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Examining the Link Between Health Measures, Management Practices and Establishment Performance

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Content

Abstract

We examine the relationship between establishment-level health measures, Anglo-Saxon management practices and labor productivity, as well as median wages. Based on the observation that management practices are positively associated with establishment outcomes, we test whether health measures have a distinct effect on their own, or if they are already comprised in management practices. Using representative survey data from the German Management and Organizational Practices Survey, we find a strong increase in the use of health measures from 2008 to 2013, predominantly in large establishments. Fixed effects regressions confirm that management practices significantly increase labor productivity, however, health measures do not. The reverse is true for median wages, such that health measures are positively associated with median wages, but management practices are not.

Zusammenfassung

Wir untersuchen den Zusammenhang zwischen betrieblichen Gesundheitsmaßnahmen, Managementpraktiken und Arbeitsproduktivität, sowie Medianlöhnen. Aus der bisherigen Forschung ist bekannt, dass Managementpraktiken in einer positiven Beziehung zu betrieblichen Erfolgsfaktoren stehen. Daher beleuchten wir, ob betriebliche Gesundheitsmaßnahmen, unabhängig von traditionelleren Managementpraktiken, einen Einfluss auf Arbeitsproduktivität und Medianlöhne haben. Repräsentative Befragungsdaten des „Management and Organizational Practices Survey“ zeigen einen Anstieg in der Nutzung von betrieblichen Gesundheitsmaßnahmen zwischen den Jahren 2008 und 2013, insbesondere in großen Betrieben. Während Managementpraktiken in einer positiven Beziehung zur Arbeitsproduktivität stehen, haben sie keinen Einfluss auf Medianlöhne. Bei Gesundheitsmaßnahmen lässt sich ein anderes Muster erkennen, sodass diese in keinem Zusammenhang mit der Arbeitsproduktivität stehen, jedoch einen positiven Zusammenhang mit Medianlöhnen aufweisen.

JEL-Klassifikation: D22, I15, J24, L2, M2

Keywords: management practices, health measures, establishment performance, labor productivity, median wages, linked survey-administrative data, establishments

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1 Introduction

Economists are unable to fully clarify observed productivity differences between firms (Syverson, 2011). Traditionally explained by input factors such as capital and labor, as well as country or industry affiliation, newer approaches explain productivity differences between firms through more intangible input factors such as management practices. Recent work by Bloom et al. (2013) for the US, as well as Broszeit et al. (2016) for Germany shows that management practices have a substantial impact on labor productivity. Bloom et al. (2016) find that differences in management quality explain about 30 percent of differences in total factor productivity across countries. The management practices analyzed in these studies focus on monitoring, target setting and incentives, all of which are practices that have become well-established in the business literature. We contribute to this strand of research by analyzing the effects of health measures as innovative human resources practices. Similar to Buhai et al. (2016), we interpret health measures as investments establishments make to ensure sustainable productivity levels first by attracting and retaining employees and second by safeguarding their health.

Health measures have become increasingly more important, not least since the German government has been promoting health awareness, with initiatives such as the "Act to Strengthen Health Promotion and Preventative Health Care" or the German Social Code which makes tax exemptions for firms investing in health measures available (§20f. SGB V). Nevertheless, the black box of how health measures work is largely left unexplained. Thus, an interest on the part of employers, stakeholders and policy makers remains in whether health programs at the firm level are profitable and under which circumstances. Amongst others, health measures are believed to enhance personnel marketing strategies and recruitment, especially when employees demand healthy lifestyle choices and suitable health policies as crucial prerequisites of firm attractiveness. In addition, health measures can be regarded in a human capital theory context, in which health is considered as an investment in human capital (Becker, 1975). Accordingly, health measures would increase employee productivity.

Based on novel data from the "German Management and Organizational Practices" (GMOP) survey combined with administrative establishment data, we investigate the extent of health measures implemented in German establishments and their relationship with two performance measures. In particular, we are interested in labor productivity and median wages measured at the establishment-level. We analyze these two outcomes, as they reflect different aspects of an establishment's performance. Moreover, we pursue the question whether health measures have a distinct effect in addition to Anglo-Saxon management practices, as described in the World Management Survey and in the GMOP. We are interested in health measures as we want to investigate if "softer" measures in addition to hard fact-based ones, such as monitoring and target setting, play a role in establishment success.

Following Bloom et al. (2013) we generate an index measuring management quality. Expanding on this work, we further calculate an index of health measures. The health

measures we regard include the offer of health days, health check-ups, healthy diets, relaxation techniques and exercise, ergonomic measures at work and management seminars for health-oriented leadership. Descriptive analyses reveal that health measures are not equally implemented across establishments and are more often implemented in larger and internationally oriented establishments. Furthermore, better managed establishments are also more likely to score higher in terms of health measures.

Multivariate results indicate that a differentiated view of health measures' effects on establishment outcomes is required. We cannot confirm that there is an overlying significant effect of the health index on labor productivity. However, we find a significant relationship between the health index and labor productivity for establishments with higher shares of female employees. The analyses further reveal that health measures contribute to median wages on their own, i.e. irrespectively of overall management quality. This finding is in line with the human capital theory's (Becker, 1975) predictions. We interpret this result such that health measures directly affect the people-related median wages, but not the sales-related labor productivity measures. While both measures reflect one facet of establishment productivity, they are not identically related to health measures and it seems that health measures are more directly related to people-oriented outcome measures.

We contribute to the existing literature by showing that health measures have an impact on median wages, and to a lesser extent on labor productivity, that is separate from that of management practices. We therefore argue that health measures are a distinct concept which is separate from established Anglo-Saxon management practices. This finding leads to several political implications including the suggestion to support establishments' efforts to increase health measures in order to increase median wage levels.

The remainder of the paper is structured as follows: In the next section, we regard the related literature and explore the possible channels through which health measures could impact firm success. Section three gives an overview of the data and the determinants of the health score. Section four describes the empirical strategy. Section five presents results and their implications. The final section offers concluding remarks.

2 Related Literature and Derived Hypothesis

In recent years, a growing number of empirical studies have convincingly established the link between Anglo-Saxon management practices and productivity (e.g. Bloom and van Reenen, 2010; Bloom et al., 2013; Huselid, 1995) and other firm performance outcomes like profitability, employment growth, firm size, exports or qualification structure (Bloom et al., 2013). These studies combine a set of well-established practices regarding monitoring, targets and incentives to calculate an indicator for overall management quality (Bloom and van Reenen, 2010; Bloom et al., 2013). They confirm a positive association with productivity, innovative success and employment

growth. These findings can be explained by the classic principal-agent theory, according to which management practices help align employer and employee goals (Jensen and Meckling, 1976).

In addition to the Anglo-Saxon management practices, "softer" practices concerning health measures are analyzed. While a small body of empirical literature on the impact of health measures on firm performance already exists, the link and the various impact channels of health measures have not yet been resolved (Lerner et al., 2013). The mechanisms at work which link human resources measures to firm performance are therefore still a black box and disentangling these mechanisms is not trivial, especially since important complementarities between practices can occur and choosing the best practices and bundles thereof can be a puzzle (Becker and Huselid, 2006; Lengnick-Hall et al., 2009).

Nevertheless, prior research has pointed to some possible channels.[1] Management practices and health measures influence employer attractiveness and thereby indirectly affect productivity. Employers with good working conditions generally have a better reputation and thus a comparative advantage over firms without appropriate measures (Ferris et al., 2007). Human resource management practices can be the reason for being listed in employer rankings and for receiving awards or distinctions (Areal and Carvalho, 2016). This sends a strong message about a company's quality and work environment. Human resources management can thus serve as a signal to costumers, job applicants, high potentials, investors or other stakeholders.[2] There is evidence that well-managed firms are generally able to recruit and retain the most talented employees (Bender et al., 2016). Employer attractiveness can also lead to workforce composition effects, as employees self-select into establishments. Possible consequences are less voluntary turnovers (Cottini et al., 2011; Huselid, 1995) and increased individual-level tenure (Huber et al., 2015), which both lead to the retention of human capital and tacit know-how. In the same line of arguments, health measures may be a good instrument to foster good employer-employee relations and increase employee motivation, satisfaction and commitment. In turn, higher employee workplace satisfaction can lead to higher establishment productivity (Böckerman and Ilmakunnas, 2012) and positive employee relations contribute to firm-level performance (Fulmer et al., 2003).

Several studies find that health measures directly relate to productivity. In the context of human capital theory, health can be seen as an investment in human capital and

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1 An overview on the effectiveness and economic benefits of health measures is provided by Sockoll et al. (2009). For the sake of brevity, we mainly concentrate on papers relating to productivity increases.

2 An interesting further strand of the literature focuses on the beneficial effects of health measures accrued via higher product prices, which firms with good reputation can justify. These highly productive firms also have better access to investor credits and thus are more resilient in times of crises (Areal and Carvalho, 2016).

should thus pay off in higher individual productivity (Becker, 1975). Transferring this argument to the establishment level means that health measures - as a proxy for the investment in health - should increase individual productivity, reflected in wages, and therefore also establishment-level productivity.

Buhai et al. (2016) show that physical workplace health and safety measures, i.e. the solving of problems concerning the dimensions “monotonous repetitive work” and “internal climate”, are directly and positively related to firm-level total factor productivity in Denmark. As no other health measure dimensions show significant results, the authors conclude that the causal mechanism that links health measures and firm performance is a direct one by making employees more productive. Further evidence for a direct link between health measures and employee productivity, albeit only for a subsample of older workers and age-related health measures, is provided by Göbel and Zwick (2013) using the Linked Employer-Employee Data from the IAB (LIAB), in which the IAB Establishment Panel Survey is matched with administrative individual data. At the same time however, Rongen et al. (2013) summarize that the overall effectiveness of workplace health promotion programs is low, but do concede that health measures amongst younger individuals are more effective.

Further research indicates that unhealthy lifestyle and working behaviors reduce health and increase the number of sick days, as well as the probability of catching diseases (Rongen et al., 2013). In the case of sickness, employees are either unable to work, or they go to work with limited capacities, a phenomenon called sickness presenteeism (van den Heuvel et al., 2010). Thus, health measures could have an effect by reducing sick days. Especially in Western societies’ aging populations, firms may require preventative health policies in order to ensure the sustainable productivity of (older) workers. While this assumption may seem trivial, an estimated productivity loss of 57 billion euros was calculated for 2014 due to sickness. In this year German employees missed 14.4 days on average due to sickness, with even higher numbers in the manufacturing sector (17.3 days) (BMAS and BAuA, 2016). Accordingly, one possible channel through which health measures affect productivity is by directly reducing sick days. Note that we cannot control for an individual’s actual health or number of sick days, such that health measures are used as a proxy. For these measures to be effective, management buy-in is crucial, as is the creation of a culture of health in the establishments (Goetzel et al., 2014).

Considering the literature, we formulate three hypotheses. The first performance outcome we look at is labor productivity, for which we expect a positive relationship.

H1: Health measures are positively associated with labor productivity.

We do not only want to look at labor productivity, as we believe that it only captures one facet of firm performance. Labor productivity is output-oriented and can be highly dependent on (short-term) shocks external to the firm. Therefore we chose another performance indicator reflecting other dimensions of performance to paint a more

complete picture of the contribution of health measures to firm success. This performance outcome is median wages of the establishment, which should capture performance mechanisms internal to the firm.

> H2: Health measures are positively associated with establishment-level median wages.

Bloom and van Reenen (2006) look at complementary effects between management practices and work-life balance practices. They find that better work-life balance measures are correlated with higher productivity. However, this effect disappears when controlling for management indicating that plants with higher management quality have both more work-life balance practices and better performance outcomes. Analogously, we test whether health measures have a distinct effect on their own. We contribute to this strand of the literature, first by looking at health measures as a new determinant of performance outcomes; and second, we also regard wages as a new outcome variable in addition to labor productivity:

> H3: Health measures and Anglo-Saxon management practices each have a distinct effect on labor productivity and median wages.

3 Data and Descriptive Statistics

The analyses are based on linked survey and administrative data, for which we combined the German Management and Organizational Practices (GMOP) survey administrative establishment-level data from the Institute of Employment Research (IAB), called the Establishment History Panel (BHP).

3.1 The GMOP Survey

The GMOP survey asks German establishments about management practices and performance. The design and questionnaire are based on the US “Management and Organizational Practices Survey” (MOPS) documented by Bloom et al. (2013). Split into sections, the survey enquires about management practices, establishment background information and economic figures. Additionally, it asks about personal characteristics of the respondent, mostly the CEOs or plant managers. The main focus of the survey lies on management practices with 16 questions on monitoring, targets and incentives invented by Bloom and van Reenen (2007). As addition, we included six questions on measures to promote and maintain employees’ health.

The survey was carried out jointly by the IAB, the Kiel Institute for the World Economy (IfW), and the Institute for Applied Social Sciences (infas) in 2014/2015. The sample was drawn from German administrative establishment data linked with company-level data from Bureau van Dijk (BvD) and the population was restricted to establishments in the manufacturing industry or the construction sector with 25 or more employees subject to social security contributions. Overall 1,927 establishments provided answers pertaining retrospectively to the years 2008 and 2013. Broszeit and Laible (2017) provide information on the survey design and its representativeness.

3.2 Further Data Sources

We link the GMOP survey to establishment-level administrative data through a common establishment identifier. The BHP contains all German establishments with at least one employee liable to social security on the reference day June 30th and provides detailed information on the workforce composition regarding qualification, age and gender (Schmucker et al., 2016). Using supplementary administrative data provides the advantage that additional information about the establishment's workforce becomes available, as well as wage information. Furthermore, if the number of employees was missing in the survey data, the administrative information was used. Finally, we can compare the information in the survey with the administrative data and our validity checks show mismatches for less than 4 percent of the observations. For these cases we compute a dummy to control for deviations. This ensures the credibility of the survey data.

3.3 Sample Description

We look at private, profit maximizing establishments in the manufacturing industry or the construction sector[3], which had at least 25 employees subject to social security contributions[4] at the time of the sample drawing in 2011. The survey data is available for 2008 and 2013. According to German law, explicit consent to linkage is mandatory when combining different data sources. Therefore, we can only match GMOP establishments to their corresponding BHP information if consent was given. This is the case for 53 percent of the observations.[5]

Table 1[6] provides summary statistics for the sample used to analyze labor productivity, as well as the sample used to inspect wages, for both of which we only regard establishments with valid information for both years. The two samples differ from each other due to a higher number of missing observations and outliers in the labor productivity variable compared to the median wage variable. The means and standard deviations of the key variables do not differ much between the two samples. For a full overview of all variables including their origin and definition see Table A1 of the Appendix.

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3 As the construction sector is structurally different from the manufacturing sector, we run the regressions for both outcomes for samples where we exclude the construction sector. We report the results for all industries in the following sections, as they were not affected by the exclusion of the construction sector.

4 The results do not change when we exclude smaller establishments from the sample, therefore we report the results for all establishment sizes.

5 Regarding the variable means, the numbers reveal no severe differences between the two samples indicating that the linked sample is not biased compared to the full data. Broszeit and Laible (2017) provide evidence for the representativeness of the full data.

6 Note that Table 1 indicates few changes for average establishment characteristics. Within variation of the respective variables is nevertheless given and thus allows the estimation of the first differences.

Table 1
Summary Statistics

	Labor Productivity sample				Wage sample			
	2008		2013		2008		2013	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Health score	0.21	(0.21)	0.37	(0.27)	0.21	(0.21)	0.37	(0.27)
Management score	0.52	(0.16)	0.59	(0.15)	0.51	(0.17)	0.58	(0.16)
Employees	119.34	(284.19)	132.37	(309.77)	120.32	(258.42)	133.16	(281.64)
Foreign ownership (D)	0.09	(0.29)	0.09	(0.29)	0.11	(0.32)	0.11	(0.32)
Independent company (D)	0.87	(0.34)	0.87	(0.34)	0.84	(0.36)	0.84	(0.36)
Works council (D)	0.40	(0.49)	0.40	(0.49)	0.39	(0.49)	0.39	(0.49)
Engagement abroad (D)	0.16	(0.37)	0.18	(0.38)	0.17	(0.38)	0.19	(0.39)
Exports (D)	0.63	(0.48)	0.64	(0.48)	0.64	(0.48)	0.66	(0.47)
Competition (D)	0.29	(0.45)	0.50	(0.50)	0.30	(0.46)	0.50	(0.50)
Crisis (D)	0.39	(0.49)	0.39	(0.49)	0.39	(0.49)	0.39	(0.49)
Women (share)	0.25	(0.18)	0.25	(0.18)	0.27	(0.19)	0.27	(0.19)
High qualified (share)	0.11	(0.12)	0.12	(0.12)	0.10	(0.12)	0.12	(0.12)
Mean age of employees	41.42	(3.62)	42.80	(3.89)	41.28	(3.73)	42.87	(3.86)
Age of establishment	21.50	(11.45)	26.50	(11.45)	21.82	(11.38)	26.82	(11.38)
East Germany (D)	0.25	(0.43)	0.25	(0.43)	0.23	(0.42)	0.23	(0.42)
Observations	468		468		718		718	

Notes: Weighted.

Source: Own calculations based on GMOP and BHP.

With a mean number of employees of around 120-130, the majority of the establishments analyzed in this paper are small-or medium-sized[7], the so called German "Mittelstand". As the German establishment structure favors smaller and medium-sized establishments, with few very large establishments, this average establishment size is not surprising. Most establishments are of German ownership, however two thirds export and over a sixth are engaged abroad. On average, the establishments are 22 years old in 2008 and a fourth of them is located in East Germany. The average employee age is 42 years and 10-12 percent of the workforce is considered to be highly qualified, measured as the share of employees with university degrees divided by the total number of employees. 40 percent of all establishments indicate having a works council, which is important in the German context as the works council can to some degree restrict the flexibility of management decisions and at the same time ensure employee and employer buy-in.

3.4 Management and Health Scores

We construct a management score following Bloom et al. (2013) by using the 16 items on management practices in the survey. These management practices combine elements of shop-floor operations pertaining to lean manufacturing, monitoring in terms

[7] The median rose from 54 in 2008 for both samples to 65 and 64 for the labor productivity and the median wage sample respectively. The 75 percent percentile does not exceed 124. This indicates that we predominantly analyze the German "Mittelstand".

of process tracking, setting meaningful targets, as well as practices regarding people management.

The items on targets concern the communication of production targets to managers and employees, the time frame of targets as well as the degree of effort that is required to achieve production targets. The questions for people management inquire about performance bonuses, promotions and dealing with underperforming employees. Questions relating to monitoring are the recording and reviewing of key performance indicators, the use of production display boards and problem solving in the production process. The management score is calculated from observations with at least 11 non-missing values and responses are normalized. The score thus lies between zero and one, with one indicating the most structured management practices. Following Bloom et al. (20013), we assume that more structured means better. For more information on the construction of the management score refer to Broszeit et al. (2016).

The six health measures inquired about in the GMOP survey are: health days, health check-ups, management seminars for health-oriented leadership, sport and relaxation offers such as back or autogenous training, healthy nutrition and ergonomic measures at the workplace. As shown in Appendix A.2, each survey respondent was asked whether the establishment offered these measures in 2008 and/or 2013. The analyses focus on a health score, which is constructed analogously to the management score. We only use observations where at least four out of the six questions have non-missing answers and normalize the score to be between zero and one. A higher score implies the existence of more health measures and again we assume that more is better.[8]

Table 2 provides information on the use of single health measures in 2008 and 2013 as well as on correlations between them. We observe quite some variation in the use of single measures and on average the measures most employed are health check-ups and ergonomic measures. Increasing the use of health measures compared to 2008, 85 percent of all establishments had at least one health measure in 2013, 64 percent at least two and 37 percent at least three health measures. Although most establishments had implemented one or more health measures, a non-negligible number of plants did not employ any measure in 2013 (15 percent).

[8] We cannot take into account that the use of health measures results from a firm's optimization decision and that in some cases more is not always better due to high implementation costs, bureaucratic burden or employee requirements. Unfortunately, we do not have information on the costs of health measures nor on the reasons for which establishments adopt the measures.

Table 2
Means and Pairwise Correlations of the Health Items

	2008		2013		2013					
	Mean	SD	Mean	SD	Correlations					
					1)	2)	3)	4)	5)	6)
1) Health days	0.08	(0.27)	0.20	(0.40)	1.00					
2) Health check-ups	0.40	(0.49)	0.57	(0.50)	0.24	1.00				
3) Management seminars for health-oriented leadership	0.07	(0.25)	0.20	(0.40)	0.33	0.22	1.00			
4) Exercise and recreation offers (e.g. back exercise, autogenic training)	0.12	(0.33)	0.30	(0.46)	0.44	0.18	0.25	1.00		
5) Healthy diet	0.10	(0.29)	0.23	(0.42)	0.37	0.20	0.26	0.42	1.00	
6) Ergonomic measures at the work-place	0.50	(0.50)	0.72	(0.45)	0.18	0.26	0.17	0.22	0.20	1.00
At least one measure	0.67	(0.47)	0.85	(0.35)						
At least two measures	0.37	(0.48)	0.64	(0.48)						
At least three measures	0.14	(0.34)	0.37	(0.48)						
Observations	718		718				718			

Notes: Weighted. All correlations are statistically significant at the1%-level.
Source: Own calculations based on GMOP.

Overall, the correlations between the individual measures are not very strong as shown in Table 2. This observation, taken together with the results of factor analyses indicating that the health measures reflect six different aspects, leads to the conclusion that the index represents a holistic image of health practices. Table 3 further indicates the correlation between the health and management scores for both years, which is not very high, indicating that the two scores capture different dimensions of management practices.

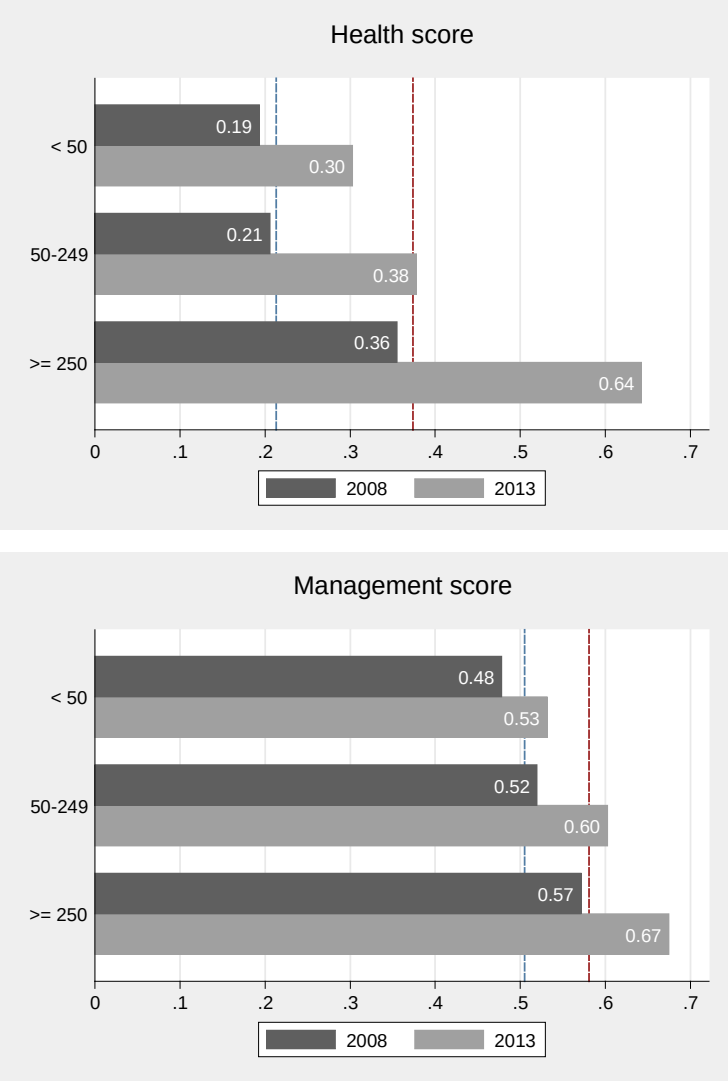
Table 3
Correlation of the Health and Management Scores

	2008		2013	
	1) Health Score	2) Management Score	1) Health Score	2) Management Score
1) Health Score	1.00		1.00	
2) Management Score	0.31	1.00	0.34	1.00
Observations	718	718		718

Notes: Weighted.
Source: Own calculations based on GMOP.

We do not find significant differences for the mean health score in East and West Germany and it seems that in both parts of Germany health measures are similarly implemented. However, the same is not true for management practices, where we reveal significantly higher average management scores for West Germany in both years.

Figure 1
Health and Management Scores Across Firm Sizes and Years



Notes: Weighted. Differences for establishment size are statistically significant at the 1% level. Means and SD of Health Score as shown by the vertical lines: 2008: Mean = 0.213 SD = 0.212; 2013: Mean = 0.374 SD = 0.272
Means and SD of Management Score as shown by the vertical lines: 2008: Mean = 0.505 SD = 0.169; 2013: Mean = 0.581 SD = 0.158

Source: Own calculations based on GMOP.

Figure 1 further deepens our understanding for the differences between the management and the health score by showing both scores across years and firm sizes. We define three firm size categories, namely small establishments with less than 50 employees, medium-sized establishments with 50 to 249 employees and large establishments with 250 or more employees. We observe an increase in the two scores between 2008 and 2013, whereby the increase in the use of health measures is more pronounced. Compared to the average management score, which increased by 0.08 points from 0.505 (SD=0.169) in 2008 to 0.581 (SD=0.158) in 2013; the average health score started at a lower level with a mean of 0.213 (SD=0.21) in 2008, but increased two times as much (0.16 points) reaching a value of 0.374 (SD=0.272) in

2013. Especially large establishments with 250 or more employees show a strong increase in the health score thus standing out from smaller establishments[9].

To better understand which measures drive the increase in the mean health score, Figure 2 illustrates the growth of individual heath measures for establishments with more and less than 100 employees respectively. It seems that health check-ups and ergonomics had already been widely used in 2008 independent of firm size. Large increases in individual scores are predominantly observed in larger establishments, but the use of health days, leadership seminars for health orientation, exercise and healthy diets meaningfully increased for both size categories.

Figure 2
Individual Health Measures and Establishment Size

Notes: Weighted.
Means and SD of Health Score as shown by the vertical lines: 2008: Mean = 0.213 SD = 0.212; 2013: Mean = 0.374 SD = 0.272
Means and SD of Management Score: 2008 as shown by the vertical lines: Mean = 0.505 SD = 0.169; 2013: Mean = 0.581 SD = 0.158

Source: Own calculations based on GMOP.

This descriptive finding suggests that health is an increasingly important topic in personnel management. An explanation for the noteworthy increase in health measures can be found in the political debate and ensuing media coverage. While a firm's provision of health measures is voluntary, legal facilitators have been put in place in recent years. According to §§20ff of the German Social Code V (SGB V), statutory health insurance providers have to actively promote health in German establishments. Further, according to the Income Tax Code (Einkommensteuergesetz, EStG §3 Nr. 34) and starting on January 1st 2008, tax-exemptions of 500€ per employee per

[9] T-tests reveal that the mean scores differ significantly between the establishment size categories.

year were made available for each firm to be invested in health measures according to §20 and §20a of SGB V. Measures supported by this law include exercise programs, provision of healthy nutrition, addiction prevention and stress reduction. Further, a campaign called "Unternehmen unternehmen Gesundheit"[10] ("firms undertake health") was initiated in 2011 by the German Federal Ministry of Health to inform firms about the implementation of health measures. These government initiatives culminated in the adoption of the Act to Strengthen Health Promotion and Preventative Health Care[11] which became effective in July 2015.

3.5 Determinants of the Health Score

While firm size seems to be an important factor in the adoption of health measures, a deeper investigation of the drivers of the health, as well as the management score, is in order. Table 4 clarifies the characteristics that influence an establishments' choice of implementing management practices and health measures.

Two regressions analyzing variables influencing the management and the health scores are reported in Columns 1 and 2. As had been illustrated in Broszeit et al. (2016), the management score is mainly driven by establishment size and international affiliation, both in terms of foreign ownership and exports. In addition to this paper, which also corroborates the results reported in Bloom et al. (2013), more establishment characteristics can be considered here since administrative data was merged. The new findings show that the share of highly qualified employees is positively correlated with the management score, while the share of women and the establishments' age show negative significant associations with the management score. Unlike Bloom and van Reenen (2006), we do not find a positive relationship between establishments' perceived pressure from competition and the management score. Thus, tougher competition neither hampers nor strengthens the use of management practices. This finding also applies to health measures.

The health score is mainly driven by the establishment's size and share of high-qualified employees, suggesting that qualified employees may predominantly demand these measures. Establishments with a high share of older workers less often implement innovative practices. However, the workforce composition in terms of gender does not seem to play a driving role for the health score. Bloom and van Reenen (2006) do not find a significant relationship between the share of females and work-life balance practices either.

The results in Column 2 further reveal a significant positive association between the calculated health and management scores indicating that establishments with good management practices provide more health measures. When regressing the health

[10] http://www.bundesgesundheitsministerium.de/themen/praevention/betriebliche-gesundheitsfoerderung/unternehmen-unternehmen-gesundheit.html

[11] http://www.bundesgesundheitsministerium.de/themen/praevention/praeventionsgesetz.html

score only onto the management score, the point estimate barely changes, however a rather low R-squared of five percent hints to a limited explanatory power of health measures for management practices. The result that management practices and health measures are related is not unexpected, as establishments may implement a bundle of practices at the same time in order to save implementation costs. Good experiences with Anglo-Saxon management practices may also induce managers to continue implementing different practices. Finally, it might be that good managers provide good work environments, both in terms of management practices and also in terms of health measures.

Table 4
What Drives the Use of Health Measures?

Dependent Variable	Management score	Health score	Introduction of at least one health measure between 2008 and 2013
Employees (ln)	0.045***	0.065***	0.027
	(0.006)	(0.010)	(0.023)
Foreign ownership (D)	0.039***	-0.004	0.210***
	(0.015)	(0.027)	(0.063)
Family ownership (D)	0.002	0.007	0.037
	(0.011)	(0.016)	(0.039)
Independent company (D)	-0.006	-0.018	-0.042
	(0.015)	(0.024)	(0.055)
Works council (D)	-0.003	-0.026	0.045
	(0.012)	(0.019)	(0.043)
Engagement abroad (D)	-0.003	0.005	0.107**
	(0.013)	(0.019)	(0.045)
Exports (D)	0.032**	-0.022	-0.012
	(0.014)	(0.020)	(0.047)
Competition (D)	-0.016	0.008	-0.068**
	(0.010)	(0.014)	(0.031)
Women (share)	-0.064**	-0.006	-0.005
	(0.032)	(0.046)	(0.107)
High qualified (share)	0.073*	0.162**	0.225
	(0.042)	(0.067)	(0.154)
Mean age of employees (ln)	-0.047	-0.148*	-0.433**
	(0.062)	(0.079)	(0.194)
Age of establishment (ln)	-0.027***	-0.016	0.062**
	(0.008)	(0.012)	(0.030)
East Germany (D)	0.043***	-0.007	-0.029
	(0.013)	(0.020)	(0.045)
Management score		0.382***	-0.035
		(0.044)	(0.107)
Controls	yes	yes	yes
Establishment FE	no	no	no
Observations	1,407	1,407	1,407
Adj. R^2, Pseudo R^2	0.198	0.276	0.113

Notes: Average marginal effects from probit estimations in column 3. Clustered robust standard errors at the establishment-level are in parentheses. Controls include year (D), 2-digit industry levels, settlement structure, noise variables (gender, tenure, position and answering method) and a dummy for deviations between the survey and administrative data. D indicates a dummy variable. */**/*** denote significance levels at 10%/5% /1%.

Source: Own calculations based on GMOP and BHP.

In Column 3 we investigate the implementation of new health measures between 2008 and 2013 to see which establishments were the most likely to adopt new practices in recent years. Probit estimations, with the dependent variable taking the value one if

at least one health measure was introduced between the two survey years, reveal a significant positive association of foreign ownership and engagement abroad and the implementation of new measures. One interpretation is that establishments with foreign affiliations benefit from knowledge-spillovers and the experiences made in other countries.

The mean employee age has a negative relationship indicating that health measures may be more important in establishments with a younger workforce, which is in line with the observation that firms with a younger workforce benefit more from health measures (Rongen et al., 2013).

3.6 Outcome Measures

As we believe that establishment performance is too multi-dimensional to be captured in one variable, we look at two different outcomes which can be impacted by health measures, each of which covers one aspect of performance. First, we are interested in *labor productivity* as a direct measure of an establishment's output. We construct labor productivity by dividing sales minus intermediates by the number of employees all of which are taken from the survey. Intermediates include all intermediate inputs and costs associated with the sales, such as raw materials, supplies, commodities, wage work, external services, rents and other costs. We deflate labor productivity and use the natural logarithm in our estimations. Further, we drop the bottom and top five percent of the distribution of labor productivity, as we suspect measurement errors in the data.

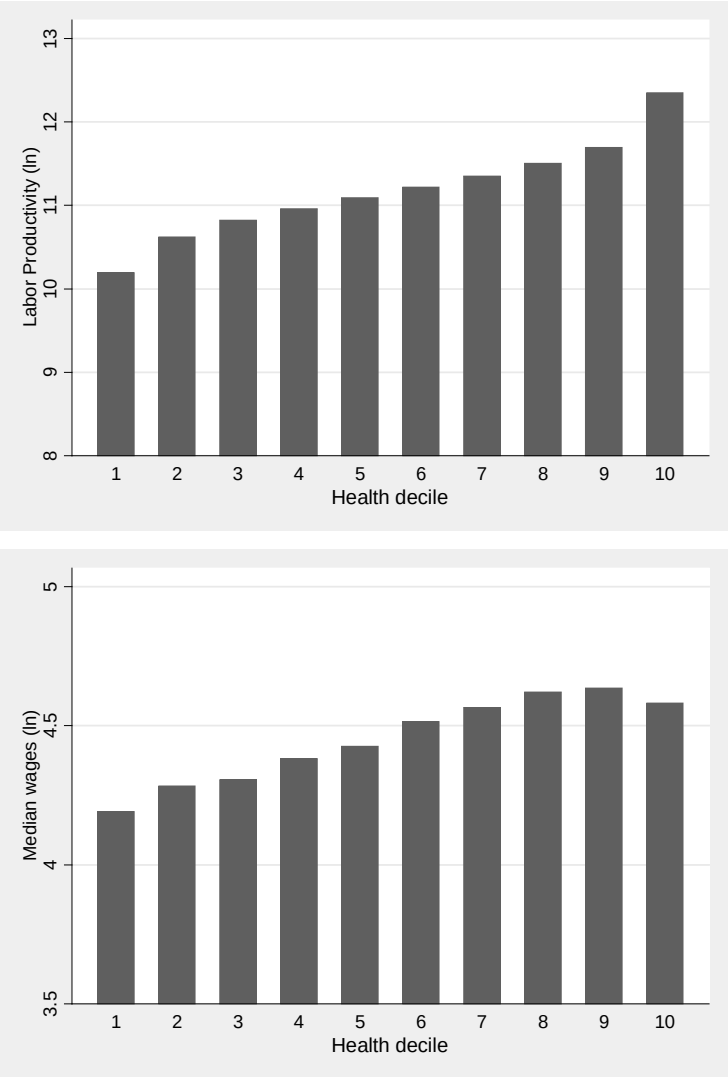
Labor productivity reflects not only processes internal to the firm, but also those external to the firm, for example the economic situation or shocks, which influence the establishment's sales. We therefore also look at wages, which are determined within the firm and cannot be adjusted as quickly to external conditions. We believe that labor productivity captures both labor and capital to some extent, at least through the deduction of intermediates, while wages refer solely to labor. Additionally, health measures should also predominantly affect labor and not capital and therefore an analysis of the relationship between health measures and wages is valuable.

We use information from the BHP on *median wages*. According to human capital theory, health is an investment in productivity and productivity is valuated through wages in the labor market. Therefore we assume, that health measures should increase the establishments' median wages. The variable reflects the median imputed gross average daily wage of an establishments' full-time employees[12] (Schmucker et al., 2016), which we compute as a deflated natural logarithm. We chose median wages instead

[12] This variable is computed by Schmucker et al. (2016) as the individual wage of all employees of one establishment. For individuals whose wage is above the social security contribution threshold, the wages were imputed. The individual median wages are then aggregated to the establishment level and the median is computed.

of mean wages, as wages in the administrative data is top-coded and the former thus better reflects the establishment's wage structure.

Figure 3
Health Score and Outcome Variables



Notes: Weighted.
Source: Own calculations based on BHP and GMOP.

Figure 3 descriptively depicts the relationship between our outcome measures and the health score's deciles. For both labor productivity and median wages, we see an approximately linear increase of the outcome measures with increasing health score deciles, indicating a positive linear association[13] between the respective measures and the health score.

[13] The idea of a linear relationship is corroborated by the insignificant effects of the inclusion of the health score raised to the power of two and three.

4 Empirical Strategy

In a first step, we estimate a function of the form:

$$Y_{it} = \beta_0 + \beta_1 MS_{it} + \beta_2 HS_{it} + \beta_3 X_{it} + u_{it} \ , \qquad (1)$$

where the subscript $i = 1, \dots N$ indexes the establishments and $t = 1, \dots T$ the time periods. As explained in section 3.6, the dependent variable Y_{it} is either labor productivity or median wages. The main variables of interest are MS, the management score and HS, the health score. X is a vector of time-varying establishment-level parameters both from the survey and the administrative data. They include the natural logarithm of the number of employees to approximate labor, dummies for foreign ownership, a works council, engagement abroad and exports, a dummy indicating whether the establishment is an independent firm or part of a larger company, the mean age of employees, the share of women, the share of high-qualified employees as well as establishment age. Due to precision advantages, the qualification structure from the BHP is used even though categorical information on the share of managers and non-managers with a university degree is available in the GMOP. u is the remaining error term, clustered at the establishment-level. For an overview of all variables see Table A1.

To account for measurement error, "noise controls", i.e. survey-specific variables and paradata are included. They comprise the survey method (paper or online) and characteristics of the respondent (gender, tenure and job position). We also include a dummy variable called "deviation" which takes the value one if the number of employees in the GMOP was missing and replaced by the administrative data. The dummy further takes the value one, if the number of employees in the administrative data is more than three times higher than that indicated in the survey. Lastly the variable is one if the industry classification changed or if the establishment was not found in the BHP 2014.[14]

First, we estimate pooled cross-sectional ordinary least squares (OLS) regressions. Since we do not know a priori whether health measures impact performance or performance impacts the offer of health measures, reverse causality cannot be excluded. It is possible that establishments implement certain practices as a response to positive productivity shocks. Alternatively, especially larger firms may be under social pressure to offer practices as part of their corporate social responsibility strategies (Yamamoto and Matsuura, 2014). Selectivity may also occur, as establishments with high health scores might have already been more successful before the health

[14] As a robustness check, we estimated the FE equations again with a sample in which observations with deviations between the survey and administrative data, were dropped. This reduced sample did not change the results for either dependent variable.

measures were introduced. To deal with these issues, we estimate within fixed effects (FE)[15] regressions in a second step according to the following equation:

$$Y_{it} = \gamma_1 MS_{it} + \gamma_2 HS_{it} + \gamma_3 X_{it} + \propto_i + e_{it} \ , \qquad (2)$$

where $\propto_i$ is an unknown intercept for each establishment. All other variables are the same as in equation (1) and we cluster the standard errors at the establishment-level.

We show the results of both the pooled OLS regressions and the FE regressions, as both have advantages. First, by showing the pooled OLS results, we can compare the health measures' importance with that of work-life balance measures found in Bloom and van Reenen (2006). However, we want to take a further step and get a first impression of a potential causal relationship. As the FE model controls for time-invariant differences between the establishments, it provides a more believable interpretation of the results, nevertheless we do not claim causality for our results. We have limited time variation with a time lag of five years between the two periods of observation, thus we estimate first differences and measure long-term effects with the FE estimations. The estimation of long-term effects is reasonable, as we do not expect health measures to have an immediate impact on performance outcomes. Rather, health measures are regarded as long-term investments, whose impact will take some time to manifest.

5 Results

5.1 The Link Between Health Measures and Labor Productivity

5.1.1 Health Measures and Management in Pooled OLS Estimations

Table 5 reports the results for the baseline pooled OLS and FE labor productivity estimations. In the pooled OLS estimations, having a highly qualified labor force, a works council and being active abroad through exports or a business engagement in other countries positively influences labor productivity, as does a longer existence of the establishments. Having a high share of female employees, as well as being located in East Germany negatively impacts labor productivity. The first result is most likely due to the fact that women work in different occupations or tasks, as well as more often in part-time compared to men. East German establishments and labor markets structurally differ from West German ones, which may explain the latter negative coefficient. Because the survey years include the Great Recession, a control for the crisis is included and as expected, establishments which were negatively affected by the Great Recession have a lower labor productivity compared to those which were not affected. For the FE estimations, only the share of female employees and the age of the establishment remain significant.

[15] Hausmann tests clearly rejected the RE model in favor of the FE model for estimations with both dependent variables.

Column 1 of the pooled OLS estimation implies that an increase in the health score is associated with a significant increase in labor productivity. Analogously, Column 2 shows that an increase in the management score positively impacts labor productivity, which is consistent with earlier work for Germany (Broszeit et al., 2016) and the US (Bloom et al., 2013). The effect size for the management score is also similar to the coefficient calculated by Bloom et al. (2016) with cross-country WMS data. While smaller than the management score, the health score's coefficient is still meaningful in size and statistically significant.

As indicated in Table 3 the health and management scores are correlated. Thus, the effect of the management score could simply pick up the effect of the health score. We test this idea by including both scores jointly in the regressions in Table 5, Column 3. If both coefficients are statistically significant and meaningful of size, both scores have a distinct effect on the outcome. Our estimations show that the magnitude of both scores decrease slightly, which is not surprising as we expected both scores to capture some parts of each other. But as both estimates are still statistically significant and of considerable economic size, we conclude that health measures and overall management quality are distinct concepts.

Table 5
Health Measures, Management and Labor Productivity

	OLS	OLS	OLS	FE	FE	FE
Health score	0.282***		0.207**	0.052		0.019
	(0.087)		(0.087)	(0.056)		(0.059)
Management score		0.611***	0.538***		0.239**	0.229**
		(0.137)	(0.140)		(0.104)	(0.110)
Employees (ln)	-0.086**	-0.093**	-0.106***	-0.343***	-0.348***	-0.349***
	(0.037)	(0.037)	(0.037)	(0.072)	(0.071)	(0.072)
Foreign ownership (D)	-0.020	-0.036	-0.036			
	(0.103)	(0.101)	(0.101)			
Independent company (D)	-0.182**	-0.190**	-0.181**			
	(0.084)	(0.083)	(0.082)			
Works council (D)	0.150***	0.150***	0.155***			
	(0.057)	(0.057)	(0.057)			
Engagement abroad (D)	0.196***	0.209***	0.205***	0.059	0.063	0.063
	(0.069)	(0.069)	(0.069)	(0.061)	(0.064)	(0.063)
Exports (D)	0.148**	0.128**	0.136**	-0.005	-0.009	-0.011
	(0.064)	(0.063)	(0.064)	(0.054)	(0.052)	(0.053)
Crisis (D)	-0.082*	-0.082*	-0.082*			
	(0.046)	(0.045)	(0.045)			
Women (share)	-0.787***	-0.760***	-0.768***	-0.451*	-0.439*	-0.441*
	(0.168)	(0.165)	(0.165)	(0.252)	(0.249)	(0.250)
High qualified (share)	0.845***	0.815***	0.796***	-0.343	-0.327	-0.331
	(0.280)	(0.280)	(0.280)	(0.417)	(0.413)	(0.414)
Mean age of employees (ln)	-0.312	-0.297	-0.284	-0.407	-0.389	-0.383
	(0.245)	(0.244)	(0.243)	(0.250)	(0.256)	(0.254)
Age of establishment (ln)	0.079*	0.080**	0.087**	0.181***	0.184***	0.183***
	(0.040)	(0.040)	(0.039)	(0.053)	(0.052)	(0.052)
East Germany (D)	-0.104*	-0.129**	-0.126**			
	(0.061)	(0.062)	(0.061)			
Controls	yes	yes	yes	yes	yes	yes
Establishment FE	no	no	no	yes	yes	yes
Observations	936	936	936	936	936	936
Number of Establishments	468	468	468	468	468	468
Adj. R^2 , R^2 within	0.238	0.248	0.254	0.147	0.156	0.156

Notes: Pooled OLS and balanced panel FE. Controls include year (D), 2-digit industry levels, settlement, noise variables (gender, tenure, position and answering method) and a dummy for deviations between the survey and administrative data. Clustered robust standard errors at the establishment-level are in parentheses. */**/*** denote significance levels at 10%/5%/1%. Standard deviation of the health score is 0.255. Standard deviation of the management score is 0.161.

Source: Own calculations based on GMOP and BHP.

An increase in the management score by 0.1 points is associated with an increase in labor productivity by 5.5 percent.[16] This magnitude is only slightly smaller than 6.2 percent, a comparable one found in Table 3, Column 5 of Broszeit et al. (2016), thus corroborating the previously found result with a different sample and additional controls. An increase in the health score is linked to an increase in labor productivity by 2.1 percent.[17] With a standard deviation of the health score of 0.255 (pooled mean: 0.293), a one standard deviation increase is associated with an increase in labor

[16] exp(0.538*0.1) = 1.055

[17] exp(0.207*0.1) = 1.021

productivity of 5.4 percent.[18] Compared to a labor productivity increase of 9.0 percent[19], which is associated with a one standard deviation increase of the management score (pooled mean: 0.543; std. dev.: 0.161), the effect of the health score is non-negligible. Unlike work-life balance measures, which lose their significance once management is controlled for (Bloom and van Reenen, 2006), the significant relationship between health measures and labor productivity remains. This finding attributes quite some importance to health measures.

5.1.2 Health Measures and Management in Fixed-Effects Estimations

To address possible endogeneity occurring as health programs and management practices are chosen by establishments as a result of optimization, Table 5 additionally reports the results of fixed effects estimations as shown in equation (2). The results of these first-differences can be interpreted as long-term effects of the health and management scores. [20]

We observe that the magnitude of both the health and management scores drop compared to the pooled OLS estimations. The health score's coefficient becomes insignificant and very small both when included separately as well as when included together with the management score. Although falling over one-half, the significant positive impact of management practices on labor productivity is confirmed.[21] A possible explanation for the vanishing effect of health measures on labor productivity is that we are only able to regard a limited time period of five years, which may not yet capture the true impact of health measures, as it may need more time to manifest (Grossmeier et al., 2012). Further, as Goetzel et al. (2014) argue, health measures only work when they are structured, well designed and effectively executed, which we cannot control for but which could impact our results. We also assume that implementing health practices is costly, which could weaken labor productivity through the deduction of higher intermediate costs. At the same time, we also do not find a negative effect of health measures, thus, while they do not increase labor productivity, they do not cause losses either, possibly paying for themselves.

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[18] exp(0.207*0.255) = 1.054

[19] exp(0.161*0.538) = 1.090

[20] To test for robustness and to alleviate any concerns that may arise due to the limited time variation of two waves, we also estimate a lagged model in which labor productivity is measured in 2013 and all covariates in 2008. The results of the lagged model confirm the pattern of the FE estimations, such that health measures become insignificant when the management score is added in the equation. For the lagged model health measures are significant when the management score is not included, indicating that it may pick up some of the management score's effect in this estimation.

[21] We cannot evaluate a possible measurement error properly. Measurement error biases the estimates towards zero and causes inconsistency. Thus, the true coefficients may be larger.

5.1.3 Integrating Single Health Measures

Due to the heterogeneity of the health measures investigated, we additionally run regressions in which we include all measures separately. As shown in Table 6 three of the six health measures - management seminars for health oriented leadership, exercise/recreation offers and health days - show positive significant associations with labor productivity in the pooled OLS regression.

Table 6
Single Health Measures, Management and Labor Productivity

				OLS				FE
Management score	0.548***	0.584***	0.528***	0.540***	0.554***	0.563***	0.532***	0.223*
	(0.144)	(0.148)	(0.144)	(0.142)	(0.145)	(0.144)	(0.148)	(0.119)
Health days	0.121*						0.065	0.056
	(0.065)						(0.072)	(0.042)
Health check-ups		-0.025					-0.069	-0.028
		(0.044)					(0.049)	(0.029)
Management seminars			0.153**				0.142**	-0.036
			(0.060)				(0.064)	(0.041)
Exercise & recreation				0.137**			0.120*	0.021
				(0.058)			(0.064)	(0.029)
Healthy diet					0.054		-0.003	0.020
					(0.059)		(0.070)	(0.041)
Ergonomic measures						0.017	-0.002	0.003
						(0.049)	(0.050)	(0.029)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Establishment FE	no	no	no	no	no	no	no	yes
Observations	858	858	858	858	858	858	858	858
N. of Establishments	424	424	424	424	424	424	424	424
Adj. R^2 , R^2 within	0.250	0.246	0.253	0.253	0.246	0.246	0.258	0.166

Notes: Pooled OLS and balanced panel FE. Smaller sample size due to missings in single health measure variables. Controls include employees (ln), foreign ownership (D), independent company (D), works council (D), engagement abroad (D), exports (D), crisis (D), women (share), high qualified (share), mean age of employees (ln), age of establishment (ln), year (D), East Germany (D), 2-digit industry levels, settlement structure, noise variables (gender, tenure, position and answering method) and a dummy for deviations between the survey and administrative data. Clustered robust standard errors at the establishment-level are in parentheses. */**/*** denote significance levels at 10%/5%/1%.

Source: Own calculations based on GMOP and BHP.

For health programs to be effective, management support is of crucial importance. Health measures can only work if they are strategically planned, linked to business objectives, motivated by incentives, achieve high participation rates, communicated well and evaluated regularly all of which are management tasks (Goetzel et al., 2014). Furthermore, managers need to set goals, make resources available and delegate responsibilities. Developing an awareness of “healthy working” and learning how to effectively introduce appropriate health measures is taught in management seminars, which may explain the significant positive coefficient for this measure. The participation in management seminars can be a proxy for an establishment’s “culture of health”, an organizational culture which fosters a healthy lifestyle. Foss (2001) shows that managers solve coordination problems by influencing beliefs, which is how managers transfer their newly acquired knowledge to their employees. This communicated culture of health does not just apply to the provision of one health day per year,

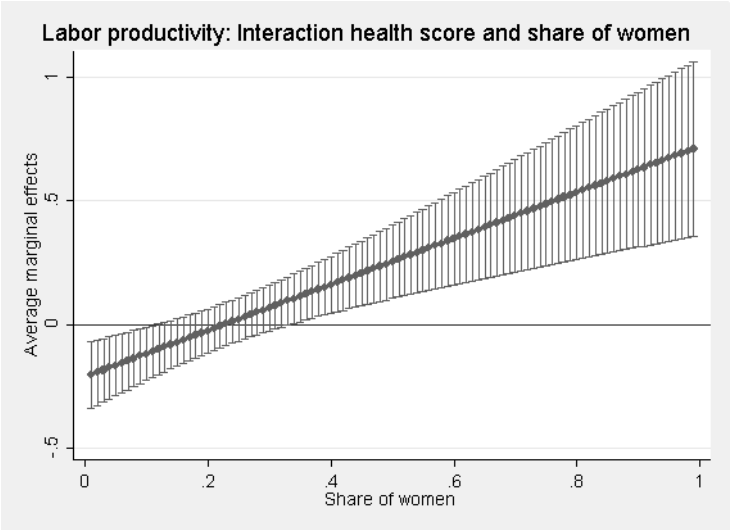
but the permanent integration of health awareness in the establishment's culture (Goetzel et al., 2014).

While the individual health measures coefficients become insignificant in the FE estimations, the management score's coefficient remains robust both in the pooled OLS and the FE estimations. This is in line with the results for the overall health and management scores as shown in Table 5 and may again indicate that positive effects of health measures may not yet be reaped as they have not been implemented long enough to impact the workforce.

5.1.4 Interaction Effects with Respect to Workforce Composition

So far, our results did not show an overall clear association between health measures and labor productivity. One possible explanation could be that health measures are particularly valued or used by certain employee groups, such as the literature (Göbel and Zwick, 2013; Rongen et al., 2013) suggested for example elderly or female employees. We test this assumption by including interaction terms between the health score and firm characteristics.

Figure 4
Interaction Effects of the Health Score and the Share of Women for Labor Productivity Estimations



Notes: Average marginal effects. 90% confidence interval.
Source: Own calculations based on BHP and GMOP.

The analysis reveals that in establishments with a high share of female employees, health measures significantly increase labor productivity. For women, health measures thus seem to be a good instrument to foster productivity. As Figure 4 shows, this observation is not true for establishments with low shares of women, rather health measures have a negative impact on labor productivity for these establishments. The overall effect of health measures calculated at the mean of the share

of women of 0.27 in the establishment is 0.038.[22] We conclude that a critical mass of females in the establishment is needed in order to reap the benefits of health measures.

However, we do not observe this pattern for the age and qualification structures. While the share of below 30 year olds has a significant positive relationship with labor productivity, the interaction with health does not. This result is somewhat unexpected as the literature pointed to differentiated age effects, particularly for younger (Rongen et al., 2013) and older employees (Göbel and Zwick, 2013). A possible explanation is that we do not have very young or very old employees in the sample, with the first age percentile being at 34 years and the 99 percentile at 51 years. Thus our relatively homogenous age group may be in an age range where health measures do not play an important role. As the interaction between health and the share of employees below 40 years of age is also not significant, we conclude that we do not find differentiated age effects.

Additionally, the share of qualified employees interacted with the health score does not relate to labor productivity. We hypothesize that highly qualified employees are on the one hand specifically time constrained and therefore refrain from making use of offered health measures during working hours and on the other hand may be more able to afford private health prevention and exercise. Further, interactions between the health score and the establishment size are also not significant, thus indicating that the effect of health measures is independent of the number of employees in an establishment. Finally, the same observation holds for the interaction between the management score and the health score.

Taking the overall results for the relationship between health measures and labor productivity into account, we cannot corroborate or reject our first hypothesis. It seems that health measures and labor productivity have a relationship under certain conditions, but an overall effect cannot be deduced.

5.2 The Link Between Health Measures and Median Wages

In this section we inspect the relationship between the health and management scores with median wages, as we believe that wages reflect a facet of establishment performance that is directly related with employee productivity which in turn should more directly be affected by health.

5.2.1 Baseline Results

Table 7 presents the baseline results for pooled OLS and FE estimations. As opposed to the results obtained for labor productivity, neither exports, engagement abroad nor

[22] The coefficients obtained from an FE estimation with an interaction between the health score and the share of women with a mean female share of 0.27 are: -0.213 + (0.931*0.27) = 0.038.

the crisis affect median wages. However, as with labor productivity, median wages are positively affected by the existence of a works council, as well as a higher establishment age, while being located in East Germany is negatively associated with median wages. Establishments with a higher share of highly qualified employees, but a lower share of females seem to pay higher wages.

Following human capital theory, we expect the health score to be positively related to median wages, as investments in health constitute an investment in human capital which is rewarded by higher productivity measured in wages. This theory is corroborated by the pooled OLS estimation results in Column 1 of Table 7, which shows a positive significant relationship between the health score and median wages. Compared to the productivity estimations, the coefficient is smaller and loses its significance when included in an estimation with the management score and the controls. The same pattern can be observed for the management score. It seems that the two scores eliminate each other's effects in the pooled OLS estimation. One possible explanation is that specific bundles of different human resources practices yield the best results (Ichniowski and Shaw, 2003) and that the best bundles have yet to be found. Some Anglo-Saxon management practices may hinder health measures and vice versa and we can for example imagine that health days or exercise and recreation offers stand in direct opposition with reaching production targets, which could in turn confound the effects of the scores.

When we turn to the FE estimations in the last column though, this possible negating effect is no longer in place as the coefficient for the health score is now significant, while the management score's is not. As the first differences estimations capture long-term effects, we could assume that a better combination of practices and measures was achieved and that the benefits of health measures can now be reaped.

The FE estimation results are surprising insofar as the management score does not play a role in the determination of median wages, neither in a specification without the health score, nor in one including the health score. The health score on the other hand is significant for both specifications, albeit with a rather small coefficient magnitude.[23] Nevertheless, it seems that the roles of the management score and the health score are reversed for the median wages estimations compared to the labor productivity estimations. This finding is in line with the idea that the management score incorporates aspects of lean production, monitoring to increase efficiency and for example dealing with underperforming employees, all of which should impact output and therefore labor productivity.

[23] The estimation of lagged models confirm these results to some degree. Neither the management nor the health score are significant in the lagged model, however the effect size of the health score does not change.

Table 7
Health Measures, Management and Median Wages

	OLS	OLS	OLS	FE	FE	FE
Health score	0.050*		0.041	0.038**		0.037**
	(0.026)		(0.026)	(0.015)		(0.016)
Management score		0.076*	0.061		0.022	0.001
		(0.041)	(0.042)		(0.034)	(0.036)
Employees (ln)	0.028**	0.028***	0.025**	-0.122***	-0.122***	-0.122***
	(0.011)	(0.011)	(0.011)	(0.042)	(0.042)	(0.042)
Foreign ownership (D)	0.019	0.017	0.017			
	(0.020)	(0.020)	(0.020)			
Independent company (D)	-0.047***	-0.048***	-0.047***			
	(0.017)	(0.017)	(0.017)			
Works council (D)	0.075***	0.074***	0.075***			
	(0.016)	(0.016)	(0.016)			
Engagement abroad (D)	-0.013	-0.013	-0.013	0.020	0.020	0.020
	(0.016)	(0.016)	(0.016)	(0.015)	(0.015)	(0.015)
Exports (D)	0.029*	0.026	0.027	0.011	0.014	0.011
	(0.017)	(0.017)	(0.017)	(0.016)	(0.017)	(0.016)
Crisis (D)	0.008	0.007	0.007			
	(0.013)	(0.013)	(0.013)			
Women (share)	-0.515***	-0.512***	-0.512***	-0.085	-0.078	-0.085
	(0.041)	(0.041)	(0.041)	(0.088)	(0.088)	(0.089)
High qualified (share)	0.994***	0.997***	0.989***	0.301	0.313	0.301
	(0.065)	(0.064)	(0.065)	(0.211)	(0.211)	(0.211)
Mean age of employees (ln)	0.185**	0.182**	0.187**	-0.063	-0.081	-0.063
	(0.074)	(0.074)	(0.074)	(0.135)	(0.138)	(0.136)
Age of establishment (ln)	0.028**	0.028**	0.029***	-0.001	-0.002	-0.001
	(0.011)	(0.011)	(0.011)	(0.021)	(0.021)	(0.022)
East Germany (D)	-0.362***	-0.364***	-0.364***			
	(0.019)	(0.019)	(0.019)			
Controls	yes	yes	yes	yes	yes	yes
Establishment FE	no	no	no	yes	yes	yes
Observations	1,436	1,436	1,436	1,436	1,436	1,436
Number of Establishments	718	718	718	718	718	718
Adj. R^2 , R^2 within	0.669	0.669	0.670	0.228	0.223	0.228

Notes: Pooled OLS and balanced panel FE. Controls include 2-digit industry levels, settlement structure, noise variables (gender, tenure, position and answering method) and a dummy for deviations between the survey and administrative data. Clustered robust standard errors at the establishment-level are in parentheses. */**/*** denote significance levels at 10%/5%/1%. Standard deviation of the health score is 0.257. Standard deviation of the management score is 0.168.

Source: Own calculations based on GMOP and BHP.

Health measures on the other hand directly only relate to people management in terms of well-being and less to establishment-level sales. Thus, as health measures may be expensive to implement, their positive effect on labor productivity could be offset by their costs, which is why the estimations show no results. Labor productivity will be lower for establishments with a high share of intermediates and this could play a role for the results. For median wages however, the potential costs of health measures are irrelevant, as they are not deduced from wages. The coefficients therefore only capture their benefits, thereby revealing a positive significant relationship. This association may also capture the notion that it takes some time in order for the health measures to be effective, going hand in hand with the idea that health measures present a long-term investments (Buhai et al., 2016).

Thus, a 0.1 point increase in the health score is associated with a 0.4 percent increase in median wages.[24] We further find no significant interaction effects with establishment characteristics, such as the share of women, the age and qualification structure, nor the establishment size. This result points to an overall positive effect of health measures, irrespective of implementing establishment's characteristics.

A comparison of the health score's economic significance with that of the prominence of education is in order within the context of human capital theory. With a standard deviation of the health score of 0.257 (mean: 0.293) an increase in one standard deviation is associated with an increase in median wages of one percent.[25] Compared to the effect on an individual's wages due to an additional year of education of 6 to 15 percent (Ashenfelter et al., 1999; Belzil and Hansen, 2002), the health scores' importance is lower. The result that the effect of health measures is lower than that of an additional year of education is not unexpected. We only observe an association between health measures and median wages at the establishment-level, as we have no information on individual health or wages and this aggregation difference makes direct comparisons harder. Formal education plays an essential role in the German labor market in determining wages and promotions and it seems reasonable that this role is more important than that of preventative health measures, taken not at the individual- but at the establishment-level. Further, we do not know if the establishment's employees take advantage of the health measures provided and it is reasonable to believe that only a fraction of the employees do. Thus, we most likely measure a lower bound.

The interpretation via human capital theory is only one of several possible explanations, as the channel through which health measures impact median wages is still unclear. The above presented interpretation assumes a direct positive effect of health measures on employee productivity and in turn on wages. Further possible channels are an increase in motivation, satisfaction or tenure. If one believes that health measures rather affect wages through the channel of tenure, a different interpretation becomes plausible. Here health measures can be regarded as benefits which could for example signal a good organizational culture and thus increase tenure. Tenure in turn is remunerated on the labor market. Hence the positive coefficient of health measures could capture a channel where health measures increase tenure, which impacts wages. At the same time though, health measures could be regarded as a fringe benefit in addition to wages, i.e. a non-wage amenity which lowers the need to attract and retain employers through wages only. In the extreme, establishments may opt to pay lower wages in return for providing fringe benefits and the literature provides some evidence that fringe benefits and higher wages reduce turnover (Dale-Olsen, 2006). This would mean that wages may be lower as a compensation for fringe

[24] exp(0.037*0.1)= 1.004

[25] exp(0.037*0.257) = 1.010.

benefits, but the effect of tenure could again show a positive estimate of the health score.

To dig further into the relationship between health measures and median wages, we regard additional estimations in which we control for a further establishment characteristic, namely a dummy for a high wage establishment. This exercise alleviates the concern that the FE results merely reflect reverse causality, i.e. that high wage establishments have the financial background to implement health measures. To test this assumption, we include a dummy in our FE estimation which is one when an establishment is in the top 25% of the median wage distribution in a certain year and industry. Upon the inclusion of this dummy, the effect size and significance of the health measure does not change, indicating that we do not merely capture an establishment effect. We further interact this dummy with health measures. For this estimation, both the coefficient for the health score and for the high wage dummy are positive and significant. The coefficient for the health score is larger in magnitude then it was before. The interaction, albeit insignificant, is negative, indicating that the effect of health measures is smaller in the top paying establishments. This results hints towards the fact that establishments at the bottom of the wage distributions benefit more from implementing health measures than do establishments in the top of the wage distribution - in terms of making the establishment more attractive by raising median wage levels (an indicator for the human capital theory interpretation), as well as by offering fringe benefits.

Overall, the positive significant relationship of the health score with median wages, in combination with human capital theory predictions, leads to the interpretation that health measures are an investment which increases human capital and therefore also wages, which is reflected in establishment-level median wages. Therefore, we deduce that our third hypothesis cannot be rejected.

5.2.2 Integrating Single Health Measures

To determine which health measures in particular impact median wages, we separately add dummies for each measure into the equations as shown in Table 8. Compared to labor productivity, different individual measures seem to play a role for median wages. As expected, the measures which have a significant relationship with median wages, are those that directly relate to health, i.e. health days and a healthy diet for the pooled OLS estimations (and exercise and a healthy diet for the individual FE estimations). When including all measures in one specification, only the coefficient for a healthy diet remains significant in the pooled OLS estimation.

Thus, while manager buy-in through management seminars seemed important for labor productivity, measures directly affecting individual employee's well-being, specifically a healthy nutrition, are more important for median wages levels. This result is not surprising as partaking in healthy nutrition is a personal decision, which does not need a manager's impulse. The results are further unsurprising as they are derived from human capital theory predictions.

Table 8
Single Health Measures, Management and Median Wages

				OLS				FE
Management score	0.054	0.057	0.056	0.054	0.046	0.064	0.046	-0.029
	(0.044)	(0.044)	(0.043)	(0.044)	(0.043)	(0.045)	(0.045)	(0.045)
Health days	0.033*						0.017	0.004
	(0.018)						(0.020)	(0.011)
Health check-ups		0.007					0.002	-0.004
		(0.012)					(0.012)	(0.010)
Management seminars			0.019				0.008	0.003
			(0.018)				(0.018)	(0.011)
Exercise & recreation				0.020			0.005	0.012
				(0.014)			(0.015)	(0.010)
Healthy diet					0.050***		0.044**	0.021
					(0.018)		(0.019)	(0.013)
Ergonomic measures						-0.007	-0.015	0.003
						(0.013)	(0.014)	(0.010)
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Establishment FE	no	no	no	no	no	no	no	yes
Observations	1,286	1,286	1,286	1,286	1,286	1,286	1,286	1,286
N. of Establishments	643	643	643	643	643	643	643	643
Adj. R^2 , R^2 within	0.672	0.671	0.671	0.671	0.674	0.671	0.673	0.124

Notes: Balanced panel data. Smaller sample size due to missings in single health measure variables. Controls include employees (ln), foreign ownership (D), independent company (D), works council (D), engagement abroad (D), exports (D), crisis (D), women (share), high qualified (share), mean age of employees (ln), age of establishment (ln), year (D), East Germany (D), 2-digit industry levels, settlement structure, noise variables (gender, tenure, position and answering method) and a dummy for deviations between the survey and administrative data. Clustered robust standard errors at the establishment-level are in parentheses. */**/*** denote significance levels at 10%/5%/1%.

Source: Own calculations based on GMOP and BHP.

6 Discussion

We take a first step in investigating the effect of health measures on establishment-level outcomes. While many channels through which health measures could affect performance exist, we concentrate on labor productivity and median wages. Our results indicate that the health score has a positive relationship with labor productivity in establishments with a higher share of women, however we cannot confirm an overall relationship between the health score and labor productivity. We do find a significant overall association between the health score and median wages, hinting that health measures have an impact on people-related, but not on output-oriented outcomes. It is also quite possible that some establishments offer health measures and a health-beneficial organizational culture as a fringe benefit, i.e. non-wage amenities. As such, health measures could be regarded as compensation to offset lower wages. However, previous work has shown that high wage establishments offer more fringe benefits on average (Dale-Olsen, 2006). In this case, we would underestimate the reported effects.

Further, we show that the management score does not subsume the health score, rather both are distinct concepts on their own. This is an important finding, as Bloom and van Reenen (2006) could not claim the same for work-life balance measures, whose effects evaporated upon the inclusion of the management score. They argue

that management is an omitted variable that is responsible for spurious relations between work-life balance and productivity (Bloom, Kretschmer, van Reenen, 2009). Clearly, this is not the case for health measures. Therefore, we conclude that health measures can contribute to establishment success in addition to Anglo-Saxon management practices.

Health measures might be regarded as an add-on or a benefit which only attractive employers offer. Therefore, establishments may benefit from offering health measures in addition to Anglo-Saxon management practices – even when they don't observe an immediate and direct effect on labor productivity. By introducing health measures as strategic instruments, sustainable effects might occur which affect long-term productivity and wage levels through different channels, for example by attracting and retaining a healthy workforce, thus interweaving effects of composition, employee motivation and satisfaction, as well as employee productivity.

However, we are not able to dig deeper into the specific circumstances that make health measures effective. Our results suggest that health measures may be more effective when managers endorse them, as we find a significant effect of health awareness trainings. Further, the impact of health measures might be dependent on the bundles of practices offered in one particular establishment. Disentangling the different channels through which health measures contribute to firm performance remains for future research.

We contribute by taking the next step towards showing how establishment-level health measures are associated with labor market outcomes. Nevertheless, more research is needed to fully understand the importance of health measures taken by establishments. We cannot fully exclude selection in our estimations, as we only have a two-wave panel. It is possible, that establishments who are better off, may be better able to pay for the costs of implementing health measures, meaning we would capture reverse causality with our health score. However, when we include a dummy for high paying establishments, this does not affect our results. Still, in order to fully control for selection a longer panel is needed.

Our analysis are a first approach to this topic. In this paper, health measures are used as a proxy for actual health, such that individual-level data is needed to estimate the true human capital effects of health in the sense of Becker. We can only look at the meso-level and highly interesting questions arise concerning the individual level, which could further disentangle the mechanisms through which health measures work. While we are not able to provide insights into all possible channels through which health measures may impact performance, we do make a strong argument for investigating these measures for establishment- and individual-level outcomes. Nevertheless, we believe that we took a valuable first step in highlighting the importance of establishment- level health measures for labor market success.

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Appendix

A.1 Variable Overview

Table A1: Estimation Variables Overview

Variable	Source	Question/Definition
Labor productivity (ln)	GMOP	Natural log of value added (sales-intermediates) per employee (deflated)
Intermediates (%)	GMOP	Share of sales attributed to intermediate inputs and external costs, including but not limited to all raw materials and supplies, commodities, wage work, external services, rents and other costs that were purchased from other companies or facilities
Median wages (ln)	BHP	Natural log of median imputed gross average daily wage of an establishment's full-time employees (deflated)
Management score	GMOP	Score between 0 and 1 based on 16 questions on management practices (following Bloom et al., 2013; see also Broszeit et al., 2016)
Health score	GMOP	Score between 0 and 1 based on 6 questions on health measures
Size (ln)	GMOP BHP	Natural log of sum of employed managers and non-managers on the reference date 30.06.; administrative data used when GMOP data was missing
Foreign ownership (D)	GMOP	Was this establishment mainly or exclusively… 1) German property 2) foreign property 3) equally divided into German and foreign property
Works council (D)	GMOP	Does this establishment have a works council? 1) Yes 2) No
Engagement abroad (D)	GMOP	Was your establishment active abroad? This includes taking over of a company abroad, setting up a location or subsidiary abroad or an equity participation amounting to a minimum of 10 % of foreign companies. 1) Yes, active abroad in this sense 2) No, not active abroad in this sense
Exports (D)	GMOP	Did this firm export? 1) Yes 2) No
Competition (D)	GMOP	Competitive pressure was... 1) Very low 2) Rather low 3) Rather high 4) Very high
Independent (D)	GMOP	Is this establishment … 1) an independent company 2) the head office of a company 3) a place of business/office/branch of a larger company 4) a regional or specific middle-level authority of a multi-level company
Crisis (D)	GMOP	Was your establishment negatively affected by the economic and financial crises 2008/2009? 1) Yes, very badly 2) Yes, rather badly 3) Yes, a little bit 4) No
Women (share)	BHP	Percentage of female employees as part of total number of employees

Variable	Source	Question/Definition
High qualified (share)	BHP	Percentage of highly qualified employees as part of total number of employees. Highly qualified is defined as having a university degree
Mean age of employees (ln)	BHP	Mean age of all the employees in the establishment
Age of establishment (ln)	BHP	Time since the establishment first appeared in the administrative data
East Germany (D)	BHP	0) West Germany 1) East Germany
Method (D)	GMOP	0) Online 1) Paper-Pencil
Gender (D)	GMOP	0) Male 1) Female
Tenure	GMOP	Number of years the respondent is working in this establishment
Position	GMOP	1) CEO, Executive Officer 2) Manager of multiple establishments 3) Manager of one establishment 4) Manager within an establishment 5) Non-manager 6) Other
2-digit-industry-classification	BHP	WZ 2008
Settlement type	BBSR	1) Larger cities 2) Urban regions 3) Rural regions with signs of densification 4) sparsely populated rural regions
Deviation (D)	Generated	1 if … the number of employees in the GMOP was missing and replaced by the administrative data the number of employees in the administrative data is more than three times higher than indicated in the GMOP the industry classification changed the establishment was not found in the BHP 2014

Notes: Bold letters indicate that the dummy takes the value one for these categories. BBSR = Federal Institute for Research on Building, Urban Affairs and Spatial Development. Source: GMOP and Schmucker et al. (2016).

A.2 Survey Questions on Health Measures

Which of the following measures did this establishment offer to promote and maintain employee health and performance?

Answer options for 2008 and 2013 each are “yes”, “no” or “don’t know”.

- Health days
- Health check-ups
- Management seminars for health-oriented leadership
- Sport and relaxation offers (e.g. back exercise, autogenic training, etc.)
- Healthy diet
- Ergonomic measures at the workplace

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