MANAGEMENT AS A TECHNOLOGY?

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Abstract

Does management have technological aspects? We collect data on management practices on over 8,000 firms in 20 countries in the Americas, Europe and Asia. The US has the highest average management score and around 30% of this is due to more powerful selection effects. Management accounts for up to half of the TFP gap between the US and other countries. The stronger correlation between firm size (and growth) and management quality is related to greater competition (especially from lower trade barriers) and weaker labor regulation. Using panel data on changes in management practices over time, we argue that more intense product market competition generates both powerful selection effects and incentivizes incumbent firms to upgrade their management practices. Part of this competition effect is due to changing a firm's (over-optimistic) perceptions of their management quality.

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I. INTRODUCTION

Productivity differences between firms and between countries remain startling.[1] For example, within four-digit US manufacturing industries, Syverson (2011) finds that labor productivity for firms at the 90th percentile was four times as high as plants at the 10th percentile. Even after controlling for other factors, Total Factor Productivity (TFP) was almost twice as high. These differences persist over time and are robust to controlling for plant-specific prices in homogeneous goods industries. TFP heterogeneity is evident in all other countries where data is available[2]. One explanation is that these persistent productivity differentials are due to "hard" technological innovations as embodied in patents or adoption of new advanced equipment. Another explanation for this phenomenon is that they reflect variations in management practices. This paper focuses on the latter explanation.

We put forward the idea that (some forms) of management are a "technology". This has a number of empirical implications that we examine and find support for in the data. We argue that this perspective on management is distinct from alternative groups of theories such as management as just another factor of production or simply an issue of optimal design depending only on the contingent features of the firm's environment.

Empirical work to measure differences in management practices across firms and countries has been limited. Despite this lack of data, the core theories in many fields such as international trade, labor economics, industrial organization and macroeconomics are now incorporating firm heterogeneity as a central component. Different fields have different labels. In trade, the focus is on an initial productivity draw when the plant enters an industry that persists over time (e.g. Melitz, 2003). In industrial organization the focus has traditionally been on firm size heterogeneity (e.g. Sutton, 1997; Lucas, 1978). In macro-economics, organizational capital is sometimes related to the

[1] See, for example, Foster, Haltiwanger and Syverson (2008) show large differences in total factor productivity even within very homogeneous goods industries such as cement and block ice. Hall and Jones (1999) and Jones and Romer (2010) show how the stark differences in productivity across countries account for a substantial fraction of the differences in average income.

[2] See Bartelsman, Haltiwanger and Scarpetta (2012) for a general survey. For example, in the UK Criscuolo, Haskel and Martin (2003) show that 90th-10th difference in labor productivity is 5.2 and 1.6 for TFP.

firm specific managerial know-how built up over time (e.g. Prescott and Visscher 1980; or Atkeson and Kehoe 2005).

To address the empirical lacuna we have collected original survey data on management practices in 21 countries covering over 7,500 firms with up to three waves of panel data. We first present some "stylized facts" from this database in the cross country and cross firm dimension. We then examine some empirical implications of the model of management as a technology and find several pieces of supporting evidence:

(i) Management is associated with higher productivity and profitability. Unlike other factors of production the elasticity of output with respect to management seems broadly stable across industries. From experimental evidence it appears to be causal.

(ii) There is reallocation of activity towards better managed firms in terms of inputs (e.g. employment) and sales growth. This force of reallocation is much stronger in the US than elsewhere and these accounts for about 30% of the managerial advantage of the US. Lower trade barriers and more flexible labor markets help speed up reallocation.

(iii) One of the most important factors in improving average management quality is product market competition. This operates both through selection and incentive effects. Part of the reason for this is that competition causes managers to more realistically revise their perceptions of their performance.

The structure of the paper is as follows. We first describe some theories of management (Section II) and how we collect the management data (Section III). We then describe some of the data and stylized facts (Section IV). Section V details our empirical results and Section VI concludes. In short, although there may be other explanations, we provide considerable evidence for our model of "management as a technology".

II. SOME ECONOMIC THEORIES OF MANAGEMENT

For econometricians, believing that management is a cause of productivity heterogeneity may be natural. Since at least Mundlak (1961) the fixed effect in panel data estimates of production functions (i.e. permanent unobserved TFP that is correlated with factor inputs) has been labelled "management quality". In the next section I will consider approaches which try and measure this directly instead of just treating it as an unobserved variable in the estimation.

Economists have focused on how the creation and diffusion of technological innovations could be the driving factor behind the variation. Endogenous growth theory has focused on R&D, and empirical economists have continued in this vein examining the relationship between TFP and innovation as measured by R&D, patents and/or more direct proxies for innovation[3] and diffusion (such as ICT). Much has been learned from this body of work and there is much more robust evidence of the causal importance of "hard" technology for productivity growth[4]. Such estimates are important for both shedding light on theory and innovation policy.

There are at least two major problems, however, in focusing on these aspects of technical change as the causes of productivity. First, even after controlling for a wide range of observable measures of technology a large residual still remains. A response to this is that these differences still reflect some unmeasured "hard technology" differences which, if we measured them properly would be properly accounted for. But an alternative view is that we need to widen our definition of technology to incorporate managerial and organisational aspects of the firm.

A second problem is that many recent studies of the impact of new technologies on productivity have stressed that the impact of technologies such as ICT varies widely across firms and countries. In particular, it appears that ICT has systematically a much larger effect on the productivity of firms who have complementary organisational structures which enable the technology to be more efficiently exploited. In their case studies of ICT in retail banking, for example, Autor et al (2002) and Hunter et al (2001) found that banks who failed to re-organise the physical and social relations

[3] Examples would include the UK SPRU dataset (e.g. Van Reenen, 1996) or the European Community Innovation Survey.

[4] Zvi Griliches pioneered work in this area which motivated the work of the NBER productivity group from the 1980s onwards. A representative collection would be Griliches (1998). For an example of recent work looking at the causal effect of R&D on productivity (and spillovers) using R&D tax policy as a natural experiment see Bloom, Schankerman and Van Reenen (2012).

within the workplace reaped little reward from new ICT (like ATM machines). More systematically, Bresnahan, Brynjolfsson and Hitt (2002) found that decentralised organisations tended to enjoy a higher productivity pay-off from IT. Similarly, Bloom, Sadun and Van Reenen (2012) found that IT productivity was higher for firms with tougher better people management practices (e.g. careful hiring, merit based pay and promotion and vigorously fixing/firing under-performers). Since these were much more prevalent in US firms such firms obtained faster productivity growth when IT prices fell very rapidly as they did in the post 1995 period. This phenomenon was true even those US multinational subsidiaries located in Europe. The authors argue that about half of the faster productivity growth in the US relative to Europe in the decade after 1995 could be attributed to these different US people management practices interacted with the exogenous fall in IT prices.

Given these two issues we believe it is worth directly considering management practices as a factor in raising productivity. In addition, there is a huge body of case study work in management science which also suggests a major role for management in firm performance.

II.1 Theories of the variation in management practices

There are at least four economic perspectives on management. First, there is the cynical view that all management is just fads or fashions and should be ignored by serious economists (except with regard to why such fashions should ever be adopted). There is certainly a large amount of snake oil masquerading as scholarship as any browse around the business section of an airport bookshelf will reveal. But given the large amounts of money paid for by such management advice by profit-oriented firms and by prospective MBA students, it is worth considering the view that management may actually matter.

There are a large number of theories and notions of "management practices" in economics. First,
It is useful to analytically distinguish between three approaches which we can embed in a simple production function framework where output, *Q*, is produced is follows:

$$Q = G(A,X,M) \qquad (1)$$

where A is an efficiency term, X, are conventional factors of production, and M is management quality.

Management as a standard Factor of Production

A second perspective is that management should be considered as a factor of production no different from any other. In terms of equation (1), M would simply be another element in the vector X. As such the study of management is the same as the supply and demand for any other investment good (e.g. human capital). The simplest view is that management is another factor of production, like labor or capital. In this view there is a market price for the management input, and the price of this will determine the optimal level. For example, firms in regions with low wage rate for workers with engineering or MBA qualifications may optimally hire more of these types of workers, leading to better measured management practices. As a result, while differences in management practices will be correlated with differences in productivity they should not be systematically correlated with differences in profitability.

There is certainly something to be said for this view and investment in management has aspects of other capital goods. Yet, as was recognised by Kaldor (1934) among others, there is an aspect of a firm which is authority - an irreducible decision making aspect of how the firm is organised that is hard to reduce to the standard approach to considering factor choices. Such management decisions can raise or reduce the productivity of all other factors of production.

Management as Design

The economics of contracts (see Bolton and Dewatripont, 2005, for an overview) and the economics of organisations (see Gibbons and Roberts, 2011) have made huge strides in recent decades. The design perspective borrows three key economic principles. First, firms and workers are rational maximising agents (profits and utility respectively). Secondly, it is assumed that labor and product markets must reach some sort of price-quantity equilibrium, which provides some discipline for the models. Finally, the stress is very much on private efficiency with an emphasis on why some employment practices, which may look to be perplexing and inefficient on the surface (e.g. mandatory retirement and huge pay disparities for CEOs), may actually be privately optimal.

Under the Design approach the production function can be written as equation (1), but for some firms and practices $G'(M) < 0$. Even if M is free and could be costlessly introduced, output would fall.

The key feature of the design approach is that the management practices we observe are chosen by firms to maximise profits in an environment that departs from perfectly competitive spot markets. For example, unlike the standard Personnel Management texts, Organisational Economics leads to sharper predictions and generalisations: it is not the case that "every workplace is fundamentally different". However, the design approach puts the reason for heterogeneity in the adoption of different practices as mainly due to the different environments firms face – say in the industry's technology, rather than inefficiencies. The managerial technology view, described next, sees a large role for inefficiencies.

Management as a Technology

The large dispersion in firm productivity motivates an alternative perspective that some types of management (or bundles of management practices) are better than others for firms in the same environment. There are three types of these best practices. First, there are some practices that have always been better throughout time and space (e.g. not promoting gross incompetents to senior positions) or collecting some information before making decisions. Second, there may be genuine managerial innovations (Taylor's Scientific Management; Lean Manufacturing; Demming's Quality movement, etc.) in the same way there are technological innovations. There are likely to be arguments over the extent to which managerial innovation is real technical progress or just a fad or fashion. It is worth recalling that this debate historically occurred for many of the "hard" technological innovations which we now take for granted such as computers and the Internet. Thirdly, many practices may have become optimal due to changes in the economic environment over time, as the design perspective highlights. Incentive pay may be an example of this: the proportion of firms using piece rates declined from the late 19th Century, but today incentive pay appears to be making somewhat of a comeback. Lemieux et al (2009) suggest that this may be due to advances in ICT – companies like SAP make it much easier to measure output in a timely and

robust fashion, making effective incentive pay schemes easier to design[5]. In these circumstances, some firms may be faster than others in switching to the new best practice. The differential speed of adjustment to the new equilibrium can be due to information differences, complementarities and agency issues.

II.2 Models of Management as a Technology

We can divide the management as a technology perspective into two types: nontransferable and transferable. The former is more conventional than the latter, so we start here first. All theories have to tackle the essential question of why all firms do not adopt the management practice if it is profitable?

Nontransferable management practices: Imperfect Competition

The large-scale productivity dispersion described in Section 2 posed serious challenges to the representative firm approach. Firm heterogeneity has always been important in Industrial Organization, but there has been a wholesale re-evaluation of theoretical approaches in several fields. For example, in international trade the dominant paradigm has already started to shift towards heterogeneous firm models. This is due to the increasing weight of empirical evidence documenting the persistent heterogeneity in firm export patterns (e.g. exporters tend to be larger and more productive). Melitz (2003) follows Hopenhayn (1992) in assuming that firms do not know their productivity before they pay a sunk cost to enter an industry, but when they enter they receive a draw from a known distribution. Productivity does not change over time and firms optimize subject to their constraint of having permanently higher or lower productivity. Firms who draw a very low level of productivity will immediately exit as there is some fixed cost of production they cannot profitably cover. Those who produce will have a mixture of productivity levels, however. A natural interpretation of this set-up is that entrepreneurs found firms with a distinct managerial culture which is imprinted on them until they exit, so some firms are permanently "better" or "worse" managed. Over time, the low productivity firms are selected out and the better ones survive

[5] Hard technological advances have also facilitated managerial innovations such as Just in Time. Keane and Feinberg (2007) stress the importance of these improved logistics for the growth of intra-firm trade between the US and Canada.

and prosper. There is some stochastic element to this, however, so in the steady state there will always be some dispersion of productivity.

Imperfect competition is one obvious ingredient for these models. With imperfect competition firms can have differential efficiency and still survive in equilibrium. With perfect competition inefficient firms should be rapidly driven out of the market as the more efficient firms undercut them on price. In Syverson (2004b), for example, there is horizontal product differentiation based on transport costs so firms have local market power. He shows theoretically and empirically that increases in competition will increase average productivity by reducing the mass of less productive plants in an area.

Nontransferable management practices: Talent models

The classic contribution here is the Lucas (1978) span of control model that has been built on by many subsequent authors. In the Lucas model managerial/entrepreneurial talent is the ability to organize teams of workers together in a way that enhances all of their productivity. Managerial talent is heterogeneous in the population with the most able managers increasing worker productivity by more. Managers leverage their ability by founding firms employing larger numbers of workers so the most talented manager will run the largest firms. What limits the best manager from taking over the entire economy is managerial overload causing decreasing returns to scale and a finite span of control. So in equilibrium the best managers will have the largest span of controls and we have a theory of the distribution of firm size which perfectly reflects the differences in underlying managerial talent. Since individuals can also be employed as workers, what determines the number of managers (compared to workers) is the marginal person who is indifferent between being a manager or a worker[6].

Managerial talent will show up as TFP (if properly measured) because two firms with the same inputs will produce more output with the better manager. Thus, this is a theory of TFP dispersion as well as a theory of firm size. The Lucas model is individualistic – better management is due to a higher ability CEO. There is certainly evidence that individual managers do matter. For example,

[6] The model can be enriched to allow for a variety of imperfections such as labor market regulations. Garicano, Lelarge and Van Reenen (2011) show how size-related regulations allow econometricians to identify the welfare costs of regulation in a Lucas model.

using a sample of large publicly quoted US firms Bertrand and Schoar (2006) show that there is substantial variation in "management styles" (e.g. in merger and acquisition behavior) between CEOs that are correlated with management characteristics. For example, older managers that have experienced the Great Depression tend to be more cautious than younger managers with MBA training on the tax advantages of debt leverage. Performance differences are large between different managers. Another example would be the work discussed below on family firms that shows how performance deteriorates when the CEO is appointed as the eldest son of the founder.

The view of management practices as being simply the human capital of senior managers does seem to lack the notion that the performance of a firm persists even after an individual CEO comes and goes (something captured crudely by the imperfect competition models). Although there are clear differences between the two main classes of non-transferable management models, many of the predictions of the Lucas model are actually similar to those from imperfect competition models (see Hsieh and Klenow, 2009, for example, of how similar predictions on the size and productivity distribution can be derived).

A common feature of both imperfect and perfect competition models is that management is partially like a technology, so there are distinctly good (and bad) practices that would raise (or lower) productivity. But under both sets of theories, however, management does not change in a fundamental sense. Managerial talent cannot be transferred between firms in the basic Melitz model. Although firm productivity is perfectly transferable across workers and plants in the same firm (even when located in another country in Helpman, Melitz and Yeaple, 2004) when a firm dies, so does its knowledge on raising productivity. In the Lucas (1978) model talent does not transfer between individuals, so the only way that management quality is transferred between firms is when managers move across companies.

Transferable management practices

An alternative view is that management is partially transferable even without labor mobility or the entrance of a new firm. A natural context for such models is that there are genuine managerial innovations that are "new to the world" not merely "new to the firm". In this view, Toyota's production system of lean manufacturing was a genuinely new idea that would have raised

productivity in other car manufacturers such as GM or Chrysler had they come up with the Toyota system or adopted earlier. The fact that adoption was not immediate for all the beneficiaries should not come as a huge surprise as "hard" technological innovations are also adopted slowly and with a considerable lag by other firms. Indeed, seen in this perspective all the diffusion models that are well studied by economies (e.g. see the survey by Hall, 2003, Skinner and Staiger (2009), or Foster and Rosenzweig, 2010) become relevant to understanding the spread of management practices

Although, in principle, this slow adoption could be down to differences in the environment such as different prices and costs across firms, there is much evidence that the diffusion curve also has other influences such as informational constraints. This is information relating both to whether the firm knows that it is badly managed and even if it does know this, not knowing what to do to improve things. These are likely to be related to the human capital of the manager and the density of economic activity which influences learning. Of course, even if there is full information, the manager may not have sufficient incentives to change because of competition, adjustment costs[7], corporate governance, etc. Finally, there are co-ordination problems in getting the rest of the organization to respond even if the CEO is fully informed and properly motivated. These are all in a standard economic rational choice framework, but of course behavioral considerations such as overconfidence or procrastination could also be at play (see Bloom and Van Reenen, 2011, for a discussion of these).

Summary

The three groups of theories offer different predictions on the links between management quality, productivity, profitability and factor inputs. The management as a factor input predicts a positive correlation between management and productivity and higher quality factor inputs, but not profitability. Management as technology predicts positive correlations between management and productivity and profitability, but no predictions over the correlations of management with factor

[7] In principle all the heterogeneity in management practices could be explained away by firms with different long-run levels of management practices, heterogeneous shocks and adjustment costs. It would be difficult to reconcile this perspective with the fact that exogenous "improvements" to management practices causes higher profits as shown by some of the experimental work.

inputs. While management as a design predicts no correlations between management practices and either productivity or profitability, but correlations with intensity of different factor inputs. [8]

The theories also offer different predictions over the relationship between management practices and

1. Firm size: management quality should be higher in larger firms in the factor inputs and technology theories
2. Firm growth and survival: management quality and firm survival should be positively correlated in the technology theories
3. Exporting and multinational status: this should be positively correlated in the technology theories
4. Product market competition: this should improve management through selection in the technology theories.

We will also examine how management changes over time in a given firm, in particular in response to increases in competition.

III. DATA

III.1 Survey Method

To measure management practices we developed a new "double blind" survey methodology in Bloom and Van Reenen (2007). We descibe the methodology underlying this type of survey technique in more detail in Bloom and Van Reenen (2010). This uses an interview-based evaluation tool that defines and scores from one ("worst practice") to five ("best practice") across 18 basic management practices on a scoring grid. This evaluation tool was developed by an international consulting firm, and scores these practices in three broad areas[9]:

[8] This will depend at what practices are being examined. If the environment is changing such that a new set of practices becomes the new long-run equilibrium, firms who are able to change more rapidly will see their productivity improve. For example, if falling IT prices makes decentralized decisions and incentive pay optimal whereas it was not before (e.g. because individual output can now be measured and robustly verified), a switch from flat pay to higher powered incentives could be associated with higher productivity (e.g. Lazear, 2000).

[9] Bertrand and Schoar (2003) focus on another important managerial angle - CEO and CFO management style - which will capture differences in management strategy (say over mergers and acquisitions) rather than practices per se.

- *Monitoring*: how well do companies track what goes on inside their firms, and use this for continuous improvement?

- *Target setting*: do companies set the right targets, track the right outcomes and take appropriate action if the two are inconsistent?

- *Incentives/people management*[10]: are companies promoting and rewarding employees based on performance, and systematically trying to hire and keep their best employees?

To obtain accurate responses from firms we interview production plant managers using a 'double-blind' technique. One part of this double-blind technique is that managers are not told in advance they are being scored or shown the scoring grid. They are only told they are being "interviewed about management practices for a piece of work".

To run this blind scoring we used open questions. For example, on the first monitoring question we start by asking the open question "tell me how your monitor your production process", rather than closed questions such as "do you monitor your production daily [yes/no]". We continue with open questions focusing on actual practices and examples until the interviewer can make an accurate assessment of the firm's practices. For example, the second question on that performance tracking dimension is "what kinds of measures would you use to track performance?" and the third is "If I walked round your factory could I tell how each person was performing?". The scoring grid for this performance tracking dimension is shown in Table 1 for an example set of questions. The full list of questions for the grid are in the Appendix and given in more detail in Bloom and Van Reenen (2006).

The other side of the double-blind technique is that interviewers are not told in advance anything about the firm's performance. They are only provided with the company name, telephone number and industry. Since we randomly sample medium-sized manufacturing firms (employing between 50 to 5,000 workers) who are not usually reported in the business press, the interviewers generally

[10] These practices are similar to those emphasized in earlier work on management practices, by for example Ichinowski, Prennushi and Shaw (1997) and Black and Lynch (2001).

have not heard of these firms before, so should have no preconceptions. By contrast, it would be hard to do this if an interviewer knew they were talking to an employee of Microsoft, General Electric or Boeing. Focusing on firms over a size threshold is important as the formal management practices we consider will not be so important for smaller firms. We did not focus on smaller firms where more formal management practices may not be necessary. Since we only interviewed one or two plant managers in a firm, we wold only have an inaccurate picture of very large firms.

The survey was targeted at plant managers, who are senior enough to have an overview of management practices but not so senior as to be detached from day-to-day operations. We also collected a series of "noise controls" on the interview process itself – such as the time of day, day of the week, characteristics of the interviewee and the identity of the interviewer. Including these in our regression analysis typically helps to improve our estimation precision by stripping out some of the measurement error.

To ensure high sample response rates and skilled interviewers we hired MBA students to run interviews because they generally had some business experience and training. We also obtained Government endorsements for the surveys in each country covered. Most importantly we positioned it as a "piece of work on Lean manufacturing", never using the word "survey" or "research". We also never ask interviewees for financial data obtaining this from independent sources on company accounts. Finally, the interviewers were encouraged to be persistent – so they ran about two interviews a day lasting 45 minutes each on average, with the rest of the time spent repeatedly contacting managers to schedule interviews. These steps helped to yield a 44% response rate which was uncorrelated with the (independently collected) performance measures.

III.2 Survey Waves

We have administered the survey in several waves since 2004. There were three large waves in 2004, 2006 and 2009, but we also collected some data for a smaller number of firms/countries in the years in between. In summer 2004 wave we surveyed four countries (France, Germany, the UK and the US). In summer 2006 we expanded this to twelve countries (including Brazil, China, India and Japan) continuing random sampling, but also re-contacting all of the 2004 firms to establish a panel. In winter 2009/10 we re-contacted all the firms surveyed in 2006, but did not do a

refreshment sample (due to budgetary constraints). The final sample includes 20 countries and a short panel of up to three years for some firms.

In the full dataset we have 8,117 firms and 10,161 interviews where we have usable management information. We have smaller samples depending on the type of analysis undertaken – many firms do not have accounting data for example as this depends on disclosure rules.

III.3 Internal Validation

Before presenting the results of the management scores it is worth discussing a survey validation step we undertook to validate our management data. We re-surveyed 5% of the sample using a second interviewer to independently survey a second plant manager in the same firm. The idea is the two independent management interviews on different plants within the same firms reveal where how consistently we are measuring management practices. We found that in the sample of 222 re-rater interviews the correlation between our independently run first and second interview scores was 0.51 (p-value 0.001). Part of this difference across plants within the same firms is likely to be real internal variations in management practices, with the rest presumably reflecting survey measurement error. The highly significant correlation across the two interviews suggests that while our management score is clearly noisy, it is picking up significant management differences across firms.

III.4 Panel Data: Managerial Innovation

In the 2006 survey wave we followed up all of the firms surveyed in 2004 and in the 2009 survey wave we followed up all of the firms surveyed in 2006. Because we sampled a much wider number of countries in 2006 the 2006-2009 panel (1600 firms) is much larger than the 2004-2006 panel (396 firms). These are balanced panels, but are not random as better managed firms were significantly less likely to exit. We were concerned that response to the survey may not be random with respect to management. The fact that productivity and profitability were uncorrelated with response probability in the cross section was reassuring (see Appendix and Bloom and Van Reenen, 2007). But even better is the fact that the 2009 response rate (of firms that had survived since 2004) was uncorrelated with the 2006 management score (see Data Appendix).

Table 2 shows the transition matrices for management quality where we divide the firms into quintiles of the management scores. Panel A does this for the 2004-2006 sample where we only have four countries (France, Germany, the UK and the US). It is clear that there is persistence in management quality. 44% of firms who were in the top 20% of the management score in 2004 stayed in this top quintile in 2006. Similarly 43% of the worst managed quintile of firms in 2004 were also in the same quintile in 2006. Panel B replicates this analysis for the same four countries and shows a very similar picture: 43% of the top quintile remained were they were as did 47% of the bottom quintile. In the middle quintiles there was substantial churn in all years. Panel C of Table 2 replicates this analysis for all the countries we surveyed in 2006. The picture is very similar, although there is greater persistence in this larger sample – now 52% of the worst managed firms stay in the same quintile.

This persistence is comparable with the persistence performance differentials when looking at TFP. For example, Panel D reproduces the Bailey et al (1993) analysis of TFP dynamics. Despite the different years, time frame and measure, the degree of persistence looks broadly comparable.

On the other hand, Table 2 does show that there is substantial movement over years even at extremes of the management distribution. For example, 54% of firms in the top quintile of management in 2006 fell out of this quintile after three years. This certainly does not fit the picture of the model in Hoppenhayn (1992) or Melitz (2003) were firms take an initial productivity draw and do not change this until they exit. It looks much more like firms are changing their management practices. Of course, there is likely to be a role for measurement error here, but when we look at the correlation of changes of management with changes in productivity, we continue to find a significant positive correlation, which suggests that there is some information in the change of the management scores.

IV. MANAGEMENT PRACTICES OVER FIRMS AND COUNTRIES: SOME STYLIZED FACTS

In this section we describe some of the patterns, or "stylized facts" in the management data both across firms and across countries.

IV.1 Cross Country patterns

The bar chart in Figure 1 plots the average (unweighted) management practice score across countries. This shows that the US has the highest management practice scores on average, with the Germans, Japanese, Swedes and Canadians below, followed by a block of mid-European countries (e.g. France, Italy, Ireland, UK and Poland), with Southern Europe (Portugal and Greece) and developing countries (Brazil, China and India) at the bottom. In one sense this cross-country ranking is not surprising since it approximates the cross-country productivity ranking. But the correlation is far from perfect – Southern European countries do a lot worse than expected and other nations – like Poland – do better.

A key question is whether management practices are uniformly better in some countries like the US compared to India, or if differences in the shape of the distribution drive the averages? Figure 2 plots the firm-level histogram of management practices (solid bars) by country, and shows that management practices display tremendous within country variation. Of the total firm-level variation in management only 11.7% is explained by country of location, with the remaining 88.3% within country heterogeneity. Interestingly, countires like Brazil, China and India have a far larger left tail of badly run firms than the US (e.g. scores of 2 or less). This immediately suggests that one reason for the better average performance in the US is that the American economy is more ruthless at selecting out the badly managed firms. Hsieh and Klenow (2009) find that the TFP distribution is much less dispersed in the US than in China and India. They attribute this partially to larger distortions in the developing countries generating greater heterogeneity in the effective cost of capital. But their Figure 1 shows that there is a thinner tail of less productive plants in the US even in the underlying "true" productivity distribution (TFPQ) which is consistent with our Figure 2. We will investigate the role of product market competition directly in the next section.

IV.2 Contingency and Specialization

Figure 3 plots the relative management styles by country as the difference between management scores for monitoring and target setting and incentives. Positive values indicate countries that are relatively better at monitoring and target setting (sometimes called operations management) and negative scores indicate countries that are better at incentives management (hiring, firing, pay and promotions). It is clear that the US, India, China and Ireland have the biggest *relative* advantage in

incentive management, and Japan, Sweden, Italy and Germany the biggest *relative* advantage in monitoring and target setting management. There could be many reasons for this pattern of specialization across countries, but an obvious candidate is labor market regulation. If labor market regulations constrain manager's ability to hire, fire, pay and promote employees it will tend to reduce the scores of the incentives questions. To investigate this Figure 4 plots each country's average management scores on hiring, firing, pay and promotion practices against the standard World Bank employment rigidity index (Botero et al, 2004).[11] It is clear that tougher labor markets regulation is significantly negatively correlated with the management score across these types of practices (where a high score indicates these activities are linked to effort and ability). In contrast labor market regulations are not significantly correlated with management practices in other dimensions like monitoring, where they should not impose a direct constraint.[12] We return to other ways that employment protection can affect reallocation later.

Patterns of specialization in different styles of management are also observable at the firm level. The answers to the individual questions tend to be positively correlated - a firm which is good at one dimension of management will tend to be good at all. However, Bloom and Van Reenen (2007) show that there is a discernible second factor that loads positively on incentives/people management and negatively on the performance management questions. The relative specialization in incentives tends to be stronger for firms and industries that are more human capital intensive.

V. IMPLICATIONS OF MANAGEMENT AS A TECHNOLOGY

V.1 Management and Firm Performance

Basic Results

The most obvious implication of seeing management as a technology is that it should raise firm performance. Table 3 examines the correlation between different measures of firm performance and productivity. To measure firm performance we used company accounts data and found that for our sample of manufacturing firms that higher management scores are robustly associated with better

[11] This measures the difficult of hiring workers, firing workers and changing their hours and pay.

[12] The cross-country correlation of labor market regulations and pay, promotions, hiring and firing management practices is -0.630 (p-value 0.069). In contrast the correlation of labor market regulations and monitoring management is -0.179 (p-value 0.429).

performance.[13] In column (1) we regress ln(sales) against ln(employment) and the management score (we z-scored each individual practice and averaged across all 18 questions), finding a highly significant coefficient of 0.355. This suggests that firms with one standard deviation of the management score is associated with 35.5 log points higher labor productivity (i.e. about 43%). In column (2) we add controls for country, industry, capital, average hours per worker, percentage with college degree and noise controls. These additional controls cause the coefficient on management to drop to 0.158 and it remains highly significant. Column (3) includes a full set of firm fixed effects, a very tough test given the likelihood of attenuation bias. The coefficient on management does fall substantially, but remains positive and significant at conventional levels[14].

As discussed in Section II one of the most basic predictions is that better managed firms should be larger than poorly managed firms. Indeed, in some models (e.g. Hsieh and Klenow, 2007) measured TFP ("TFPR") should be unrelated to management quality ("TFPQ") as more productive firms charge lower prices and are therefore larger because of higher demand. More generally, however, better managed firms should both be larger and have higher measured productivity (e.g. Foster, Haltiwanger and Syverson, 2008; Bartelsman, Haltiwanger and Syverson, 2012). Column (4) shows that better managed firms are significantly larger than poorly managed firms with a one standard deviation of management associated with 28.7 log point increase in size.[15] In the next section we will show that this bivariate correlations is robust to other controls, but also shows a distinct pattern across countries, being stronger in the US than elsewhere.

In column (4) of Table 2 we use profitability as measured by "Return on Capital Employed" as the dependent variable, and find that this is almost two percentage points higher for every one point increase in the management score. In column (5) we look at sales growth and show that a one-point increase in management is associated with about a 6.8% increase in growth. Finally, column (7) uses whether the firm had exited to bankruptcy as an outcome – an extreme measure of

[13] Our sampling frame contained 90% private firms and 10% publicly listed firms. In most countries around the world both public and private firms publish basic accounts. In the US, Canada and India, however, private firms do not publish (sufficiently detailed) accounts so no performance data is available. Hence, these performance regressions use data for all firms except privately held ones in the US, Canada and India.

[14] Note that these correlations are not simply driven by the "Anglo-Saxon" countries, as one might suspect if the measures were culturally biased. The relationship between productivity and management is strong across all regions.

[15] If we used the manager's declared firm employment the coefficient is almost identical: 0.284 with a standard error of 0.023.

performance. Better managed firms were significantly less likely to die. Since the mean of exit to bankruptcy is only 2.2%, the point estimate suggests a quantitatively substantial effect.[16]

Causality effects of management on performance

These correlations are interesting, but are they remotely causal? The work on randomized control trials in Indian textile firms suggests that the relationships between performance and management are causal. Bloom, Eifert, Mahajan, McKenzie and Roberts (2011) introduce intensive management consultancy to treatment plants and compare these to control plants who receive a light consultancy treatment (just sufficient to obtain data). The management consultancy was geared at the type of practices surveyed here, especially the monitoring and targets questions. They find significant increases in productivity as a result of these interventions. The intervention raised TFP by 10% for a one standard deviation increase in the management score, somewhere between columns (2) and (3). Even more pertinently to the management as a technology model, they find significant effects on profitability as the interventions would have repaid themselves (at full market rates) in less than a year.

The association of management practices with performance is also clear in other sectors outside manufacturing. In Bloom, Propper, Seiler and Van Reenen (2010) we interviewed 181 managers and physicians in the orthopedic and cardiology departments of English acute care hospitals. We also found that management scores were significantly associated with better performance as indicated by improved survival rates from emergency heart attack admissions and other forms of surgery, lower in-hospital infection rates and shorter waiting lists. In Bloom, Sadun and Van Reenen (2012) we show similar strong correlations in a larger sample of hospitals across seven countries. We also found that pupil performance (as measured by test score value added for example) was significantly higher in better managed schools.

Heterogeneity of the effects of management on performance

[16] Is it the case that higher management scores are associated with worse outcomes for workers and for the environment? In the 2004 survey wave we also collected information on aspects of work-life balance such as child-care facilities, job flexibility and self-assessed employee satisfaction. Well managed firms actually tended to have better facilities for workers along these dimensions (Bloom, Kretschmer and Van Reenen, 2011). Similarly, in terms of the environment we find that better firm-level management is also strongly associated with energy efficiency because of their use of Lean Manufacturing techniques that economizes on energy use (Bloom, Genakos, Martin and Sadun, 2010).

The positive and causal relationship between management and productivity (although not profitability) would also have been predicted by the theory of management as a productive factor (although not the design or fad theories). But under this perspective we would expect substantive differences in the coefficient on management between different industries, just as we would expect the output elasticity with respect to labor or capital to be different across sectors. To probe this further we ran regressions of the form:

$$\ln Q_{it} = \alpha_{jM} M_{it} + \alpha_{jL} \ln L_{ijt} + \alpha_{jK} \ln K_{it} + \alpha_X x_{ijt} + u_{ijt} \tag{1}$$

Where Q = output (as proxied by real sales), L = labor, K = capital, M = management, x is a vector of other controls, u is an error term. A strong view of the management as a technology model is that $\alpha_{jM} = \alpha_M$, i.e. we cannot reject that the management effect is the same across sectors whereas the view that management is just another productive factor would imply $\alpha_{jM} \neq \alpha_M$, just as $\alpha_{jL} \neq \alpha_L$ and $\alpha_{jK} \neq \alpha_K$.

Table B1 contains the result. Column (1) is the same specification as column (3) of Table 2 except we use two digit industry dummies instead of three digit. The results are robust to using SIC3, but we were concerned that the number of observations in some cells would be small reducing the power of the tests of joint significance of the interactions. Column (2) then allows labor, capital and management to have difference coefficients across each industry. The tests in the rows at the base of the column show that we reject the hypothesis that the coefficients on labor and capital are the same across industries (at the 1% and 10% significance level respectively). By contrast we cannot reject this hypothesis for management – it appears stable across sectors (p-value of joint significance of interactions is 0.69).

Of course, the factor inputs are likely to be endogenous. One way to tackle this is to calculate TFP as Solow residual using the factor shares of labor and capital as weights (we do this separately for each two digit sector). This brings the conventional factor inputs to the left hand side of the regression. We do this in column (3) and show first that management is significantly correlated with TFP. In column (4) we repeat the test of interacting management with a full set of country dummies and again cannot reject the hypothesis that that they are equal (p-value=0.78). We repeat the specifications using firm fixed effects in the final two columns. Again, we reject the hypothesis that

the labor and capital coefficients are stable across industries (at the 1% level), but cannot reject this hypothesis for management (p-value=0.20).

Taking the non-experimental evidence from Tables 3 and B1 together with the experimental evidence leads us to conclude that the performance-management relationship offers some support for the management as a technology model.

V.2 Reallocation effects

Basic Correlations between firm activity and management scores

If management is a technology, then more economic activity is likely (on average) to be allocated to these firms. If management is purely a matter of design or a productive factor it is not obvious why they should be successful in acquiring more market share. If product market competition is imperfect, low productivity firms will be able to survive. This is consistent with Figure 3 indicating that the US, which generally has very competitive product markets, does not have much of a tail of badly managed firms as other countries. We also found in Table 2 that poorly managed firms are more likely to exit, which is consistent with the importance of selection.

We investigate this in a regression framework by considering the equation:

$$Y_{it} = \gamma(M_{it} * RL)_{it} + \delta_1 M_{it} + \delta_2 RL_{it} + \delta_3 x_{ijt} + v_{ijt} \qquad (2)$$

Where Y is firm size and RL is a measure of the degree of "pressure for reallocation" in firm i's environment. The model of management as a technology implies that the covariance between firm size and management should be stronger when reallocation forces are stronger, so $\gamma > 0$. How can we test this? The simplest method is to use a set of country dummies to proxy reallocation as we know that it is much more likely that reallocation will be stronger in some countries (like the US) than others (like Greece). Firm employment is a good quantitative indicator of the level of economic activity and Figure 1 showed that better managed firms tend to be larger, so we begin with employment (L) to proxy Y in equation (2).

Table 5 extends this analysis to examine how the size-management relationship varies across countries. Column (1) reports the results of a regression of firm employment on the average management score and a set of industry, year and country dummies[17]. The results indicate that firms with one unit (a standard deviation) higher management practices tend to have an extra 179 workers. Column (2) includes a number of additional controls for firm skills, age and survey noise which increases the coefficient on management slightly to 194. In column (3) we allow the management coefficient to vary with country with the US as the omitted base. The significance of the coefficient on linear management indicates that there is a very strong relationship between size and management in the US compared to other countries, with an extra point on the management index being associated with 353 extra workers. With only one exception (out of twenty countries)[18], every other country interaction with management has a negative coefficient indicating that reallocation is weaker than in the US. For example, a standard deviation improvement in management is associated with only 246 (=353-107) extra workers in the UK, 65 extra workers in Italy and essentially zero extra workers in Greece.

We move from long-run static equilibrium in Table 5 to dynamic selection to Table 6. Here, we replace employment in equation (2) with the annual sales growth rate of firms on their lagged management scores. The sample is smaller here because sales are not included for all firms in the accounting databases (some firms do not require reporting of sales for smaller firms). Column (1) shows that firms with higher management scores tend to grow faster, as we would expect. A one point higher management score is associated with about a 2% higher annual growth rate. As with the previous table, Column (2) allows the management coefficient to vary by country with the US as the omitted base. Every interaction is negative, indicating that the relationship between management and reallocation is stronger for the US than for any other country. This pattern persists in column (3) where we include firm age and noise controls[19]. Column (4) re-runs the specification

[17] This is the measure of firm size reported by the plant manager which for a multinational is ambiguous. The global size is not necessarily closely related to the management practices of the plant we survey. Consequently, this table drops domestic and foreign multinationals and their subsidiaries.

[18] The Chinese interaction is positive which is surprising, but it is insignificant. We suspect this may be related to the unusual size distribution and sampling in China and we are still working out why this is the case.

[19] We also investigated the survival equation of the final column of Table 2. The coefficient on the US interaction was 0.001, suggesting that death rates were 20% more likely for a badly managed firm in the US compared to a badly managed firm in another country. Although this corroborates the patterns found in the sales growth and size equations, the interaction was insignificant. This is probably because of the low mean exit rate in the data.

of column (3) on the sub-sample where we drop all multinationals, as in Table 4. Again, the results are robust to this.

The results in Tables 4 and 5 suggest that reallocation is stronger in the US than for the other countries which are consistent with the findings on productivity in Bartelsman, Haltiwanger and Scarpetta (2012) and Hsieh and Klenow (2009). This could explain why there is such a thin tail of very badly managed firms in the US. It is also consistent with the model of management as a technology.

Policy variables explaining reallocation

There are a large number of possible policy-relevant variables that could account for the greater degree of reallocation in the US than in other nations. We investigated a large number of the country-level policy variables that have been developed by the OECD, World Bank and other organizations. Two groups of variables consistently stood out as being important in accounting for reallocation: labor and (trade-related) product market regulations. We illustrate these in Table 6. We re-estimate equation (2) using employment as in Table 5. However, instead of country dummies include the quantitative policy indicator. In column (1) we use the OECD's average Employment Protection Law (EPL) index averaged over 1985-2008 ("EPL1"). 2008 was the last year of data collected by the OECD and 1985 the first. The interaction between EPL and management is significantly negative, indicating that a country with higher EPL has significantly less reallocation towards better managed firms. For example, the model predicts that a one standard deviation increase in management increases employment by 314 workers in the US (EPL1 = 0.2) but by only 128 in Brazil (EPL1=2.75).

Column (2) of Table 6 uses a more recent average, 1998-2008, of the EPL and column (3) uses just 2008. The interaction remains negative and significant as in column (1). Column (4) uses an alternative definition of EPL from the World Bank (as in Figure 4). Again, there is a negative and significant coefficient. It is smaller in absolute magnitude only because the World Bank Index runs from 1 to 100 whereas the OECD's is from 0 to 6. Column (5) switches to looking at a measure of product market competition, the cost of exporting to other countries (again from the OECD in US$). This generally reflects the cost of export licenses, taxes, etc. The negative and significant

coefficient indicates that countries that are effectively more isolated have much less reallocation than those that are more integrated with the world economy.

Other policy measures generally took their expected signs, but it was these labor and trade restrictions which were robustly significant.[20] Horse races between trade and EPL variables suggested that trade restrictions were more important. A problem with these regressions, of course, is that we are relying on cross-country variation and we have, at best, only 20 countries (and therefore 20 values of the policy variables). There could be many other correlates with these country-level policy variables we cannot control for. Hence, in Table 7 we use a measure of tariffs – a trade measure that varies at the industry by country level (see Feenstra and Romalis, 2012). We express this variable in deviations from the industry and country average in the regressions to take out global industry and country-specific effects.

Column (1) of Table 7 first presents a regression where we use management as the dependent variable. As we might expect higher tariffs are associated with poorer management practices. Column (2) returns to the reallocation analysis. We regress firm employment on a linear tariff and management variable. Unsurprisingly higher tariffs are associated with smaller firms. Column (3) includes the management*tariff interaction. Consistent with our earlier interpretation, higher tariffs depress reallocation, even after removing country and industry effects.

To give some quantitative guide to this effect, the results in column (3) imply that a one standard deviation increase in the management score is associated with 98 extra employees if a country has no tariff barriers. If this country increased tariff barriers to 4 percentage points (roughly the difference in tariff levels between the US and Greece), the increase in employment would fall by a third (=8.13*4/98).

Olley-Pakes Decomposition of share weighted Management Scores

[20] We examined credit restrictions, start-up costs, contract enforceability, product substitutability (e.g. Syverson, 2004), etc. Full results available on request.

Define an "aggregate management index" following Bartelsman, Haltiwanger and Scarpetta, 2012, and Olley and Pakes (1996) as:

$$\begin{aligned} M &= \sum_i M_i Y_i = \sum_i [(M_i - \bar{M}_i)(Y_i - \bar{Y}_i)] + \bar{M} \\ &= OP + \bar{M} \end{aligned} \tag{3}$$

Where, as before, M_i is the management score for firm *i* and Y_i is a size measure like employment size. $\bar{M}$ is the unweighted average management score across firms and OP indicates the "Olley Pakes" covariance term, $\sum_i [(M_i - \bar{M}_i)(Y_i - \bar{Y}_i)]$. This expression simply divides management into a within and between/reallocation term. Comparing any two countries *j* and *j'*, the difference in weighted scores is decomposed into the difference in reallocation and unweighted management scores:

$$M^j - M^{j'} = (OP^j - OP^{j'}) + (\bar{M}^j - \bar{M}^{j'}) \tag{4}$$

A deficit in aggregate management is composed of a difference in average (unweighted) firm management scores (as analyzed in e.g. Bloom and Van Reenen, 2007) and the reallocation effect $(OP^j - OP^{j'})$ as focused on in Hsieh and Klenow (2009), for example. Note that one could replace Management, MP, by TFP or labor productivity for a more conventional analysis.

Table 8 and Figures 5-7 contains the results of this analysis and more details are in Appendix B. In column (1) of Table 8 we present the employment share-weighted management scores (*M*) in z-scores, so all differences can be read in standard deviations. This is illustrated in Figure 5 which has a broadly similar ranking to Figure 1 even though the methodology is different in many respects.[21] In column (2) we show the Olley Pakes reallocation term (*OP*) and in column (3) the unweighted management score ($\bar{M}_i$). From this we can see that, for example, the leading country of the US has

[21] Apart from Figure 1 being unweighted and Figure 5 weighted the sampling is on data from only the 2006 wave and includes only domestic firms (we discuss what happens when including multinationals later) where we have reliable employment data. Another difference is that we correct for non-random sampling responses rates through a propensity score method to re-weight the data. We run a country specific response rate regression on the sampling frame where the controls are firm employment, listing status, age and one digit firm employment. We then construct weights based on the inverse sampling probability.

a score of 0.67 which is split almost half and half between a reallocation effect (0.36) and a within firm effect (0.31). The US not only has the highest unweighted management score (see Bloom et al, 2012), but it also has the highest degree of reallocation (see Figure 2). Germany and Japan also have a high degree of reallocation (0.28). By contrast, Southern European countries have little reallocation and Greece stands out uniquely as having no positive reallocation at all. Interestingly, these results are consistent with Bartelsman et al, 2012, who conducted a similar analysis for productivity on larger samples of cross country data. Although the countries we examine do not perfectly overlap the ranking in Bartelsman et al, 2012, also has the US at the top with Germany second and the France. This is identical to our ranking.[22]

Perhaps a more revealing way to illustrate these results is to calculate each country's management gap with the US as in equation (4). Column (4) of Table 8 does this for the overall gap and column (5) for the reallocation component and this is illustrated in Figure 7. Reallocation accounts for between 22% and 58% of the management gap with the US, with an average of just over 30%. To it another way, the weighted average difference between the US and Greece's management is 1.65 (= 0.67 + 0.98) standard deviations and 30% or 0.49 standard deviation (= 0.26+0.07) of this difference is due to worse relocation in Greece than the US. Pushing this further, if we assume that a one standard deviation increase in management causes a 10% increase in TFP, then improving Greece's weighted average management score to that of the US would increase Greek TFP by 16.5%, a third of the total TFP gap between Greece and the US (Jones and Romer, 2010, Table 5, http://www.stanford.edu/~chadj/tfpdata2000.txt). Improving reallocation by itself would bridge over 11% of the US-Greece TFP gap. Similar calculations for the other countries imply that management account for between only 6% of the US TFP gap with Japan up to 48% of the US-Portugal TFP gap (with an average of just under 30%).

More generally, the comparison between unweighted means as in Figure 1 appears to underestimate the American advantage of better reallocation.

[22] Britain does somewhat better in our analysis, being above France, but our data is more recent (2006 compared to 1992-2001) and Bartelsman et al (2012) note that Britain's reallocation position improved in the 2000s (see their footnote 9).

In Appendix B we consider a wide variety of robustness tests of this basic finding allowing for alternative sampling re-weighting schemes, using other inputs like capital as well as labor, including multinationals and also controlling for the fact that we do not run our survey on very small and very large firms. Although the exact quantitative findings change, the main results are robust to all these extensions.

The Great Recession as a quasi-experiment

The reallocation evidence so far focuses on the equilibrium management-size relationship. But we have noted that in a dynamic context, we would expect better managed firms to grow faster and poorly managed firms to shrink and exit. The evidence in Tables 3 and 6 broadly support this notion with better managed firms more likely to survive and also to have faster sales growth, especially in the US compared to other countries.

The recent experience of the Great Recession offers a natural experiment of this hypothesis. Many firms faced a large negative shock after the credit crunch and collapse of Lehman's in 2008. The magnitude of this shock is unrelated to firm choices and was dramatic and unexpected. Our model predicts that the worse managed firms will be much more likely to shrink and exit after such a shock than the better managed firms.

To examine this idea we run regressions of the form:

$$\Delta \ln Q_{ijkt} = \beta_1 (SHOCK_{jkt} * M_{ijkt-1}) + \beta_2 (SHOCK_{jkt}) + \beta_3 M_{ijkt-1} + \beta_4 x_{ijkt} + \varepsilon_{ijkt} \qquad (5)$$

Where *SHOCK* is an indicator of the negative shock which we define in an industry country cell: we would expect to be associated with a fall in sales all else equal. Our key reallocation hypothesis is that $\beta_1 > 0$, i.e. firms with better management (in the pre-crisis period) will not shrink as fast as poorly managed firms. The control variables, *x*, include industry dummies and country dummies. We also consider survival as an outcome.

We build several measures of the *SHOCK*. First, we aggregate all information on exports in the UN COMTRADE database in the three digit industry by country cell. Trade fell more than GDP during the crisis and are more likely to be determined by factors exogenous to the firm's behavior. We then calculate the change in (real) exports between the average of 2006 and 2007 ("pre crisis") to the

average of 2008 and 2009 ("crisis"). *SHOCK* is defined as all cells which had a negative fall in this industry trade measure. Second, we calculated aggregate sales at the same country by three digit industry level (from ORBIS) and deducted the firm's own sale to avoid the most obvious form of feedback. *SHOCK (ORBIS)* is defined as all cells which had a negative fall in this industry sales measure. Our third measure uses the NBER value added data defined solely from the US.

Table 9 presents the results. The findings are consistent with the idea that reallocation forces are stronger in the recession. Column (1) confirms, unsurprisingly that firms in industry by country pairs that experienced a greater shock were more likely to shrink. Column (2) is of more interest as it shows that firms who were better managed in the pre-shock period (2006) were significantly less likely to shrink in the face of a negative demand shock than those who were poorly managed. This result is robust whether we define the shock in terms of sales specific to the industry*country pair in column (4). In columns (5) and (6) we use value added in the US industry and the interaction is again positive. These results are all conditional on survival. If we repeat this specification but use survival as the dependent variable the interaction with the industry shock is also positive and weakly significant.[23]

Overall then, the experience of the Great Recession confirms the notion that reallocation is strong in sectors which experienced a large and arguably more exogenous demand shock.

Summary on Reallocation

The MAT model implies that better managed firm should enjoy higher market shares and this should be stronger in environments where selection/reallocation is expected to be stronger. We find evidence to support this proposition in Tables 4-9. First, better managed firms are larger (and grow more swiftly) and this effect is stronger in the US than elsewhere. The greater reallocation in the US accounts for on average about 30% of the overall higher US management advantage over other nations. Second, this appears to be related to more competitive labor and product markets. Third, after the shock of the Great Recession, worse managed firms were more likely to shrink and exit.

[23] In a specification analogous to column (2) the marginal effect of the interaction in a probit is -0.234 with a standard error of 0.138.

V.3 Competition

A third implication of the management technology model is that tougher competition is likely to improve average management scores. One route for competition to improve management practices may be through selection, with badly run firms exiting more speedily in competitive markets. This clearly occurs as better managed firms survive longer (see Table 3). Another route may be through incentives to improve practices, which could be sharper when competition "raises the stakes" (either because efficiency improvements have a larger impact on shifting market share or because managers are more fearful of losing their jobs[24]).

Table 10 presents the management practice score regressed on three competition measures. We use the four countries that we have the most extensive panel data (France, Germany, the UK and the US). Since we do not yet have industry data for 2009/10 we pool data from the 2006 and 2004 waves in order to look at changes over time. The first four columns use the inverse industry Lerner index as a measure of competition (as in Aghion, Bloom, Blundell, Griffith and Howitt, 2005). This is calculated as the median price cost margin using all firms in the accounting population database (except the firm itself). We lag this variable by two years to reduce feedback effects. We include a full set of industry dummies and country dummies as well as the general and noise controls. Column (1) simply reports the pooled OLS results. Higher competition as proxied by the inverse of the Lerner index is associated with significantly higher average management scores. Column (2) includes industry by country fixed effects so that the competition effect is only identified from changes over time in the degree of competition within an industry by country cell. The coefficient on the inverse Lerner actually increases in the within dimension, suggesting industries that grew more competitive also significantly increased their management scores. Column (3) conditions on the balanced panel of the 429 firms who we have full data on in both 2004 and 2006 and runs the same specification as column (1), producing again a positive and significant correlation with a similar coefficient, implying that there is little bias associated with the firms in the balanced sub-sample. Column (4) estimates the regression in differences for this subsample and produces a

[24] Theoretically competition has ambiguous effects on incentives of course. Tougher competition means lower profit margins and therefore less of an upside for improving efficiency as Schumpeter emphasised.

similar coefficient to column (2). This indicates that the "effect" of competition on management appears to be primarily through incumbent firms becoming more productive and not simply entry and exit.

The next four columns of Table 10 repeat the same specifications, but use (lagged) trade openness as a competition measure defined as the (natural logarithm of) imports divided by home production in the plant's industry by country cell. Imports are also positively associated with improved management practices across all specifications, with the marginal effects for the specifications that include industry by country fixed effects (column (5)) or firm effects (column (9)) having the larger coefficients. The final four columns use the plant manager's stated number of rivals as the competition measure. Significant positive effects are evident in all columns with and without fixed effects.

The conclusion from the analysis in Table 10 is that competition is having an effect through changing incumbent firm's behavior and not simply through a reallocation effect.

V.4 Information

Having some market imperfection is a necessary condition for persistent performance differences. But what could account for heterogeneity in management? These do not seem to be purely permanent differences as firms change their management practices over time: this was clear from Table 2 and the evidence from experimental interventions.

Poor incentives arising from lack of competition or none value maximizing owners (e.g. family or governments) could be reasons for the failure of firms to adopt best practice. But aside from motivation, information could be another reason for the heterogeneity. Part of the problem may simply be that managers do not realize how bad they actually are (or they may know this, but not know what to do about it). Some indication on this is available from our survey since at the end of our survey 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*". The distribution of answers to this question is in Figure 9. Unsurprisingly the vast majority of managers believe their

firms to be better managed than average (this managerial overconfidence is shared in many areas such as driving ability). There is no significant correlation of perceptions with performance, though.

Table 11 examines whether competition influences managerial self-perception. We begin by repeating the analysis of Table 10 regressing our measures of management on competition. Because this is available from the survey we have it for all years and can use the full sample of data. Column (1) includes all observations, column (2) conditions on those firms where we have at least two time series observations (in order to be comparable with the later specifications that include fixed effects). Column (3) includes fixed effects and column (4) includes fixed effects and the full set of controls from columns (1) and (2). Throughout all the specifications there is a strong and significant association between better management and tougher competition. This is all consistent with the previous Table using a larger sample.

The last four columns repeat the same four specifications but the dependent variable is now the perceptions of managerial quality. The coefficients are the opposite in sign of the first four columns, although the standard errors are also larger. Tougher competition appears to make managers judge themselves more harshly and this could be a reason why it invigorates firms to work harder to improve their practices. They perceive themselves in a worse light than before and this makes them work harder.

VI. CONCLUSIONS

Economists and the public have long believed that management practices are an important element in productivity. We collect original panel data on over 10,000 interviews on over 8,000 firms across 21 countries to provide robust firm-level measures of management in an internationally comparable way.

We contrast different economic theories of management as fashion, productive factors and contingent design. We argue that management has technological aspects, a model that has at least three empirical implications: (i) management should improve firm performance; (ii) better managed firms should have a higher market shares, and this correlation should be systematically greater in

countries like the US where reallocation is stronger; (iii) competition should improve management quality.

The data appears to support these three broad predictions. Management appears to improve firm performance in both experimental and non-experimental data. Reallocation effects are present and stronger in the US as better managed firms are able to obtain a greater size to a greater extent than other countries. But competition also appears to have an effect though changing the behaviour of incumbent firms, possibly via better information. In our panel, industries and firms that experienced an increase in competition were more likely to improve their practices than those who did not. This suggests that the aggregate superiority of US management is due, at least in part, to tougher competition which both acts as a selection device to reallocate output away from badly management firms and an incentive mechanism to improve management quality. We also showed evidence that trade barriers and flexibly labor markets helped foster more allocation.

In future work we are planning to examine many other factors that influence management such as the supply the skills (e.g. through universities and business schools), information and co-ordination. But this work, we hope, opens up a fascinating research agenda on why there appear to be so many very badly managed firms and what factors can help improve aggregate productivity.

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TABLE 1: EXAMPLE OF A MANAGEMENT PRACTICE QUESTION

Management Practice Dimension 4 ("Performance tracking")			
	Score 1	**Score 3**	**Score 5**
Scoring grid	Measures tracked do not indicate directly if overall business objectives are being met. Tracking is an ad-hoc process (certain processes aren't tracked at all).	Most key performance indicators are tracked formally. Tracking is overseen by senior management.	Performance is continuously tracked and communicated, both formally and informally, to all staff using a range of visual management tools.
Example firm	*A manager tracks a range of measures when he does not think that output is sufficient. He last requested these reports about 8 months ago and had them printed for a week until output increased again. Then he stopped and has not requested anything since.*	*At a firm every product is bar-coded and performance indicators are tracked throughout the production process. However, this information is not communicated to workers*	*A firm has screens in view of every line, to display progress to daily target and other performance indicators. The manager meets daily with the shop floor to discuss performance metrics, and monthly to present a larger view of the company goals and direction. He even stamps canteen napkins with performance achievements.*

Note: This in an example of one of the 18 questions used in the Management Survey. Interviewers code any integer between one and 5 depending on the manager's response to the open ended question. For a full list of questions and scoring grid see Appendix A and Bloom and Van Reenen (2007)

TABLE 2: TRANSITION MATRIX FOR MANAGEMENT PRACTICES

PANEL A: 2004-2006, France, Germany, UK and US (396 firms)

	Bottom Quintile in 2006	Second Quintile in 2006	Third Quintile in 2006	Fourth Quintile in 2006	Top Quintile in 2006	Total
Bottom Quintile in 2004	42	20	15	15	8	100
Second Quintile in 2004	23	39	18	16	3	100
Third Quintile in 2004	20	28	11	29	12	100
Fourth Quintile in 2004	9	14	24	21	32	100
Top Quintile in 2004	4	11	16	25	44	100
Total	20	23	17	21	19	100

PANEL B: 2006-2009, France, Germany, UK and US (789 firms)

	Bottom Quintile in 2009	Second Quintile in 2009	Third Quintile in 2009	Fourth Quintile in 2009	Top Quintile in 2009	Total
Bottom Quintile in 2006	47	22	16	13	3	100
Second Quintile in 2006	24	36	16	14	11	100
Third Quintile in 2006	19	24	22	19	17	100
Fourth Quintile in 2006	9	19	20	23	28	100
Top Quintile in 2006	5	8	17	27	43	100
Total	21	22	18	19	20	100

Notes: Panel A (B) is the balanced panel of firms interviewed in 2004 (2006) and 2006 (2009). Firms are ranked by their initial year management z-score and then grouped by quintile. We follow them through to their position in the distribution in the later year.

PANEL C: 2006-2009, All countries (1600 firms)

Quintile in 2009	Bottom	Second	Third	Fourth	Top
Quintile in 2006					
Bottom	52	22	15	9	3
	(61)	(15)	(7)	(6)	(9)
Second	23	25	25	8	10
	(30)	(32)	(16)	(6)	(5)
Third	16	24	26	19	15
	(12)	(22)	(20)	(22)	(15)
Fourth	7	16	26	26	24
	(15)	(19)	(19)	(17)	(19)
Top	6	8	13	28	46
	(14)	(16)	(9)	(16)	(32)

Notes: The top figures in each cell are from the balanced panel of firms who we interviewed in 2006 and 2009. Firms are ranked by their management score in 2006 and then grouped by quintile. We follow them through to their position in the distribution in 2009. The bottom figures in brackets ( ) are the quintiles for plant level total factor productivity from Bailey, Hulten and Campbell (1993) comparing productivity quintiles between 1972 and 1977. These are included to highlight the similarity between the transition matrix for firm-level management scores and plant level total factor productivity.

PANEL D – COMPARISON WITH US PLANT DATA FROM BAILEY, HULTEN AND CAMPBELL (1993)

Quintiles in 1977

Quintiles in 1972: *Plant group*	*1*	*2*	*3*	*4*	*5*	*Switch out*	*Death*	*Row total*
1	60.75 52.89	14.86 18.81	7.08 13.69	5.57 11.34	5.49 8.90	4.01 22.04	2.24 16.67	25.77
2	30.28 18.16	31.85 27.77	15.60 20.77	6.46 9.06	7.61 8.49	5.44 20.56	2.76 14.12	17.75
3	12.30 6.11	21.94 15.83	19.64 21.65	22.12 25.68	15.26 14.11	4.46 13.97	4.27 18.12	14.70
4	14.51 6.21	18.76 11.68	18.53 17.61	17.08 17.09	18.84 15.02	7.32 19.78	4.95 18.08	12.67
5	14.13 9.58	16.47 16.23	9.92 14.93	15.81 25.05	32.44 40.94	5.53 23.65	5.70 33.01	20.06
Switch in	24.97 4.13	24.40 5.87	19.16 7.04	15.65 6.06	15.82 4.87	. . . . . .	. . . . . .	4.90
Birth	20.79 2.92	18.66 3.81	13.82 4.31	17.44 5.73	29.30 7.66	. . . . . .	. . . . . .	4.16
Column total	29.60	20.36	13.33	12.66	15.90	4.69	3.46	100.00

Source: Authors' calculations.

a. The top number in each cell shows where the plants that were in a given quintile in 1972 ended up in 1977. The bottom number in each cell shows where the plants that were in a given quintile in 1977 came from. Top numbers are row percentages; bottom numbers are column percentages.

TABLE 3: PERFORMANCE REGRESSIONS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable	**Ln (Sales)**	**Ln (Sales)**	**Ln (Sales)**	**Ln (Sales)**	**Ln (Employees)**	**Profit-ability (ROCE, %)**	**5 year Sales growth (%)**	**Death (%)**	**Ln (Tobin Q)**
Management	0.355***	0.158***	0.137***	0.030**	0.287***	0.911**	0.049***	-0.007***	0.086***
(z-score)	(0.020)	(0.017)	(0.020)	(0.015)	(0.021)	(0.368)	(0.014)	(0.002)	(0.033)
Ln(Employees)	0.917***	0.658***	0.637***	0.375***					
	(0.019)	(0.026)	(0.031)	(0.112)					
Ln(Capital)		0.293***	0.296***	0.243***					
		(0.021)	(0.027)	(0.090)					
General controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	Yes	No	No	No	No	No
Firms	2,925	2,925	1,340	1,340	2,925	2,925	2,925	7532	683
Observations	7,035	7,035	5,450	5,450	7,035	7,035	7,035	7,532	1,801

***Note*:** All columns estimated by OLS with standard errors are in parentheses under coefficient estimates clustered by firm. *** denotes 1% significant, ** denotes 5% significance and * denotes 10% significance. For sample comparability columns (1) to (7) are run on the same sample of firms with sales, employment, capital, ROCE and 5 years of sales data. Columns (8) and (9) are run on the sample of firms with exit data and which are publicly listed respectively. We condition on a sample with non-missing values on the accounting variables for sales, employment, capital, ROCE and 5-year sales growth data. Column (3) also restricts to firms with two or more surveys and drops the noise controls (which have little time series variation). "**Management"** is the firm's normalized z-score of management (the average of the z-scores across all 18 questions, normalized to then have itself a mean of 0 and standard-deviation of 1). **"Profitability"** is "Return on Capital Employed" (ROCE) and "**5 year Sales growth"** is the 5-year growth of sales defined as the difference of current and 5-year lagged logged sales. All columns include a full set of country, three digit industry and time dummies. "**Death**" is the probability of exit by 2010 (sample mean is 2.4%). "**Tobin's Q**" is the stock-market equity and book value of debt value of the firm normalized by the book value of the firm, available for the publicly listed firms only. "**General controls**" comprise of firm-level controls for average hours worked and the proportion of employees with college degrees (from the survey) , plus a set of survey noise controls which are interviewer dummies, the seniority and tenure of the manager who responded, the day of the week the interview was conducted, the time of the day the interview was conducted, the duration of the interviews and an indicator of the reliability of the information as coded by the interviewer.

TABLE 4: FIRM SIZE AND MANAGEMENT ACROSS COUNTRIES

Dependent Variable:	**Firm Employment**	**Firm Employment**	**Firm Employment**
Management (MNG)	179.2***	194.1***	353.1***
	(30.3)	(38.5)	(101.6)
MNG*US is omitted base			
MNG*Argentina			-273.1**
			(111.5)
MNG*Australia			-259.8*
			(147.9)
MNG*Brazil			-210.1*
			(110.7)
MNG*Canada			-170.3
			(105.6)
MNG*Chile			-167.9
			(113.4)
MNG*China			95.7
			(115.5)
MNG*France			-497.6**
			(225.9)
MNG*Germany			-18.7
			(135.5)
MNG*Greece			-352.1***
			(107.0)
MNG*India			-148.6
			(120.3)
MNG*Ireland			-257.9**
			(108.4)
MNG*Italy			-288.7***
			(108.1)
MNG*Mexico			-243.3*
			(126.6)
MNG*NZ			-376.9*
			(225.5)
MNG*Japan			-301.4**
			(145.2)
MNG*Poland			-305.2***
			(107.7)
MNG*Portugal			-306.1***
			(103.7)
MNG*Sweden			-213.0
			(149.2)
MNG*UK			-107.4
			(192.7)
General Controls	No	Yes	Yes
Observations	5,662	5,662	5,662

Notes: *** significance at the 1%, 5% (**) or 10% (*) level. OLS with standard errors clustered by firm below coefficients. All columns include full set of three digit industry dummies, year dummies, # management questions missing and a full set of country dummies. Firm size taken from survey. Multinationals dropped because of the difficulty of defining size. *MNG* is z-score of the average z-scores of

the 18 management questions. “General” controls include firm age, skills and noise (interviewer dummies, reliability score, the manager’s seniority and tenure and the duration of the interview).

TABLE 5: THE RELATIONSHIP BETWEEN SALES GROWTH AND MANAGEMENT IS STRONGEST IN US FIRMS (US IS OMITTED BASE)

Dependent Variable	Sales Growth	Sales Growth	Sales Growth	Sales Growth
Management (MNG)	0.018***	0.035***	0.031**	0.098***
	(0.006)	(0.011)	(0.012)	(0.036)
MNG*Argentina		-0.092***	-0.093**	-0.143***
		(0.035)	(0.037)	(0.052)
MNG*Australia		-0.076	-0.082	-0.155**
		(0.059)	(0.054)	(0.072)
MNG*Brazil		-0.022	-0.034	-0.108***
		(0.021)	(0.022)	(0.040)
MNG*Canada		-0.033	-0.054	-0.138**
		(0.057)	(0.057)	(0.067)
MNG*Chile		-0.030	-0.049	-0.166
		(0.125)	(0.096)	(0.130)
MNG*China		-0.011	-0.011	-0.067
		(0.033)	(0.034)	(0.047)
MNG*France		-0.055***	-0.059***	-0.099**
		(0.021)	(0.022)	(0.044)
MNG*Germany		-0.004	-0.006	-0.081*
		(0.020)	(0.019)	(0.049)
MNG*Greece		-0.039*	-0.040*	-0.103**
		(0.024)	(0.021)	(0.041)
MNG*India		0.020	0.021	-0.070
		(0.041)	(0.037)	(0.052)
MNG*Ireland		-0.006	-0.040	-0.094
		(0.077)	(0.084)	(0.091)
MNG*Italy		-0.026	-0.055**	-0.100**
		(0.025)	(0.026)	(0.044)
MNG*Mexico		-0.028	-0.033*	-0.082*
		(0.022)	(0.019)	(0.044)
MNG*NZ		-0.012	0.731***	0.745**
		(0.167)	(0.244)	(0.296)
MNG*Japan		-0.032	-0.042*	-0.107**
		(0.021)	(0.023)	(0.042)
MNG*Poland		-0.009	-0.015	-0.064
		(0.022)	(0.023)	(0.042)
MNG*Portugal		-0.048	-0.062*	-0.117**
		(0.032)	(0.034)	(0.047)
MNG*Sweden		-0.025	-0.009	-0.075
		(0.041)	(0.035)	(0.055)
MNG*UK		-0.008	-0.044*	-0.071
		(0.022)	(0.025)	(0.053)

Controls for noise and age	No	No	Yes	yes
Drop multinationals?	No	No	No	Yes
N	3734	3734	3734	2756

Notes: *** indicates significance at the 1%, 5% (**) or 10% (*) level. OLS estimates with standard errors clustered by (up to 2,551) firm in parentheses below coefficients. All columns include a full set of linear country dummies and three digit industry dummies. Sample is all countries in the 2006 survey wave with non-missing sales information from company accounts. Sales growth is logarithmic change between 2007 and 2006. *MNG* is the z-score of the average of the z-scores of the 18 questions in the management grid. Noise controls include a set of interviewer dummies, the reliability score, the manager's seniority and tenure and the duration of the interview.

TABLE 6: FIRM SIZE AND MANAGEMENT ACROSS COUNTRIES – IMPACT OF POLICY VARIABLES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	**Employment**	**Employment**	**Employment**	**Employment**	**Employment**	**Employment**	**Employment**
Management (MNG)	223.18***	315.02***	364.54***	359.66***	344.70***	219.25**	370.62***
	(37.48)	(94.53)	(115.83)	(123.12)	(55.99)	(106.64)	(63.31)
MNG*EPL (World Bank, 2008)	-1.46**						-1.22
	(0.70)						(0.76)
MNG*EPL (OECD, 1985-2008)		-68.79*					
		(38.62)					
MNG*EPL3 (OECD, 1998-2008)			-92.98*				
			(49.41)				
MNG*EPL4 (OECD, 2008)				-85.09*			
				(50.39)			
MNG*trade cost (World Bank, 2008)					-0.17***		-0.17***
					(0.05)		(0.05)
MNG*PMR (OECD, 2008)						-14.92	
						(46.72)	
Observations	5,580	5,504	5,504	5,504	4,916	5,504	4,916

Notes: *** significance at the 1%, 5% (**) or 10% (*) level. OLS with standard errors clustered by firm below coefficients. All columns include full set of three digit industry dummies, year dummies, # management questions missing and a full set of country dummies. Firm size taken from survey. Multinationals dropped because of the difficulty of defining size. *MNG* is z-score of the average z-scores of the 18 management questions. "General" controls include firm age, skills and noise (interviewer dummies, reliability score, the manager's seniority and tenure and the duration of the interview). EPL (WB) is the "Difficulty of Hiring" index is from World Bank (from 1 to 100). OECD EPL are different indicators of Employment Protection Laws on index of 0 (least restrictions) to 6 (most restrictions). "Trade Cost" is World Bank measure of the costs to export in the country (in US$). PMR is OECD index of Product Market regulation from 0 (least restrictions) to 6 (most restrictions).

TABLE 7: FIRM SIZE AND MANAGEMENT – THE IMPACT OF COUNTRY*INDUSTRY SPECIFIC TARIFFS

	(1)	(2)	(3)
Dependent Variable:	**Management**	**Firm Employment**	**Firm Employment**
Tariff Level	-0.008***	-3.371	-5.257
	(0.003)	(4.105)	(4.197)
MNG		156.980***	97.934
		(60.435)	(67.238)
MNG*Tariff			-8.127**
			(3.338)
MNG*country interactions	No	Yes	Yes
General controls	Yes	Yes	Yes
Observations	1,559	1,559	1,559

Notes: *** indicates significance at the 1%, 5% (**) or 10% (*) level. OLS estimates with standard errors clustered by firm in parentheses below coefficients. All columns include a full set of linear country dummies and three digit industry dummies. Sample is all countries in the 2006 survey wave with non-missing data on all variables. *MNG* is z-score of the average z-scores of the 18 management questions. "General" controls include firm age, skills and noise (interviewer dummies, reliability score, the manager's seniority and tenure and the duration of the interview). Tariffs are specific to the industry and country (MFN rates) kindly supplied by John Romalis (see Feenstra and Romalis, 2012).

TABLE 8: DECOMPOSITION OF WEIGHTED AVERAGE MANAGEMENT SCORE

	(1)	(2)	(3)	(4)	(5)	(6)
Country	Share-Weighted Average Management Score (1)=(2)+(3)	Reallocation effect (Olley-Pakes)	Unweighted Average Management Score	"Deficit" in Share-weighted Management Score relative to US	"Deficit" in Reallocation relative to US	% of deficit in management score due to worse reallocation (6)=(5)/(4)
US	0.67	0.36	0.31	0	0	
Japan	0.47	0.28	0.19	-0.2	-0.08	40%
Sweden	0.43	0.22	0.20	-0.24	-0.14	58%
Germany	0.31	0.28	0.03	-0.36	-0.08	22%
GB	-0.07	0.17	-0.24	-0.74	-0.19	26%
Poland	-0.14	0.18	-0.32	-0.81	-0.18	22%
Italy	-0.15	0.07	-0.23	-0.82	-0.29	35%
France	-0.31	0.10	-0.41	-0.98	-0.26	27%
China	-0.51	0.10	-0.61	-1.18	-0.26	22%
Portugal	-0.53	0.09	-0.62	-1.20	-0.27	22%
Greece	-0.98	-0.13	-0.85	-1.65	-0.49	30%
Unweighted av.						30.5%

Notes: Colum (1) is the employment share weighted management score in the country. Management scores have standard deviation 1, so Greece is 1.65 (0.67 + 0.98) standard deviations lower than the US. Column (2) is the Olley-Pakes reallocation term, the sum of all the management-employment share covariance in the country. Column (3) is the raw unweighted average management score. The sum of columns (2) and (3) equal column (1). Columns (4) and (5) deduct the value in column (1) from the US level to show relative country positions. Column (6) calculates the proportion of a country's management deficit with the US that is due to reallocation. All scores are adjusted for nonrandom selection into the management survey through the propensity score method (selection equation uses country-specific coefficients on employment, listing status, age, SIC1). Only domestic firms used in these calculations (i.e. multinationals and their subsidiaries are dropped).

TABLE 9: THE EFFECTS OF THE GREAT RECESSION ON REALLOCATION

Dependent variable: Growth in firm sales	(1)	(2)	(3)	(4)	(5)	(6)
SHOCK (COMTRADE)	-0.051***	-0.052***				
	(0.014)	(0.014)				
Management*SHOCK (COMTRADE)		0.018*				
		(0.010)				
SHOCK (ORBIS)			-0.033**	-0.035**		
			(0.014)	(0.014)		
Management*SHOCK (ORBIS)				0.027**		
				(0.011)		
SHOCK (NBER)					-0.062***	-0.063***
					(0.017)	(0.017)
Management*SHOCK (NBER)						0.011
						(0.013)
Management	0.001	-0.008	0.002	-0.014	0.001	-0.007
	(0.006)	(0.009)	(0.006)	(0.010)	(0.006)	(0.012)
Firms	1,599	1,599	1,567	1,567	1,629	1,629
Observations	1,685	1,685	1,653	1,653	1,716	1,716

Notes: Estimation by OLS with standard errors clustered by firm. The dependent variable is the percentage change in firm sales before and during the Great Recession, defined as mean sales in 2006 and 2007 pooled as pre-crisis and mean sales in 2008 and 2009 pooled as during crisis. All columns include a full set of country and two digit industry dummies; firm controls (log share of employees with a college degree, log employment, share of plant employment, multinational status, listed status, CEO onsite dummy); noise controls (analyst dummies, interview reliability, interview duration, manager tenure in position, manager seniority, years used to compute the change in firm sales, and dummies to flag companies that appear to have changed ownership or sector, or to be out of business in 2010). SHOCK is a dummy variable equal to unity if a negative shock was experienced in the firm three-digit industry and country cell, and zero otherwise. "SHOCK(ORBIS)" is defined using information on aggregate sales growth before and during the Great Recession, excluding the firm itself. SHOCK=1 if the change in sales in the three digit industry and country cell before and during the Great Recession is negative (defined as mean sales in 2006 and 2007 pooled as pre-crisis and mean sales in 2008 and 2009 pooled as during crisis). "SHOCK(COMTRADE)" is defined in an analogous way, but using data on exports to the world at the three digit industry-country level, derived from the COMTRADE dataset. "SHOCK(NBER)" is defined in an analogous way but using value added at the three digit industry level in the US from the NBER dataset. All firm and industry data used to compute the changes are expressed in constant 2005 US dollars. Standard errors are clustered at the three digit by country cell level.

TABLE 10: COMPETITION AND MANAGEMENT

Dependent variable:	(1) Management	(2) Management	(3) Management	(4) Δmanagement	(5) Management	(6) Management	(7) Management	(8) Δmanagement	(9) Management	(10) Management	(11) Management	(12) Δmanagement
(1 – Lerner)	5.035**	17.534***	4.915*									
	(2.146)	(3.846)	(2.747)									
Change in (1-Lerner)				20.677***								
				(6.467)								
Ln(Import Penetration)					0.081*	0.805***	0.095**					
					(0.044)	(0.236)	(0.042)					
Change in ln(Import Penetration)								0.608**				
								(0.230)				
Number of Rivals									0.115***	0.121***	0.141***	
									(0.023)	(0.023)	(0.041)	
Change in number of rivals												0.120**
												(0.052)
Observations	2,819	2,819	858	429	2,657	2,657	810	412	2,789	2,789	864	432
Number of clusters	76	76	64	64	65	65	55	55	2,352	2,352	432	432
Type of Fixed effects	Industry & country	Industry by country	Industry & country	Long Diffs	Industry & country	Industry by country	Industry & country	Long Diffs	Industry & country	Industry by country	Industry & country	Long Diffs
Clustering	Industry* Country	Industry* country	Industry* country	Industry* country	Industry* country	Industry* country	Industry* country	Industry* Country	Firm	Firm	Firm	Firm

Notes: ** indicates significance at 5% level and * at the 10%. OLS estimates with clustered standard errors in parentheses below coefficients. All columns include a full set of linear country dummies. Countries are US, UK, France and Germany. "Number of rivals" is the perceived number of competitors; import penetration is the (lagged) log of the value of all imports normalized divided by domestic production in the plant's two-digit industry by country cell; Lerner is the (lagged) median gross margin across all firms in the plant's two-digit industry by country cell. Columns (1), (2), (5), (6), (9), (10) are on the full cross section of all firms (and include controls for the proportion of employees with a college degree, ln(size) and whether the first is publicly listed). The other columns are restricted to the balanced panel (up to 432 firms in 2004 and 2006). Apart from the differenced specifications all columns include noise controls.

TABLE 11: COMPETITION AND PERCEPTIONS OF MANAGEMENT: COMPETITION IMPROVES MANAGEMENT AND ALSO MAKES MANAGERS TOUGHER ON THEMSELVES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	**Management**	**Management**	**Management**	**Management**	**Self-score Management**	**Self-score Management**	**Self-score Management**	**Self-score Management**
Fixed Effect	**SIC3**	**SIC3**	**Firm**	**Firm**	**SIC3**	**SIC3**	**Firm**	**Firm**
Sample	**All**	**2+ obs per plant**	**2+ obs per plant**	**2+ obs per plant**	**All**	**2+ obs per plant**	**2+ obs per plant**	**2+ obs per plant**
Competition	0.064***	0.082***	0.119**	0.112**	-0.038*	-0.041	-0.046	-0.048
	(0.018)	(0.031)	(0.051)	(0.051)	(0.023)	(0.039)	(0.073)	(0.074)
%college	0.115***	0.109***		0.039	0.040***	0.069***		-0.004
	(0.008)	(0.014)		(0.024)	(0.011)	(0.020)		(0.036)
Ln(emp)	0.175***	0.157***		0.055	0.069***	0.060***		0.016
	(0.009)	(0.017)		(0.036)	(0.012)	(0.022)		(0.051)
Foreign	0.436***	0.308***		0.045	0.113***	0.069		0.058
MNE	(0.024)	(0.041)		(0.144)	(0.030)	(0.055)		(0.244)
Domestic	0.192***	0.111**		-0.031	0.078**	0.076		-0.029
age)	(0.000)	(0.001)		(0.004)	(0.000)	(0.001)		(0.006)
Observations	8,776	3,276	3,349	3,349	7,960	2,934	3,007	3,007

Notes: ** indicates significance at 5% level and * at the 10%. OLS estimates with clustered standard errors by firm in parentheses below coefficients. All columns include a full set of linear country dummies, time dummies, four digit industry dummies, average hours and noise controls.

APPENDIX A: DATA

A1. Firm-level Accounting Databases

Our sampling frame was based on the Bureau van Dijk (BVD) Amadeus dataset for Europe (France, Germany, Greece, Italy, Ireland, Poland, Portugal and the U.K.), on BVD Icarus for the US, on CMIE Firstsource dataset for India, on the BVD Oriana dataset for China and Japan, on BVD Orbis for Argentina, Brazil, Canada, Mexico, on BVD Orbis and Duns & Bradstreet for Australia and New Zealand, and on the Industrial Annual Survey Sample of Firms (Encuesta Nacional Industrial Annual - ENIA) for Chile. These databases all provide sufficient information on companies to conduct a stratified telephone survey (company name, address and a size indicator). These databases also typically have accounting information on employment, sales and capital. Apart from size, we did not insist on having accounting information to form the sampling population, however.

Amadeus, Firstsource, and Orbis are constructed from a range of sources, primarily the National registries of companies (such as Companies House in the UK and the Registry of Companies in India). Icarus is constructed from the Dun & Bradstreet database, which is a private database of over 5 million US trading locations built up from credit records, business telephone directories and direct research. Oriana is constructed from Huaxia credit in China and Teikoku Database in Japan, covering all public and all private firms with one of the following: 150 or more employees, 10 million US$ of sales or 20 million US$ of assets. ENIA, collected by the Chilean Statistic Agency, covers all the manufacturing plants that employ at least 10 individuals.

Census data do not report firm sizes on a consistent basis across which is why we use the BVD and CMIE datasets. We discuss issues of representativeness below in sub-section A2.

A2. The Management Survey

In every country the sampling frame for the management survey was all firms with a manufacturing primary industry code with between 100 and 5,000 employees on average over the most recent three years of data prior to the survey[25]. In Japan and China we used all manufacturing firms with 150 to 5000 employees since Oriana only samples firms with over 150 employees, while in Portugal we supplemented the sample with firms with 75 to 100 employees.[26] We checked the results by conditioning on common size bands (above 150 in all countries).

Interviewers were each given a randomly selected list of firms from the sampling frame. This should therefore be representative of medium sized manufacturing firms. The size of this

[25] In the US only the most recent year of employment is provided. In India employment is not reported for private firms, so for these companies we used forecast employment, predicted from their total assets (which are reported) using the coefficients from regressing ln(employees) on log (assets) for public firms.

[26] Note that the Oriana database does include firms with less than 150 employees if they meet the sales or assets criteria, but we excluded this to avoid using a selected sample.

sampling frame by country is shown in Table A1, together with information on firm size. Looking at Table A1 two points are worth highlighting on the sampling frame. First, the size of the sampling frame appears broadly proportional to the absolute size of each country's manufacturing base, with China, the US and India having the most firms and Sweden, Greece and Portugal the fewest[27]. Second, China has the largest firms on average, presumably reflecting both the higher size cut-off for its sampling frame (150 employees versus 100 employees for other countries) and also the presence of many current and ex state-owned enterprises (11% in the survey are still Government owned). When we condition on the sample of firms with more than 150 employees in all countries, median employment for Chinese firms is still relatively high, but lower than the Argentina, Canada, Mexico, US, UK and Sweden. Third, Greece and India have a much higher share of publicly quoted firms then the other countries, with this presumably reflecting their more limited provision of data on privately held firms. Because of this potential bias across countries will control for firm size and listing status in all the main regressions.

In addition to randomly surveying from the sampling frame described above we also resurveyed the firms we interviewed in the 2004 survey wave used in Bloom and Van Reenen (2007). This was a sample of 732 firms from France, Germany, the UK and the US, with a manufacturing primary industry code and 50 to 10,000 employees (on average between 2000 and 2003). This sample was drawn from the Amadeus dataset for Europe and the Compustat dataset for the U.S. Only companies with accounting data were selected. So, for the UK and France this sampling frame was very similar to the 2006 sampling frame. For Germany it is more heavily skewed towards publicly quoted firms since smaller privately held firms do not report balance sheet information. For the US it comprised only publicly quoted firms. As a result when we present results we always include controls for firm size. As a robustness test we drop the firms that were resurveyed from 2004. These resurveyed firms were randomly distributed among the relevant country interviewers.

In 2009/2010, we also resurveyed the firms we interviewed in the 2004 and 2006 survey. This was a sample of 4145 firms from China, France, Germany, Greece, India, Italy, Japan, Poland, Portugal, the UK, the US, and Sweden with a manufacturing primary industry code and 100 to 5,000 employees (on average prior to the survey). For every firm in this panel sample, we have a prior and current management score.

The Representativeness of the Sampling Frame

The accounting databases are used to generate our management survey. How does this compare to Census data? Table A2 compares the number of employees for different size bands from our sample with the figures for the corresponding manufacturing populations obtained from national Census Bureau data from each of the twenty countries. Unfortunately, figures for the population distributions are not available from every country in the same format, but all our countries do report the number of employees in enterprises with over 50 or more employees (except the US where the threshold is 20 or 100) so we report this.

Note that there are several reasons for mismatch between Census data and firm level accounts. First, even though we only use unconsolidated firm accounts, employment may include some jobs in overseas branches. Second, the time of when employment is recorded in

[27] The size of the manufacturing sector can be obtained from http://laborsta.ilo.org/, a database maintained by ILO. Indian data can be obtained from Indiastat, from the "Employment in Industry" table.

a Census year will differ from that recorded in firm accounts (see base of each column in Table A2). Third, the precise definition of "enterprise" in the Census may not correspond to the "firm" in company accounts (see notes in table for exact definitions). Fourth, we keep firms whose primary industry is manufacturing whereas Census data includes only plants whose primary industry code is manufacturing. Fifth, there may be duplication of employment in accounting databases due to the treatment of consolidated accounts[28]. Finally, reporting of employment is not mandatory for the accounts of all firms in all countries. This was particularly a problem for Indian and Japanese firms, so for these countries we imputed the missing employment numbers using a sales regression.

Despite these potential differences, the broad picture that from Table A2 is that in eight countries the sample matches up reasonably with the population of medium sized manufacturing firms (being within 17% above or below the Census total employment number). This suggests our sampling frame covers near to the population of all firms for most countries. In two countries the coverage from accounting databases underestimates the aggregate: the Swedish data covers only 62% of Census data and the Portuguese accounting database covers 72%. This is due to incomplete coverage in ORBIS of these smaller nations. In the US and Japan the accounting databases appears to overestimate the employment of manufacturing firms compared to Census data, by about 36%. We think this is due to some double counting of the employment of subsidiaries due to imperfect recording of the consolidation markers in Japanese and US accounts.

These issues will be a problem if our sampling frame is non-randomly omitting firms – for example under-representing smaller firms – because it would bias our cross-country comparisons. We try a couple of approaches to try and address this. First, in almost all the tables of results we include country fixed-effects to try to control for any differences across countries in sample selection bias. Hence, our key results are identified by within country and region variation. Second, in our quantification analysis when we compare across countries we control for size, public listing status and industry. This should help to condition on the types of factors that lead to under/over sampling of firms. Since these factors explain only a limited share of cross country variation in decentralization this suggests this differential sampling bias is not likely to be particularly severe. Finally, we also present experiments where we drop the four possibly problematic countries (Japan, Portugal, Sweden and the US) from the analysis to show that the results are robust. In the specification of column (2) in Table 3 the coefficient on trust actually rose to 2.048 (standard error = 0.961) even though we now have only 81 regions.

The Survey Response Rate

As shown in Table A3 of the firms we contacted 42.2% took part in the survey: a high success rate given the voluntary nature of participation. Of the remaining firms 14.7% refused to be surveyed, while the remaining 42.9% were in the process of being scheduled when the survey ended.

The reason for this high share of 'scheduling in progress' firms was the need for interviewers to keep a portfolio of firms who they cycle though when trying to set up interviews. Since interviewers only ran an average of 2.8 interviews a day the majority of their time was spent

[28] Table A2 is built omitting all consolidated accounts to avoid duplications. Still, for some companies the consolidated accounts marker is sometimes missing so that duplications might still be present causing a "double counting" problem.

trying to contact managers to schedule future interviews. For scheduling it was efficient for interviewers to keep a stock of between 100 to 500 firms to cycle through. The optimal level of this stock varied by the country – in the US and UK many managers operated voicemail, so that large stocks of firms were needed. In Japan after two weeks the team switched from working Japanese hours (midnight to 8am) to Japanese afternoons and UK morning (4am till midday), which left large stocks of contacted firms in Japan.[29] In Continental Europe, in contrast, managers typically had personnel assistants rather than voicemail, who wanted to see Government endorsement materials before connecting with the managers. So each approach was more time consuming, requiring a smaller stock of firms.

The ratio of successful interviews to rejections (ignoring 'scheduling in progress') is above 1 in every country. Hence, managers typically agreed to the survey proposition when interviewers were able to connect with them. This agreement ratio is lowest in Japan. There were two reasons for this: first, the Japanese firms did appear to be genuinely more willing to refuse to be interviewed; and second, the time-zone meant that our interviewers could not run talk during the Japanese morning; which sometimes led to rejections if managers were too busy to talk in the afternoon.

Table A4 analyses the probability of being interviewed[30]. In all columns, we compare the probability of running an interview conditional on contacting the firm, so including rejections and 'scheduling in progress' firms in the baseline. The decision to accept is uncorrelated with revenues per worker, firm age and listed status. The probability of being interviewed is also uncorrelated with the average level of trust and the percentage of hierarchical religions in the region. Large firms and multinationals did appear to be more predisposed to agree to be interviewed, although the size of this effect if not large – multinationals were about 11 percentage points more likely to agree to the interview and firms about 10 percentage points more likely for a doubling in size. Firms that were contacted earlier on in the survey were also significantly more likely to end up being interviewed, with firms contacted at the beginning of the survey over 8 percentage points more likely to be interviewed than those contacted towards the end (3 months later). The reason is that firms contacted early on in the survey were subsequently contacted many more times as interviewers cycled through their stocks of 'scheduling in progress firms'. Finally, compared to the US, France, Germany, Greece, India, Italy, Poland, Portugal and Sweden had significantly higher conditional acceptance rate — while China had a significantly lower acceptance rate. Column (2) shows that the likelihood of a contacted firm eventually being interviewed is also uncorrelated with return on capital employed, a basic profits measure.

So, in summary, respondents were not significantly more productive or profitable than nonresponders. Firms contacted earlier on in the survey process were more likely to end up being interviewed. Respondents did tend to be slightly larger and more likely to be a multinational subsidiary, but were not more likely to be stock-market listed or older. Chinese and Japanese firms less likely to respond and European firms more likely to respond. Note, however, that we address this potential source of bias including in all regressions controls for size, multinational status and country dummies.

[29] After two weeks of the Japanese team working midnight to 8am it became clear this schedule was not sustainable due to the unsociability of the hours, with one of the Japanese interviewers quitting. The rest of the team then switched to working 4am until noon.

[30] Note this sample is smaller than the total survey sample because some firms do not report data for certain explanatory variables, for example US private firms do not report sales.

Firm-level variables

Our firm accounting data on sales, employment, capital, profits, shareholder equity, long-term debt, market values (for quoted firms) and wages (where available) came from BVD Amadeus dataset for Europe (France, Germany, Greece, Italy, Ireland, Poland, Portugal and the U.K.), on BVD Icarus for the US, on CMIE Firstsource dataset for India, and on the BVD Oriana dataset for China and Japan, on BVD Orbis for Argentina, Brazil, Canada, Mexico, on Duns & Bradstreet for Australia and New Zealand, and on the Industrial Annual Survey Sample of Firms (Encuesta Nacional Industrial Annual - ENIA) and BVD Orbis for Chile

BVD and CMIE also have extensive information on ownership structure, so we can use this to identify whether the firm was part of a multinational enterprise. We also asked specific questions on the multinational status of the firm (whether it owned plants aboard and the country where the parent company is headquartered) to be able to distinguish domestic multinationals from foreign multinationals.

We collected many variables through our survey including information on plant size, skills, organization, etc. as described in the main text. We asked the manager to estimate how many competitors he thought he faced (top-coded at 10 or more) which was used to construct the firm level competition variable (see next sub-section for the other industry-level competition measures). We also collected management practices data in the survey. These were scored following the methodology of Bloom and Van Reenen (2007), with practices grouped into four areas: *operations* (three practices), *monitoring* (five practices), *targets* (five practices) and *incentives* (five practices). The shop-floor operations section focuses on the introduction of lean manufacturing techniques, the documentation of processes improvements and the rationale behind introductions of improvements. The monitoring section focuses on the tracking of performance of individuals, reviewing performance, and consequence management. The targets section examines the type of targets, the realism of the targets, the transparency of targets and the range and interconnection of targets. Finally, the incentives section includes promotion criteria, pay and bonuses, and fixing or firing bad performers, where best practice is deemed the approach that gives strong rewards for those with both ability and effort. Our management measure uses the unweighted average of the z-scores of all 18 dimensions.

A.3 Industries and Industry level data

Our basic industry code is the U.S. SIC (1997) three digit level - which is our common industry definition in all countries. We allocate each firm to its main three digit sector (based on sales), covering 135 unique three-digit industries. There are at least ten sampled firms in each industry for 96.9% of the sample.

The “Lerner index of competition” constructed, as in Aghion et al. (2005), as the mean of (1 - profit/sales) in the entire database (excluding the surveyed firms themselves) for every country industry pair. Profits are defined as EBIT (earnings before interest and taxation) to include the costs of labor, materials and capital but exclude any financing or tax costs. The five year period 2000 to 2004 is used in every country to ensure comparability across countries (since earlier data is not available in Oriana). In the US and India private firms do not provide profits data so the index was constructed from the population of all publicly listed firms, obtained from Compustat for the US and the CMIE Prowess dataset for India.

TABLE A1

The 2006/2007 Sampling Frame

	CN	FR	GE	GR	IN	IT	JP	PO	PT	SW	UK	US
Sampling frame, number of firms (#)	86,733	4,683	9,722	522	31,699	5,182	3,546	3,684	1,687	1,034	5,953	27,795
Employees (median, sampling frame)	290	201	198	180	175	183	240	200	127	206	219	200
Employees (median, conditioning on firms with 150+ employees)	290	291	285	269	229	262	240	260	239	315	311	300
Publicly listed (%)	1	4	1	17	11	1	1	3	1	6	4	4

The 2008/2009/2010 Sampling Frame

	AR	AU	BR	CA	CL	IR	MX	NI	NZ
Sampling frame, number of firms (#)	1,000	492	5,617	5,215	1,516	596	4,662	203	67
Employees (median, sampling frame)	200	533	191	185	200-499	85	250	109	321
Employees (median, conditioning on firms with 150+ employees)	292	639	294	300	200-499	255	344	276	390
Publicly listed (%)	0.13		0.09	0.42	4.08	1.85	0.08	0	

Notes: AR=Argentina, AU=Australia, BR=Brazil, CA=Canada, CL=Chile, CN=China, FR=France, GE=Germany, GR=Greece, IN=India, IT=Italy, IR=Republic of Ireland, JP=Japan, MX=Mexico, NI=Northern Ireland, NZ=New Zealand, PO=Poland, PT=Portugal, SW=Sweden, UK=United Kingdom, US=United States.
Sampling frame is the total number of eligible firms for the survey. The sampling frame includes all firms between 100 and 5,000 employees in the population accounting databases for all countries, excluding China and Japan (for which the employment bracket is 150 to 5,000 employees) and Portugal (for which the employment bracket is 75 to 5,000 employees). **Employees** are the median number of employees in the firm. **Publicly listed** is the percentage of firms which are directly publicly listed (note that some firms may be privately incorporate subsidiaries of publicly listed parents). Indian and Japanese employment numbers are predicted from balance sheet information for privately held firms (India) and unconsolidated accounts (Japan).

TABLE A2

The Coverage of the Firm Accounting Databases

	CN	FR	GE	GR	IN	IT	JP	PO	PT	SW	UK	US
Employees in firms in accounting databases with 50+ employees, 000's	56,742	2,223	6,453	153	6,773	1,754	9,214	1,224	380	331	2,188	15,150
Employees in firms with 50+ employees in the accounting databases as % of Census data	84%	89%	117%	92%	103%	89%	137%	72%	96%	62%	100%	135%
Sample median year	2007	2006	2006	2006	2004	2006	2007	2006	2006	2006	2006	2007
Census year	2004	2006	2006	2006	2005	2006	2006	2006	2006	2006	2006	2006

	AR	AU	BR	CA	CL	IR	MX	NZ
Employees in firms in accounting databases with 50+ employees, 000's								
Employees in firms with 50+ employees in the accounting databases as % of Census data								
Sample median year								
Census year								

Notes: AR=Argentina, AU=Australia, BR=Brazil, CA=Canada, CL=Chile, CN=China, FR=France, GE=Germany, GR=Greece, IN=India, IT=Italy, IR=Republic of Ireland, JP=Japan, MX=Mexico, NI=Northern Ireland, NZ=New Zealand, PO=Poland, PT=Portugal, SW=Sweden, UK=United Kingdom, US=United States. This compares total employment in our accounting database (from which the sampling frame was drawn) that should cover the population of manufacturing firms with Census Bureau data (from mandatory government surveys). All census units are firms except India which is plant level. **Employees in firms in the accounting databases with 50+ employees, 000's** reports the number of employees in firms in the accounting databases with 50 or more employees (in thousands). **Employees in firms with 50+ in the accounting databases as % of Census data** reports the share of employees in the accounting databases in firms with 50 or more employees as a proportion of the values reported in national Census data (except for the US, where we report the share of employees in firms with 20 or more employees as the 50 or more cut-off is not available). Census data is drawn from Eurostat Structural Business Statistics for the European countries, Bureau of the Census for the US, Statistics Bureau for Japan, Annual Survey of Industries for India, and Chinese Industrial Survey. For China and India, Census calculations done by Albert Bollard on data provided by Pete Klenow. Consolidated accounts are excluded from accounting data to avoid duplications. Eurostat defines an enterprise as the "smallest combination of legal units that is an organizational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, and an enterprise carries out one or more activities at one or more locations". The Bureau of the Census defines an enterprise as "a business organization consisting of one or more domestic establishments under common ownership or control". The Statistics Bureau of Japan defines an enterprise as "an entity composed of the head office and branch establishments, if any, whose legal organization is a stock company, limited company, limited or unlimited partnership, limited liability company, or mutual insurance company". In the Indian Annual Survey of Industries a factory "refers to any whereon ten or more workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on with the aid of power, or is ordinarily so carried on, or whereon twenty or more workers are working or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on without the aid of power, or is ordinarily so carried on". In the Chinese Industrial Survey "industrial establishments refer to economic units which are located in one single place and engage entirely or primarily in one kind of industrial activity, including financially independent industrial enterprises and units engaged in industrial activities under the non industrial enterprises (or financially dependent). Industrial establishments generally meet the following requirements: They have each one location and are engaged in one kind of industrial activity each; they operate and manage their industrial production activities separately; they have accounts of income and expenditures separately."

TABLE A3

The Survey Response Rate

	CN	FR	GE	GR	IN	IT	JP	PO	PT	SW	UK	US
Interviews completed (%)	43.9	59.3	58.6	53.4	61.4	68.2	21.5	37.5	60.5	68.2	32.9	37.2
Interviews refused (%)	13.7	13.7	27.2	10.7	13.7	20	20.1	16.5	15.8	16.9	19.6	13.7
Scheduling in progress (%)	40.1	27	14.2	35.9	25	11.8	58.4	46	23.7	14.9	47.4	49.1
Survey sample, number of firms (#)	727	528	526	350	761	304	563	637	293	380	1,851	1,833
Interviews completed (#)	319	313	308	187	467	207	121	239	177	259	609	682

	AR	AU	BR	CA	CL	IR	MX	NZ	NI
Interviews completed (%)	42.4	32.8	43.3	33.2	42.7	43.2	41.4	44.1	53.7
Interviews refused (%)	14.3	11.0	9.3	10.4	22.8	10.6	17.8	8.4	6.4
Scheduling in progress (%)	43.3	56.2	47.4	56.4	34.5	46.3	40.8	47.5	39.9
Survey sample, number of firms (#)	589	1,355	1,381	1,246	663	387	461	345	203
Interviews completed (#)	250	445	598	423	283	167	191	152	109

Notes: AR=Argentina, AU=Australia, BR=Brazil, CA=Canada, CL=Chile, CN=China, FR=France, GE=Germany, GR=Greece, IN=India, IT=Italy, IR=Republic of Ireland, JP=Japan, MX=Mexico, NI=Northern Ireland, NZ=New Zealand, PO=Poland, PT=Portugal, SW=Sweden, UK=United Kingdom, US=United States. **Interviews completed** reports the percentage of companies contacted for which a management interview was completed. **Interviews refused** reports the percentage of companies contacted in which the manager contacted refused to take part in the interview. **Scheduling in progress** reports the percentage of companies contacted for which the scheduling was still in progress at the end of the survey period (so the firm had been contacted, with no interview run nor any manager refusing to be interviewed). **Survey sample** is the total number of firms that were randomly selected from the complete sampling frame.

TABLE A4: RESPONSE RATES TO THE SURVEY

	(1)	(2)
Sample	**All firms contacted**	**All firms contacted**
Log (Sales/employee)	0.029	
	(0.031)	
Return on Capital Employed (ROCE) §		0.025
		(0.043)
Trust (region)§§	-0.226	0.310
	(0.457)	(0.580)
Hierarchical (region) §§	-0.356	-0.301
	(0.266)	(0.423)
Log (employment)	0.099***	0.073**
	(0.025)	(0.031)
Listed	-0.042	0.060
	(0.075)	(0.106)
Log (Age of firm), in years	0.021	0.029
	(0.028)	(0.034)
Multinational subsidiary	0.118**	0.125**
	(0.051)	(0.056)
Days from the start of the survey until firm contacted§	-0.087***	-0.101**
	(0.023)	(0.041)
Country is China	-1.465***	n/a
	(0.444)	
Country is France	0.886***	0.837***
	(0.219)	(0.247)
Country is Germany	0.902***	1.109***
	(0.171)	(0.216)
Country is Greece	0.512*	0.468
	(0.275)	(0.382)
Country is India	0.583***	n/a
	(0.218)	
Country is Italy	0.955***	0.859**
	(0.276)	(0.359)
Country is Japan	-0.123	n/a
	(0.207)	
Country is Poland	0.726**	0.470
	(0.286)	(0.402)
Country is Portugal	0.905**	1.016**
	(0.369)	(0.445)
Country is Sweden	0.929***	0.597**
	(0.236)	(0.256)
Country is UK	0.114	Baseline
	(0.105)	
Country is US	Baseline	n/a
Pseudo R^2	0.162	0.138
Number of firms	6,679	4,308

Notes: The dependent variable is a dummy for a completed interview. All columns estimated by probit with robust standard errors in parentheses (marginal effects reported). All columns include a full set of 44 interviewer dummies, and 142 three digit industry dummies. The dependent variable takes value one if the firm was interviewed, and zero if the interview was refused, or if scheduling was still in progress as the end of the project. In column (2) firms are dropped if Return on Capital Employed data is available. § Coefficient and standard-errors multiplied by 100. §§ Refers to region where the company is headquartered. Regressions weighted by the share of World Values Survey respondents in the region in the country.

APPENDIX B: FURTHER RESULTS

In the section on decomposing share-weighted management into reallocation and unweighted average components (equation (3)) we made a variety of assumptions and modeling decisions that we now relax to see how they alter our results. Note that the sample we use is a sub-sample of that underlying Figure 1 as we focus on the survey wave in 2006, drop multinationals, drop countries were we have poor employment data, weight the management data according to country-specific market share and adjust for non-random selection.

Differential response rates to the survey

There are several potential sources of sample selection, the most obvious one being that the firms who responded from the sampling frame were non-random in some dimension. Appendix A has examined the overall evidence on sampling bias and argued that these were relatively small both on the observable and unobservable dimensions. Nevertheless, the baseline results attempted to control for this by calculating (country-specific) weights for the sample response probabilities. We do this by running country-specific probit models where the control variables are employment size, firm age, whether the firm was publicly listed and one-digit industry dummies. We then calculate the weights as the inverse of the probability of response. We chose these controls as they are available for responders and non-responders and there was some evidence that larger firms were more likely to respond (see Appendix A).

We experimented with an alternative first stage probit based on just using employment rather than a richer set of controls. The results are in Table B1 and Figures B1A-B1C which mirror Table 8 and Figures 5-7. Although there are a few minor changes, the results appear very stable.

Non-labour inputs

We have focused on employment as our key measure of size as it is simple and broadly straightforward to measure across countries. An alternative way to measure size is to look at a measure of weighted inputs, so we follow Bartelsman et al (2012) and construct a measure using capital stock information from Orbis where inputs = exp[0.7*ln(labor) + 0.3*ln(capital)]. The results are in B2A-B2C and again are similar to the baseline.

Multinationals

We dropped multinationals because of the difficulty of measuring group size appropriately for such entities. As an alternative we included them, but recalculated the sample response rate weights as multinational were more likely to participate in the survey. Thus we re-ran country-specific probits but included MNE status as an additional variable to size, listing, age and industry. The results of repeating the decomposition are in Figures B3A-B3C. The broad qualitative picture is the same as the baseline with the US still having the highest weighted and unweighted management scores and the greatest degree of reallocation. Further, there are a group of countries just behind the US who do very well: Japan, Sweden and Germany.

There are a few differences, however. Greece's gap with the US shrinks to -1.29 from -1.65 and Portugal's improves to -0.89 from -1.2. This is because multinationals tend have high management scores and both countries have a good fraction of foreign multinationals. France also improves its position (-0.51 behind the US instead of -0.98), moving ahead of the UK with a larger reallocation term of 0.24, closer to that in Bartelsman et al, 2012.

Sampling biases associated with dropping very small and very large firms

Our management surveys focus on medium sized firms defined as those with over 50 and under 5000 employees. This was in order to compare firms of a broadly comparable size. However, it could potentially cause bias in our comparisons of management levels across countries as the size distribution is different across nations (e.g. Garicano, Lelarge and Van Reenen, 2012). Obviously we do not know the exact distribution of management scores in these very large and very small firms, but we can estimate with additional assumptions what the potential biases could be.

From the Census population databases of firm demographics we know the number of firms and workers above and below 50 employees in most countries. We need to then make an assumption about the relationship between firm size and management, which we extrapolate off the size-management relationship over the part of the distribution that we observe. We then use this information to estimate what the weighted average management score across the entire distribution.

Relevant information for France and the US is in Table B2. Using this we estimate that the management gap between falls only slightly from -0.98 to -0.82 after correcting for the missing parts of the distribution.

TABLE B1: ALLOWING THE MANAGEMENT COEFFICIENTS TO BE DIFFERENT ACROSS INDUSTRIES

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Ln(sales)	Ln(sales)	TFP	TFP	Ln(sales)	Ln(sales)
Management	0.140***	0.146***	0.133***	0.120***	0.028**	0.011
	(0.014)	(0.047)	(0.014)	(0.044)	(0.014)	(0.042)
ln(labor)	0.642***	0.537***			0.363***	0.258**
	(0.025)	(0.063)			(0.108)	(0.110)
ln(capital)	0.319***	0.355***			0.245***	0.442***
	(0.020)	(0.054)			(0.087)	(0.077)
Fixed Effects	No	No	No	No	Yes	Yes
Interactions with Industry dummies	No	Yes	No	Yes	No	Yes
F-test (p-value) of joint significance of:						
Management*SIC2		0.81		0.74		1.26
		(0.69)		(0.78)		(0.20)
Ln(labour)*SIC2		2.39				6.69
		(0.00)				(0.00)
Ln(capital)*SIC2		1.47				1.79
		(0.09)				(0.01)
Firms	2927	2927	2927	2927	1345	1345
Observations	7094	7094	7094	7094	5512	5512

Notes: All columns estimated by OLS with standard errors are in parentheses under coefficient estimates clustered by firm. "**Management"** is the firm-level management z-score. Sample of all firms with available accounts data from 2002-2010 (except final column which is whether firm had exited by the end of 2010).
"**Interactions with industry dummies**" indicate whether we include a full set of interactions between management and two digit industry dummies (SIC2). Note that columns (2) and (6) also include a full set of interactions between ln(labor) and two digit industry dummies and ln(capital) and two digit industry dummies. The F-tests are of the joint significance of these interactions. Note that in these specifications, we use industry 20/21 as the omitted base industry (so the linear coefficients are those for this arbitrary industry). Full set of 18 country dummies, time dummies, two digit industry dummies, % college degree and average hours are controls in all columns. "Fixed effects" include a full set of firm fixed effects and are estimated on the sample where we have at least two waves of management interviews.

TABLE B2: DECOMPOSITION OF WEIGHTED AVERAGE MANAGEMENT SCORE, ALTERNATIVE SELECTION ASSUMPTIONS

	(1)	(2)	(3)	(4)	(5)	(6)
Country	Share-Weighted Average Management Score (1)=(2)+(3)	Reallocation effect (Olley-Pakes)	Unweighted Average Management Score	"Deficit" in Share-weighted Management Score relative to US	"Deficit" in Reallocation relative to US	% of deficit in management score due to worse reallocation (6)=(5)/(4)
US	0.62	0.31	0.31	0	0	n/a
Sweden	0.42	0.22	0.20	-0.2	-0.09	45%
Japan	0.36	0.19	0.16	-0.26	-0.12	46%
Germany	0.29	0.26	0.03	-0.33	-0.05	15%
Great Britain	-0.06	0.17	-0.24	-0.68	-0.14	21%
Italy	-0.07	0.13	-0.20	-0.69	-0.18	26%
Poland	-0.16	0.17	-0.33	-0.78	-0.14	18%
France	-0.30	0.09	-0.40	-0.92	-0.22	24%
China	-0.49	0.12	-0.61	-1.11	-0.19	17%
Portugal	-0.52	0.11	-0.63	-1.14	-0.20	18%
Greece	-0.92	-0.08	-0.84	-1.54	-0.39	25%
Unweighted Average		0.20		-0.76	-0.17	25.5%

Notes: Colum (1) is the employment share weighted management score in the country. Management scores have standard deviation 1, so Greece is 1.54 (0.62 + 0.92) sd lower than the US. Using column (2) of Table 3 this implies that Greece's TFP would be 23% = 1 - exp(0.14*1.5)) higher if it had US levels of management, which would account for about half the total US-Greece TFP gap. Column (2) is the Olley-Pakes reallocation term, the sum of all the management-employment share covariance in the country. Column (3) is the raw unweighted average management score. The sum of columns (2) and (3) equal column (1). Columns (4) and (5) deduct the value in column (1) from the US level to show relative country positions. Column (6) calculates the proportion of a country's management deficit with the US that is due to reallocation. All scores are adjusted for nonrandom selection into the management survey through the propensity score method (selection equation uses country-specific coefficients on employment only). Only domestic firms used in these calculations (i.e. multinationals and their subsidiaries are dropped).

TABLE B3: CORRECTING FOR CHOOSING A SAMPLING FRAME OF MEDIUM SIZED FIRMS IN MANUFACTURING

	(1)	(2)	(3)
Firm Size Class	% employees	% firms	Weighted average firm size
US, 2007, LBD, http://www.census.gov/ces/dataproducts/bds/data_firm.html			
Over 5,000 employees	0.35	0.003142	6,182
50-5,000 employees	0.49	0.129795	208
Under 50 employees	0.16	0.867063	10
Total numbers, (1000s)	14,743,400	268,000	55
France, 2002-2007 average, FICUS (Garicano et al, 2012)			
Over 5,000 employees	0.29	0.0002	11,338
50-5,000 employees	0.62	0.069	224.6
Under 50 employees	0.09	0.930	7.7
Total numbers, (1000s)	3,537,210	141,952	

APPENDIX C: MANAGEMENT PRACTICES QUESTIONNAIRE

Any score from 1 to 5 can be given, but the scoring guide and examples are only provided for scores of 1, 3 and 5. The survey also includes a set of Questions that are asked to score each dimension, which are included in Bloom and Van Reenen (2006).

(1) Modern manufacturing, introduction			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Other than Just-In-Time (JIT) delivery from suppliers few modern manufacturing techniques have been introduced, (or have been introduced in an ad-hoc manner)	Some aspects of modern manufacturing techniques have been introduced, through informal/isolated change programs	All major aspects of modern manufacturing have been introduced (Just-In-Time, autonomation, flexible manpower, support systems, attitudes and behaviour) in a formal way
(2) Modern manufacturing, rationale			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Modern manufacturing techniques were introduced because others were using them.	Modern manufacturing techniques were introduced to reduce costs	Modern manufacturing techniques were introduced to enable us to meet our business objectives (including costs)
(3) Process problem documentation			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	No, process improvements are made when problems occur.	Improvements are made in one week workshops involving all staff, to improve performance in their area of the plant	Exposing problems in a structured way is integral to individuals' responsibilities and resolution occurs as a part of normal business processes rather than by extraordinary effort/teams
(4) Performance tracking			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Measures tracked do not indicate directly if overall business objectives are being met. Tracking is an ad-hoc process (certain processes aren't tracked at all)	Most key performance indicators are tracked formally. Tracking is overseen by senior management.	Performance is continuously tracked and communicated, both formally and informally, to all staff using a range of visual management tools.
(5) Performance review			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Performance is reviewed infrequently or in an un-meaningful way, e.g. only success or failure is noted.	Performance is reviewed periodically with successes and failures identified. Results are communicated to senior management. No clear follow-up plan is adopted.	Performance is continually reviewed, based on indicators tracked. All aspects are followed up ensure continuous improvement. Results are communicated to all staff
(6) Performance dialogue			
	Score 1	**Score 3**	**Score 5**

Scoring grid:	The right data or information for a constructive discussion is often not present or conversations overly focus on data that is not meaningful. Clear agenda is not known and purpose is not stated explicitly	Review conversations are held with the appropriate data and information present. Objectives of meetings are clear to all participating and a clear agenda is present. Conversations do not, as a matter of course, drive to the root causes of the problems.	Regular review/performance conversations focus on problem solving and addressing root causes. Purpose, agenda and follow-up steps are clear to all. Meetings are an opportunity for constructive feedback and coaching.
(7) Consequence management			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Failure to achieve agreed objectives does not carry any consequences	Failure to achieve agreed results is tolerated for a period before action is taken.	A failure to achieve agreed targets drives retraining in identified areas of weakness or moving individuals to where their skills are appropriate
(8) Target balance			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Goals are exclusively financial or operational	Goals include non-financial targets, which form part of the performance appraisal of top management only (they are not reinforced throughout the rest of organization)	Goals are a balance of financial and non-financial targets. Senior managers believe the non-financial targets are often more inspiring and challenging than financials alone.
(9) Target interconnection			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Goals are based purely on accounting figures (with no clear connection to shareholder value)	Corporate goals are based on shareholder value but are not clearly communicated down to individuals	Corporate goals focus on shareholder value. They increase in specificity as they cascade through business units ultimately defining individual performance expectations.
(10) Target time horizon			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Top management's main focus is on short term targets	There are short and long-term goals for all levels of the organization. As they are set independently, they are not necessarily linked to each other	Long term goals are translated into specific short term targets so that short term targets become a "staircase" to reach long term goals
(11) Targets are stretching			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Goals are either too easy or impossible to achieve; managers provide low estimates to ensure easy goals	In most areas, top management pushes for aggressive goals based on solid economic rationale. There are a few "sacred cows" that are not held to the same rigorous standard	Goals are genuinely demanding for all divisions. They are grounded in solid, solid economic rationale
(12) Performance clarity			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Performance measures are complex and not clearly understood. Individual performance is not made public	Performance measures are well defined and communicated; performance is public in all levels but comparisons are discouraged	Performance measures are well defined, strongly communicated and reinforced at all reviews; performance and rankings are made public to induce competition

(13) Managing human capital			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Senior management **do not** communicate that attracting, retaining and developing talent throughout the organization is a top priority	Senior management believe and communicate that having top talent throughout the organization is a key way to win	Senior managers are evaluated and held accountable on the strength of the talent pool they actively build
(14) Rewarding high-performance			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	People within our firm are rewarded equally irrespective of performance level	Our company has an evaluation system for the awarding of performance related rewards	We strive to outperform the competitors by providing ambitious stretch targets with clear performance related accountability and rewards
(15) Removing poor performers			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Poor performers are rarely removed from their positions	Suspected poor performers stay in a position for a few years before action is taken	We move poor performers out of the company or to less critical roles as soon as a weakness is identified
(16) Promoting high performers			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	People are promoted primarily upon the basis of tenure	People are promoted upon the basis of performance	We actively identify, develop and promote our top performers
(17) Attracting human capital			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Our competitors offer stronger reasons for talented people to join their companies	Our value proposition to those joining our company is comparable to those offered by others in the sector.	We provide a unique value proposition to encourage talented people join our company above our competitors
(18) Retaining human capital			
	Score 1	**Score 3**	**Score 5**
Scoring grid:	We do little to try to keep our top talent.	We usually work hard to keep our top talent.	We do whatever it takes to retain our top talent.

Source: Bloom and Van Reenen (2006)