Firm organization with multiple establishments

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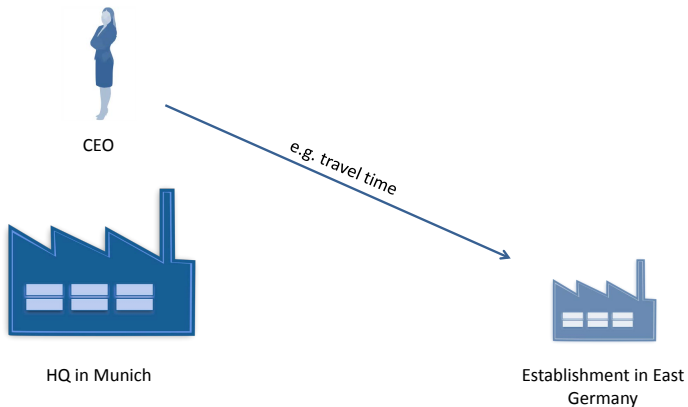NBER Organizational Economics Meeting

Motivation

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

Negative effect of distance on **establishment performance**
(e.g. Giroud, 2013; Kalnins & Lafontaine, 2013)

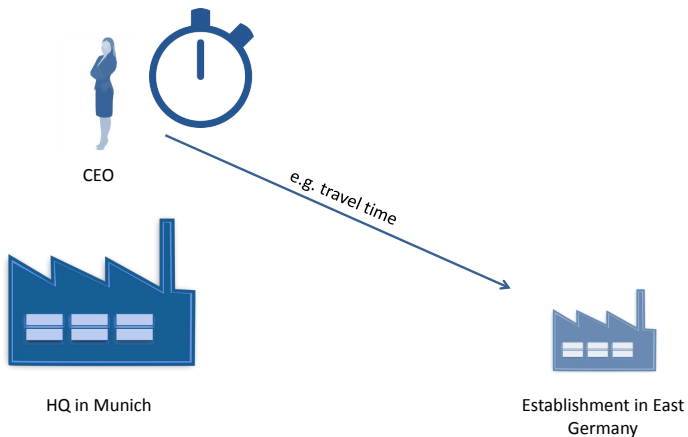Potential reason: distance causes **managerial frictions**

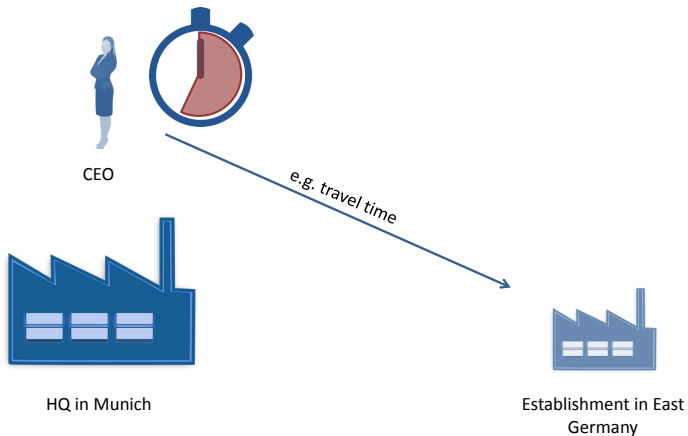# Geographic frictions increase helping costs for establishment

CEO

e.g. travel time

HQ in Munich

Establishment in East Germany

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

Geographic frictions increase helping costs for establishment

CEO

e.g. travel time

HQ in Munich

Establishment in East Germany

Geographic frictions increase helping costs for establishment

CEO

e.g. travel time

HQ in Munich

Establishment in East Germany

Middle managers mitigate impact of geographic frictions

CEO

e.g. travel time

middle manager

HQ in Munich

Establishment in East Germany

...and release CEO time

CEO

HQ in Munich

middle manager

Establishment in East Germany
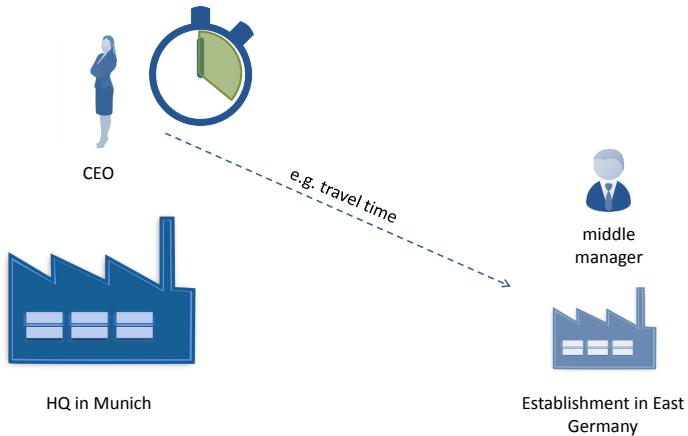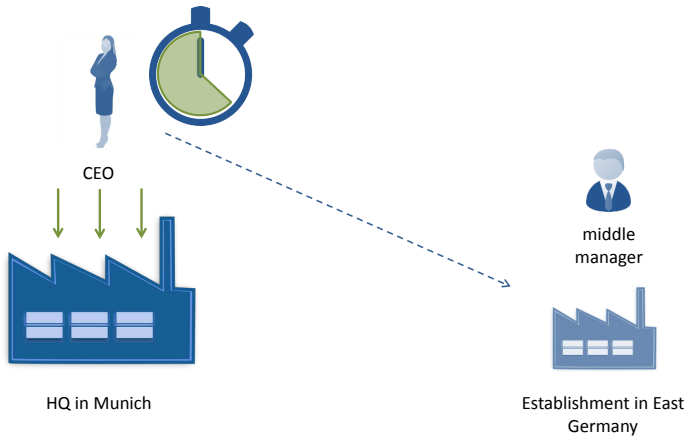
This paper

1. **Stylized 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**

Implication:

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
for Germany, from administrative sources

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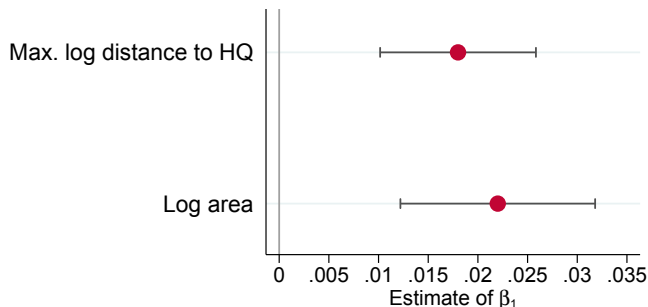
2. How do geographic frictions affect managerial organization of ME firms?

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

Use of middle managers increases with geographic frictions

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

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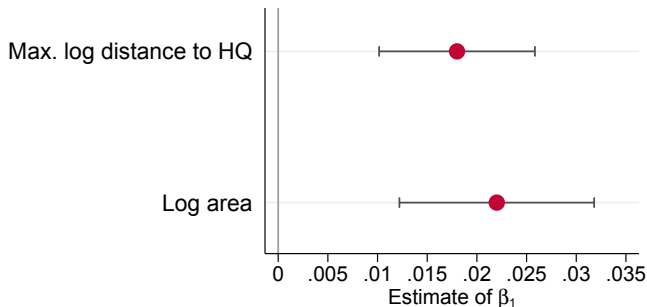

Table

Use of middle managers increases with geographic frictions

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

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

Table

$\rightarrow$ **Doubling maximum log distance to HQ $\approx$ increasing sales by 17%**

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.

ME firms add middle managers either at HQ or establishment as they grow
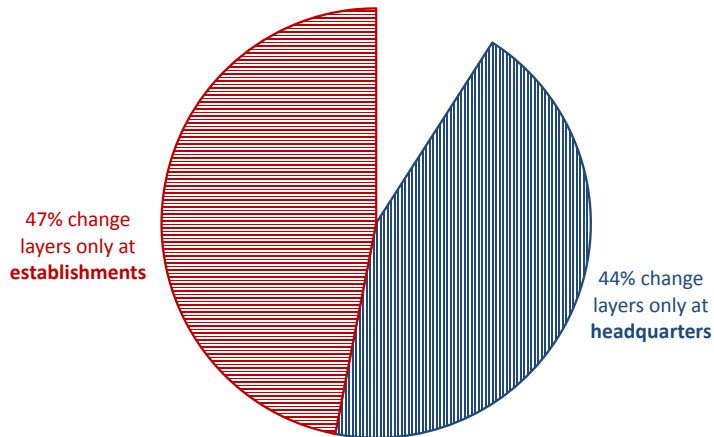
Multi-establishment firms with changes in managerial structure

47% change layers only at **establishments**

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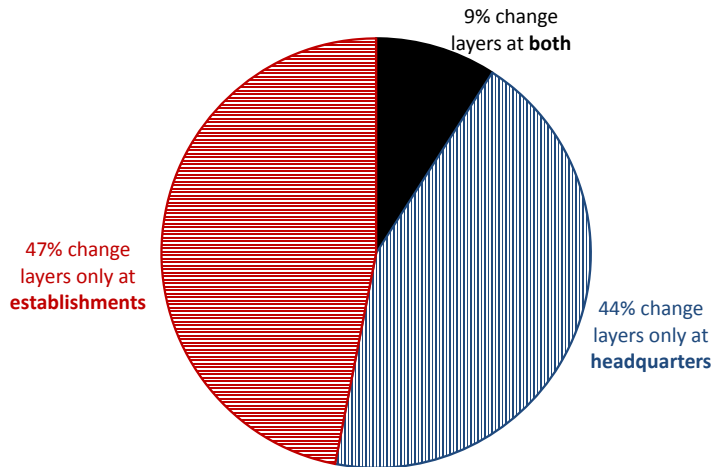
44% change layers only at **headquarters**

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

Multi-establishment firms with changes in managerial structure

9% change layers at **both**

47% change layers only at **establishments**

44% change layers only at **headquarters**
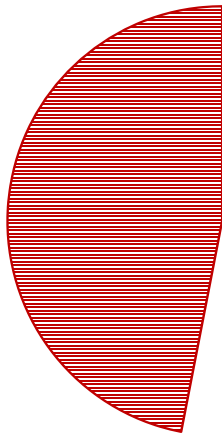
Part 2:
Model of multi-establishment firm organization

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

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**

Geographic frictions increase helping cost for CEO to help employees at establishment

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
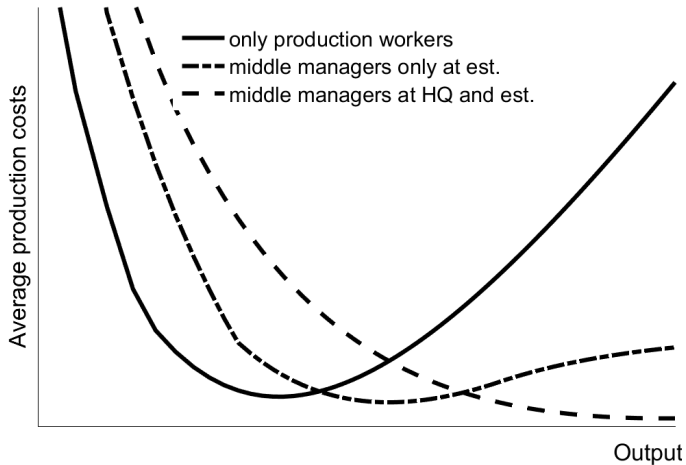
- **Firm level:**
    - CEO knowledge
    - Production quantities and allocation of CEO time

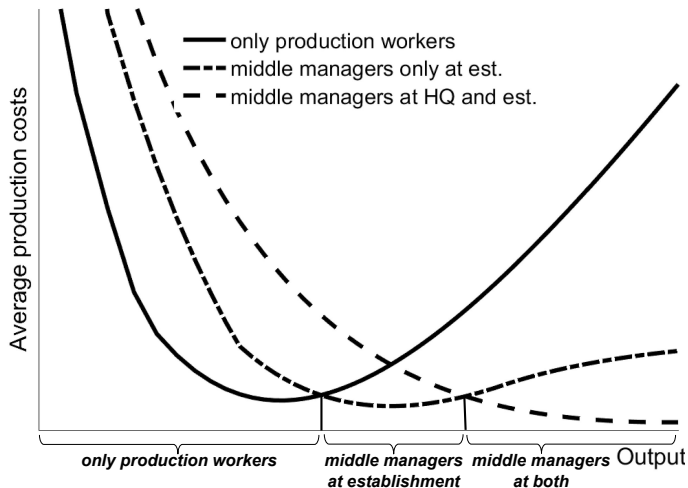- **HQ/ Establishment level:**
    Number and knowledge of employees per layer

Impact of output on number of layers of middle managers

Impact of output on number of layers of middle managers

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

Impact of helping costs on firm/ HQ/ establishment choices

Higher helping costs...

- **increase** amount of CEO knowledge,

Impact of helping costs on firm/ HQ/ establishment choices

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- **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...

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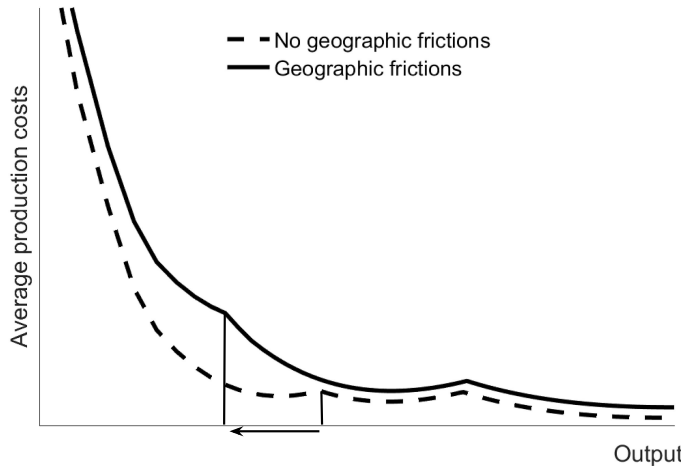
⇒ **Higher helping costs increase use of middle managers**

The optimal output

Objective: maximize profits

Higher helping costs...

- **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

$\Rightarrow$ **Higher helping costs decrease establishment output and investment probability**

Summary

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

1. Geographic frictions **decrease establishment output and investment probability**.
   $\rightarrow$ Consistent with Fact 1

2. Geographic frictions **increase use of middle managers**.
   $\rightarrow$ Consistent with Fact 2

3. Multi-establishment firms **add middle managers at either HQ or establishment** as they grow.
   $\rightarrow$ 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 (state-owned German railway firm)
Travel times between 115 stations connected to long-distance train network
in 2001, 2004, 2008
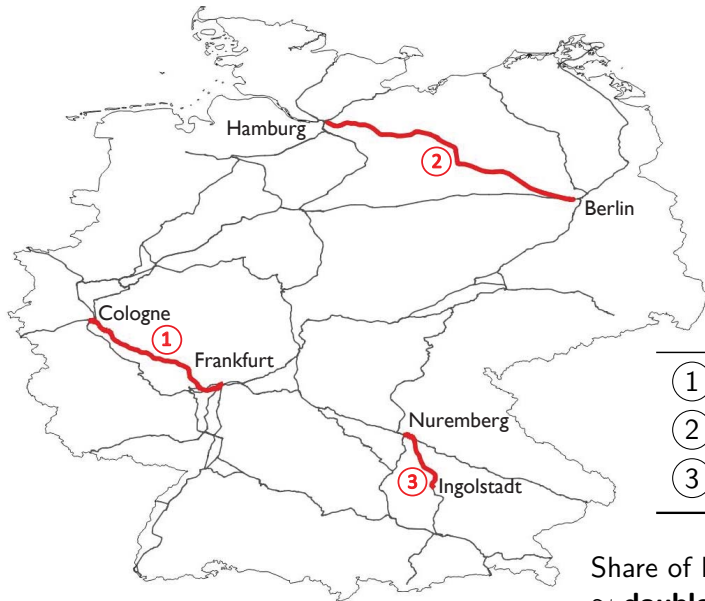
	opened	after	Δ	car
①	2002	1h16	**-44%**	> 2h
②	2004	1h30	**-33%**	∼ 3h
③	2006	0h30	**-55%**	> 1h

Share of business travelers on new routes
≈ **double** average share

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Share of business travelers on new routes
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New high-speed train routes reduce travel times from HQ to est. $\Rightarrow$ **helping costs ↓**

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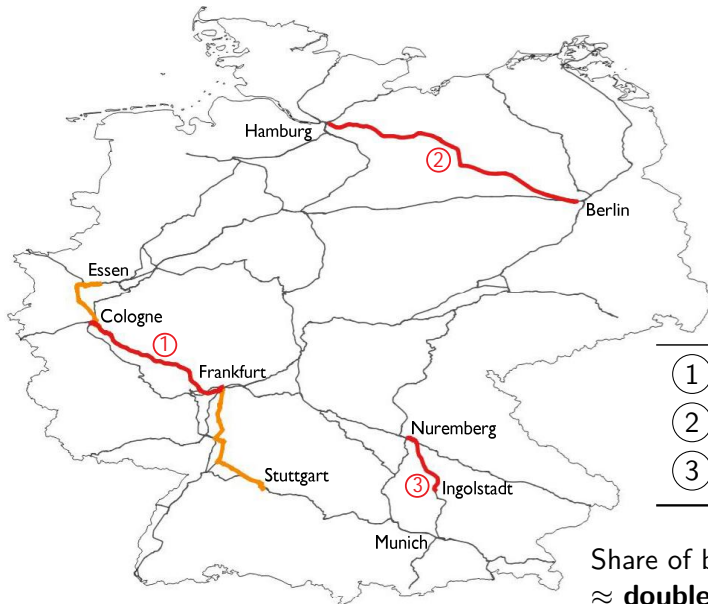
Model predictions

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**

Predictions:

- ▶ Lower travel times affect organization of **headquarters** and **all** establishments (today)
- ▶ Disentangle direct and indirect effect of lower travel times on number of layers at firm level (appendix)

Estimation equations

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

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

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

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

- $\mathbf{1}\{\}$: 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	0.067^{***}	0.000	-0.250
	(0.012)	(0.009)	(0.262)
Headquarters			
Lower travel times	-0.013	0.042^{*}	0.996^{**}
	(0.019)	(0.019)	(0.320)
Not directly affected establishments			
Lower travel times	-0.030^{**}	0.004	0.221
	(0.011)	(0.008)	(0.235)

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. Caliendo & Rossi-Hansberg, 2012; 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

Record linkage procedure

Social Security Records: data on establishments and employees
ORBIS: balance sheet information on firms

1. **Assign establishments to firms**
   Using 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 more 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***	−0.357***	−0.106***	−0.137***
	(0.021)	(0.020)	(0.018)	(0.017)
Log market potential	0.690***		0.485***	
	(0.026)		(0.044)	
Relative wages	−0.732***		−0.330**	
	(0.066)		(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

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

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	0.018***		0.019***	
distance to HQ	(0.004)		(0.004)	
Log area		0.022***		0.026***
		(0.005)		(0.004)
Log sales	0.125***	0.094***		
	(0.004)	(0.005)		
Log # non-mg.			0.139***	0.109***
employees			(0.004)	(0.006)
# firms	5,111	1,661	9,275	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	0.050*** (0.008)		0.029* (0.012)	
Log area		0.074*** (0.011)		0.074*** (0.014)
# firms	9,275	2,768	9,275	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

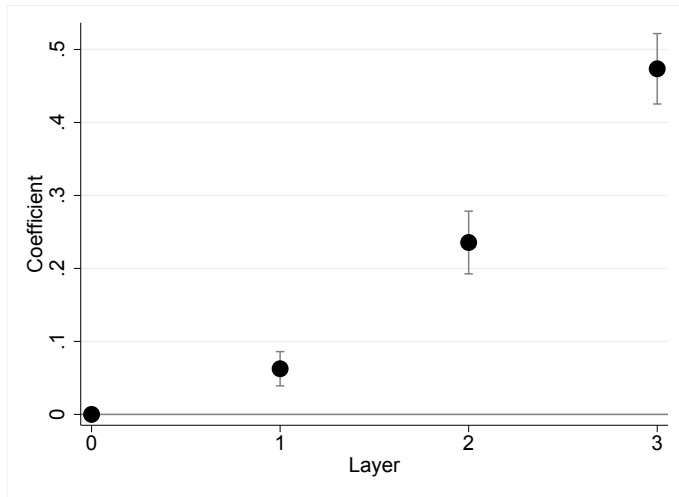**Data:** 2006 BiBB/BAuA Survey of the Working Population
20,000 individuals

OLS regressions

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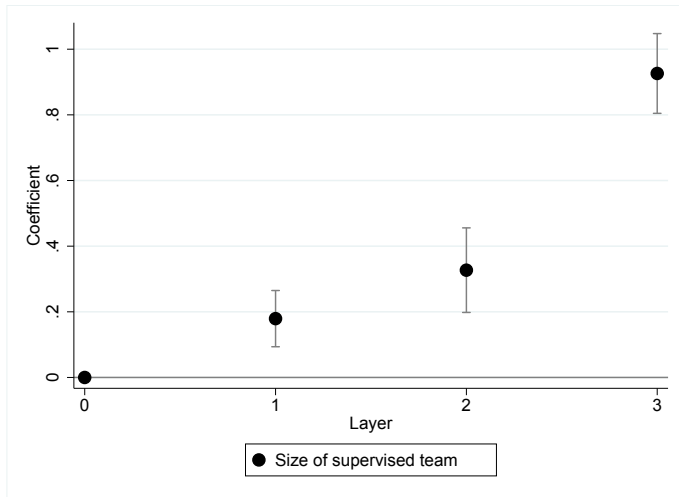
with

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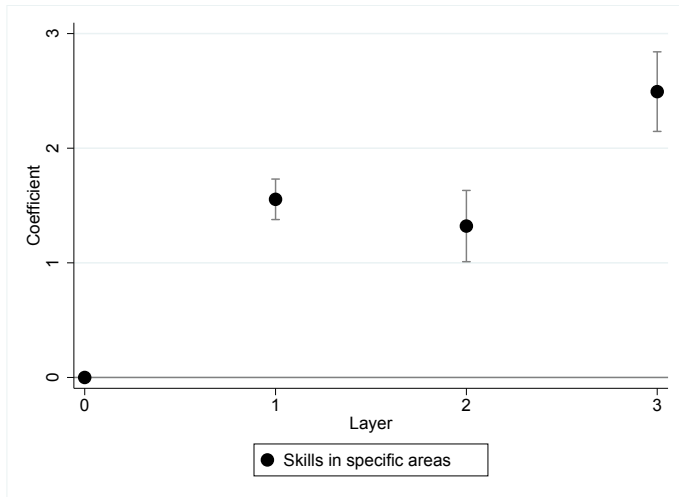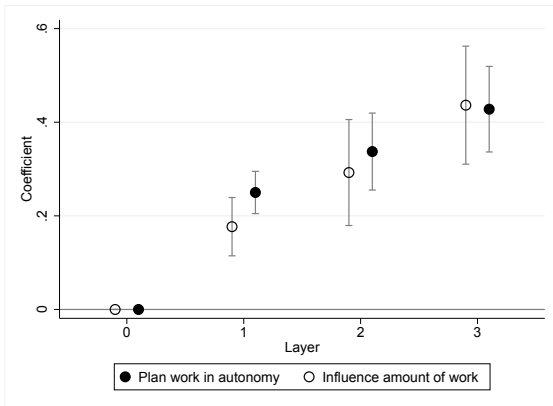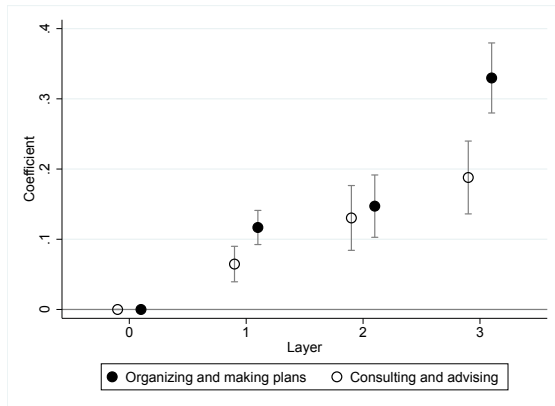
Supervisor status

Team size (in logs)

Skill requirements
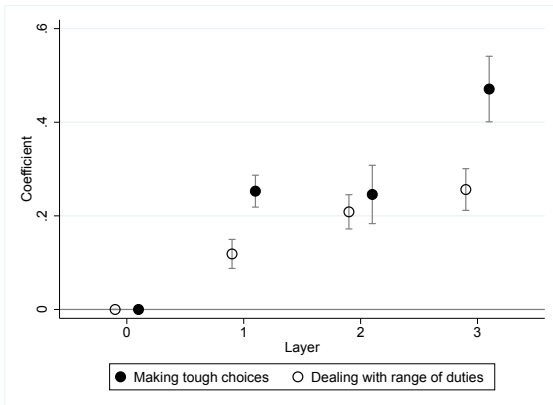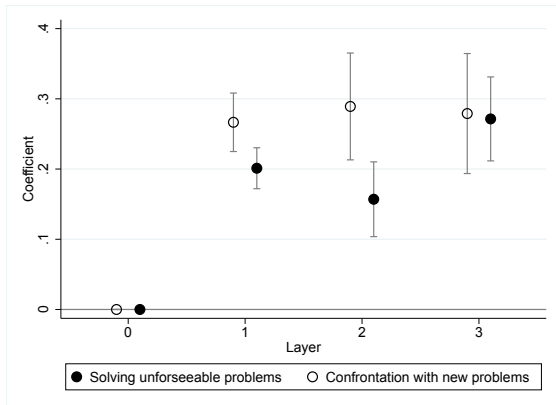
Tasks: planning, organizing and consulting

Tasks: problem solving and decision making

Regressions: Supervisor/skill/planning

	Spec. skills	Supervisor	Org. & plan	Consult & advise
Layer 1	1.554***	0.063***	0.117***	0.199***
	(0.090)	(0.012)	(0.012)	(0.012)
Layer 2	1.321***	0.236***	0.147***	0.252***
	(0.159)	(0.022)	(0.023)	(0.022)
Layer 3	2.494***	0.474***	0.330***	0.327***
	(0.177)	(0.025)	(0.025)	(0.025)
Age	-0.026***	0.000	-0.003***	-0.003***
	(0.004)	(0.000)	(0.000)	(0.000)
Tenure (decades)	0.151***	0.037***	0.018***	0.027***
	(0.043)	(0.005)	(0.005)	(0.005)
Gender	-1.282***	-0.114***	-0.021*	0.100***
	(0.072)	(0.009)	(0.009)	(0.009)
Constant	20.451***	0.009	0.293***	0.507***
	(0.296)	(0.036)	(0.037)	(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***	0.119***	0.201***	0.267***	0.250***	0.177***
	(0.017)	(0.015)	(0.015)	(0.021)	(0.023)	(0.031)
Layer 2	0.246***	0.209***	0.157***	0.289***	0.337***	0.293***
	(0.032)	(0.018)	(0.027)	(0.038)	(0.042)	(0.057)
Layer 3	0.471***	0.256***	0.271***	0.279***	0.428***	0.436***
	(0.036)	(0.022)	(0.031)	(0.043)	(0.047)	(0.063)
Age	-0.002***	-0.003***	-0.007***	-0.006***	-0.002	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tenure (decades)	0.054***	0.027**	0.001	0.050***	0.087***	0.021
	(0.008)	(0.008)	(0.007)	(0.009)	(0.010)	(0.014)
Gender	-0.169***	0.027	-0.120***	-0.082***	0.028	-0.187***
	(0.013)	(0.014)	(0.011)	(0.015)	(0.017)	(0.023)
Constant	1.616***	1.624***	1.830***	2.223***	2.434***	2.197***
	(0.052)	(0.057)	(0.044)	(0.062)	(0.121)	(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. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

back