

Firm organization with multiple establishments

Anna Gumpert Henrike Steimer Manfred Antoni

LMU Munich, CEPR and CESifo / LMU Munich and Stanford GSB / Institute for Employment Research (IAB)

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Motivation

Large firms are often **multi-establishment (ME) firms**

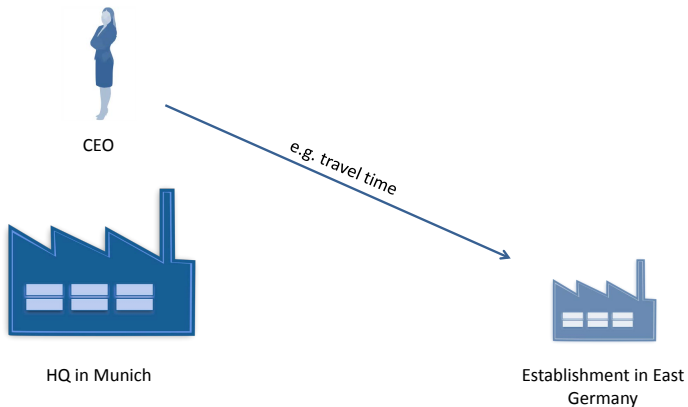
Motives: factor price differences, proximity to customers

Negative effect of distance on **establishment performance**

(e.g. Giroud, 2013; Kalnins & Lafontaine, 2013)

Potential reason: distance causes **managerial frictions**

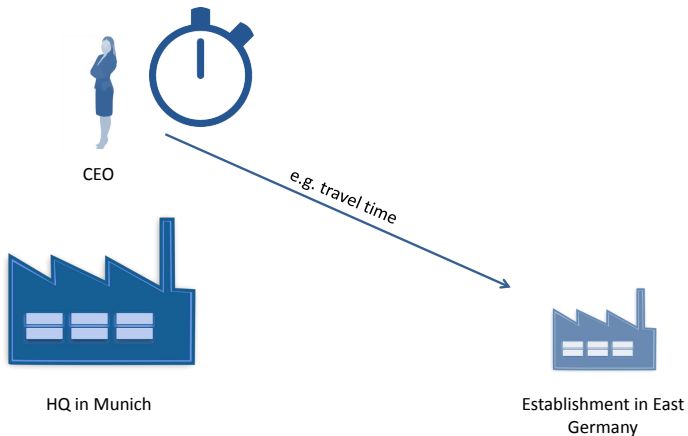
Geographic frictions increase helping costs for establishment



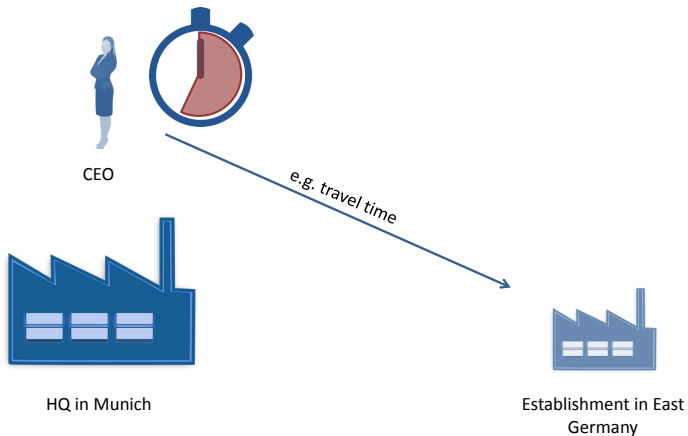
Research Question

How do **geographic frictions** affect **firm organization**?

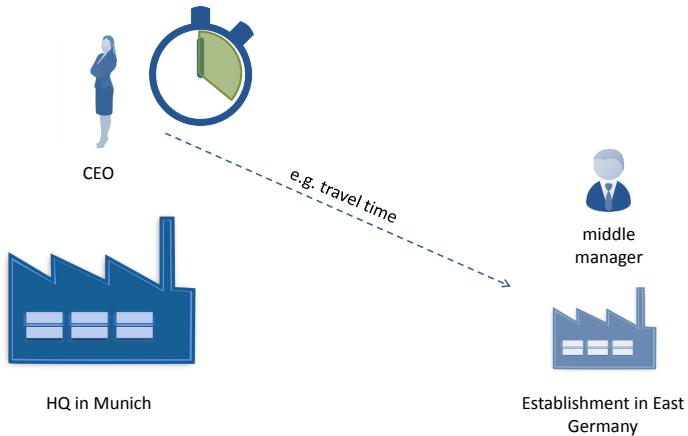
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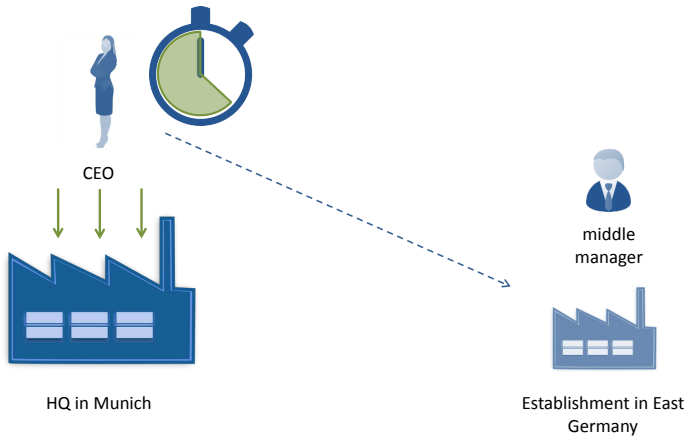
Geographic frictions increase helping costs for establishment



Middle managers mitigate impact of geographic frictions



...and release CEO time



This paper

1. **Facts** on multi-establishment firm organization
2. **Model** of multi-establishment firm organization
3. **Evidence** on reorganization due to new high-speed train routes

Take-away

1. Geographic frictions **increase use of middle managers**
2. Geographic frictions affect organization of **both establishment and headquarters**

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Implications:

- ▶ In multi-establishment firms, organization should be studied **at firm level**
- ▶ Multi-establishment firms **propagate shocks** to local conditions across space **through firm organization**

Part 1:

Facts on multi-establishment firm organization

Data

Linked firm-establishment-employee data based on German social security records

[Details](#)

Panel for **2000-2012**

2012 : 10k multi-establishment firms
 45k establishments
 2.2m employees

Outcome variable: organizational structure

Measure: # of managerial layers

Four layers based on **occupation** of employees (Caliendo et al., 2015)

Layer 3	CEOs, managing directors
Layer 2	Senior experts, upper middle managers
Layer 1	Supervisors, lower middle managers, engineers, professionals
Layer 0	Clerks, operators, production workers

Validate assignment of occupations to layers using survey data on tasks

Plausibility

Facts

1. Where do ME firms invest?

Investment probability and establishment size **decrease with distance** to HQ.

Evidence

Facts

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Evidence

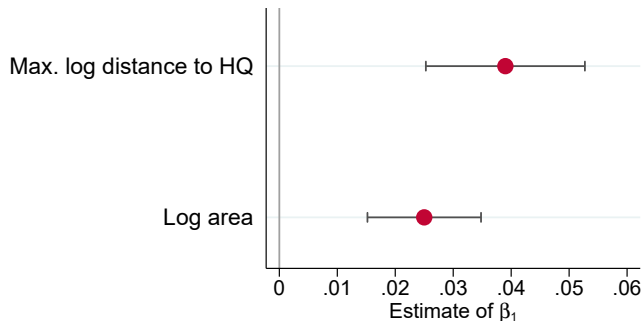
2. How do geographic frictions affect managerial organization of ME firms?

Use of middle managers **increases with geographic frictions**.

Use of middle managers increases with geographic frictions

$$\# \text{ managerial layers}_i = \exp(\beta_0 + \beta_1 \text{geographic frictions}_i + \beta_2 \text{size}_i + \alpha_l + \alpha_n + \alpha_s)$$

with i : ME firm, l : legal form, n : county of HQ, s : HQ sector; 2012 cross-section

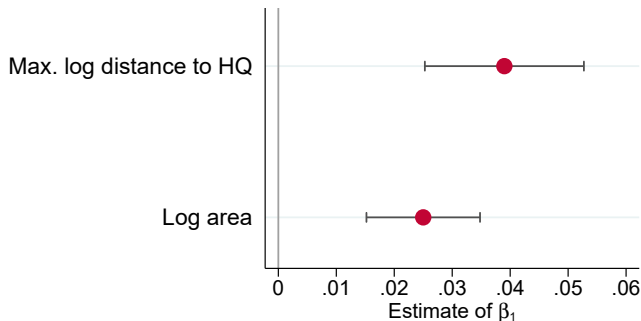


Table

Use of middle managers increases with geographic frictions

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with i : ME firm, l : legal form, n : county of HQ, s : HQ sector; 2012 cross-section



Table

→ Doubling maximum distance to HQ \approx increasing sales by 34%

Facts

1. Where do ME firms invest?

Investment probability and establishment size **decrease with distance** to HQ.

Evidence

2. How does geography affect managerial organization of ME firms?

Use of middle managers **increases with distance**.

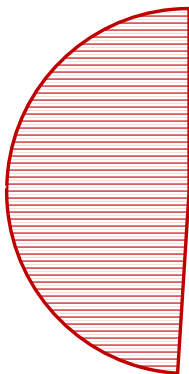
3. How does managerial organization evolve over time?

ME firms **add middle managers either at headquarters or establishment** as they grow.

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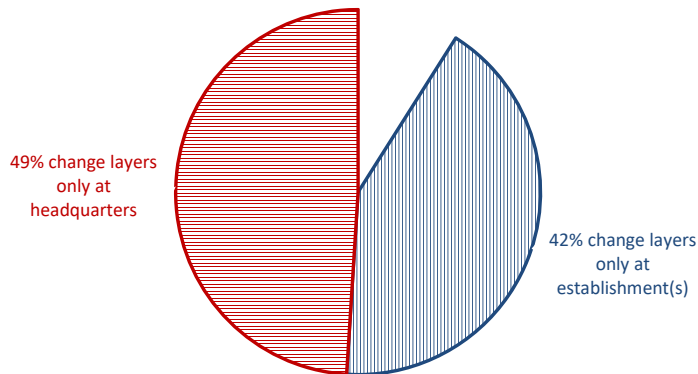
Multi-establishment firms with changes in managerial structure

49% change layers
only at
headquarters



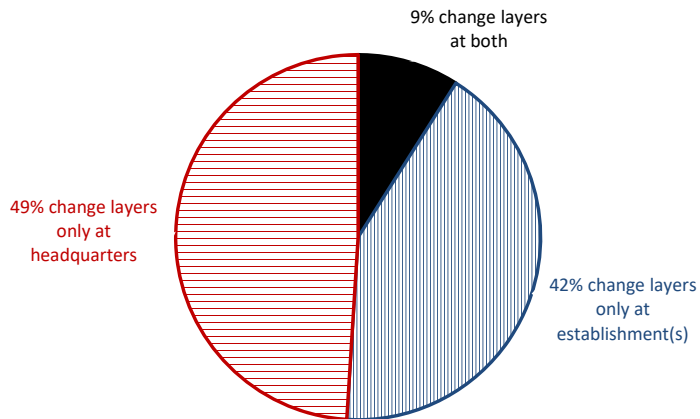
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Multi-establishment firms with changes in managerial structure



ME firms add middle managers either at HQ or establishment as they grow

Multi-establishment firms with changes in managerial structure



Part 2:

Model of multi-establishment firm organization

Set-up (I)

Setting: two potential locations, $j = \{0, 1\}$

Local labor markets with wages w_j

Local output markets with (for now) exogenous local output \tilde{q}_j

Firm = HQ + possibly establishment, HQ at $j = 0$, establishment at $j = 1$

Firm chooses optimal organization

Set-up (II)

Production is based on labor and knowledge; both are endogenously chosen

- ▶ Labor generates problems
- ▶ Knowledge solves problems to produce output

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Firm consists of **CEO, production workers** and possibly **middle managers**

- ▶ Production workers input labor and some knowledge
- ▶ CEO uses knowledge to help workers, but **helping costs time**;
CEO has only **one unit of time**
- ▶ Middle managers help workers in place of CEO, but entail **quasi-fixed costs**

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I.e., Garicano (2000) model with CEO time constraint + heterogeneous wages/helping costs

ME firms add middle managers either at HQ or establishment

Marginal costs **increase with output** due to CEO time constraint

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Organizational structure \approx **production technology**

CEO + production workers

\approx Low fixed costs, high MC

CEO + production workers + middle managers

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ME firms can “**combine technologies**” (choose different organization at HQ and est.)

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ME firms can “**combine technologies**” (choose different organization at HQ and est.)

\Rightarrow Small firms: CEO + production workers

Medium firms: CEO + production workers + middle managers **at one unit**

Large firms: CEO + production workers + middle managers **at both units**

\Rightarrow **ME firms add middle managers either at HQ or establishment as they grow**

Geographic frictions increase use of middle managers

Higher helping costs at establishment affect choices at establishment **and headquarters**

Higher helping costs

- ▶ **increase** marginal costs at establishment
- ▶ **decrease** marginal costs at headquarters

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⇒ Use “high fixed costs, low marginal costs technology” at lower output

⇒ **Geographic frictions increase use of middle managers**

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Higher helping costs

- ▶ **increase** marginal costs at establishment
- ▶ **decrease** marginal costs at headquarters

⇒ Use “high fixed costs, low marginal costs technology” at lower output

⇒ **Geographic frictions increase use of middle managers**

Plus: lower establishment output, higher headquarter output

Summary of model results

How do **geographic frictions** affect **firm organization**?

1. Geographic frictions **decrease establishment output and investment probability**.
→ Consistent with Fact 1
2. Geographic frictions **increase use of middle managers**.
→ Consistent with Fact 2
3. Multi-establishment firms **add middle managers at either HQ or establishment** as they grow.
→ Consistent with Fact 3
4. Geographic frictions affect organization of **establishment and headquarters**.

Part 3:

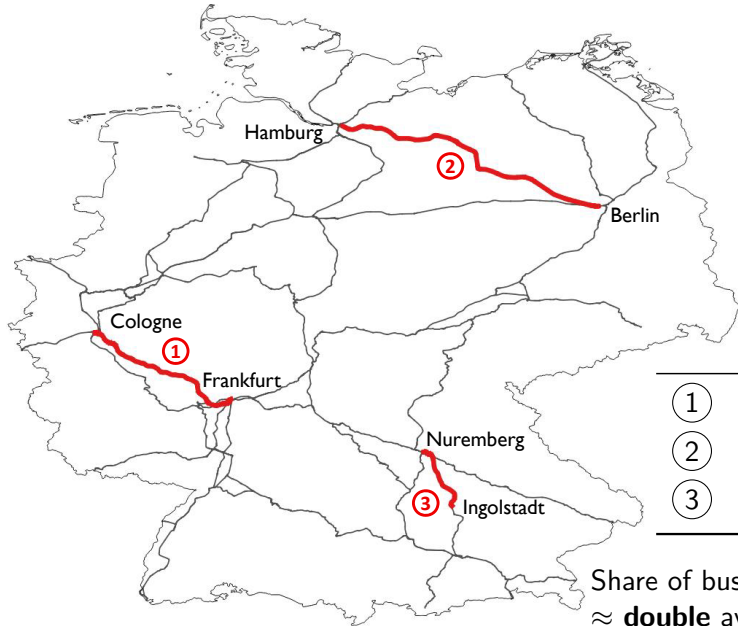
Reorganization due to high-speed train routes

Travel time data

Exogenous variation: **Opening of three new high-speed train routes**

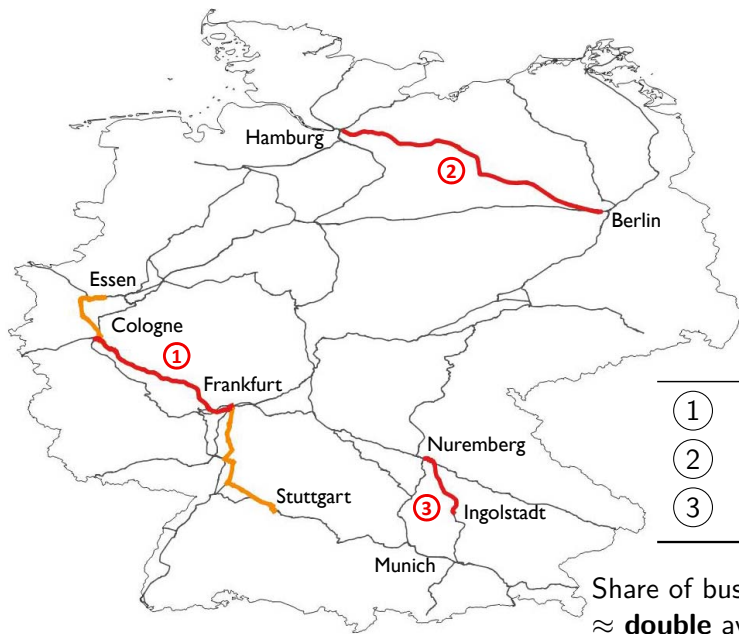
Data from Deutsche Bahn AG

Travel times between 115 stations connected to long-distance train network
in 2001, 2004, 2008



	opened	after	Δ	car
①	2002	1h16	-44%	> 2h
②	2004	1h30	-33%	~ 3h
③	2006	0h30	-55%	> 1h

Share of business travelers on new routes
 \approx **double** average share



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Model predictions

New high-speed train routes reduce travel times from HQ to est. \Rightarrow **helping costs** \downarrow

- ▶ **Direct** effect on organization
- ▶ **Indirect** effect due to **higher output**

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Testable prediction:

Lower travel times affect organization of **headquarters** and **all** establishments

Estimation equations

$$y_{ijt} = \beta_0 + \beta_1 1\{\text{Lower travel times}\}_{ijt} + \alpha_j + \alpha_{ct} + \epsilon_{ijt}$$

with

- ▶ y : # workers, # layers, managerial share in wage sum
- ▶ i : firm; j : establishment/HQ; c : county; t : year; α : fixed effect

Effect of lower travel times on better connected establishments

- ▶ $1\{\}$: travel time decrease from HQ to establishment j of ≥ 30 min

Effect of lower travel times on headquarters/not better connected establishments

- ▶ $1\{\}$: travel time decrease from HQ to *any* est. of firm i of ≥ 30 min

Regression results, firms with ≥ 2 establishments

	# workers	# layers	Mg.share
Better connected establishments			
Lower travel times	0.074*** (0.019)	0.001 (0.009)	-0.033 (0.241)
Headquarters			
Lower travel times	-0.018 (0.021)	0.041* (0.019)	1.054** (0.323)
Not directly affected establishments			
Lower travel times	-0.003 (0.018)	0.009 (0.008)	0.523* (0.217)

Robust SE in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

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Conclusion

How do **geographic frictions** affect **firm organization**?

Geographic frictions **increase use of middle managers** in firms

- ▶ Literature on firm hierarchies

e.g., Antràs, Garicano & Rossi-Hansberg, 2006, 2008; Caliendo & Rossi-Hansberg, 2012; Chen, 2017; Chen & Suen, 2017; Garicano, 2000; Guadalupe & Wulf, 2012; Ke, Li & Powell, 2018

- ▶ Literature on management practices

e.g., Bloom et al., 2016; Bloom, Garicano, Sadun & Van Reenen, 2014

Conclusion

How do **geographic frictions** affect **firm organization**?

Multi-establishment firm organization is **interdependent** across HQ and establishments

- ▶ Literature on propagation of shocks through ME firms

e.g., Giroud & Mueller, 2017; Seetharam, 2018

- ▶ Literature on ME/multinational firm performance

e.g., Charnoz, Lelarge & Trevin, 2015; Giroud, 2013; Kalnins & Lafontaine, 2013; Antràs & Yeaple, 2014; Keller & Yeaple, 2013

Record linkage procedure

Social Security Records: data on establishments and employees

ORBIS: balance sheet information on firms

1. Assign establishments to firms

Exploit regulation about establishment names as well as legal form

2. Identify headquarters

Headquarters = establishment with firm zip code and/or locality

Issue: “false positives” - “multi-establishment firms” that in fact are several single-establishment firms with the same name

⇒ Approach: keep only exact matches

- ▶ Exact long/short name and legal form
- ▶ Exact long name (w/ or w/o activity component) and zip code
- ▶ Exact short name (w/ or w/o activity component) and zip code

Distance decreases location probability and est. size

	Location		Log # employees	
	(1)	(2)	(3)	(4)
Log distance to HQ	-0.304*** (0.021)	-0.357*** (0.020)	-0.106*** (0.018)	-0.137*** (0.017)
Log market potential	0.690*** (0.026)		0.485*** (0.044)	
Relative wages	-0.732*** (0.066)		-0.330** (0.108)	
# observations	3,719,275	3,719,275	21,496	21,496
County FE	N	Y	N	Y

Col. 1/2: Legal form, HQ county, HQ sector FE. Col. 3/4: Firm FE. *** $p < 0.001$.

Use of middle managers increases with geographic frictions

$$\# \text{ managerial layers}_i = \exp(\beta_0 + \beta_1 \text{geographic frictions}_i + \beta_2 \text{size}_i + \alpha_l + \alpha_n + \alpha_s)$$

with i : ME firm, l : legal form, n : county of HQ, s : HQ sector; 2012 cross-section

# mg. layers	(1)	(2)	(3)	(4)
Maximum log distance to HQ	0.039*** (0.007)		0.050*** (0.006)	
Log area		0.025*** (0.005)		0.027*** (0.004)
Log sales	0.115*** (0.004)	0.082*** (0.006)		
Log # non-mg. employees			0.109*** (0.004)	0.088*** (0.005)
# firms	4,323	1,661	7,742	2,768

Legal form, HQ county, HQ sector FE. *** $p < 0.001$. [Share](#) [back](#)

Managerial share increases with distance

Model: Generalized Least Squares based on Papke & Wooldridge (1996)

Mg. share ($\in [0, 1]$)	Layers		Blossfeld	
	(1)	(2)	(3)	(4)
Maximum log distance to HQ	0.152*** (0.014)		0.131* (0.010)	
Log area		0.070*** (0.011)		0.072*** (0.013)
# firms	7,742	2,768	7,742	2,768

Robust SE in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

HQ sector, HQ county FE included. [back](#)

Plausibility: assignment of occupations to layers

Data: 2006 BiBB/BAuA Survey of the Working Population
20,000 individuals

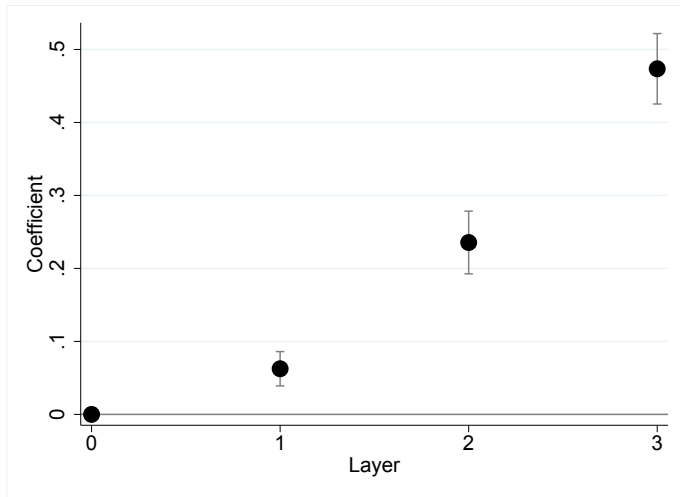
OLS regressions

$$y_i = \beta \mathbf{D}_{\text{layer},i} + \gamma \mathbf{X}_i + \delta \mathbf{Z}_i + u_i$$

with

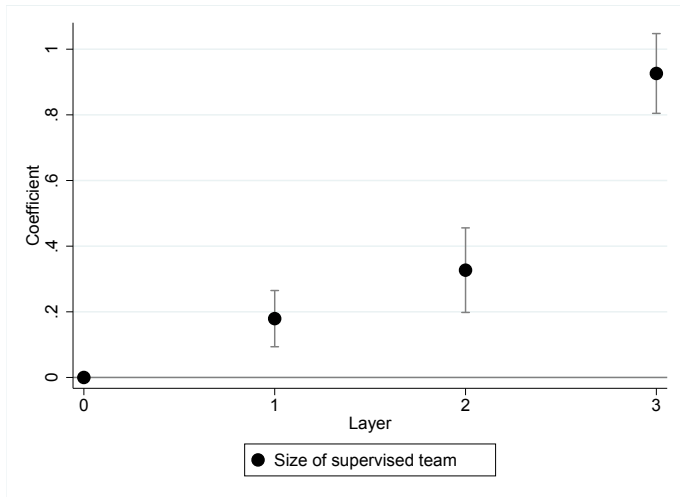
- ▶ $\mathbf{D}_{\text{layer},i}$: layer dummy
- ▶ \mathbf{X}_i : employee characteristics (age, gender, education, tenure)
- ▶ \mathbf{Z}_i : employer characteristics (size class, sector)

Supervisor status



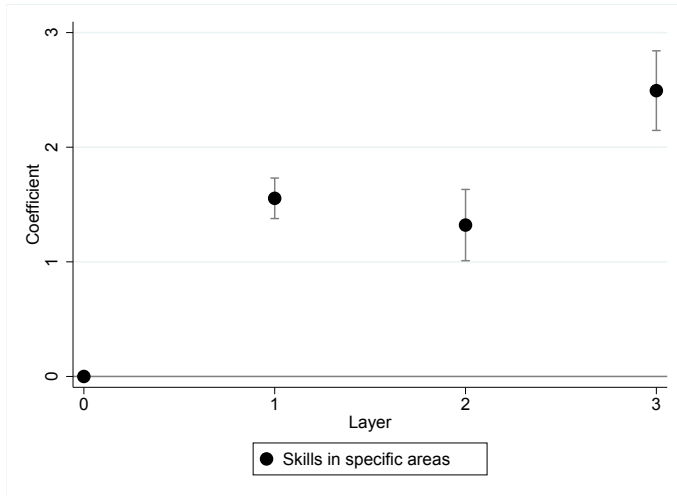
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Team size (in logs)



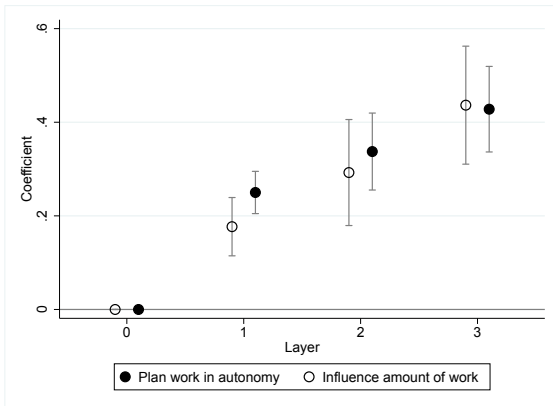
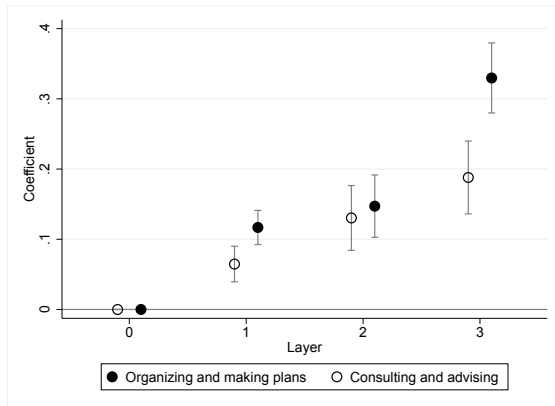
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Skill requirements



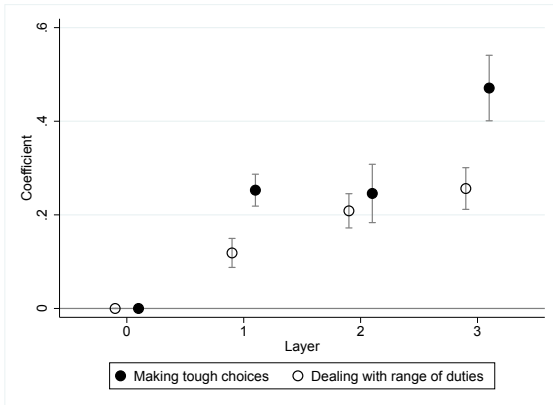
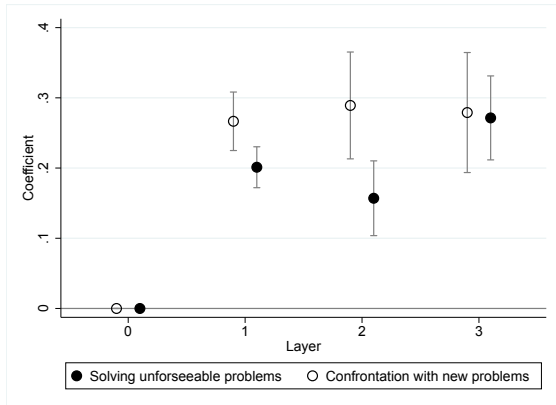
[back](#)

Tasks: planning, organizing and consulting



[back](#)

Tasks: problem solving and decision making



[back](#)

Regressions: Supervisor/skill/planning

	Spec. skills	Supervisor	Org. & plan	Consult & advise
Layer 1	1.554*** (0.090)	0.063*** (0.012)	0.117*** (0.012)	0.199*** (0.012)
Layer 2	1.321*** (0.159)	0.236*** (0.022)	0.147*** (0.023)	0.252*** (0.022)
Layer 3	2.494*** (0.177)	0.474*** (0.025)	0.330*** (0.025)	0.327*** (0.025)
Age	-0.026*** (0.004)	0.000 (0.000)	-0.003*** (0.000)	-0.003*** (0.000)
Tenure (decades)	0.151*** (0.043)	0.037*** (0.005)	0.018*** (0.005)	0.027*** (0.005)
Gender	-1.282*** (0.072)	-0.114*** (0.009)	-0.021* (0.009)	0.100*** (0.009)
Constant	20.451*** (0.296)	0.009 (0.036)	0.293*** (0.037)	0.507*** (0.036)
Education FE	Y	Y	Y	Y
Firm size FE	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y
Observations	10,282	12,514	12,514	12,514

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regressions: Autonomy/problem solving/decisions

	Tough choices	Many duties	Problems	New prob.	Autonomy	Amount
Layer 1	0.253*** (0.017)	0.119*** (0.015)	0.201*** (0.015)	0.267*** (0.021)	0.250*** (0.023)	0.177*** (0.031)
Layer 2	0.246*** (0.032)	0.209*** (0.018)	0.157*** (0.027)	0.289*** (0.038)	0.337*** (0.042)	0.293*** (0.057)
Layer 3	0.471*** (0.036)	0.256*** (0.022)	0.271*** (0.031)	0.279*** (0.043)	0.428*** (0.047)	0.436*** (0.063)
Age	-0.002*** (0.001)	-0.003*** (0.001)	-0.007*** (0.001)	-0.006*** (0.001)	-0.002 (0.001)	0.005*** (0.001)
Tenure (decades)	0.054*** (0.008)	0.027** (0.008)	0.001 (0.007)	0.050*** (0.009)	0.087*** (0.010)	0.021 (0.014)
Gender	-0.169*** (0.013)	0.027 (0.014)	-0.120*** (0.011)	-0.082*** (0.015)	0.028 (0.017)	-0.187*** (0.023)
Constant	1.616*** (0.052)	1.624*** (0.057)	1.830*** (0.044)	2.223*** (0.062)	2.434*** (0.121)	2.197*** (0.163)
Education FE	Y	Y	Y	Y	Y	Y
Firm size FE	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y
Observations	12,510	12,509	12,511	12,510	11,958	11,926

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The optimal organization

Objective: minimize production costs

Choice variables:

- ▶ **Organizational structure:**

- ▶ HQ vs. HQ and establishment
- ▶ Number of layers of middle managers at HQ/establishment

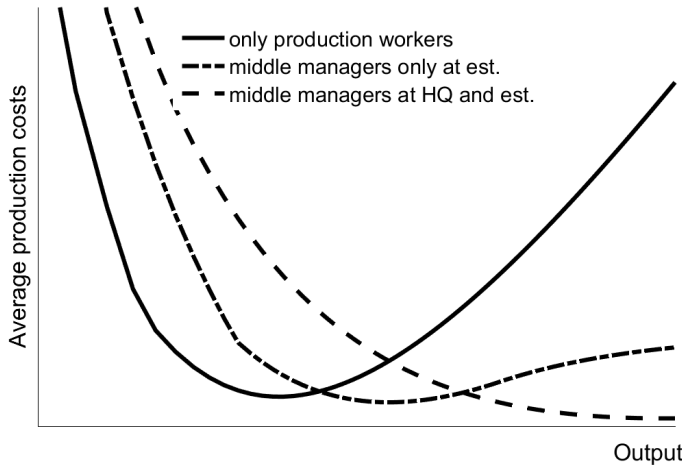
- ▶ **Firm level:**

- ▶ CEO knowledge
- ▶ Production quantities and allocation of CEO time

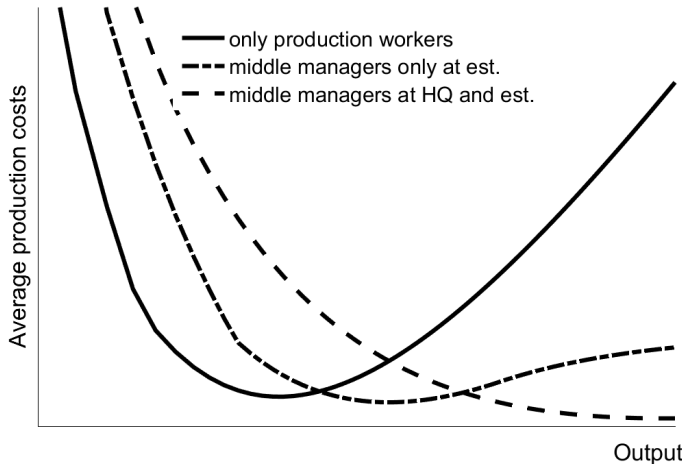
- ▶ **HQ/Establishment level:**

Number and knowledge of employees per layer

Impact of output on number of layers of middle managers

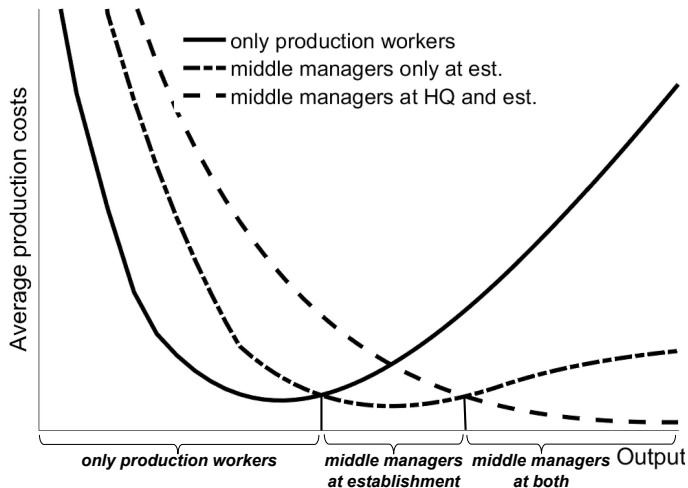


Impact of output on number of layers of middle managers



U-shape: quasi-fixed costs of CEO, middle managers vs. increasing marginal costs

Impact of output on number of layers of middle managers



⇒ **Multi-establishment firms add middle managers at either HQ or establishment**

Impact of helping costs on firm/ HQ/ establishment choices

Higher helping costs at establishment...

- ▶ **increase** amount of CEO knowledge,

Impact of helping costs on firm/ HQ/ establishment choices

Higher helping costs at establishment...

- ▶ **increase** amount of CEO knowledge,
- ▶ affect optimal choices at **establishment** *and* **headquarters**:

	establishment	headquarters
Number of prod. workers/ middle managers	↓	
Knowledge of prod. workers/ middle managers	↑	
Marginal production costs	↑	

Impact of helping costs on firm/ HQ/ establishment choices

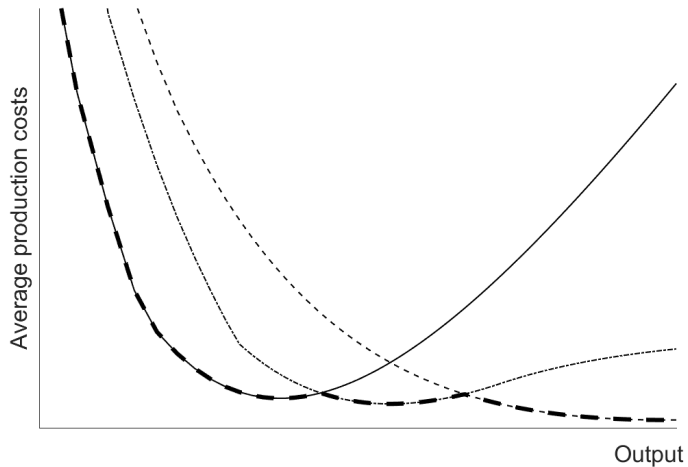
Higher helping costs at establishment...

- ▶ **increase** amount of CEO knowledge,
- ▶ affect optimal choices at **establishment** *and* **headquarters**:

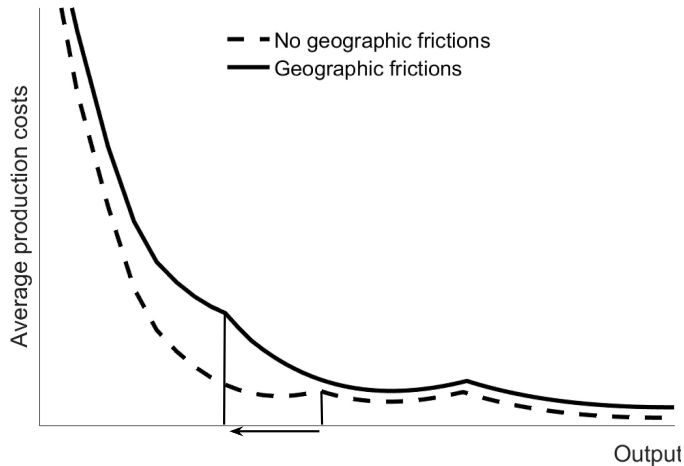
	establishment	headquarters
Number of prod. workers/ middle managers	↓	↓
Knowledge of prod. workers/ middle managers	↑	↓
Marginal production costs	↑	↓

⇒ **Higher helping costs affect organization of establishment and headquarters**

Impact of helping costs on number of layers of middle managers



Impact of helping costs on number of layers of middle managers



⇒ **Higher helping costs increase use of middle managers**

The optimal output

Objective: maximize profits

Higher helping costs at establishment...

- ▶ **decrease** output at **establishment**,
- ▶ **increase** output at **headquarters**

Intuition: impact on local marginal production costs

Higher helping costs **decrease** probability to maintain establishment

Intuition: cheaper to ship output from headquarters

⇒ **Higher helping costs decrease establishment output and investment probability**