Lecture 2: Firm Organization & Decentralization

John Van Reenen (LSE)
NBER Entrepreneurship Boot Camp (July 2013)

http://www.youtube.com/watch?v=wBloV_CSqyl&feature=related
Theory ahead of measurement in org econ?

• Large theoretical literature on the organization of the firm (e.g. Gibbons & Roberts, 2013)

• Traditionally much less empirical work because of difficulties in robustly collecting information over large number of firms
  – consequently, a focus on case studies

• Introduction to new types of data on firm organization & some factors that seem to determine decentralization
Lecture 2: Overview

1. Measuring organization: spans and decentralization

2. Differences in organization across firms, countries & time

3. Factors affecting firm decentralization

4. Organization and productivity

5. Conclusions
The simple model – organization within a 2-level firm

**Manager**

**Workers**

*Span of control:* the number of workers reporting to the manager

*Worker autonomy:* low if managers take most decisions; high if workers take most decisions
A more realistic multi-plant multi-level firm example

**CEO span:** number of plants

**Plant manager autonomy:**
- low if CEO takes most decisions;
- high if plant manager takes most decisions

**Plant manager span:**
- people reporting to PM

**Worker autonomy:**
- low if plant managers take most production decisions;
- high if workers take most decisions
Bloom, Sadun and Van Reenen (2012, QJE) collect span and decentralization data on about 3,600 firms

1) **Quantifying**: measure decentralization of hiring, investment, sales and production decisions from CHQ to plant manager. Also collect spans and worker decentralization (detailed in Bloom, Garicano, Sadun and Van Reenen, 2012)

2) **Truth**: use double blind as in Bloom and Van Reenen (2007)

3) **Data**: use various tricks as in Bloom and Van Reenen (2007)
   - Introduced as “Lean-manufacturing” interview, no financials
   - Official Endorsement: Bundesbank, Treasury, RBI, etc.

4) **Sample**: Manufacturing firms with 50 to 5,000 employees
**The decentralization survey page**

<table>
<thead>
<tr>
<th>Company Name</th>
<th>WUZHI LVYU CHEMICAL &amp; ELECTRIC CO.LTD.</th>
</tr>
</thead>
</table>

**Scoring**

<table>
<thead>
<tr>
<th>1</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No authority - even for replacement hires</td>
<td>Requires sign-off from CHQ based on the business case. Typically agreed (i.e. about 80 or 90% of the time).</td>
<td>Complete authority - it is my decision entirely</td>
</tr>
</tbody>
</table>

1. **To hire a FULL-TIME PERMANENT SHOPFLOOR worker, what agreement would your plant need from CHQ?**

   - Score 1: No authority - even for replacement hires
   - Score 3: Requires sign-off from CHQ based on the business case. Typically agreed (i.e. about 80 or 90% of the time).
   - Score 5: Complete authority - it is my decision entirely

2. **Where are decisions taken on new product introductions - at the plant, at the CHQ or at both?**

   - Score 1: All new product introduction decisions taken at the CHQ
   - Score 3: New product introductions are jointly determined by the plant and CHQ
   - Score 5: All new product introduction decisions take at the plant level

3. **How much of sales and marketing is carried out at the plant level (rather than at CHQ)?**

   - Score 1: None - sales and marketing is all run by CHQ
   - Score 3: Sales and marketing decisions are split between the plant and CHQ
   - Score 5: The plant runs all sales and marketing
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The Bloom, Sadun and Van Reenen (BSV 2012, QJE) empirical decentralization measure

- Main measure averages the z-score (scores normalized to mean 0, standard-deviation 1) of each variable:
  - Hiring senior employees (discrete, 1 to 5)
  - Maximum Capital expenditure (continuous, in $)
  - Introduction of new products (discrete, 1 to 5)
  - Sales and marketing (discrete, 1 to 5)
Decentralization varies across countries

- Most centralized
  - Asia
  - Southern Europe

- Least centralized
  - Scandinavian countries
  - Anglo-Saxon countries
External validation – country level

• Do these cross-country values look sensible?

• Only prior firm decentralization measure to check with we are aware of is Hofstede (1980)
  – Surveyed c.100,000 IBM employees across 50 countries during the 1970s & early 80s
  – Questions on management style (autocratic/paternalistic or consultative) and preferences for delegation
  – Combined into *Power Distance* index (1-100), low means limited (preference for) delegation
‘Power distance’ seems correlated with our firm decentralization.
Alternative ways to measure organization

1) Analysis of a firm’s formal structures
   – BSV also ask about span (number of direct reports)

   – Alternative is to look at a firm’s formal organizational structure (“organogram”). Usually case study but Rajan & Wulf (2006) have HR consultancy data across ~300 US firms

   – Another possibility is to look at whether firm organized into decentralized profit centers (vs. cost/ revenue centers or centralized; e.g. Acemoglu et al, 2007)

Problem is that real authority different from formal authority e.g. http://www.youtube.com/watch?v=5FRVvjGL2C0
Alternative ways to measure organization

2) Traditional arms length surveys on formal or real authority
   — Less costly than BSV but harder to probe managers for truth & open to more ambiguity of interpretation.

3) Examination of communication networks
   - Surveys (e.g. Boning & Shaw, 2007, on steel mini-mills)
   - e-mail traffic (Palacios-Huerta & Prat, 2010)

4) Insider Econometrics. “Case study” of a change (e.g. Wu, 2010, on Chinese journalists)
Increasing Delayering – positions reporting to CEO

Source: Rajan and Wulf, 2006, 300+ large US corporations
Lecture 2

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5. Conclusions
Lecture 2

1. Measuring organization: spans and decentralization

2. Differences in organization across firms, countries & time

3. Factors affecting firm decentralization
   – Technological (learning, ICT)
   – Skills
   – Culture

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A LEARNING MODEL WITH INCENTIVES: ACEMOGLU, AGHION, LELARGE, VAN REENEN & ZILIBOTTI (2007, QJE)

- Firm choosing whether to adopt a new technology. Should CEO delegate decision to plant manager?
  - Agent (plant manager) is informed about profitability of technology (which is idiosyncratic between firms)
  - Principal (CEO) is correctly aligned with owners’ incentives
    - Principal learns about likely profits of adoption based on public history of profits from others’ use
A LEARNING MODEL WITH INCENTIVES: ACEMOGLU, AGHION, LELARGE, VAN REENEN & ZILIBOTTI (2007, QJE)

• Trade-off between information (delegate) & incentives (centralize)

• Predictions are that decentralization more likely
  • For younger firms (less to learn from past experience)
  • Closer to the technological frontier (less experiments by other firms to learn from)
  • For more volatile/heterogeneous industries (because harder to learn from others)
YOUNG (ENTREPRENEURIAL?) FIRMS MORE DECENTRALIZED

Figure 3: Age and decentralization
Decentralization to Profit Centres (COI)
Technologically advanced firms (i.e. close to frontier) more likely to be decentralized
Firms who are in more heterogeneous/volatile sectors are more likely to be decentralized.

![Heterogeneity increases with decentralization](chart.png)
INFORMATION AND COMMUNICATION TECHNOLOGIES

- Garicano (2000) - Firms as cognitive hierarchy: exist to solve problems

- Agent (e.g. plant manager) solves as many problems as he can, then passes up complex problems to CHQ. CHQ solves but this involves communication cost

- Information Technologies (e.g. ERP) help plant managers to solve more problems, lower info acquisition costs.
  - Increases in IT causes more decentralization

- Communication Technologies (e.g. networks) makes “asking” cheaper
  - Increases in CT cause less decentralization
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERP (Enterprise Resource Planning)</td>
<td>0.104*</td>
<td>0.054</td>
</tr>
<tr>
<td>Information technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NETWORK</td>
<td>-0.098*</td>
<td>0.053</td>
</tr>
<tr>
<td>Communication technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ln(Computers/Employee)</td>
<td>-0.041</td>
<td>0.031</td>
</tr>
</tbody>
</table>

INFORMATION TECHNOLOGY INCREASES DECENTRALIZATION, COMMUNICATION TECHNOLOGY DECREASES DECENTRALIZATION

Source: Bloom, Garicano, Sadun & Van Reenen (2012)

Notes: OLS, industry & country dummies, 948 firms, noise controls, CEO on-site dummy, size, skills and multinational status. Dependent variable plant manager autonomy z-score. SE clustered by firm.
ENDOGENEITY OF ICT

- Use distance from SAP’s HQ in Waldorf/Hiedelberg (birthplace of most popular SAP) as an IV for ERP. EU firms only
- Use tele-communication costs as an IV for networks
- Strengthens results
Lecture 2

1. Measuring organization: spans and decentralization

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3. Factors affecting firm decentralization
   - Technological (learning, ICT)
   - Skills
   - Culture

4. Organization and productivity

5. Conclusions
“SKILL BIASED ORGANIZATIONAL CHANGE” DOES HUMAN CAPITAL COMPLEMENT DECENTRALIZATION?

- From cognitive viewpoint (Garicano, 2000), the more skilled less likely to make mistakes

- Fall in IT prices leads to complementary organizational changes (decentralization/delayering) and increased demand for more skilled workers
  - More inequality
  - Higher productivity
Plants with more skilled workers are more decentralized

Proportion of employees with a college degree

- Under 20% (base)
- 20-40%
- 40-60%
- 60-80%
- 80-100%
Three implications of complementarity between human capital and decentralization

- **Production or cost function** \( Y = AF(L, K, SKILL, ORG) \)
  - Positive interactions between skills and organization in a production function

- **Skill demand equation**
  - Does decentralization increase demand for more skilled workers?

- **Organization equation**
  - Decentralization more likely when supply of human capital increases, e.g. do higher relative prices of skilled workers inhibit decentralization?

- Caroli & Van Reenen (2001) & Bresnahan, Brynjolfsson and Hitt (2002, QJE) find evidence in favor of all 3 predictions
### TABLE V

**DETERMINANTS OF ORGANIZATIONAL CHANGE IN GREAT BRITAIN AND FRANCE**

<table>
<thead>
<tr>
<th></th>
<th>Britain</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean of dependent variable</td>
<td>.432</td>
<td>.524</td>
</tr>
<tr>
<td>(1)</td>
<td></td>
<td>(3)</td>
</tr>
<tr>
<td>OC</td>
<td></td>
<td>OC</td>
</tr>
<tr>
<td>Regional relative wage (high-low education)</td>
<td>-0.893</td>
<td>-1.122</td>
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<td></td>
<td>(0.285)</td>
<td>(0.629)</td>
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<td>(4)</td>
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<td>OC</td>
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</tbody>
</table>
Lecture 2

1. Measuring organization: spans and decentralization

2. Differences in organization across firms, countries & time

3. **Factors affecting firm decentralization**
   - Technological (learning, ICT)
   - Skills
   - Culture

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5. Conclusions
TRUST AND DECENTRALIZATION

• Trust may affect optimal decentralization
  – Agent is less likely to “steal”
  – Facilitate cooperative solutions in repeated game settings: e.g. Baker, Gibbons and Murphy (1999)
  – Proxy the congruence of incentives: e.g. Aghion and Tirole (1997)

• We find evidence of robust positive relationship between trust in region where plant’s HQ is located and decentralization
MEASURING TRUST

• Measure trust using the World Value Survey, from the question:

  “Generally speaking, would you say that most people can be trusted or that you can’t be too careful in dealing with people?”

  Trust by region of the country defined as % of people answering “yes” to first part of the trust question

• Experimental studies show this question linked with trust/trusting behavior (Glaeser et al, 2000, Sapienza et al, 2007)

• Used in prior social capital literature: e.g. Knack & Keefer (1997); Guiso, Sapienza, Zingales (2004);
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust (in plant’s CHQ region)</td>
<td>1.231***</td>
<td>0.440</td>
<td></td>
</tr>
<tr>
<td>Rule of Law</td>
<td>0.580***</td>
<td>0.071</td>
<td></td>
</tr>
<tr>
<td>Plant Skills (% college)</td>
<td>0.122***</td>
<td>0.030</td>
<td></td>
</tr>
<tr>
<td>Firm Size</td>
<td>0.047*</td>
<td>0.025</td>
<td></td>
</tr>
<tr>
<td>Plant Size</td>
<td>0.098***</td>
<td>0.026</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>3,655</td>
<td>3,655</td>
<td>3,655</td>
</tr>
<tr>
<td>Country dummies &amp; other controls</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

**Notes:** controls are SIC3 dummies, noise (interviewer dummies, tenure & and seniority, etc.), listing, CEO onsite, plant size, regional GDP/head & population, Multinational, SE clustered by 112 regions.

**Source:** Bloom, Sadun & Van Reenen (2012)
USE MULTINATIONALS AS A SECOND TEST FOR IMPORTANCE OF TRUST

- Is there bias due to trust proxying for other country/regional variables

- We look at affiliates of foreign multinationals and investigate whether trust in their home country also matters
  - Can control for region of location dummies

- Also use EuroBarometer survey which asks individuals in all European countries how much they trust people in other countries (inc Japan and US) Bilateral trust
  - Control for region of location & CHQ country of origin
  - IV strategies based on religious & somatic distance
## DECENTRALIZATION & TRUST IN MULTINATIONALS

<table>
<thead>
<tr>
<th>Sample:</th>
<th>CHQ in different region</th>
<th>CHQ in different region</th>
<th>Foreign MNEs OLS</th>
<th>Foreign MNEs OLS</th>
<th>Foreign MNEs IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust (CHQ region)</td>
<td>0.606**</td>
<td>0.579**</td>
<td>-0.219</td>
<td>(0.270)</td>
<td>(0.284)</td>
</tr>
<tr>
<td></td>
<td>(0.270)</td>
<td>(0.284)</td>
<td>(0.471)</td>
<td></td>
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<tr>
<td>Trust (bilateral from origin cty to location cty)</td>
<td></td>
<td></td>
<td>1.765***</td>
<td>1.669**</td>
<td>3.071**</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>(0.619)</td>
<td>(0.789)</td>
<td>(1.253)</td>
</tr>
<tr>
<td>Regional of location dummies</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Country CHQ dummies</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Clustering</td>
<td>Region</td>
<td>Region</td>
<td>CHQ by plant location</td>
<td>CHQ by plant location</td>
<td>CHQ by plant location</td>
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<tr>
<td>Observations</td>
<td>1094</td>
<td>1094</td>
<td>282</td>
<td>282</td>
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</tr>
</tbody>
</table>

**Notes:** Controls are country & SIC3 dummies, noise controls (interviewer dummies, interviewee tenure & seniority, etc.), public listing, CEO onsite, plant size, regional GDP/head, Regional population, multinational status. IV is religious distance

**Source:** Bloom, Sadun & Van Reenen (2012,)
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TWO CHANNELS FOR THE IMPACT OF DECENTRALIZATION

• Between firm effect of reallocation

• Within firm effect where decentralization can be a complement for new technologies
TWO CHANNELS FOR THE IMPACT OF DECENTRALIZATION

Firm size:
Early work on the structure of firms argued that decentralization was critical for large firms, Penrose (1959) & Chandler (1962)

Indeed, see that larger firms are more decentralized (over)

Essential for productivity growth as reallocation - which accounts for ≈1/2 of US TFP growth - needs productive firms to grow

Hence, factors driving decentralization – trust, rule of law, competition – also drive growth via facilitating decentralization
Larger Firms are more decentralized

Number of employees in the firm:
- 100-200
- 200-500
- 500-1000
- 1000+

Mean of decentralization:
- 50
- 100
- 200
- 500
- 1000
# TRUST ENABLES FIRMS TO GROW LARGER

**Dependent variable: mean ln(size) in the region**

<table>
<thead>
<tr>
<th>Sample:</th>
<th>All</th>
<th>Foreign MNEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust (CHQ region)</td>
<td>2.270**</td>
<td>5.578***</td>
</tr>
<tr>
<td></td>
<td>(0.826)</td>
<td>(1.477)</td>
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<tr>
<td>Trust (bilateral from origin cty to location cty)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>110</td>
<td>292</td>
</tr>
</tbody>
</table>

**Notes:** Controls are regional GDP per capita, population, % of employees with a degree and country dummies

**Source:** Bloom, Sadun & Van Reenen (2012, QJE)
SUMMARY

• Decentralization a key organizational trait of firms

• Varies by country – Northern Europe and North America decentralized, Southern Europe and Asian centralized

• Systematically Varies by firm – Firm age, high trust, industry heterogeneity & human capital all positively linked to decentralization

• Important for reallocation: firms need to decentralize to grow, and firm growth required for productivity enhancing reallocation

• Important for firm level productivity of certain factors – e.g. IT
Five outstanding research questions on ORG

1. What fraction of the differences in TFP across firms and countries can organizational differences explain?

2. What is the life-cycle of a firm’s organizational structure (e.g. how do entrepreneurs “let go”)

3. How quickly can firms change real organizational structures?

4. Is the optimal organizational structure changing over time, and if so why?

5. Links between the boundary of the firm & decentralization within firms
Back Up
What about changes in decentralization over time?

"Globalization and the arrival of the information economy have rapidly demolished all the old precepts. The management of global companies, which must innovate simultaneously and speed information through horizontal globe-spanning networks, has become a daunting challenge. Old, rigid hierarchies are out ...."

Business Week, cover story August 21, 2000
Decentralization also varies across firms

Decentralization measure (higher number is more decentralized)
Competition and decentralization – basic theory (1/7)

• Theory ambiguous
  • Competition may affect information:
    – Improves the value of timely responses to local conditions (e.g. Aghion & Tirole, 1997)
    – But, reduces value of local information as more firms for the principal to learn from (e.g. Acemoglu et al., 2007)
  
• Competition may also affect incentives:
  – Lower risk of manager abusing autonomy as incentives more aligned with firm (e.g. Schmidt 1997, Vives 2005)
  – Less incentive to co-ordinate prices (Alonso et al., 2008)

• Bloom, Sadun & Van Reenen (2010, AER P&P)
## Decentralization higher with more competition (2/7)

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<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Coefficient</td>
<td>Coefficient</td>
<td>Coefficient</td>
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<td>Coefficient</td>
</tr>
<tr>
<td>Import Penetration</td>
<td>0.131***</td>
<td>0.184***</td>
<td>(0.050)</td>
<td>(0.073)</td>
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<tr>
<td>1 – Lerner Index</td>
<td>6.537***</td>
<td>2.265***</td>
<td>(1.176)</td>
<td>(1.081)</td>
<td>(1.081)</td>
<td>(1.081)</td>
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<tr>
<td>Number of competitors</td>
<td></td>
<td>0.134***</td>
<td></td>
<td></td>
<td></td>
<td>0.094**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Skills</td>
<td>0.081***</td>
<td>0.090***</td>
<td>(0.018)</td>
<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.016)</td>
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<tr>
<td>Ln(Firm Size)</td>
<td>0.076**</td>
<td>0.068***</td>
<td>(0.026)</td>
<td>(0.017)</td>
<td>(0.018)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>Ln(Plant size)</td>
<td>0.119**</td>
<td>0.091**</td>
<td>(0.024)</td>
<td>(0.022)</td>
<td>(0.022)</td>
<td>(0.022)</td>
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<tr>
<td>Country &amp; Ind. dummies</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Clustering</td>
<td>Cty *Sic2</td>
<td>Cty *Sic2</td>
<td>Cty *Sic3</td>
<td>Cty *Sic3</td>
<td>Firm</td>
<td>Firm</td>
</tr>
</tbody>
</table>

Notes: Other controls are SIC3 dummies, 12 country dummies, noise controls (interviewer dummies, Interviewee tenure and seniority, etc.), public listing, CEO onsite, plant size, Number of competitors (0=none, 1=between 1 and 4, 2=5 or more (as reported by plant manager)).
Other studies also find a positive correlation


The relationship is likely to be causal. Guadalupe and Wulf (2010, AEJ)

- look at Canadian free trade natural experiment
- Use Rajan & Wulf (2006) panel data of Compustat/Hewitt firms
- Find that US firms in industries which faced more competition because of fall in tariffs were more likely to delayer/decentralize
**Complexity:** Multinationals (even controlling for size) are more decentralized

<table>
<thead>
<tr>
<th>Dependent variable: Decentralization</th>
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<tbody>
<tr>
<td>Foreign Multinational</td>
<td>0.157***</td>
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<tr>
<td></td>
<td>(0.058)</td>
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<tr>
<td>Firm employment</td>
<td>0.052**</td>
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<td></td>
<td>(0.022)</td>
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<tr>
<td>Plant employment</td>
<td>0.089***</td>
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<td></td>
<td>(0.030)</td>
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<td>Plant Skills (% employees with a degree)</td>
<td>0.085***</td>
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<tr>
<td></td>
<td>(0.015)</td>
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<tr>
<td>Observations</td>
<td>3,660</td>
</tr>
</tbody>
</table>

Industry dummies (112)  yes
Country dummies (12)  yes
Other controls (60)  yes

*Source: Bloom, Sadun and Van Reenen (2012)*
Firm level productivity:
Typically think of decentralization as a control variable – firms choose the right level – so not “right” or “wrong” level

But this level may be hard to change, so can be “right” or “wrong” level in the short-run if situation changes

Good example is IT – huge fall in IT prices, especially since 1995. Garicano (2000) implies optimal form is decentralization but takes time due to adjustment costs

Bresnahan, Brynjolfsson and Hitt (2002, QJE); Bloom, Sadun and Van Reenen (2012, QJE) find strong complementarity between IT and decentralization