Productivity, Management and the Organization of Firms

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London School of Economics
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Yrjö Jahnsson Lecture
Helsinki, January 29th 2010
INTRODUCTION

• Continue Fabrizio’s theme of productivity differences between countries
  – Same technologies exploited differently between countries & firms: depends on firm organization
  – “Management as a technology”
• To understand this we need better data on management and firm organization
• Research program to answer fundamental questions of:
  – Why organizations differ so much?
  – Why productivity so heterogeneous between firms?
  – Can this account for differences in cross country performance (micro to macro)
- Productivity
  - Between countries and between firms
  - Causes

- Management Practices

- Organization: Decentralization

- Bringing it all together
LARGE INCOME & TFP DIFFERENCES BETWEEN COUNTRIES

Source: Jones and Romer (2009). US=1
PRODUCTIVITY DIFFERENCES ACROSS FIRMS WITHIN COUNTRIES IS ALSO HUGE

- US Census data on population of plants
  - plant at the 90th percentile produced 4 times higher labor productivity as plant at the 10th percentile (Syverson, 2004)
  - controlling for other inputs, TFP difference still 1.9x

- Not just mismeasured plant-specific prices
  - in detailed industries like Boxes, Bread, Carbon black, block ice, concrete, plywood, etc.) TFP dispersion gets larger when we control for prices (Foster, Haltiwanger and Syverson, 2008, AER)

- Not just temporary shocks
  - Top 1/3 of plants in highest TFP quintile stay there 5 years later (Bartelsman & Dhrymes, 1998)

- Therefore, this micro-economic dispersion could account for large part of cross country differences
DISTRIBUTION OF PLANT TFP DIFFERENCES: MUCH LARGER VARIANCE OF PRODUCTIVITY BETWEEN INDIAN PLANTS COMPARED TO US PLANTS

Source: Hsieh and Klenow (2009, QJE), manufacturing sector
FACTORS INCREASING PRODUCTIVITY

• Proximate factors:
  – Adoption of “Hard” technology (e.g. computers, mobile phones, web application, etc.)
  – Management Practices

• Some deeper factors “driving” proximate factors
  – Competition
  – Supply of Human Capital
  – Globalization
  – Regulations/policies
  – Culture
• Productivity

• Management Practices
  – Measuring
  – Describing
  – Explaining
  – Causal impact

• Decentralization

• Bringing it all together
MANAGEMENT AS A TECHNOLOGY

Waves of management technologies have arisen over time

• American System of Manufacturing (1850s)
• Taylor’s Scientific management (1900s)
• Mass production (1920s)
• Alfred Sloan’s M-form firm (1930s)
• Demming’s quality movements (1950s)
• Toyota production system (1970s)
WHAT DO WE NEED?

• The Data Constraint
  – “It is the preparation of the econometric chef that catches the professional eye, not the quality of the raw materials in the meal” Zvi Griliches (1986)

• A way to quantitatively benchmark management practices:
  – At the firm-level
  – Across countries and sectors
  – That can be matched with firm performance data

• Joint work with Nick Bloom & Raffaella Sadun
THE SURVEY METHODOLOGY

1) Developing management questions
   • Scorecard for 18 practices: monitoring, targets, people
   • ≈45 minute phone interview of manufacturing plant managers

2) Obtaining unbiased comparable responses ("Double-blind")
   • Interviewers do not know the company’s performance
   • Managers are not informed (in advance) they are scored
   • Run from London, with same training and country rotation

3) Getting firms to participate in the interview
   • Introduced as “Lean-manufacturing” interview, no financials
   • Official Endorsement: Bundesbank, PBC, CII & RBI, etc.
   • Run by 78 MBAs types (assertive with business experience)
| Score | (1): Measures tracked do not indicate directly if overall business objectives are being met. Certain processes aren’t tracked at all | (3): Most key performance indicators are tracked formally. Tracking is overseen by senior management | (5): Performance is continuously tracked and communicated, both formally and informally, to all staff using a range of visual management tools |

**MONITORING** - e.g. “*HOW IS PERFORMANCE TRACKED?*”
MANAGEMENT SURVEY SAMPLE

• Interviewed about 6,000 firms across Asia, Europe & Americas
• Obtained 45% response rate (uncorrelated with performance)
• Have run 3 waves to date (2004, 2006, 2009)

Medium sized manufacturing firms:
• Medium sized (100 - 5,000 employees, median ≈ 250) because firm practices more homogeneous
• Manufacturing as easier to measure productivity
  - also analyzing Retail, Law Firms, Hospitals, Schools,
  - others extending this to tax collection agencies, charities, etc.
INTERNAL VALIDATION: RE-RATER ANALYSIS

Re-interviewed 222 firms with different interviewers & managers

Firm average scores (over 18 questions)

Firm-level correlation of 0.627
EXTERNAL VALIDATION: FIRM PERFORMANCE

Performance measure
(e.g. \( \ln(\text{output}) \))

\[
\hat{y}_i = \beta MNG_i + \alpha_l l_i + \alpha_k k_i + \alpha_m h_i + \gamma x_i + u_i
\]

- Note – not a causal estimation, only an association (e.g. correlation of management with TFP)
- Randomized control trials in Indian textile firms outside Mumbai suggest large causal impacts of management interventions (Bloom et al, 2010 – see later)
EXTERNAL VALIDATION: BETTER PERFORMANCE IS CORRELATED WITH BETTER MANAGEMENT

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Productivity (% increase)</th>
<th>Profits (ROCE)</th>
<th>5yr Sales growth</th>
<th>Share Price (Tobin Q)</th>
<th>Exit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimation</td>
<td>OLS</td>
<td>OLS</td>
<td>OLS</td>
<td>OLS</td>
<td>Probit</td>
</tr>
<tr>
<td>Firm sample</td>
<td>All</td>
<td>All</td>
<td>All</td>
<td>Quoted</td>
<td>All</td>
</tr>
<tr>
<td>Management</td>
<td>28.7***</td>
<td>2.02***</td>
<td>4.70***</td>
<td>25.0***</td>
<td>-26.2**</td>
</tr>
<tr>
<td>Firms</td>
<td>3,469</td>
<td>1,994</td>
<td>1,883</td>
<td>374</td>
<td>3,161</td>
</tr>
</tbody>
</table>

Note: Includes controls for country and industry dummies, year, firm-size, firm-age, skills

Significance levels: *** 1%, ** 5%, * 10%.

Sample of all firms where accounting data is available
• Productivity

• **Management Practices**
  – Measuring
  – **Describing**
  – Explaining
  – Causal impact

• Decentralization

• Bringing it all together
### “TAILS” DRIVES DIFFERENCES ACROSS COUNTRIES

<table>
<thead>
<tr>
<th>Country</th>
<th>Australia</th>
<th>Brazil</th>
<th>Canada</th>
<th>China</th>
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<tbody>
<tr>
<td>Density</td>
<td>[Graph]</td>
<td>[Graph]</td>
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<table>
<thead>
<tr>
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<th>France</th>
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<th>Great Britain</th>
<th>Greece</th>
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<tr>
<td>Density</td>
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<table>
<thead>
<tr>
<th>Country</th>
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<th>Ireland</th>
<th>Italy</th>
<th>Japan</th>
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<tr>
<td>Density</td>
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<td>[Graph]</td>
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<td>[Graph]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Poland</th>
<th>Portugal</th>
<th>Sweden</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>[Graph]</td>
<td>[Graph]</td>
<td>[Graph]</td>
<td>[Graph]</td>
</tr>
</tbody>
</table>

#### Firm-Level Management Scores

- **Y-axis:** Density
- **X-axis:** Firm-Level Management Scores

- **Note:** Red circles highlight specific density patterns in Japan and US.

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The image illustrates the distribution of firm-level management scores across different countries. The red circles emphasize unusual densities in Japan and the US, suggesting notable differences in these countries compared to others.
COUNTRIES ALSO HAVE DIFFERENT RELATIVE STRENGTHS IN MANAGEMENT PRACTICES

People management (hiring, firing, pay & promotions) – operations (monitoring, continuous improvement and Lean)

Relatively better at ‘talent’ management (hiring, firing, pay, promotions etc)

Relatively better at ‘operations’ management (monitoring, continuous improvement, Lean etc)

Sweden
France
Australia
Italy
Portugal
Germany
Japan
Greece
Canada
Great Britain
Brazil
Northern Ireland
US
Republic of Ireland
China
Poland
India
• Productivity

• **Management Practices**
  – Measuring
  – Describing
  – **Explaining**
  – Causal impact

• Decentralization

• Bringing it all together
FACTORS ASSOCIATED WITH DIFFERENCES IN MANAGEMENT PRACTICES

- Competition
- Governance - Family firms & Private Equity
- Multinationals
- Labor market regulations
- Supply of Human Capital
COMPETITION IS ASSOCIATED WITH BETTER MANAGEMENT PRACTICES

Assessed management practice score

Reported number of competitors, 10+
TOUGH COMPETITION IS STRONGLY LINKED TO BETTER MANAGEMENT PRACTICES

<table>
<thead>
<tr>
<th>Competition proxies</th>
<th>Dependent variable: Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import penetration (SIC-3 industry, 1995-99)</td>
<td>0.066** (0.033)</td>
</tr>
<tr>
<td>“1-Rents” measure(^1) (SIC-3 except firm itself, 1995-99)</td>
<td>1.964** (0.721)</td>
</tr>
<tr>
<td># of competitors (Firm level, 2004)</td>
<td>0.158*** (0.023)</td>
</tr>
<tr>
<td>Observations</td>
<td>2,499</td>
</tr>
<tr>
<td>Full controls(^2,3)</td>
<td>Yes</td>
</tr>
</tbody>
</table>

\(^1\) 1-Rents = 1- (operating profit – capital costs)/sales
\(^2\) Includes 108 SIC-3 industry, country, firm-size, public and interview noise (analyst, time, date, and manager characteristic) controls
\(^3\) S.E.s in ( ) below, robust to heteroskedasticity, clustered by country-industry
A VARIETY OF WAYS COMPETITION CAN HELP TO IMPROVE MANAGEMENT PRACTICES

- “Incentive” effect – competition forces badly managed firms to improve performance
  - Using the panel of firms we can show that management quality improves when competition increases

- “Selection” effect – competition selects out badly managed firms (they go bankrupt)
  - Evidence from less of a US “tail”
  - Reallocation effects (over)
COMPETITION NOT ONLY DRIVES OUT BADLY MANAGED FIRMS, BUT ALLOCATES MORE JOBS TO EFFICIENT FIRMS

- An additional sd on average management score associated with an increase of employment of:
  - **US** ~700
  - **UK** ~550
  - **India** ~260
  - **Italy** ~250

- Competitive forces of reallocation weaker in India/Italy compared to US
• Productivity

• Management Practices
  – Measuring
  – Describing
  – Explaining
  – Causal impact

• Decentralization

• Bringing it all together
RANDOMIZED CONTROL TRIAL OF MANAGEMENT INTERVENTION IN INDIAN TEXTILE FACTORIES OUTSIDE MUMBAI

(1) Winding the yarn thread onto the warp beam

(2) Drawing the warp beam ready for weaving

(3) Weaving the fabric on the weaving loom

(4) Quality checking and repair
MANY PARTS OF THESE PLANTS WERE DIRTY AND UNSAFE

Garbage outside the plant

Garbage inside a plant

Flammable garbage in a plant

Chemicals without any covering
PLANT FLOORS WERE DISORGANIZED

Instrument not removed after use, blocking hallway.

Old warp beam, chairs and a desk obstructing the plant floor.

Dirty and poorly maintained machines.

Tools left on the floor after use.
Unfinished rough path along which several 0.6 ton warp beams were taken on wheeled trolleys every day to the elevator, which led down to the looms.

This steep slope, rough surface and sharp angle meant workers often lost control of the trolleys. They crashed into the iron beam or wall, breaking the trolleys. So now each beam is carried by 6 men.

A broken trolley (the wheel snapped off)

At another plant both warp beam elevators had broken down due to poor maintenance. As a result teams of 7 men carried several warps beams down the stairs every day. At 0.6 tons each this was slow and dangerous - two serious accidents occurred in our time at the plant.
PREVIOUSLY MENDING WAS RECORDED ONLY TO CROSS-CHECK AGAINST CUSTOMERS’ CLAIMS FOR REBATES

Defects log with defects not recorded in an standardized format. These defects were recorded solely as a record in case of customer complaints. The data was not aggregated or analyzed.
NOW MENDING IS RECORDED DAILY IN A STANDARD FORMAT. IT CAN ANALYZED BY LOOM, SHIFT, DESIGN & WEAVER
THE QUALITY DATA IS NOW COLLATED AND ANALYZED AS PART OF THE NEW DAILY PRODUCTION MEETINGS

Plant managers now meet regularly with heads of quality, inventory, weaving, maintenance, warping etc. to analyze data.
DEFECT RATES FALL IN TREATMENT PLANTS

Notes: Displays the average quality defects index, which is a weighted index of quality defects, so a higher score means lower quality. This is plotted for the 14 treatment plants (square symbols) and the 6 control plants (+ symbols). Values normalized so both series have an average of 100 prior to the start of the intervention.
• Productivity

• Management Practices

• **Firm Organization: Decentralization**

• Bringing it all together
DECENTRALIZATION

• Fundamental to most social sciences, more recently key part of economics of organization

• We want to explain decentralization & analyze whether it influences productivity (e.g. when new technologies important)

• Measurement
  – Key example: delegation from CEO and plant manager
  – Formal (e.g. profit centers vs. cost centers)
  – Real (direct surveys of employees)
Example A:
Domestic Firm
2 Sites, Single Plant

Central HQ
(New York Site)

D, Decentralization

Plant
(Albany Site)
Example B:
US Domestic Firm
Multi-Site, Multi-Plants

Central HQ
(New York Site)

Plant 1
(Buffalo Site)

Plant 2
(Albany Site)

Plant 3
(Scranton Site)
**THE DECENTRALIZATION SURVEY PAGE**

Company Name

**WUZHI LVYU CHEMICAL & ELECTRIC CO.LTD.**

<table>
<thead>
<tr>
<th>Scoring</th>
<th>1</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>To hire a FULL-TIME PERMANENT SHOPFLOOR worker what agreement would your plant need from CHQ?</strong></td>
<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>

<table>
<thead>
<tr>
<th>Scoring</th>
<th>1</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Where are decisions taken on new product introductions - at the plant, at the CHQ or at both?</strong></td>
<td>All new product introduction decisions taken at the CHQ</td>
<td>New product introductions are jointly determined by the plant and CHQ</td>
<td>All new product introduction decisions take at the plant level</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scoring</th>
<th>1</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How much of sales and marketing is carried out at the plant level (rather than at CHQ)?</strong></td>
<td>None - sales and marketing is all run by CHQ</td>
<td>Sales and marketing decisions are split between the plant and CHQ</td>
<td>The plant runs all sales and marketing</td>
</tr>
</tbody>
</table>
OUR 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 ACROSS COUNTRIES

Decentralization measure

Most centralized
- Asia
- Southern Europe

Least centralized
- Scandinavian countries
- Anglo-Saxon countries

Greece | Japan | India | China | Poland | France | Portugal | Italy | Germany | UK | US | Sweden

Decentralization across countries:
- Asia and Southern Europe are the most centralized regions.
- Scandinavian and Anglo-Saxon countries are the least centralized.
FACTORS AFFECTING DECENTRALIZATION

- Basic framework is decision Principal makes over how much power to delegate to Agent
  - Determined by a trade-off between information and incentives
  - Example: how to learn the best way to implement a new technology (Acemoglu, Aghion, Lelarge, Van Reenen and Zilibotti, QJE 2007). Learning.

- Factors determining decentralization
  - Economic (e.g. human capital, Caroli and Van Reenen, QJE 2001)
  - Technological (e.g. heterogeneity)
  - Cultural (e.g. trust)
MORE TECHNOLOGICALLY ADVANCED FIRMS (I.E. CLOSE TO FRONTIER) MORE LIKELY TO BE DECENTRALIZED

Source: Acemoglu, Aghion, Lelarge, Van Reenen and Zilibotti (2007)
FIRMS WHO ARE IN MORE HETEROGENEOUS INDUSTRIES ARE MORE LIKELY TO BE DECENTRALIZED

Source: Acemoglu, Aghion, Lelarge, Van Reenen and Zilibotti (2007)
CULTURE: DECENTRALIZATION AND TRUST

- In high trust areas managers likely to be trusted to carry out more activities

- How to measure? World Value Survey has 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

- Experiments show this question linked with trust/trusting behavior (Glaeser et al, 2000, Sapienza et al, 2007)
The graph shows median level of trust. The vertical bars denote minimum and maximum levels.
TRUST AND DECENTRALIZATION

• Trust may affect optimal decentralization
  – Facilitate cooperative solutions in repeated game settings: e.g. Kreps et al. (1982), and 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 is located and decentralization
  - Control for country dummies
## DECENTRALIZATION HIGHER IN AREAS WITH MORE TRUST

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust (region)</td>
<td>1.115***</td>
<td>(0.437)</td>
</tr>
<tr>
<td>Plant Skills</td>
<td>0.085***</td>
<td>(0.015)</td>
</tr>
<tr>
<td>Firm Size</td>
<td>0.052*</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Plant Size</td>
<td>0.089***</td>
<td>(0.030)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Observations</th>
<th>3,660</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country dummies</td>
<td>no</td>
</tr>
<tr>
<td>Other controls</td>
<td>no</td>
</tr>
</tbody>
</table>

**Notes:** Other controls are SIC3 dummies, noise controls (interviewer dummies, Interviewee tenure and seniority, etc.), public listing, CEO onsite, plant size, regional GDP/head, Regional population, Multinational status. Weighted by % of WVS respondents in region in country. SE clustered by 112 regions.
USE MULTINATIONALS AS A SECOND TEST FOR IMPORTANCE OF TRUST

• Could worry about bias due to trust proxying for other country/regional variables

• So look at affiliates of foreign multinationals and investigate whether trust in their home country also matters

• And examine bilateral trust (including region of location and country of origin dummies)
## TAB 2: DECENTRALIZATION & TRUST IN MULTINATIONALS

<table>
<thead>
<tr>
<th>Sample:</th>
<th>Multinational Firms</th>
<th>EU multinationals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust (region of location)</td>
<td>0.451 (0.602)</td>
<td>0.131 (1.999)</td>
</tr>
<tr>
<td>Trust (country of origin)</td>
<td>0.767** (0.298)</td>
<td>0.206 (0.556)</td>
</tr>
<tr>
<td>Trust (bilateral from origin cty to location cty)</td>
<td>1.711** (0.721)</td>
<td>2.025* (1.112)</td>
</tr>
<tr>
<td>Regional dummies</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Country origin dummies</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Clustering</td>
<td>Region</td>
<td>Origin country</td>
</tr>
<tr>
<td>Observations</td>
<td>866</td>
<td>866</td>
</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. Weighted by % of WVS respondents in region in country. SE clustered by 112 regions.
• Productivity

• Management Practices

• Decentralization

• Bringing it all together
WITHIN FIRMS: ICT INCREASES PRODUCTIVITY BY 4x MORE IN DECENTRALIZED FIRMS


Notes: 1,694 firms in 7 EU countries & US between 2000-2006
DECENTRALIZATION AND FIRM PERFORMANCE

• To be large you need some decentralization. Factors holding back decentralization (like trust)
  - distorts firm size distribution
  - affects industry structure

• Nations where decentralization is hard slows down reallocation process
EUROPEAN PRODUCTIVITY HAD BEEN CATCHING UP WITH THE US FOR 50 YEARS…

Source: GGDC Dataset
BUT SINCE 1995 US PRODUCTIVITY ACCELERATED AWAY AGAIN FROM EUROPE
THE POST 1995 US PRODUCTIVITY MIRACLE

• “Americans do I.T. Better” Bloom, Sadun and Van Reenen (2009)
• EU sectors/firms that use ICT intensively benefit by less than US
• US multinationals “transplant” their managerial and organizational practices into Europe
• Effect of ICT on productivity higher for US multinationals than non-US multinationals even when located in Europe (e.g. Wal-Mart/Asda)
• We account for about 50% of US-EU productivity gap through US management/organization
CONCLUSIONS

• Methodological
  – Opening up the “black box” of the internal organization (macro questions with micro data)
  – Management & decentralization important in explaining productivity differences
  – Multinationals like immigrants: good test beds

• Substantive
  – Management key mechanism for improving productivity
  – Decentralization important fostering more productivity from new technologies like ICT
  – Policies to foster competition, openness to FDI, broad education and social capital
MY FAVOURITE QUOTES:

The difficulties of defining ownership in Europe

*Production Manager:* “We’re owned by the Mafia”

*Interviewer:* “I think that’s the “Other” category………although I guess I could put you down as an “Italian multinational” ?”

Americans on geography

*Interviewer:* “How many production sites do you have abroad?

*Manager in Indiana, US:* “Well…we have one in Texas…”
Production Manager: “Your accent is really cute and I love the way you talk. Do you fancy meeting up near the factory?”

Interviewer: “Sorry, but I’m washing my hair every night for the next month….”
Production Manager: “Are you a Brahmin?’

Interviewer “Yes, why do you ask?”

Production manager “And are you married?”

Interviewer “No?”

Production manager “Excellent, excellent, my son is looking for a bride and I think you could be perfect. I must contact your parents to discuss this”
Back-up
FURTHER READING

• Bloom, Nick, Sadun, Raffaella and Van Reenen, John (2010) “RECENT ADVANCES IN THE EMPIRICS OF ORGANIZATIONAL ECONOMICS”, Annual Review

• Nick Bloom and John Van Reenen (2010) “New approaches to measuring management and firm organization” forthcoming, American Economic Review


### Change in Competition Linked to Improving Management: So Not Just Selection

<table>
<thead>
<tr>
<th>Competition proxies</th>
<th>Dependent variable: Change in Management 2006-2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Import penetration</td>
<td>0.013** (0.005)</td>
</tr>
<tr>
<td>Change in “1-Rents” measure¹</td>
<td>1.006** (0.415)</td>
</tr>
<tr>
<td>Change in Number of rivals</td>
<td>0.120** (0.052)</td>
</tr>
<tr>
<td>Firms</td>
<td>421       404       432</td>
</tr>
</tbody>
</table>

¹ 1-Rents = 1- (operating profit – capital costs)/sales

S.E.s in ( ) below, robust to heteroskedasticity, clustered by country-industry

Longitudinal data in UK, US, France and Germany only

Source: Bloom, Genakos, Sadun and Van Reenen (2009)
## ICT: PLANT MANAGER AUTONOMY & ICT

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate 1</th>
<th>Estimate 2</th>
<th>Estimate 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Resource Planning</td>
<td>0.104*</td>
<td>0.116**</td>
<td></td>
</tr>
<tr>
<td>Information technology</td>
<td>(0.054)</td>
<td>(0.054)</td>
<td></td>
</tr>
<tr>
<td>NETWORK</td>
<td>-0.098*</td>
<td>-0.110**</td>
<td></td>
</tr>
<tr>
<td>Communication technology</td>
<td>(0.053)</td>
<td>(0.053)</td>
<td></td>
</tr>
<tr>
<td>Computers/Employee</td>
<td>-0.041</td>
<td>-0.021</td>
<td>-0.031</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.031)</td>
<td>(0.031)</td>
</tr>
</tbody>
</table>

- Information technology (IT) increase decentralization
- Communications technology (CT) decreases decentralization

Notes: Controls are SIC3 dummies, country dummies, noise controls (interviewer dummies Interviewee tenure and seniority, etc.), public listing, CEO onsite, plant size,
## ICT: WORKER AUTONOMY & ICT

<table>
<thead>
<tr>
<th></th>
<th>CADCAM</th>
<th>Information technology</th>
<th>NETWORK</th>
<th>Communication technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.540**</td>
<td>(0.275)</td>
<td>-0.229</td>
<td>(0.178)</td>
</tr>
<tr>
<td>ln(Computers/Employee)</td>
<td>-0.004</td>
<td>0.025</td>
<td>0.010</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.108)</td>
<td>(0.108)</td>
<td>(0.109)</td>
<td></td>
</tr>
</tbody>
</table>

- Information technology (IT) increase decentralization
- Communications technology (CT) decreases decentralization

Notes: Controls are SIC3 dummies, country dummies, noise controls (interviewer dummies Interviewee tenure and seniority, etc.), public listing, CEO onsite, plant size,
Better Managed firms are larger

Average management score from 1 (worst practice) to 5 (best practice)

Employees in the firm

<table>
<thead>
<tr>
<th>Employees in the firm</th>
<th># firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000-5000</td>
<td>308</td>
</tr>
<tr>
<td>2000-3000</td>
<td>271</td>
</tr>
<tr>
<td>1000-2000</td>
<td>611</td>
</tr>
<tr>
<td>750-1000</td>
<td>278</td>
</tr>
<tr>
<td>500-750</td>
<td>692</td>
</tr>
<tr>
<td>400-500</td>
<td>403</td>
</tr>
<tr>
<td>300-400</td>
<td>635</td>
</tr>
<tr>
<td>250-300</td>
<td>422</td>
</tr>
<tr>
<td>200-250</td>
<td>602</td>
</tr>
<tr>
<td>150-200</td>
<td>693</td>
</tr>
<tr>
<td>100-150</td>
<td>832</td>
</tr>
</tbody>
</table>

Note: Averages taken across all firms within each country. 5,747 observations in total. Mean and median firm size is 701 and 320 employees respectively.
Complexity: Larger Firms are more decentralized
**Complexity:** Multinationals (even controlling for size) are more decentralized

<table>
<thead>
<tr>
<th>Dependent variable: Decentralization</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign Multinational</td>
<td>0.157***</td>
</tr>
<tr>
<td></td>
<td>(0.058)</td>
</tr>
<tr>
<td>Firm employment (in logs)</td>
<td>0.052**</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
</tr>
<tr>
<td>Plant employment (share of firm)</td>
<td>0.089***</td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
</tr>
<tr>
<td>Plant Skills (% employees with a degree)</td>
<td>0.085***</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
</tr>
</tbody>
</table>

Observations: 3,660

Industry dummies (112): yes
Country dummies (12): yes
Other controls (60): yes
Learning: Younger firms are more decentralized

Source: Acemoglu, Aghion, Lelarge, Van Reenen and Zilibotti (2007)
## TRUST AND FIRM SIZE

<table>
<thead>
<tr>
<th>Dep Var. Average size in population of firms of:</th>
<th>100+ employees</th>
<th>100+ employees</th>
<th>All employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust measured in firm's region of location</td>
<td>2.216***</td>
<td>1.851**</td>
<td>1.540*</td>
</tr>
<tr>
<td></td>
<td>(0.478)</td>
<td>(0.889)</td>
<td>(0.858)</td>
</tr>
<tr>
<td>Rule of Law (country)</td>
<td>0.476***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(-2.5=low, 2.5=high)</td>
<td>(0.079)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>110</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>Regional controls</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Country dummies</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

Notes: Regional controls are GDP per capita, population in the region and % of employees with a degree.
Trust levels around the world: % answering “most people can be trusted”
THE LINK BETWEEN PRODUCTIVITY AND MANAGEMENT HOLDS TRUE ACROSS DIFFERENT COUNTRIES

* Log scale (sales per worker)

** Firms are grouped in 0.5 increments of assessed management score
FIRMS WITH MORE SKILLED WORKERS ARE MORE DECENTRALIZED

Proportion of employees with a college degree in the firm

Source: Caroli and Van Reenen, 2001)
Exhibit 2: These plants operate 24 hours a day for 7 days a week producing fabric from yarn, with 4 main stages of production:

1. Winding the yarn thread onto the warp beam
2. Drawing the warp beam ready for weaving
3. Weaving the fabric on the weaving loom
4. Quality checking and repair
This production technology has not changed much over time: Lowell Mill warping looms (1854, Lowell, Massachusetts)
WHY PRODUCTIVITY MATTERS FOR POLICY

- Increasing TFP means that the economic pie is bigger so more room for
  - Consumption
  - Tax cuts
  - Increases in public goods (e.g. Environmental quality)

- Harder to achieve if productivity stagnant

- But what can be done to increase productivity?