

Productivity, Market Structure and Management

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Istambul, EARIE 2010



INTRODUCTION

- What is the effect of market structure on 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 1st order economic fact
 - Related to management practices (required new data collection)
 - Management is, in part, a “technology”
 - Competitive pressure improves management (& other technologies)

Facts on productivity

Theories

Measuring Management

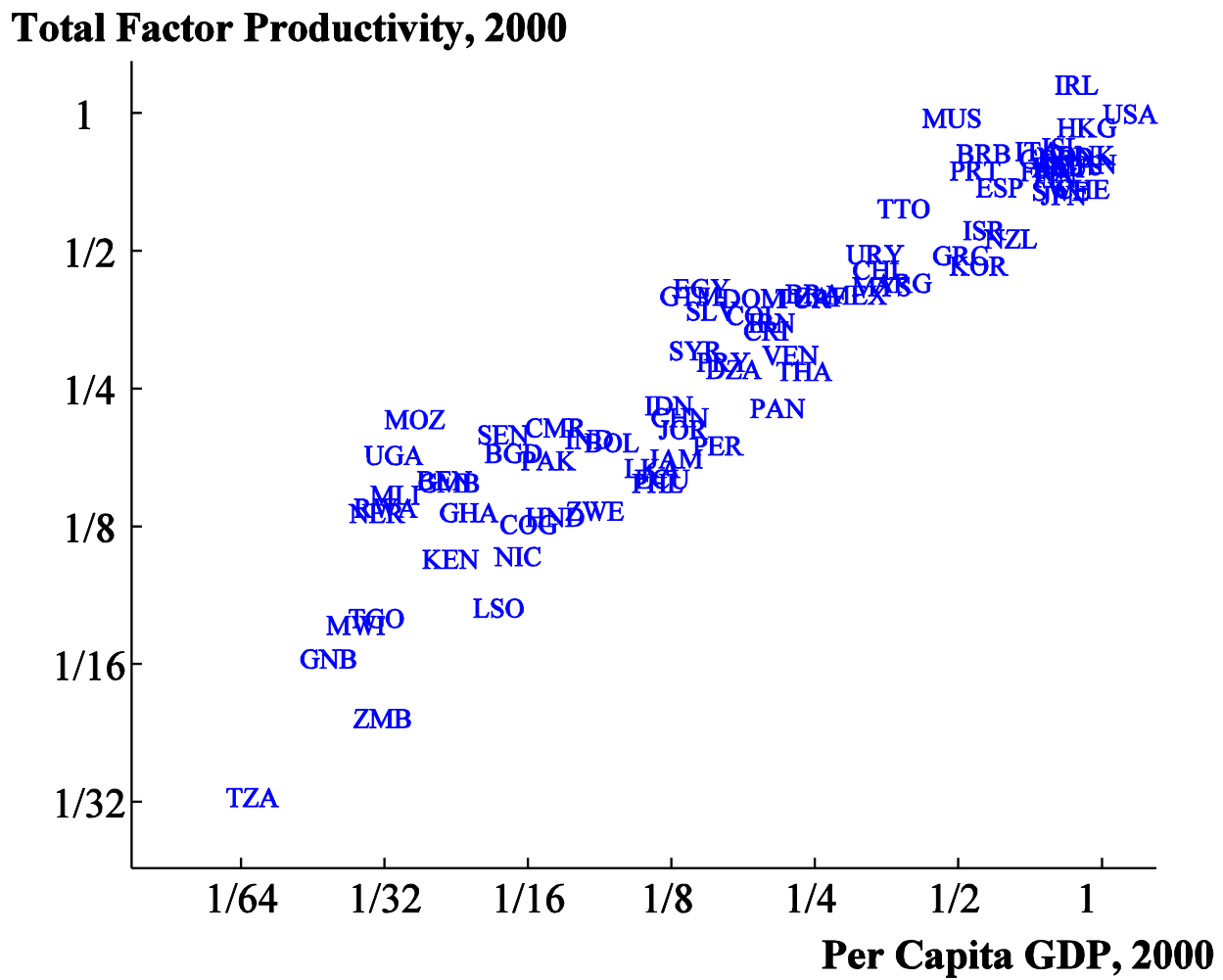
Market Structure effects on management & productivity

Effects of Management on productivity

SOME FACTS ON AGGREGATE PRODUCTIVITY

- Aggregate growth a Total Factor Productivity (TFP) story (Solow)
- About $\frac{1}{2}$ of country variation in GDP per capita TFP related (Jones and Romer, 2009)

LARGE INCOME & TFP DIFFERENCES BETWEEN COUNTRIES

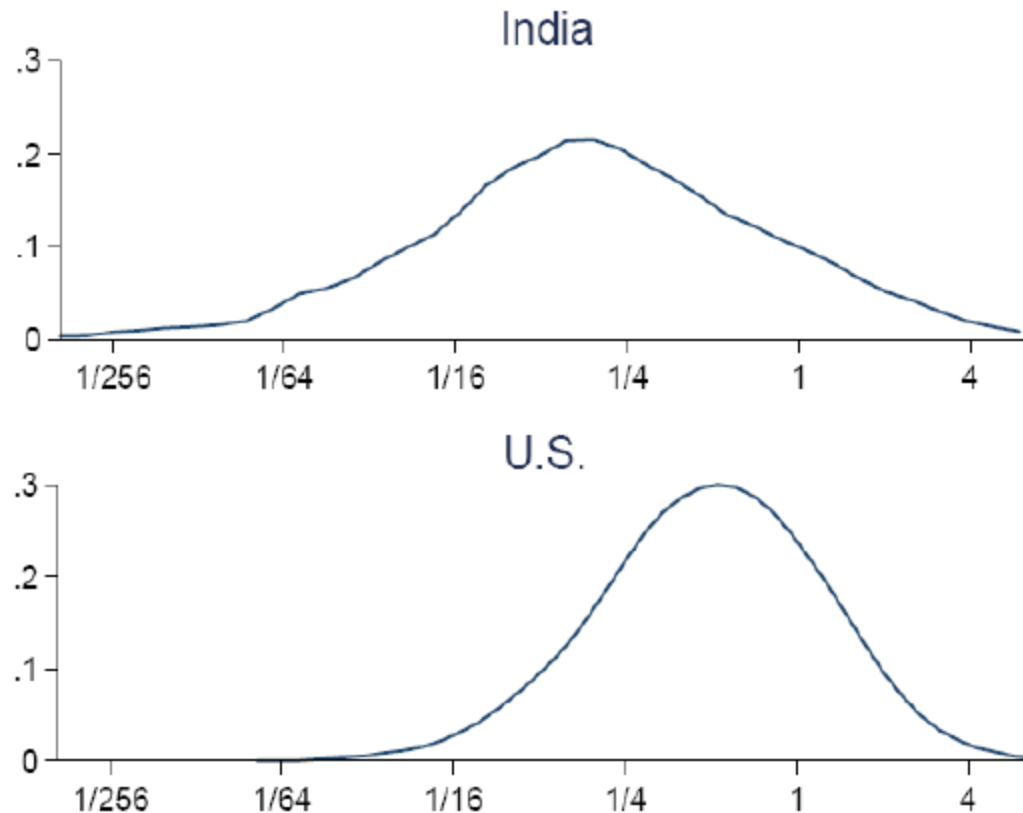


Source: Jones and Romer (2009). US=1

SOME FACTS ON PRODUCTIVITY

- Aggregate growth a Total Factor Productivity (TFP) story (Solow, 1956)
- About $\frac{1}{2}$ of country variation in GDP per capita TFP related (Jones and Romer, 2009)
- **Reallocation** of output from low TFP to high TFP plants
 - Aggregate growth within countries (Bailey et al, 1992)
 - Productivity across countries (Hsieh & Klenow, 2009)

DISTRIBUTION OF PLANT TFP DIFFERENCES IN US VS. INDIA HIGHER US TFP DUE TO REALLOCATION - THINNER "TAIL" OF LESS PRODUCTIVE PLANTS



Source: Hsieh and Klenow (2009); US mean=1

PRODUCTIVITY DISPERSION WITHIN COUNTRIES

- **Large cross sectional dispersion *within* countries**
 - Syverson (2004): Within US SIC4, plant labor productivity 90th-10th $\approx 4x$ (TFP $\approx 2x$). Other countries bigger (e.g. Criscuolo & Martin, UK LP ≈ 5);
 - These plant productivity differences are persistent
- **Is it all measurement problems? NO**
 - cf. debate on aggregate TFP (Griliches, 1997)
 - Robust to different methods of production function estimation (Olley-Pakes, 1996; Blundell-Bond, 2000; Akerberg et al, 2007, Solow residual)
 - 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 RECOGNIZED

“...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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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, 2007; BBH, 2002)
- **Heterogeneity of management practices & organization?**
 - Econometric tradition that fixed effects in production function = managerial ability (Mundlak, 1961)
 - Case studies & recent advances in measurement
 - Management strongly correlated with performance

THEORETICAL PERSPECTIVES ON MANAGEMENT

- **Fads and fashions?** MBA example
- **“Design Approach” of Organizational Economics**
 - Example: Personnel Economics (Lazear & Oyer, 2009) application of economics to Human Resources
 - More generally: Decentralization, Span of control, vertical integration, etc.
- **“Management as a technology”**
 - Incorporates firm heterogeneity in productivity
 - *Non transferable* management capabilities (IO models & talent models)
 - *Transferable* capabilities “diffusion” models
 - Tackles question of “How do badly managed firms survive?”

MANAGEMENT AS A *NON-TRANSFERABLE* TECHNOLOGY

- **Talent & human capital (e.g. Lucas, 1978)**
 - Managerial talent is heterogeneous in population
 - Talent can be leveraged through Span of control
 - Shows up as TFP: managers earn rents to scare talent
 - Overload (e.g. communication costs) limits size of firm
- **IO perspective of Imperfect Competition**
 - Low productivity firms can survive because they have a degree of market power
 - Examples: Melitz (2003), Foster et al (2009)
- Some implications similar (e.g. Hsieh and Klenow, 2009)
 - Reallocation of output to better managed firms

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

EXAMPLES OF MANAGEMENT AS A NEW 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 of "lean manufacturing" (1970s)

MANAGEMENT AS A *TRANSFERABLE* TECHNOLOGY

- **Technological Diffusion is not immediate**
 - Hybrid corn (Griliches, 1958)
 - Beta blockers (Skinner and Staiger, 2008)
 - Computers & other forms of ICT
- **Many causes of slow diffusion**
 - Competition (as in IO models)
 - Human Capital (as in Lucas model)
 - Information (standard model)
 - Adjustment costs (“frictions”)
 - Incentives (agency issues, ownership & governance)
 - Institutions (e.g. labor market regulations)

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BLOOM - VAN REENEN (2007) SURVEY METHODOLOGY

1) Developing management questions

- Scorecard for 18 monitoring (e.g. lean), targets & people (e.g. pay, promotions, retention and hiring). ≈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 England, RBI, etc.
- Run by 55 MBA types (loud, assertive & business experience)

MONITORING – e.g. “HOW IS PERFORMANCE TRACKED?”

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

Note: All 18 dimensions and over 50 examples in Bloom & Van Reenen (2006)

PEOPLE – e.g. “HOW IS PROMOTION DETERMINED?”

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

MANAGEMENT SURVEY SAMPLE

- Interviewed over 6,000 firms across Americas, Asia & Europe
- Obtained 45% response rate from sampling frame (with responses uncorrelated with performance measures)

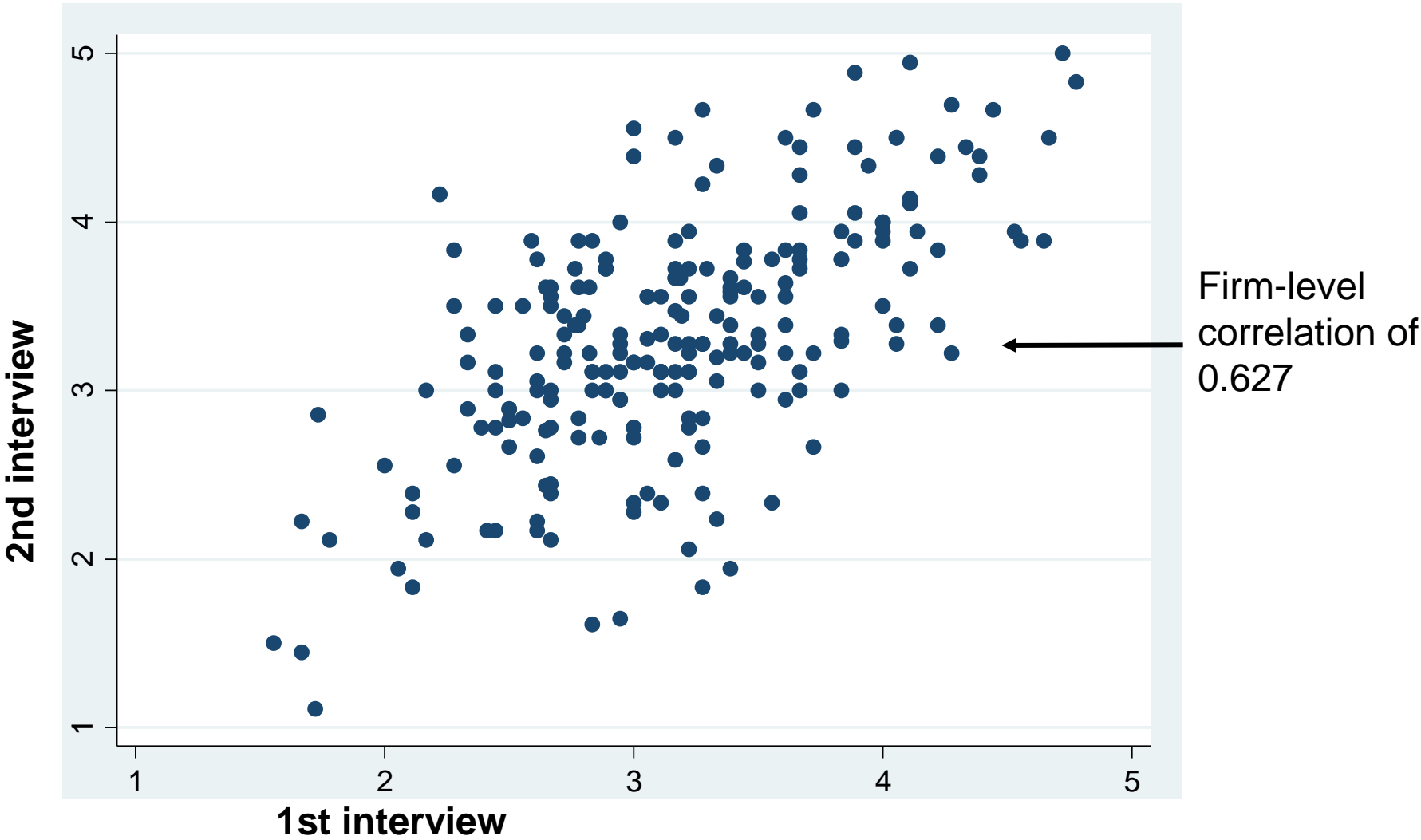
Medium sized manufacturing firms:

- Medium sized (100 - 5,000 employees, median \approx 250) because firm practices more homogeneous
- Have run 3 waves (2004, 2006, 2009)
- Manufacturing as easier to measure productivity
 - Now extended to Hospitals, Retail, Schools, Charities, Nursing homes, Law Firms, Government agencies, etc.

INTERVAL VALIDATION OF THE SCORING

Re-interviewed 222 firms with different interviewers & managers

Firm average scores (over 18 question)



ADDITIONAL CONTROLS FOR BIAS & NOISE

8 INTERVIEWEE CONTROLS

- Gender, seniority, tenure in post, tenure in firm, countries worked in, foreign, worked in US, plant location, reliability score

3 INTERVIEWER CONTROLS

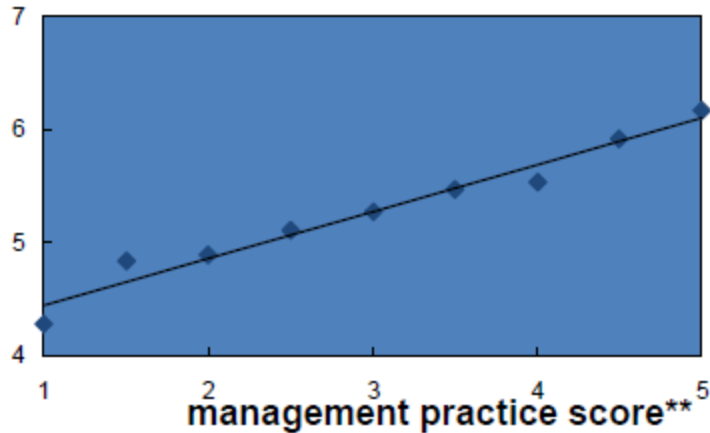
- Set of analyst dummies, cumulative interviews run, prior firm contacts

5 TIME CONTROLS

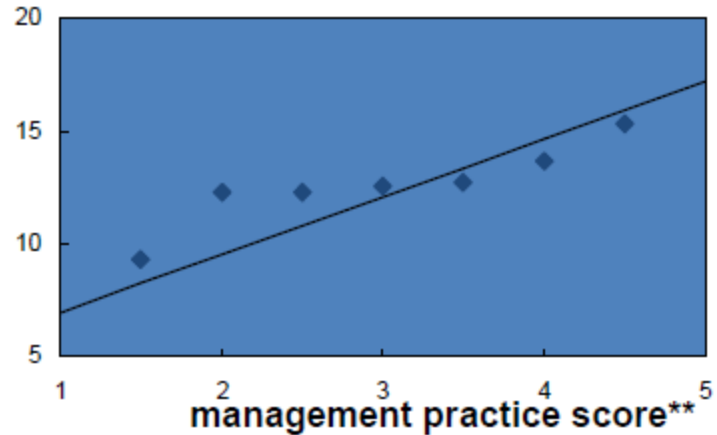
- Day of the week, time of day (interviewer), time of the day (interviewee), duration of interview, days from project start

EXTERNAL VALIDATION: MANAGEMENT SCORE CORRELATES WELL WITH PERFORMANCE INDICATORS

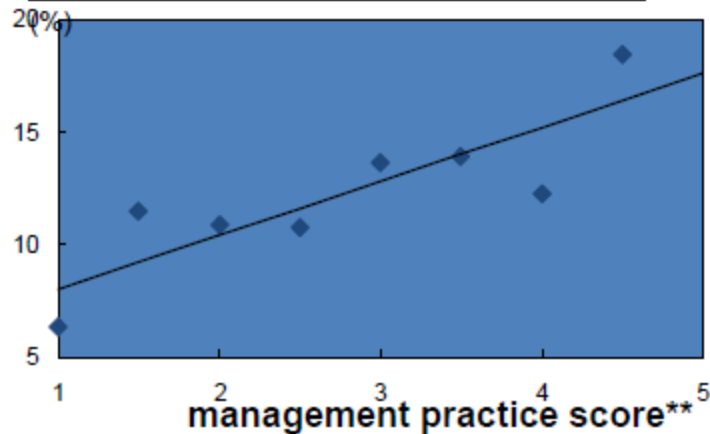
Labour productivity*



Sales growth (%)



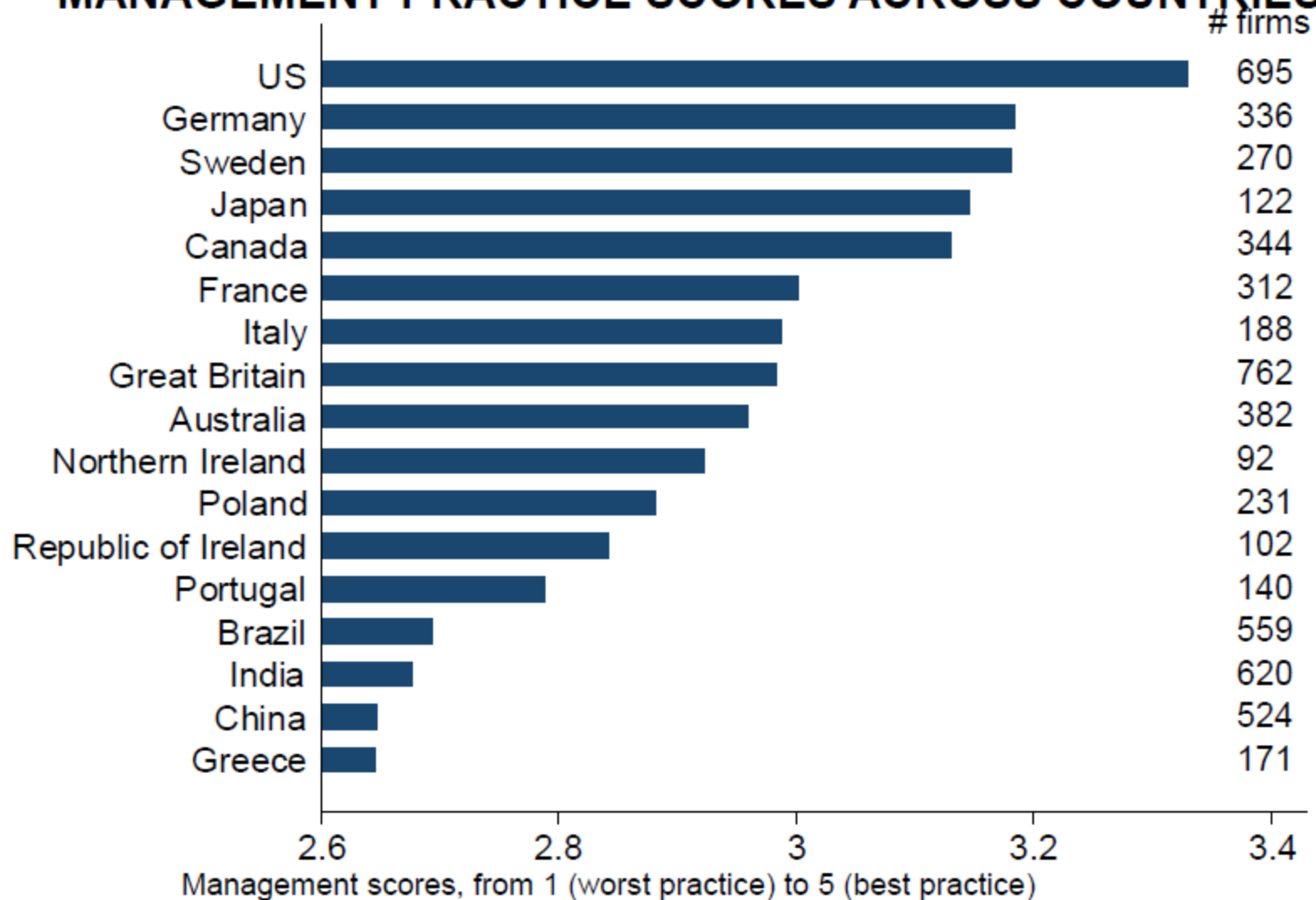
Return On Capital Employed, ROCE



* Log scale

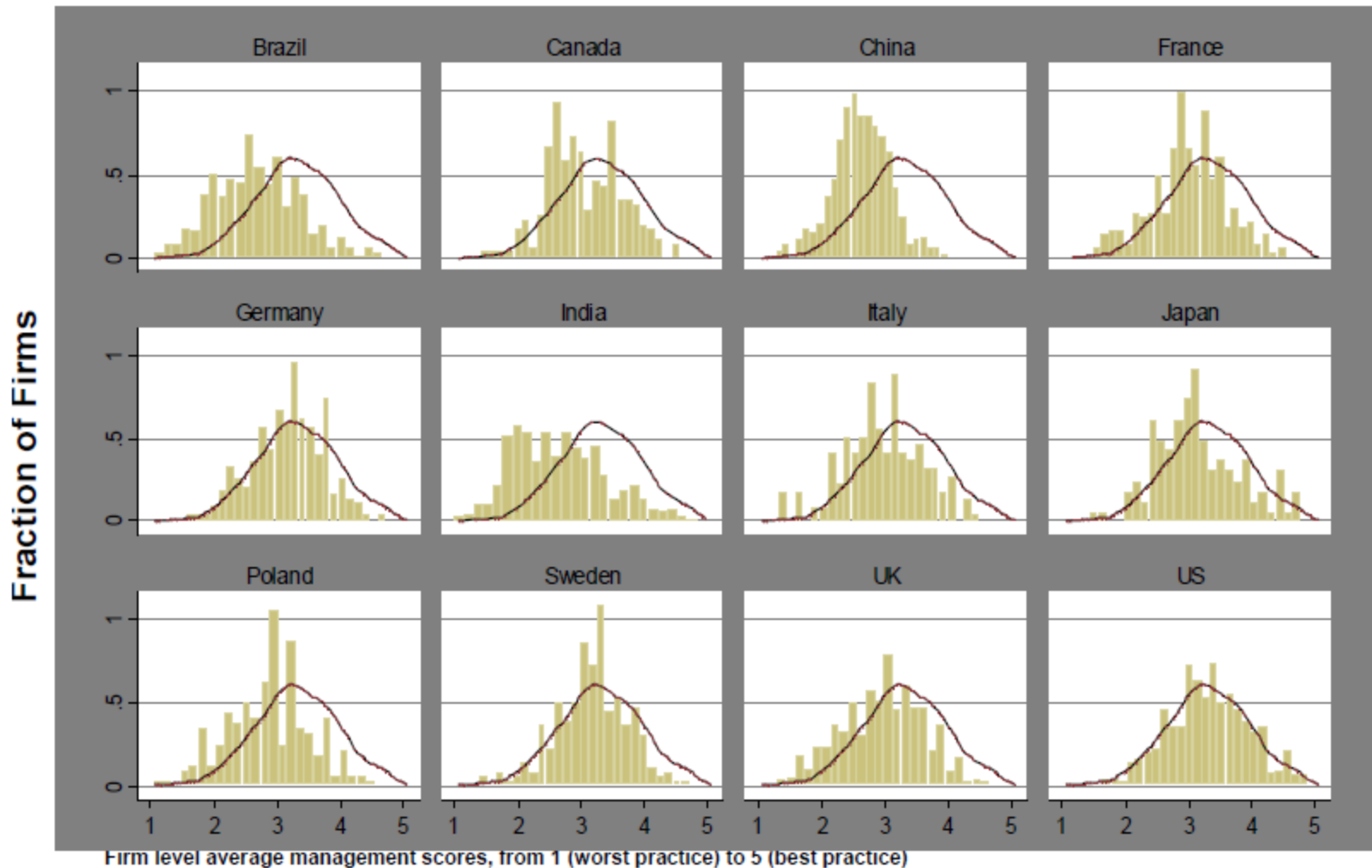
** Firms are grouped in 0.5 increments of assessed management score

MANAGEMENT PRACTICE SCORES ACROSS COUNTRIES



Note: Averages taken across all firms within each country. 5,850 observations in total. Firms per country in the right column
Source: Bloom, Genakos, Sadun and Van Reenen (2009)

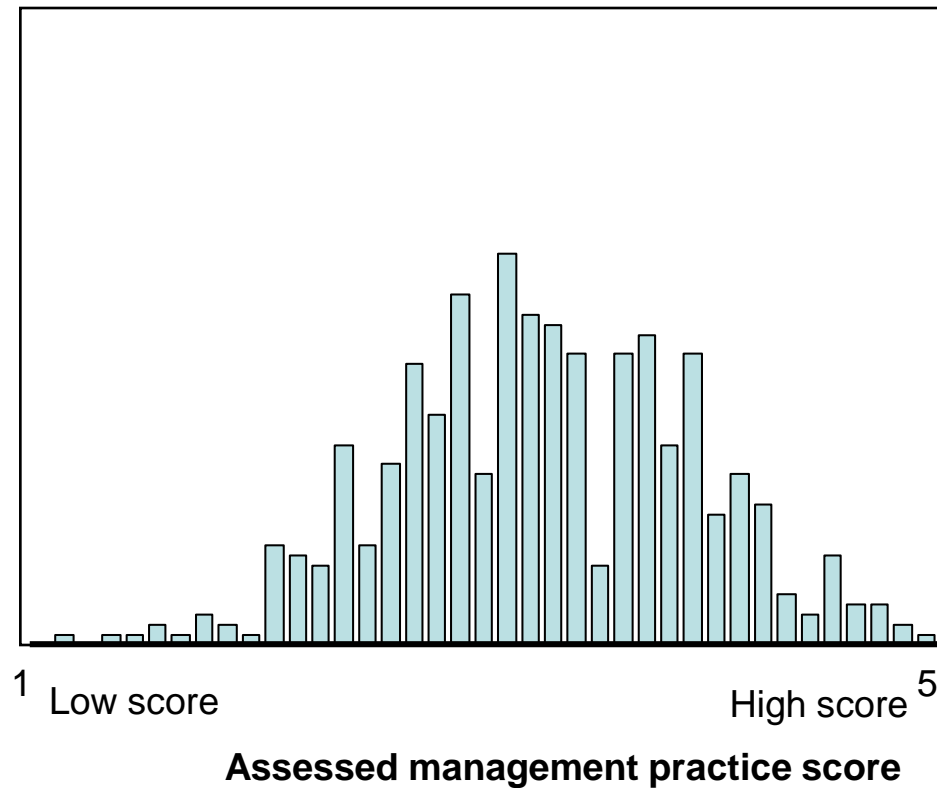
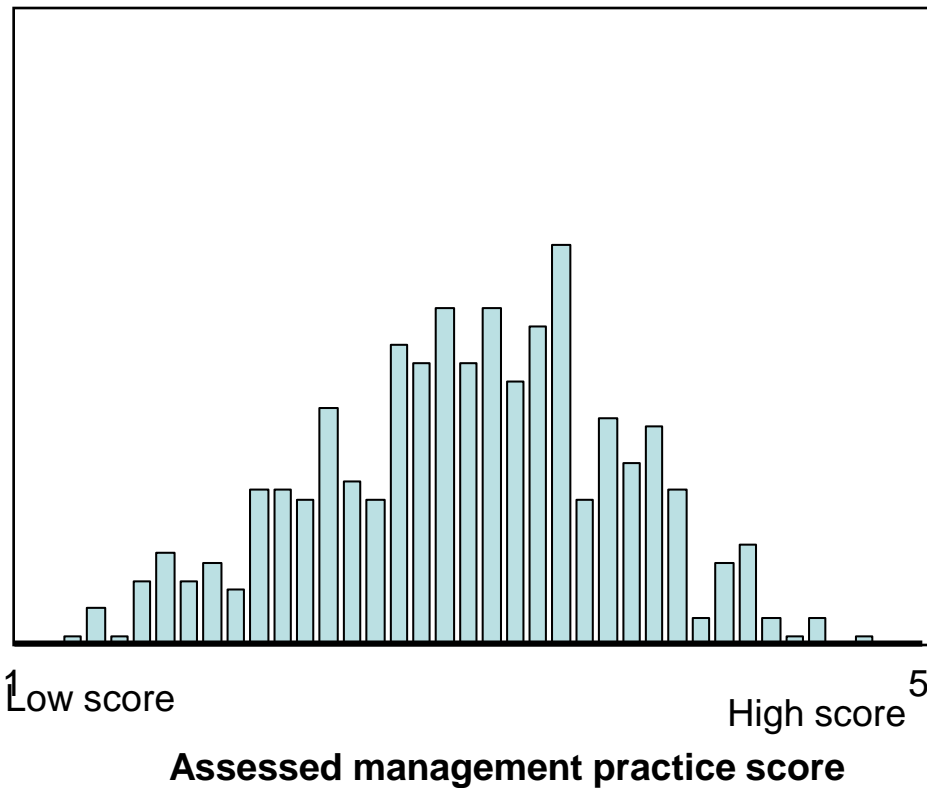
MANAGEMENT PRACTICE SCORES ACROSS FIRMS



Note: The bars are the histogram of the actual density. The line is the kernel of the US density for comparison. Portugal, Ireland and Greece omitted for presentational reasons, <http://www.nber.org/reporter/2008number4/bloom.html>

MUCH OF THE CROSS-COUNTRY DIFFERENCES DUE TO THE “LOWER TAIL”

Distribution of firm level management practice scores

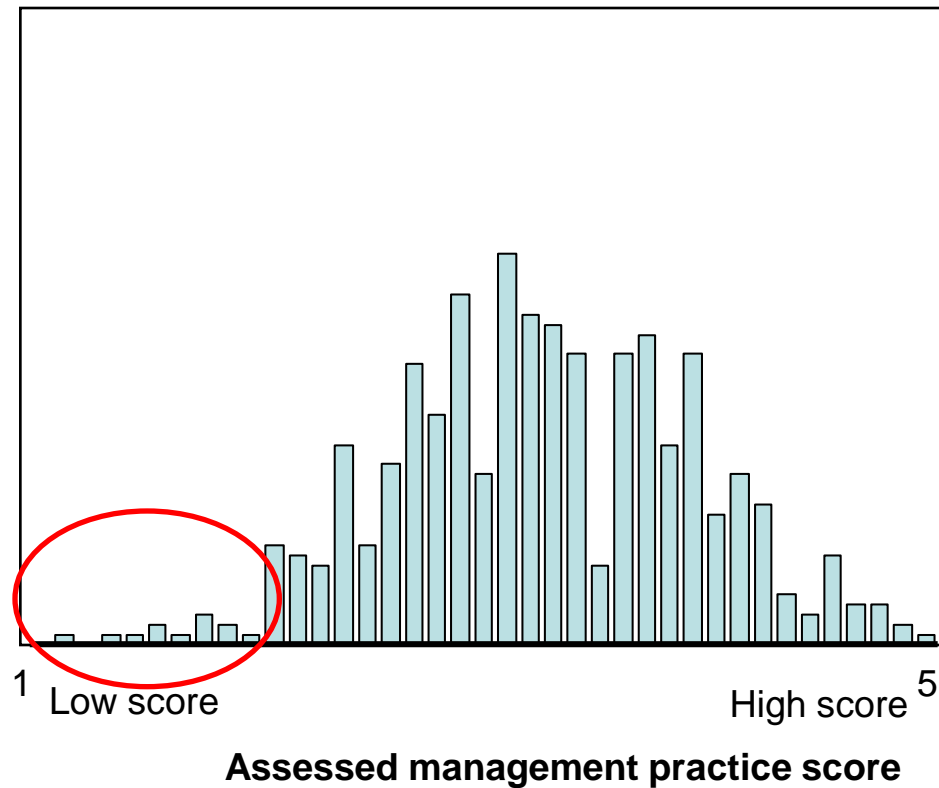
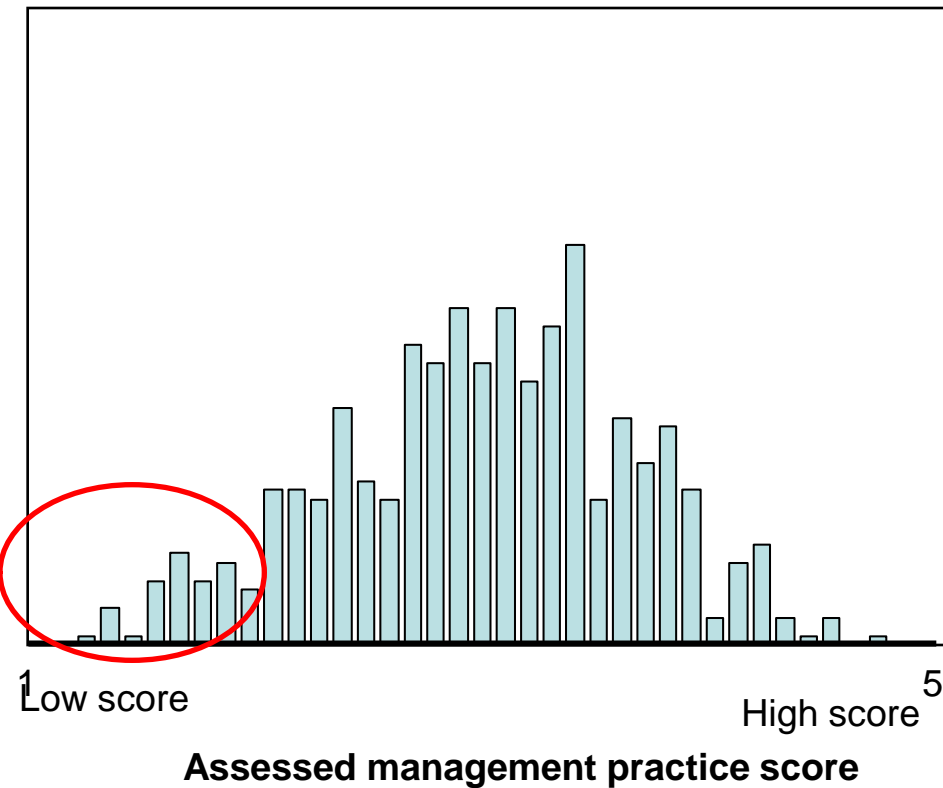


MUCH OF THE CROSS-COUNTRY DIFFERENCES DUE TO THE “LOWER TAIL”

Distribution of firm level management practice scores

 U.K.

 U.S.



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MARKET STRUCTURE & MODELS OF MANAGEMENT

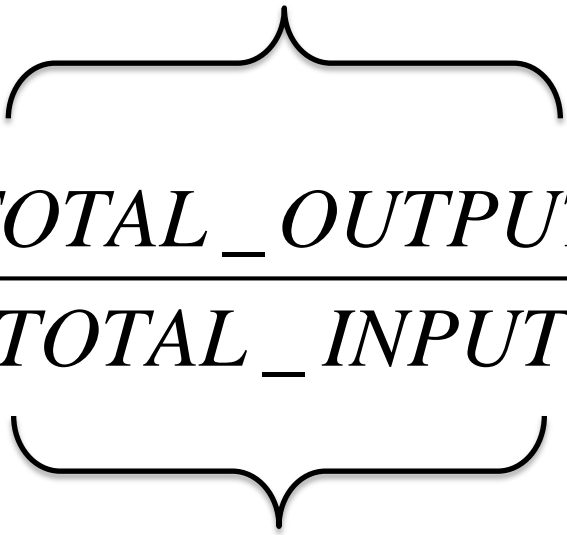
- Various ways that competition may influence management
 - Selection – badly run firms more likely to exit
 - Effort – forces badly run firms to try harder to survive
- Using panel we can find a role for both mechanisms
- Illustrate using a simple model based on Holmes & Schmitz (2010) simplified version of Melitz (2003)

SIMPLE MODEL OF PRODUCTIVITY

- Firms can enter at 2 locations: $j = \{1,2\}$
- Demand at location j : $Q^j = S^j d(p^j)$, $S =$ population at j
- Transportation costs, $T + D^j$, tariff
- Potential entrants at each location face fixed cost of entry $F^j + E^j$, entry tax (could be firm-specific).
- Entrants differ in post-entry productivity/management
- Production function is $y_i = A_i f(n)$; $n =$ labor
- Wage = 1
- Entry and production are simultaneous move Cournot
- Competitive environment e , denoting equilibrium levels under alternative parameters of $\{D, E\}$
- $B^{j,e}$ is the set of firms who choose to enter

SIMPLE MODEL OF AVERAGE INDUSTRY PRODUCTIVITY

Output of all firms in locations 1 and 2


$$Productivity = \frac{TOTAL_OUTPUT}{TOTAL_INPUT}$$

Inputs (labor and fixed capital) of all firms in locations 1 and 2 + Transportation costs

Note that taxes and tariffs are not included as inputs in the denominator

SIMPLE MODEL OF AVERAGE INDUSTRY PRODUCTIVITY

Output of all firms in location 1 Output of all firms in location 2

$$prod = \frac{\sum_{i \in B^{1,e}} A_i^{1,e} f(n_i^{1,e}) + \sum_{i \in B^{2,e}} A_i^{2,e} f(n_i^{2,e})}{\sum_{i \in B^{1,e}} (n_i^{1,e} + F_i^{1,e}) + \sum_{i \in B^{2,e}} (n_i^{2,e} + F_i^{2,e}) + q_{ship}^e T^e}$$

SIMPLE MODEL OF AVERAGE INDUSTRY PRODUCTIVITY

$$\begin{aligned}
 & \text{Output of all firms in location 1} && \text{Output of all firms in location 2} \\
 & \underbrace{\sum_{i \in B^{1,e}} A_i^{1,e} f(n_i^{1,e})}_{\text{Output of all firms in location 1}} + \underbrace{\sum_{i \in B^{2,e}} A_i^{2,e} f(n_i^{2,e})}_{\text{Output of all firms in location 2}} \\
 \text{prod} = & \frac{\sum_{i \in B^{1,e}} (n_i^{1,e} + F_i^{1,e}) + \sum_{i \in B^{2,e}} (n_i^{2,e} + F_i^{2,e}) + q_{ship}^e T^e}{\underbrace{\sum_{i \in B^{1,e}} (n_i^{1,e} + F_i^{1,e})}_{\text{Inputs (labor and fixed) of all firms in location 1}} + \underbrace{\sum_{i \in B^{2,e}} (n_i^{2,e} + F_i^{2,e})}_{\text{Inputs (labor and fixed) of all firms in location 2}} + q_{ship}^e T^e}
 \end{aligned}$$

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 \end{aligned}$$

CHANGES IN COMPETITIVE ENVIRONMENT

- **Mechanisms**
 - Reallocation
 - Scale
 - Within firm
- **Policy Changes**
 - *Tariffs reduced.* The more efficient firms in one location will displace the less efficient firms in the other location. Again, reallocation & scale.
 - *Entry restrictions relaxed.* Reallocation improves as threshold productivity needed to survive rises. Fewer firms & larger firms so scale benefit.
 - *Within firm* effect could matter in both of these

EFFECT OF INCREASES IN COMPETITION ON WITHIN FIRM PRODUCTIVITY– CONSIDER TARIFF FALL

- **Negative**
 - Schumpeterian: less rents, less incentive to improve
- **Positive**
 - “Raises stakes” marginal effect of productivity improvement bigger effect on profitability (Raith, 2003)
 - Managerial agency issues (Schmidt, 1997)
 - Fewer firms, but each larger. Scale effect: as fixed costs spread over more units (Vives, 2008)
 - **Displacement Effect** (Arrow, 1962). Opportunity costs lower for “trapped factors” (Bloom, Romer & VR, 2010)
- **Ambiguous**, no “canonical model” (cf. Aghion et al, 2005 “inverted U” innovation-competition relationship)

METHODS OF IDENTIFYING EFFECT OF MARKET STRUCTURE ON MANAGEMENT & PRODUCTIVITY

- **Cross industries**
 - Cross sectional
 - Fixed effects

- **Industry-specific Studies**
 - Specific changes in competition
 - Trade liberalizations

COMPETITION AND MANAGEMENT PRACTICES

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

Competition proxies	Dependent variable: Management			
Import penetration (lagged industry-country level)	0.066** (0.033)			
1- Lerner Index¹ (lagged industry-country level)		1.964*** (0.721)		
# of competitors (Firm level)			0.115*** (0.023)	0.120** (0.052)
Observations	2,499	2,980	3,589	864
Firm fixed effects?	No	No	No	Yes
Full controls²	Yes	Yes	Yes	Yes

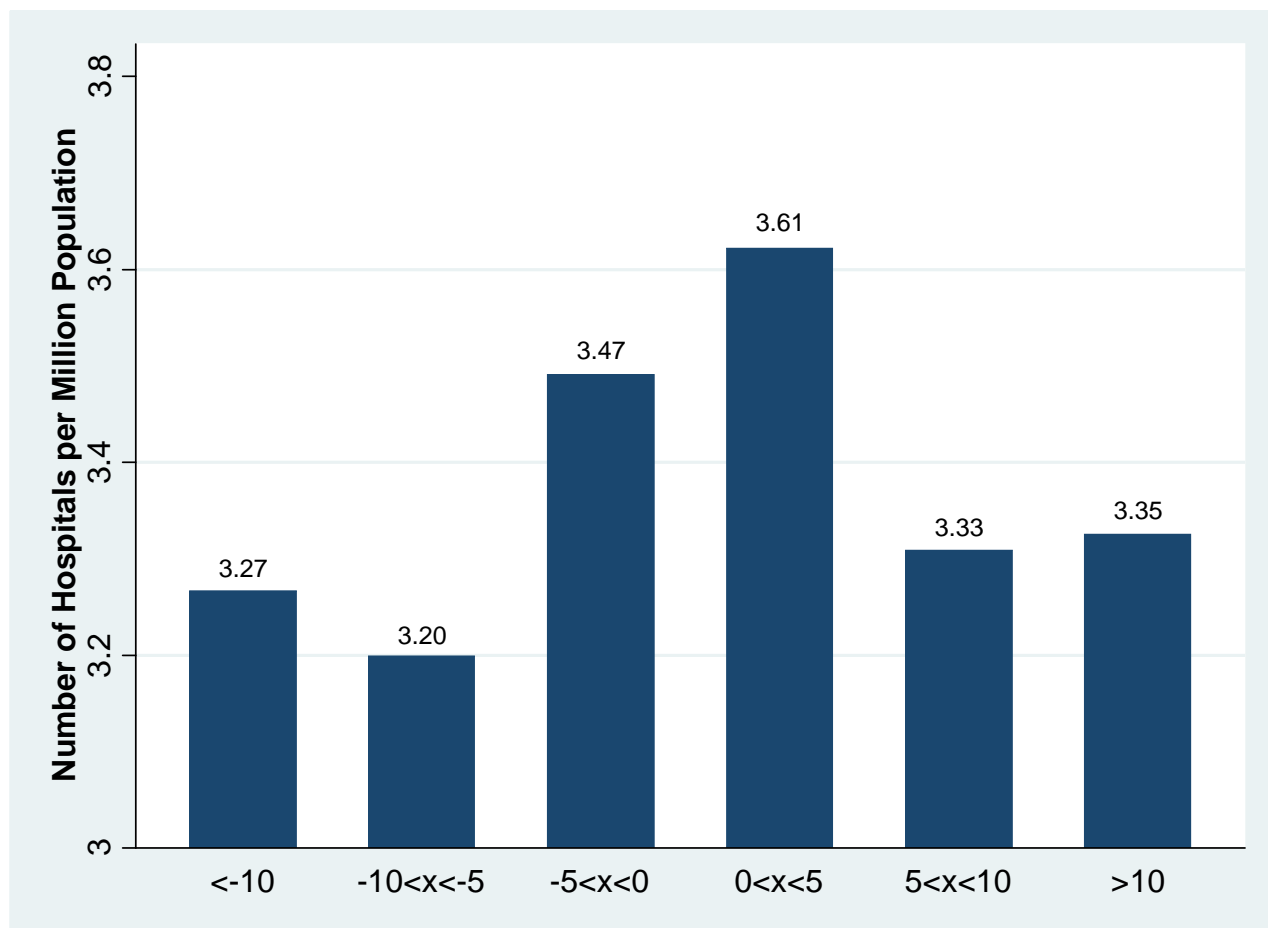
Source: Bloom, Genakos, Sadun & Van Reenen (2010)

Notes: “Full controls” includes 108 SIC-3 industry, country, firm-size, public and interview noise (interviewer, time, date & manager characteristic) controls

SINGLE INDUSTRY APPROACHES OF COMPETITION & MANAGEMENT

- Problem is identifying exogenous shocks to product market competition
- Bloom, Propper, Seiler & Van Reenen (2010) examine management in UK public hospitals. Competition driven by geographical proximity of rival hospitals
- In UK, exit (& entry) controlled by central government. Closing hospitals very politically unpopular, so we use exogenous variation in degrees of political contestability to construct instrumental variables (IV's)
 - Hospital in “marginal” political districts much less likely to be closed

NUMBER OF HOSPITALS IN A POLITICAL CONSTITUENCY IS GREATER WHEN POLITICAL DISTRICT IS MARGINAL



Labour party's winning % margin (1997)

Notes: Mean number of hospitals per 1 million people within a 30km radius of centre of a political constituency; “winning margin” (x) is % of votes ahead of second party

CAUSAL EFFECT OF COMPETITION ON MANAGEMENT & PATIENT OUTCOMES (DEATH RATES) IN HOSPITALS

Type of Regression	OLS	IV: 1 st Stage	IV: 2 nd Stage	IV: 2 nd Stage
Dependent variable	Management	# Competing Hospitals	Management	Emergency AMI death rate
# Competing Hospitals	0.121** (0.058)		0.361* (0.215)	-1.827* (1.037)
Marginal Constituencies		5.850*** (1.553)		
F-statistic of excluded instrument		14.18		
Observations	161	161	161	140

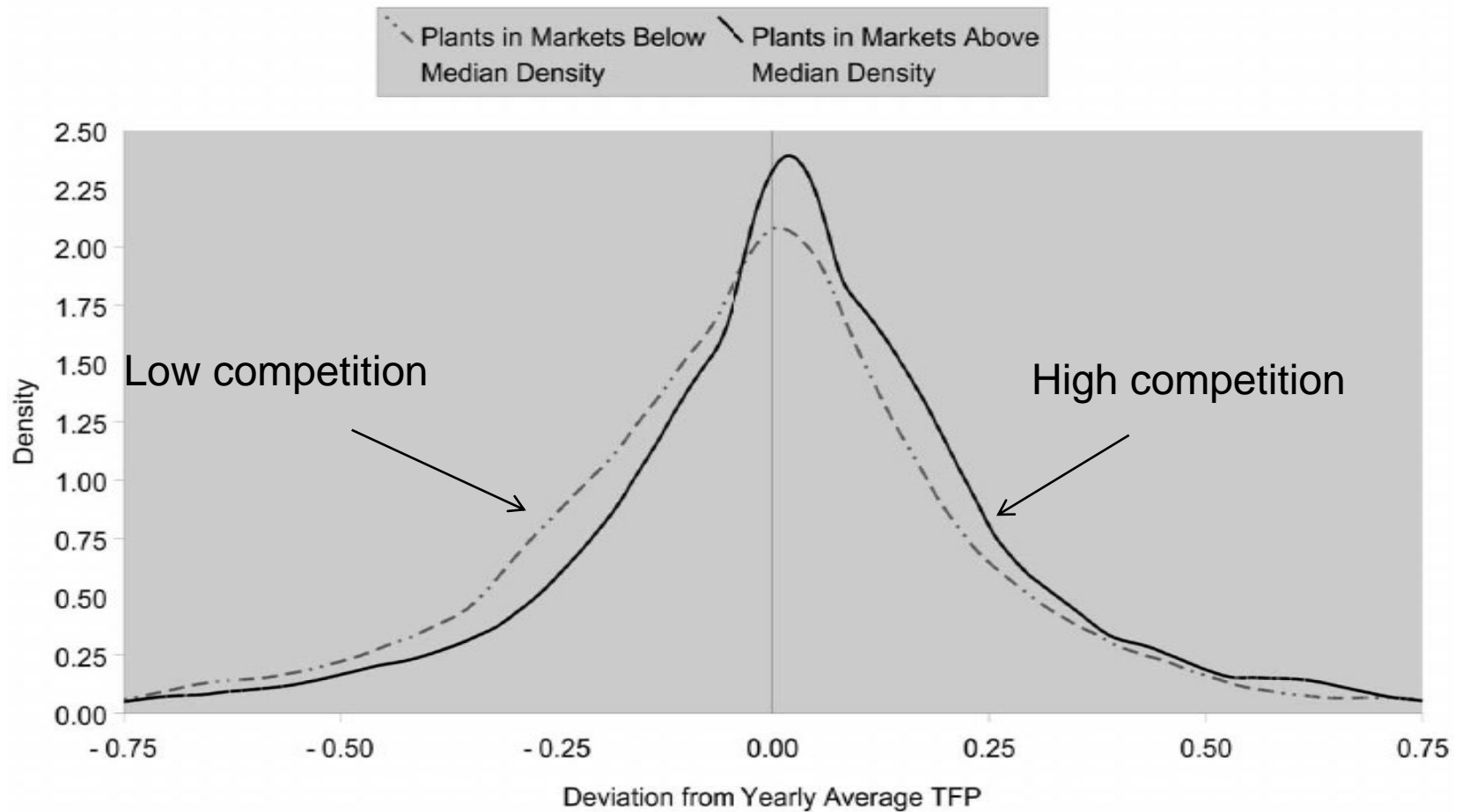
Source: Bloom, Propper, Seiler & Van Reenen (2010)

Notes: Constituency marginal if won by <5%. S.Es clustered by hospital. Controls include casemix (age/gender of admissions), population density, age profile (11 categories), Foundation Trust & interviewer dummies (4); % Labour votes, #political constituencies & mortality in catchment area; respondent tenure & whether she was a manager or clinician, regional dummies, # hospital sites, # admissions, % managers with a clinical degree and a dummy for joint decision making at the hospital level.

OTHER SINGLE INDUSTRY STUDIES OF COMPETITION AND PRODUCTIVITY

- **Syverson** (2004) *concrete* (market size in different geographical markets). See over

TFP DISPERSION AMONG CONCRETE PLANTS: COMPETITION MEANS HIGHER PRODUCTIVITY (CUTS OFF LOWER TAIL)



Source: Syverson (2004)

OTHER SINGLE INDUSTRY STUDIES OF COMPETITION AND PRODUCTIVITY

- **Syverson** (2004) *concrete* (market size in different geographical markets). See over
- **Holmes & Schmitz** (2001) *Water shipping* (effect of railroads)
- **Matsa** (2009) *Supermarkets* (Wal-Mart entry)
- **Bridgeman et al** (2008) *Sugar cartel* (disbanded in 1974)
- **Specific sectors:** de Loecker (2009) *Belgium*; Dunne et al (2008); US *Cement* (imports from e.g. Mexico, Venezuela & Australia); Schmitz (2005) US *Iron Ore* (Brazilian imports)
- **Summary**
 - All find productivity increased
 - Large within-plant component
 - Stress management changes as important

TRADE LIBERALIZATION –INCREASE IN COMPETITION

- **Examples:** Pavcnik (2002) *Chile*; Ferreira & Rossi (2003) *Brazil*; Trefler (2004) *Canada*; Amiti & Konings (2007) *Indonesia*; Fernandes (2007) *Columbia*; Ruiz & Utar (2009); *Mexico*; Sivadasan (2009) *India*; Bustos (2010) *Argentina*
- Mix several effects – export market size, learning
- **Bloom, Draca & Van Reenen (2010)**
 - Use growth of **Chinese** import competition in 12 European nations since 1990s
 - Productivity, jobs & technology (R&D, patents, ICT)
 - Macro impact large (~15% of EU productivity growth), about ½ reallocation and ½ within firm
 - Focus on textiles & apparel following China's WTO entry

MULTI FIBER AGREEMENT POLICY EXPERIMENT

- The Multi Fiber Agreement (1974) restricted apparel and textile exports from developing countries
- The MFA was negotiated into GATT (WTO) as part of the Uruguay Round in 1994, with a 4 phase abolition 1995-2005
- When China entered the WTO in Dec 2001 it gained access to this phased abolition, occurring between 2001 and 2005
- When Chinese products came off quota there was huge surge of imports into EU and US
- Because there was some (endogenous) re-introduction of some quotas in 2006 we use baseline quotas in 2000

IV ESTIMATES USING CHANGES IN EU TEXTILE & CLOTHING QUOTAS – 5 YEAR GROWTH IN TFP

Method	$\Delta \ln(\text{TFP})$ OLS	Δ Chinese Imports First Stage	$\Delta \ln(\text{TFP})$ IV
Δ Chinese Imports	0.829*** (0.303)		1.490*** (0.608)
Quotas removal		0.088*** (0.011)	
Sample period	2005-1999	2005-1999	2005-1999
Units	12,470	12,470	12,470
Industry clusters	200	200	200
Observations	21,007	21,007	21,007

SE clustered by 4 digit industries, Country-year and site type dummies included

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IDENTIFICATION

Productivity measure

$$y_{it} = \beta m_{it} + \alpha x_{it} + \eta_i + u_{it}$$

management practices

- Cross section
- Fixed effects
- Quasi-experiment before & after a firm's policy change
- Randomized control trials

BETTER PERFORMANCE IS CORRELATED WITH BETTER MANAGEMENT “EXTERNAL VALIDATION”:

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

Notes: One sd change in management. Regressions includes controls for country, with results robust to controls for industry, year, firm-size, firm-age, skills etc.

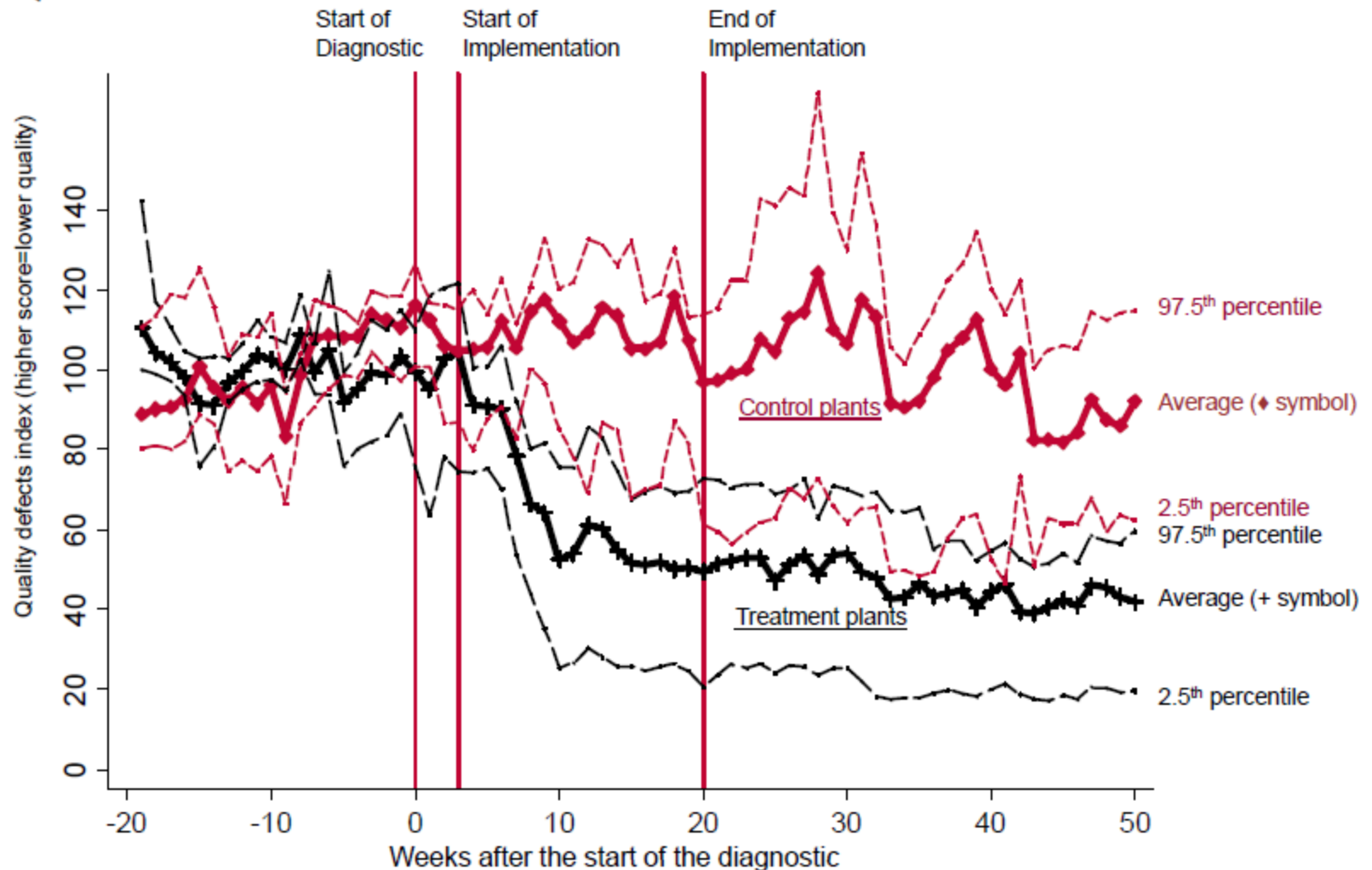
Source: Bloom and Van Reenen (2010)

- Relationship persists after controls for fixed effects
- Not causal – we treat as “external validation” of management score

RANDOMIZED CONTROL TRIALS: BLOOM, EIFERT, MCKENZIE, MAHAJAN & ROBERTS (2010)

- 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
 - Appears informational constraints were a major reason for lack of prior adoption, but often other constraints also present

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.

CONCLUSIONS

- Heterogeneity in firm productivity a first order fact
- Linked to management and organization of firms.
- Management a “technology”, static non-transferable way (e.g. Lucas and Melitz), but also partially transferrable (diffusion models)
- Competition stimulates better management & productivity via **reallocation & within firm** effects
- Which theories best explain this & in which sectors not well understood
 - Fruitful dialogue between industrial organization and economics of organization
 - Data constraints being relaxed

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:

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”

RELATIONSHIP BETWEEN MANAGEMENT & SIZE IS MUCH 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 (Bloom, Genakos, Sadun & Van Reenen, 2010):
 - US ~720 more workers
 - UK ~550 more workers
 - India ~260 more workers
 - Italy ~250 more workers
- Competitive forces of reallocation weaker in India/Italy compared to US

HUMAN RESOURCE MANAGEMENT & PRODUCTIVITY

- **Individual incentive pay (increase in productivity)**
 - Lazear (2000). *Safelite*. 44%
 - Bandeira et al (2007, 2009). *Fruit farm*. 21%
 - Freeman and Kleiner (2005). *Shoes* (6%)
 - Shearer (2004). *Tree Planters* (22%)
 - Lavy (2002, 2008). *Teachers*.
- **Group incentive pay**
 - Blasi et al (2009) *Meta study* mean effects (+4.5%)
 - Hamilton et al (2003). *Garment factory* (18%)
 - Knez and Simester (2001). *Continental Airlines*
 - Ichinowski et al (1997). *Steel finishing lines*.
- **Note: Generally all find positive effects**

IV ESTIMATES USING CHANGES IN EU TEXTILE & CLOTHING QUOTAS – PATENTS AND TFP

	Δ PATENTS	Δ Chinese Imports	Δ PATENTS	$\Delta \ln(\text{TFP})$	Δ Chinese Imports	$\Delta \ln(\text{TFP})$
Method	OLS	First Stage	IV	OLS	First Stage	IV
Δ Chinese Imports				0.829*** (0.303)		1.490*** (0.608)
Δ Chinese Imports (t-3)	1.294*** (0.478)		3.933* (2.382)			
Quotas removal		0.034*** (0.015)			0.088*** (0.011)	
Sample period	2005-1999	2005-1999	2005-1999	2005-1999	2005-1999	2005-1999
Units	1,810	1,810	1,810	12,470	12,470	12,470
Industry clusters	81	81	81	200	200	200
Observations	3,339	3,339	3,339	21,007	21,007	21,007

SE clustered by 4 digit industries, Country-year and site type dummies included