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IT and Management in America

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Abstract

The Census Bureau recently conducted a survey of management practices in over 30,000 plants across the US, the first large-scale survey of management in America. Analyzing these data reveals several striking results. First, more structured management practices are tightly linked to higher levels of IT intensity in terms of a higher expenditure on IT and more on-line sales. Likewise, more structured management is strongly linked with superior performance: establishments adopting more structured practices for performance monitoring, target setting and incentives enjoy greater productivity and profitability, higher rates of innovation and faster employment growth. Second, there is a substantial dispersion of management practices across the establishments. We find that 18% of establishments have adopted at least 75% of these more structured management practices, while 27% of establishments adopted less than 50% of these. Third, more structured management practices are more likely to be found in establishments that export, who are larger (or are part of bigger firms), and have more educated employees. Establishments in the South and Midwest have more structured practices on average than those in the Northeast and West. Finally, we find adoption of structured management practices has increased between 2005 and 2010 for surviving establishments, particularly for those practices involving data collection and analysis.

Key words: IT, Management, productivity and organization
JEL: M1

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1. Introduction

A growing literature has highlighted the huge dispersion in productivity across establishments in the US. For example, Syverson (2004) finds that establishments at the 90th percentile are almost twice as productive at those at the 10th percentile within the same narrowly defined industry. One explanation for these differences has been variation in output prices – maybe some firms face less competitive markets so can charge more for their products, making them appear more productive. However, Foster, Haltiwanger and Syverson (2008) find this establishment-level dispersion in productivity still remains even after controlling for establishment-level output prices in apparently homogeneous product industries like concrete, white pan bread, and block-ice.

An alternative explanation for this dispersion in productivity is the different use of inputs like R&D and skills. It may be that some firms outperform others because they spend more on developing new products or on training their employees. But again, even after decades of research controlling for these knowledge and human capital factors a large dispersion of productivity remains (Syverson, 2011).

In this paper we focus on differences in IT and management practices and their relationship to variation in performance. While the popular press and business schools have long stressed the impact of the IT revolution and the importance of good management, economists until recently have generally had less to say (particularly on management) because of the lack of data.[8] Over the last few years, however, researchers have started to build international management databases highlighting the role of management practices in driving differences in firm and national performance (Bloom, Genakos, Sadun and Van Reenen 2012). But the evidence on management in America is limited to few hundred firms, making detailed analysis difficult. Fortunately, the US Census Bureau recently completed a large management survey of over 30,000 manufacturing establishments, which we provide the first analysis of in this paper.

8 There are of course some exceptions, such as Osterman (1994), Huselid (1995), Ichniowski, Shaw and Prennushi (1997), Black and Lynch (2001), Capelli and Neumark (2001) and Bresnahan, Brynjolfsson and Hitt (2002), but as the surveys in Bloom and Van Reenen (2011), Gibbons and Henderson (2011) and Oyer and Lazear (2012) point out economists have tended to ignore management as a factor explaining differences in firm performance.

We find four main results. First, as show in Figure 1a, structured management practices for performance monitoring, targets and incentives and strongly linked to more intensive use of information technology. Plants using more structured management practices have higher levels of investment in IT per worker (top left panel), more investment in IT overall (top-right panel) and conduct more sales over electronic networks (bottom left panel). This is indicative of the tight relationship between IT and modern management practices, something that was very evidence in the cross-country work on IT and management in, for example, Bloom, Sadun and Van Reenen (2012). So not surprisingly, as shown in Figure 1b, structured management practices are also tightly linked to better performance. Establishments adopting these practices display greater productivity, profitability, innovation (as proxied by R&D and patent intensity) and growth. This relationship is robust to wide range of controls including industry, education, establishment and firm age, and potential survey noise. The relationship between structured management and performance also holds over time within establishments (establishments that adopt more of these practices between 2005 and 2010 also saw improvements in their performance) and across establishments within firms (establishments within the same firm with more structured management practices achieve better performance outcomes) as we will show in the regression results.

Second, as shown in Figure 2, there is enormous dispersion of management practices across America: 18% of establishments adopt at least 75% of structured management practices for performance monitoring, targets and incentives; while 27% of establishments adopt less than 50% of these practices.

Third, there is a positive correlation between structured management practices and location, firm size, establishment-level measures of worker education, and export status. Establishments in the South and Midwest have more structured practices on average than those in the Northeast and West, as shown in Figures 3 and 4. This geographical difference appears to be partly explained by other factors – like firm size and industry – but not entirely. For reasons that are still not entirely clear (but could be related to state specific policies), there appears to be a more structured style of management practices for establishments located in the South and Midwest.

Finally, looking at the "surviving" establishments in 2010 who had been operating for at least five years, we find US management appears to have become more structured in the previous half-decade, particularly for practices involving data collection and analysis (see Figure 5). This may partly reflect the increasing adoption of modern information technologies, like Enterprise Resource Planning (ERP) systems, which make data collection and processing much cheaper, easier and more effective. We also find that establishments report learning about new management practices most frequently from their headquarters, followed by trade-associations, conferences, and consultants.

In Section 2 we describe the survey and the sampling process, in Section 3 we outline the relationship between management and performance, while in Section 4 we examine the variation in management practices across firms, regions and industries, and over time. We also report some analysis of how establishments come to learn about new management practices. In Section 5 we conclude and highlight areas for future analysis.

2. Survey and Sample

The Management and Organizational Practices Survey (MOPS) was jointly funded by the Census Bureau and the National Science Foundation as a supplement to the Annual Survey of Manufactures (ASM). The original design was based in part on a survey tool used by the World Bank[9] and adapted to the US through several months of development and cognitive testing by the Census Bureau. It was sent by mail and electronically to the ASM respondent for each establishment, which was typically the accounting, establishment or human-resource manager. Most respondents (58.4%) completed the survey electronically, with the remainder completing the survey by paper (41.6%). Non-respondents were given up to three follow-up telephone calls if no response had been received within three months.

[9] See Bloom, Schweiger and Van Reenen (2012).

2.1 Survey Questions

The survey comprised 36 multiple choice questions about the establishment, taking about 20 to 30 minutes to complete. The questions were split into three sections: management practices (16 questions), organization (13 questions) and background characteristics (7 questions).

Management: The management practices covered three main sections: monitoring, targets and incentives, based on Bloom and Van Reenen (2007), which itself was based in part on the principles continuous monitoring, evaluation and improvement from Lean manufacturing (e.g. Womack, Jones and Roos, 1990).

The monitoring section asked firms about their collection and use of information to monitor and improve the production process. For example, how frequently were performance indicators tracked at the establishment, with options ranging from "*never*" to "*hourly or more frequently*". The targets section asked about the design, integration and realism of production targets. For example, what was the time-frame of production targets, ranging from "*no production targets*" to "*combination of short-term and long-term production targets*". Finally, the incentives asked about non-managerial and managerial bonus, promotion and reassignment/dismissal practices. For example, how were managers promoted at the establishment, with answers ranging from "*mainly on factors other than performance and ability, for example tenure or family connections*" to "*solely on performance and ability*"? The full questionnaire is available on http://bhs.econ.census.gov/bhs/mops/form.html.

In our analysis, we aggregate the results from these 16 check box questions into a single measure of structured management. The structured management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. Thus the summary measure is scaled from 0 to 1, with 0 representing an establishment that selected the bottom category (little structure around performance monitoring, targets and incentives) on all 16 management dimensions and a 1 representing an establishment that selected the top category (an explicit focus on performance monitoring, detailed targets and strong

performance incentives) on all 16 dimensions. (See the Appendix for more details.).

Organization: The organization section of the survey covered questions on the decentralization of power from the headquarters to the establishment manager based on Bresnahan, Brynjolfsson and Hitt (2002) and Bloom, Sadun and Van Reenen (2012). This asked, for example, where decisions were made on pay increases, ranging from "*only at headquarters*" to "*only at this establishment*". A second set of questions asked about establishment-manager span of control and reporting levels based on Bloom, Garicano, Sadun and Van Reenen (2011), for example asking how many employees report directly to the establishment manager. A final set of questions based on Brynjolfsson, Hitt and Kim (2011) asked about data use in decision making, for example asking the use of data in decisions making at that establishment with response options ranging from "*decision making does not use data*" to "*decision making relies entirely on data*". In addition, one question asks about how managers learn about management practices with answers concerning a variety of sources ("*Consultants*", "*Competitors*", etc.). For reasons of space we do not describe and analyze these data here (except for the question about learning), but leave this for a companion paper in future research.

Background characteristics asked a range of questions about the number of managers and non-managers at the establishment, the share of both groups that had a bachelor degree, the share of employees in a union, and the seniority and tenure of the respondent.

Interview and interviewee characteristics. We also collected a large amount of information on the interviewee (e.g. seniority and tenure) and interview process itself (date and day of week of interview, whether it was filed online). These will generate measurement error in the management score and in some robustness tests we try to control for these "noise" variables (see the appendix for detailed description of these "noise" controls).

2.2 Sample and Sample Selection

The MOPS survey was sent to all ASM establishments in the ASM mailout sample.[10] Overall, 49,782 MOPS surveys were sent, of which 47,534 were successfully delivered, and 37,177 filled surveys were received, implying a response rate of 78%, which is extremely high for firm surveys. For most of our analysis, we further restrict the sample for establishments with at least 11 non-missing responses to management questions and also have positive value added, positive employment and positive imputed capital in the ASM.[11] Table 1 shows how our various samples are derived from the universe of establishments.

In Appendix Table A1 we report the results for linear probability models for the different steps in the sampling process. We show that establishments which were mailed and responded to the MOPS survey are somewhat larger. These also tend to be slightly more productive compared to the entire ASM mailout sample. While the differences are statistically significant they are quantitatively small. For example, in column 5 of Appendix Table A1, we see that an establishment that is 10% larger is 0.94 percentage points more likely to be in our clean sample compared to the ASM (compared to the mean response rate of 78%) and one that is 10% more productive is 0.38 percentage points more likely to be included.

2.3 Additional Performance Data

In addition to our management data we also use a performance data from other Census and non-Census data sets. We use establishment level data on sales, value-added and labor inputs from the ASM. As described in detail in the Appendix, we also combine capital stock data from the Census of Manufactures (CM) with investment data from the ASM and apply perpetual inventory method to construct capital stocks at the establishment level. At the firm level, we use data from the 2009 Business R&D and Innovation Survey (BRDIS) on R&D expenditure and

[10] The Appendix provides more details on external datasets including the ASM and CM and BRDIS.

[11] These naturally require also a successful match to the ASM. Two more technical conditions are that we require the establishment to have a valid LBDNUM, as well as to be tabbed in ASM tabulations. We give more details about sample selection in each step of the sampling process in the Appendix.

patent applications by the establishment's parent firm. Finally, we use Compustat to calculate Tobin's q for the parent firm and match these measures to establishments with publicly traded parent firms. Since the Compustat-SSEL bridge is only updated up to 2005, we focus on analysis of the MOPS 2005 recall questions when using Compustat (companies who are publicly listed on the US stock market).

Table A2 provides more descriptive statistics on the samples we use for analysis. The mean establishment size is 167 employees and the median is 80. The average establishment in our sample has been in operation for 22 years, 44% of managers and 9% of non-managers have college degrees, 13% of their workers are in unions, 42% export and 69% are part of larger multi-plant firms.

3. Management and Performance

In this section we investigate whether these more structured management practices are related to performance. We do not attribute a causal interpretation to the results in the section, but rather think about these results as a way to establish whether this management survey is systematically capturing meaningful content rather than just statistical noise.

As we saw in Figure 2 a range of performance measures – productivity, profits, growth, export status, R&D intensity and patenting - are all rising across the deciles of management score. These graphs show basic unconditional correlations, demonstrating that in the raw data establishments with more structured management practices are better performing across a wide range of measures.

Of course one concern is our management scores are just proxying for some other characteristic of the firm, like its size, age, industry or the education of the employees. To examine this we include observable controls in a more formal regression analysis. While again this does not attempt to establish a causal relation between management and performance, we can at least control for a rich set of establishment and firm characteristics. In the following two subsections we summarize our findings from this analysis for labor productivity (section 3.1) and for other

performance measures (section 3.2).

3.1. Management and Productivity

We start by looking at the relation between labor productivity and management. Suppose that the establishment production function is as given in equation (1):

$$Y_{i,t} = A_{i,t}K_{i,t}^{\alpha}L_{i,t}^{\beta}e^{\gamma X_{i,t}}e^{\delta M_{i,t}} \quad (1)$$

where Y_{it} is real value added (output - materials), A_{it} is productivity (excluding management practices), K_{it} denotes the establishment's capital stock at the beginning of the period, L_{it} is the labor force, X_{it} is a vector of additional factors like industry and education, and M_{it} is our management score.[12] Management is an inherently multi-dimensional concept, so for this study we focus on a single dimension, the extent to which firms adopt more structured practices.[13]

Dividing by labor and taking logs we can rewrite this in an easier form to estimate on the data

$$Log\left(\frac{Y_{i,t}}{L_{i,t}}\right) = \alpha \log\left(\frac{K_{i,t}}{L_{i,t}}\right) + (\beta + \alpha - 1)\log(L_{i,t}) + \gamma X_{i,t} + \delta M_{i,t} + f_i + e_{i,t} \quad (2)$$

where we have substituted the productivity term for a set of industry (or establishment) fixed effects f_i and a stochastic residual e_{it}. Because we may have multiple establishments per firm, and sometimes the same person fills out the ASM form for several establishments, we also cluster our standard errors at the firm (rather than establishment) level.

In Table 2 column (1) we start by running a basic regression of log(value added/employee) on our management score without any controls. We find a highly significant coefficient of 1.272, suggesting that every 10% increase in our management score is associated with a 13.6% (13.6%=exp(0.1272)) increase in labor productivity. To get a sense of this magnitude, our management score has a sample mean of 0.64 and a standard deviation of 0.152 (see the sample statistics in Appendix Table A2), so that a 1 standard-deviation change in management is associated with a 21.3% (21.3%=exp(0.152*1.272)) higher level of labor productivity. On a lower row of Table 2 at the base of the regression results we also report the increase in

12 We put the management score and x_{it} controls to the exponential simply so that after taking logs we can include them in levels rather than logs.

13 The individual practices are highly correlated which may reflect a common underlying driver or complementarities among the practices as they form a coherent system.

productivity associated with moving from the 10th to the 90th percentile of the management practices distribution – a move from very informal to very structured management – is 63.1% in column (1). Hence, the raw correlation of management and labor productivity (value added per employee) is both statistically highly significant (a t-statistic of over 25) and quantitatively extremely large.

In column (2) of Table 2 we include over 450 NAICS 6-digit industry fixed effects and find the management coefficient halves, suggesting much of the correlation between labor productivity and management occurs across industries. Nevertheless, the within industry correlation of management practices and labor-productivity is still quantitatively very large. Moving from the 10th to 90th percentile of the management score associated with a 28.7% increase in productivity even for establishments within the same narrowly defined 6-digit NAICS industry.

In column (3) of Table 2 we estimate the full specification from equation (1) with industry fixed effects and various types of controls for potential survey bias, and again find a large and highly significant management coefficient. Controlling for capital intensity, establishment size and employee education reduces the coefficient on management only modestly.[14] Even after conditioning on many observables, a key question that remains is whether our estimated OLS management coefficient captures a relation between management and productivity, or whether it is just correlated with omitted factors that affect the management score and the productivity measure.

Using the 2005 recall questions, matched to the 2005 ASM files, we can construct a two period panel of management, productivity and other controls, to at least partially address this concern over omitted factors. As long as the unobserved factors that are correlated with management are fixed over time at the establishment level (corresponding to f_i in equation (1)), we can difference them out by running a fixed effect panel regression (same as a long-difference). Column (4) reports the results for the 2005-2010 pooled panel regression (including a 2010 time dummy).[15] The coefficient on management, 0.298, is still significant at the 1% level with a substantive

[14] Employee education is calculated as a weighted average of managers' and non-managers' education.
[15] Note that for each year the sample is smaller, as we now require non-missing controls also for 2005.

magnitude – moving from the 10th to 90th percentile of management is associated with a 12.2% increase in productivity. Of course this coefficient may still be upwardly biased if management practices are proxying for time-varying unobserved coefficients. But the coefficient on management could also be attenuated towards zero by measurement error, and this downward bias is likely to become much worse in the fixed effect specification.

The rich structure of our data allows us to compare firm-level versus establishment-level management practices. In particular, by restricting our analysis to multi-establishment firms, we can check whether we can find a correlation between structured management and labor productivity *within* a firm.[16] When including a firm fixed effect the coefficient on management is identified solely off the variation of management and productivity across plants within each firm in 2010. Column (5) shows our OLS estimates for the sub-sample of multi-establishment firms with firm-effects, so that we are comparing across establishments within the same firm. The within firm management coefficient of 0.233 is highly significant and quantitatively substantial, implying a 9.4% increase in labor productivity when moving from the 10th to the 90th percentile of structured management. Hence, even within the very same firm when management practices differ across establishments, we find large differences in productivity associated with these variations in management practices. The establishments with higher management scores within each firm are on average also more productive.

Since columns (3)-(5) condition on other factor inputs like capital, the coefficient on management can be interpreted as the association between Total Factor Productivity (TFP) and our management score. In columns (6) and (7) we present an alternative approach where we explicitly use an estimate of the log of TFP as the dependent variable. We calculate TFP by deducting labor and capital from value added, using industry-specific cost-share weights. This allows the production function to be industry specific, so is more general than the previous columns. We can also drop capital and labor from the right hand side which has some attractions as these are endogenously chosen by the firm. The results are comparable to the earlier results: the management coefficient remains positive and significant with a similar implied magnitude in

[16] Interestingly, in the data we find that 53.2% of the variation in the data is explained by variation in management practices across establishments.

the cross section (column (6)) or time series (column (7)) dimension.

We also ran a series of other robustness tests, like using z-scores (rather than the 0-1 management scores), dropping individual questions that might be output related and using ASM sampling weights, and found very similar results. Hence, a robust result from Table 2 is that establishments reporting more structured management have higher productivity.

3.2. Management, Size, Growth, Profitability, Exports and Innovation

After establishing the relation between management and productivity, we turn now to demonstrate the robust correlation between management and other measures of performance. Our first finding is that larger establishments and firms have more structured management practices. Figures 6 and 7 plot the average size of establishments and firms against their management scores. These figures show that both establishment and firm management scores are rising until they reach at least 1000 employees[17]. This difference is also quantitatively large – for example, going from a firm with 10 employees to a firm with 1000 employees is associated with an increase in the management score from about 0.5 to 0.7, which is comparable to moving from about the 20th percentile to the 70th percentile of the management score distribution.

One explanation for this strongly positive management-size relationship is that more effectively managed firms gain higher market share over time (e.g. Lucas, 1978). Another explanation is running large establishments is organizationally complex, so necessarily requires more structured, proactive and explicit management practices.[18] In other words there may be fixed costs of adopting these types of management practices, so only larger establishments will find it worthwhile to introduce them. In the current data it is impossible for us to tease out these types of different stories and both are likely to be in operation. Bloom, Eifert, Mahajan, McKenzie and Roberts (2012) find evidence from experiments on Indian manufacturing establishments that

[17] The X axis is logarithmic. In both cases the central estimates of the management score continue to rise until they reach 10,000 employees but after about 2000 employees the standard errors become so wide (because of the smaller samples of larger establishments and firms) that this increase is no longer statistically significantly.

[18] Most obviously, in an establishment of 10 employees the establishment manager can potentially run the operations solely through informal observation and interactions on a daily basis with each employee while in an establishment of 1000 employees this is infeasible.

exogenous adoption of these more structured management practices enabled firms to increase their productivity and expand. In a similar vein, Bloom, Sadun and Van Reenen (2012) found that the size-management covariance is stronger in environments where better managed firms should find it easier to expand (e.g. reallocation was stronger in the US than other countries and where competition was higher and labor regulations more flexible).

In Table 3 we examine the other performance measures we plotted against the raw management score deciles in Figure 1. Starting in Column (1) of Table 3 we show that establishments with more structured management practices grew significantly faster over the last 5 years, even after controlling for capital inputs, size, skills, and a full set of industry controls.[19] Column (2) looks at profitability – measured as operating profits (value added minus wages and salaries) normalized by sales – and finds establishments with higher management scores are significantly more profitable. Column (3) looks at the sample of establishments which reported management scores for both 2010 and 2005 and shows those with improving management scores display significantly faster increases in profitability.

In columns (4) and (5) we examine two measures of innovation – R&D spending per employee and patents applied for at the US Patent Office per employee – finding that establishments with higher management scores also appear to be significantly more innovative on these measures. Finally, in column (6) we look at Tobin's q – a measure of stock-market valuation – for the publicly listed parents of establishments in our management sample. We find that firms with higher management scores also appear to be more highly valued on the stock-exchange, consistent with Brynjolfsson, Hitt and Yang's (2002) findings about the importance of organizational capital.

In summary, we find strong evidence in Figure 1 and Table 3 that establishments and firms with more structured management practices outperform their competitors on a range of performance measures, including employment growth, profitability, R&D, patenting and stock-market valuations. Since this performance data was collected independently from our management

[19] For column 1, we condition on management (and all other controls) in 2005 so that we are looking so subsequent growth.

survey it suggests that the responses to the management survey were informative about establishments' performance. Establishments and firms adopting these kinds of proactive monitoring, targets and incentives practices do seem to robustly outperform those that do not. Given this validation test of the management data we now turn to examining the management data itself – what patterns do we see in the data and what factors appear to account for differences in management practices across firms, industries and regions?

4. Management Practices across Establishments, Regions and Time

In this section we will first examine some of the differences across establishments and regions in our data, and then turn to examining the changes in management practices over time and the factors potentially explaining this.

4.1. Differences in Management across Establishment and Regions

In Table 4 we examine what factors can explain the large spread in management practices across establishments and regions shown in Figures 2, 3 and 4. Starting in column (1) we include only indicators of the region of location and find that, as indicated in Figure 3, establishments in the Northeast (the baseline category) have the least structured management, with those in the Midwest and South scoring significantly higher.[20] In columns (2) and (3) we look at establishment and firm size individually, finding both are significantly positive, consistent with Figures 6 and 7. Larger establishments and firms seem to adopt more structured management practices. In column (4) we examine establishment age, finding older establishments have significantly higher management scores. In column (5) we look at whether the establishment was part of a multi-unit parent (part of a firm with other establishments) and find this is significantly associated with higher management scores. In column (6) we examine the share of managers and employees with a degree, and find both education measures are significantly related to higher management scores. In column (7) we examine union membership and find no significant correlation, while in column (8) we examine export status and find this is strongly related to be

[20] The point estimate for the West is higher than the Northeast, but the difference is not statistically different, so could be explained simply by sampling variation.

more structured management.

These unconditional correlations are helpful descriptive statistics but are limited because many of these factors are interrelated. For example, larger establishments tend to also be older and more heavily unionized. We may also worry about variations across industries and sampling noise – for example, maybe larger establishments have more senior managers filling out the survey who tend to be more positive on their management practices.

So in column (9) of Table 4 we include all of our establishment characteristics simultaneously, plus a set of NAICS 6-digit industries dummies, plus a full range of survey noise controls like the manager's position, the survey filing date, and the tenure of the respondent. Interestingly, we find all but two of the individual characteristics remain statistically significant and qualitatively similar. The first exception is unionization which is now negative and significant, reflecting the fact that unionized establishments tend to be larger, which once this is controlled for leads to a significant negative correlation. The second is establishment age which now has a negative (rather than positive) coefficient, because older establishments also tend to be larger.

An interesting result in column (9) is that controlling for these establishment characteristics helps to reduce the differences between regions – for example, the gap between the Northeast and the South has fallen by over half from 0.024 to 0.010 points – but remains statistically significant. Hence, while differences in industry mix and our establishment characteristics explain a large share of the differences across regions, they cannot explain all of them. So there is something beyond basic differences in sampling composition which account for the more structured management practices of establishments in the South and Midwest.

In order to investigate what factors might account for these regional differences in Table 5 we report the management scores broken down by state (for states with at least 250+ establishments). We find that the more structured management in the South and Midwest is not driven by some outlier state, but appear to reflect generally higher scores across all the states in

the region. For example, all of the top-10 states ranked by average management score are in the Midwest or South. While we do not currently have a full explanation for these differences across states and regions, we are studying these as part of our ongoing research.

4.2. Changes in Management Practices over Time

In our survey we asked respondents to report on management practices in their establishments in both 2010 and 2005, allowing us to evaluate self-reported changes in management over the previous half-decade. As we saw in Figure 5, management practices appear to have become more structured between 2005 and 2010, at least as reported by respondents of surviving establishments. Breaking down these 16 practices into sub-groups we discovered that most of the rise in structured management practices has come in practices for data-driven performance monitoring. This covered questions 1 to 5 and 8 in the survey, asking respondents about the number, frequency and extent of performance monitoring. Establishments with high scores on these questions measured a wide range of performance indicators (e.g. production, cost, waste, inventory, defects, energy use, absenteeism, deliveries on time etc.), reviewed these with managers and non-managers on at least a daily basis, and displayed these measures prominently around the establishment. Establishments with low scores collected very little performance data, evaluated this infrequently, and typically did not publicly display this information. This increase in data driven performance monitoring could reflect the increasing use of Information Communication Technology (ICT) which makes it easier for establishments to collect, display and analyze performance monitoring.

The other sub-set of questions were incentives and targets (questions 6, 7 and 9-16), which focus on management practices around pay, promotions, hiring and firing, alongside the range, depth and effectiveness of targets. These practices also appear to be becoming more structured.

To try to investigate the sources of these improvements in management practices we also asked respondents about where the managers learned about new management practices. We summarize the responses in Table 6. This shows that the most common source of new management

practices, reported by 53.7% of our establishments, is the firm headquarters. This suggests that one explanation for the more structured management practices of multi-establishment firms shown in Table 4 is the ability of individual establishments to learn from other establishments within the firm.

Secondly, we see trade associations and conferences are noted by 47.9% of establishments as a source of learning of new management practices, suggesting these played an important role in diffusing management practices. Next are consultants at 45.2%, reflecting the role of paid management consultants in helping firms adopt modern management practices. After this we see customers and suppliers (the upstream and downstream members of the supply chain) registering as accounting for 39.5% and 36.1% of respondents' sources of new management practices. Finally, a range of other sources including new employees, competitors and "none of the above" were reported by about 30% or less of respondents as sources of new management practices. In columns (2) and (3) of Table 6 we break the sample down by large and small establishments, finding relatively similar results, as we do if we split by establishment age.

5. Conclusions and Future Research

We report the results from the 2010 Census Bureau Management and Organizational Practices Survey of over 30,000 establishments across the US, finding several striking results. First, structured management practices are tightly linked to better performance: establishments adopting more structured practices for performance monitoring, target setting and incentives enjoy greater productivity and profitability, higher rates of innovation and faster employment growth. Second, there is a substantial dispersion of these practices across U.S. manufacturing establishments. We find that 18% of establishments have adopted at least 75% of structured management practices, while 27% of establishments adopted less than 50% of these. Third, larger establishments in larger firms, with more educated employees, as well as exporting establishments tend to have more structured management practices. Establishments in the South and Midwest have more structured management on average than those in the Northeast and West. Finally, we find US management appears to have become more structured over the last

half-decade for incumbents, particularly for practices involving data collection and analysis.

This was only an initial investigation, and we are currently continuing to work with the data to try and understand in more detail the factors accounting for differences in management practices across establishments, firms, industries and regions. We are also looking into refining our understanding of the importance of management practices in accounting for differences in performance across establishments – for example, in what regions and industries are management practices more or less important? Are those operating with high technology in highly competitive export markets particularly sensitive to more structured management practices? Finally, we are interested in understanding the consistency and complementarity of management practices. When and where are structured management practices most correlated with each other and with higher performance? What other management practices cluster together and when do they predict performance? Do some types of industries and regions have more consistent practices within and across establishments, and does learning about and change in management practices differ by establishment types? What type of practices fit better together and what styles work better in different industries and environments? These and a host of other questions we hope we and other researchers will answer as we continue to work on the new Management and Organizational Practices Survey (MOPS).

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Appendix:

Sample Selection: The universe for the MOPS survey is the 2009 Annual Survey of Manufactures mailout sample (ASM). The ASM is a rotating 5 year panel, conducted annually by the Census Bureau since 1973 in all years other than years for which the Census of Manufactures (CM) is not conducted (years ending in 2 and 7 when the Economic Census is conducted). The ASM sample was last revised in 2009, and it includes with certainty all manufacturing plants with at least 1,000 employees in the 2007 census and a stratified random sample of smaller establishments.[21]

The MOPS survey was sent to all ASM establishments in the ASM mailout sample. Overall, 49,782 MOPS surveys were sent, of which 2,248 were undeliverable as addressed. For the 47,534 surveys which were successfully delivered, 37,177 responses were received, implying a very high response rate of 78%. For most of our analysis, we further restrict the sample to establishments with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, have a valid identifier in the LBD (LBDNUM), have positive value added, positive employment and positive imputed capital in the ASM (see below for details on capital imputation). Table 1 shows how the numbers of firms and average employment changes as we condition on different sub-samples.

In Appendix Table A1 we report the results for linear probability models for the different steps in the sampling process. In column (1) the sample is 2010 ASM observations with positive employment and sales, which were tabbed, and the dependent variable is an indicator that equals 1 if MOPS was sent to the establishment. The right hand side of the regression includes the log of employment and a set of region and industry dummies. The establishments which were mailed the MOPS survey are somewhat larger. This is not surprising, given that establishments in ASM which were not sent the MOPS survey are expected to be either administrative records or establishments which exited late in 2010, both expected to be smaller than the average establishment. In column (2) we compare MOPS respondents to the MOPS mailout sample, finding that MOPS respondents tend to be slightly larger. Finally, in columns (3) to (5) we compare our "clean" sample to the sample of respondents and to the ASM sample, finding again that the "clean" sample has slightly larger establishments, which are also slightly more productive (column 5).

Management Scores: The management score for each establishment is generated in two steps.[22] First, the responses to of the 16 management each questions are normalized on a 0-1 scale. The response which is associated with the most structured management practice is normalized to 1, and the one associated with the least structured is normalized to zero. We define more structured management practices as those that are more specific, formal, frequent or explicit. For example, when asking "*...when was an under-performing non-manager reassigned or dismissed?*", the response "*Within 6 months of identifying non-manager under-performance*" is ranked 1 and the response "*Rarely or never*" is ranked 0. If a question has three categories, the "in between"

21 The certainty category slightly differs over industries. For more details on the ASM sample design see: http://www.census.gov/manufacturing/asm/how_the_data_are_collected/index.html

22 The full survey and instructions are available on http://bhs.econ.census.gov/bhs/mops/SUR766_9.html

category is assigned the value 0.5. Similarly for four categories the "in between" categories are assigned 1/3 and 2/3 and so on.[23] Second, the management score is calculated as the unweighted average of the normalized responses for the 16 management questions. In robustness tests we also evaluated another way to average across the 16 individual scores. We used a management z-score, which normalizes each question to have a mean of 0 and a standard deviation of 1 and averaging across these. We found that all our results were extremely similar because the average z-score is extremely correlated with our main management measure.

Additional Databases:

Establishment level: Our primary source of establishment level external data is the ASM from 2003 to 2010. We use the CM from 2002 and 2007 to obtain data on capital stocks, which is then combined with the ASM data on investment flows to impute capital stock for 2005 and 2010 (see details below). The CM is conducted every 5 years (for years ending 2 and 7) since 1967. It covers all establishments with one or more paid employee in the manufacturing sector (SIC 20-39 or NAICS 31-33) which amounts to 300,000 to 400,000 establishments per survey. Both the CM and the ASM provide detailed data on sales, value added, labor inputs, labor cost, cost of materials, capital expenditures, inventories and much more. We match the MOPS to the ASM using the SURVU_ID variable, and match the ASM to the CM, as well as ASM and CM over time using the LBDNUM variable. Finally, we use the Longitudinal Business Database (LBD) to describe the universe of establishments in Table 1 of the main paper.

Firm level: We use the 2009 Business R&D and Innovation Survey (BRDIS) data to obtain information on R&D spending and patent applications by the parent firm associated with each establishment. BRDIS provides a nationally representative sample of all companies with 5 or more employees. It is conducted jointly by the Census Bureau and the NSF and collects data on a variety of R&D activities. It replaced the Survey of Industrial Research and Development (SIRD) in 2008. The BRDIS is matched to the ASM (and then to MOPS) using the LBD. We are able to match a total of 13,888 MOPS observations in our "clean" sample to BRDIS observations with non-missing data on R&D spending and patent applications.[24] We use Compustat to calculate Tobin's q for firms. We then use the FIRMID variable to match establishments to the Compustat-SSEL bridge which allows us to match establishments with publicly traded parent firms to the parent firm record in Compustat. Since the Compustat-SSEL bridge is only updated up to 2005, we focus on analysis of the MOPS 2005 recall questions when using Compustat.

Industry level: We use the NBER-CES data for industry-level price indices for total value of shipments (PISHIP), and capital expenditures (PIINV), as well as for total cost of inputs for labor (PAY), used in the construction of cost share. We match the NBER data to the establishment data using 6-digit NAICS codes.[25] We use the BLS multifactor productivity

[23] For multiple choice questions which allow for the selection of more than one answer per year, we use the average of the normalized answers as the score for the particular question. If the question does not allow for the selection of more than one answer, but more than one box is selected, we treat the observation as missing.

[24] See http://www.census.gov/manufacturing/brdis/index.html and http://www.nsf.gov/statistics/srvyindustry/about/brdis/interpret.cfm for more details.

[25] See: http://www.nber.org/data/nbprod2005.html for the public version. We thank Wayne Gray for sharing his version of the dataset that is updated to 2009. Since The NBER-CES data are available only up to 2009, we use the 2009 values for 2010 for all external data. There are 2 industries (327111, 327112) that are missing MATCOST for 2008, and two (331411, 331419) that are missing it starting 2006. These observations are

database for constructing industry-level cost of capital and capital depreciation, and the BEA fixed assets tables to transform establishment-level capital book value to market value.[26]

Capital Imputation: As mentioned above, the capital measures are based on the CM 2002 and 2007 reported book value of assets. We first transform book values to market using the industry-level BEA fixed assets tables, and then deflate both the initial stock and the investment flows using the NBER deflators. We then apply the perpetual inventory method (PIM) to impute capital stocks for 2005 and 2010. This procedure only provides us with capital stock values in 2010 for establishments which were in the CM in 2007 and in the ASM in both 2008, 2009 and in the ASM 2010 but do not follow this criteria:

(a) If investment in 2009 is missing, impute it using the average investment for the plant in 2008 and 2010 (or 2007 and 2010 if 2008 missing).

(b) Similarly if investment in 2008 is missing, impute it using 2007 and 2009 (or 2007 and 2010 if 2009 is missing).

(c) For 2008 and 2009 births, use the establishment's 2008 or 2009 investment to initialize the capital stock. To do that use the 2007 median ratio of book value to investment for new establishments by 6 digit NAICS (winsorized at the 95%, since some industries have very small number of observations). Run the PIM again using these initial capital stocks, only for observations with missing capital stock in 2010.

(d) For observations which are still missing capital stock, impute it by using the industry median ratio of book value of capital stock to investment (these are establishments which appear in 2008 or 2009 but not in 2007, but are not marked as births). Run the PIM again only on the establishments with missing capital stock in 2010.

(e) Finally, if PIM implied zero capital stock for 2010, but investment in 2010 is positive, impute the 2010 stock using industry median as in (d).

Performance measures: Below is a summary of the measures used in the analysis:

Value added per worker: Calculated as establishment value added over total employment. In Figure 2 raw (nominal) value added is used, while in Table 2 it is deflated using industry level deflators.

Value added TFP: Value added TFP is calculated using cost shares following for example Foster, Haltiwanger, and Krizan (2000). Our calculations of TFP follow closely the appendix in Bloom et al. (2012).[27]

Employment Growth: We define growth of employment from 2005 to 2010 as $(emp_{2010}-emp_{2005})/(0.5*emp_{201}+0.5*emp_{2005})$.

Profitability: We measure profitability from ASM data as [value added-total salaries]. In Figure 2 we use this value for profitability, while in the regressions in Table 3 we use (value added- total salaries)/(total value of shipments).

R&D intensity: R&D intensity is defined as (domestic R&D expenditures)/(domestic employees). In the regressions in Table 3 the dependent variable is log(1+R&D intensity).

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therefore missing cost shares for (which are used to calculate TFP). For these 4 industries we roll forward the last value for which we have cost shares.

[26] For more details about the relevant variables from the BLS and BEA tables, see the appendix to Bloom, Floetotto, Jaimovich, Terry and Saporta (2012).

[27] The only difference is that we use a single capital stock, rather than separating equipment and structures, because separate stocks are no longer reported in the CM in recent years.

Patent intensity: R&D intensity is defined as (patent applications)/(domestic employment). In Figure 2 we report this measure multiplied by a 1,000. In the regressions in Table 3 the dependent variable is log(1+patent intensity).
Tobin's q: We compute Tobin's q as (Market value + long term debt)/(property, plant and equipment + net inventories), or using the Compustat variable names (mkvalt+ditt)/(ppent+invt).

Interview and Interviewee Characteristics: For many of the regressions we run, we check that the results are robust to including interview and interviewee Characteristics, referred to as "noise" controls or variables, These include:

- Measures for the distance between ASM and MOPS reported employment for 2005 and 2010. These are calculated as the absolute values of the difference between the MOPS and ASM reported March employment for 2010 and 2005 respectively.
- Online filing indicator.
- Date of filing in calendar weeks and the date squared. This variable would capture differences in filing patterns between early and late respondents.
- Day of week.
- Tenure of the respondent, calculated as number of years since the respondent started working at the establishment (see MOPS question 31).
- Seniority of the respondent, introduced as a set of dummy variables to capture the categories in MOPS question 30 (CEO or Executive Officer, Manager of multiple establishments, Manager of one establishment, Non-manager, Other).

Appendix Table A1: Linear regressions for sample selection

	Mailed MOPS vs ASM	MOPS Respondents vs. Mailed MOPS	Clean sample vs. MOPS respondents	Clean sample vs. ASM	Clean sample vs. ASM
Log(employment)	0.059***	0.031***	0.057***	0.096***	0.094***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log(sales/employment)					0.038***
					(0.004)
F-stat (region)	5.591	45.381	1.1	34.665	33.443
(p-value)	(0.001)	(0)	(0.348)	(0)	(0)
F-stat (industry)	10.213	7.871	8.399	15.267	11.948
(p-value)	(0)	(0)	(0)	(0)	(0)
Observations	51,461	47,503	36,140	51,461	51,461
Number of firms	28,905	26,345	20,694	28,905	28,905

Note: The table reports the results from linear probability regressions. In column 1 the sample is 2010 ASM observations with positive employment and sales, which were tabbed, and the dependent variable is an indicator that equals 1 if MOPS was sent to the establishment. In column 2 the sample is the subsample of the one in column 1, also conditioning on MOPS mailed, and the dependent variable is an indicator that equals 1 if MOPS survey was filled. In column 3 the sample is the subsample of the one in column 2, also conditioning on MOPS respondent, and the dependent variable is an indicator that equals 1 if the observation is in our baseline "clean" sample. In columns 4 and 5 the sample is as in column 1, and the dependent variable is an indicator that equals 1 if the observation is in our baseline "clean" sample. Standard errors are clustered at the firm level.

Appendix Table A2: Descriptive Statistics

A. Management Descriptives	**Mean**	**S.D.**	**p(10)**	**p(25)**	**p(50)**	**p(75)**	**p(90)**
Management score	0.640	0.152	0.427	0.553	0.667	0.753	0.812
Data driven performance monitoring	0.665	0.180	0.417	0.556	0.694	0.806	0.868
Incentives and targets	0.623	0.176	0.381	0.526	0.650	0.750	0.825
B. Establishment Characteristics							
Size	167.0	385.1	15.0	33.6	80.0	174.9	359.0
Parent firm size	3332.6	8739.8	24.0	60.0	258.3	1938.7	8327.6
Establishment Age	22.0	12.1	4.0	11.0	24.0	35.0	35.0
Parent firm age	28.4	10.4	9.0	24.0	35.0	35.0	35.0
% of managers with degree	43.6%	31.1%	10.0%	10.0%	43.6%	70.0%	90.0%
% of non-managers with degree	9.4%	12.0%	0.0%	5.0%	5.0%	15.0%	40.0%
% of union members	12.6%	27.6%	0.0%	0.0%	0.0%	0.0%	70.0%
Exporter	42.2%	49.4%	0	0	0	1	1
Multi-unit Parent	69%	46.2%	0	0	1	1	1

Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample in all columns is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, have positive value added, positive employment and positive imputed capital in the ASM. For the few cases where establishment characteristics had missing values (for the degree and union questions), we replaced these with the means in the sample, so to keep a constant sample size. P(n) is the value at the n-th percentile, e.g. p(50) is the median value (fuzzed).

Table 1: MOPS Surveyed Approximately 32,000 Manufacturing Establishments

Sample	Source	Sample Criteria	Number of establishments (in thousands)	Total employment (in thousands)	Average employment
(1) Universe of establishments	LBD	None	7,041	134 ,637	19.1
(2) Manufacturing	LBD	NAICS 31-33	298	12,027	40.4
(3) Annual Survey of Manufactures	ASM	NAICS 31-33, and either over 500 employees, or in ASM random sample. Positive employment and sales, and tabbed	51	7,387	143.5
(4) MOPS respondents	MOPS	As in (3), also responded to MOPS	36	5,629	155.8
(5) MOPS clean (baseline sample)	MOPS	As in (4) with 11+ non-missing responses, match to ASM, tabbed in ASM and have positive value added, employment and imputed capital in ASM 2010	32	5,308	167

Note: The LBD numbers are from 2009. ASM and MOPS numbers are for 2010.

Table 2: Establishments with Higher Management Scores are More Productive

Dependent variable	**Log (Value Added Per Employee)**					**Log (Productivity)**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Management	1.272***	0.657***	0.498***	0.298***	0.233***	0.488***	0.241***
	(0.05)	(0.035)	(0.037)	(0.065)	(0.082)	(0.035)	(0.069)
Log(capital/employee)			0.179***	0.036*	0.193***		
			(0.007)	(0.02)	(0.016)		
Log(employees)			-0.035***	-0.198***	-0.064***		
			(0.006)	(0.029)	(0.012)		
Share of employees with a college degree			0.418***	-0.096	0.421***		
			(0.041)	(0.138)	(0.076)		
% rise in productivity from 10^{th} to 90^{th} management %tile	63.1	28.7	21.2	12.2	9.4	20.7	9.7
Observations	31,793	31,793	31,793	35,688	17,235	31,793	35,688
Number of establishments	31,793	31,793	31,793	17,844	17,235	31,793	17,844
Number of firms (clusters)	17,843	17,843	17,843	10,557	3,285	17843	10557
Noise controls	No	No	Yes	No	Yes	No	No
Sample	Baseline	Baseline	Baseline	Both in 2005 and 2010	2010 multi-establishments	Baseline	Both in 2005 and 2010
FIXED EFFECTS	None	Industry	Industry	Establishment	Firm	Industry	Establishment

Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample in all columns is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, have positive value added, positive employment and positive imputed capital in the ASM. In columns 1 through 5 the dependent variable is log(real value added over total employment). In columns 6 and 7, the dependent variable is log of value added TFP, calculated using cost shares at the four digit level. Whenever establishment fixed effects are applied, both 2005 and 2010 are used, and the regression includes a year dummy for 2010. Noise controls (when used) include: (1) measures for the distance between ASM and MOPS reported employment for 2005 and 2010; (2) online filing indicator; (3) date of filing and date; (4) day of week; (5) tenure of the respondent; (6) seniority of the respondent. Standard errors are clustered at the firm level.

Table 3: Plants with more Structured Management are Faster Growing, More Profitable, More Innovative and More Valuable

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Emp. Growth (t to t+5)**	**Profitability (Operating profit/sales)**	**Profitability (Operating profit/ sales)**	**Log(1+R&D per employee)**	**Log(1+Patent per employee)**	**Log (Tobin's q)**
Management	0.149***	0.058***	0.041**	0.385***	0.51***	0.236**
	(0.023)	(0.01)	(0.02)	(0.104)	(0.101)	(0.095)
Log(capital/employee)	0.064***	0.01***	0.002	0.12***	0.117***	0.009
	(0.005)	(0.002)	(0.005)	(0.016)	(0.016)	(0.017)
Log(employees)	-0.114***	0.001	-0.011	0.102***	0.091***	-0.014
	(0.005)	(0.002)	(0.008)	(0.014)	(0.015)	(0.016)
Share of employees with degree	0.102***	0.004	-0.047	1.008***	0.626***	0.241***
	(0.03)	(0.011)	(0.038)	(0.09)	(0.093)	(0.093)
% rise in productivity from 10th to 90th management %tile	5.9	2.2	1.6	16.0	21.7	9.5
Observations	17,844	31,793	35,688	13,888	13,888	4,666
Number of establishments	17,844	31,793	17,844	13,888	13,888	4,666
Number of firms (clusters)	8,804	17,843	10,557	4,914	4,914	778
Sample	Both in 2005 and 2010	Baseline	Both in 2005 and 2010	Baseline + in BRDIS	Baseline + in BRDIS	2005, Compustat
FIXED EFFECTS	Industry	Industry	Establishment	Industry	Industry	Industry

Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample in all columns is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, have positive value added, positive employment and positive imputed capital in the ASM. In column 1 the dependent variable is change in employment growth between 2005 and 2010. The sample also restricts to non-missing employment and controls in the ASM for 2005 and 2010. In columns 2 and 3 the dependent variable is value added minus wages and salaries over total value of shipments. The sample in column 3 is as in column 1. In column 4 the dependent variable is the log of 1+R&D per 1000 employee from BRDIS. In column 5 the dependent variable is the log of 1+patents per 1000 employee from BRDIS. Lastly, in column 6, the dependent variable is log of Tobin's q, calculated using Compustat, and matched to ASM using the Compustat Bridge. Tobin q is defined as (market value + long term debt)/(book value of capital + inventories). Since the Compustat Bridge is updated only through 2005, this column 5 uses the 2005 management scores. In all column we have noise controls: (1) measures for the distance between ASM and MOPS reported employment for 2005 and 2010; (2) online filing indicator; (3) date of filing and date^2; (4) day of week; (5) tenure of the respondent; (6) seniority of the respondent. Standard errors are clustered at the firm level. The number of clusters is different for columns 1 and 3 because some establishments changed firm ownership between 2005 and 2010.

Table 4: Accounting for Differences in Management Practices

Dependent variable: Management Score									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Northeast	*baseline*								*Baseline*
Midwest	0.016***								0.008***
	(0.003)								(0.002)
South	0.024***								0.01***
	(0.003)								(0.002)
West	0.004								0.005*
	(0.003)								(0.003)
Log(establishment employees)		0.043***							0.024***
		(0.001)							(0.001)
Log(firm employees)			0.027***						0.015***
			(0.001)						(0.001)
Log(establishment age)				0.01***					-0.006***
				(0.001)					(0.001)
Multi-unit parent					0.09***				0.038***
					(0.002)				(0.003)
Share managers with a degree						0.081***			0.044***
						(0.004)			(0.003)
Share employees with a degree						0.100***			0.064***
						(0.008)			(0.007)
Share of union members							-0.004		-0.044***
							(0.003)		(0.003)
Exporter								0.031***	0.007***
								(0.002)	(0.002)
Noise controls	No	No	No	No	No	No	No	No	Yes

Note: 31,793 observations in every column. The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The regressors in column 1 include region dummies, with Northeast being the base. In columns 2 and 3 the regressors are log of establishment and firm employment respectively, where firm employment is total employment of the firm's establishments in the ASM. In column 4 the regressor is log of establishment age from the LBD. In column 5 the regressor is multi-unit parent flag from the LBD. In columns 6 and 7 share of managers and employees with degree, and share of union workers from MOPS are used. In column 8, the regressor is the exporter flag from the ASM. Finally, in column 9 we run all the regressors from previous columns and add noise controls: (1) measures for the distance between ASM and MOPS reported employment for 2005 and 2010; (2) online filing indicator; (3) date of filing and date^2; (4) day of week; (5) tenure of the respondent; (6) seniority of the respondent. All regressions include industry fixed effects. Standard errors are clustered at the firm level. The number of firms (clusters) is 17,843 for all columns.

Table 5: Management Scores by States and Regions

State	Score	Margin of Error	Rank*	Region	Observations
Alabama	0.612	+/- 0.019	10	South	619
Arizona	0.584	+/- 0.022	22	West	397
Arkansas	0.620	+/- 0.020	7	South	406
California	0.572	+/- 0.008	30	West	2,891
Colorado	0.580	+/- 0.023	26	West	348
Connecticut	0.584	+/- 0.018	23	Northeast	415
Florida	0.576	+/- 0.018	28	South	796
Georgia	0.623	+/- 0.017	6	South	1,025
Illinois	0.591	+/- 0.013	17	Midwest	1,584
Indiana	0.609	+/- 0.015	11	Midwest	1,188
Iowa	0.624	+/- 0.015	4	Midwest	595
Kansas	0.631	+/- 0.017	1	Midwest	423
Kentucky	0.607	+/- 0.020	13	South	645
Louisiana	0.583	+/- 0.032	24	South	382
Maryland	0.556	+/- 0.027	35	South	330
Massachusetts	0.575	+/- 0.017	29	Northeast	667
Michigan	0.566	+/- 0.014	31	Midwest	1,337
Minnesota	0.576	+/- 0.015	27	Midwest	876
Mississippi	0.615	+/- 0.015	9	South	358
Missouri	0.580	+/- 0.017	25	Midwest	743
Nebraska	0.609	+/- 0.019	12	Midwest	274
New Jersey	0.560	+/- 0.018	34	Northeast	628
New York	0.561	+/- 0.015	33	Northeast	1,074
North Carolina	0.623	+/- 0.013	5	South	1,176
Ohio	0.605	+/- 0.010	14	South	1,805
Oklahoma	0.615	+/- 0.021	8	South	358
Oregon	0.591	+/- 0.017	18	West	494
Pennsylvania	0.565	+/- 0.015	32	Northeast	1,646
South Carolina	0.624	+/- 0.020	3	South	634
Tennessee	0.626	+/- 0.014	2	South	858
Texas	0.604	+/- 0.010	15	South	1,981
Utah	0.585	+/- 0.033	21	West	343
Virginia	0.603	+/- 0.015	16	South	618
Washington	0.588	+/- 0.017	20	West	605
Wisconsin	0.589	+/- 0.013	19	Midwest	1,356
Region					
Northeast	0.568	+/- 0.007	4		5,071
Midwest	0.594	+/- 0.005	2		10,455
South	0.607	+/- 0.005	1		10,496
West	0.579	+/- 0.006	3		5,771
All	0.590	+/- 0.003	NA		

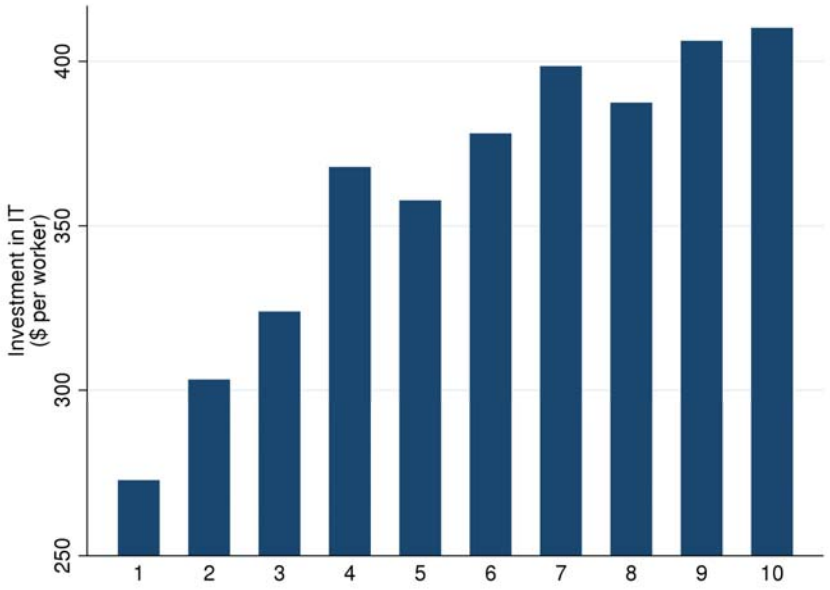
Note: Only the 35 states which had at least 250 observations are reported. The means by region and for "All" include all 50 states and the District of Columbia. All values are calculated using ASM weights. The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, have positive value added, positive employment and positive imputed capital in the ASM.

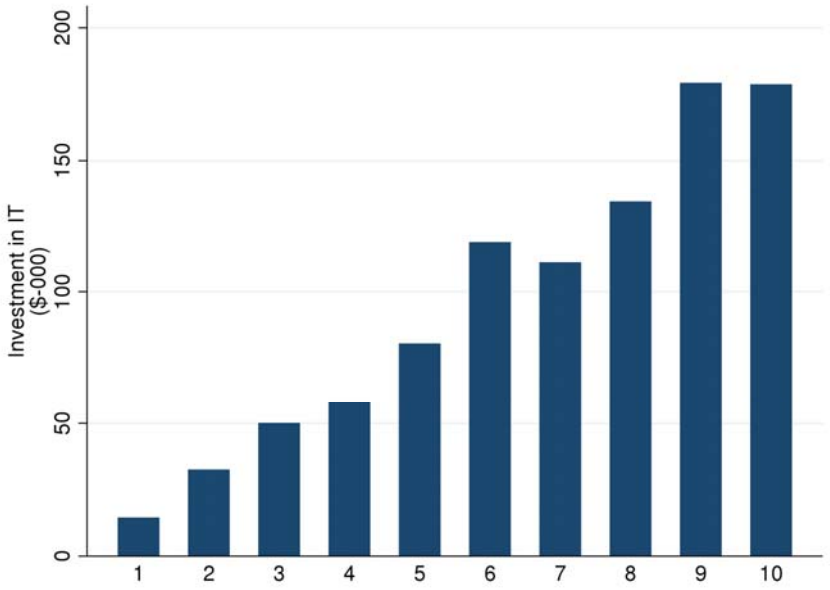
Table 6: Proportion who Learned about Management from:

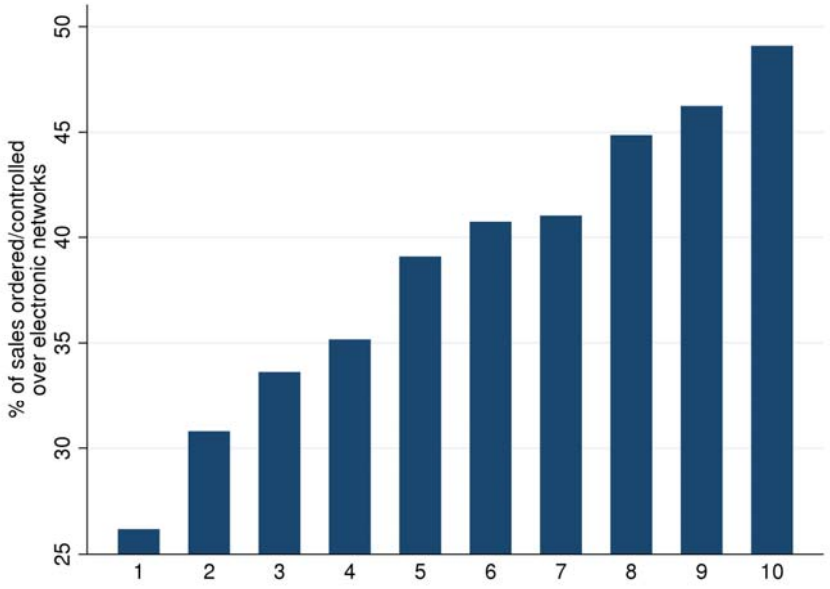
	All	Large	Small
Headquarters	0.537	0.642	0.457
Trade associations or conferences	0.479	0.563	0.416
Consultants	0.452	0.571	0.362
Customers	0.395	0.451	0.352
Suppliers	0.361	0.414	0.321
New employees	0.308	0.410	0.231
Competitors	0.243	0.269	0.224
None of the above	0.139	0.072	0.190
Other	0.074	0.083	0.067
Observations	31,626	13,590	18,036

Note: The sample is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, and have positive value added, positive employment and positive imputed capital in the ASM. The proportion is out of all non-missing responses for the question number 29 in the survey. Note that establishments were allowed to mention more than one source. In column 2, large establishments are defined as 100 employee or more.

Figure 1a: IT intensity is also associated with structured management



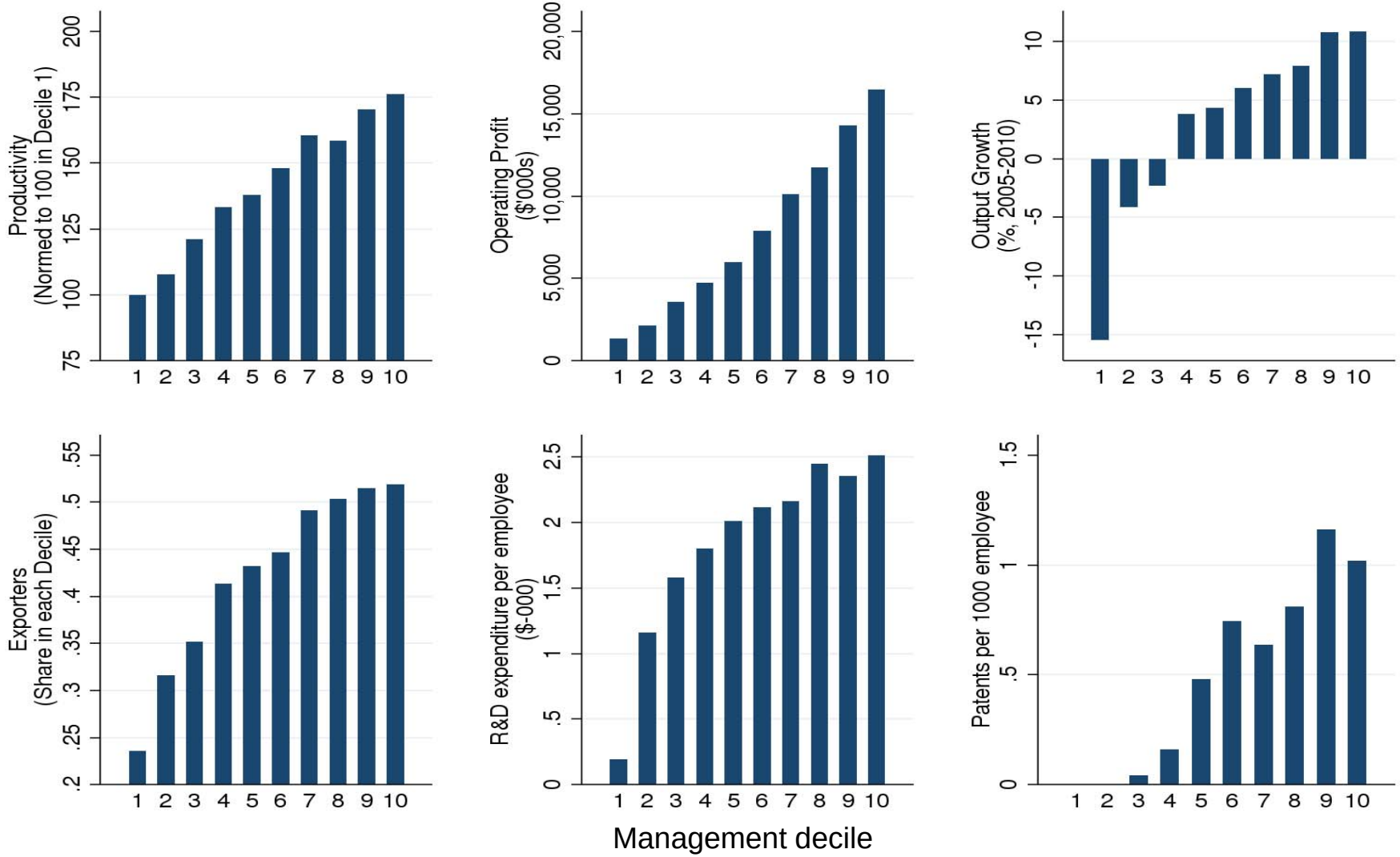




Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, and have positive value added, positive employment and positive imputed capital in the ASM. Management deciles are calculated using 2010 management scores, and the figures are unweighted.

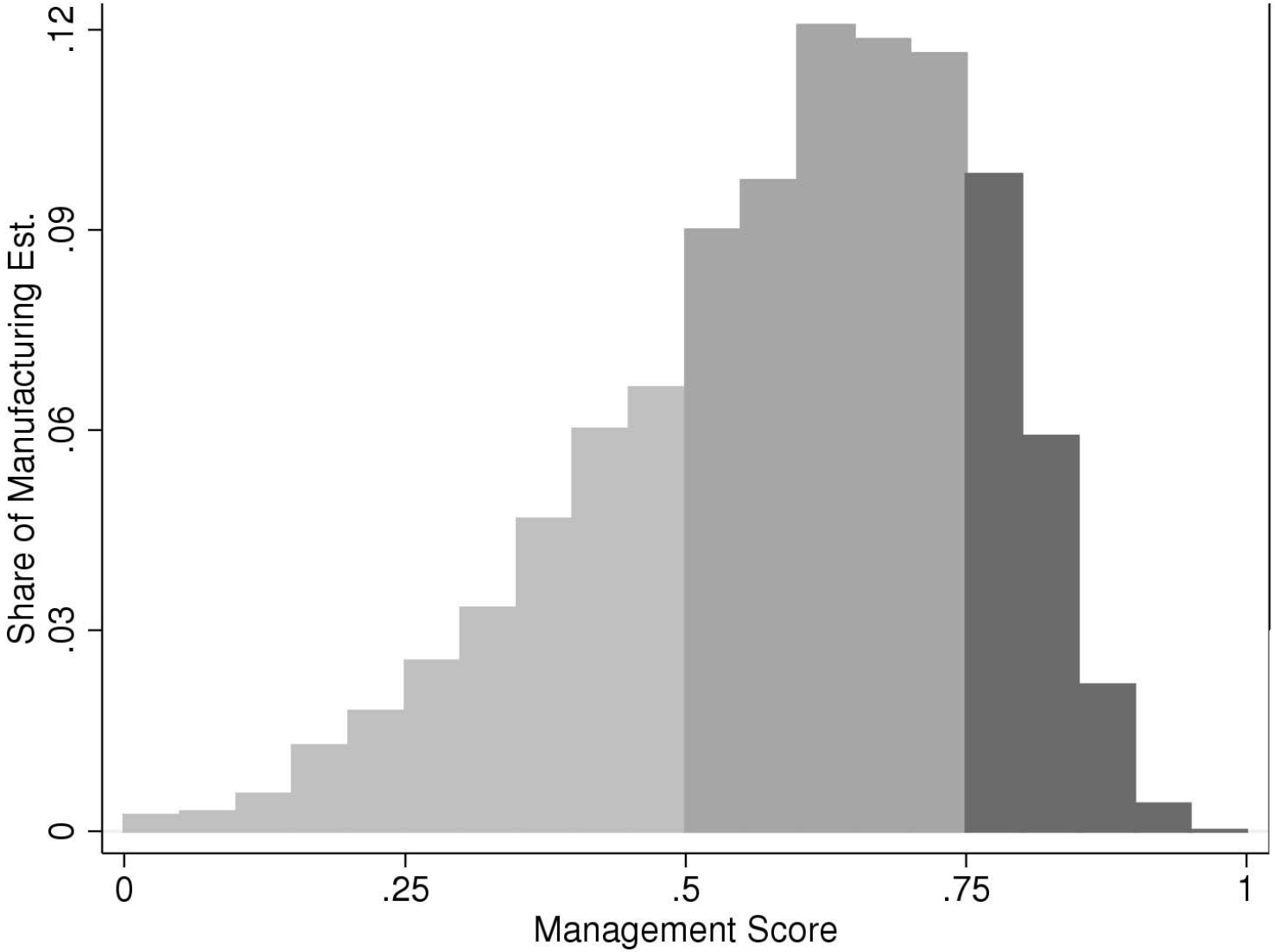
Management decile

Figure 1b: Better Performance is Associated With More Structured Management



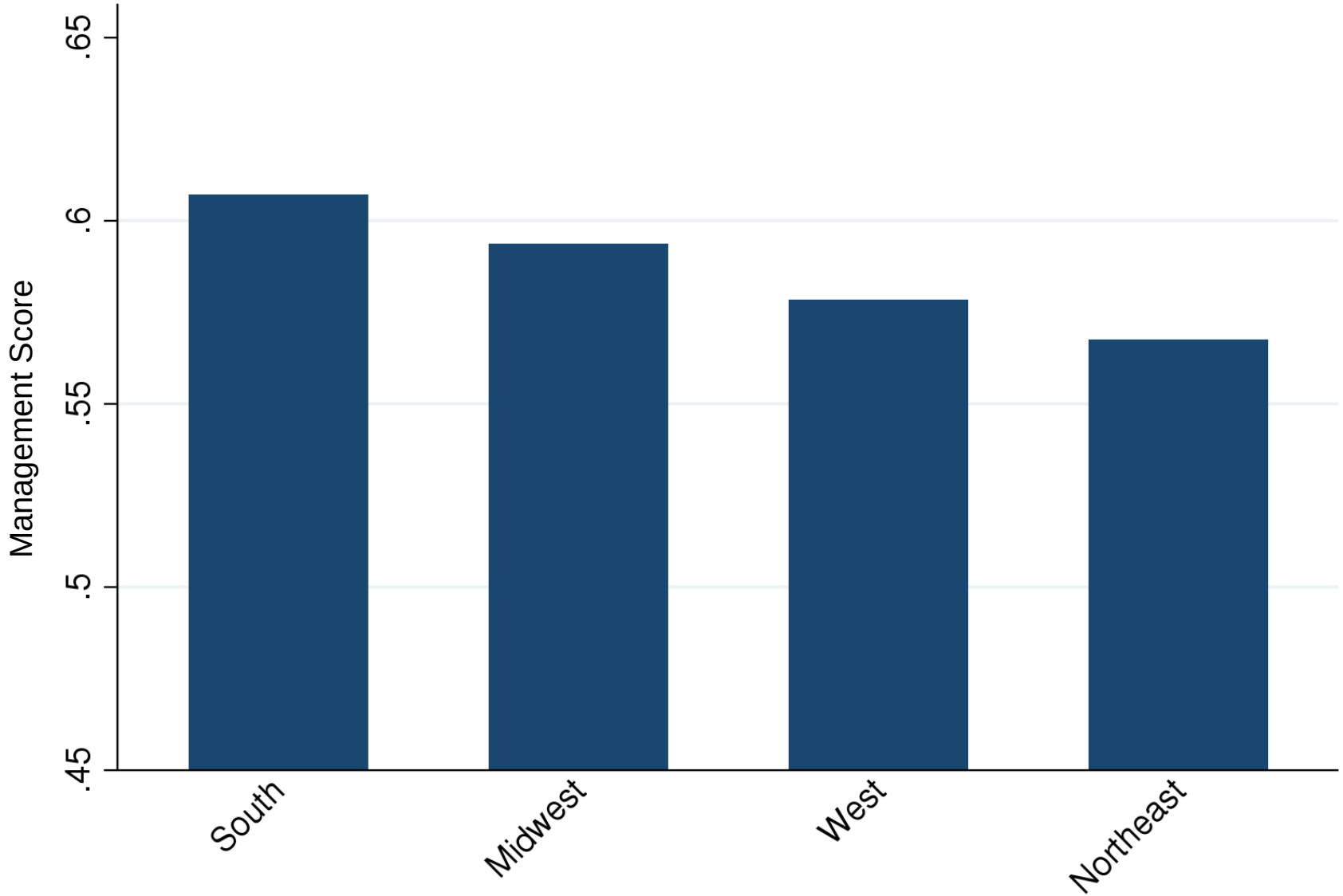
Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample for panels 1, 2 and 4 is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, and have positive value added, positive employment and positive imputed capital in the ASM. The sample in panel 3 is similar to panel 1, but also conditions on non-missing total value in the ASM 2005. The sample for panels 5 and 6 is similar to panel 1, also conditioning on non-missing R&D or patents requests count in the BRDIS survey. Management deciles are calculated using 2010 management scores for all panels. The deciles are re-calculated for the different samples. The figures are unweighted.

Figure 2: The Wide Spread of Management Scores Across Establishments



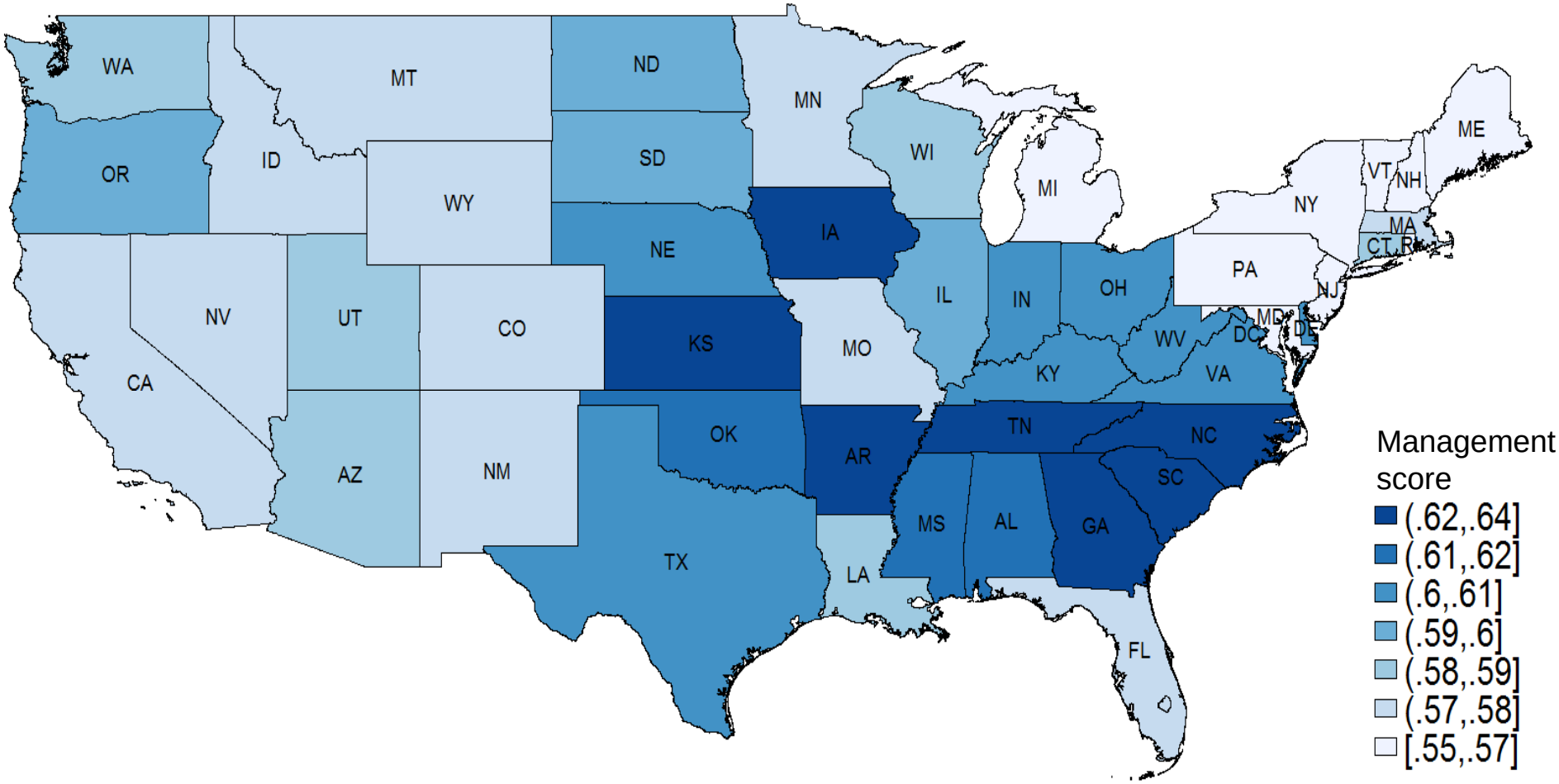
Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, and have positive value added, positive employment and positive imputed capital in the ASM. Figures are weighted using ASM weights.

Figure 3: Average Management Scores are Highest in the South and Midwest



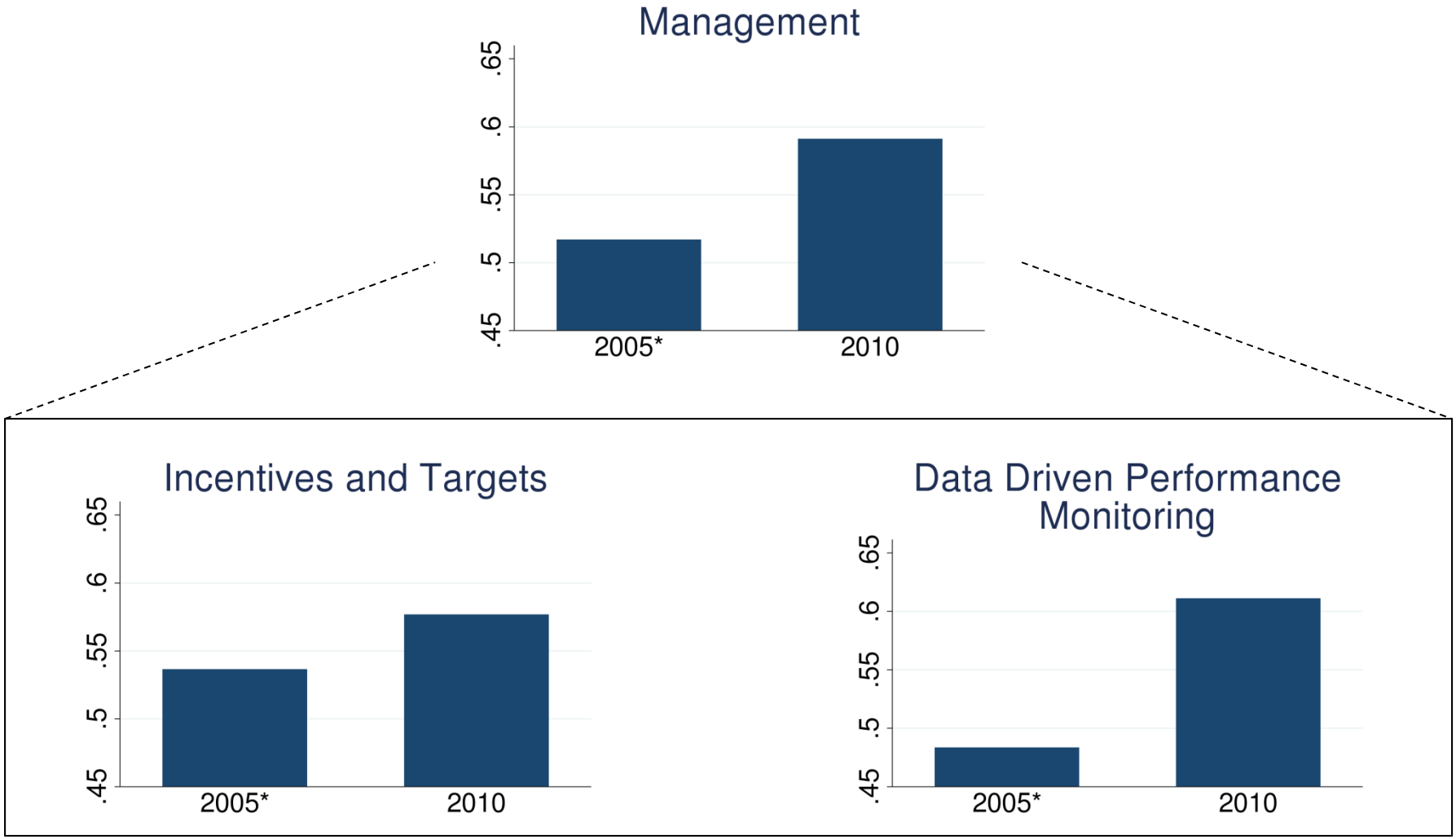
Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, and have positive value added, positive employment and positive imputed capital in the ASM. Figures are weighted using ASM weights.

Figure 4: Average Management Scores vary Across States



Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, and have positive value added, positive employment and positive imputed capital in the ASM. Figures are weighted using ASM weights. States with less than 250 observations have been given the values for their region as reported in Table 5. Differences in shading may not be statistically significant (see Table 5 for margins of error by state and region).

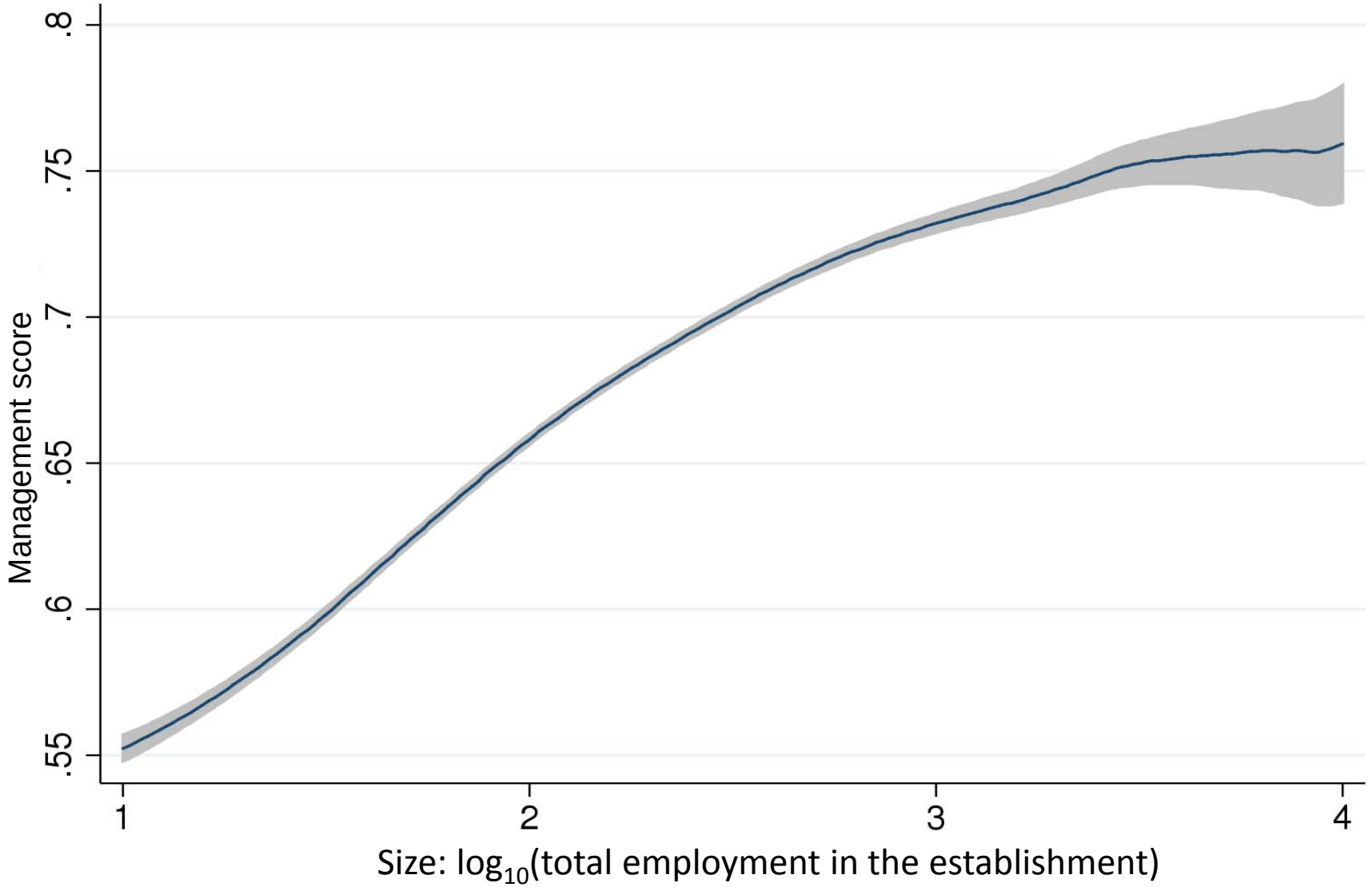
Figure 5: Average Management Scores Increased between 2005 and 2010, Especially for Data Driven Performance Monitoring



* Based on recall: When surveyed in 2010, respondents were asked about 2005.

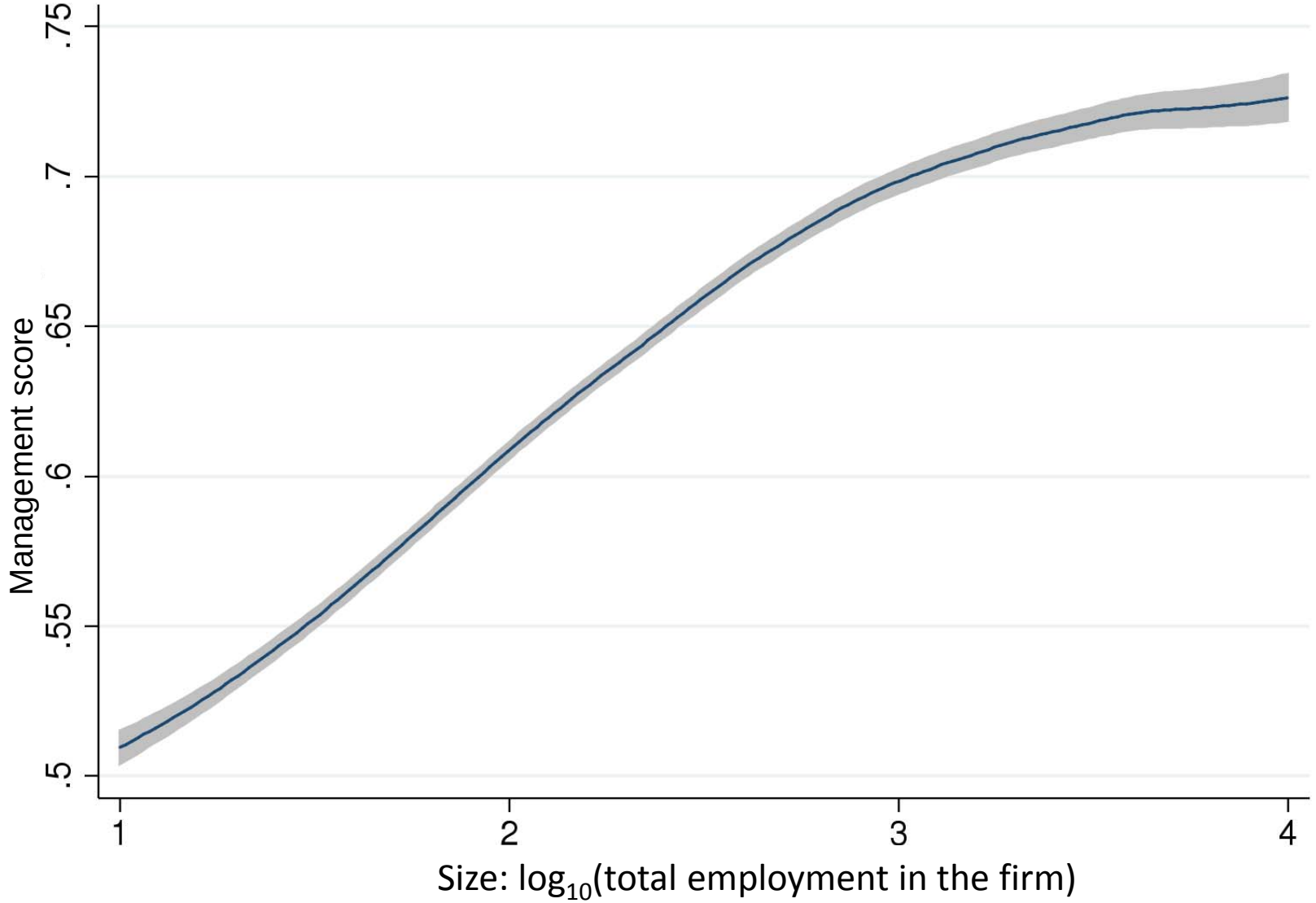
Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample is all plants with at least 11 non-missing responses to the 16 management questions for both 2010 and 2005 recall question. Figures are weighted using ASM weights, where 2010 weight is also applied to the 2005 recall question.

Figure 6: Average Management Score Rises with Establishment Size



Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, and have positive value added, positive employment and positive imputed capital in the ASM. The figure further restricts to establishment with 10 employees or more, and windsorizes establishment size at 10,000 employees. The figure was generated using a local mean smoother with Epanechnikov kernel and 0.25 bandwidth. The X axis is base 10 logarithm.

Figure 7: Average Management Score rises with Firm Size



Note: The management score is the unweighted average of the score for each of the 16 questions, where each question is first normalized to be on a 0-1 scale. The sample is all MOPS observations with at least 11 non-missing responses to management questions and a successful match to ASM, which were also included in ASM tabulations, and have positive value added, positive employment and positive imputed capital in the ASM. The figure further restricts to firms with 10 to 10,000 employees. The firm's management score is the unweighted average of the firm's establishments management scores. The figure was generated using a local mean smoother with Epanechnikov kernel and 0.25 bandwidth. The X axis is base 10 logarithm.

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