ONLINE APPENDIX

"Building a productive workforce: the role of structured management practices,"

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A Details of Data and Data Preparation

A.1 Preparation of RAIS Data and Estimation of the AKM Model

We prepare the data from RAIS in three steps. First, we extract and clean the data for the years 2003–2013. Second, we estimate the AKM model on the data from 2003–2007. Finally, we merge the estimated AKM worker and employer effects back the the RAIS data for the years of our main analysis: 2008–2013.

We otherwise impose minimal restrictions on the data for 2008–2013, which we use in our analysis. To compute the real hourly wage (in 2015 Brazilian Reais), we divide real monthly earnings by the number of contracted hours per month. To approximate the number of hours a worker is contracted to work each month, we multiply contracted hours per week, which is reported in RAIS, by $\frac{30}{7}$. Average monthly earnings are reported in nominal reais, which we convert to constant 2015 reais using the OECD's Consumer Price Index for Brazil (Organization for Economic Co-operation and Development 2019).

Before estimating the AKM model on the 2003–2007 data, we retain only observations for contract-years where: both the worker and employer IDs are valid; the record is not for a non-employer business; average monthly earnings are positive; the employed worker is between 20 and 60 years of age. For each worker, we restrict the data to one job per year: the one they worked the longest over the year, using earnings to break ties. Finally, we drop observations with data missing on race, gender, age, or education.

To estimate the AKM model, we follow the now standard approach as outlined by Abowd et al. (2002) and the implementation details from Card et al. (2013) in preparing the estimates used in Bender et al. (2018). Specifically, our time-varying observables consist of a cubic in age interacted with race and gender, along with a full set of unrestricted year effects. To ensure the worker effects are separately identified relative to the year effects and linear term in age, we normalize the age profile to flatten out at age 30 (Card et al. 2018). We find the parameter vector that solves the least squares normal equations using the pre-conditional conjugate gradient algorithm (`pcg` in MATLAB) and then separately identify the firm and worker effects within each connected components of the realized mobility network following Abowd et al. (2002).

Our primary interest is in the worker effects, θ_i, which capture the value of portable skills and represent our measure of worker quality. Under strict exogeneity of ε_{it} with respect to x_{it}, θ_i and ψ_j, least squares will produce unbiased estimates of the worker and establishment effects. Similar to Germany (Card et al. 2013), Portugal (Card et al. 2016) and the US (Song et al. 2019), the AKM model provides a reasonable description of cross-sectional variation in log wages for Brazil.[31]

After our sampling restrictions, we fit the AKM model on 176,452,785 worker-year observations that follow 52,438,357 across 3,222,859 establishments. There are 612,801 connected components, or groups, within which worker and firm effects are separately identified. As is common, well over 95 percent of all observations are within this connected component, and 100 percent of the WMS firms that we are able to match to RAIS. After fitting the AKM model, we merge the estimated worker and establishment effects to all years of the unrestricted RAIS panel. We then use the data from 2008–2013 to construct both employer-level summaries and worker-level microdata for the subsequent analysis. In this full panel, we construct several additional key variables. We use data on the date the worker separates from their job and the reason why to create a variable indicating whether a worker quit or was fired during the year. We also create a variable indicating whether a worker was hired in the current year. The RAIS data explicitly record the date of hire, so we do not have to infer when a worker was hired based on their first appearance in the firm.

We also construct indicator variables to distinguish managers from non-managers using information in reported occupation codes. In RAIS, occupations are classified according to the 2002 vintage *Classificação Brasileiro de Ocupações* (CBO) (*Classificação Brasileiro de Ocupações: Downloads - 5.1.0* 2020). We classify as managers all workers in jobs where the first digit of the CBO code is "1" or where the third digit is "0". The former captures all high-level managers and directors, while the latter captures workers who supervise others in the same broad (2-digit) occupation group. Bender et al. (2018) cannot distinguish managers directly, and instead classify as managers all workers whose estimated AKM worker effect is in the top 25 percent within their firm. We also construct an indicator variable for this alternative proxy of managerial status. Table A.1 reports a summary of the share of workers within occupations and quartiles of quality. In the Brazilian data, the classification of managers in Bender et al. does a good job in capturing the majority of managers (86%) and supervisors (67%). However, because the production workers vastly outnumber managers and supervisors, the top quartile of quality is made up of mostly production workers (51%) and technical workers (28%), with only 21% of the classification accounting for managers and production supervisors.

[31] See Alvarez et al. (2018) for evidence supporting the the AKM modeling assumptions in RAIS.

Table A.1: Quartile of wages and occupations

(a) Panel A: Share of total workers within each occupation

Occupation type	**Quartile of quality**				**Total %**	**Total count**
	1	**2**	**3**	**4**		
Managers	1.3%	3.5%	9.2%	86.0%	100%	3,481
Production workers	29.9%	28.1%	25.6%	16.4%	100%	90,133
Supervisor (production)	5.9%	8.2%	18.5%	67.5%	100%	4,787
Supervisor (technical)	23.1%	23.6%	30.2%	23.1%	100%	182
Technical/professional	11.6%	18.0%	27.2%	43.3%	100%	18,795
Total %	-	-	-	-	-	
Total count	29,521	29,278	29,413	29,166		**117,378**

(b) Panel B: Share of total workers within each quartile

Occupation type	**Quartile of quality**				**Total %**	**Total count**
	1	**2**	**3**	**4**		
Managers	0%	0%	1%	10%	-	3,481
Production workers	92%	87%	79%	51%	-	90,133
Supervisor (production)	1%	1%	3%	11%	-	4,787
Supervisor (technical)	0%	0%	0%	0%	-	182
Technical/professional	7%	12%	18%	28%	-	18,795
Total %	100%	100%	100%	100%	-	
Total count	29,521	29,278	29,413	29,166		**117,378**

Notes: Data from WMS-RAIS matched dataset for 2008 only. Occupation types are classified using the Brazilian Occupational Classification (CBO), and quartiles of quality are classified based on the top quartile of worker quality estimated using an AKM model on the RAIS data from 2003 to 2007. Panel (A) has the share of workers within each occupation across each quartile of quality, with each row adding up to 100%. Panel (B) has the share of workers within each quartile of quality across each occupation, with each column adding up to 100%.

A.2 Analysis Samples

We construct our main plant-level analysis samples to replicate Bender et al. (2018), treating the full WMS as a repeated cross-section, and merging plant-level summaries from the RAIS data for each plant-year observation. In Brazil, the WMS was conducted in two waves: one in 2008 and another in 2013. The WMS data for Brazil cover 1,145 firm-year observations: 585 from 2008 and 560 from 2013. In 2013, 331 are re-interviews of firms originally surveyed in 2008. There are 814 distinct firms. Of these, 69 firms do not have a valid identifier, so 745 firms are at risk to be matched to RAIS. We are able to match RAIS summaries to 966 observations. We standardize the management scores and summaries of average worker quality relative to the matched sample.

Bender et al. (2018) prepare the data used for analysis of worker flows in a slightly different way. They use construct a single cross-section of firms that ever appear in WMS. They then construct and match summaries of the characteristics of workers who join or leave the WMS firms over a range of years. To replicate their analysis, we prepare the data similarly. We construct a cross-section of WMS firms. For firms that appear in both 2008 and 2013, we retain the information from 2008. We then match these firms to summaries of the RAIS data for each year between 2008–2013. We are able to match 706 of the 745 WMS firms with valid identifiers to data and a total of 3,857 plant-year observations. This represents the maximum number of firms in each piece of analysis, though sometimes the firm count drops slightly as a result of missing observations for key variables in a particular model. We also use the microdata version of the flow data in our extensions looking at hiring, firing, and retention differences between firms with and without structured management practices. Specifically, using the same cross-section information on the 745 WMS firms, we match the microdata records for each contract in each year between 2008 and 2013. There are approximately 1.2 million contract-year observations with AKM information in the flow microdata.

B Productivity estimates

We match firm revenue, employment and materials expenditures from the Brazilian annual industrial survey, *Pesquisa Industrial Anual* (PIA) to our WMS-RAIS matched sample of firms. While the survey does not produce a direct measure of capital stock, one is estimated by the flagship Brazilian economic research institute, *Instituto de Pesquisa Economica Avancada* (IPEA) and made available to eligible researchers. We accessed PIA through an agreement with the Brazilian statistics agency, *Instituto Brasileiro de Geografia e Estatistica* (IBGE), in Rio de Janeiro. For this analysis, we use the definition of worker quality based on occupation codes, and not simply the top quartile of workers as in Bender et al..

We favor this classification because, as discussed in the paper, the top quartile definition in Brazil picks up primarily production workers and not managers or supervisors.

Columns (1) and (2) exclude factor inputs and replicate the finding from Germany that firms with higher overall management scores have larger revenues. Moving from Column (1) to Column (2), we see that part, but not all, of the relationship between management score and revenues is mediated through average worker quality. Adding the factor inputs in Column (3) reduces the estimated management-score coefficient by almost 50%, similar to Bender et al.[32]

In Columns (4)-(6), we use our occupation-based definition to distinguish manager and non-manager quality. Column (4) indicates that both matter for productivity, but variation loads to a much greater degree on manager quality: the manager quality coefficient estimate of .078 is more than twice that of non-managers. Column (5) shows the results are robust to controlling for the share of workers with a college degree, another proxy for worker quality. When we add the AKM firm effect in Column (6), the estimated coefficient of production-worker quality is no longer statistically significant. However, the management score and manager quality still predict sales, albeit with slightly smaller magnitudes. These results are consistent with the conclusion of Bender et al. that not all of the relationship between management practices and productivity can be explained by differences across firms in worker quality. They also suggest that higher wages may be one tool firms use to attract better production workers and motivate them to work harder.

We also replicate the productivity-related figures in Bender et al. in Figure B.1. Panel (a) replicates the relationship between productivity and the management score, where we see a consistent positive (and effectively linear) relationship. Panel (b) replicates the relationship between productivity and the average worker fixed effect from the AKM model. Here there is a difference in the shape of the relationship, where in Brazil it is more consistently positive across the support of the distribution whereas in Germany it is relatively flat in the lower end of the employee quality distribution, and positive in the upper half of the distribution. Panel (c) replicates the relationship between productivity and the average firm fixed effect from the AKM model. We again see a consistent positive relationship. In Panel (d) we replicate the relationship between management score and the firm fixed effect, and see a consistent positive relationship albeit slightly noisier.

[32]The decision to include the management score as a linear term may appear to be a strong assumption given evidence elsewhere showing non-linear relationships between performance and strategic management (Chadwick 2007). The assumption of linearity is supported by Figure B.1, which shows the non-parametric relationship between the WMS management score and productivity.

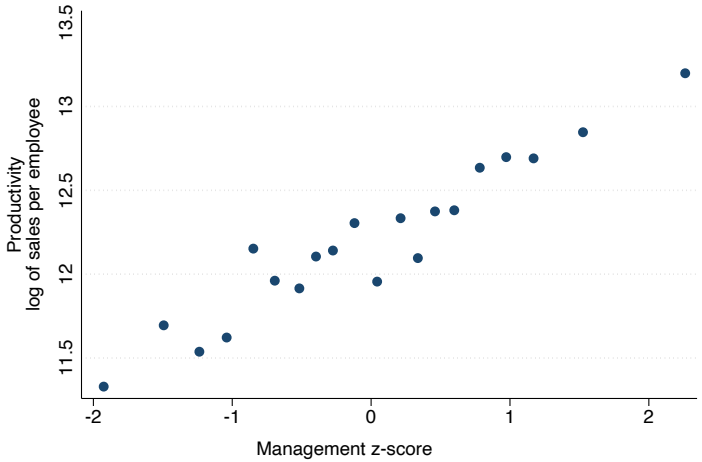
Table B.2: Productivity, management practices, and worker quality

Dependent variable: ln(sales)	(1)	(2)	(3)	(4)	(5)	(6)
Management score						
z-management	0.213***	0.168***	0.088***	0.065***	0.064***	0.059***
	(0.039)	(0.039)	(0.02)	(0.01)	(0.01)	(0.01)
AKM quality measures						
z-worker quality		0.247***	0.076***			
		(0.039)	(0.02)			
z-production worker quality				0.031**	0.028*	0.010
				(0.02)	(0.02)	(0.02)
z-manager quality				0.078***	0.076***	0.053***
				(0.02)	(0.02)	(0.02)
z-AKM firm effect						0.098***
						(0.02)
Firm characteristics						
Share workers with college degree					0.05	0.05
					(0.10)	(0.10)
Factor inputs			✓	✓	✓	✓
Industry	✓	✓	✓	✓	✓	✓
Ownership	✓	✓	✓	✓	✓	✓
# Observations	775	775	773	663	663	663
# Firms	679	679	679	594	594	594
R^2	0.753	0.796	0.96	0.97	0.97	0.97
Bender et al estimates for their Table 3 (for comparison, coefficients only)						
Management score	*0.264****	*0.199****		*0.35****	*0.33**	*0.029*
Employee quality		*0.821****		*0.110**	*0.083*	*0.058*
Managerial quality				*0.082**	*0.082**	*0.082**
ln(firm effect - wages)						*0.039**
% employees with college degree					*0.192*	*0.282*

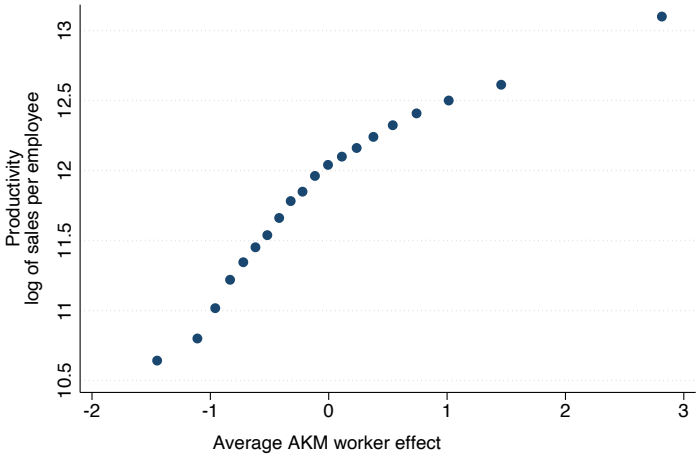
Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Estimates from regressions of ln(sales) on WMS management score, AKM quality measures, and firm characteristics. Factor inputs include log of capital, raw materials, and log of number of employees.

Figure B.1: Replication of Bender et al. (2018) figures associated with production function estimation

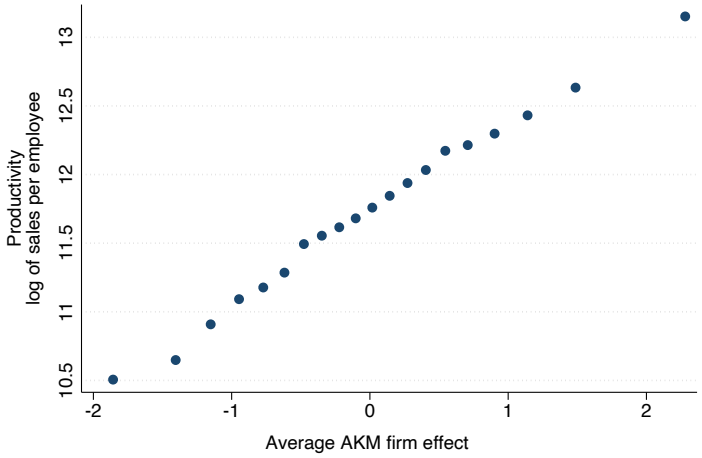
(a) Bender et al. (2018) Figure 5 replication



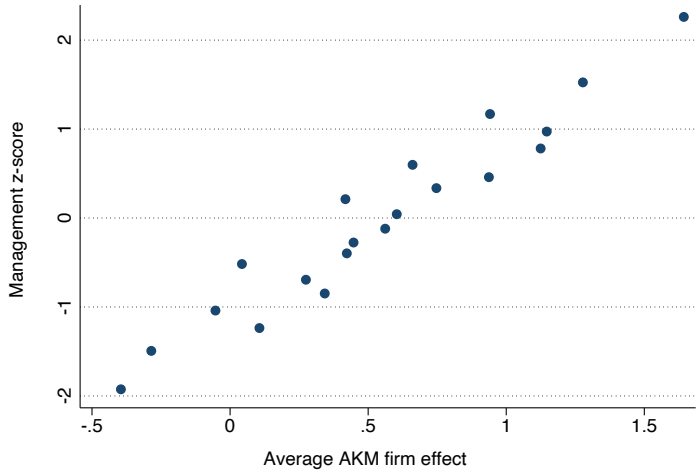
(b) Bender et al. (2018) Figure 6 replication



(c) Bender et al. (2018) Figure 7(a) replication



(d) Bender et al. (2018) Figure 7(b) replication



Notes: Firm data from the Brazilian Annual Industrial Survey (PIA). Management data from the World Management Survey (WMS). Worker data from the Brazilian roster of formal employment, (RAIS). Productivity is measured as the log of sales per employee. Management is measured as the standardized average score of the WMS questions. AKM effects are the two-way fixed effects estimated using the Abowd et al. method. Panels (a) to (c) show average productivity within vingtiles of management in (a), vingtiles of AKM worker effect in (b), and vingtiles of AKM firm effect. Panel (d) shows the average management z-score relative to vingtiles of the AKM firm effect. Variables were residualized by regressing the underlying variable on log employment.

C Clarification of variable definitions

The Bender et al. code archive does not include the processing code that generated the dependent variables used in their Tables 7 and 8. It also does not include the code used to produce Table 8. We believe, based on statements in the text and the context, that our dependent variables are equivalent to the variables they used for these models. However, the variable labels in their Tables 7 and 8 in Bender et al. are unclear, and in some cases we believe them to be unintentionally inaccurate. The lack of clarity has primarily to do with how they communicate about what they call worker "ability", and we call worker quality. In both papers, these terms refer to the estimated worker effects from the AKM decomposition. The worker effects are measured in logarithmic units by construction, leading to some confusion in the table labeling.

For example in their Table 7 ("Outflows to Unemployment"), the dependent variable is labeled as "ln(Average Ability of Outflows) - ln(Average Ability of Incumbents)". Taken at face value, this labeling suggests that they (1) compute the average worker effect of outflows, and then take its logarithm; (2) compute the average worker effects of incumbents, and take its logarithm, then (3) take the difference. Constructing the dependent variable that way does not make sense, though, because worker effects are already in logarithmic units. The authors are clearly aware of this: in the text, they state that "the dependent variable in all models is the average value of the person effect for leavers who move to unemployment, normalized by differencing from the mean person effect at the firm among all employees in the previous year". The code archive provided by *Journal of Labor Economics* does not include the code that generated that variable, but their naming conventions elsewhere suggest it is a measure of the standardized person effect of outflows to unemployment, presumably net of the standardized person effect of retained workers based on the text. The dependent variable in our corresponding Table VI is defined, as we state in the text, as "the difference between the average ability of fired and retained workers". That is, in exactly the same way as in their paper.

In building our replication of their Table 8 (our Table III), the code archive does not describe how their table was estimated nor how the dependent variables were constructed. The text does not provide any clarification. The dependent variables in our Table III are:

- The difference between the log wages of the 90th percentile worker and the 10th percentile worker (Columns 1 and 2).
- The standard deviation of log wages within the firm-year (Columns 3 and 4).
- The difference between the estimated person effects of the 90th percentile worker and the 10th percentile worker (Columns 5 and 6).

- The standard deviation of estimated person effects within the firm-year (Columns 7 and 8).

These definitions are based on the text and the nature of the exercise. Bender et al. state that they "take the 90-10 difference in ln(wages) at each firm in our sample as the dependent variable" for columns 1 and 2. Because the AKM model is additive in log wages, the worker effects (called “quality” or “ability” in our paper and theirs) are already measured in logarithmic units. Hence, we conclude that the dependent variable in columns (5) and (6) of their table is the 90-10 difference in worker ability / person effects, without any redundant logarithmic transformation. As we state in footnote 4 from the previous submission. One apparent discrepancy is that their labeling suggests they report results for the coefficient of variation in the natural logarithm of wages and the natural logarithm of worker quality. We use the standard deviation because wages and worker quality are already measured in logarithmic units, so re-scaling by the mean is not necessary. Additionally, note that using the standard deviation is consistent with other work by some of the authors (Card et al. 2013; Song et al. 2019). For completeness, Table C.3 shows results using the coefficient of variation rather than the standard deviation of log wages and worker quality.

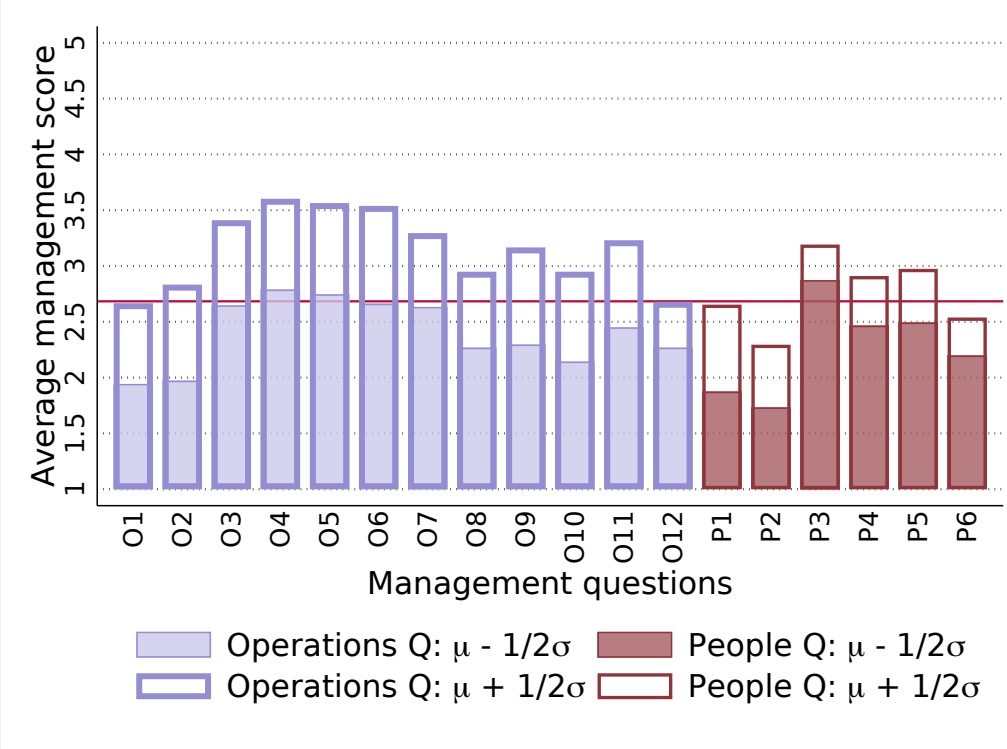
Table C.3: Within-firm heterogeneity in wages and worker quality, using coeff. of variation

	90-10 Log Wages		Coefficient of Variation in Log Wages		90-10 Quality		Coefficient of Variation in Quality	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
z-management	0.143***	0.096***	0.008***	0.004	0.175***	0.106***	3.647	5.428
	(0.016)	(0.016)	(0.002)	(0.002)	(0.025)	(0.024)	(4.332)	(6.079)
General Controls		✓		✓		✓		✓
Observations	964	964	964	964	964	964	964	964
Firms	696	696	696	696	696	696	696	696

Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. This table is identical to Table C.3 in the main text, except here we report models of the coefficient of variation in log wages and in worker quality for consistency with the presented results in Bender et al. (2018). Estimates from linear regression models on matched WMS-RAIS firm-year data. All models control for year effects. Where indicated, models also include the set of general controls: region indicators, total employment, firm age, ownership status, the female share in employment, the number of competitors, 2-digit industry controls, and a cubic in the AKM coverage share. The management score is standardized relative to the estimation sample.

D Supplementary tables and figures

Figure D.2: Scores on individual management questions for firms above and below the overall average



Notes: Data from the World Management Survey, averaging 1,145 observations for 814 Brazilian firms. Each shaded bar plots the average score for firms half a standard deviation below the mean, and each line bar plots the average score for firms half a standard deviation above the mean for that management topic. The overall average management score, which is indicated by the horizontal red line, is 2.6 for Brazilian firms.

Table D.4: World Management Survey Questions: Operations management

Q	Question topic	Explanation of scoring
O1	Adoption of modern practices (Lean operations sub-index)	What aspects of manufacturing have been formally introduced, including just-in-time delivery from suppliers, automation, flexible manpower, support systems, attitudes, and behavior?
O2	Rationale for adoption (Lean operations sub-index)	Were modern manufacturing techniques adopted just because others were using them, or are they linked to meeting business objectives like reducing costs and improving quality?
O3	Process problem documentation (Monitoring sub-index)	Are process improvements made only when problems arise, or are they actively sought out for continuous improvement as part of normal business processes?
O4	Performance tracking (Monitoring sub-index)	Is tracking ad hoc and incomplete, or is performance continually tracked and communicated to all staff?
O5	Performance review (Monitoring sub-index)	Is performance reviewed infrequently and only on a success/failure scale, or is performance reviewed continually with an expectation of continuous improvement?
O6	Performance dialogue (Monitoring sub-index)	In review/performance conversations, to what extent are the purpose, data, agenda, and follow-up steps (like coaching) clear to all parties?
O7	Consequence management (Monitoring sub-index)	To what extent does failure to achieve agreed objectives carry consequences, which can include retraining or reassignment to other jobs?
O8	Target balance (Target setting sub-index)	Are the goals exclusively financial, or is there a balance of financial and non-financial targets?
O9	Target interconnection (Target setting sub-index)	Are goals based on accounting value, or are they based on shareholder value in a way that works through business units and ultimately is connected to individual performance expectations?
O10	Target time horizon (Target setting sub-index)	Does top management focus mainly on the short term, or does it visualize short-term targets as a "staircase" toward the main focus on long-term goals?
O11	Target stretching (Target setting sub-index)	Are goals too easy to achieve, especially for some "protected/special" areas of the firm, or are goals demanding but attainable for all parts of the firm?
O12	Performance clarity (Target setting sub-index)	Are performance measures ill-defined, poorly understood, and private, or are they well-defined, clearly communicated, and made public?

Notes: Table contents from Bloom et al. (2014). The Q column refers to the question numbers as we have defined the indices in this paper (operations and people management), and matches the summary statistics in Figure D.2. The question topic column includes the topic title and, in parentheses, the WMS sub-index topic. The main difference between our categorization and the WMS is that we

Table D.5: World Management Survey Questions: People management

Q	Question topic	Explanation of scoring
P1	Managing human capital (People management sub-index, survey Q13)	To what extent are senior managers evaluated and held accountable for attracting, retaining, and developing talent throughout the organization?
P2	Rewarding high performance (People management sub-index, survey Q14)	To what extent are people in the firm rewarded equally irrespective of performance level, or is performance clearly related to accountability and rewards?
P3	Fixing poor performers (People management sub-index, survey Q15)	Are poor performers rarely removed, or are they retrained and/or moved into different roles or out of the company as soon as the weakness is identified?
P4	Promoting high performers (People management sub-index, survey Q16)	Are people promoted mainly on the basis of tenure, or does the firm actively identify, develop, and promote its top performers?
P5	Attracting human capital (People management sub-index, survey Q17)	Do competitors offer stronger reasons for talented people to join their companies, or does a firm provide a wide range of reasons to encourage talented people to join?
P6	Retaining human capital (People management sub-index, survey Q18)	Does the firm do relatively little to retain top talent, or does it do whatever it takes to retain top talent when they look likely to leave?

Notes: Table contents from Bloom et al. (2014). The Q column refers to the question numbers as we have defined the indices in this paper (operations and people management), and matches the summary statistics in Figure D.2. The question topic column includes the topic title and, in parentheses, the WMS sub-index topic. The main difference between our categorization and the WMS is that we bundle the operations sub-practices into one, so we can effectively compare people and non-people practices. The last column includes a more detailed explanation of the types of follow-up questions that are asked of the manager to garner the information required for scoring.

Table D.6: Frame frequencies: RAIS, Orbis, and WMS

Count of firms that...	2008	2013
Appear in RAIS but not in Orbis	3021141	3758345
Appear in RAIS and Orbis but not in WMS frame	18025	14663
Appear in RAIS and WMS frame, but were not surveyed	754	444
Appear in RAIS and WMS survey sample	492	491
Appear in WMS survey sample but not RAIS	93	69
Total	3040505	3774012

Notes: This table reports the number of firms in different cuts of the data.
Row 1 reports the number of firms that appear in RAIS in 2008 or 2013 that do not appear in the Orbis universe.
Row 2 reports the number of firms that appear in RAIS and Orbis universe that do not appear in the WMS sampling frame.
Row 3 reports the number of firms that appear in RAIS and in the WMS sampling frame that are not surveyed.
Row 4 reports the number of firms that are surveyed for WMS and match to RAIS.
Row 5 reports the number of firms surveyed for WMS that do not match to RAIS.

Table D.7: Sampling and frame restrictions (RAIS): 2008

	RAIS w/o Orbis	Orbis w/o Frame	Frame w/o WMS	WMS with RAIS
General RAIS				
End of year emp. (RAIS)	12.07	100.5	296.6	270.1
share of male employees (RAIS)	0.579	0.673	0.692	0.725
Avg. worker age (RAIS)	33.66	32.71	33.67	33.44
Monthly earnings (2015 BRL)	1138.9	1616.3	2392.1	2665.6
Share white	0.668	0.696	0.686	0.689
Size class				
Zero	0.111	0.0155	0.0106	0.0102
less than 5	0.570	0.0388	0.0411	0.0142
5 to 9	0.159	0.0223	0.0186	0.00610
10 to 19	0.0868	0.0400	0.0265	0.0183
20 to 49	0.0472	0.352	0.0650	0.0630
50 to 99	0.0131	0.327	0.147	0.120
100 to 249	0.00767	0.140	0.377	0.429
250 to 499	0.00294	0.0391	0.172	0.226
500 to 999	0.00147	0.0161	0.0849	0.0752
Region				
North	0.0375	0.0352	0.0398	0.0467
Northeast	0.142	0.0920	0.0716	0.0813
Southeast	0.509	0.560	0.622	0.573
South	0.219	0.274	0.240	0.266
Central-West	0.0913	0.0385	0.0265	0.0325

Notes: This table reports the summaries of RAIS variables for firms in different data samples, as defined in Table D.6.
Column 1 includes firms that appear in RAIS in 2008 or 2013 that do not appear in the Orbis universe.
Column 2 includes firms that appear in RAIS and Orbis universe that do not appear in the WMS sampling frame.
Column 3 includes firms that appear in RAIS and in the WMS sampling frame that are not surveyed.
Column 4 includes firms that are surveyed for WMS and match to RAIS.

Table D.8: Sampling and frame restrictions (WMS): 2008

	WMS w/RAIS	WMS w/o RAIS
General WMS		
Management score	2.706	2.612
# employees (plant)	316.7	267.9
Firm age (years)	35.72	35.76
% of managers	4.515	4.570
Ownership		
Family owned	0.234	0.204
Founder owned	0.370	0.430
Manager owned	0.0183	0.0108
Nonfamily private owned	0.134	0.118
Institutionally owned	0.201	0.183
Government ownership	0.0427	0.0538

Notes: This table reports the summaries of WMS variables for firms that are, and are not matched to RAIS.
Column 1 includes firms that are surveyed for WMS and match to RAIS.
Column 2 includes firms surveyed for WMS that do not match to RAIS.

Table D.9: Sampling and frame restrictions (RAIS): 2013

	RAIS w/o Orbis	+ Orbis w/o Frame	+Frame w/o WMS	+ WMS
General RAIS				
End of year emp. (RAIS)	12.11	118.9	271.6	304.5
share of male employees (RAIS)	0.556	0.654	0.653	0.698
Avg. worker age (RAIS)	34.53	35.15	35.60	34.53
Monthly earnings (2015 BRL)	1367.8	1950.9	2683.5	3001.6
Share white	0.604	0.646	0.646	0.643
Size class				
Zero	0.106	0.0241	0.0293	0.0163
less than 5	0.564	0.0659	0.0653	0.0285
5 to 9	0.164	0.0376	0.0248	0.0143
10 to 19	0.0886	0.0681	0.0631	0.0265
20 to 49	0.0498	0.261	0.133	0.0570
50 to 99	0.0140	0.275	0.176	0.145
100 to 249	0.00792	0.173	0.245	0.312
250 to 499	0.00286	0.0574	0.133	0.240
500 to 999	0.00143	0.0237	0.0833	0.110
Region				
North	0.0415	0.0358	0.0428	0.0367
Northeast	0.155	0.0926	0.0811	0.0896
Southeast	0.493	0.565	0.606	0.578
South	0.216	0.269	0.232	0.269
Central-West	0.0955	0.0374	0.0383	0.0265

Notes: This table reports the summaries of RAIS variables for firms in different data samples, as defined in Table D.6.
Column 1 includes firms that appear in RAIS in 2013 that do not appear in the Orbis universe.
Column 2 includes firms that appear in RAIS and Orbis universe that do not appear in the WMS sampling frame.
Column 3 includes firms that appear in RAIS and in the WMS sampling frame that are not surveyed.
Column 4 includes firms that are surveyed for WMS and match to RAIS.

Table D.10: Sampling and frame restrictions (WMS): 2013

	WMS	WMS - RAIS
General WMS		
Management score	2.685	2.597
FIRM: employees (plant)	329.6	269.1
Firm age (years)	37.95	38.69
% of managers	5.088	6.319
Ownership		
Family owned	0.297	0.203
Founder owned	0.348	0.507
Manager owned	0.0102	0.0145
Nonfamily private owned	0.143	0.0725
Institutionally owned	0.185	0.203
Government ownership	0.0163	0

Notes: This table reports the summaries of WMS variables for firms that are, and are not matched to RAIS.
Column 1 includes firms that are surveyed for WMS and match to RAIS.
Column 2 includes firms surveyed for WMS that do not match to RAIS.

Table D.11: Cause of separation and next-job statistics

Type of separation	Mean	SD	Min	Max	N
Fires					
change in log wage	0.031	0.471	-4.827	4.770	549852
months in unemployment	8.400	3.968	0	20	400562
Quits					
change in log wage	0.162	0.446	-3.966	4.801	139927
months in unemployment	7.634	4.361	0	20	74130
Other					
change in log wage	0.117	0.373	-4.413	4.282	407051
months in unemployment	4.522	3.147	0	20	305388

Notes: This table reports an analysis of a five percent random sample of all male workers age 23 to 50 observed in RAIS between 2008 and 2013. Each entry corresponds to a pair of adjacent years for which the RAIS report that the job in the initial year ended for any reason. We restrict the sample to include only observations where we observe a change in the employer identifier acros adjacent years. For each observation, we record the change in the hourly wage between the initial year dominant job and the next year dominant job and the number of months between the reported end date of the initial job and the reported start date of the new job. Duration of unemployment measured in months.

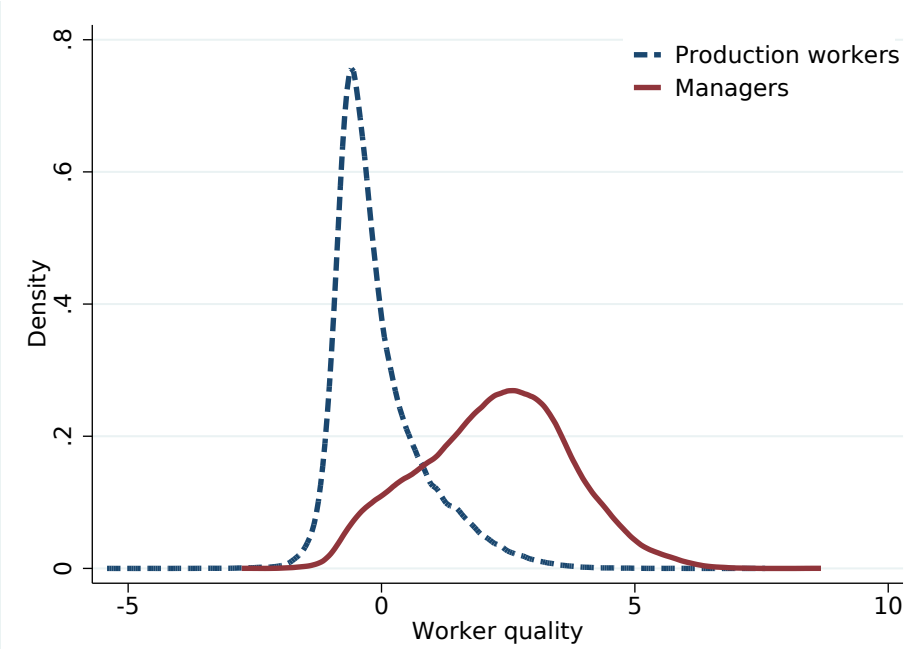
Table D.12: Correlation between management practices and worker quality: Alternative specifications

	Overall mgmt. z-score		People mgmt. z-score	
	(1)	(2)	(3)	(4)
Mean employee quality	-0.074		0.003	
	(0.076)		(0.073)	
Mean manager quality (BBCVW measure)	0.207**		0.109	
	(0.073)		(0.077)	
Mean non-manager quality (occ.-based)		0.073		0.098*
		(0.038)		(0.041)
Mean manager quality (occ.-based)		0.041		-0.018
		(0.038)		(0.041)
Ln of firm employment (WMS)	0.301***	0.302***	0.238***	0.243***
	(0.033)	(0.034)	(0.037)	(0.038)
% all workers with degree	1.421***	1.464***	1.422***	1.461***
	(0.274)	(0.276)	(0.267)	(0.267)
Observations	964	964	964	964
Firms	696	696	696	696

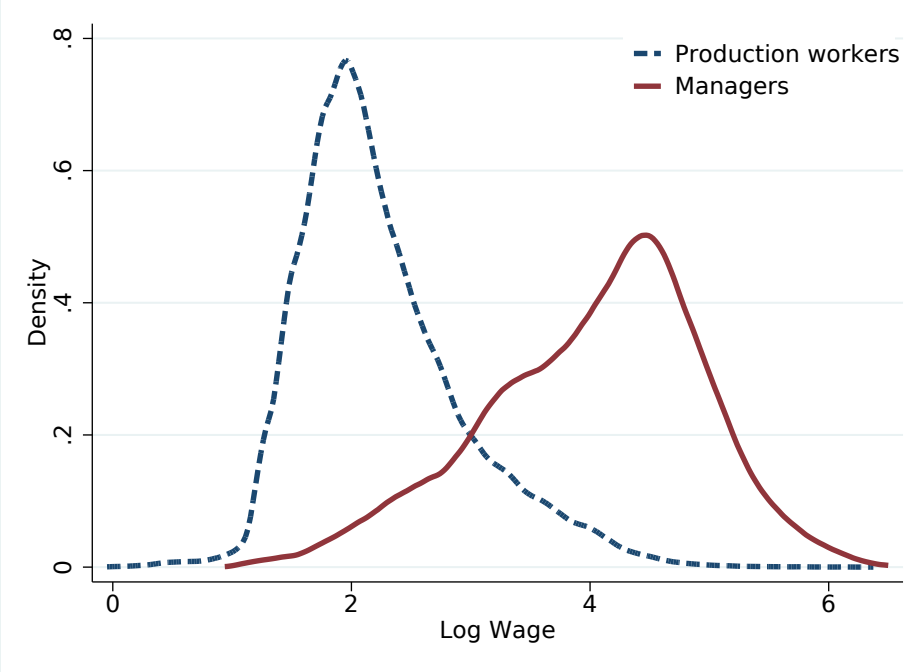
Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Estimates from linear regression models on matched WMS-RAIS firm-year data. The dependent variable in columns (1) and (2) is the standardized WMS overall management score, and in columns (3) and (4) is the standardized people management score. In addition to the variables listed, all models also include year effects, region indicators, total employment, firm age, ownership status, the female share in employment, the number of competitors, 2-digit industry controls, and a cubic in the AKM coverage share. These models also control for the number of sites operated by the firm. Columns (1) and (2) All worker quality measures are standardized relative to the estimation sample.

Figure D.3: Distribution of worker quality and wages

(a) Estimated worker fixed effects (AKM)



(b) Log of wages

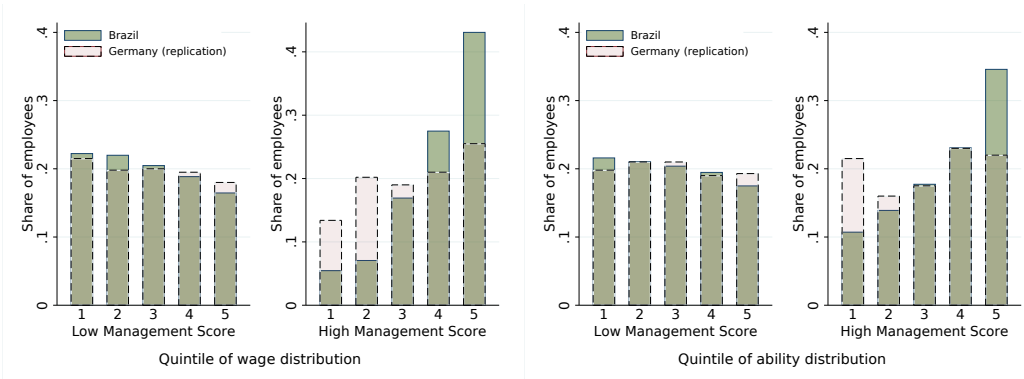


Notes: Panel A plots the distribution of Abowd et al. (1999) worker fixed effects estimated using data from RAIS from 2003 to 2008. Panel B plots the distribution of log of wages for the same set of workers.

Figure D.4: Fraction of workers in different wage and ability quintiles

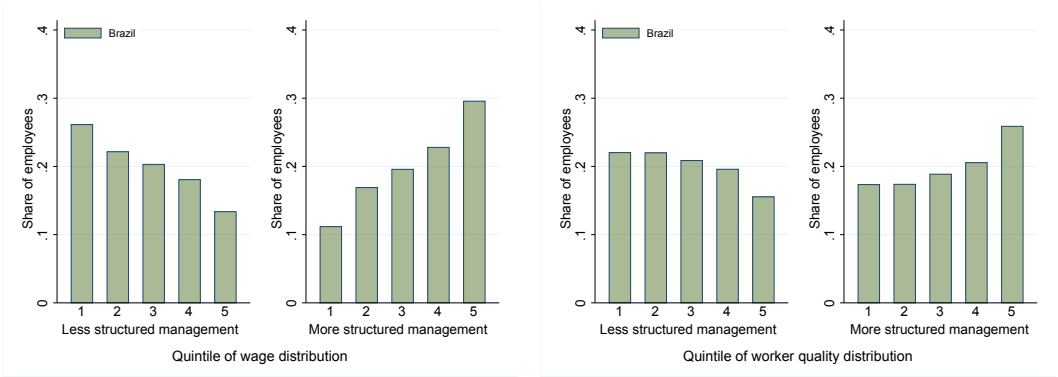
(a) Replication with Brazilian data

(b) Replication with Brazilian data



(c) Extension: different threshold definition

(d) Extension: different threshold definition



Notes: Each bar plots the average share of employees within each quintile of the wage distribution (panels a and c) and ability distribution (panel b and d) for firms with low/high management score. In panels a and b, low/high management scores correspond to firms below/above the 90th percentile of the country score distribution. In panels c and d, low/high scores follow our more/less structured management practices classification. The definition for "more structured management" is whether a firm scores equal or above a score of 3 in the WMS 1 to 5 classification. "Less structured management" is defined as a firm that scores between 1 and 3 in that classification. Please see the Data section for further details on the rationale behind this definition.

Table D.13: Inflows to WMS firms

	Share of hired workers at or above quantiles of the quality distribution				
	10%	25%	50%	75%	90%
	(1)	(2)	(3)	(4)	(5)
	A. Not Including Size Control				
z-management	0.001	0.006*	0.012**	0.014**	0.012***
	(0.001)	(0.003)	(0.004)	(0.004)	(0.004)
% college	0.000*	0.001**	0.001*	0.001*	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	B. Including Size Control				
z-management	0.002	0.005	0.011*	0.011*	0.009*
	(0.002)	(0.003)	(0.004)	(0.005)	(0.004)
% college	0.000*	0.001**	0.001*	0.001*	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(employment)	-0.002	0.001	0.004	0.007	0.008*
	(0.002)	(0.003)	(0.004)	(0.005)	(0.004)
Observations	3857	3857	3857	3857	3857
Firms	706	706	706	706	706
Bender et al estimates for their Table 6 (for comparison, coefficients only)					
	A. Not Including Size Control				
Management score	*0.003*	*0.003*	*0.006*	*0.016***	*0.019****
Management score	*0.003*	*0.004*	*0.005*	*0.007*	*0.010**

Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. This table reports additional parameter estimates from models reported in Table D.13 in the main text. The dependent variable in each column is the share of newly hired workers with quality at or above the labeled percentile. The set of full controls includes year effects, region indicators, firm age, ownership status, the female share in employment, the number of competitors, 2-digit industry effects, a cubic in the AKM coverage share, and the share of employees with a college degree. Panel A omits the control for number of employees. The management score is standardized relative to the estimation sample.

Table D.14: Hiring rank-rank regressions: Managers

	Dependent variable: Worker rank in the distribution of new manager hires					
	(1)	(2)	(3)	(4)	(5)	(6)
More structured mgmt = 1			-1.111***			-1.221***
			(0.089)			(0.215)
Rank	1.411***	0.749***	1.411***	1.409***	0.750***	1.410***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
Rank Squared	-0.004***	0.003***	-0.004***	-0.004***	0.003***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
More structured mgmt = 1			-0.662***			-0.660***
× Rank			(0.004)			(0.004)
More structured mgmt = 1			0.007***			0.007***
× Rank Squared			(0.000)			(0.000)
Year controls	✓	✓	✓	✓	✓	✓
Firm & Worker controls				✓	✓	✓
N	1735	2758	4493	1735	2758	4493
Firms	330	209	539	330	209	539
Sample:	**Less**	**More**	**All**	**Less**	**More**	**All**
(firm type)	**Structured**	**Structured**		**Structured**	**Structured**	

Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Analysis of worker-year RAIS data for 2008–2013 matched to WMS firm characteristics. The sample is restricted to newly-hired workers. The dependent variable is a worker's rank in the distribution of newly-hired workers, conditional on being employed in either a firm that does, or does not use structured management practices. Where indicated, these models also control for employer size, employer age, number of competitors, ownership type, region, gender, race, education, and two-digit industry effects.

Table D.15: Hiring rank-rank regressions: Non-managers

	Dependent variable: Worker rank in the distribution of new non-manager hires					
	(1)	(2)	(3)	(4)	(5)	(6)
More structured mgmt = 1			1.925***			1.559***
			(0.148)			(0.286)
Rank	1.089***	0.840***	1.089***	1.088***	0.843***	1.088***
	(0.004)	(0.007)	(0.004)	(0.003)	(0.006)	(0.003)
Rank Sq.	-0.001***	0.001***	-0.001***	-0.001***	0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
More structured mgmt = 1			-0.250***			-0.246***
× Rank			(0.008)			(0.007)
More structured mgmt = 1			0.002***			0.002***
× Rank Squared			(0.000)			(0.000)
Year controls	✓	✓	✓	✓	✓	✓
Firm & Worker controls				✓	✓	✓
N	114923	74653	189576	114923	74653	189576
Firms	469	242	711	469	242	711
Sample:	**Less**	**More**	**All**	**Less**	**More**	**All**
(firm type)	**Structured**	**Structured**		**Structured**	**Structured**	

Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Analysis of worker-year RAIS data for 2008–2013 matched to WMS firm characteristics. The sample is restricted to newly-hired workers. The dependent variable is a worker's rank in the distribution of newly-hired workers, conditional on being employed in either a firm that does, or does not use structured management practices. Where indicated, these models also control for employer size, employer age, number of competitors, ownership type, region, gender, race, education, and two-digit industry effects.

Table D.16: Firing and management practices: Managers

	(1) Fired = 1	(2) Fired = 1	(3) Fired = 1	(4) Fired = 1	(5) Fired = 1	(6) Fired = 1
More structured mgmt = 1			-0.050**			0.469**
			(0.019)			(0.148)
Manager quality	-0.017**	-0.018*	-0.017**	-0.013*	-0.005	-0.013*
	(0.006)	(0.007)	(0.006)	(0.005)	(0.005)	(0.005)
Manager quality squared	0.002	0.003**	0.002	0.003**	0.002	0.003*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
More structured mgmt = 1			-0.002			0.008
× Manager quality			(0.009)			(0.008)
More structured mgmt = 1			0.001			-0.001
× Manager quality squared			(0.002)			(0.002)
Year controls	✓	✓	✓	✓	✓	✓
Firm & Worker controls				✓	✓	✓
N	15883	22354	38237	15883	22354	38237
Firms	438	239	677	438	239	677
Sample:	**Less**	**More**	**All**	**Less**	**More**	**All**
(firm type)	**Structured**	**Structured**		**Structured**	**Structured**	

Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Estimates of linear regression models in worker-year RAIS data for 2008–2013 matched to WMS firm characteristics. The dependent variable is an indicator for whether the worker was fired. Where indicated, these models also control for job tenure, employer size, employer age, number of competitors, ownership type, region, gender, race, education, and two-digit industry effects.

Table D.17: Firing and management practices: Non-managers

	(1) Fired = 1	(2) Fired = 1	(3) Fired = 1	(4) Fired = 1	(5) Fired = 1	(6) Fired = 1
More structured mgmt = 1			-0.009			0.085
			(0.012)			(0.065)
Non-manager quality	-0.030***	-0.044***	-0.030***	-0.020***	-0.027***	-0.020***
	(0.004)	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)
Non-manager quality squared	0.004*	0.009***	0.004*	0.004***	0.008***	0.004***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
More structured mgmt = 1			-0.013*			-0.008*
× Non-manager quality			(0.005)			(0.003)
More structured mgmt = 1			0.006**			0.004**
× Non-manager quality squared			(0.002)			(0.001)
Year controls	✓	✓	✓	✓	✓	✓
Firm & Worker controls				✓	✓	✓
N	710460	500770	1211230	710460	500770	1211230
Firms	478	244	722	478	244	722
Sample:	**Less**	**More**	**All**	**Less**	**More**	**All**
(firm type)	**Structured**	**Structured**		**Structured**	**Structured**	

Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Estimates of linear regression models in worker-year RAIS data for 2008–2013 matched to WMS firm characteristics. The dependent variable is an indicator for whether the worker was fired. Where indicated, these models also control for job tenure, employer size, employer age, number of competitors, ownership type, region, gender, race, education, and two-digit industry effects.

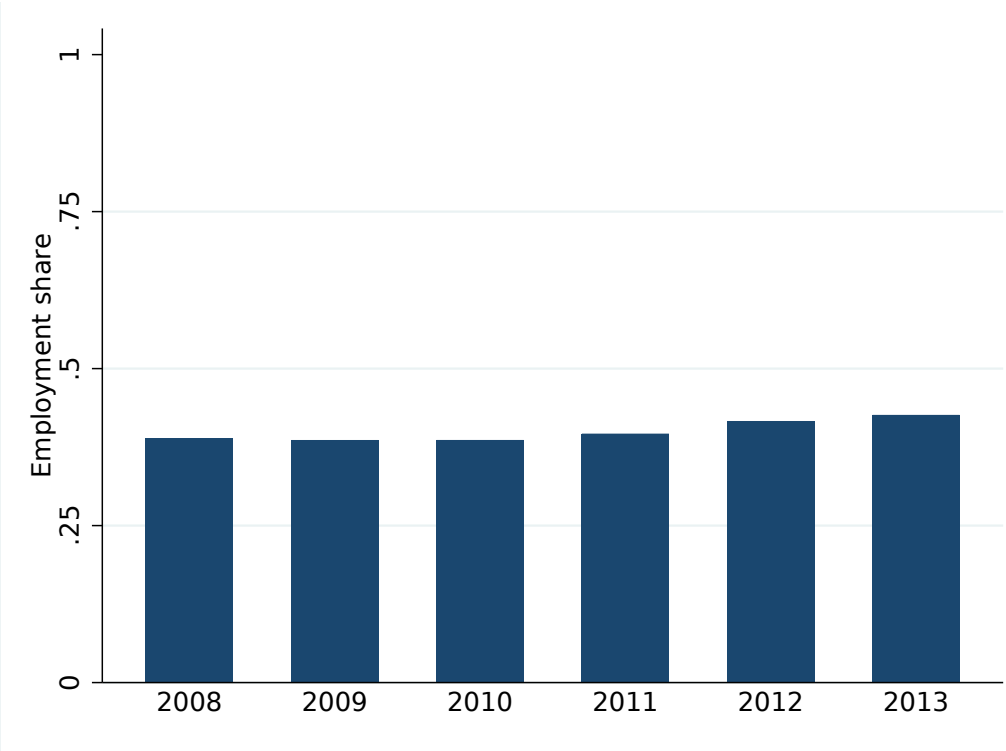
E Additional descriptive statistics and model specifications

Table E.1: Correlation among components of the management score

	overall	people	operations
overall	1.00		
people	0.86	1.00	
operations	0.74	0.53	1.00

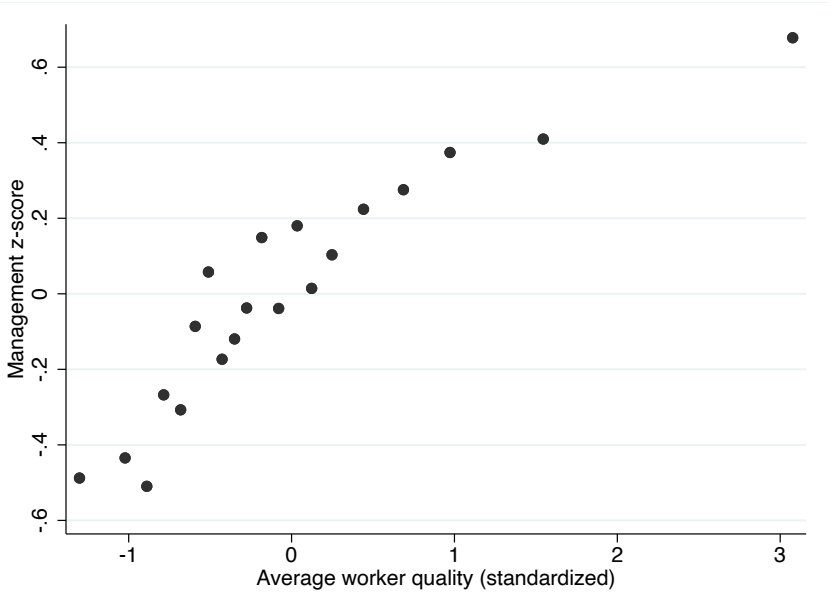
Notes: This table reports the correlations among different management scores across all plant-year observations from the WMS for Brazil. The overall management score is the simple average of the 18 individual management practices scored by the WMS. The people score is the simple average on the six practices covering people management. The operations score is the simple average of the 12 management practices not associated with people management.

Figure E.1: Share of employment in structured management firms



Notes: Each bar reports the share of employment in the sample that is captured by firms classified as having structured management practices, relative to the firms classified as having unstructured management practices. The share of employment only includes firms in the WMS sample for each year, and it is simply the sum of employees who work in firms that have structured management relative to the entire set of employees captured in the firms within the WMS sample.

Figure E.2: Correlation between management score and worker quality: No controls



Notes: This graph is a binned scatterplot of the raw correlation between the overall management score index and average worker quality (AKM worker fixed effect) for Brazil. This graph does not include any controls.

Table E.2: Correlation between management practices and worker quality: Distinguish non-managers using quality quartiles

	Management z-score			
	(1)	(2)	(3)	(4)
Average employee quality (AKM worker effects)	0.131***			
	(0.036)			
Average managerial quality (top quartile worker effects)		0.177***	0.215***	0.188***
		(0.036)	(0.052)	(0.050)
Mean non-manager quality (bottom quartiles)			-0.050	-0.061
			(0.050)	(0.048)
Log of firm employment (WMS)	0.362***	0.353***	0.352***	0.341***
	(0.031)	(0.031)	(0.031)	(0.030)
% of employees with college degree (WMS)				1.331***
				(0.277)
Observations	964	964	964	964
Firms	696	696	696	696

Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Estimates from linear regression models on matched WMS-RAIS firm-year data. The dependent variable is the standardized WMS overall management score. In addition to the variables listed, all models also include year effects, region indicators, total employment, firm age, ownership status, the share of female workers, the number of competitors, 2-digit industry controls, and a cubic in the AKM coverage share. Here, we report models that include mean non-manager quality, measured as the average quality of the bottom 75 percent of workers in the firm. All worker quality measures are standardized relative to the estimation sample.

Table E.3: Correlation between management practices and worker quality: Distinguish non-managers using quality quartiles

	Management z-score	
	(1)	(2)
Average employee quality (AKM worker effects)	0.113**	0.081
	(0.043)	(0.041)
Average managerial quality (occupation-based)	0.034	0.028
	(0.042)	(0.040)
Log of firm employment (WMS)	0.358***	0.346***
	(0.032)	(0.031)
% employees with college degree (WMS)		1.359***
		(0.280)
Observations	964	964
Firms	696	696

Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Estimates from linear regression models on matched WMS-RAIS firm-year data. The dependent variable is the standardized WMS overall management score. In addition to the variables listed, all models also include year effects, region indicators, total employment, firm age, ownership status, the female share in employment, the number of competitors, 2-digit industry controls, and a cubic in the AKM coverage share. Here, we report models that include the average quality of all workers and the average quality of managers, where managers are identified from occupation codes. All worker quality measures are standardized relative to the estimation sample.

Table E.4: Within-firm heterogeneity in wages and worker quality: Added controls

	90-10 log wage	Standard deviation of log wage	90-10 Abilty	Standard deviation of ability
	(1)	(2)	(3)	(4)
z-management	0.094***	0.029***	0.101***	0.034***
	(0.017)	(0.006)	(0.024)	(0.009)
General Controls	✓	✓	✓	✓
Observations	964	964	964	964
Firms	696	696	696	696

Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Estimates from linear regression models on matched WMS-RAIS firm-year data. All models control for year effects. Where indicated, models also include the set of general controls: region indicators, total employment, firm age, ownership status, the female share in employment, the number of competitors, 2-digit industry controls, and a cubic in the AKM coverage share. Relative to the main text, these models also include controls for the firm's number of sites. The management score is standardized relative to the estimation sample.

Table E.5: Within-firm heterogeneity in wages and worker quality: Relationship to people management

	90-10 log wage	Standard deviation of log wage	90-10 Abilty	Standard deviation of ability
	(1)	(2)	(3)	(4)
z-people	0.060***	0.016**	0.069**	0.020*
	(0.015)	(0.005)	(0.022)	(0.008)
General Controls	✓	✓	✓	✓
Observations	964	964	964	964
Firms	696	696	696	696

Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Estimates from linear regression models on matched WMS-RAIS firm-year data. All models control for year effects. Where indicated, models also include the set of general controls: region indicators, total employment, firm age, ownership status, the female share in employment, the number of competitors, 2-digit industry controls, and a cubic in the AKM coverage share. Relative to the main text, the key regressor is the standardized people management score rather than the overall management score. The management score is standardized relative to the estimation sample.

Table E.6: Firing logit model: Base specification

	Managers		Non-managers	
	(1) Fired = 1	(2) Fired = 1	(3) Fired = 1	(4) Fired = 1
Quality	-0.016**	-0.017**	-0.031***	-0.041***
	(0.005)	(0.006)	(0.004)	(0.003)
Qual. Sq.	0.002	0.003**	0.002	0.007***
	(0.001)	(0.001)	(0.002)	(0.001)
Year controls	✓	✓	✓	✓
N	15883	22354	710460	500770
Firms	438	239	478	244
Sample:	**Less Structured**	**More Structured**	**Less Structured**	**More Structured**

Notes: * p<0.05, ** p<0.01, *** p<0.001. Estimates of logit models in worker-year RAIS data for 2008–2013 matched to WMS firm characteristics. The dependent variable is an indicator for whether the worker was fired. The sample indicates whether firms were classified as having more or less structured management. The table reports marginal effects evaluated at the sample mean, along with standard errors in parentheses computed using the delta method.

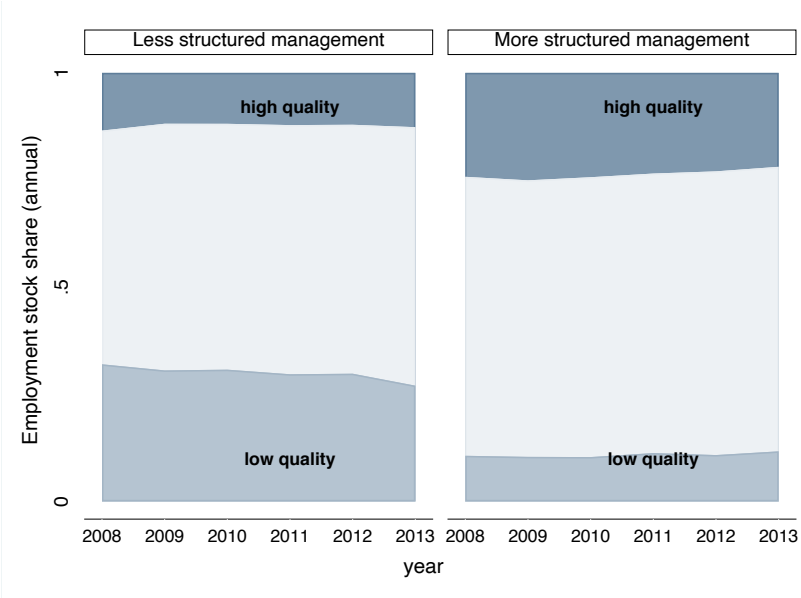
Table E.7: Predicting quality of stayers: Added controls

	Panel A: Avg. manager quality			
	(1)	(2)	(3)	(4)
z-management	0.108***			
	(0.033)			
z-operations		0.098***		0.103***
		(0.030)		(0.034)
z-people			0.034	-0.011
			(0.031)	(0.034)
	Panel B: Avg. non-manager quality			
	(1)	(2)	(3)	(4)
z-management	0.088***			
	(0.034)			
z-operations		0.067**		0.044
		(0.031)		(0.036)
z-people			0.071**	0.051
			(0.030)	(0.035)
Year controls	✓	✓	✓	✓
Full controls	✓	✓	✓	✓
College share	✓	✓	✓	✓
# Observations	964	964	964	964
# Firms	696	696	696	696

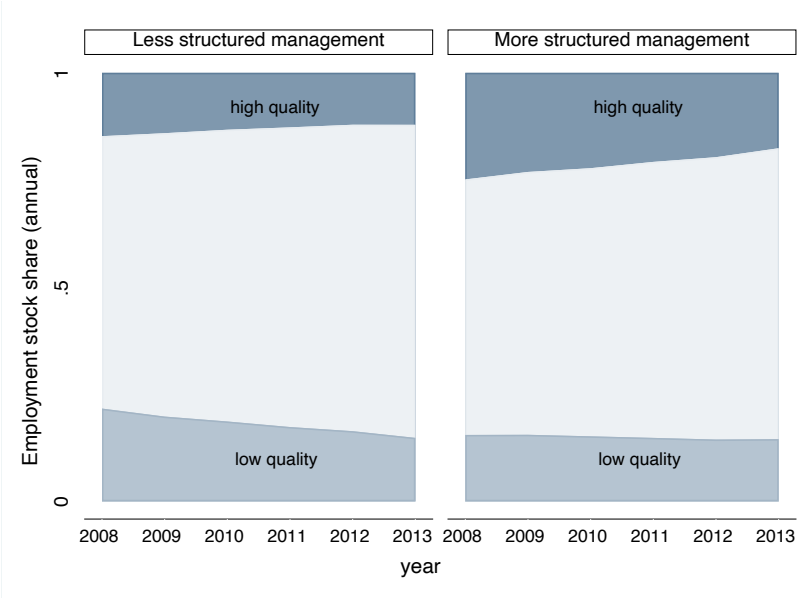
Notes: Robust standard errors clustered at firm level in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Estimates from linear regression models on matched WMS-RAIS firm-year data. The dependent variable is the standardized WMS overall management score. In Panel A, the dependent variable is average quality of workers in managerial occupations. In Panel B, the dependent variable is average quality of workers in all other occupations. The set of full controls includes region indicators, total employment, firm age, ownership status, the female share in employment, the number of competitors, 2-digit industry controls, and a cubic in the AKM coverage share. Relative to the main text, these models also include controls for the firm's number of sites. All worker quality measures are standardized relative to the estimation sample.

Figure E.3: Share of retained employees over time

(a) Managers



(b) Non-managers



Notes: The graphs depict the share of retained managers (Panel A) and Non-managers (Panel B) in firms across years, within quartile of worker quality and firm type. Retained workers are those that did not change place of employment, and were not hired neither fired within that year. Worker quality is defined by the Abowd et al. (1999) fixed effects. High quality workers are defined as those within the top quartile of worker quality, and low quality workers are defined as those within the bottom quartile of worker quality. Less structured management refers to firms with a score below 3 on the WMS. More structured management refers to firms that score a 3 or above on the WMS.

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