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**Variable Payment Schemes and Productivity: Do Individual-Based Schemes
Really Have a Stronger Influence Than Collective Ones?**

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Abstract: While studies on individual-based and collective payment schemes are largely unconnected, there appears to be a widely held belief that individual-based schemes have a stronger influence on firm performance than collective ones. This also applies to an index of best management practices developed by Bloom and Van Reenen (2007). The index assigns the highest weight to individual-based performance pay, a medium weight to group-based performance pay and a low weight to profit sharing. This weighting is obviously driven by the implicit assumption that collective payment schemes suffer from a free-rider problem so they have a less strong influence on productivity than individual-based schemes. We show that this assumption is questionable from both a theoretical and an empirical point of view. Using the German Management and Organizational Practices Survey, one of the datasets initiated by Bloom and Van Reenen, we show that individual-based performance pay does not outperform group-based performance pay or profit sharing. The finding also holds when accounting for possible interactions among the payment schemes and considering the moderating roles of firm size, employee representation, and innovativeness. Our results suggest that researchers should be careful with respect to the assumptions and subjective priors guiding their empirical analyses.

Keywords: Management practices, free-rider problem, individual performance pay, group performance pay, profit sharing.

JEL: J33, M52, M50.

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1. Introduction

During the last decades, various types of variable payment schemes have spread among firms in the United States and many European countries (Lemieux et al. 2009, Ligthart et al. 2022, Zwysen 2021). However, it is an open question as to which of the various schemes is most suited to increase firm performance. As we will make clear, this question is unsolved particularly when it comes to individual-based and collective payment schemes. Studies on individual-based and collective payment schemes form two different strands of literature. These strands of literature are largely unconnected since they usually examine only one type of payment scheme in isolation. Examining individual-based and collective schemes in isolation does not yield insights into their relative effects and, hence, does not allow a clear ranking of these schemes.

Nonetheless, as pointed out by Pfeffer (1998a), there appears to be a widely held belief that individual-based payment schemes have a stronger influence on firm performance than collective ones. Pfeffer calls this a dangerous myth about compensation driven by the assumption that collective payment schemes suffer from a free-rider problem. The myth exaggerates the severity of the free-rider problem and ignores that individual-based performance pay entails its own shortcomings.

Against this background, we examine the influences of individual-based and collective payment schemes by scrutinizing an index of best management practices suggested by Bloom and Van Reenen (2007). This additive index captures three broad areas – monitoring, targets and incentives – and has been used in a series of important follow-up studies covering several tens of thousands of organizations across more than twenty countries (Bender et al. 2018, Bloom and Van Reenen 2010, Bloom et al. 2011, Bloom et

al. 2012, Bloom et al. 2013, Bloom et al. 2014, Bloom et al. 2019, Broszeit et al. 2019, Cornwell et al. 2021, Jirjahn et al. 2023). Most salient to our topic, the management index accounts for three types of variable pay – individual performance pay, group performance pay, and profit sharing. Without providing any explanation, Bloom and Van Reenen assign the highest weight to individual-based performance pay, a medium weight to group-based performance pay and a low weight to profit sharing. This weighting is obviously driven by Pfeffer’s (1998a) dangerous myth about compensation. The implicit assumption is that collective payment schemes suffer from a serious free-rider problem so they have a less strong influence on productivity than individual-based schemes. This assumption is questionable from both a theoretical and an empirical point of view.

As we will discuss in detail, theory does not offer a clear ranking of individual and collective payment schemes with respect to their incentive effects. There are several ways of overcoming or at least mitigating the free-rider problem. Moreover, even in the presence of a free-rider problem collective schemes can have specific advantages over individual ones as they provide incentives for multitasking, cooperation and flexibility. In a similar vein, a clear ranking of individual and collective payment schemes is also not possible with respect to their sorting effects. Thus, in the end, only empirical research can answer the question of whether individual-based or collective schemes have a stronger influence on firm performance.

Our empirical analysis uses panel data from the German Management and Organizational Practices Survey (GMOP). This is one of the firm-level datasets initiated by Bloom and Van Reenen. Applying a reformulated version of the Mundlak estimator, we find substantial long-run, but no short-run effects of individual performance pay, group

performance pay and profit sharing. Most salient to our topic, our results do not support the assumption that collective payment schemes have a weaker influence on firm performance than individual-based schemes. Quite the contrary, the basic estimations show that profit sharing and group performance pay even have a stronger influence on productivity than individual performance pay. This result also holds when accounting for possible interactions among the three types of variable pay. In fact, our estimates suggest that the influences of profit sharing, group performance pay and individual performance pay are largely additive.

We also examine whether the ranking of the three types of variable pay depends on circumstances and type of firm. While the influences of individual performance pay and group performance pay depend firm size, worker representation and innovativeness, profit sharing is not strongly influenced by moderating factors and, hence, appears to work for a variety of different types of firms. Most importantly, even when accounting for moderating factors, we do not find evidence that individual performance pay outperforms collective performance pay.

Altogether, using one of Bloom and Van Reenen's own datasets, our analysis casts serious doubts on the weights they assign to individual and collective payment schemes in their management index. The analysis shows that we should be careful with respect to the assumptions and subjective priors that guide our empirical research. Thus, on the one hand, our study provides support for Pfeffer's (1998a) warning about dangerous myths by showing that profit sharing and group-based performance pay can even outperform individual performance pay. The free-rider problem does not appear to be the most important force driving the relative performance effects of variable pay schemes.

Collective schemes can have advantages over individual-based ones in other respects or firms may find ways to mitigate or overcome the problem.

However, on the other hand, our study does not support the view that individual-based performance pay is necessarily detrimental to firm performance. Critics of individual performance pay argue that it harms performance by undermining intrinsic motivation or cooperation among employees (Bowles and Polania-Reyes 2012, Gneezy et al. 2011). Our findings suggest that individual performance pay can have a positive influence on productivity if the respective preconditions are met. As the influences of the various payment schemes appear to be largely additive, firms may use individual performance pay on top of profit sharing or group performance pay.

The rest of the paper is organized as follows. Section 2 provides the background discussion. Section 3 describes the data and variables. Section 4 presents the empirical results. Section 5 discusses the results. Section 6 concludes.

2. Background Discussion

Variable payment schemes can have an influence on productivity through a sorting and through an incentive effect; i.e., through the way they attract employees with specific productivity characteristics and through the way they induce employees to exert effort. In what follows, we argue that both theory and previous empirical research do not offer a clear ranking of individual and collective payment schemes with respect to their sorting and incentive effects. Thus, it is an open question whether individual or collective payment schemes have the strongest influence on productivity.

2.1 Incentives

A widely held view is that collective payment schemes suffer from a free-rider problem among employees and, hence, do not have strong incentive effects (Alchian and Demsetz 1972, Oyer 2004). The incentive to exert effort dissipates as the returns to that effort are distributed among all employees participating in the collective scheme. The free-rider problem gets more severe as the number of employees increases. Thus, individual-based payment schemes should have the strongest, group-based schemes a less strong, and profit sharing only a weak or even no incentive effect.

However, from a theoretical viewpoint, there are several ways to solve or at least mitigate the free rider problem. Possible ways to overcome the problem are repeated games (Che and Yoo 2001, MacLeod 1988), mutual monitoring and peer pressure (Carpenter et al. 2009, Freeman et al. 2010, Kandel and Lazear 1992), reciprocity and co-worker altruism (Cornelissen et al. 2014, FitzRoy and Kraft 1986, Rotemberg 1994), and production technologies characterized by a high degree of worker interdependence (Adams 2006, Heywood and Jirjahn 2009).

Moreover, even in the presence of a free rider problem collective payment schemes can have specific advantages over individual-based schemes (Heywood and Jirjahn 2006). This can be best illustrated by comparing individual performance pay with profit sharing. If jobs are characterized by multitasking, employees must allocate their efforts across different tasks. Individual performance measures are often unavailable for all tasks. An emphasis on individual performance as measured by one or a few indicators causes employees to cut back on productive behaviors for which they are not rewarded (Bartel 2017, Holmstrom and Milgrom 1991, Kerr 1975). These behaviors include sharing

information, helping colleagues, maintaining equipment, cultivating customer goodwill, striving for quality and reducing the risk of workplace injury. In contrast to individual performance pay, profit sharing provides incentives to exert effort in all activities that are relevant to the firm's profit (Baker 2002, Drago and Turnbull 1988, Jirjahn 2000). Thus, one advantage of profit sharing is that it provides incentives for multitasking and cooperation.

Of course, individual-based performance pay may also allow for a comprehensive reward of employee performance if it is not only based on objective performance measures, but also on subjective performance evaluations by superiors. While objective measures of individual performance may be not available for dimensions such as cooperativeness or customer orientation, these dimensions can be assessed through subjective performance appraisals (Brown and Heywood 2005, Gibbons 1998, Jirjahn and Poutsma 2013, Prendergast 1999). However, the subjective and discretionary nature of performance appraisals entails its own problems. It not only opens the door to arbitrary management favoritism leading to perceptions of unfair treatment (Pfeffer 2007). It also allows employees to strategically engage in influence activities that result in a positive evaluation, but not necessarily in increased performance (Acemoglu et al. 2008, Milgrom and Roberts 1988). By contrast, profit sharing reduces the incentives to engage in influence activities as these counterproductive activities negatively affect firm performance (Jirjahn 1998).

Another important aspect is the flexibility of a payment scheme. Profit sharing provides incentives for flexibility as it increases employees' willingness to respond to changes in production technology, work organization or external market conditions (Drago and Turnbull 1991, Jirjahn 1998). Individual-based performance pay provides less

flexibility. Changes in production processes require an adjustment of the payment scheme to account for changes in employees' tasks (Freeman and Kleiner 2005). For example, the employer has to assign new weights to the various dimension of performance if changes in the production concept involve an increased importance of quality, cooperativeness or customer orientation. Adjusting the payment scheme requires time and firm resources. Not adjusting the payment scheme implies that it provides the wrong incentives when change happens.

Clearly, the incentive effects of variable payment schemes can depend on a series of preconditions. A basic requirement for positive incentive effects is that employees have sufficient knowledge about the schemes and comprehend their functioning. In this respect, both profit sharing and individual-based performance pay can have limitations. If employees do not fully understand the nature and scope of profit sharing and cannot see clearly how their performance relates to a firm's profits, incentive effects will be diluted (Budd 2010, Jones and Kato 2012, Sweins and Kalmi 2008). Similarly, a large number of performance metrics, vague performance standards and insufficient information on how to trade off different objectives can make individual-based performance pay too complicated for employees to understand and, hence, undermine its incentive effects (Bartel 2017, Jirjahn and Poutsma 2013).

A further requirement for positive incentive effects is that employees have sufficient trust in a variable payment scheme and perceive it as fair (Freeman et al. 2010, Sung et al. 2017). This applies to both individual-based performance pay and profit sharing. Individual-based performance pay will only involve positive incentive effects if employees trust that the employer correctly evaluates their individual performance. Profit sharing will

only involve positive incentive effects if employees trust the accounting of profits and that the employer pursues firm strategies and investments designed to increase financial performance.

Of course, variable payment schemes may not only require trust, but vice versa may also influence employees' trust. Profit sharing may have an advantage in this respect. Profit sharing contributes to trustful employer-employee relations as it signals that the employer is benevolent, considers employees' needs and is willing to voluntarily return to them a portion of the fruits of their collective labor (Bayo-Moriones and Larraza-Kintana 2009, Coyle-Shapiro et al. 2002). By contrast, excessive monitoring of individual performance may rather be perceived as an expression of coercion and hostility and, hence, leads to increased distrust (Fehr and Falk 2002, Heinz et al. 2020).

Altogether, from a theoretical viewpoint it is not clear whether individual-based performance pay or profit sharing has a stronger incentive effect. The potential free-rider problem associated with profit sharing may suggest that profit sharing provides weaker incentives than individual performance pay. However, there are several mechanisms helping mitigate or overcome the problem. Moreover, the free-rider problem is not the only aspect that is relevant for the incentive effects of payment schemes. Profit sharing can have specific advantages as it provides incentives for multitasking, cooperation and flexibility. Furthermore, a crucial requirement for positive incentive effects of a payment scheme is that employees understand the functioning of the scheme and perceive it as fair. In this respect, both individual-based performance pay and profit sharing have their own limitations and it is not clear what limitation is more severe.

Adding group-based performance pay to the comparison also does not yield a clear ranking. As already mentioned, group performance pay may have a disadvantage over individual performance pay and an advantage over profit sharing. Similar to profit sharing, group-based performance pay may suffer from a free-rider problem. However, as the number of team members is smaller than the number of all employees in a firm, the free-rider problem is likely to be less severe. The picture becomes more complicated when we consider incentives for multitasking and cooperation. Group-based performance pay provides incentives to exert effort in all activities that are relevant for the performance of the team. For example, it provides incentives to help other team members. This suggests that group-based performance pay can have advantages over individual-based payment schemes. However, the incentives for multitasking and cooperation are confined to the team. Group-based performance pay does not provide incentives to exert effort in activities that are relevant for firm performance, but go beyond the output of the employee's own team (e.g., helping other teams). Thus, group-based performance pay can have disadvantages over profit sharing.

2.2 Sorting

A clear ranking of individual and collective payment schemes is also not possible with respect to their sorting effects. Each scheme can involve positive and negative sorting effects. Lazear's (1986) classical sorting model suggests that individual-based performance pay attracts high-ability employees.¹ However, this presupposes a comprehensive measurement of individual performance so that performance pay adequately rewards every employee characteristics that is relevant for production. If the measurement of employee performance is only available for a limited set of dimensions, individual-based pay

schemes induce a distorted sorting process, as they do not reward all the worker attributes needed for production (Jirjahn and Mohrenweiser 2019). Individual performance pay may attract employees who are strong in the measured performance dimensions, but are weak in the non-measured dimensions. One way to curb this problem is to use subjective performance evaluations which allow for a comprehensive measurement of individual employee performance. However, this is likely to entail a new adverse selection problem. Using subjective performance appraisals attracts employees who have a high ability of manipulating their superiors' evaluations by engaging in counterproductive influence activities.²

From a theoretical viewpoint, profit sharing also involves positive and negative sorting effects (Jirjahn and Mohrenweiser 2019). On the one hand, to the extent profit sharing suffers from a free-rider problem, it attracts talented free riders; e.g., employees who are not responsive to peer pressure (Kandel and Lazear 1992). On the other hand, as profit sharing rewards all employee characteristics relevant for the firm's performance, it has the potential to attract those employees whose skills and abilities match the various job requirements. For example, it may attract employees with a high willingness to help colleagues. As shown by Kamei and Markussen (2022), such endogenous sorting is also a potential remedy against free riding if it improves the matching between employees' tasks and their task preferences.

Adding group-based performance pay to the comparison again does not yield a clearer ranking. On the one hand, to the extent group-based performance suffers from a free rider problem, it also attracts talented free riders. However, if the free rider problem is less severe than the one associated with profit sharing, the adverse selection is likely to be

less pronounced. On the other hand, group-based performance pay uses a broader performance measure than individual-based performance pay as it rewards all employee characteristics relevant for the output of the team. Thus, it can have an advantage over individual-based performance pay by attracting employees with a higher willingness to cooperate in teams. However, as group-based performance pay does not reward employee characteristics relevant for broader firm performance, it may have a disadvantage over profit sharing.

2.3 Previous Empirical Research on the Ranking of Payment Schemes

Altogether, theory does not offer a clear ranking of individual and collective payment schemes with respect to their influence on firm performance. Nonetheless, Bloom and Van Reenen's management index assumes a clear ranking without providing any explanation. It assigns the highest weight to individual-based performance pay, a medium weight to group-based performance pay and a low weight to profit sharing. This holds for their initial study (Bloom and Van Reenen 2007) and for follow-up studies using the management index (Bender et al. 2018, Bloom and Van Reenen 2010, Bloom et al. 2013, Bloom et al. 2014, Bloom et al. 2019, Broszeit et al. 2019). Of course, even if theory provides no clear guidance, one may ask whether previous empirical examinations on variable pay schemes provide clear support for the ranking. Unfortunately, the answer to this question is no.

On the one hand, some studies indeed show that individual-based performance pay is positively associated with productivity (Belfield and Marsden 2003, Heywood et al. 1997, Heywood et al. 2011, Lavy 2009, Lazear 2000, Shearer 2004). On the other hand, a series of studies find that profit sharing has a positive influence on productivity (see the meta-analyses by Blasi et al. 2010, Doucouliagos et al. 2020 and Nyberg et al. 2018). The

basic problem is that most studies on variable payment schemes only consider one type of pay scheme or combine different types in a single indicator (Gielen et al. 2010). In general, econometric studies on individual-based and collective schemes appear to form two different strands of literature that are largely unconnected. Examining single payment schemes in isolation does not yield insights into their relative effects and, hence, does not provide information on how to rank the various schemes.

Only a small number of econometric studies compare the productivity effects of individual-based and collective payment schemes. These studies do not indicate that individual-based payment schemes outperform collective ones. Quite the contrary, they suggest that collective schemes have a stronger influence on productivity. A case study by Hamilton et al. (2003) shows that the shift by a US garment manufacturer from individual pay to group pay was associated with a substantial increase in productivity. Using a large panel dataset from Finnish firms, Kato and Kauhanen (2018) find a positive influence of collective payment schemes and particularly profit sharing on productivity, but no influence of individual-based performance pay. These results fit an early German study by Kraft (1991). Finally, using panel data from Germany, Jirjahn (2016) shows that individual performance pay, group performance pay and profit sharing are all positively associated with productivity whereby the influences of group performance pay and profit sharing are stronger than the influence of individual performance pay.

Experimental studies on individual-based and collective payment schemes obtain mixed results. While Erev et al. (1993) find that collective incentives lead to lower levels of effort than individual-based incentives, van Dijk et al. (2001) and Bortolotti et al. (2016) show that effort provision is similar under collective and individual-based schemes.

A ranking of variable payment schemes may be complicated if there are interactions among the various schemes and, hence, combinations of payment schemes are crucial for productivity. However, the evidence on possible interaction effects is rare and mixed. Pendleton and Robinson (2017) find for Britain that a combination of profit sharing with individual performance pay or group performance pay is associated with higher productivity. This can be seen as evidence of positive interaction effects. An experimental study by Barnes et al. (2011) points to the opposite conclusion. That study suggests that combining a collective pay scheme with an individual-based one simply leads team members to focus on the individual scheme.

2.4 Moderating Influences

A clear ranking may be also complicated if the effects of the various payment schemes depend on circumstances and type of firm. Pendleton and Robinson's study (2017) indicates that the complexity of tasks within a firm plays a moderating role. Individual-based performance pay appears to be only productive in low task variety settings. This conforms to the notion that individual-based performance pay only works if tasks are characterized by a low degree of multitasking. However, DeVaro and Kurtulus (2010) challenge this notion. They report (in their sensitivity analysis) a positive association between individual performance pay and a worker's authority to make decisions.

Firm size may also play a moderating role. The free rider problem is often thought to get more severe in larger firms. However, even the evidence on the role of firm size is mixed. Prendergast (1999) reviews evidence from medical and legal partnerships showing that profit sharing becomes increasingly irrelevant in motivating workers as the size of the partnership increases. By contrast, Knez and Simester (2001) provide a case study for

Continental Airlines showing that profit sharing can involve positive incentives even for very large companies. Moreover, most studies on the determinants of profit sharing adoption do not find a negative link between firm size and the use of profit sharing (e.g., Heywood and Jirjahn 2002, Jones and Pliskin 1997, Kruse 1996). Most salient to our topic, previous studies on the moderating role of firm size focus on profit sharing and, hence, do not examine the question of how firm size influences the productivity effects of other types of variable pay.

Furthermore, worker representation may play a moderating role in the link between variable pay and productivity. As discussed, variable payment schemes will only involve positive incentive effects if the schemes are perceived as fair and workers trust that their performance is correctly measured. This suggests that the productivity effects of variable payment schemes may be stronger if worker representation helps ensure that the payment schemes are implemented and operated as agreed upon. Evidence from the U.S. does not provide support for this hypothesis. Studies by Cooke (1994) and Black and Lynch (2004) suggest that union representation lowers the productivity effect of profit sharing or at best has no influence on this effect. However, the moderating role of worker representation may depend on the specific institutional setting and the type of payment scheme. In Germany, works councils provide a highly developed mechanism for nonunion worker representation at the firm level. Jirjahn et al. (2023) find that Bloom and Van Reenen's composite management index has a stronger impact on productivity in firms where a works council is present. However, they do not consider the various components of the index. Thus, it is an open question how works councils moderate the productivity effects of individual and collective payment schemes.

2.5 Short-run and Long-run Effects

Finally, a ranking of variable payment schemes may be complicated if the schemes differ in their short-run and long-run effects. Findings by Kruse (1993) and Lucifora and Origo (2015) indicate that the productivity effects of profit sharing are rather short-lived. By contrast, studies by Jones and Kato (1995), Kato and Morishima (2002) and Eriksson (2003) show that it takes time for new management practices to deliver higher performance. Thus, while previous studies provide sparse and mixed evidence on the short-run and long-run effects of management practices, it is obvious that a systematic ranking of payment schemes should distinguish between these effects.

As our review of the empirical literature makes clear, more research is urgently required. Not only theoretical considerations, but also previous empirical studies cast doubt on the weights assigned to individual and collective payment schemes in Bloom and Van Reenen's management index. Thus, in what follows, we use one of the datasets initiated by Bloom and Van Reenen to examine the influences of individual performance pay, group performance pay and profit sharing on productivity.

3. Data, Variables and Methodology

3.1 Dataset

Our empirical analysis uses panel data from the GMOP (Broszeit et al. 2019). The GMOP is closely related to the Management and Organizational Practice Survey (MOPS) carried out by the US Census Bureau (Bloom et al. 2019). The MOPS is a follow-up study for manufacturing firms in the U.S. that leans on Bloom and Van Reenen's (2007) initial World Management Survey.

The GMOP survey was carried out from November 2014 to May 2015 by the Kiel Institute for the World Economy (IfW) and the Institute for Employment Research (IAB). The Institute for Applied Social Sciences (infas), a professional survey and opinion institute, conducted the interviews. Financial support was provided by the Leibniz Association.

The GMOP is a representative sample of manufacturing establishments with at least 25 employees in Germany. The sample was drawn from administrative data of the Employment History Panel (BHP). 1,927 establishments participated in the survey. Data collection was based on a questionnaire in paper-pencil or online interviews with top managers of the establishments. Most of the questions were asked for the years 2008 and 2013. Thus, a two-wave panel can be constructed. Information on some establishment characteristics which usually do not change within a few years were only asked for the year 2013. These variables can be used with suitable caution as time-invariant variables.

3.2 Variables

Table 1 provides definitions and descriptive statistics of the key variables. Our dependent variable is the log of productivity with productivity being defined as value added per employee.³ Information on productivity is available for the years 2008 and 2013.

The management index (and particularly the information on variable payment schemes contained in this index) is the explanatory variable of primary interest. The index is based on 16 questions capturing three areas: monitoring, targets and incentives (see Appendix Table A1). The questions on management practices were asked for both years 2008 and 2013. As we will detail, this allows us examining the short-run and the long-run effects of the practices.

Most salient to our topic, the management index assumes a clear ranking of variable payment schemes. It assigns the highest weight to individual-based performance pay, a medium weight to group-based performance pay and a low weight to profit sharing. In order to examine if this ranking is appropriate, we define three dummy variables capturing the establishment's use of variable payment schemes for nonmanagerial employees: individual performance pay, group performance pay and profit sharing.

The data allows controlling for a rich set of firm characteristics. Table A2 shows variable definitions and descriptive statistics. We include time-varying control variables for firm size, capital intensity, export activities, subsidiaries abroad, intensity of product market competition, product innovations, qualification of managerial and non-managerial employees, and variable pay for managerial employees. The time-invariant control variables capture works council incidence, collective bargaining coverage, foreign ownership, family ownership, region of location, and industry.

3.3 Methodology

Our regressions are based on a reformulated version of Mundlak's (1978) approach. This allows differentiating between within-establishment and between-establishment effects. The estimation equation for Mundlak's approach is:

$$(1) \quad y_{it} = \beta_0 + \beta_1' x_{it} + \beta_2' \bar{x}_i + \beta_3' z_i + u_i + \varepsilon_{it},$$

where y_{it} is the log of productivity of establishment i in year t ($t = 2008, 2013$), x_{it} a vector of time-varying variables, \bar{x}_i the vector of establishment-specific averages for each of these variables, z_i a vector of time-invariant variables, u_i the establishment-specific random effects and ε_{it} the time-variant error term. The intercept and the vectors of coefficients are given by β_0 , β_1 , β_2 and β_3 . Equation (1) is estimated by using a random

effects model. It is important to note that β_1 shows the within-establishment effects as the between-establishment effects are controlled for by \bar{x}_i . However, the interpretation of β_2 is inconvenient as this reflects the difference between the within and the between effects.

A more straightforward interpretation can be obtained by centering the time-variant variables on their establishment-specific averages, $x_{it} - \bar{x}_i$ (Bell and Jones 2015, Bell et al. 2019, Booth et al. 2017). The estimation equation is now given by:

$$(2) \quad y_{it} = \beta_0 + \beta_1'(x_{it} - \bar{x}_i) + \beta_4'\bar{x}_i + \beta_3'z_i + u_i + \varepsilon_{it}.$$

Here β_4 shows the between-establishment effects. The within-establishment effects are still given by β_1 . These within-establishment effects are equivalent to those obtained from a fixed effects model. However, the fixed effects model throws away all the information contained in the between variation in the data. By contrast, equation (2) allows to estimate also between-establishment effects. Altogether, the reformulated version enables us to estimate both within-establishment effects capturing the influence of changes in the time-variant variables and between-establishment effects capturing the influence of the average levels of these variables. Importantly, this approach takes into account that within-establishment and between-establishment effects can differ.

4. Results

4.1 Basic Estimations

Table 2 shows the key results of our basic productivity regressions. Control variables are included in the regressions, but are suppressed to save space.⁴ The table provides both the within-establishment and the between-establishment effect. As explained above, the within-establishment effect reflects the influence of a change in the management practices over the five-year period. The between-establishment effect shows the influence of the

average level of management practices. Since the within-establishment effect controls for changes in the practices, we can interpret the between-establishment effect as the long-run, sustaining influence of management practices on productivity.

In regression (1), we set the stage by estimating the influence of Bloom and Van Reenen's composite management index. The regression shows a significantly positive within-establishment and significantly positive between-establishment effect of the management practices. The between-establishment effect is much higher than the within-establishment effect. This can be seen as first evidence that the long-term effects of management practices are stronger than the effects of newly adopted practices.

In regression (2), we replace the composite score of management practices by the sub-indices for incentives, monitoring and targets. While the indices for monitoring and targets do not take significant coefficients, the incentive index emerges as a significantly positive determinant of productivity. This suggests that specifically the incentive index drives the link between the management score and productivity. Again we find that the between-establishment effect is stronger than the within-establishment effect.

In regression (3) we focus on the three components of the incentive index that are of primary interest: individual performance pay, group performance pay, and profit sharing. The within coefficients are not significant whereas the between coefficients on all three performance pay variables are significantly positive. Note that the within coefficients capture the effects of changes in the method of payment and the between coefficients the long-run effects. Thus, the results conform to the notion that the various schemes need time to live up to their potential.⁵ Learning and adjustment processes imply that variable payment schemes have an unclear short-run, but instead a long-run, sustaining influence

on establishment performance. Most salient to our topic, while the influences of all three payment schemes are quite substantial, the regression suggests a clear ranking of the schemes. Profit sharing has the strongest, group performance pay a medium and individual performance pay a comparatively weak influence on productivity. Profit sharing is associated with a roughly 22 percent, group performance pay with a 19 percent and individual performance pay with an 11 percent higher productivity.

Thus, our basic regression does not provide support for the weighting in Bloom and Van Reenen's management index. While the index assigns the highest weight to individual schemes, the regression shows that collective performance pay outperforms individual performance pay. Our estimation suggests that Bloom and Van Reenen's ranking should be reversed by giving higher weights to profit sharing and group performance pay and a lower weight to individual performance pay.

2.2 Combining the Payment Schemes

At issue is whether combining the variable pay schemes plays a role in their ranking. Thus, we now turn to possible interactions between the schemes. The regression shown in Table 3 additionally includes interaction variables for the various combinations of the variable payment schemes. Apart from the within coefficient on the interaction of individual and group performance pay, the coefficients on the other interactions variables are all insignificant. This suggests that the influences of the various payment schemes on productivity are largely additive. Most importantly, the regression confirms our key results on the long-run productivity effects of the payment schemes with profit sharing having the strongest, group performance pay a medium and individual performance pay the least strong influence.

4.3 Moderating Factors

A further issue is that the influences of the various payment schemes could depend on moderating factors. If the influences depend on circumstances and type of establishment, there may be no universal ranking. The ranking would depend on specific contingencies. In Table 3, we examine if firm size, innovativeness and nonunion employee representation play a moderating role.

From a theoretical viewpoint, the potential free rider problem suggests that the productivity effect of profit sharing should be weaker in larger than in smaller establishments. Against this background, Panel A provides separate regressions for establishments with less and establishments with more than 100 employees. Profit sharing takes a significantly positive between coefficient in both regressions with the coefficient being even higher for the subsample of larger establishments. This finding does not support the notion that the free rider problem plays a major role in the productivity effect of profit sharing. Furthermore, while profit sharing emerges as a significantly long-term determinant of productivity for both smaller and larger establishments, individual and group performance pay have only a significant long-term influence on productivity in the subsample of larger establishments. The between coefficients on the variables for the three payment schemes are of similar magnitude in this subsample. Indeed, the null hypothesis of equal coefficients cannot be rejected.⁶ Altogether, our separate estimations for smaller and larger establishments make two things clear. First, the ranking of the three types of variable pay depends on establishment size. Second, even when accounting for the moderating role of establishment size, we do not find evidence that individual performance pay outperforms collective performance pay. In larger establishments, individual

performance pay, group performance pay and profit sharing have a similar influence on productivity. In smaller establishments, profit sharing is the only one of the three types of variable payment schemes that is significantly associated with productivity.

As suggested by our background discussion, the complexity of tasks within an establishment may also play a moderating role in the link between variable pay and productivity. In Panel B, we provide separate estimations for establishments with and without product innovations. Both theoretical contributions (Hellmann and Thiele 2011, Morita 2005) and empirical studies (Jirjahn and Kraft 2011, Jirjahn and Mohrenweiser 2019, Laursen and Foss 2003) suggest that innovativeness is associated with an increased complexity of tasks within an establishment. Our estimations show that profit sharing has a long-run influence on productivity in establishments with and without product innovations. By contrast, individual and group performance pay have a long-run impact on productivity only in establishments with product innovations. In the subsample of innovative establishments, the variables for group performance pay and profit sharing take between coefficients of similar magnitude whereas the variable for individual performance pay emerges with a much smaller coefficient. All in all, again, we do not find evidence that individual performance pay outperforms collective performance pay. First, in establishments with product innovations, the influence of individual performance pay on productivity is less strong than the influence of group performance pay or profit sharing. Second, in establishments without product innovations, profit sharing is the only payment scheme that is significantly associated with higher productivity.

Finally, as we have explained in the background discussion, employee representation may play a role in the functioning of variable payment schemes. In

Germany, works councils provide a highly developed mechanism for establishment-level participation in decision-making. German works councils have been shown to substantially shape the personnel policy of establishments (Jirjahn and Smith 2018, Mohrenweiser 2022). In Panel C, we provide separate estimations for firms with and without a works council.⁷ While profit sharing emerges as significantly long-term determinant of productivity in both establishments without and establishments with a works council, individual and group performance pay are significantly long-term determinants only in establishments with a works council. For the latter type of establishments, the variable for group performance pay takes the largest between coefficient. Considering the variables for individual performance pay and profit sharing, the null hypothesis of equal coefficients cannot be rejected.⁸ Thus, also this exercise does not provide evidence that individual performance pay has a stronger influence on productivity than collective performance pay. In establishments without a works council, profit sharing is the only variable pay scheme having a significant influence on productivity. In establishments with a works council, the influences of individual performance pay and profit sharing are of similar magnitude while group performance pay has the strongest influence.

5. Discussion of Results

More than twenty years ago, Pfeffer (1998a) issued a warning about the myth that individual-based performance pay has a stronger influence on firm performance than collective performance pay. Pfeffer's warning has not seemed to get much attention. This becomes obvious if one considers a widely recognized index of management practices developed by Bloom and Van Reenen (2007). Without any explanation, the index gives the highest weight to individual performance pay, a medium weight to group performance pay

and a lower weight to profit sharing. The implicit prior belief appears to be that collective pay schemes suffer from a free-rider problem and, hence, have a less strong influence on firm performance than individual-based schemes. Such belief is questionable from both a theoretical and an empirical viewpoint.

We use the GMOP, one of the datasets initiated by Bloom and Van Reenen, to examine the influences of individual performance pay, group performance pay and profit sharing on productivity. Our findings do not support the assumption that individual performance pay outperforms collective performance pay. Quite the contrary, our basic estimates show that profit sharing and group performance pay have a stronger influence on productivity than individual performance pay. This also holds when accounting for possible combinations of the various payment schemes. In fact, our estimates suggest that the influences of individual performance pay, group performance pay and profit sharing are largely additive. Furthermore, even when taking into account that a ranking of variable pay schemes can depend on circumstances and type of firm, we do not find evidence that individual performance pay has a stronger influence on establishment performance than collective performance pay. While our separate regressions for different types of firms provide some evidence that moderating factors play a role, individual performance pay usually shows a weaker influence or, in some instances, at the most a similar influence than group performance pay or profit sharing. All in all, our results cast serious doubt on Bloom and Van Reenen's management index and demonstrate that Pfeffer's (1998a) warning on the myth about individual performance pay is indeed legitimate.

Moreover, our analysis points to another problem of the management index. Bloom and Van Reenen (2007, 2010) aim at identifying best management practices which are

largely not contingent on contextual factors. While our estimations suggest that profit sharing works for various types establishments and perhaps might be viewed as a best practice, they also show that the productivity effects of individual and group performance pay strongly depend on moderating factors such as firm size, innovativeness and worker representation. Thus, individual and group performance pay do not appear to be best management practices which fit all types of firms. Hence, it can be questioned if it makes sense to construct an index of management practices across all types of firms. If any, it would be more appropriate to construct specific indices of best practices for different types of firms.

It is worthwhile to consider the pattern of results in more detail. Our separate estimations show significant influences of individual and group based performance pay only for firms with a works council, but not for firms without a works council. This pattern conforms to the notion that employee representation increases employees' trust in the payment schemes and, hence, improves incentive effects of the schemes (Jirjahn et al. 2022). Profit sharing shows a significant influence on productivity in firms with and without a works council. Of course, on the one hand, the functioning of profit sharing may also require trust. However, on the other hand, profit sharing itself may create trust as voluntarily sharing profits is a signal that the employer is benevolent and considers employees' needs (Bayo-Moriones and Larraza-Kintana 2009, Coyle-Shapiro et al. 2002). Thus, profit sharing appears to work even without employee representation.

Furthermore, we find significant influences of individual and group performance pay only in larger, but not in smaller firms. Larger firms are more likely to have a professional personnel management. Such professional personnel management is

important to tailor the payment schemes to the respective circumstances and to adjust the schemes to changes in production technology and the economic environment (Jirjahn and Poutsma 2003). Profit sharing already provides incentives for employees to flexibly adjust their effort to the respective circumstances and changes in these circumstances (Drago and Turnbull 1991, Jirjahn 1998). Thus, profit sharing appears to work even in smaller firms which are less likely to have a professionalized personnel management.

Finally, we find that individual and group performance pay have significant influences on productivity in innovative, but not in non-innovative firms. Taking into account that innovative firms are characterized by higher task complexity, this result fits the notion that performance pay is particularly valuable in situations where employees have high discretion in performing their tasks (DeVaro and Kurtulus 2010). Profit sharing shows a significant influence on productivity in firms with and without product innovations. This suggests that profit sharing not only provides incentives for multitasking, but also addresses general issues of employment relationships that go far beyond specific task characteristics. As discussed, these issues are related to trust, cooperation and willingness to flexibility.

On a broader scale, our results contribute to a more differentiated view of performance pay. Pfeffer (1998a, 1998b, 2007) concluded that executives spend too much time thinking about compensation when other managerial tools such as training or improving corporate culture may work better. Of course, these alternative tools are important. Nonetheless our results make clear that variable pay should not be discarded. Profit sharing appears to be a pay scheme that can be used across a variety of different types of firms to increase productivity. Group performance pay and even individual performance pay can also have a substantial impact on productivity if the respective

preconditions are met. Our results indicate that the influences of the various variable pay schemes are largely additive. This means that a firm may further increase productivity if it not only uses profit sharing, but also individual or group performance pay on top. Of course, the influences of individual and group performance pay depend to a large degree on circumstance and type of firm. However, this does not imply that executives should not think of performance pay. Quite the contrary, it implies that they should carefully think of the contextual factors in the firm that make performance pay work or not work.

Furthermore, executives should take into account that learning and adjustment processes are required so it may take some time until performance pay lives up to its potential (Jones and Kato 1995). Our findings show that this holds for all three types of variable pay – profit sharing, group performance pay, and individual performance pay. Thus, it is important to account for the short-run and the long-run effects of variable pay schemes.

6. Conclusions

Altogether, our study suggests that a much more nuanced perspective on variable pay is needed and polarizations driven by apriori assumptions should be avoided. This is also important from a practical viewpoint. The choice of payment schemes not only depends on objective firm characteristics, but also on managers' mindsets and their subjective opinions about the functioning of the payment schemes (Jirjahn 2018, Kruse 1996, Long 1997). Making an informed decision requires that managers receive advice based on sound scientific knowledge and not on advice based on scientists' own subjective priors.

Further research within this theme is certainly required. Our findings show that the influence of collective performance pay on productivity is not weaker or even stronger than

the influence of individual performance pay. This leads to the question of which specific transmission mechanisms drive the link between the various types of variable pay and productivity. From a theoretical viewpoint, firms may find ways to mitigate or overcome the free-rider problem or collective schemes may have advantages over individual ones in other respects. Future empirical research could fruitfully examine these aspects in more detail.

Moreover, our results suggest that the influences of individual and group performance pay strongly depend on employee representation, firm size and innovativeness whereas profit sharing shows a significant influence on productivity for a relatively broad variety of different types of firms. While this pattern of results makes sense from a theoretical viewpoint, more empirical research on the transmission mechanisms behind the pattern could yield valuable insights.

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Table 1: Variable Definitions and Descriptive Statistics of Key Variables

<i>Variable</i>	<i>Definition (Mean; Standard Deviation)</i>
Ln(productivity)	Log of value added (in Euro) per employee (11.166; 0.821).
Management score	Score of 16 management practices ranging from 0 to 1 (0.567; 0.156). See Table A1 for details.
Incentives	Subscore of the management score capturing incentives (0.584; 0.199). See Table A1 for details.
Monitoring	Subscore of the management score capturing monitoring (0.488; 0.194). See Table A1 for details.
Targets	Subscore of the management score capturing targets (0.655; 0.268). See Table A1 for details.
Individual performance pay	Dummy equals 1 if the firm uses individual performance pay for nonmanagerial employees (0.309; 0.462).
Group performance pay	Dummy equals 1 if the firm uses group performance pay for nonmanagerial employees (0.157; 0.364).
Profit sharing	Dummy equals 1 if the firm uses profit sharing (based on the establishment's or company's performance) for nonmanagerial employees (0.373; 0.484).

N = 1749.

Table 2: Initial Regressions

<i>Explanatory Variables</i>	<i>(1)</i>	
	<i>Within</i>	<i>Between</i>
Management score	0.226 (2.15)**	0.637 (3.57)***
Controls	Included	
Overall R ²	0.115	
Number of observations	1749	
Number of establishments	969	
<i>Explanatory Variables</i>	<i>(2)</i>	
	<i>Within</i>	<i>Between</i>
Incentives	0.263 (2.72)***	0.360 (2.31)**
Monitoring	-0.024 (0.28)	0.236 (1.30)
Targets	-0.030 (0.47)	0.037 (0.35)
Controls	Included	
Overall R ²	0.115	
Number of observations	1749	
Number of establishments	969	
<i>Explanatory Variables</i>	<i>(3)</i>	
	<i>Within</i>	<i>Between</i>
Individual performance pay	0.021 (0.35)	0.108 (1.81)*
Group performance pay	0.015 (0.27)	0.192 (2.70)***
Profit sharing	-0.023 (0.57)	0.218 (3.62)***
Controls	Included	
Overall R ²	0.124	
Number of observations	1749	
Number of establishments	969	

Dependent variable: Ln(productivity). Method: Reformulated Mundlak approach (see section 3.3 for details). The table shows the estimated coefficients. Z-values in parentheses are based on standard errors clustered at the firm level. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 3: Mixed Payment Schemes

<i>Explanatory Variables</i>	<i>Within</i>	<i>Between</i>
Individual performance pay	-0.001 (0.02)	0.139 (1.80)*
Group performance pay	-0.010 (0.19)	0.210 (2.16)**
Profit sharing	-0.042 (1.06)	0.253 (3.21)***
Individual performance pay x group performance pay	1.308 (1.92)*	0.064 (0.39)
Individual performance pay x profit sharing	-0.796 (1.36)	-0.083 (0.61)
Group performance pay x profit sharing	-0.499 (0.69)	-0.047 (0.32)
Individual performance pay x group performance pay x profit sharing	0.970 (1.32)	-0.114 (0.34)
Controls	Included	
Overall R ²	0.130	
Number of observations	1749	
Number of establishments	969	

Dependent variable: Ln(productivity). Method: Reformulated Mundlak approach (see section 3.3 for details). The table shows the estimated coefficients. Z-values in parentheses are based on standard errors clustered at the firm level.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Table 4: Split Regressions

Explanatory Variables	Panel A: Small vs. Large Establishments			
	Size ≤ 100 Employees (1a)		Size > 100 Employees (1b)	
	Within	Between	Within	Between
Individual performance pay	0.059 (1.05)	0.014 (0.31)	0.060 (0.68)	0.278 (2.96)***
Group performance pay	0.173 (2.23)**	0.012 (0.15)	-0.139 (1.83)*	0.299 (2.73)***
Profit sharing	-0.025 (0.51)	0.212 (3.18)***	-0.051 (0.61)	0.267 (2.83)***
Controls	Included		Included	
Overall R ²	0.209		0.203	
Number of observations	1143		606	
Number of establishments	665		368	
Explanatory Variables	Panel B: Establishments without and with Product Innovation			
	No Product Innovation (2a)		Product Innovation (2b)	
	Within	Between	Within	Between
Individual Performance Pay	-0.024 (0.17)	0.093 (0.97)	-0.006 (0.09)	0.130 (1.83)*
Group Performance Pay	0.033 (0.27)	0.132 (1.22)	-0.067 (0.94)	0.217 (2.49)**
Profit sharing	0.013 (0.15)	0.177 (1.81)*	-0.048 (0.87)	0.216 (3.05)***
Controls	Included		Included	
Overall R ²	0.157		0.160	
Number of observations	668		1081	
Number of establishments	413		657	
Explanatory Variables	Panel C: Establishments without and with Works Council			
	No Works Council (3a)		Works Council (3b)	
	Within	Between	Within	Between
Individual performance pay	-0.004 (0.09)	0.026 (0.30)	0.064 (0.52)	0.203 (2.35)**
Group performance pay	0.079 (1.48)	0.069 (0.72)	-0.053 (0.52)	0.308 (3.01)***
Profit sharing	-0.025 (0.71)	0.218 (2.93)***	-0.004 (0.05)	0.191 (1.92)*
Controls	Included		Included	
Overall R ²	0.142		0.116	
Number of observations	1009		740	
Number of establishments	559		410	

Dependent variable: Ln(productivity). Method: Reformulated Mundlak approach (see section 3.3 for details). The table shows the estimated coefficients. Z-values in parentheses are based on standard errors clustered at the firm level. *** p < 0.01, ** p < 0.05, * p < 0.1.

Appendix

Table A1: Items of the Management Score

Question	Answer Categories	Score
Monitoring		
What happened at this firm when a problem in the production process arose?	No action was taken.	0
	We fixed it, but did not take further action.	1/3
	We fixed it and took action to make sure that it will not happen again.	2/3
	We fixed it, took action to make sure that it will not happen again, and had a continuous improvement process to anticipate problems like these in advance.	1
How many key performance indicators were used at this firm? <i>Examples for key performance indicators are: metrics on production, cost, output, quality, inventory, energy, absenteeism and delivery on time.</i>	No performance indicators	0
	1-2	1/4
	3-9	2/4
	10-49	3/4
	50 or more	1
How frequently did <u>managers</u> take performance indicators into account when making decisions? <i>A manager is someone with a supervisory function.</i>	Never	0
	Yearly	1/6
	Quarterly	2/6
	Monthly	3/6
	Weekly	4/6
	Daily	5/6
	Hourly or more frequently	1
How frequently did <u>non-managers</u> take performance indicators into account when making decisions? <i>A non-manager is an employee without supervisory function.</i>	Never	0
	Yearly	1/6
	Quarterly	2/6
	Monthly	3/6
	Weekly	4/6
	Daily	5/6
	Hourly or more frequently	1
Did this firm have production display boards and where were they located?	We did not have any display boards.	0
	All display boards were located in one place (e. g. at the end of the production line).	1/2
	Display boards were located in multiple places (e.g. at multiple stages of the production line).	1
Targets		
What was the time frame of production targets at this firm? <i>Examples for production targets are: production, quality, efficiency, output, delivery on time.</i>	No production targets	0
	Main focus was on short-term (less than one year) production targets	1/3
	Main focus was on long-term (more than one year) production targets	2/3
	Combination of short-term and long-term production targets	1
Who was aware of the production targets at this firm?	Does not apply; no production targets	0
	Only managers	1/4
	Most managers and some non-managers	2/4
	Most managers and most non-managers	3/4
	All managers and most non-managers	1
How easy or difficult was it for this firm to achieve its production targets?	Firm did not have any production targets.	0
	Firm did not achieve production targets.	0
	Firm achieved production targets without much effort.	1/3
	Firm achieved production targets with some effort.	2/3
	Firm achieved production targets with normal amount of effort.	1
	Firm achieved production targets with more than normal effort.	2/3
	Firm achieved production targets with a lot of effort.	1/3

Incentives		
What were <u>managers</u> ' performance bonuses usually based on?	No performance bonuses	0
	Company's performance	1/4
	Establishment's performance	2/4
	Team performance	3/4
	Own performance	1
What percent of the <u>managers</u> at this firm received performance bonuses if the necessary requirements were met?	No performance bonuses	0
	No one met the requirements.	0
	1 to 33%	1/4
	34 to 66%	2/4
	67 to 99%	3/4
	100%	1
What were <u>non-managers</u> ' performance bonuses usually based on?	No performance bonuses	0
	Company's performance	1/4
	Establishment's performance	2/4
	Team performance	3/4
	Own performance	1
What percent of the <u>non-managers</u> at this firm received performance bonuses, if the necessary requirements were met?	No performance bonuses	0
	No one met the requirements.	0
	1 to 33%	1/4
	34 to 66%	2/4
	67 to 99%	3/4
	100%	1
What was the primary way <u>managers</u> were promoted at this establishment?	There were no promotions.	0
	Promotions were based mainly on factors such as tenure, family connections or age.	0
	Promotions were based partly on performance and ability, and partly on other factors such as tenure, family connections or age.	1/2
	Promotions were based solely on performance and ability.	1
What was the primary way <u>non-managers</u> were promoted at this establishment?	There were no promotions.	0
	Promotions were based mainly on factors such as tenure, family connections or age.	0
	Promotions were based partly on performance and ability, and partly on other factors such as tenure, family connections or age.	1/2
	Promotions were based solely on performance and ability.	1
How long did it usually take to reassign or dismiss under-performing <u>managers</u> ?	Never reassigned or dismissed low performers	0
	More than 6 months	1/2
	Less than 6 months	1
How long did it usually take to reassign or dismiss under-performing <u>non-managers</u> ?	Never reassigned or dismissed low performers	0
	More than 6 months	1/2
	Less than 6 months	1

The aggregated management score is the unweighted average of the scores of the 16 items.

Table A2: Variable Definitions and Descriptive Statistics of Control Variables

<i>Variable</i>	<i>Definition (Mean, Standard Deviation)</i>
Ln(size)	Log of number of employees (4.355; 0.962).
Ln(capital intensity)	Log of capital intensity (12.266; 1.351). The average capital intensity by region and industry has been calculated by using data from the IAB Establishment Panel.
Individual performance pay (manager)	Dummy equals 1 if the firm uses individual performance pay for managerial employees (0.316; 0.465).
Group performance pay (manager)	Dummy equals 1 if the firm uses group performance pay for managerial employees (0.145; 0.352).
Profit sharing (manager)	Dummy equals 1 if the firm uses profit sharing (based on the establishment's or company's performance) for managerial employees (0.634; 0.482).
University graduates, non-managers	Dummy equals 1 if more than 10% of the non-managerial employees have a university degree (0.213; 0.409).
University graduates, managers	Share of managerial employee who have a university degree (0.359; 0.300).
High competition	Dummy equals 1 if the firm faces strong or very strong competition (0.874; 0.332).
Exporter	Dummy equals 1 if the firm exports (0.700; 0.458).
Subsidiaries abroad	Dummy equals 1 if the firm has one or more subsidiaries abroad (0.214; 0.410).
Product innovation	Dummy variable equal 1 if the firm launched a new product or service (0.618; 0.486)
Foreign owner	Dummy equals 1 if a foreign owner is the majority owner of the firm (0.119; 0.324).
Family firm	Dummy equals 1 if a family is the majority owner of the firm (0.621; 0.485).
Collective agreement	Dummy equals 1 if the firm is covered by a collective bargaining agreement (0.387; 0.487).
Works Council	Dummy equals 1 if the firm has a works council (0.423; 0.494)
Urbanization dummies	Three dummies for the urbanization of the region the firm is located in.
Industry dummies	Four dummies for industries within manufacturing.
Year dummy	Dummy equals 1 if the observation is from the year 2013 (0.457; 0.248).

N = 1749

Table A3: Full Results of Regression (3) in Table (2)

<i>Explanatory Variables</i>	<i>Within</i>	<i>Between</i>
Individual performance pay	0.021 (0.35)	0.108 (1.81)*
Group performance pay	0.015 (0.27)	0.192 (2.70)***
Profit sharing	-0.023 (0.57)	0.218 (3.62)***
Individual performance pay (manager)	0.043 (1.32)	-0.010 (0.17)
Group performance pay (manager)	0.101 (1.75)*	-0.016 (0.22)
Profit sharing (manager)	-0.011 (0.34)	0.051 (0.83)
Ln(size)	-0.281 (5.25)***	-0.166 (2.39)**
Ln(capital intensity)	0.016 (0.85)	0.001 (0.01)
University graduates, non-managers	-0.077 (1.91)*	0.165 (2.15)**
University graduates, managers	0.189 (1.12)	0.157 (1.67)*
High competition	-0.055 (1.76)*	0.019 (0.22)
Exporter	-0.020 (0.48)	0.237 (3.15)***
Subsidiaries abroad	0.006 (0.14)	0.206 (2.98)***
Product innovation	0.018 (0.61)	-0.017 (0.26)
Foreign owner	-----	0.132 (1.62)
Family firm	-----	0.080 (1.58)
Collective agreement	-----	0.084 (1.43)
Works council	-----	0.270 (4.31)***
Year dummy	-----	0.005 (1.91)*
Urbanization dummies	Included	
Industry dummies	Included	
Overall R ²	0.124	
Number of observations	1749	
Number of establishments	969	

Dependent variable: Ln(productivity). Method: Reformulated Mundlak approach (see section 3.3 for details). The table shows the estimated coefficients. Z-values in parentheses are based on standard errors clustered at the firm level. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table A4: Additional Descriptive Statistics

	<i>Mean</i>		<i>Variance</i>	
	2008	2013	Between	Within
	<i>Variable Payment Schemes</i>			
Individual performance pay	0.303	0.315	0.447	0.127
Group performance pay	0.131	0.178	0.349	0.121
Profit sharing	0.343	0.399	0.465	0.145
	<i>Management Index</i>			
Management score	0.526	0.602	0.142	0.067
Incentive score	0.554	0.609	0.186	0.074
Monitoring score	0.431	0.537	0.177	0.083
Target score	0.610	0.692	0.250	0.102

N = 1749

Endnotes

¹ The term ‘ability’ should be understood in a broad way. It refers to all employee characteristics that are relevant for an employee’s productivity. Depending on the respective job, ability may involve professional qualification, cognitive and non-cognitive skills, manual skills or physical and mental fitness.

² This suggests that employers with performance appraisal systems disproportionately attract employees who are high in Machiavellianism. Psychologists define Machiavellianism as one dimension of personality (Jones and Mueller 2022). Individuals high in Machiavellianism are willing to put morality aside, use manipulative tactics, and strategically look for opportunities to exploit others for selfish gain.

³ Outliers with implausible values are removed by using Cook’s distance.

⁴ See Table A3 for the full results.

⁵ As shown in Table A4 the variables for the payment schemes not only have substantial between, but also substantial within variation. Thus, the insignificant within coefficients are not due to insufficient within variation.

⁶ The χ^2 statistics for testing the equality of coefficients are $\chi^2(\text{individual vs. group performance pay}) = 0.02$, $\chi^2(\text{individual performance pay vs. profit sharing}) = 0.01$, $\chi^2(\text{group performance pay vs. profit sharing}) = 0.05$.

⁷ While works councils have statutory rights defined in the Works Constitution Act, the creation of a works council depends on the initiative of an establishment’s workforce. Thus, works councils are not present in all eligible establishments. This allows comparing establishments with and without a works council.

⁸ $\chi^2(\text{individual performance pay vs. profit sharing}) = 0.01$.