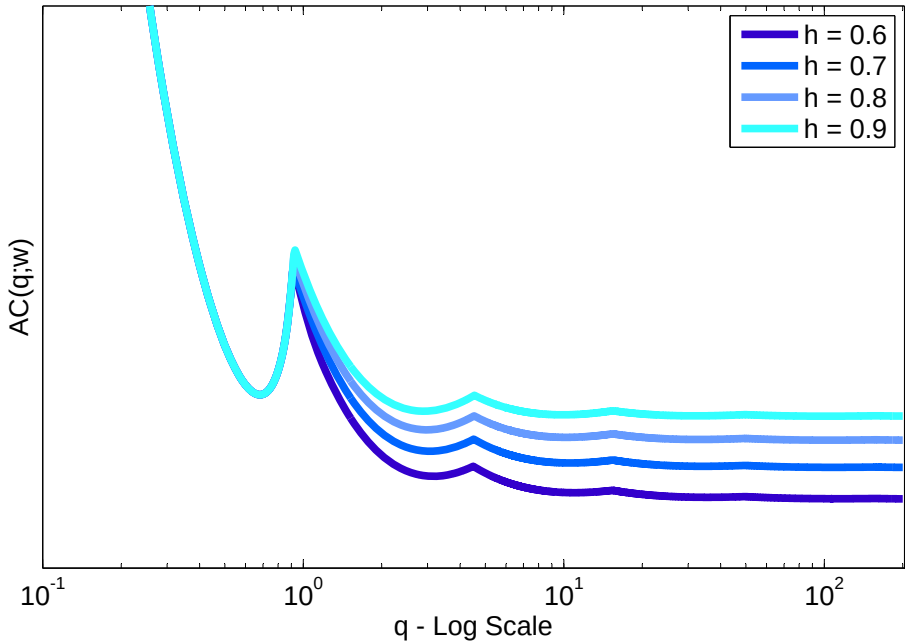
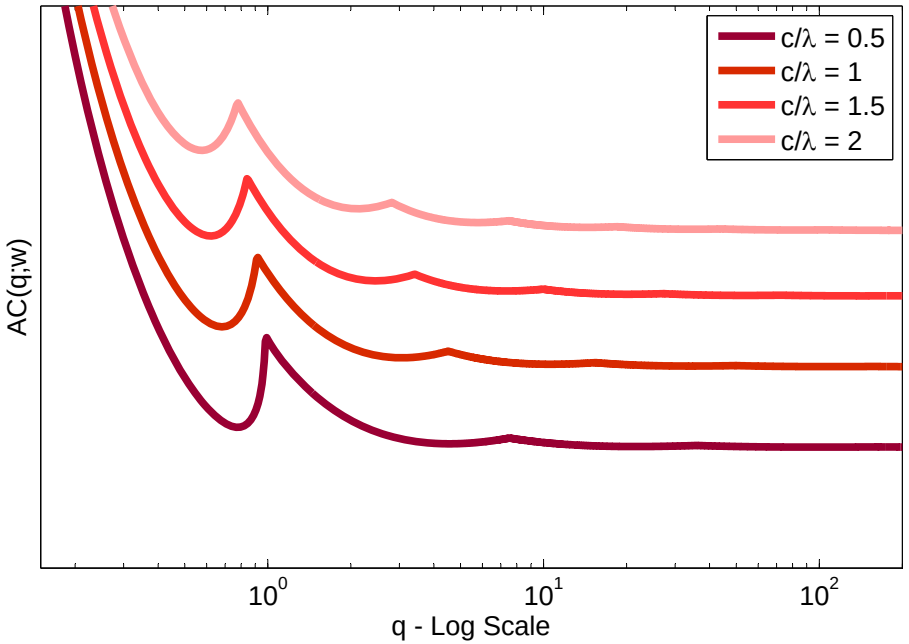
Effect of Communication and Learning Cost on AC(q;w)





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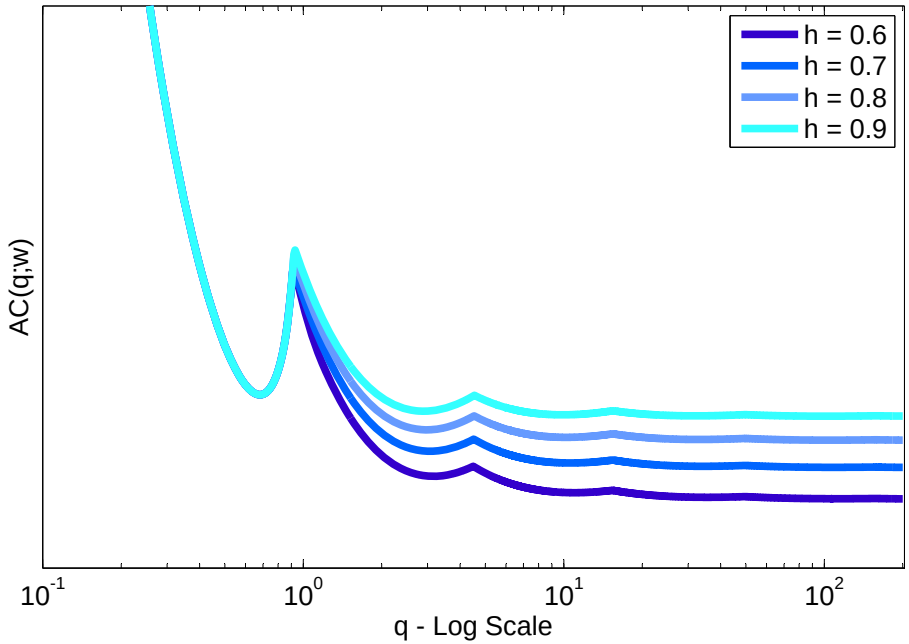
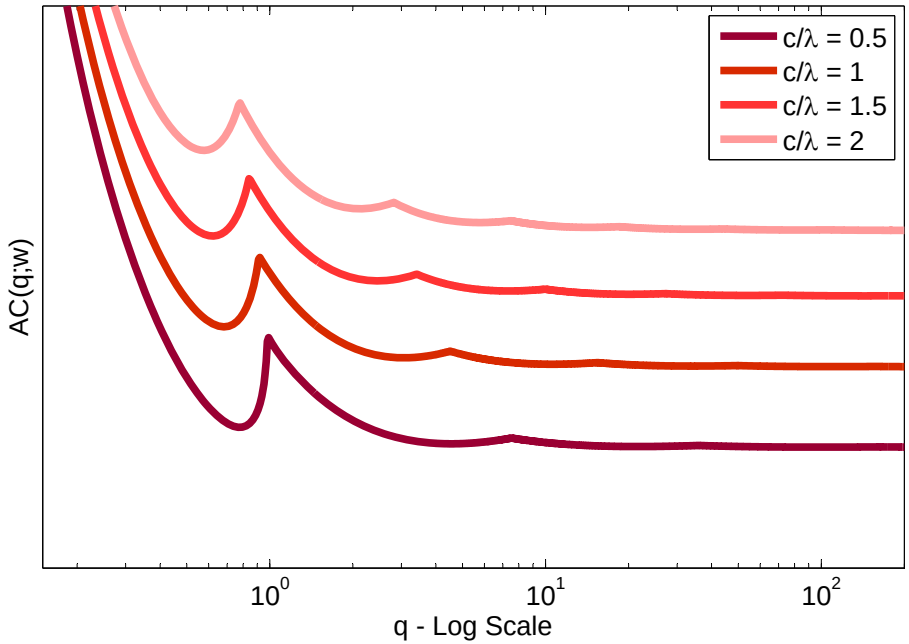
Effect of Communication and Learning Cost on AC(q;w)





▶ Back

Parameter Values

Calibrated Parameter values

Parameters	A	f^E	f_{ij}	γ	c/λ	h
Values	0.26	35.1	5.4	0.9	0.225	0.26

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Productivity Gains Relative to Autarky

	Productivity			**Revenue productivity**		
Weight	1	$n(\alpha)$	$q(\alpha)$	1	$n(\alpha)$	$q(\alpha)$
All firms	0.03%	0.30%	0.22%	8.16%	8.63%	8.47%
Exporters	0.10%	0.04%	0.05%	8.33%	8.22%	8.22%
Non-exporters	-0.08%	-0.18%	-0.21%	7.95%	7.87%	7.89%
Marginal firm		1.00%			1.82%	

	Labor productivity			**Revenue labor productivity**		
Weight	1	$n(\alpha)$	$q(\alpha)$	1	$n(\alpha)$	$q(\alpha)$
All firms	0.08%	0.35%	0.28%	8.21%	8.65%	8.53%
Exporters	0.33%	0.13%	0.13%	8.63%	8.30%	8.29%
Non-exporters	-0.03%	0.02%	0.08%	8.00%	8.10%	8.21%
Marginal firm		2.00%			2.83%	

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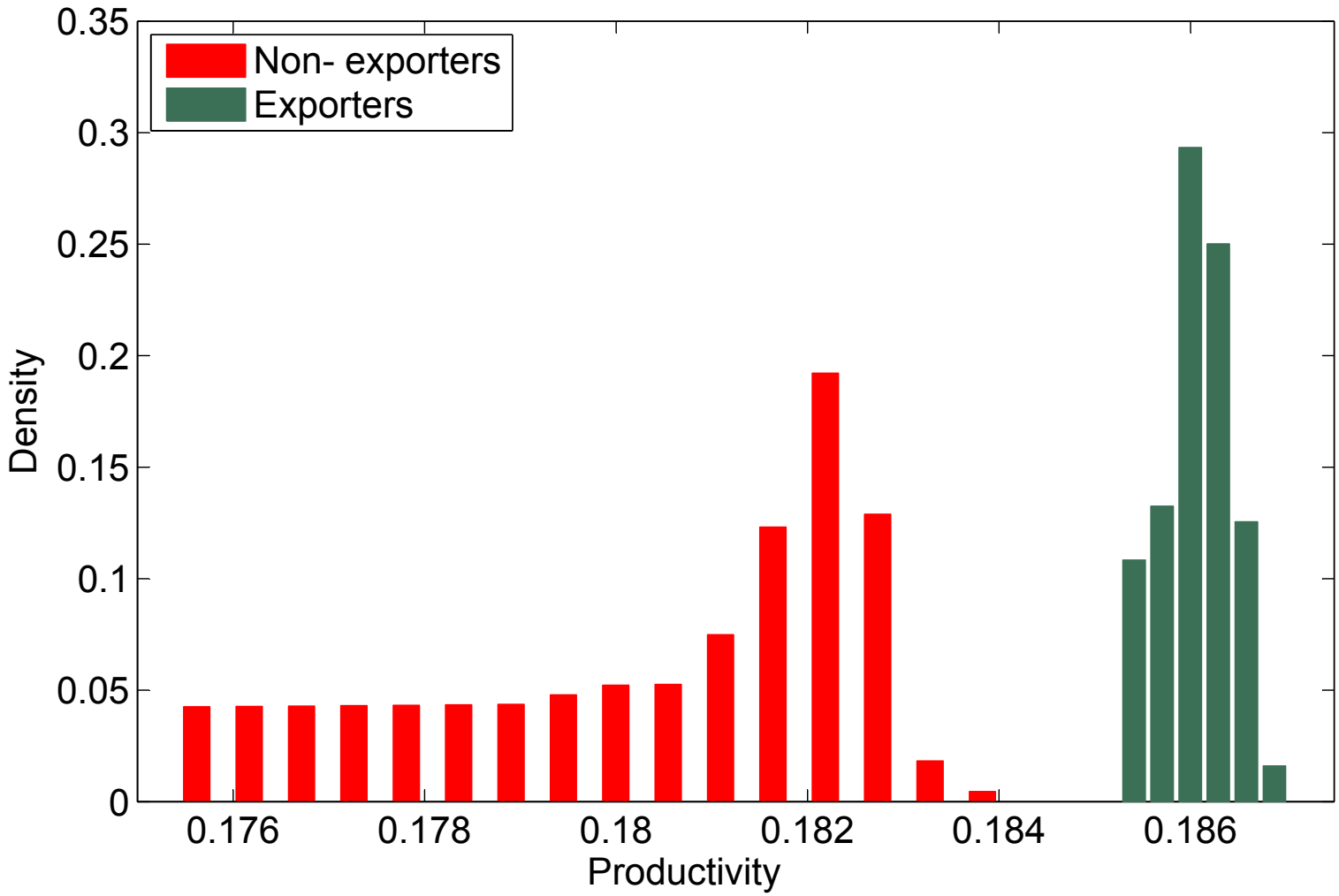
Productivity of Exporters and Non-exporters



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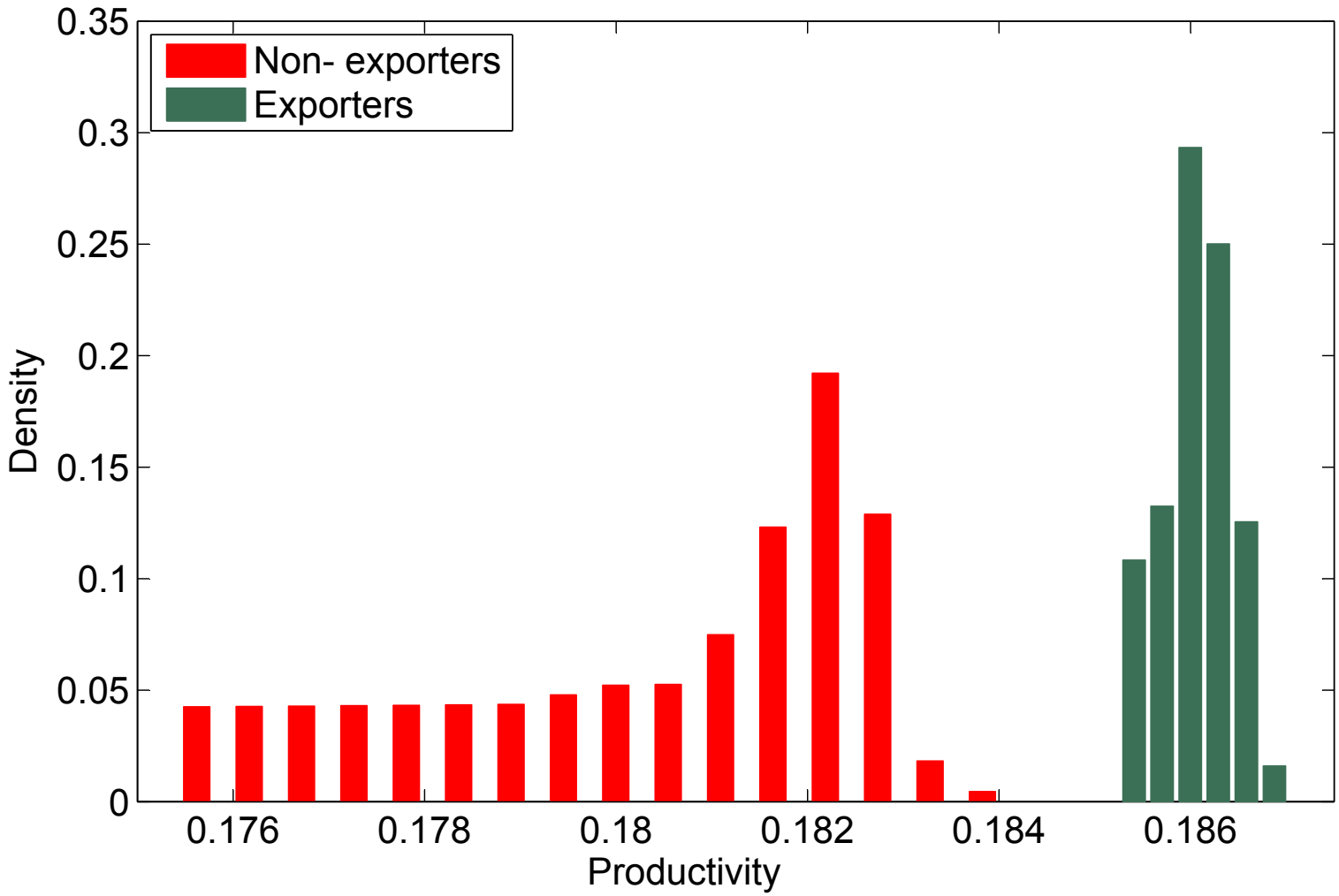
Productivity of Exporters and Non-exporters



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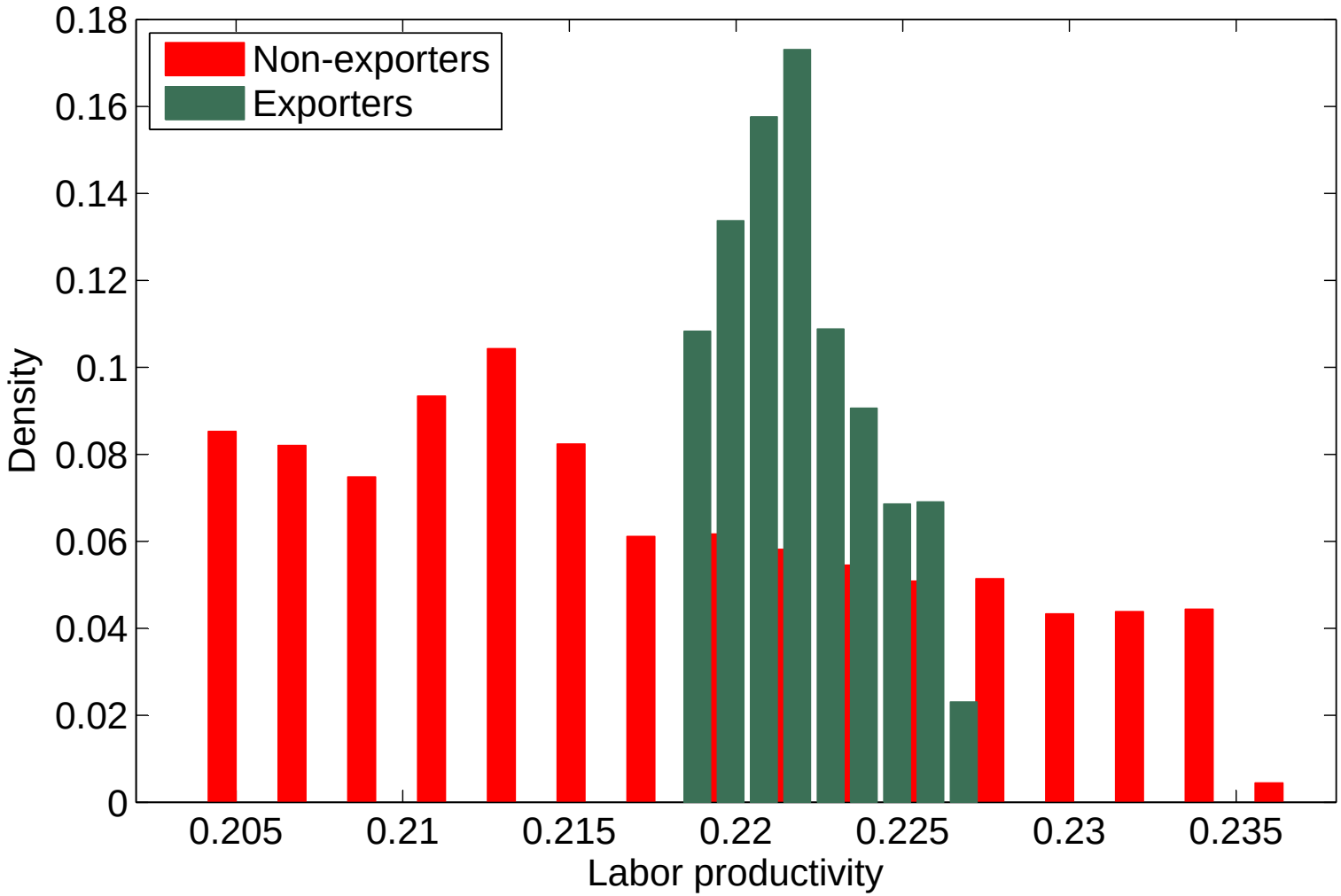
Labor Productivity of Exporters and Non-exporters



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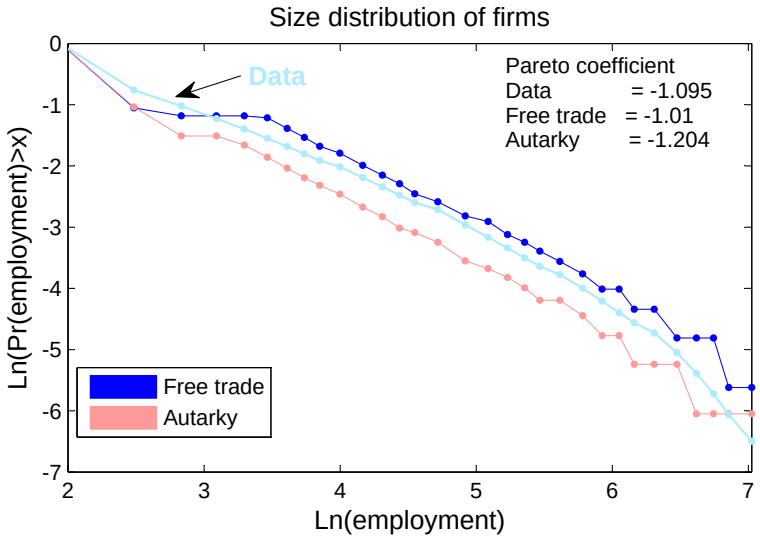
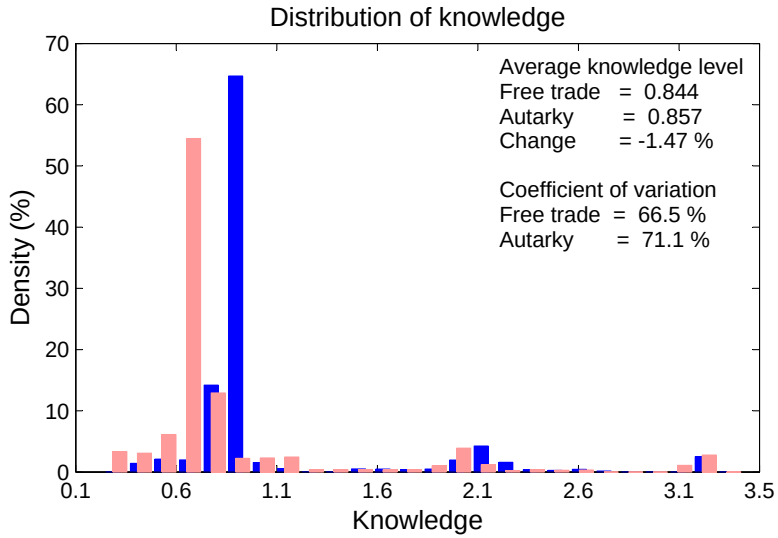
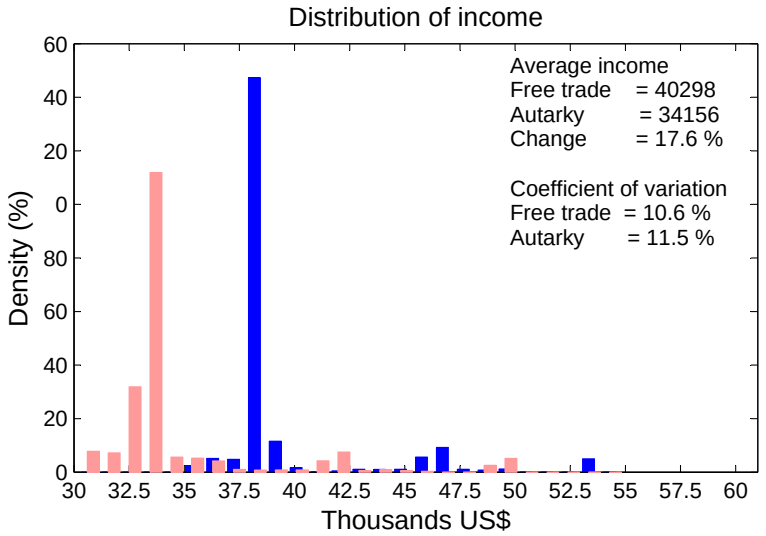
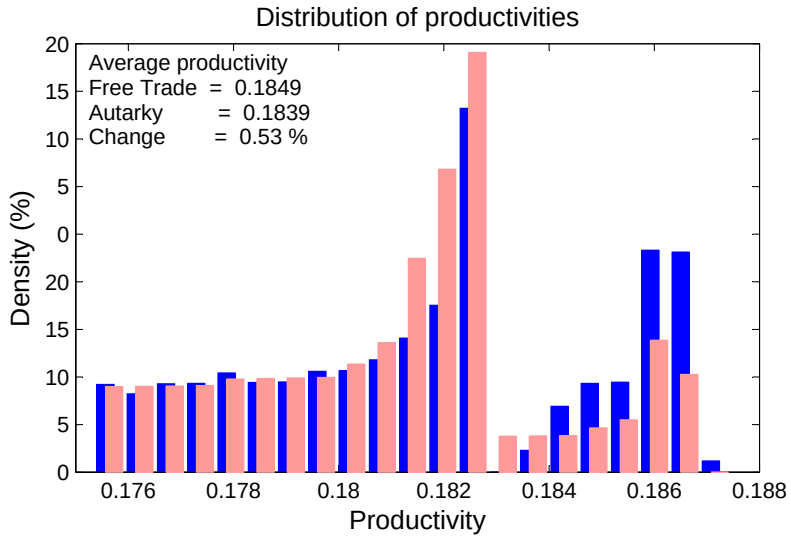
Changes in Distributions from Autarky to Free Trade









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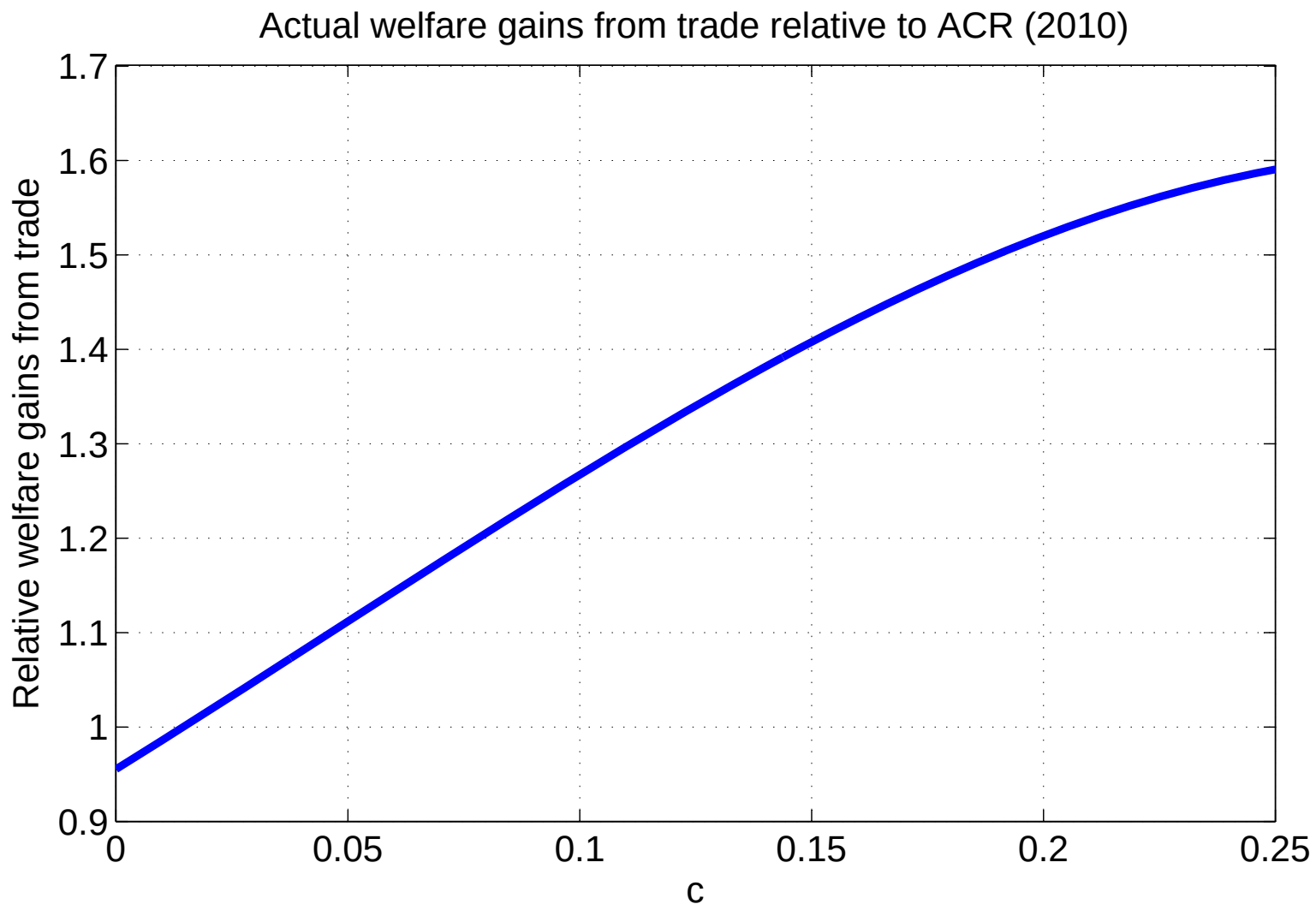
Welfare relative to Melitz



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Moments Data Source

- Share of firms that export: Bernard, et al. (2007)
- Average size of firms and size distribution of firms: 2002 Statistics of U.S. Businesses from the U.S. Census Bureau
- Share of education employees: Career Guide to Industries (CGI) from BLS Current Population Survey for 2008
  - CGI reports number of employees per occupations in different industries. We use the number reported for the Educational Services sector
- Total expenditure and share of expenditure on domestic goods: TRAINS database. We use data on imports from the manufacturing sector and gross production from the bundled sector

Back

Caliendo, Monte and Rossi-Hansberg (2013)

- Firms are heterogeneous in a variety of dimensions
  - But little is known about where this heterogeneity comes from
- Some of the observed heterogeneity is the result of organizational differences
  - The number and knowledge of employees
- Our aim is to understand empirically how firms are organized
  - Does this matter?
    - ★ Yes, because firms change organization as a result of changes in the economic environment
    - ★ Yes, because the organization of firms has aggregate consequences
- Empirical analysis is guided by Caliendo and Rossi-Hansberg (2012)
  - We divide firms into layers of employees
  - Study levels and changes in wages, spans of control, and number of employees: overall and for each layer
  - Study the effect of exporting on within-firm organization

Related Literature

- Model of organization based on Garicano (2000)
  - Applied to GE in Garicano and Rossi-Hansberg (2004, 2006, 2011)
  - With heterogeneus firms in a product market:
    - ⋆ Caliendo and Rossi-Hansberg (2012)
- Few empirical studies on organizational change
  - Baker, Gibbs, and Holmstrom (1994): Study wage policies and promotions in a firm
  - Rajan and Wulf (2006) find that hierarchies have "flattened" over time and decentralized their decision making
  - Garicano and Hubbard (2007) find that as market size increases the span of control of upper-level individuals increases
  - Guadalupe and Wulf (2010) show delayering as a result of trade competition

Sketch of Theory in CRH (2012): Cost Minimization

- Consider a firm that produces a quantity q. $C_L(q; w)$ is the minimum cost of producing q with an organization with L layers, namely,

$$C_L(q; w) = \min_{\{n_L^\ell, z_L^\ell\}_{l=1}^L \geq 0} \sum_{\ell=1}^L n_L^\ell w_L^\ell$$

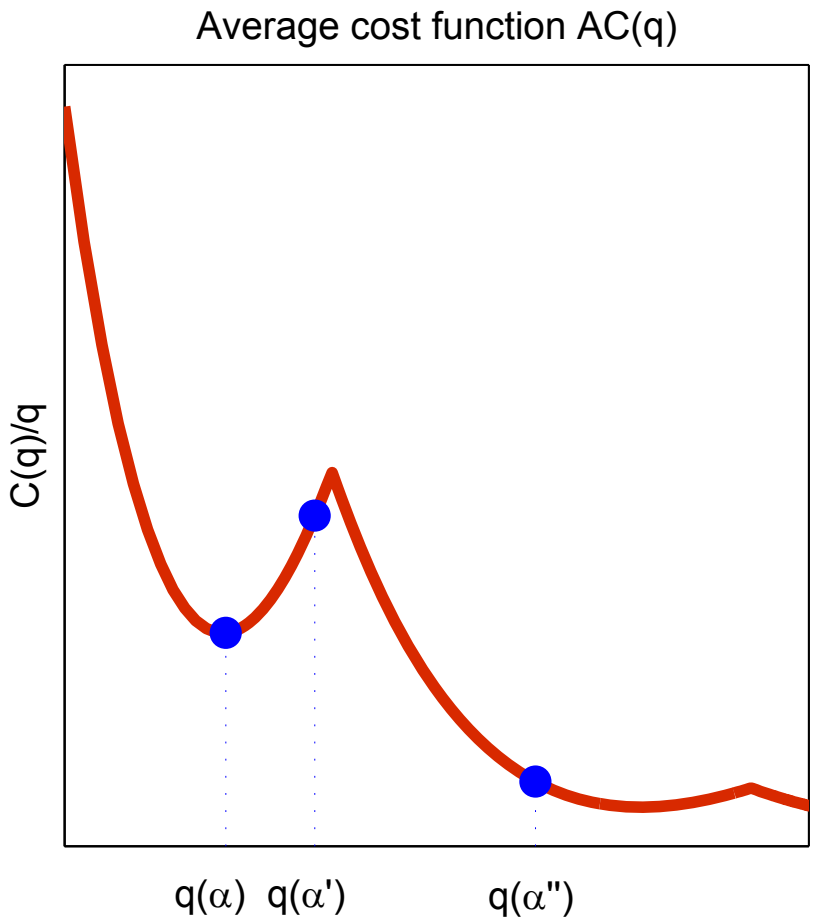
subject to

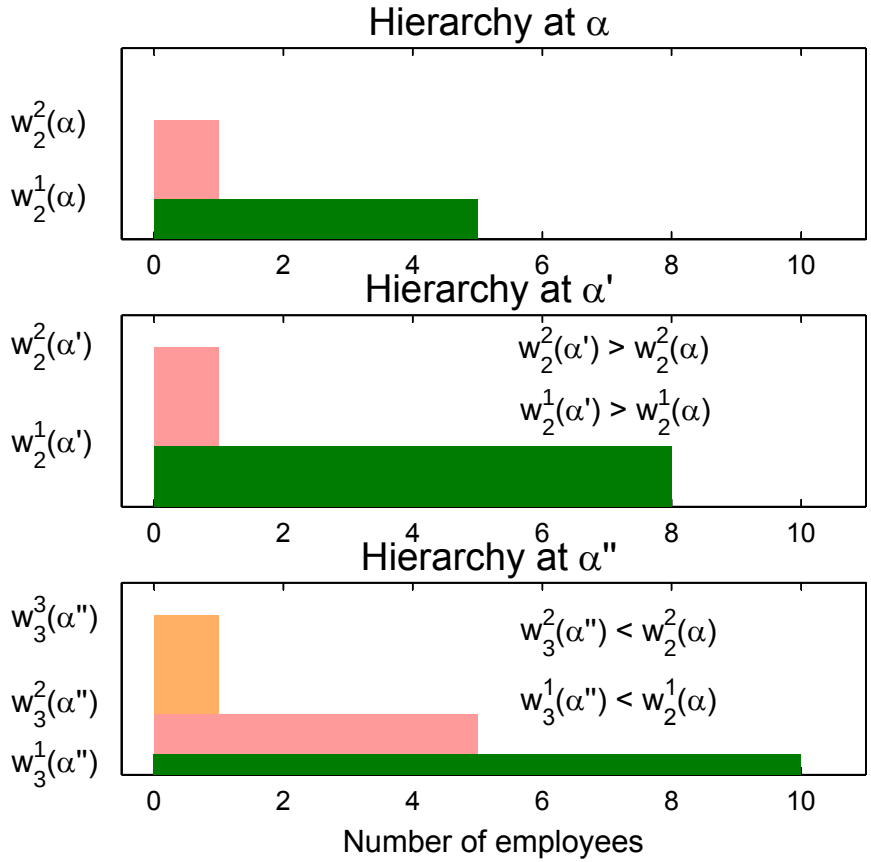
$$\begin{aligned} q &\leq F(Z_L^L) n_L^1, \\ w_L^\ell &= \bar{w}[cz_L^\ell + 1] \text{ for all } \ell \leq L, \\ n_L^\ell &= h n_L^1 [1 - F(Z_L^{\ell-1})] \text{ for } L \geq \ell > 1, \\ n_L^L &= 1. \end{aligned}$$

- The *variable* cost function is given by

$$C(q; w) = \min_{L \geq 1} \{C_L(q; w)\}$$

Sketch of Theory in CRH (2012)





Implications of the Model

1) Firms are hierarchical, $n_L^1 \geq ...n_L^\ell ... \geq n_L^L$ for all L

2) Layers L, sales pq, and total labor demand $\sum_{\ell=1}^{L} n_L^\ell$, increase with α

3) Given L, w_L^ℓ and n_L^ℓ increase with α at all ℓ

4) Given α, w_L^ℓ *decreases* and n_L^ℓ increases with an increase in L at all ℓ

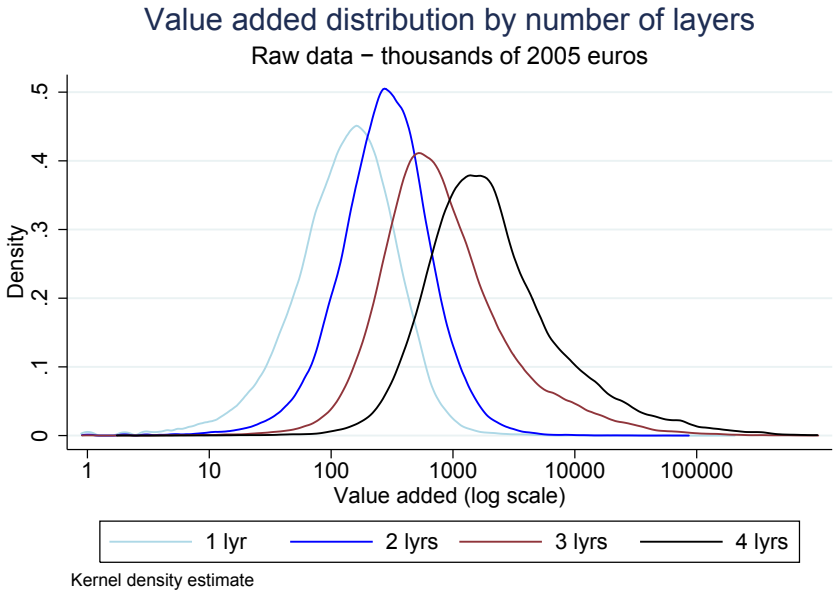
Data description

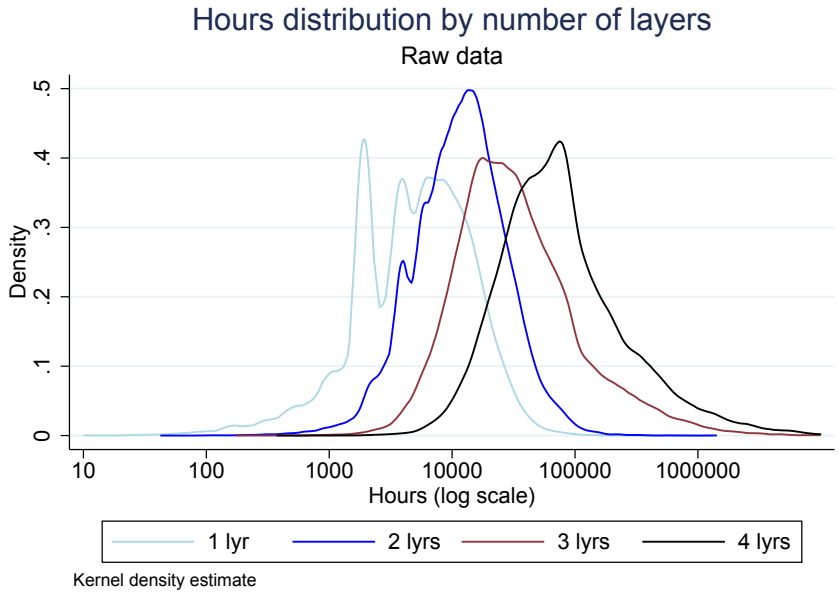
- Dataset collected by the French National Statistical Institute (INSEE)
  - We use the period from 2002 to 2007
    - ★ Before 2002 different occupational categories
- We match two sources from mandatory reports:
  - BRN: private firms balance sheet data
    - ★ 553,125 firm-year observations in manufacturing
  - DADS: occupation, hours and earning reports of salaried employees
- We lose 11% of the observations from cleaning, and 5.9% from matching
- The sample covers on average 90.7% of total value added in manufacturing
  - Small firms can choose not to report in BRN, but insignificant in terms of value added

Layers: occupational categories

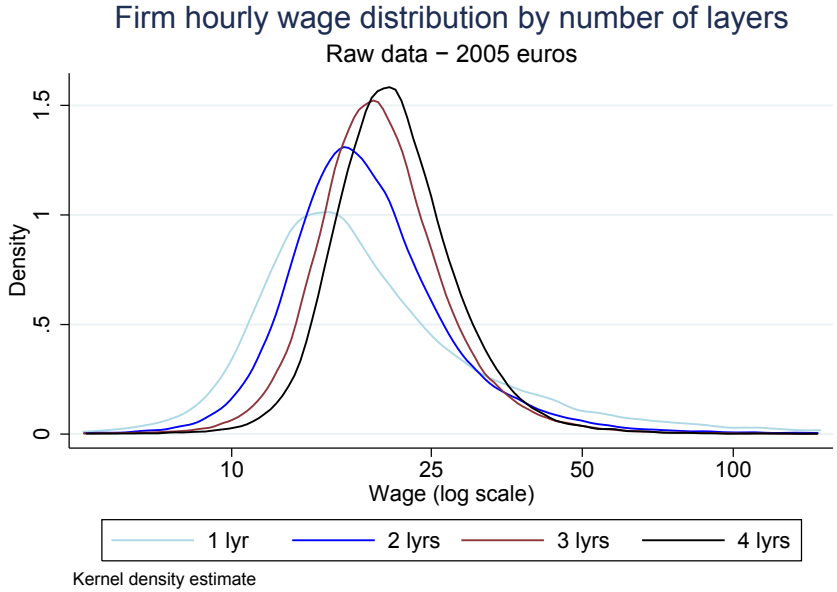
- PCS-ESE classification codes that belong to manufacturing:
  2. Firm owners receiving a wage
     - ⋆ CEO or firm directors
  3. Senior staff or top management positions
     - ⋆ chief financial officers, head of HR, logistics, purchasing managers
  4. Employees at the supervisor level
     - ⋆ quality control technicians, technical, accounting, and sales supervisors
  5. Qualified and non-qualified clerical employees (administrative tasks)
     - ⋆ secretaries, HR or accounting, telephone operators, sales employees
  6. Blue collar qualified and non-qualified workers (manual tasks)
     - ⋆ welders, assemblers, machine operators and maintenance
- Classification code 1 (farmers) does not belong to manufacturing
- We group 5 and 6 since the distribution of wages coincide ▸ data

Firms with different number of layers are different





Year	Firms	Average # of layers
2002	78,494	2.60
2003	76,927	2.58
2004	75,555	2.59
2005	74,806	2.55
2006	73,834	2.53
2007	71,859	2.51



# of layers	Firm-years
1	80,326
2	124,448
3	160,030
4	86,671

▶ Fixed effects

Firms with adjacent occupational categories

- We select the sub-sample of firms that satisfy the following criteria:
  - Layer 1 firms are firms with occupation codes 6 and 5
  - Layer 2 firms are firms with occupation codes 6, 5 and 4
  - Layer 3 firms are firms with occupation codes 6, 5, 4 and 3
  - Layer 4 firms are firms with occupation codes 6, 5, 4, 3 and 2

Percentage of firms that have adjacent layers					
	Among firms with				All firms
	1 layer	2 layers	3 layers	4 layers	
Unweighted	87.42	67.39	80.01	100	81.69
Weighted by *VA*	87.69	68.40	94.60	100	96.73
Weighted by hours	99.17	72.56	93.07	100	95.69

▸ Fraction of firms that transition to an adjacent layer

Hours and wages are hierarchical

Percentage of firms that satisfy a hierarchy

N_L^ℓ = hours at layer ℓ of a firm with L layers

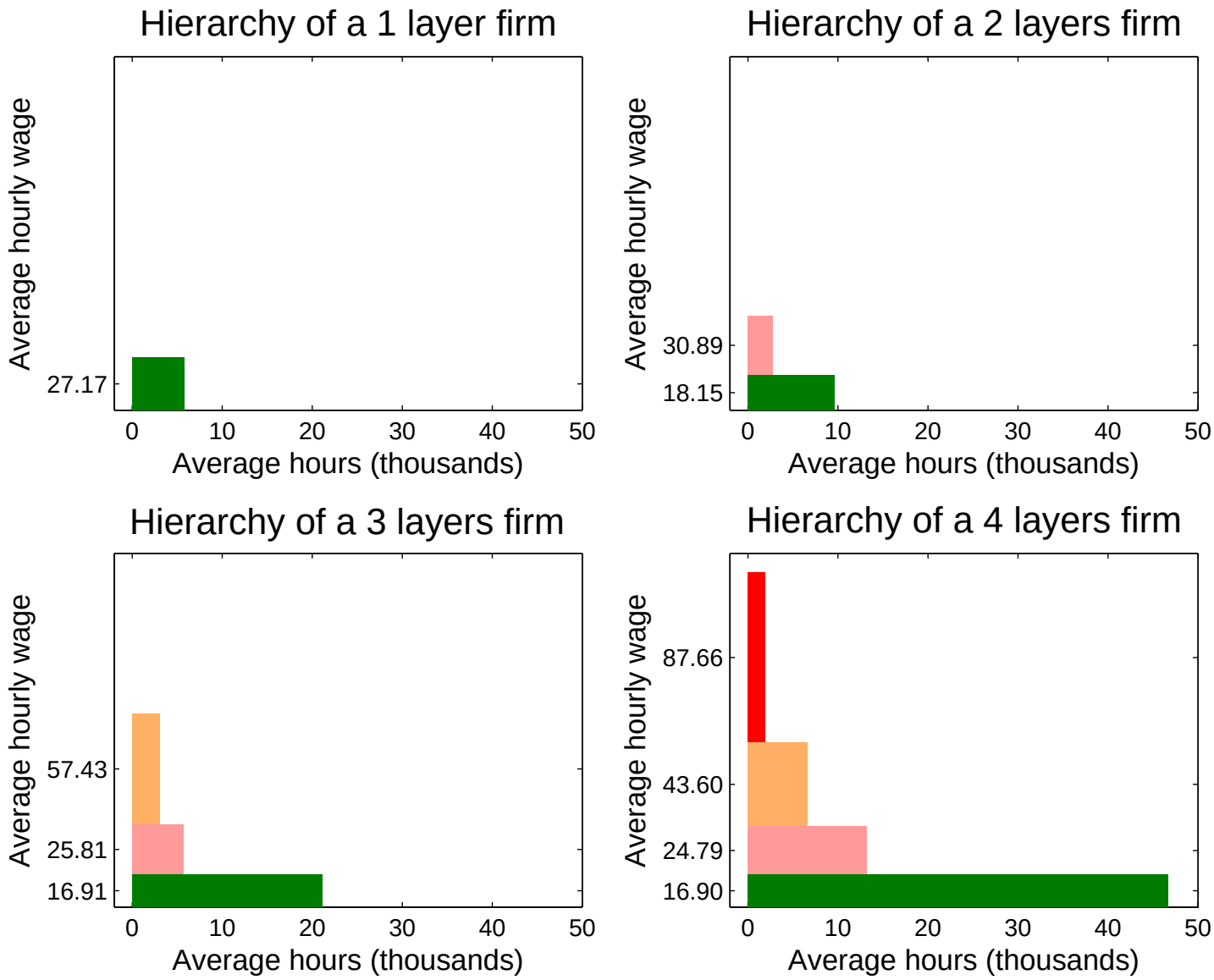
	Unweighted			
# of layers	$N_L^\ell \geq N_L^{\ell+1}$ all ℓ	$N_L^1 \geq N_L^2$	$N_L^2 \geq N_L^3$	$N_L^3 \geq N_L^4$
2	85.6	85.6	-	-
3	63.4	85.9	74.8	-
4	56.5	86.9	77.5	86.9

	Unweighted			
# of layers	$w_L^{\ell+1} \geq w_L^\ell$ all ℓ	$w_L^2 \geq w_L^1$	$w_L^3 \geq w_L^2$	$w_L^4 \geq w_L^3$
2	92.1	92.1	-	-
3	86.3	93.7	92.5	-
4	80.1	96.6	94.5	87.9

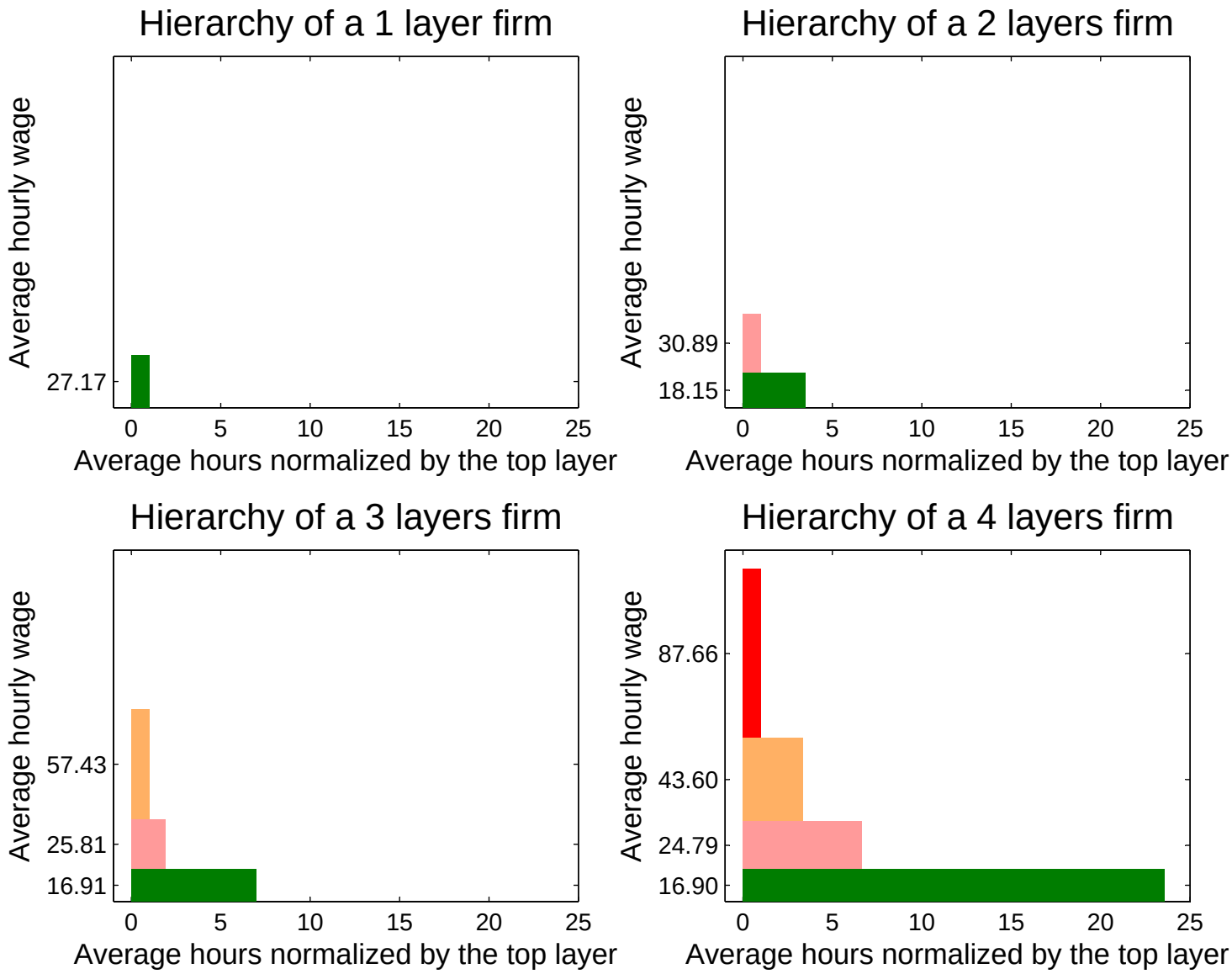
Variation in log wages

Mean share variation of wages explained by cross-layer variation				
			Weighted by	
	Firm-years	Unweighted	Hours	*VA*
All firms	434,872	0.50	0.51	0.49
Firms with more than 0 layers	370,997	0.59	0.51	0.50
Firms with 1 layer	63,875	0.00	0.00	0.00
Firms with 2 layers	124,299	0.50	0.41	0.43
Firms with 3 layers	160,028	0.62	0.51	0.50
Firms with 4 layers	86,670	0.66	0.53	0.50

Representative hierarchies



Representative hierarchies: normalized hours



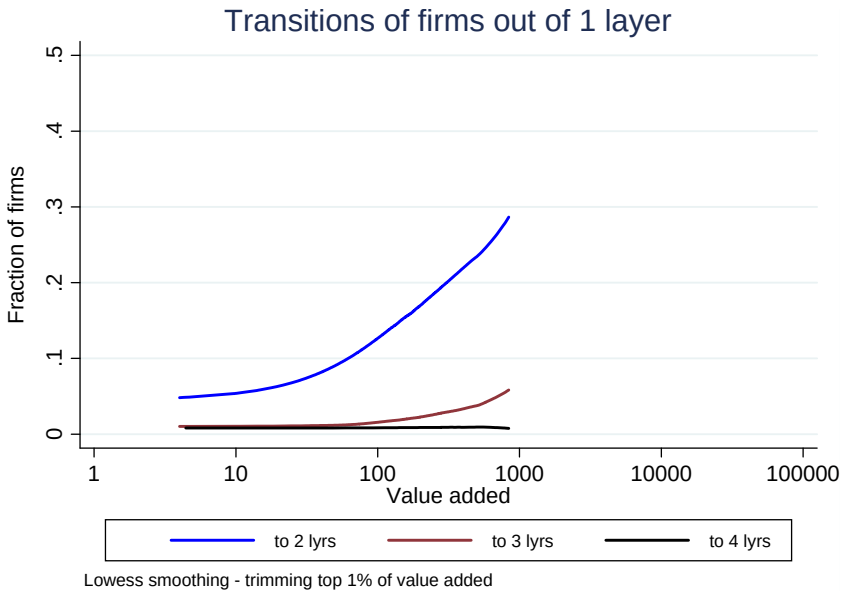
Layer transitions

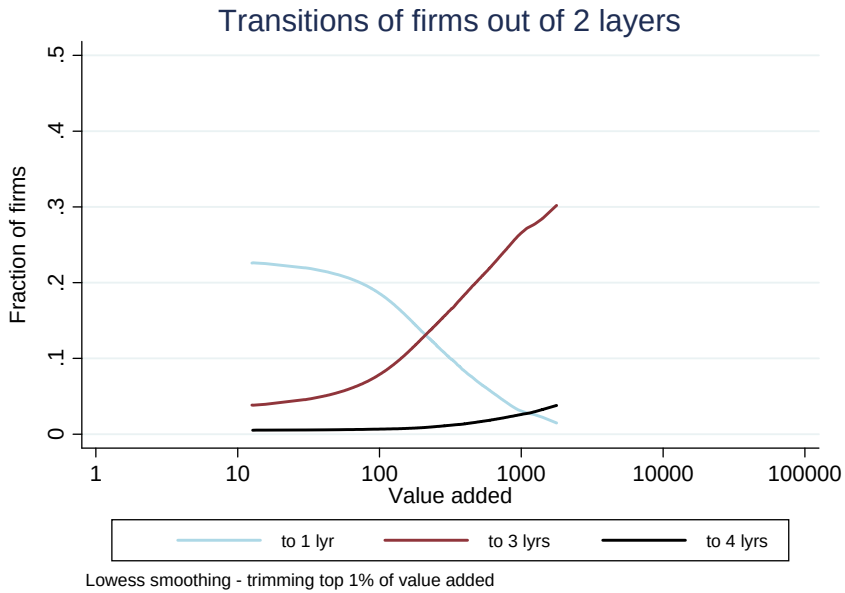
Distribution of # of layers at time t+1 given the # of layers at time t

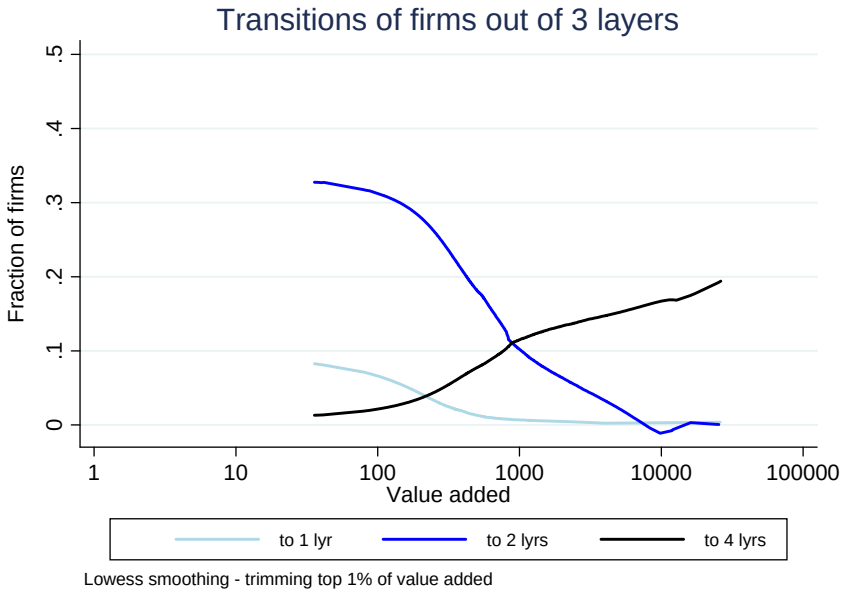
		# of layers at $t+1$					
		Exit	1	2	3	4	Total
# of layers at t	1	15.3	**67.5**	15.2	1.9	0.2	100
	2	9.8	10.7	**62.2**	16.2	1.1	100
	3	7.7	1.2	13.1	**67.6**	10.5	100
	4	6.2	0.2	2.0	20.5	**71.3**	100

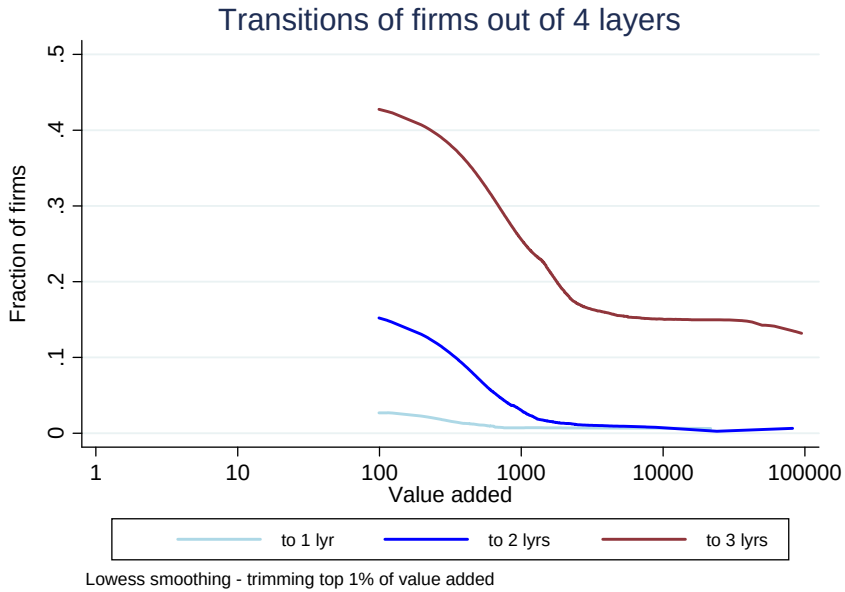
▸ Weighted by VA

Transitions across layers depend on value added

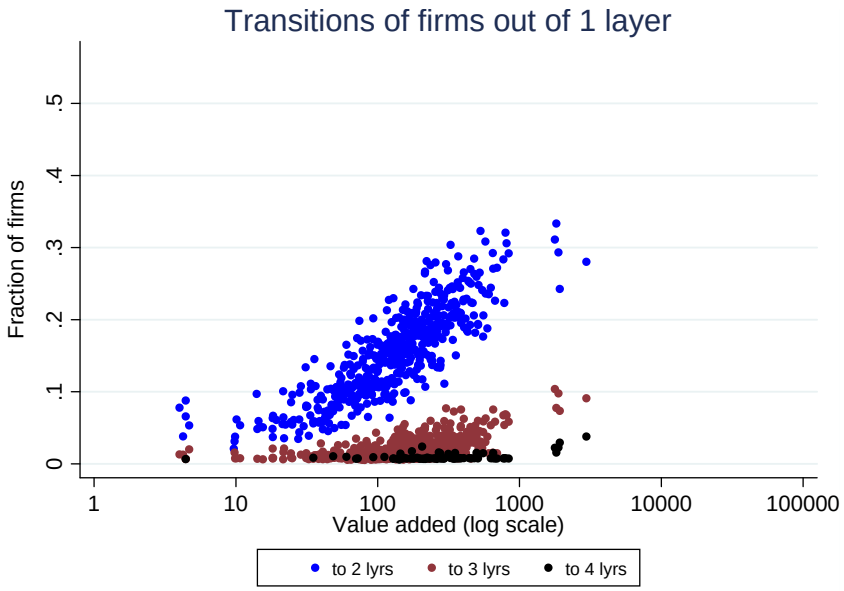


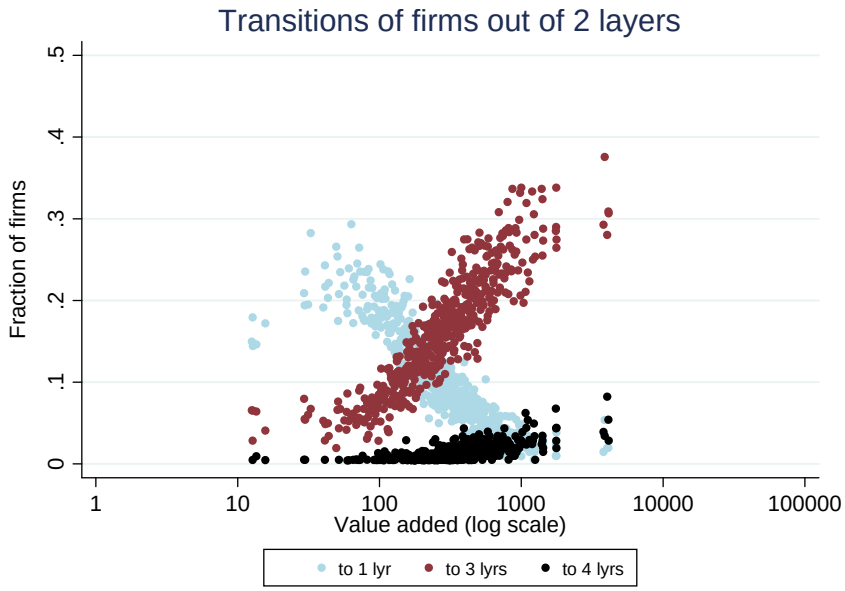


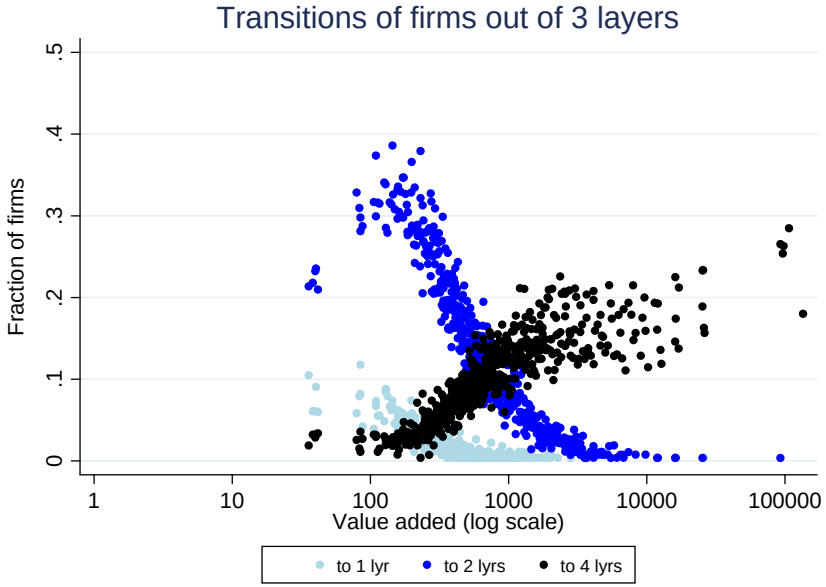


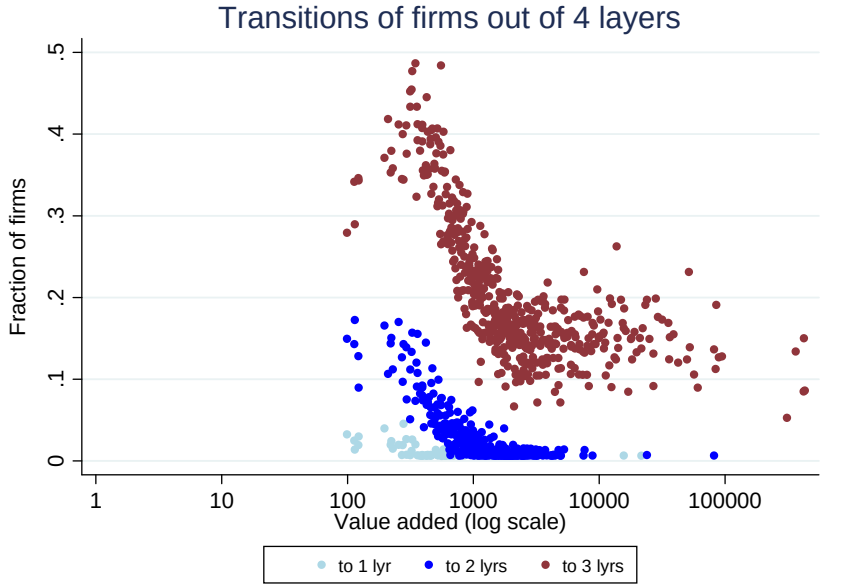


Transitions across layers depend on value added

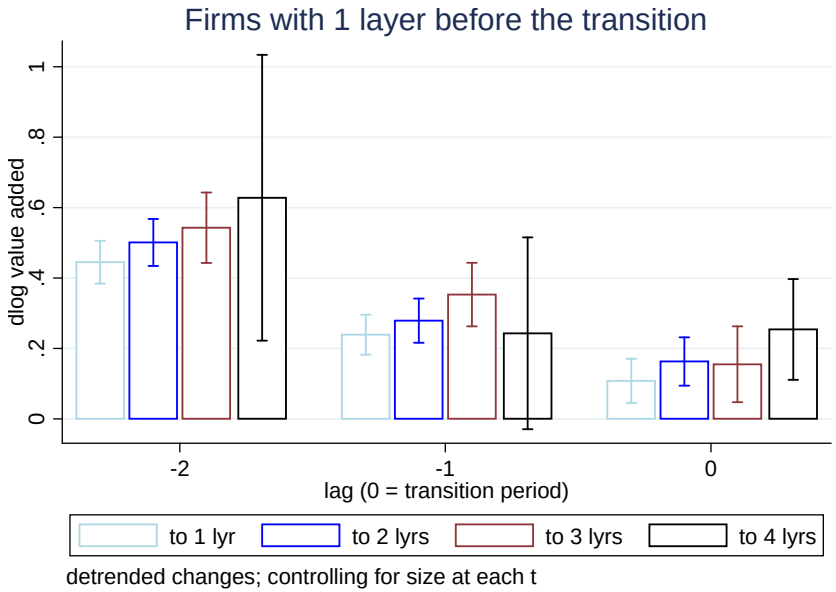


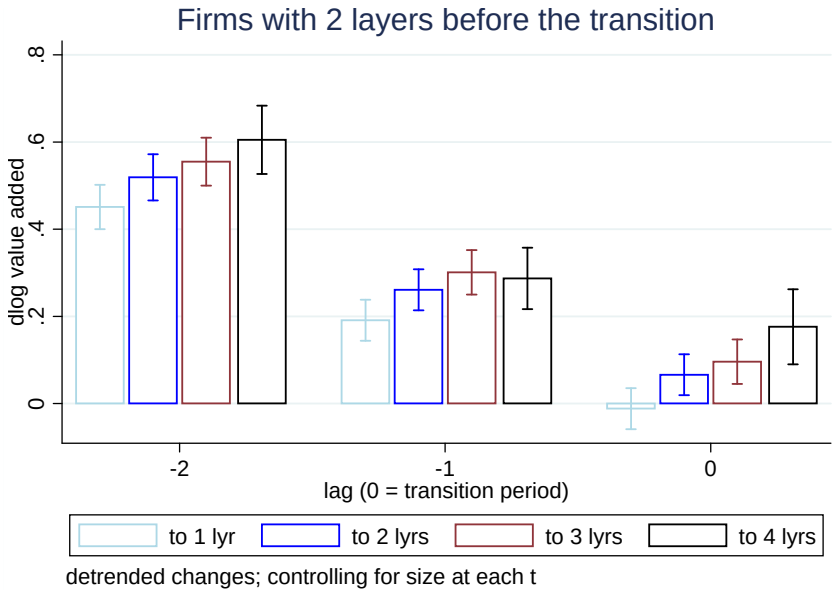


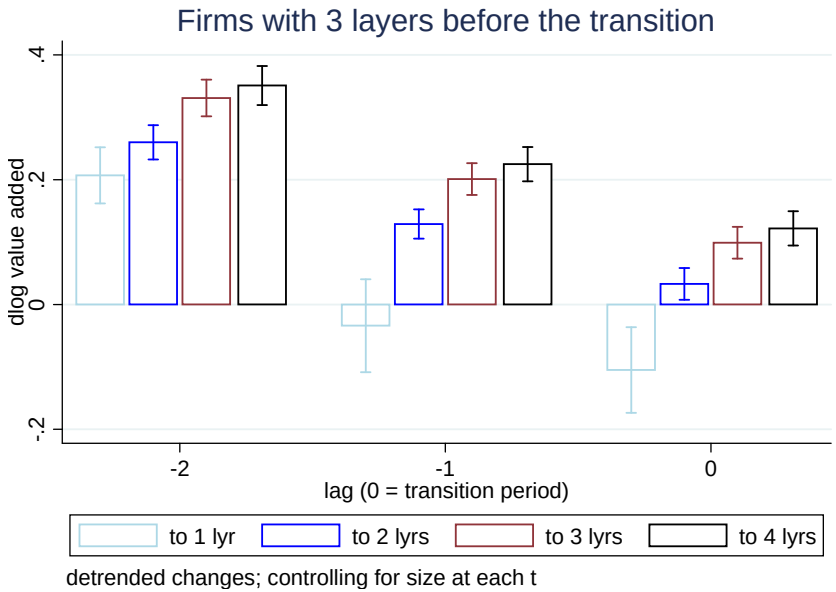


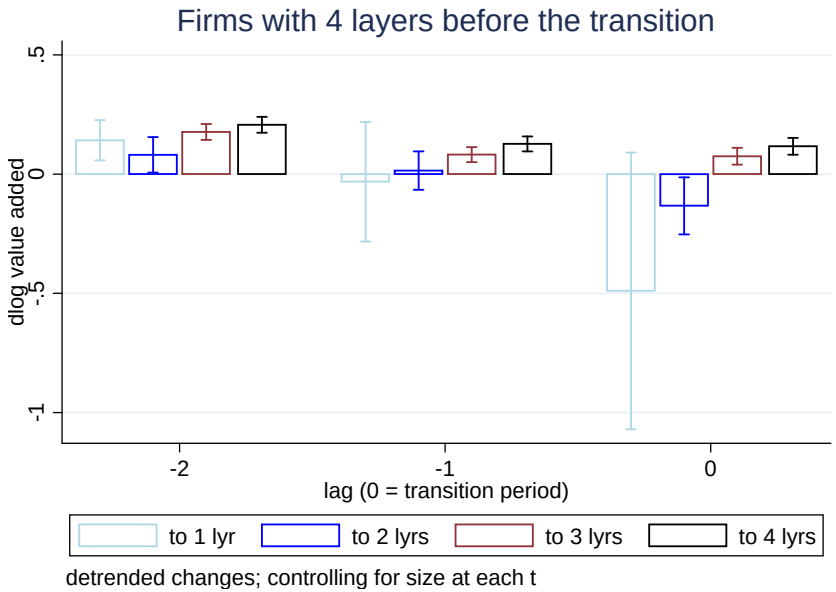


Trends before adding or dropping layers









Change in firm level outcomes during transition

Average behavior of firms by change in the number of layers

	All	Increase L	No change in L	Decrease L
d lnhours	-0.015***	0.040***	-0.012***	-0.081***
- detrended	-	0.055***	0.003***	-0.066***
$d \ln \sum_{\ell=0}^{L} n_L^\ell$	-0.011***	1.362***	0.012***	-1.404***
- detrended	-	1.373***	0.023***	-1.392***
$d \ln VA$	-0.008***	0.032***	-0.007***	-0.050***
- detrended	-	0.040***	0.001	-0.041***
d ln avg wage	0.019***	0.015***	0.019***	0.025***
- detrended	-	-0.005***	-0.000	0.006***
- common layers	*0.021****	*-0.101****	*0.019****	*0.143****
- - detrended	-	-0.122***	-0.002***	0.122***
% firms	100	12.65	73.66	13.68
% VA change	100	40.12	65.08	-5.19

*** significant at 1%.

▸ Sources of changes during transition

Normalized hours change according to the theory

- Average log change in normalized hours for firms that transition

# of layers		Layer	Change	s.e.	p-value	obs
Before	After					
1	2	1	1.537	0.018	0.00	10177
1	3	1	1.762	0.056	0.00	1263
1	4	1	2.266	0.212	0.00	97
2	1	1	-1.582	0.017	0.00	11106
2	3	1	0.716	0.012	0.00	16800
2	3	2	0.539	0.012	0.00	16800
2	4	1	1.205	0.049	0.00	1129
2	4	2	1.004	0.048	0.00	1129
3	1	1	-1.795	0.048	0.00	1584
3	2	1	-0.682	0.012	0.00	17666
3	2	2	-0.518	0.012	0.00	17666
3	4	1	1.352	0.014	0.00	14113
3	4	2	1.289	0.016	0.00	14113
3	4	3	1.174	0.016	0.00	14113
4	1	1	-2.119	0.173	0.00	123
4	2	1	-1.059	0.041	0.00	1456
4	2	2	-0.918	0.040	0.00	1456
4	3	1	-1.411	0.014	0.00	15160
4	3	2	-1.345	0.015	0.00	15160
4	3	3	-1.260	0.015	0.00	15160

Normalized hours change according to the theory

- Elasticity of n_L^ℓ with VA for firms that do not change L
- Reporting β_L^ℓ from $d \ln n_{Lit}^\ell = \alpha_L^\ell + \beta_L^\ell d \ln VA_{it} + \varepsilon_{it}$

# of layers in the firm (L)	Layer ℓ	β_L^ℓ	s.e.	p-value	obs
2	1	0.042	0.012	0.00	64,536
3	1	0.039	0.009	0.00	91,253
3	2	0.013	0.010	0.20	91,253
4	1	0.107	0.014	0.00	52,799
4	2	0.051	0.013	0.00	52,799
4	3	0.037	0.013	0.00	52,799

Wages change according to the theory

- Average log change in wages for firms that transition

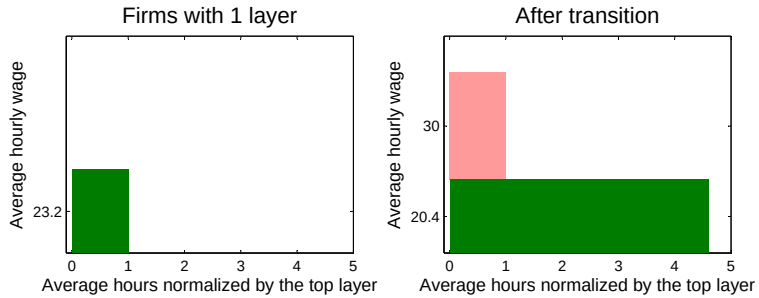
# of layers		Layer	Change	s.e.	p-value	obs
Before	After					
1	2	1	-0.129	0.005	0.00	10177
1	3	1	-0.332	0.020	0.00	1263
1	4	1	-0.678	0.117	0.00	97
2	1	1	0.167	0.005	0.00	11106
2	3	1	-0.050	0.002	0.00	16800
2	3	2	-0.255	0.004	0.00	16800
2	4	1	-0.150	0.015	0.00	1129
2	4	2	-0.409	0.019	0.00	1129
3	1	1	0.356	0.018	0.00	1584
3	2	1	0.059	0.002	0.00	17666
3	2	2	0.249	0.004	0.00	17666
3	4	1	-0.021	0.002	0.00	14113
3	4	2	-0.067	0.003	0.00	14113
3	4	3	-0.199	0.004	0.00	14113
4	1	1	0.804	0.109	0.00	123
4	2	1	0.139	0.012	0.00	1456
4	2	2	0.372	0.016	0.00	1456
4	3	1	0.009	0.002	0.00	15160
4	3	2	0.040	0.003	0.00	15160
4	3	3	0.134	0.004	0.00	15160

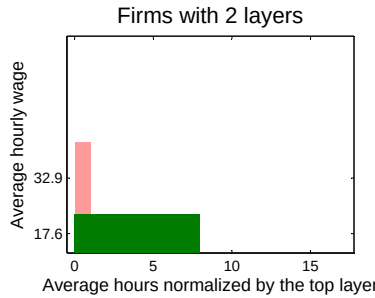
Wages change according to the theory

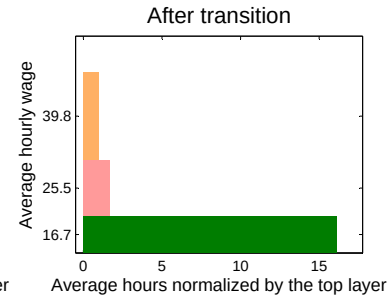
- Elasticity of w_L^ℓ with VA for firms that do not change L
- Reporting γ_L^ℓ from $d \ln w_{Lit}^\ell = \delta_L^\ell + \gamma_L^\ell d \ln VA_{it} + \varepsilon_{it}$

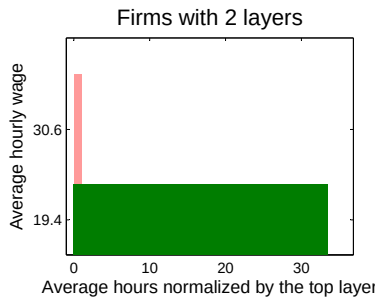
# of layers in the firm (L)	Layer ℓ	γ_L^ℓ	s.e.	p-value	obs
1	1	0.077	0.007	0.00	45,045
2	1	0.100	0.006	0.00	64,536
2	2	0.118	0.006	0.00	64,536
3	1	0.145	0.006	0.00	91,253
3	2	0.155	0.006	0.00	91,253
3	3	0.170	0.006	0.00	91,253
4	1	0.171	0.009	0.00	52,799
4	2	0.185	0.009	0.00	52,799
4	3	0.186	0.010	0.00	52,799
4	4	0.217	0.011	0.00	52,799

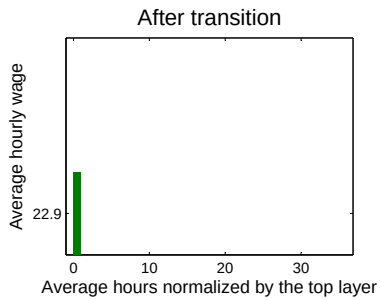
Representative hierarchies for one layer transitions

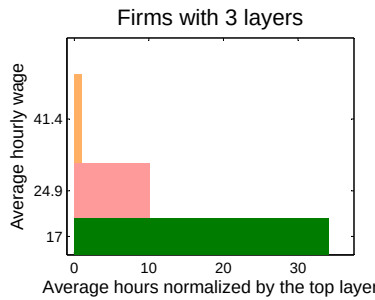


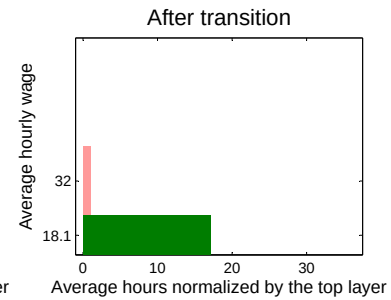


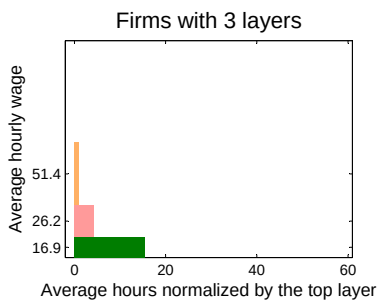


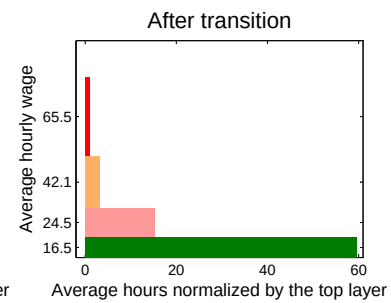


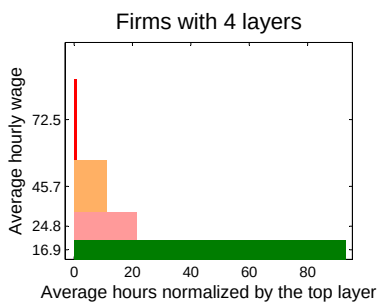


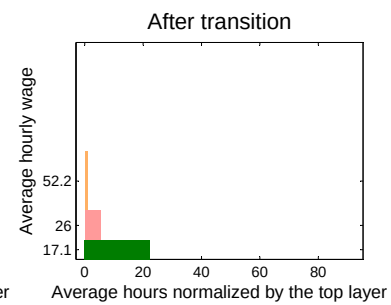




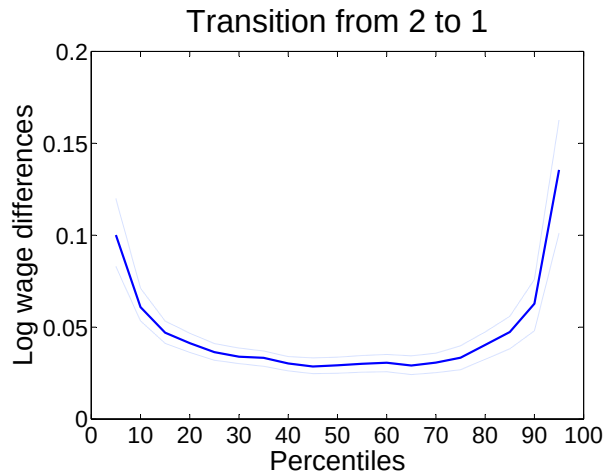


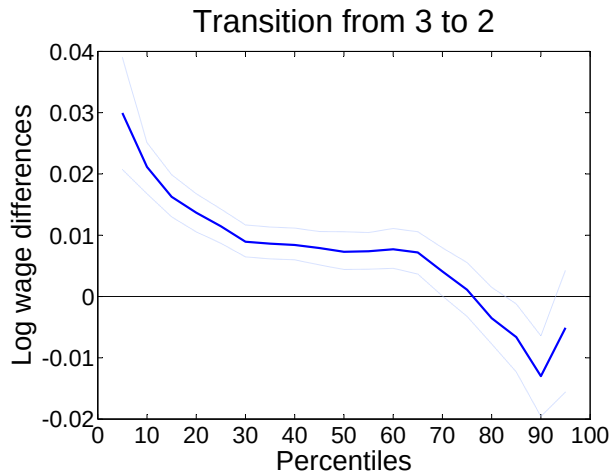


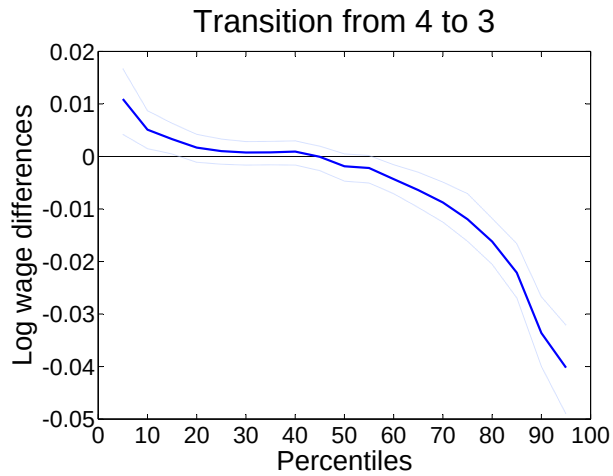


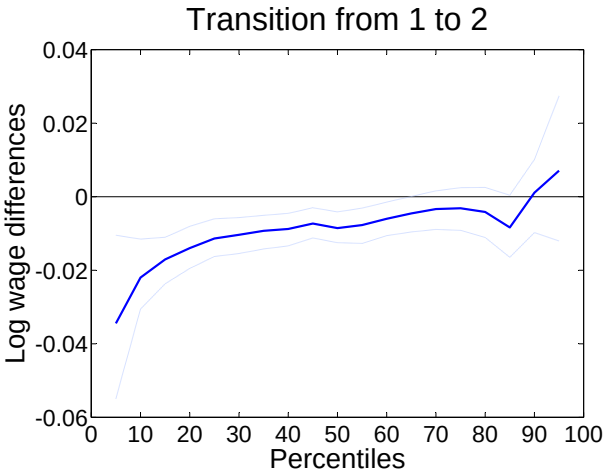


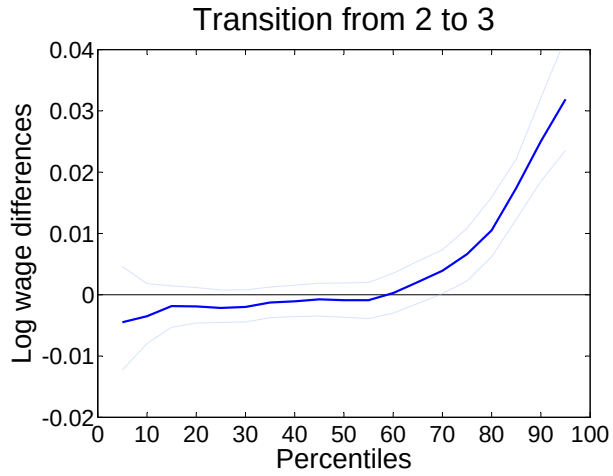
Distribution of wages after minus before transition

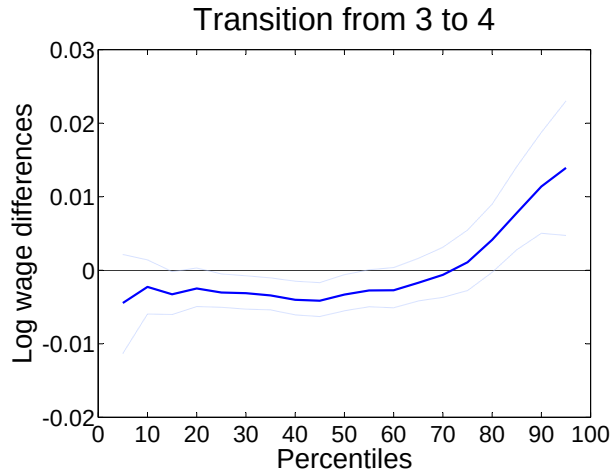






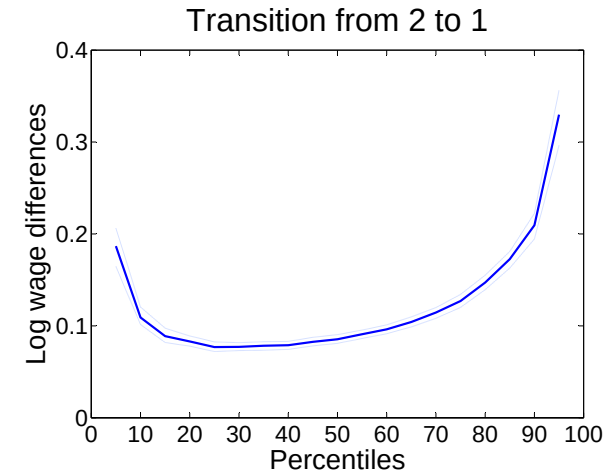


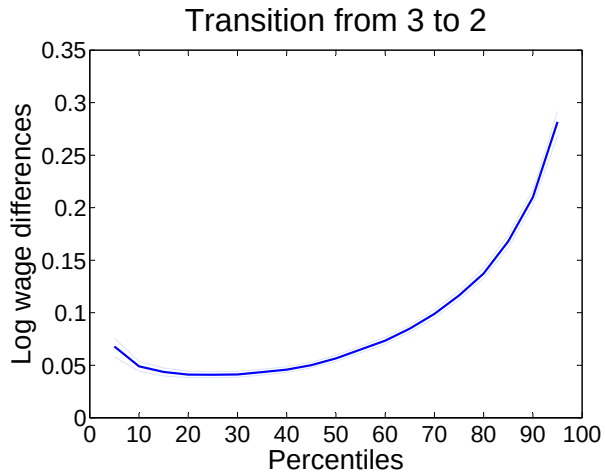


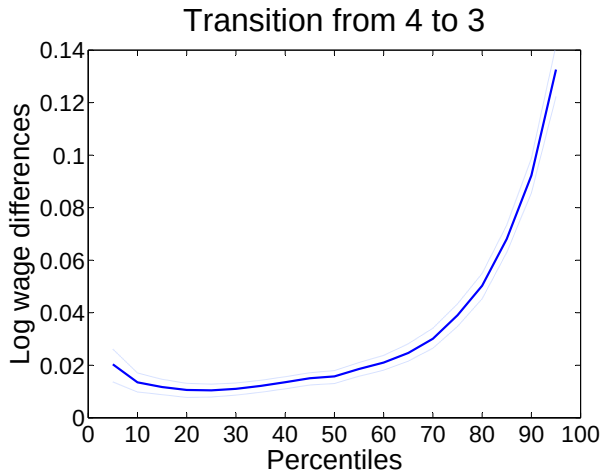


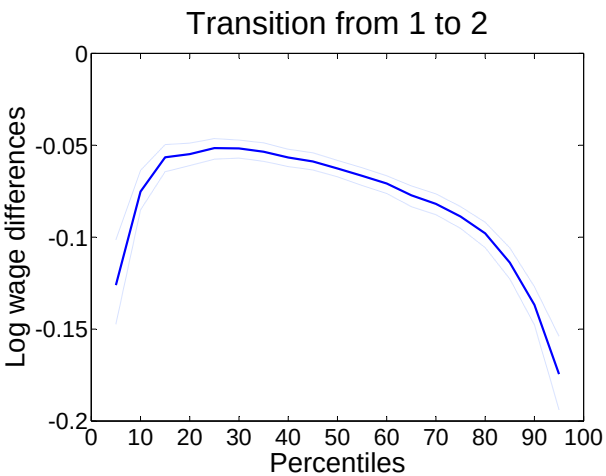
Distribution of wages after minus before transition

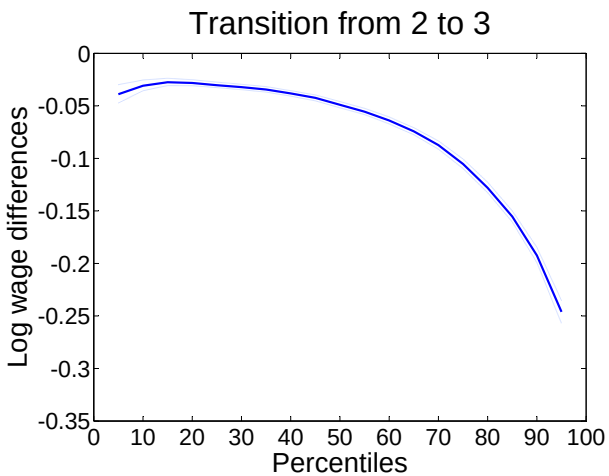
Common layers

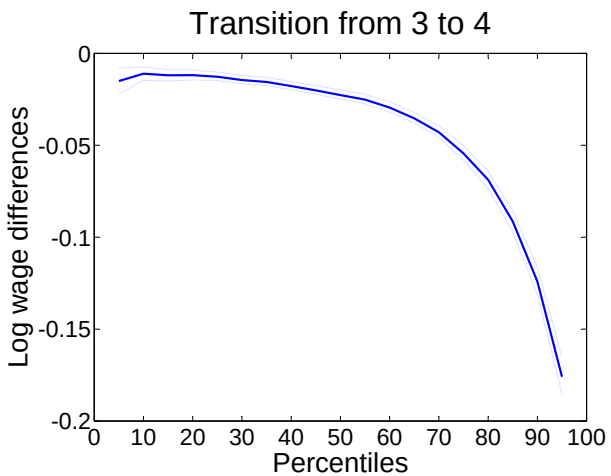






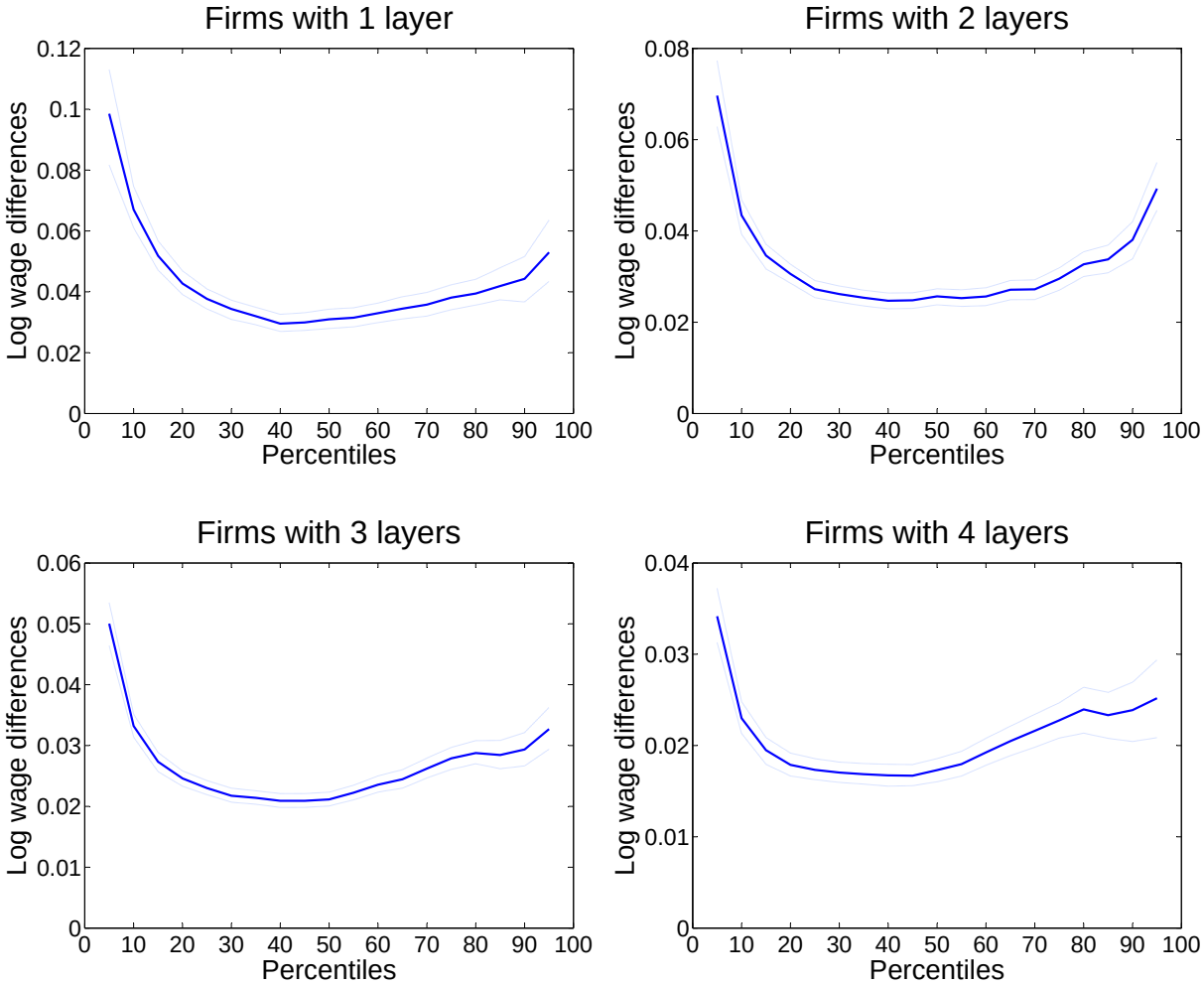






Distribution of wages after minus before

Conditioning on increase in VA > 0 and no transition



▸ Conditioning on decrease in VA

How do firms change the average wage in a layer?

Extensive versus intensive margin

Log diff. in hourly wage (after minus before the transition) for hours staying in the layer

# of layers		Layer	Change	s.e.	p-value	obs
Before	After					
1	2	1	-0.007	0.00	0.11	8625
1	3	1	-0.076	0.02	0.00	939
1	4	1	-0.262	0.13	0.05	64
2	1	1	0.095	0.00	0.00	9500
2	3	1	0.011	0.00	0.00	14948
2	3	2	0.011	0.00	0.00	9275
2	4	1	-0.039	0.01	0.00	956
2	4	2	-0.046	0.02	0.02	523
3	1	1	0.187	0.02	0.00	1225
3	2	1	0.040	0.00	0.00	15857
3	2	2	0.068	0.00	0.00	9954
3	4	1	0.007	0.00	0.00	13354
3	4	2	0.015	0.00	0.00	11907
3	4	3	0.024	0.00	0.00	8858
4	1	1	0.495	0.13	0.00	77
4	2	1	0.081	0.01	0.00	1256
4	2	2	0.134	0.02	0.00	715
4	3	1	0.022	0.00	0.00	14384
4	3	2	0.028	0.00	0.00	12853
4	3	3	0.033	0.00	0.00	10279

Log diff. in hourly wage of hours entering the layer (after transition) versus hours leaving the layer (before transition)

# of layers		Layer	Change	s.e.	p-value	obs
Before	After					
1	2	1	-0.266	0.01	0.00	7354
1	3	1	-0.454	0.02	0.00	1046
1	4	1	-0.683	0.11	0.00	82
2	1	1	0.200	0.01	0.00	7638
2	3	1	-0.137	0.00	0.00	13160
2	3	2	-0.397	0.01	0.00	11201
2	4	1	-0.226	0.02	0.00	947
2	4	2	-0.501	0.02	0.00	896
3	1	1	0.393	0.02	0.00	1224
3	2	1	0.050	0.00	0.00	13476
3	2	2	0.354	0.01	0.00	11328
3	4	1	-0.099	0.00	0.00	12506
3	4	2	-0.165	0.00	0.00	9952
3	4	3	-0.354	0.01	0.00	10240
4	1	1	0.740	0.11	0.00	106
4	2	1	0.159	0.02	0.00	1198
4	2	2	0.454	0.02	0.00	1106
4	3	1	-0.052	0.00	0.00	13453
4	3	2	0.002	0.00	0.59	10656
4	3	3	0.169	0.01	0.00	10332

▶ Hourly wage of entrants and leavers versus hourly wage of stayers

How do firms change the average wage in a layer?

Education or experience to adjust knowledge and wages

Elasticity of 'knowledge' with *VA* for firms that do not change *L*						
# of layers	Layer	Experience	p-value	Education	p-value	obs
1	1	0.0014	0.69	0.0015	0.03	45,009
2	1	-0.0101	0.01	0.0042	0.00	64,469
2	2	0.0094	0.03	0.0032	0.00	64,469
3	1	-0.0103	0.00	0.0038	0.00	91,161
3	2	-0.0011	0.97	0.0026	0.00	91,161
3	3	0.0077	0.00	0.0011	0.10	91,161
4	1	-0.0154	0.00	0.0027	0.00	52,730
4	2	-0.0036	0.28	0.0026	0.00	52,730
4	3	-0.0001	0.97	0.0002	0.79	52,730
4	4	0.0073	0.02	-0.0030	0.07	52,730

How do firms change the average wage in a layer?

Education or experience to adjust knowledge and wages

Average change in 'knowledge' for firms that change L

# of layers Before	# of layers After	Layer	Experience	p-value	Education	p-value	obs
1	2	1	-0.108	0.00	-0.004	0.00	10,171
1	3	1	-0.184	0.00	-0.003	0.29	1,261
1	4	1	-0.330	0.00	0.025	0.03	97
2	1	1	0.096	0.00	0.005	0.00	11,088
2	3	1	-0.044	0.00	0.000	0.82	16,778
2	3	2	-0.181	0.00	0.002	0.01	16,778
2	4	1	-0.064	0.00	0.002	0.29	1,124
2	4	2	-0.228	0.00	0.008	0.01	1,124
3	1	1	0.137	0.00	0.006	0.00	1,584
3	2	1	0.044	0.00	0.002	0.53	17,626
3	2	2	0.153	0.00	0.000	0.00	17,626
3	4	1	-0.011	0.00	0.001	0.10	14,098
3	4	2	-0.038	0.00	-0.001	0.00	14,098
3	4	3	-0.176	0.00	0.024	0.82	14,098
4	1	1	0.197	0.00	-0.002	0.95	123
4	2	1	0.073	0.00	0.000	0.12	1,454
4	2	2	0.172	0.00	-0.005	0.00	1,454
4	3	1	0.013	0.00	-0.002	0.26	15,150
4	3	2	0.025	0.00	-0.001	0.00	15,150
4	3	3	0.113	0.00	-0.020	0.00	15,150

Exporters - data description

Composition of firms by number of layers (percentage)

# of layers	Non-exporters	Exporters
0	26.4	7.5
1	34.3	19.5
2	29.4	42.6
3	9.9	30.4
Total	100	100

Layer transitions for exporters

Difference in the distribution of # of layers at time t+1 given the # of layers at time t

New exporters relative to non-exporters					
		# of layers at $t+1$			
		0	1	2	3
# of layers at t	0	-9.43	6.61	2.31	0.51
	1	-2.57	-3.49	5.29	0.77
	2	-0.87	-4.83	2.84	2.87
	3	-0.18	-2.20	-2.45	4.83

All significant at 1%.

Average behavior of firms that enter into the export market

	All	Increase L	No change in L
dlnhours	0.021***	0.126***	0.015***
- detrended	0.035***	0.141***	0.029***
dln $\sum_{\ell=0}^{L} n_L^\ell$	0.008	1.237***	0.024***
- detrended	0.019***	1.248***	0.035***
dln *VA*	0.038***	0.116***	0.033***
- detrended	0.046***	0.125***	0.041***
dln avg wage	0.018***	0.000	0.021***
- detrended	-0.000	-0.018**	0.003
- common layers	*0.018***	*-0.119***	*0.021***
- - detrended	-0.002	-0.139***	0.001
% firms	100	14.62	70.61
% VA change	100	18.62	73.66

** significant at 5%, *** significant at 1%.

Normalized hours change according to the theory

- Average log change in normalized hours for firms that transition and change export status

# of layers		Layer	Change	s.e.	p-value	obs
Before	After					
0	1	0	1.482	0.074	0.00	528
0	2	0	1.536	0.195	0.00	95
0	3	0	2.990	0.289	0.00	15
1	0	0	-1.482	0.084	0.00	520
1	2	0	0.670	0.046	0.00	1132
1	2	1	0.584	0.045	0.00	1132
1	3	0	0.936	0.175	0.00	91
1	3	1	0.907	0.149	0.00	91
2	0	0	-1.561	0.213	0.00	100
2	1	0	-0.600	0.046	0.00	1119
2	1	1	-0.438	0.048	0.00	1119
2	3	0	1.070	0.049	0.00	861
2	3	1	1.006	0.057	0.00	861
2	3	2	0.877	0.056	0.00	861
3	0	0	-2.900	0.304	0.00	16
3	1	0	-1.162	0.161	0.00	105
3	1	1	-0.880	0.156	0.00	105
3	2	0	-1.228	0.056	0.00	872
3	2	1	-1.159	0.061	0.00	872
3	2	2	-1.045	0.059	0.00	872

Normalized hours change according to the theory

- Firms that change export status and do not change L
- Reporting β_L^ℓ from $d \ln n_{Lit}^\ell = \alpha_L^\ell + \beta_L^\ell d \ln VA_{it} + \varepsilon_{it}$

# of layers in the firm (L)	Layer ℓ	β_L^ℓ	s.e.	p-value	obs
1	0	-0.011	0.035	0.76	6,968
2	0	0.017	0.024	0.47	10,507
2	1	-0.015	0.027	0.58	10,507
3	0	0.200	0.053	0.00	4,896
3	1	0.073	0.038	0.06	4,896
3	2	0.084	0.042	0.05	4,896

Wages change according to the theory

- Average log change in wages for firms that transition and change export status

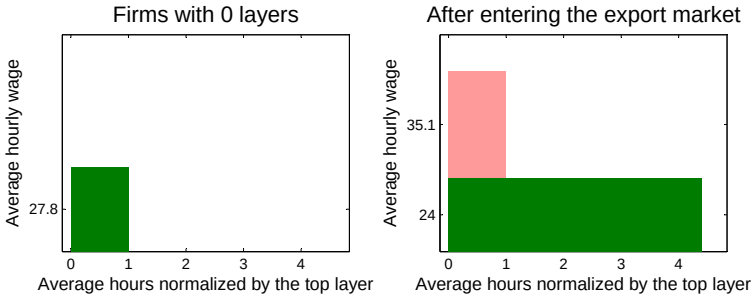
# of layers		Layer	Change	s.e.	p-value	obs
Before	After					
0	1	0	-0.144	0.022	0.00	528
0	2	0	-0.593	0.108	0.00	95
0	3	0	-1.031	0.353	0.01	15
1	0	0	0.219	0.026	0.00	520
1	2	0	-0.025	0.010	0.01	1132
1	2	1	-0.232	0.015	0.00	1132
1	3	0	-0.158	0.043	0.00	91
1	3	1	-0.334	0.056	0.00	91
2	0	0	0.524	0.088	0.00	100
2	1	0	0.074	0.010	0.00	1119
2	1	1	0.247	0.015	0.00	1119
2	3	0	0.004	0.011	0.67	861
2	3	1	-0.043	0.013	0.00	861
2	3	2	-0.165	0.017	0.00	861
3	0	0	0.769	0.346	0.04	16
3	1	0	0.126	0.049	0.01	105
3	1	1	0.465	0.073	0.00	105
3	2	0	0.023	0.009	0.01	872
3	2	1	0.051	0.012	0.00	872
3	2	2	0.169	0.016	0.00	872

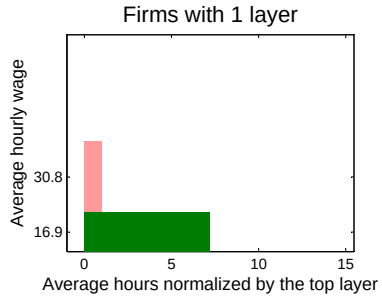
Wages change according to the theory

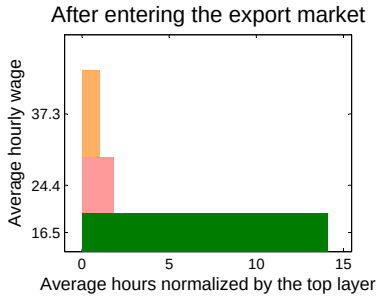
- Firms that change export status and do not change L
- Reporting γ_L^ℓ from $d \ln w_{Lit}^\ell = \delta_L^\ell + \gamma_L^\ell d \ln VA_{it} + \varepsilon_{it}$

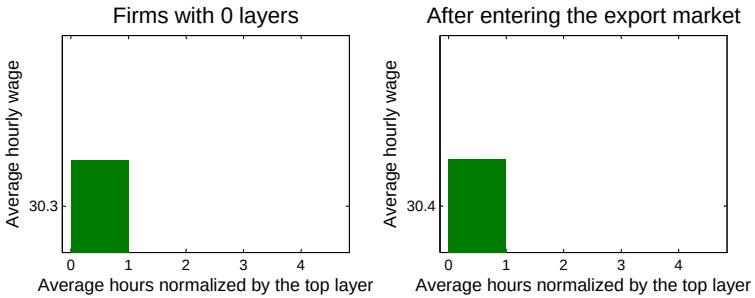
# of layers in the firm (L)	Layer ℓ	γ_L^ℓ	s.e.	p-value	obs
0	0	0.108	0.022	0.00	3,263
1	0	0.110	0.016	0.00	6,968
1	1	0.119	0.018	0.00	6,968
2	0	0.169	0.017	0.00	10,507
2	1	0.186	0.018	0.00	10,507
2	2	0.193	0.019	0.00	10,507
3	0	0.199	0.033	0.00	4,896
3	1	0.219	0.034	0.00	4,896
3	2	0.218	0.034	0.00	4,896
3	3	0.219	0.035	0.00	4,896

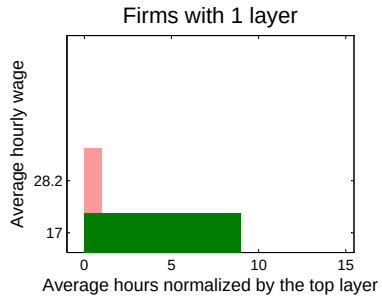
Representative exporters for one layer transitions

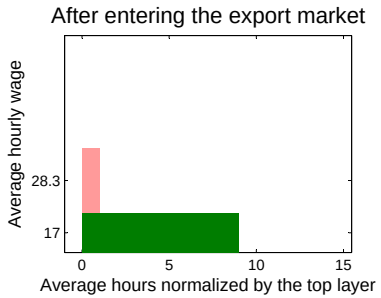


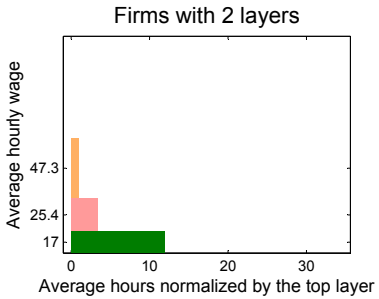


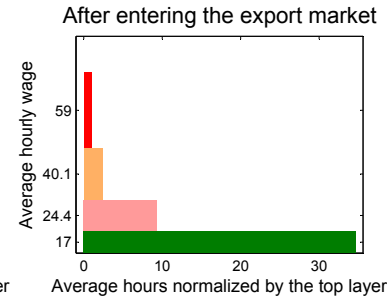


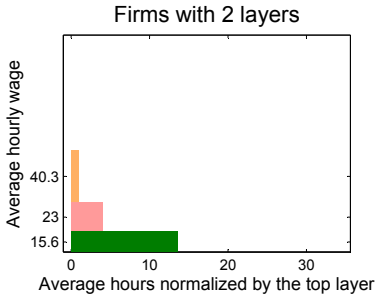


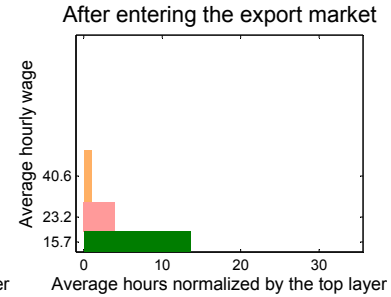












▸ Firms that exit

Conclusion

- We use French data to study the organization of production
  - Organizing the data using layers of employees is meaningful and useful
- We document that:
  1. Firms are hierarchical across layers in terms of employees and wages
  2. The probability of adding a layer increases with value added
     - ★ Firms that grow faster are also more likely to add layers
  3. Firms that grow by adding layers increase the number of employees and reduce their average wages at all layers
  4. Firms that grow but do not add layers increase the number of employees and average wages at all layers
- Our findings underscore the importance of organizational change for wage inequality and firm grow

Occupational categories

Statistics on wage by occupation

Average hourly wage by occupation in 2005 Euros					
	CEO, directors	Senior staff	Supervisors	Clerks	Blue collars
Mean	81.39	47.83	26.58	*19.01*	*20.70*
p5	23.68	21.45	14.35	*10.63*	*10.64*
p10	28.60	25.01	16.21	*11.79*	*11.82*
p25	41.51	31.00	19.36	*13.84*	*13.65*
p50	58.06	38.28	23.11	*16.49*	*15.97*
p75	80.48	47.26	27.76	*19.95*	*19.07*
p90	114.51	59.91	34.15	*24.66*	*23.40*
p95	142.29	72.08	40.45	*29.37*	*27.87*

back

Firms with adjacent occupational categories

- We select the sub-sample of firms that satisfy the following criteria:
  - Layer 1 firms are firms with occupation codes 6 and 5
  - Layer 2 firms are firms with occupation codes 6, 5 and 4
  - Layer 3 firms are firms with occupation codes 6, 5, 4 and 3
  - Layer 4 firms are firms with occupation codes 6, 5, 4, 3 and 2

Percentage of firms that have adjacent layers					
	Among firms with				All firms
	1 layer	2 layers	3 layers	4 layers	
Unweighted	87.42	67.39	80.01	100	81.69
Weighted by *VA*	87.69	68.40	94.60	100	96.73
Weighted by hours	99.17	72.56	93.07	100	95.69

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Weighted by *VA*	87.69	68.40	94.60	100	96.73
Weighted by hours	99.17	72.56	93.07	100	95.69

▸ Layers ▸ Layers + VA + H ▸ Layers + VA + NH ▸ Layers + VA ▸ Layers + H ▸ Layers + NH

Layer transitions

Distribution of # of layers at time t+1 given the # of layers at time t

		Weighted by VA: # of layers at $t+1$					
		Exit	1	2	3	4	Total
# of layers at t	1	11.3	**65.3**	19.5	3.3	0.6	100
	2	7.1	6.6	**62.7**	21.5	2.1	100
	3	5.8	0.2	2.4	**72.6**	19.0	100
	4	7.7	0.0	0.2	13.4	**78.8**	100

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Fraction of firms that transition to an adjacent layer

- What is the fraction of firms that transition up or down to an adjacent layer?
  - Conditioning of firms with adjacent layers

# of layers	Transition Up	Down
1	75.5	-
2	82.3	91.5
3	100	60.6
4	-	75.9

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Data description

By number of layers in the firm, DADS data

# of layers	Firm-years	Average VA	Average Hours	Median wage
1	81,909	205	7,946	10.18
2	126,069	403	16,450	12.08
3	161,449	2,821	85,674	14.22
4	87,211	8,879	227,070	15.71

Value added in 000s of 2005 euros.

▸ Back

How do firms change the average wage in a layer?

Extensive versus intensive margin

Log diff. in hourly wage of new hours entering the layer versus hours staying in the layer (after transition)

# of layers		Layer	Change	s.e.	p-value	obs
Before	After					
1	2	1	-0.157	0.00	0.00	6089
1	3	1	-0.122	0.01	0.00	749
1	4	1	-0.111	0.04	0.01	57
2	1	1	0.014	0.00	0.00	8170
2	3	1	-0.113	0.00	0.00	12118
2	3	2	-0.171	0.01	0.00	4629
2	4	1	-0.100	0.01	0.00	819
2	4	2	-0.138	0.02	0.00	342
3	1	1	0.052	0.01	0.00	1102
3	2	1	-0.031	0.00	0.00	13679
3	2	2	0.021	0.00	0.00	6758
3	4	1	-0.089	0.00	0.00	12266
3	4	2	-0.121	0.00	0.00	8876
3	4	3	-0.184	0.01	0.00	5673
4	1	1	0.020	0.03	0.51	67
4	2	1	0.013	0.01	0.11	1145
4	2	2	0.009	0.02	0.60	547
4	3	1	-0.072	0.00	0.00	13338
4	3	2	-0.074	0.00	0.00	10164
4	3	3	0.004	0.01	0.46	7922

Log diff. in hourly wage of hours leaving the layer versus hours who stayed in the layer (before the transition)

# of layers		Layer	Change	s.e.	p-value	obs
Before	After					
1	2	1	0.076	0.00	0.00	8014
1	3	1	0.124	0.01	0.00	898
1	4	1	0.158	0.02	0.00	56
2	1	1	-0.068	0.00	0.00	6620
2	3	1	0.034	0.00	0.00	13465
2	3	2	0.099	0.00	0.00	6873
2	4	1	0.075	0.01	0.00	897
2	4	2	0.163	0.02	0.00	438
3	1	1	-0.056	0.01	0.00	948
3	2	1	-0.028	0.00	0.00	12923
3	2	2	-0.084	0.01	0.00	4844
3	4	1	0.018	0.00	0.00	12556
3	4	2	0.040	0.00	0.00	9672
3	4	3	0.160	0.01	0.00	7273
4	1	1	-0.084	0.03	0.01	69
4	2	1	-0.034	0.01	0.00	1071
4	2	2	-0.061	0.02	0.00	463
4	3	1	0.003	0.00	0.15	13427
4	3	2	-0.003	0.00	0.33	9731
4	3	3	-0.025	0.01	0.00	6417

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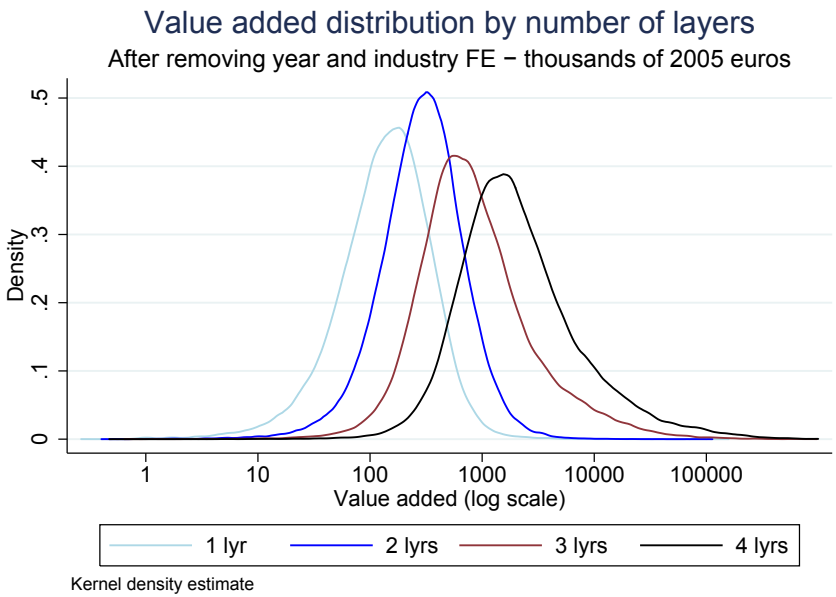
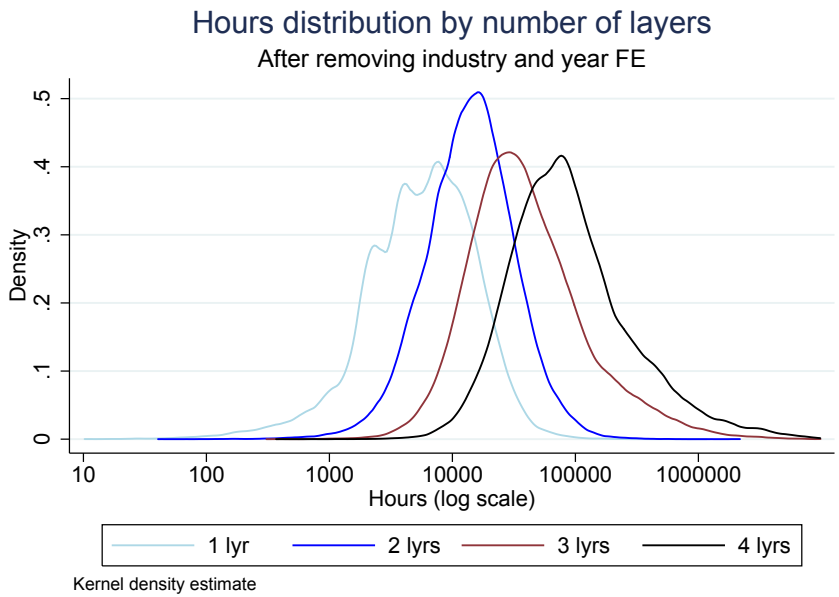
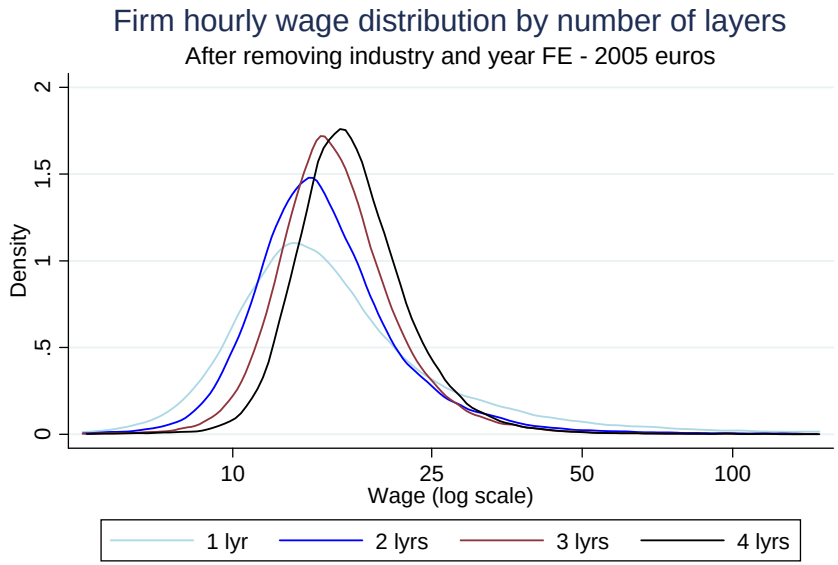
Firms with different number of layers are different







▶ Back

Sources of changes in average wage during a transition

$\bar{w}^{\ell \leq L}_{L'it+1} / \bar{w}_{Lit}$

From/to	2	3	4
1	0.963*** (10,167)	0.865*** (1,262)	0.733*** (96)
2		0.926*** (16,783)	0.876*** (1,128)
3			0.958*** (14,099)

$w^{L'}_{L'it+1} / \bar{w}_{Lit}$

From/to	2	3	4
1	1.507*** (10,166)	1.501*** (1,263)	1.602*** (97)
2		2.040 *** (16,783)	2.021*** (1,129)
3			4.385*** (14,099)

s

From/to	2	3	4
1	0.741 *** (10,166)	0.620*** (1,262)	0.563*** (97)
2		0.853 *** (16,784)	0.775 *** (1,128)
3			0.948 *** (14,099)

$d \ln \bar{w}_{Lit}$

From/to	2	3	4
1	−0.007* (10,166)	−0.094*** (1,263)	−0.305** (97)
2		0.005 ** (16,784)	−0.033** (1,129)
3			−0.001 (14,098)

All results from trimmed sample at 0.05%. *significant at 10% ** significant at 1%. Number of observations in paranthesis.

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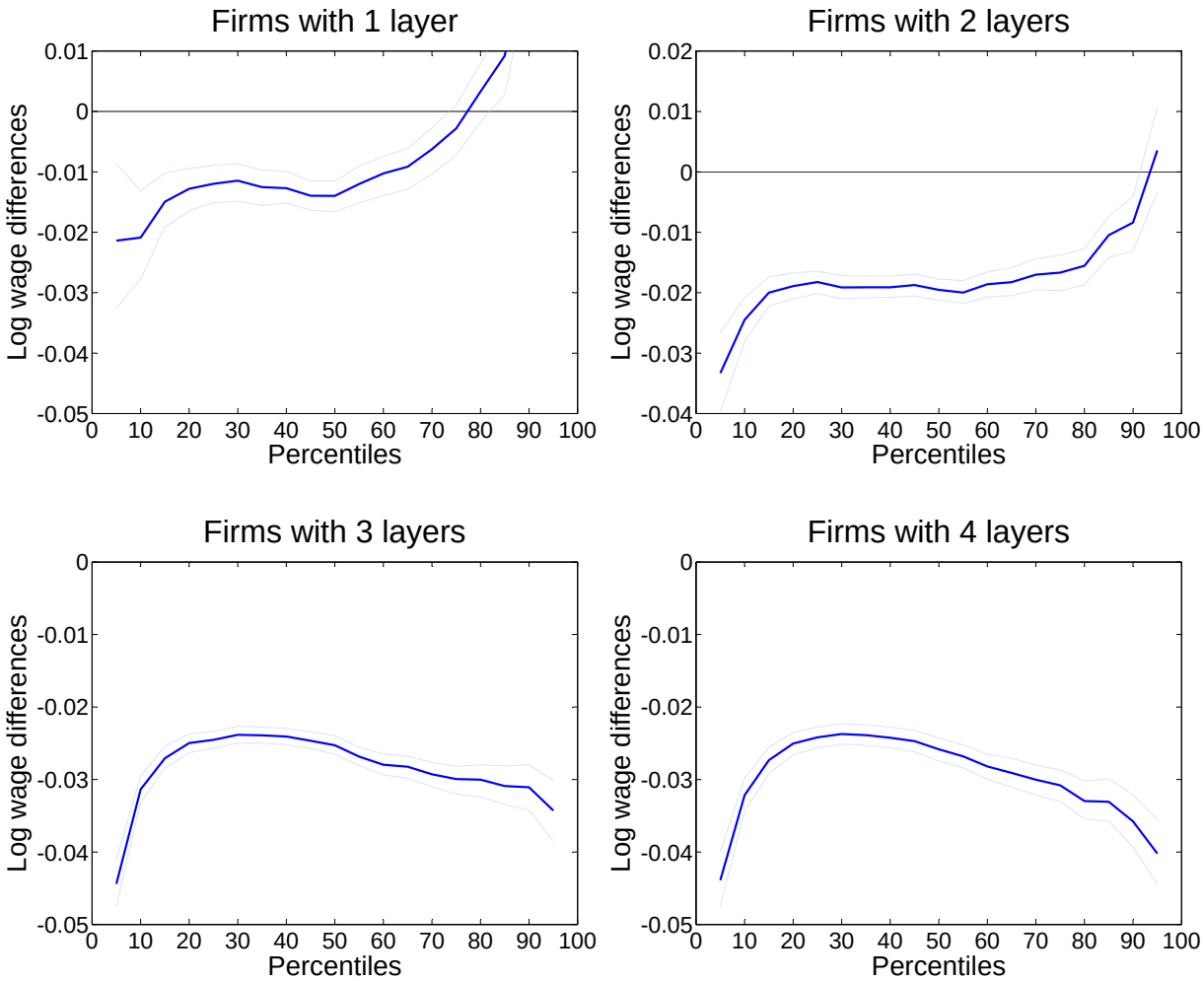
Distribution of wages after minus before

Conditioning on decrease in VA < 0 and no transition



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On the Origins of Comparative Advantage, Costinot (2006)

- This paper proposes a theory of international trade that incorporates institutions and their impact on the efficient organization of production
- A closer look at the economic role of institutions generates predictions on the determinants of international trade
- The two key elements of the theory are:
  (i) **Gains from the division of labor** (vary with a sector's *complexity*)
  (ii) **Transaction costs** (vary with a country's *quality of institutions*)
- Under autarky, the trade-off between these two forces pins down the size of productive teams across sectors in each country
- Under free trade, the endogenous differences in the optimal organization of production across countries determine the pattern of trade

On the Origins of Comparative Advantage, Costinot (2006)

1. Team size increases with goods' complexity and institutional quality, but decreases with workers' productivity
2. Better institutions and higher productivity levels are complementary sources of comparative advantage in the more complex sectors
3. Pattern of trade:
    1. Developed countries produce and export the more complex goods
    2. Developing countries produce and export the less complex goods
4. When institutional improvement and productivity gains occur in developed countries, all countries gain; but when they occur in developing countries, developed countries might be hurt

- All trade data are from the 1992 World Trade Flows Database
- Complexity is measured as the average number of months required to train a worker in a given industry, it is computed from the PSID surveys of 1985 and 1993.
- Institutional quality is based on the quality of the workforce index developed by Business Environment Risk Intelligence (B.E.R.I) S.A..
- It measures "the attributes of the workforce that contribute to its ability to perform" including: work ethic; availability and quality of trained manpower ; class, ethnic and religious factors; attention span and health; and absenteeism.
- The estimates of human capital per worker are taken from Hall and Jones (1999)

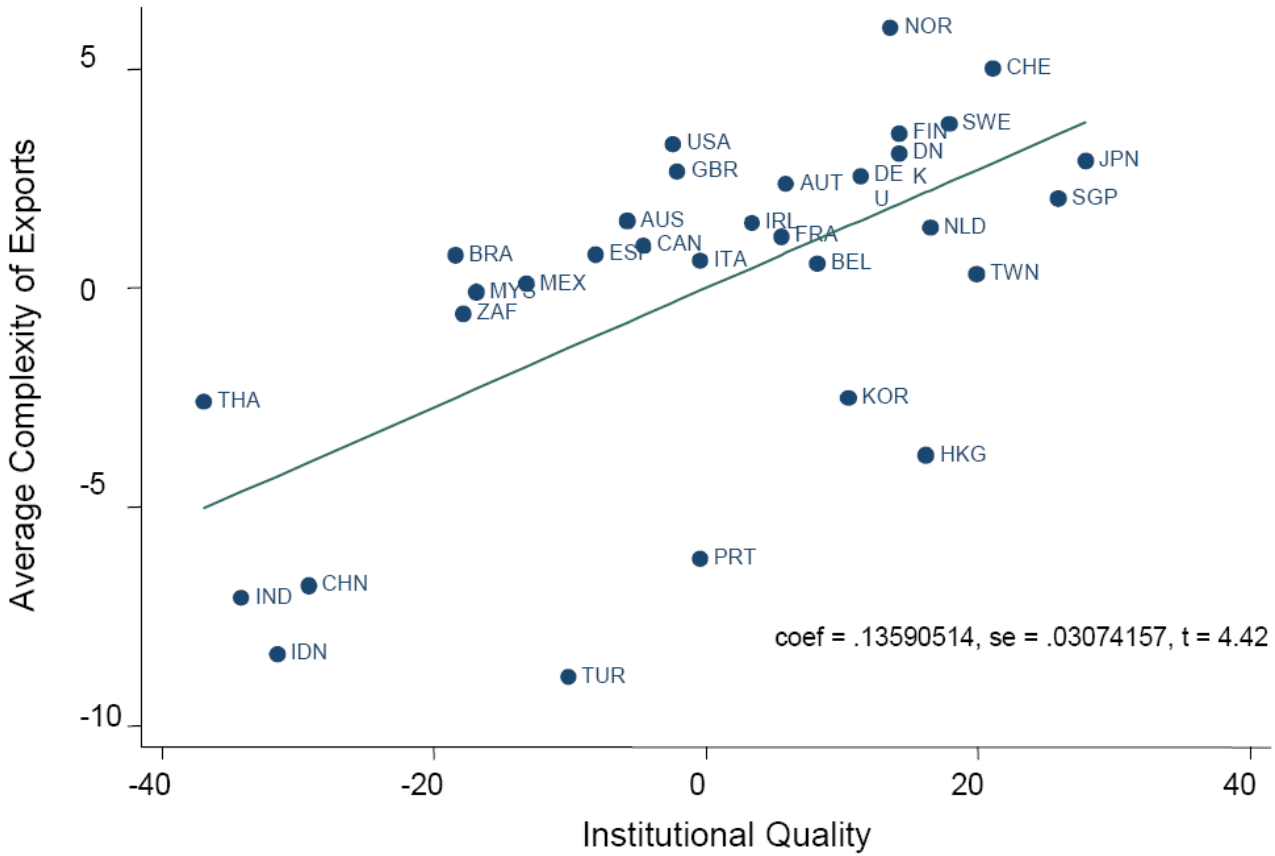


Figure 1: Average Complexity of Exports and Institutional Quality

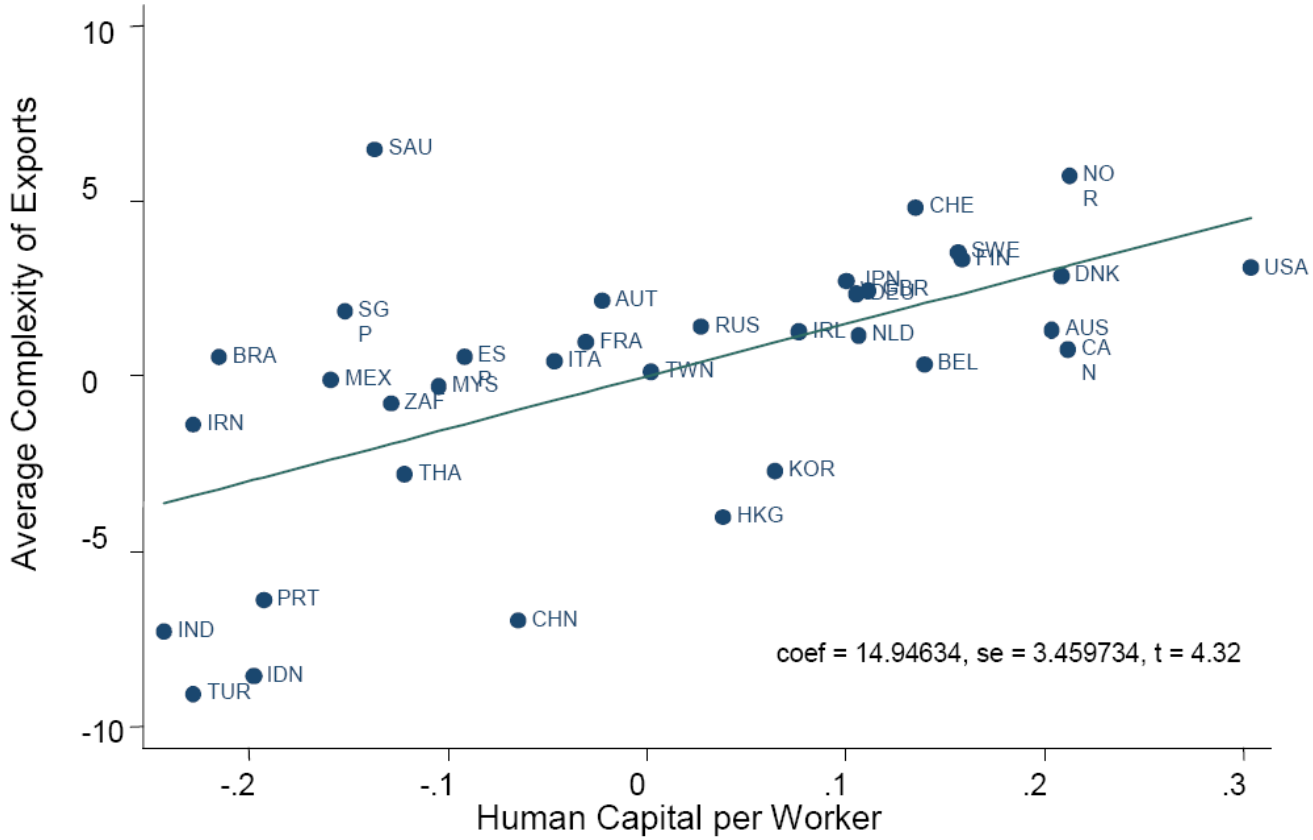


Figure 2: Average Complexity of Exports and Human Capital per Worker

The Model: Technology

- There is a continuum of goods $z \in (0, \bar{z})$, and one productive factor, labor
- In order to produce one unit of good z, a continuum of elementary tasks $s \in S_z$ must be performed:

$$q_z = \min_{s \in S_z} q(s)$$

- Measure of $S_z \equiv$ *complexity* of the production process in sector z
- Assume that the measure of S_z is equal to z in all sectors
- The economy is populated by a continuum of workers of mass L, each endowed with h units of labor where $h \equiv$ *productivity* of a representative worker
- If a worker spends $l(s)$ units of labor performing task s, her associated output $q(s)$ is given by:

$$q(s) = \max\{l(s) - k(s), 0\}$$

- Interpret the fixed overhead cost $k(s) > 0$ as the time necessary to learn how to perform task s
- Assume that $k(s) = 1$ for all s. Hence, total learning costs in sector z are equal to $\int_{s \in S_z} k(s)ds = z$

The Model: Institutions

- Focus on a single function of institutions: contract enforcement
- The contract of a given worker i stipulates her output, $q^i(s)$, on every elementary task $s \in S_z$
- Worker i is free to fulfill or ignore her contractual obligations
- She performs all tasks if $c^i \leq \pi^i$, where c^i is the cost of effort and π^i the punishment
  - otherwise, she does not perform at all
- Better institutions increase π^i for all $i \in L$, and so increase the probability that a contract is enforced
- Call $F(.)$ the distribution of $\pi^i - c^i$ over the population of workers
- Assume that $\pi^i - c^i$ is not observed by prospective employers:
  $\Rightarrow$ contracts are randomly assigned across workers and independently enforced with probability: $1 - F(0)$
- We set $1 - F(0) = e^{-\frac{1}{\theta}}$
  $\Rightarrow \theta(\geq 0) \equiv$ *quality of institutions*, which aims to capture both the efficiency of the judicial system and/or the level of trust in a given country

Closed Economy

- **Step 1**: maximization program of a benevolent social planner
  Step 2: decentralization through a competitive equilibrium
- Call L_z the mass of workers in industry z
- The social planner maximizes total output per worker, conditional on L_z.
  There is one control variable per industry: *Team size, N*
  - $N \equiv$ number of workers that cooperate on each unit of good z
- Given the team size N, workers specialize in $\frac{z}{N}$ tasks and allocate their time uniformly across these tasks

Closed Economy

- We call $\widehat{q}_z$ the potential output per worker: $\widehat{q}_z = \frac{1}{L_z} \min_{s \in S_z} \left[\int_{i \in L_z} q^i(s) di \right]$
- Gains from the division of labor given the team size N:
  $\Rightarrow q^i(s) = \frac{h - \frac{z}{N}}{\frac{z}{N}}$ for all $i \in L_z$ and $s \in S_z$
  $\Rightarrow \widehat{q}_z = \frac{h}{z} - \frac{1}{N}$
- Transaction costs: Given the team size N:
  $\Rightarrow$ each team only produces with probability $e^{-\frac{N}{\theta}}$
  $\Rightarrow$ expected output per worker in a given team $\equiv e^{-\frac{N}{\theta}} \widehat{q}_z$
  $\Rightarrow$ by LLN, total output per worker in each industry $\equiv e^{-\frac{N}{\theta}} \widehat{q}_z$

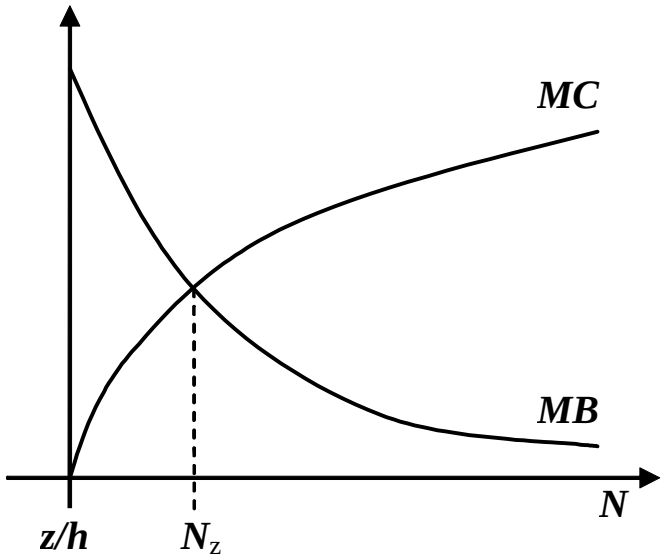
Closed Economy

- We call N_z the efficient team size in industry z. It solves:

$$\max_N e^{-\frac{N}{\theta}} \left(\frac{h}{z} - \frac{1}{N} \right)$$

The first-order condition is given by:

$$[MB =] \quad \frac{z}{N_z^2} = \frac{1}{\theta} \left(h - \frac{z}{N_z} \right) \quad [= MC]$$



Closed Economy

- Can be solved explicitly, so

$$N_z = \frac{z}{2h}\left(1+\sqrt{1+\frac{4\theta h}{z}}\right)$$

- CRS at the industry level $\Rightarrow$ There exists a CE with atomistic firms
- Efficiency of the CE $\Rightarrow$ Efficient team size
- **Proposition 1** *Team size:*
  1. *increases with institutional quality, θ*
  2. *increases with complexity, z*
  3. *decreases with workers' productivity, h*

Open Economy

- Consider a world comprising two large countries, North and South
- North and South share the same technology, but differ in the quality of their institutions, θ and θ^*, and their workers' productivity, h and h^*
- $a(z)$ is the average labor requirement of 1 unit of good z in the North:

$$a(z) = \frac{hL_z}{\widehat{q}_z e^{-\frac{N_z}{\theta}} L_z} = \frac{zhN_z e^{\frac{N_z}{\theta}}}{(hN_z - z)}$$

- The PPFs of North and South are completely characterized by the constant unit labor requirements, $a(z)$ and $a^*(z)$, in each industry

Open Economy: Pattern of Comparative Advantage

- The relative unit labor requirement is given by:

$$A(z) = \frac{a^*(z)}{a(z)} = \frac{h^* N_z^* e^{\frac{N_z^*}{\theta^*}} (hN_z - z)}{hN_z e^{\frac{N_z}{\theta}} (h^* N_z^* - z)}$$

Lemma 1 *$A(z)$ is strictly increasing in z iff $\theta h > \theta^* h^*$*

- Sketch of proof:

1. $\ln a(z) = \ln\left(\frac{zhN_z}{hN_z - z}\right) + \frac{N_z}{\theta}$
2. efficient team size $\Rightarrow \frac{d \ln a(z)}{dz} = \frac{\partial \ln a(z)}{\partial z}$
3. $hN_z = \frac{z}{2}\left(1 + \sqrt{1 + \frac{4\theta h}{z}}\right)$

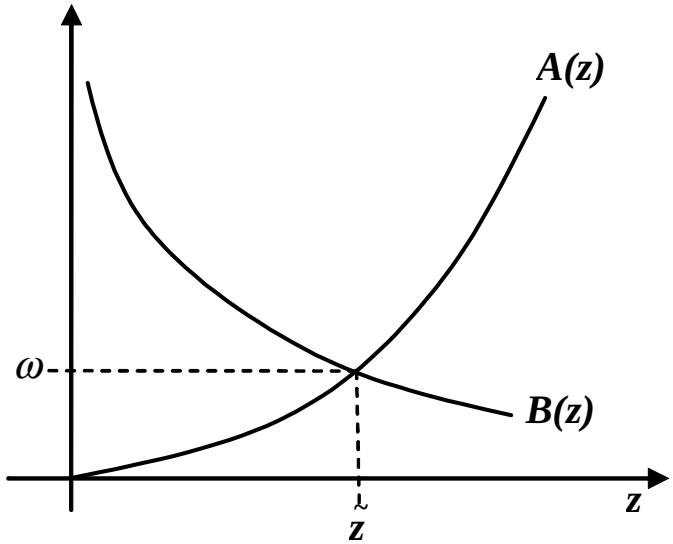
Open Economy: Pattern of Comparative Advantage

- Lemma 1 implies that:
  1. better institutions confer comparative advantage in the more complex goods
     $\Rightarrow$ "institutionally dependent" industries $\equiv$ complex industries
  2. a higher *absolute* productivity level confers *comparative* advantage in the more complex goods
     $\Rightarrow$ increase in workers' productivity $\neq$ increase in country size
  3. institutional quality and workers' productivity have *complementary* effects on the pattern of CA

Open Economy: Trade

- On the supply side, we assume that North has a CA in the more complex industries: $\theta h > \theta^* h^*$
- On the demand side, we assume that North and South have identical Cobb-Douglas preferences
- Call w and w^* the Northern and Southern wages, respectively
- By lemma 1, $A(z)$ is strictly increasing in z:
  $\Rightarrow \exists \widetilde{z}$ such that: $\omega \equiv \frac{w}{w^*} = A(\widetilde{z})$
  $\Rightarrow$ all goods $z \geq \widetilde{z}$ are efficiently produced in the North, and all goods $z \leq \widetilde{z}$ in the South

Open Economy: Trade



- The trade balance equilibrium is given by: $\omega = \frac{h^* L^* [1 - S(\widetilde{z})]}{hLS(\widetilde{z})} = B(\widetilde{z})$ with $S(\widetilde{z})$ the share of income spent on Southern goods
- **Proposition 2** *North produces and exports the more complex goods; South produces and exports the less complex ones*

Open Economy: Trade

- Proposition 2 predicts that:
  1. developing countries produce and export the less complex goods
     $\Rightarrow$ consistent with higher share of employment in primary sectors in developing countries
  2. international trade decreases average team size in developing countries, while increasing it in developed countries

Open Economy: Comparative Statics

- **Two questions:**
  1. What is the impact of institutional improvement in the North and the South?
  2. What is the impact of productivity gains in the North and the South?

  When institutional improvement and productivity gains occur in the North, both countries gain. When they occur in the South, the North might be hurt
- Intuition: institutional improvement is biased towards the "institutionally dependent" sectors
  - Same as technological change as argued by Krugman (1986)

Data

$$(M1): \ \ln x_{ij}^n = \alpha_i^n + \beta_j^n + \gamma_1 \theta_i z_j + \gamma_2 h_i z_j + \varepsilon_{ij}^n$$
$$(M2): \ \ln x_{ij}^n = \alpha_i^n + \beta_j^n + \gamma_1 \theta_i z_j + \gamma_2 h_i z_j + \delta_i s_j + \varepsilon_{ij}^n$$
$$(M3): \ \ln x_{ij}^n = \alpha_i^n + \beta_j^n + \gamma_1 \theta_i z_j + \gamma_2 h_i z_j + \delta_i s_j (1 - k_j) + \zeta_i k_j + \varepsilon_{ij}^n$$

Table 1: Export Performance

	Ability to Perform			Rule of Law		
OLS Estimates	**M1**	**M2**	**M3**	**M1**	**M2**	**M3**
γ_1	0.04	0.04	0.05	0.91	0.89	0.87
	(8.96)**	(6.36)**	(6.68)**	(9.98)**	(5.50)**	(4.60)**
γ_2	1.93	2.91	2.51	1.25	2.27	2.04
	(14.93)**	(13.49)**	(10.61)**	(8.45)**	(8.92)**	(7.29)**
Observations	8087	8087	8087	8372	8372	8372
R^2	0.74	0.75	0.76	0.74	0.75	0.76

Note: t-statistics in parentheses, calculated from White standard errors

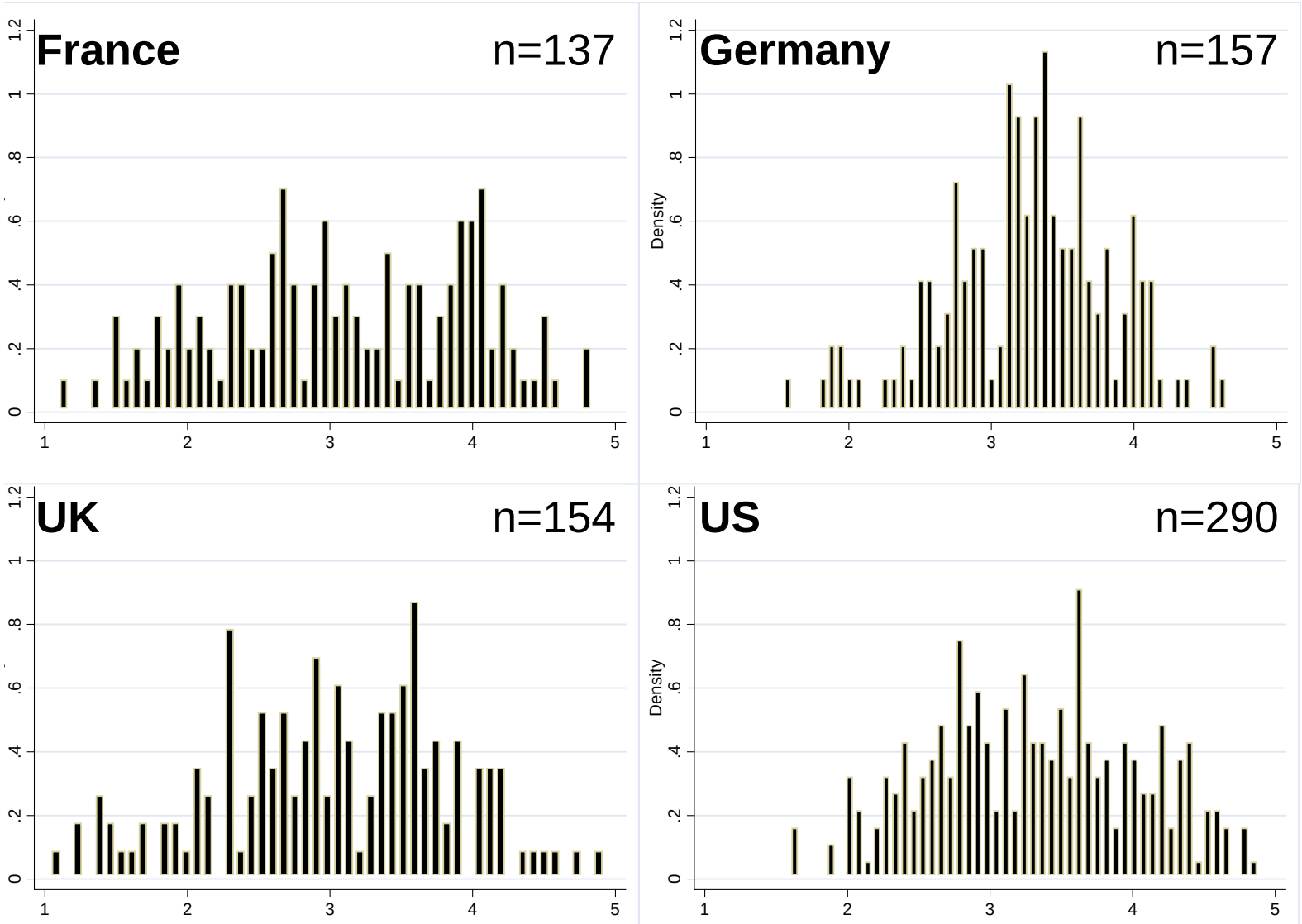
* Significant at 5% confidence level

** Significant at 1% confidence level

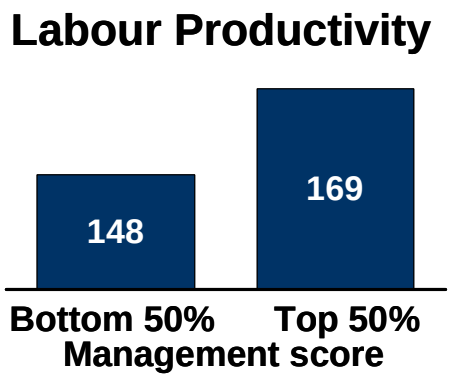
Measuring and Explaining Management Practices Across Firms and Countries, Bloom and van Reenen (2007)

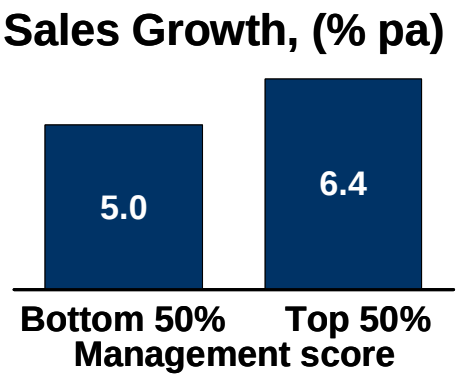
- Large persistent productivity spread across firms and countries: some argue due to differences in "management"
- Develop a survey tool to "measure" management practices: New data on 732 firms in US,UK, France & Germany
- Related to all important characteristics of the firm
- Product market competition and ownership important to explain differences in management practices
- All firms are medium size manufacturing firms (later expanded)

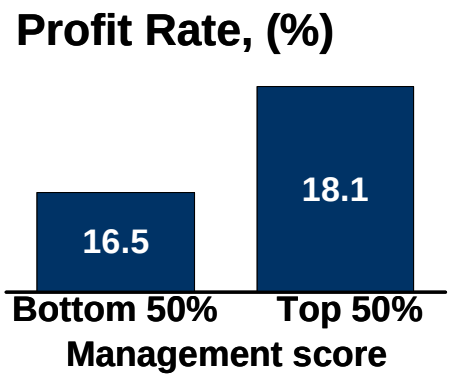
Measuring Management

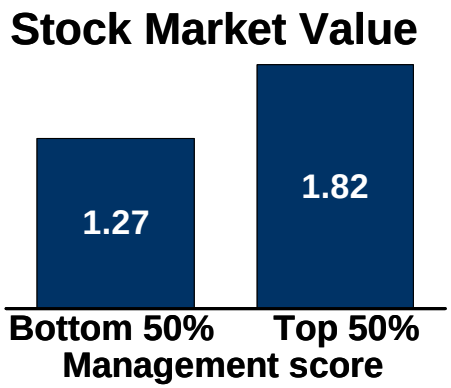


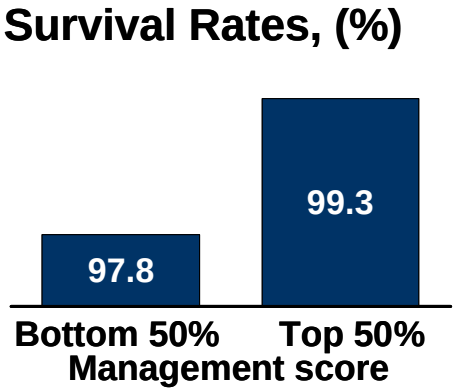
Measuring Management











Measuring Management

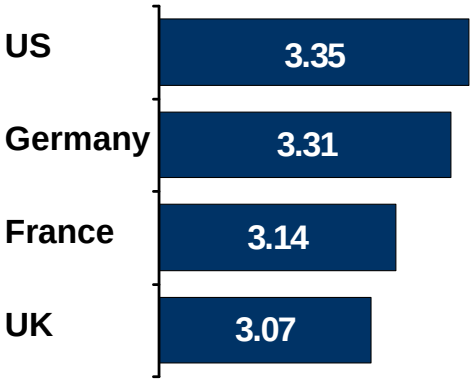
EXTERNAL VALIDATION: PRODUCTIVITY & PROFIT

Dependent variable	**Sales (in Ln)**	**Sales (in Ln)**	**Sales (in Ln)**	**ROCE**	**Tobin Q (in Ln)**	**Sales growth**	**Exit**
Estimation[1]	OLS	OLS	OLS	OLS	OLS	OLS	Probit
Firms	All	All	All	All	Quoted	All	All
Management$_i$	**0.085 (0.025)**	**0.034 (0.011)**	**0.042 (0.012)**	**2.469 (0.688)**	**0.250 (0.075)-**	**0.018 (0.006)**	**-0.200 [0.026]**
Ln(Labor) $_{it}$	0.999 (0.014)	0.539 (0.021)	0.540 (0.021)	2.172 (1.202)	0.209 (0.109)	-0.022 (0.011)	0.233 [0.045]
Ln(Capital) $_{it}$		0.103 (0.013)	0.104 (0.013)	-0.148 (0.899)	-0.029 (0.086)	0.024 (0.008)	-0.158 [0.045]
Ln(Materials) $_{it}$		0.362 (0.020)	0.354 (0.020)	-0.439 (0.723)	0.130 (0.050)	-0.010 (0.007)	-0.084 [0.231]
Controls[1]	No	Yes	Yes	Yes	Yes	Yes	Yes
Noise controls	No	No	Yes	Yes	Yes	Yes	Yes
Observations	6,267	5,350	5,350	5,089	2,635	4,777	709
Firms	732	709	709	690	374	702	709

[1] Includes country, year, SIC3 industry, skills, hours, firm-age, and public/private
Robust S.E.s in ( ) below. For probit p-values in [ ] below

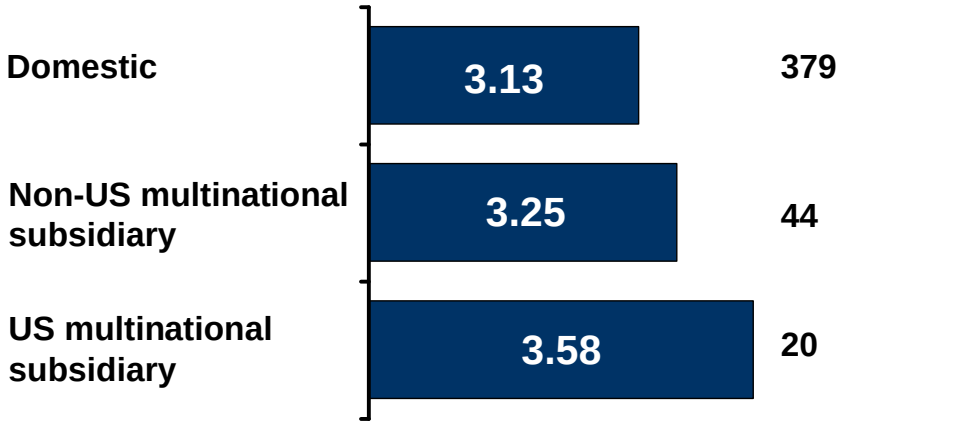
Measuring Management

COUNTRY LEVEL MANAGEMENT SCORES*



US FIRMS ARE ALSO BETTER IN EUROPE

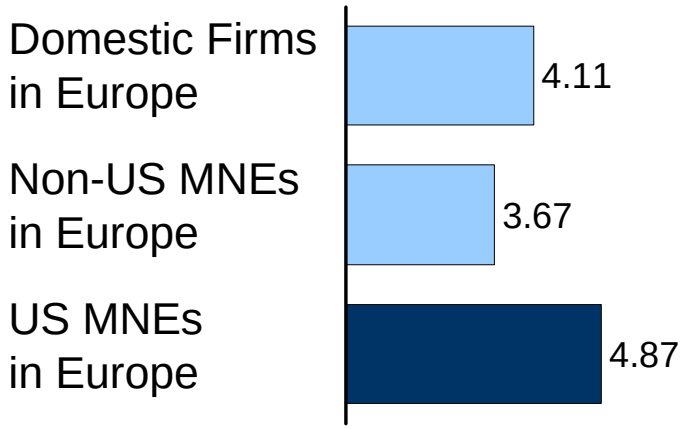
Average management score by firm type in UK, France and Germany*



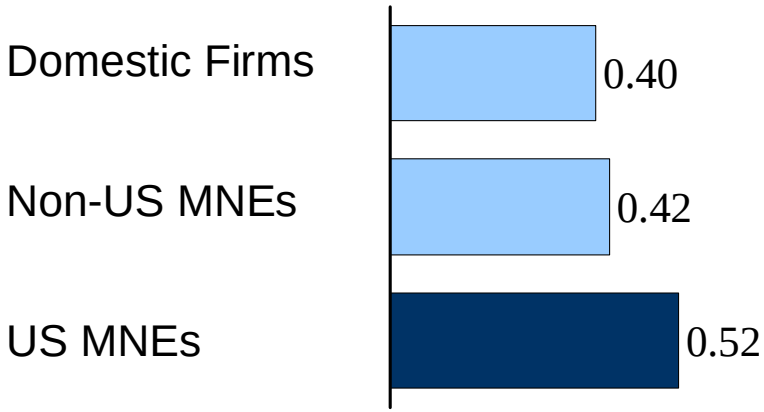
Measuring Management

Organizational devolvement

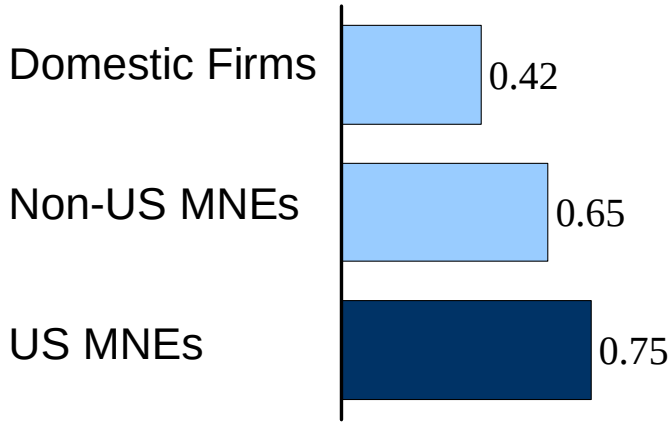
Organizational devolvement
(firms located in Europe)



Organizational change
(UK establishments, 1981-1990)



Organizational change
(UK establishments, 1998-2000)

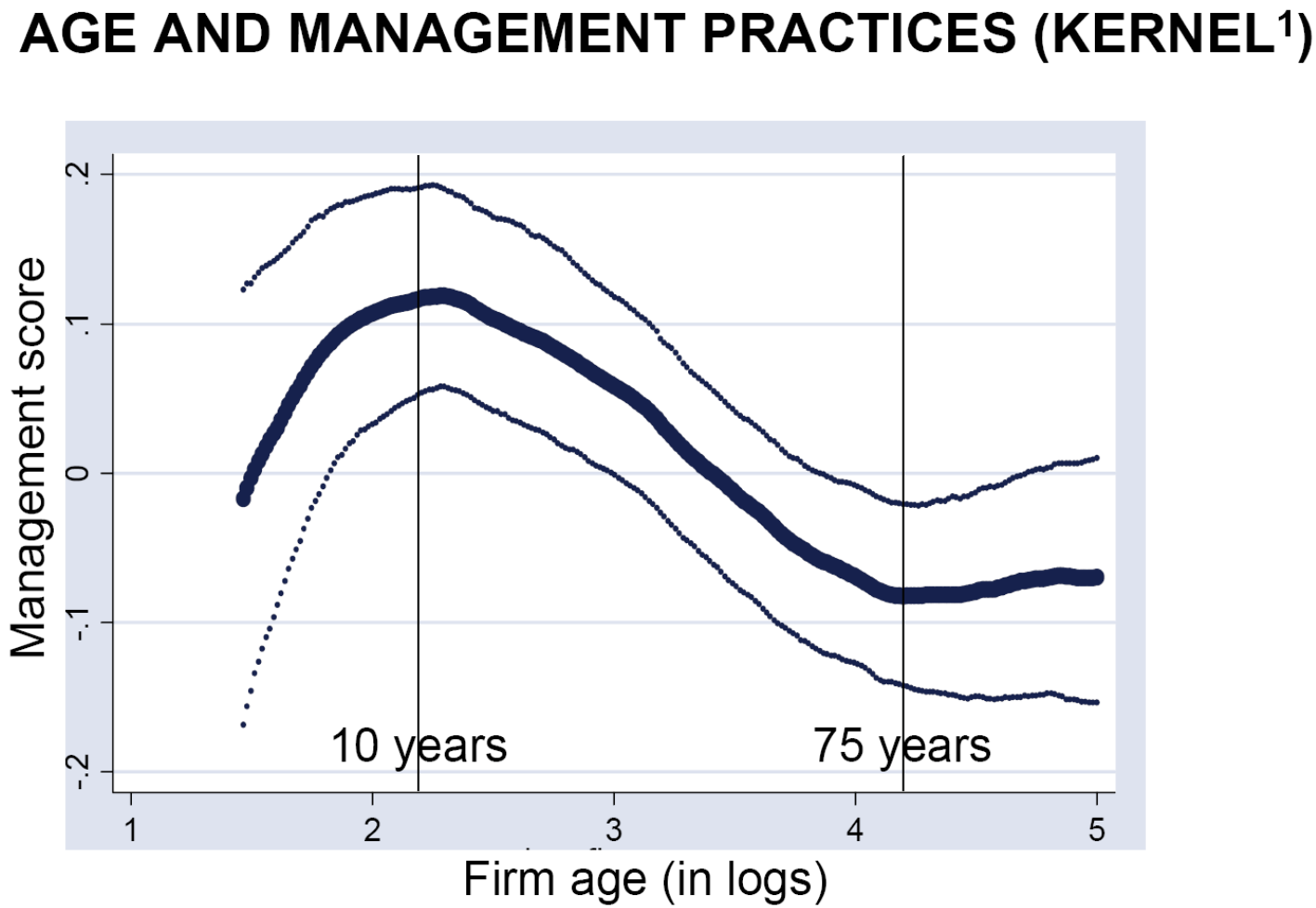


Measuring Management

Competition proxies	**Dependent variable: Management**					
Import penetration (SIC-3 industry, 1995-1999)	**0.144 (0.040)**	**0.156 (0.084)**				
1 - Lerner index[1] (SIC-3 industry except firm itself, 1995-1999)			**1.515 (0.683)**	**1.318 (0.637)**		
# of competitors (Firm level, 2004)					**0.142 (0.051)**	**0.145 (0.049)**
Full controls[2,3]	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**

%	**Dependent variable: Management**			
Family[1] largest shareholder	**-0.029 (0.094)**			**0.304 (0.166)**
Family[1] largest shareholder & family CEO		**-0.100 (0.078)**		**-0.175 (0.188)**
Family[1] largest shareholder, family CEO & *primo geniture*			**-0.281 (0.097)**	**-0.382 (0.128**
Observations[2]	**732**	**732**	**732**	**732**

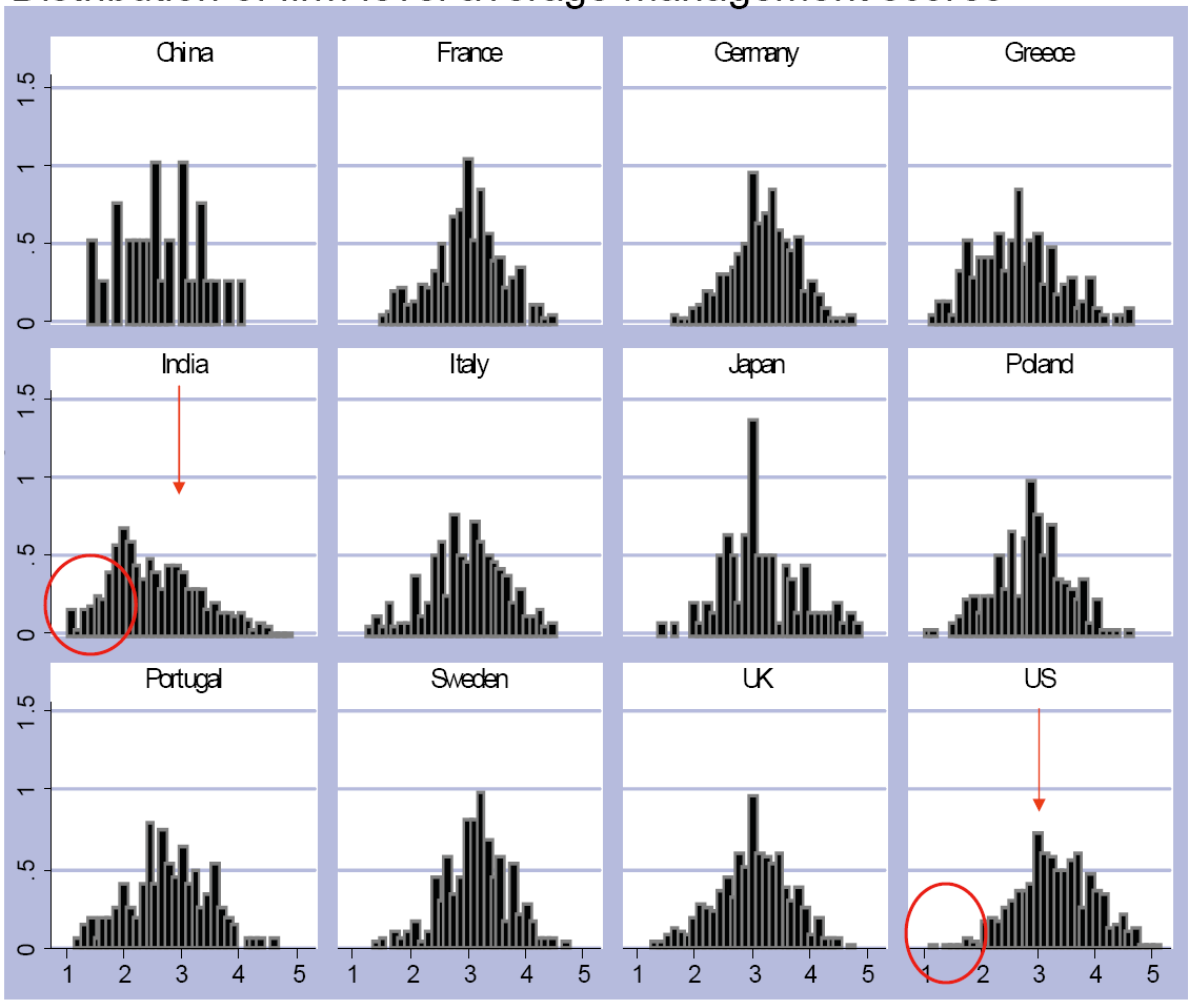
Measuring Management: Age and Management



Measuring Management: More Countries

THE AVERAGE HIDES MUCH FIRM-LEVEL VARIATION

Distribution of firm level average management scores



91% of variation in management scores within countries