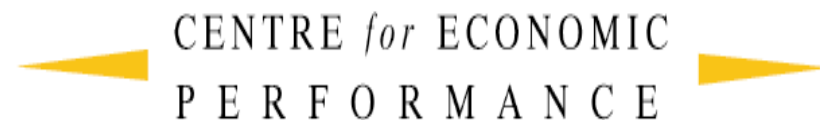


# COMPETITION AND TECHNOLOGY ADOPTION

John Van Reenen, LSE & CEP

PEDL/CEPR, London May 18<sup>th</sup> 2012



# GREAT PEOPLE TO WORK FOR?





Family-owned textile company outside  
Mumbai, India

# INTRODUCTION

- What is the effect of competition on technologies & productivity?
- “Monopoly .... is a great enemy to good management” (Adam Smith, *Wealth of Nations* Book1, XI(1) 148)
- What have we learned from explosion of empirical work on firms & plant performance in last 1-2 decades (IT and opening of National Statistical Agencies)?
  - Heterogeneity of productivity 1<sup>st</sup> order economic fact
  - Related to “conventional” (e.g. ICT, R&D, etc.) and “unconventional” technologies (e.g. management)
  - On average, competitive pressure improves productivity, management & technology adoption
- Focus on adoption (not innovation) & mainly in richer countries

# HOW CAN POLICY CHANGE COMPETITION?

- **Competition/Anti-trust policy**
  - M&A, cartels, abuse of market dominance
- **Barriers to entry**
  - Natural (sunk costs)
  - Government (e.g. licenses; ownership rules from nationalization to subsidies to foreign takeover restrictions)
- **Post-entry competition**
  - Consumer substitutability (e.g. information & communication, mobile phones)
  - State Procurement
- **Trade barriers**
  - Tariffs & non-tariff barriers

# EFFECTS OF COMPETITION

- **Between firm (selection/reallocation)**
  - Reallocation of output between incumbents
  - Entry/exit
- **Within Firm**
  - Incentives to adopt ambiguous
  - Positive effects from exit risk; raising stakes
  - Negative “Schumpeterian effects”

# OUTLINE

**1. Productivity dispersion within and between countries**

2. Measuring & describing management

3. Effect of management on performance

4. Impact of competition

# PRODUCTIVITY DISPERSION WITHIN COUNTRIES

- **Large cross sectional dispersion *within* countries**
  - Within US SIC4, plant labor productivity 90<sup>th</sup>-10<sup>th</sup>  $\approx 4x$  (TFP  $\approx 2x$ ). Syverson (2004). Other countries bigger
  - These plant productivity differences are persistent
- **Is it all measurement problems? NO**
  - Robust to different methods of production function estimation (Olley-Pakes, 1996; Blundell-Bond, 2000; Akerberg et al, 2007, Solow residual)
  - Using plant-specific prices (Foster et al, 2009)
  - Other measures of firm performance (e.g. profitability, size, management quality, etc.) show wide variation



# FIRM HETEROGENEITY HAS LONG BEEN RECOGNISED

*“...we have the phenomenon in every community and in every trade, in whatever state of the market, of some employers realizing no profits at all, while others are making fair profits; others, again, large profits; others, still, colossal profits.”*

Francis Walker (*Quarterly Journal of Economics*, '87)

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*(Quarterly Journal of Economics, 1887)*



# REASONS FOR PERFORMANCE HETEROGENEITY

- **TFP Heterogeneity due to “hard technologies”**
  - R&D, patents, diffusion of ICT (information and communication technologies), etc.
- **These hard technologies matter a lot, but:**
  - After controlling for technology, still a big TFP residual
  - Productivity effects of ICT depend on firm organization (e.g. Bloom, Sadun & Van Reenen, AER 2012; Bresnahan, Brynjolfsson and Hitt, QJE 2002)
- **Heterogeneity of management practices & organization?**
  - Econometric tradition that fixed effects in production function = managerial ability (Mundlak, 1961)
  - Case studies & recent advances in measurement

# NOTIONS OF MANAGERIAL “BEST PRACTICE”

- Management styles that have always been better
  - e.g. promotion on ability/effort (rather than family)
- **Complementarity:** Practices that have become desirable because the environment has changed
  - Technological advances makes monitoring output better (e.g. SAP) and enables more performance related pay (Lemieux et al, 2009)
- **Innovation:** Discoveries of how to manage better
  - E.g. Toyota system of Lean Manufacturing
  - **Transferable:** dynamic diffusion

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# THE SURVEY METHODOLOGY

## 1) Developing management questions

- Scorecard for 18 monitoring, targets and 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 LSE, with same training and country rotation

## 3) Getting firms to participate in the interview

- Introduced as “Lean-manufacturing” interview, no financials
- Official Endorsement: Bundesbank, Bank of Italy, RBI, etc.
- Run by ~100 MBA-types (loud, assertive, business experience)

# MONITORING – E.G. “*HOW IS PERFORMANCE TRACKED?*”

<b>Score</b>	<b>(1): Measures tracked do not indicate directly if overall business objectives are being met. Certain processes aren't tracked at all</b>	<b>(3): Most key performance indicators are tracked formally. Tracking is overseen by senior management</b>	<b>(5): Performance is continuously tracked and communicated, both formally and informally, to all staff using a range of visual management tools</b>
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**Note:** All 18 dimensions and over 50 examples in Bloom & Van Reenen (2006)



# **INCENTIVES - e.g. “HOW DOES THE PROMOTION SYSTEM WORK?”**

<b>Score</b>	<b>(1) People are promoted primarily upon the basis of tenure</b>	<b>(3) People are promoted upon the basis of performance</b>	<b>(5) We actively identify, develop and promote our top performers</b>
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**Note:** All 18 dimensions and over 50 examples in Bloom & Van Reenen (2006)

# COVERAGE OF WORLD MANAGEMENT SURVEY: 21 COUNTRIES



Source: World Management Survey, <http://worldmanagementsurvey.org/>

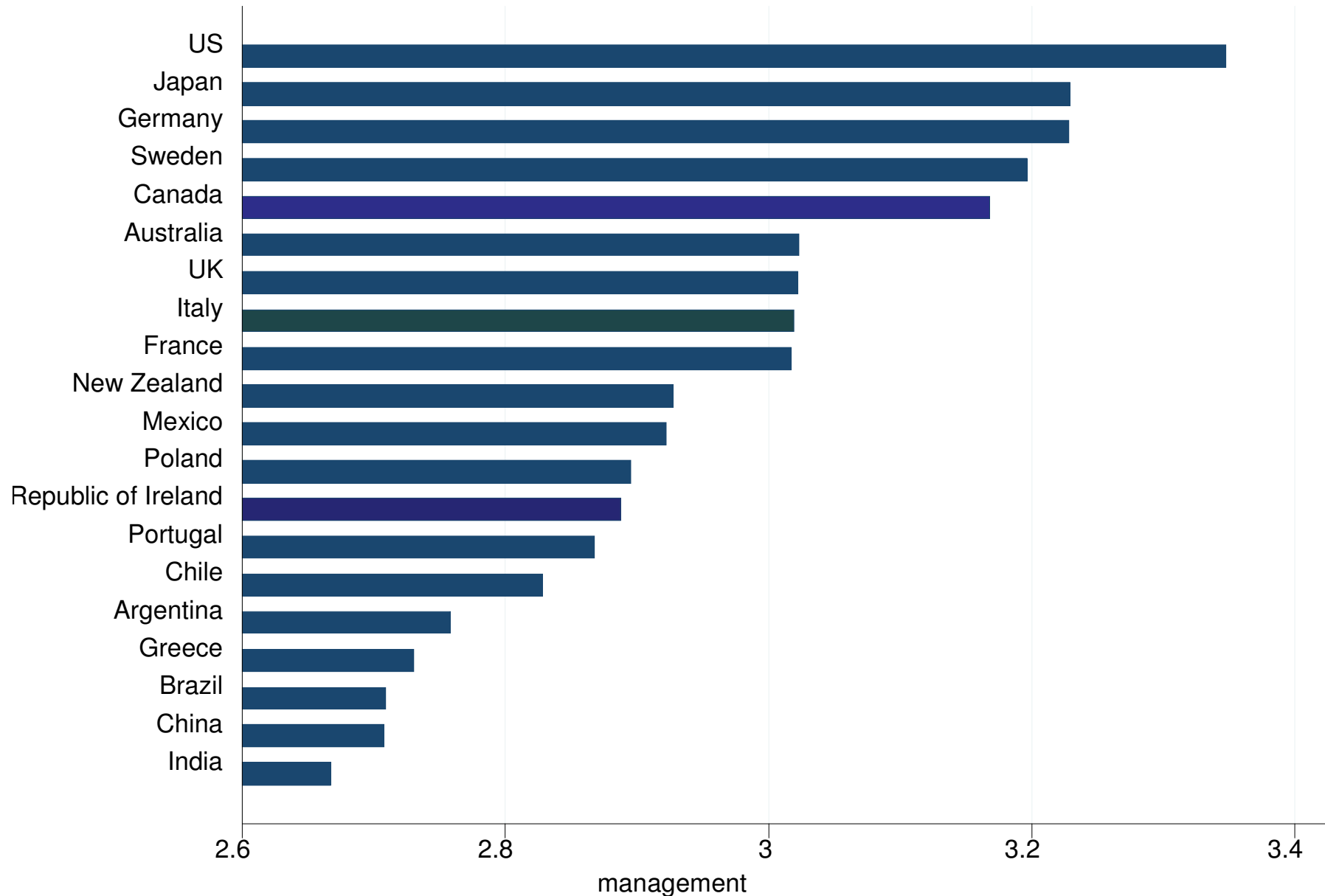
# MANAGEMENT SURVEY SAMPLE

- Interviewed over 8,000 firms across 21 countries in Americas, Asia & Europe
- 45% response rate (responses uncorrelated with performance)
- 3 major waves in 2004, 2006 & 2009 with panel element

Medium sized manufacturing firms:

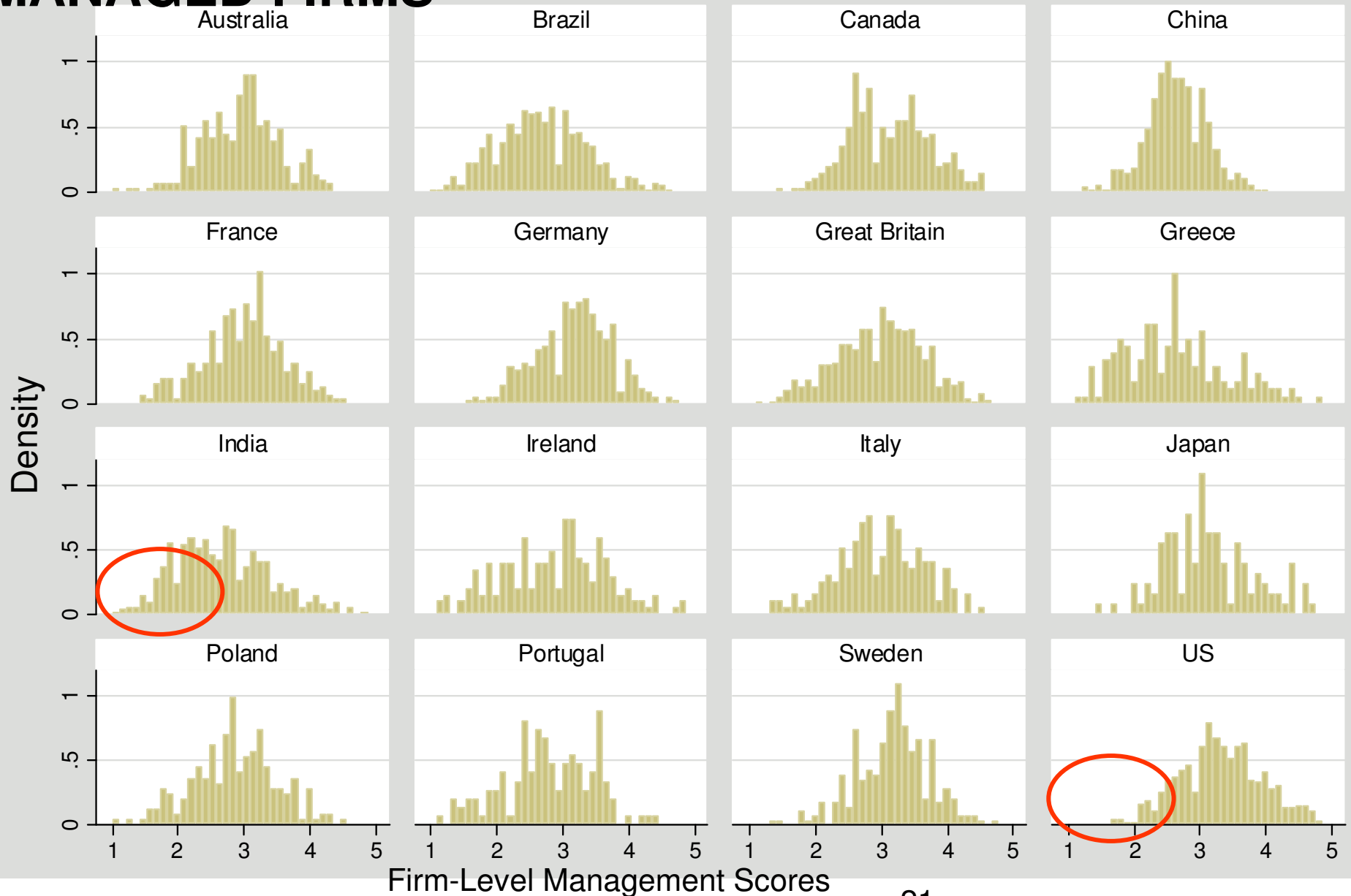
- Medium sized (100 - 5,000 employees, median  $\approx$  250) because firm practices more homogeneous
- Manufacturing as easier to measure productivity
  - Now extended to Hospitals, Retail, Schools, Charities, Nursing homes, Law Firms, Government agencies, etc.
- Many controls for measurement error – second interviews, controls for interviewer, interviewee and interview effects

# AVERAGE MANAGEMENT SCORE ACROSS COUNTRIES



Note: Averages taken across all firms within each country. 9079 observations in total.

# EMERGING COUNTRIES HAVE LONG TAIL OF BADLY MANAGED FIRMS



# OUTLINE

1. Productivity dispersion within and between countries

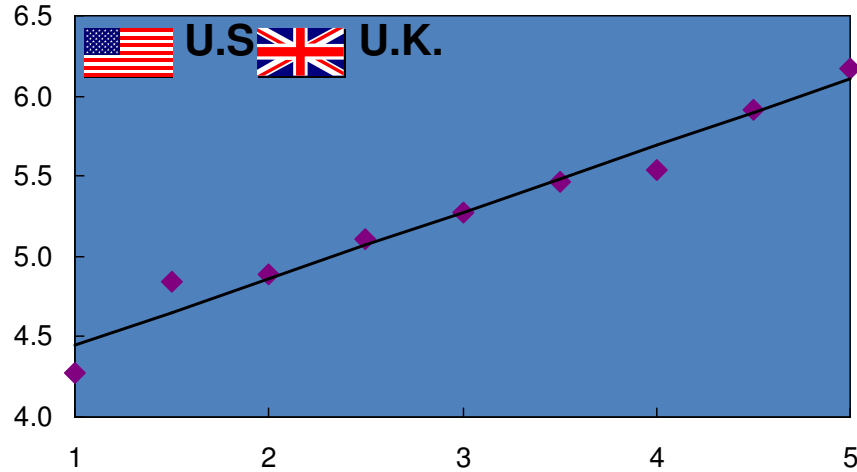
2. Measuring & describing management

**3. Effect of management on performance**

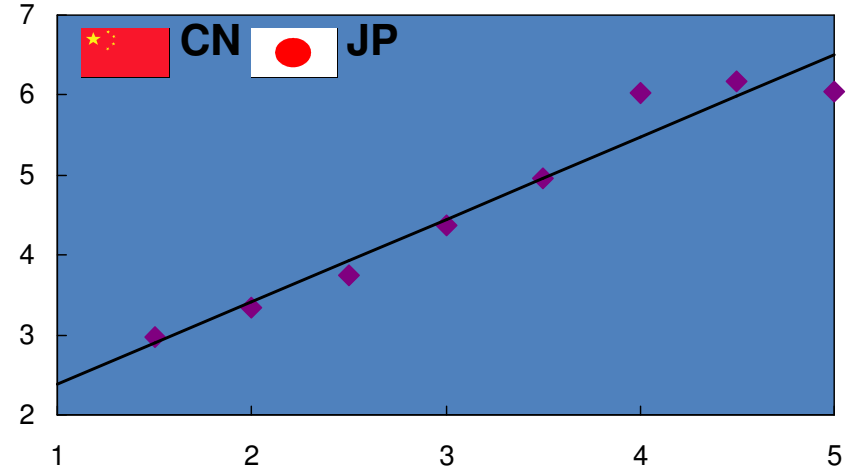
4. Impact of competition

# LINK BETWEEN PRODUCTIVITY & MANAGEMENT HOLDS TRUE ACROSS DIFFERENT COUNTRIES

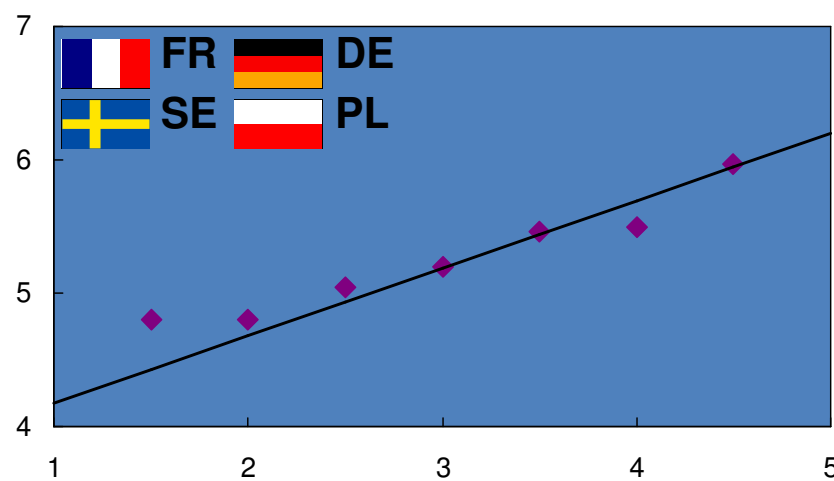
Labour productivity\*



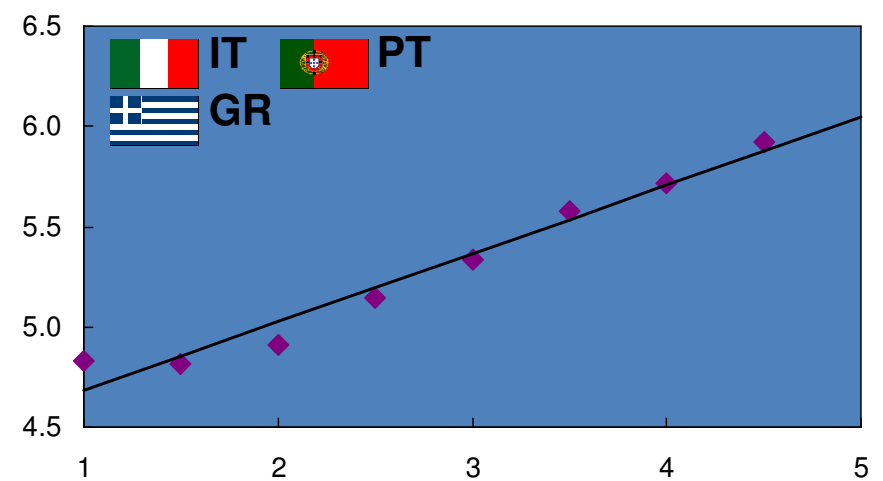
Labour productivity\*



Labour productivity\*



Labour productivity\*



management practice score\*\*

management practice score\*\*

\* Log scale (sales per worker)

\*\* Firms are grouped in 0.5 increments of assessed management score

# CAUSAL EFFECT OF MANAGEMENT ON PRODUCTIVITY? BLOOM ET AL (2011)

- Run experiment on plants in Indian textile firms outside Mumbai
- Randomized “treatment” plants get heavy management consulting; “control” plants get very light consulting (just enough to get data)
- Collect weekly performance data on all plants from 2008 to 2010
  - Improved management practices led to large and significant improvements in productivity and profitability (~\$200k pa)



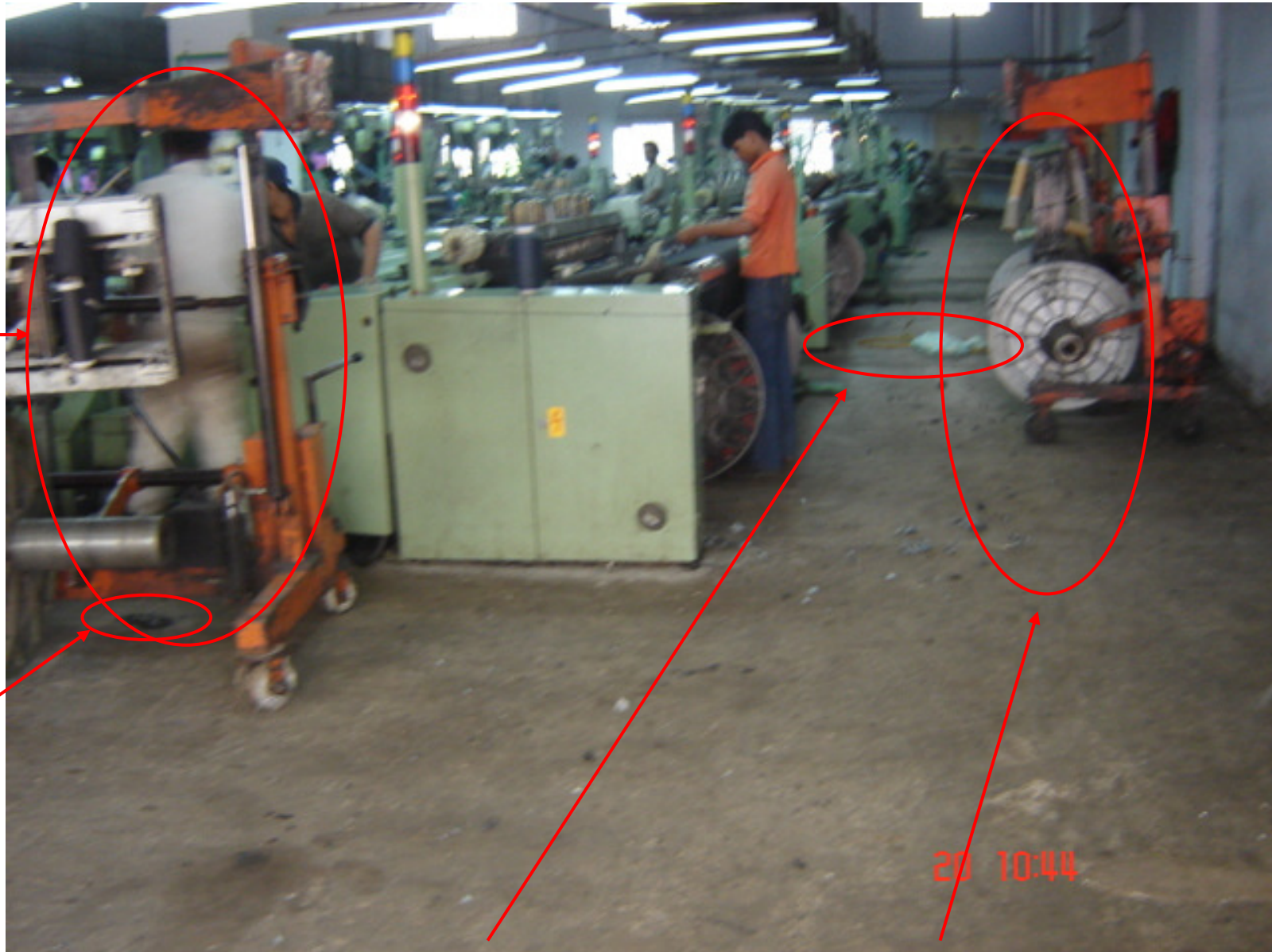
# MANY PARTS OF THE FACTORIES ARE DIRTY AND UNSAFE



# THE FACTORIES ARE ALSO DISORGANIZED

Instrument not removed after use, blocking hallway.

Oil leaking from the machine



Cotton lying on the floor

Instrument blocking the hallway



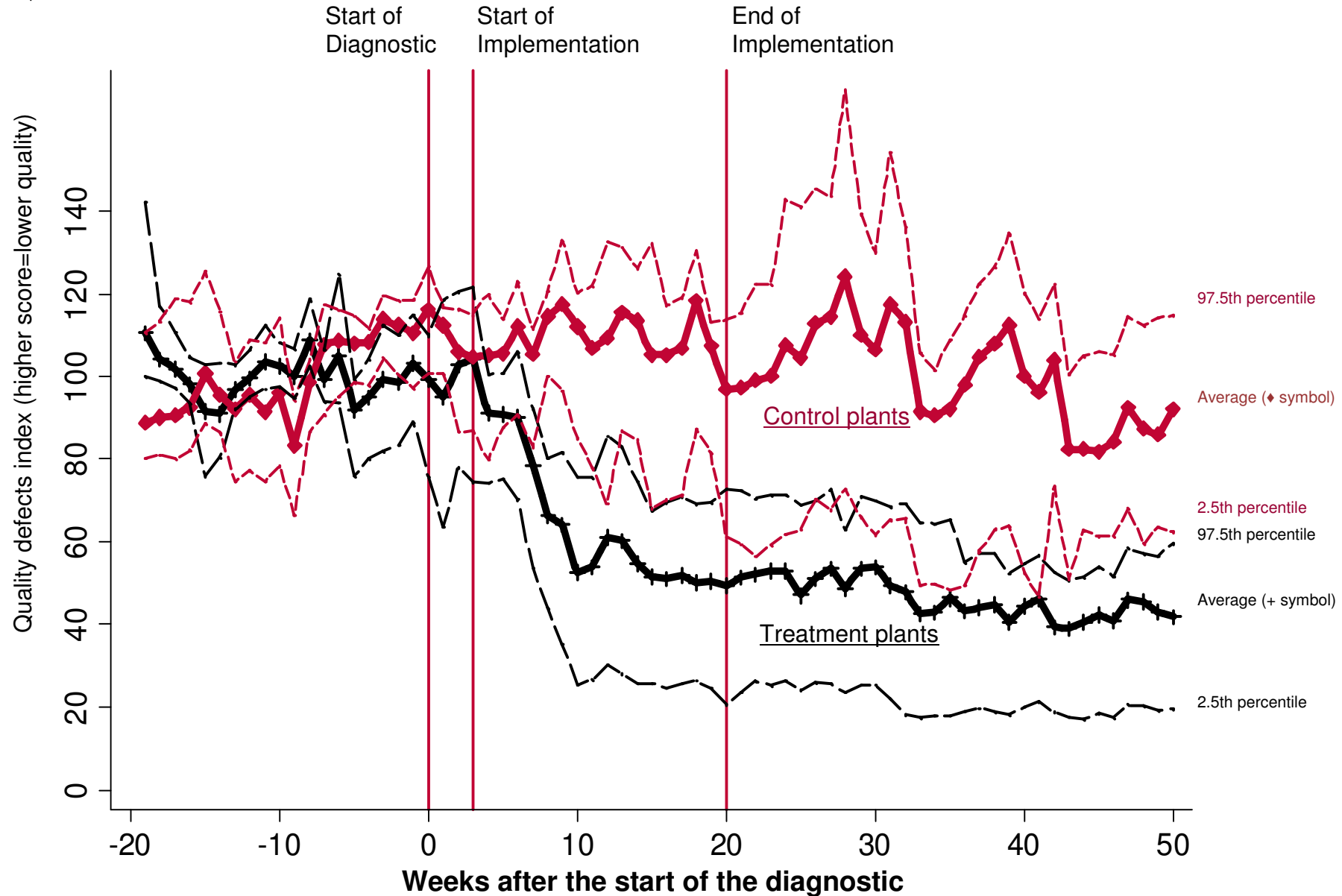
# THE TREATED FIRMS INTRODUCED BASIC INITIATIVES

Worker involved in “5S” initiative on the shop floor, marking out the area around the model machine



Snag tagging to identify the abnormalities on & around the machines, such as redundant materials, broken equipment, or accident areas. The operator and the maintenance team is responsible for removing these abnormalities.

# QUALITY DEFECTS INDEX: TREATMENT & CONTROL PLANTS



Notes: Displays the average weekly quality defects index, which is a weighted index of quality defects, so a higher score means lower quality. This is plotted for the 14 on-site treatment plants (+ symbols) and the 6 on-site control plants (♦ symbols). Values normalized so both series have an average of 100 prior to the start of the intervention. To obtain confidence intervals we bootstrapped the firms with replacement 250 times.

## **RELATIONSHIP BETWEEN MANAGEMENT & SIZE/GROWTH WEAKER IN COUNTRIES WITH LESS COMPETITION**

- “Selection” effect – market reallocates jobs to more efficient firms
- An additional sd of management score associated with of employment increase:
  - US ~295 more workers
  - UK ~204 more workers
  - India ~97 more workers
- Competitive forces of reallocation much weaker in India compared to US
- Same story with sales growth (dynamic reallocation)

# OUTLINE

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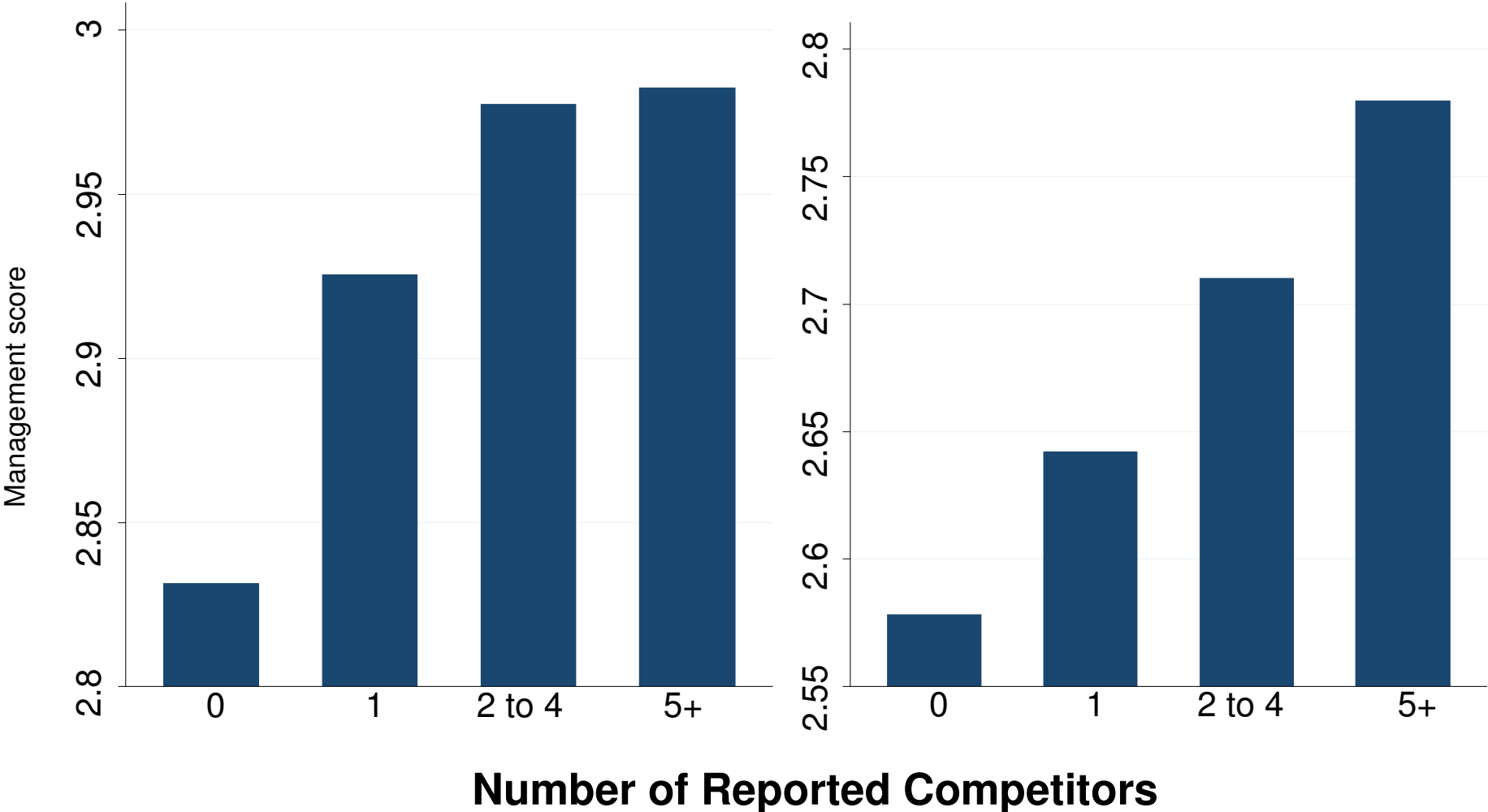
# **METHODS OF IDENTIFYING EFFECT OF MARKET STRUCTURE ON MANAGEMENT & PRODUCTIVITY**

- Cross Section
- Fixed effects
- Industry Studies
  - General changes in competition
  - Trade liberalizations
- Structural approaches

# COMPETITION SEEMS TO IMPROVE MANAGEMENT

## Manufacturing and Retail (mainly private sector)

## Hospitals and Schools (mainly public sector)



Sample of 9469 manufacturing and 661 retail firms (private sector panel) and 1183 hospitals and 780 schools (public sector panel). Reported competitors defined from the response to the question “How many competitors does your [organization] face?”



# COMPETITION AND MANAGEMENT PRACTICES

3 competition proxies from Nickell (1996) & Aghion et al. (2005)

Competition proxies	Dependent variable: Management			
<b>Import penetration</b> (lagged industry-country level)	<b>0.066**</b> <b>(0.033)</b>			
<b>1- Lerner Index<sup>1</sup></b> (lagged industry-country level)		<b>1.964***</b> <b>(0.721)</b>		
<b># of competitors</b> (Firm level)			<b>0.115***</b> <b>(0.023)</b>	<b>0.120**</b> <b>(0.052)</b>
<b>Observations</b>	<b>2,499</b>	<b>2,980</b>	<b>3,589</b>	<b>864</b>
<b>Firm fixed effects?</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>Yes</b>
<b>Full controls<sup>2</sup></b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>

**Notes:** “Full controls” includes 108 SIC-3 industry, country, firm-size, public and interview noise (interviewer, time, date & manager characteristic) controls, 2004-2006, UK, US, France and Germany only

# SINGLE INDUSTRY STUDIES OF COMPETITION AND PRODUCTIVITY

- Holmes & Schmitz (2001) *Long-distance water shipping* (effect of railroads)
- Schmitz (2005) *Iron Ore manufacturing in 1980s* (fall in transport costs for Brazilian imports)
- Matsa (2009) *Supermarkets* (Wal-Mart entry)
- Dunne et al (2008) *Cement* in 1980s (overseas imports from e.g. Mexico, Venezuela & Australia)
- Bridgeman et al (2008) *Sugar manufacturing* cartel (disbanded in 1974)
- Syverson (2004) *concrete* (market size in different geographical markets)
  - All find productivity increased with both within & between plant component. Stress management changes

# TRADE LIBERALIZATION

- Many studies – Pavcnik (2002) *Chile*; Ferreira & Rossi (2003) *Brazil*; Trefler (2004) *Canada*; Amiti & Konings (2007) *Indonesia*; Fernandes (2007) *Columbia*; Ruiz & Utar (2009); *Mexico*; Sivadasan (2009) *India*; de Loecker (2009) *Belgium*
- But typically mix several trade effects (see Melitz, 2003) – export market size, learning as well as pure competition
- Bloom, Draca & Van Reenen (2012)
  - Use growth of Chinese import competition in 12 European nations since 1990s (e.g. WTO entry & MFA)
  - Productivity, management, jobs & technology (R&D, patents, IT)
  - Macro impact large (~15% of EU productivity growth)

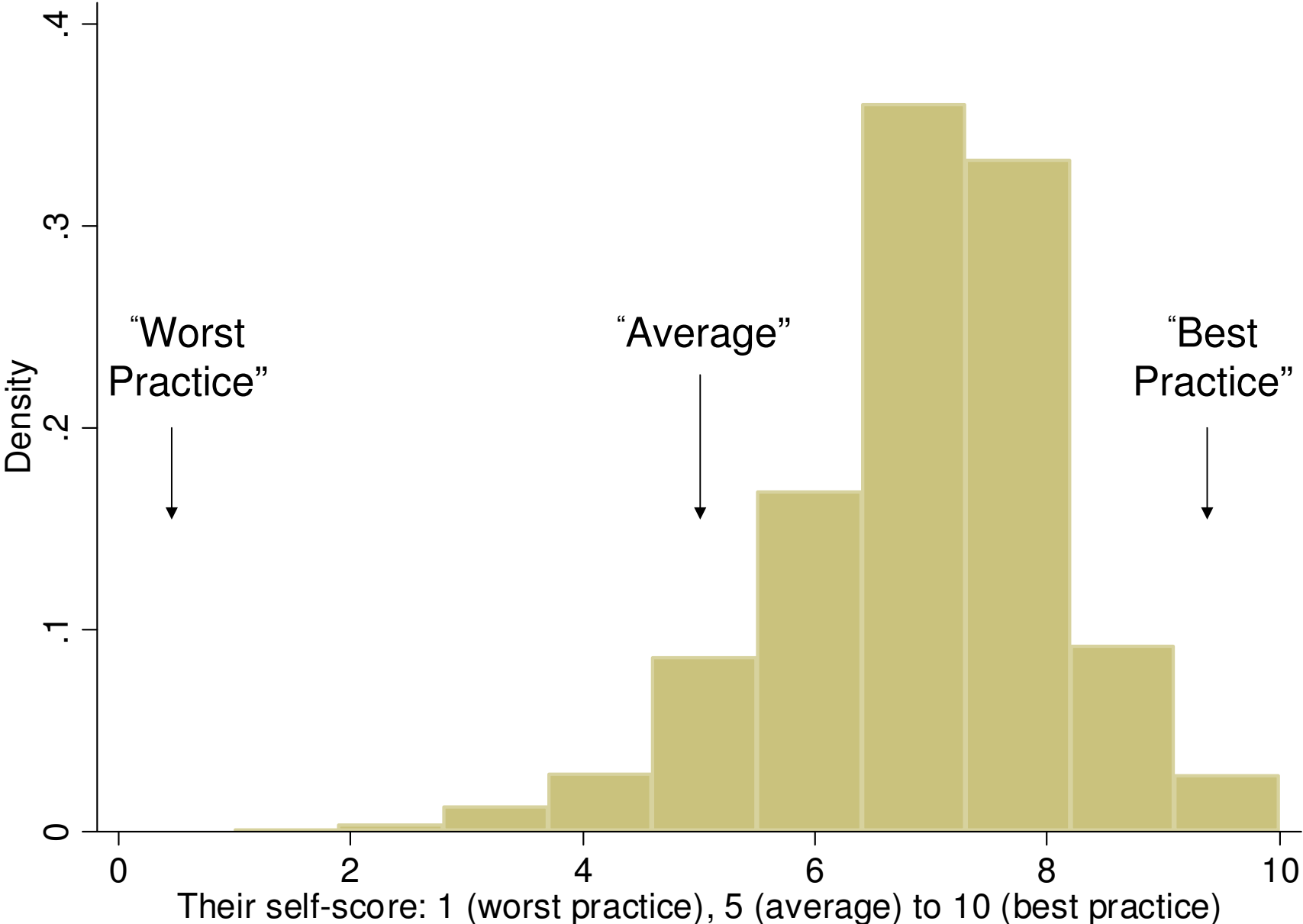
# **INFORMATION: ARE FIRMS AWARE OF THE QUALITY OF THEIR MANAGEMENT PRACTICES?**

We asked:

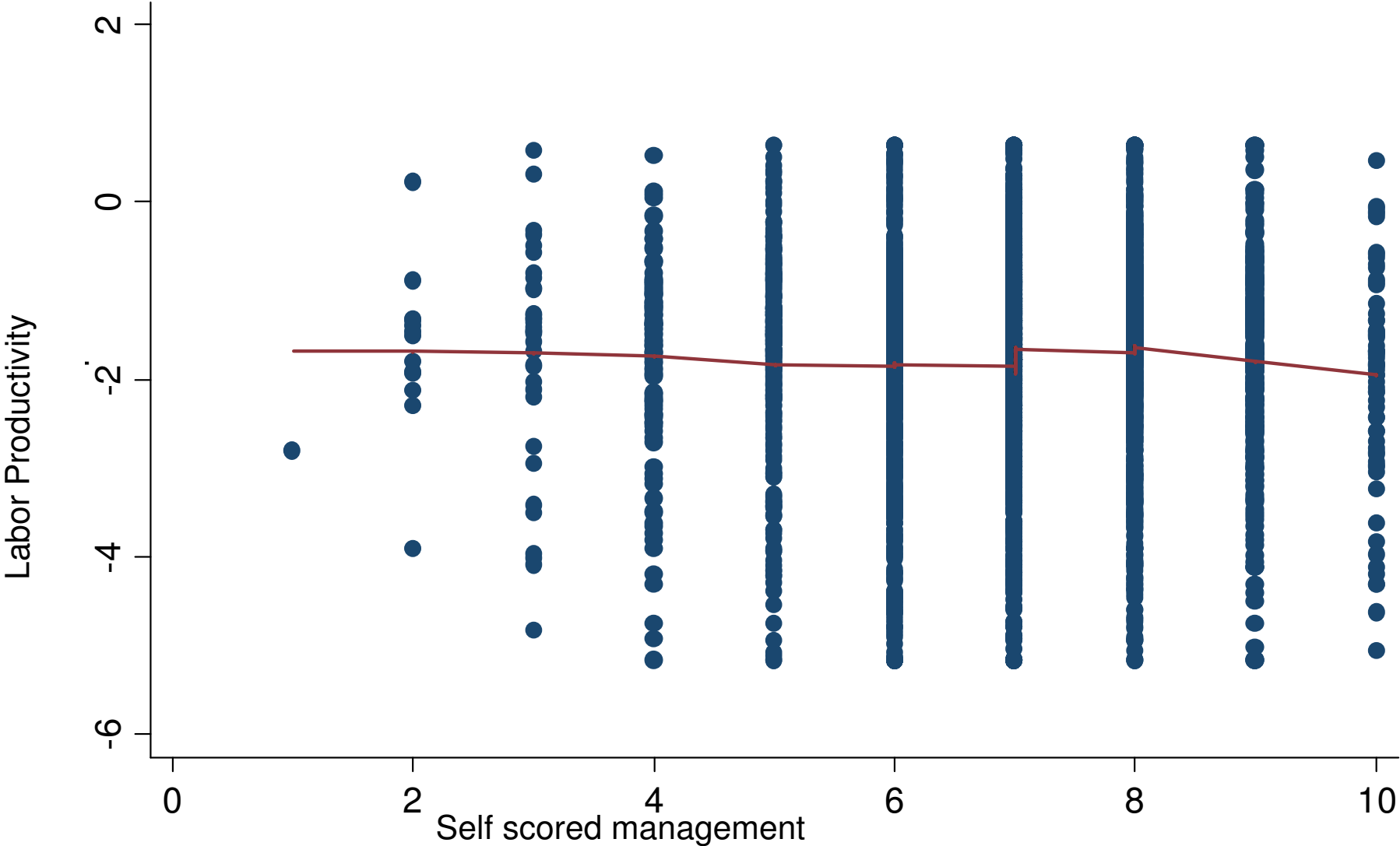
*“Excluding yourself, how well managed would you say your firm is on a scale of 1 to 10, where 1 is worst practice, 5 is average and 10 is best practice”*

We also asked them to give themselves scores on operations and people management separately

# MOST MANAGERS THINK THEY ARE WELL ABOVE AVERAGE



# SELF-SCORES UNCORRELATED WITH PRODUCTIVITY



\* Insignificant 0.03 correlation with labor productivity, cf. management score has a 0.295

# CONCLUSIONS

- Heterogeneity of productivity across firms and countries a 1<sup>st</sup> order economic fact
  - Conventional and unconventional technologies (like management) likely to be important factor
- Simple descriptives useful
- Quasi-experiments help get at causality
- Competition on average seems to spur technological adoption through both within and between firm effects
- Many other factors affecting productivity & management (meritocratic selection, LMR, human capital, FDI, ownership, etc.)

# MY FAVOURITE QUOTES:

## The traditional British Chat-Up

[Male manager speaking to an Australian female interviewer]

*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....”



# MY FAVOURITE QUOTES:

## The traditional Indian Chat-Up

*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”

# 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...”

# MY FAVOURITE QUOTES:

## Staff rewards the American way

*Production Manager:* “For example, if an employee suggests a company slogan, and his name is used, he gets a TV. If he is employee of the month, he gets a parking space”

## Staff retention the UK way

*Interviewer:* “How would you persuade your top performers to stay?”

*UK Chairman:* “Sex is a great thing! If the employee finds a new girlfriend somewhere else, I can’t do anything!”

# MY FAVOURITE QUOTES:

## The bizarre

*Interviewer:* “[long silence].....hello, hello....are you still there....hello”

*Production Manager:* “.....I’m sorry, I just got distracted by a submarine surfacing in front of my window”

## The unbelievable

[Male manager speaking to a female interviewer]

*Production Manager:* “I would like you to call me “Daddy” when we talk”

[End of interview...]

## FURTHER READING

1. Bloom and Van Reenen (2007) "Measuring and Explaining Management practices across firms and nations" *Quarterly Journal of Economics*, 122(4), 1351–1408 <http://cep.lse.ac.uk/pubs/download/dp0716.pdf>
2. Van Reenen (2011) "Does competition raise productivity through improving management practices?" *International Journal of Industrial Organization* 9(3), 306-317, <http://cep.lse.ac.uk/pubs/download/dp1036.pdf>
3. Bloom, Sadun and Van Reenen (2012) "Americans do IT better" *American Economic Review*, 102 (1), 167-201 <http://cep.lse.ac.uk/pubs/download/dp0788.pdf>
4. "Management Practices across firms and countries" Bloom, Genakos, Sadun & Van Reenen (2012). *Academy of Management Perspectives* 26 (1) 12-33, <http://cep.lse.ac.uk/new/publications/abstract.asp?index=3962>