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ORIGINAL ARTICLE OPEN ACCESS

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

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ABSTRACT

There appears to be a widely held belief that individual-based performance pay has a stronger influence on firm performance than collective performance pay. This also applies to an index of best management practices that has been used by Bloom and Van Reenen in a series of influential publications (e.g., Bloom and Van Reenen 2007, Bloom et al. 2019). 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.

JEL Classification: J33, M52, M50

1 | Introduction

Employers face the challenge to attract the right applicants and to provide incentives inducing employees to exert effort. Variable pay is often thought to serve both purposes (Heywood and Jirjahn 2006). Against this background, there has been an increasing interest in variable pay not only among scholars but also among practitioners. During the last decades, variable pay has spread among firms in the United States and many European countries (Bender and Skatun 2022; Lemieux et al. 2009; Ligthart et al. 2022; Zwysen 2021). However, there

appears to be a variety of different types of variable payment schemes employers may use to attract high-ability employees and incentivize them. This gives rise to the question as to which of the various schemes is most suited to increase firm performance. This question is unsolved particularly when it comes to individual and collective payment schemes. Nonetheless, as pointed out by Pfeffer (1998a), there appears to be a widely held belief that individual 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

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problem. The myth exaggerates the severity of the free-rider problem and ignores that individual performance pay entails its own shortcomings.

Indeed, 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, flexibility, cooperation, and even trust. In a similar vein, a clear ranking of individual and collective payment schemes is also not possible with respect to their sorting effects.

In the end, only empirical research can answer the question of whether individual or collective schemes have a stronger influence on firm performance. However, econometric studies systematically comparing the influences of individual and collective payment schemes are scarce. While the results of the few available studies cast some doubt that individual schemes have a stronger influence on firm performance than collective ones, a comprehensive analysis of factors that complicate a ranking of individual and collective payment schemes is missing. The ranking of payment schemes may depend on short-run and long-run aspects, a specific combination of the various schemes or, most importantly, on the influence of moderating factors such as firm size, industrial relations, and the organization of production. Against this background, it is not surprising that the myth about compensation still prevails and plays an important role in economic thinking.

We examine the myth and the possible factors complicating a ranking of payment schemes by scrutinizing an index of best management practices suggested by Bloom and Van Reenen (2007). The 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 20 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. 2024). Most salient to our topic, the management index also 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.¹ 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.

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 almost no short-run effects of individual performance pay, group performance pay, and profit sharing for nonmanagerial employees. 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. This 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.

Importantly, our empirical analysis provides evidence that 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, our analysis casts serious doubts on the weights Bloom and Van Reenen assign to individual and collective payment schemes in the 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. 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 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.

2 | Background Discussion

Variable payment schemes have an influence on firm 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 make clear that these sorting and incentive effects are complex from a theoretical viewpoint, so a clear ranking of individual and collective payment schemes is difficult. Moreover, there are a series of additional complicating factors in the ranking of variable payment schemes that need to be taken into account.

2.1 | Incentives Effects

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). This is called the 1/N problem. 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 payment schemes should have the strongest, group-based schemes a less strong, and profit sharing only a weak or even no incentive effect. However, 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. This can be best illustrated by comparing individual performance pay with profit sharing. If jobs require multitasking or helping colleagues, employees must allocate their efforts across different tasks. 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). 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).

Of course, if objective measures are not available for all dimensions of performance, the employer may use subjective performance appraisals by superiors for a comprehensive reward of individual performance (Brown and Heywood 2005; Gibbons 1998; Jirjahn and Poutsma 2013; Prendergast 1999). However, the discretionary nature of performance appraisals entails its own problems. It not only opens the door to arbitrary supervisor favoritism or discrimination (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 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). Such adjustment requires time and firm resources.

Clearly, 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 performance pay can have limitations. If employees do not fully understand the scope of profit sharing and

cannot see clearly how their efforts relate to the firm's profit, 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 make individual performance pay too complicated for employees to understand (Bartel 2017; Jirjahn and Poutsma 2013).

Furthermore, positive incentive effects of a variable payment scheme require that employees have sufficient trust in the scheme and perceive it as fair (Freeman et al. 2010; Sung et al. 2017). This applies to both individual performance pay and profit sharing. Individual 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 not only require trust but vice versa 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).

In summary, from a theoretical viewpoint, it is not clear whether individual performance pay or profit sharing has a stronger incentive effect. Adding group performance pay to the comparison also does not yield a clear ranking. On the one hand, group performance pay may have a disadvantage over individual performance pay and an advantage over profit sharing. Similar to profit sharing, group 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 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 and 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 Effects

A clear ranking of individual and collective payment schemes is also not possible with respect to their sorting effects.

Each scheme involves positive and negative sorting effects.² Lazear's (1986) classical sorting model suggests that individual performance pay attracts high-ability employees.³ However, if the measurement of employee performance is only available for a limited set of dimensions, individual pay schemes induce a distorted sorting process (Jirjahn and Mohrenweiser 2019). As individual performance pay does not reward all the worker attributes needed for production, it may attract employees who are strong in the measured performance dimensions but are weak in the nonmeasured dimensions. While a more comprehensive measurement of individual employee performance through performance appraisals may curb this problem, it likely entails a new adverse selection issue. Using subjective performance appraisals attracts employees who have a high ability of manipulating their superiors' evaluations by engaging in counter-productive influence activities.

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 (2023), 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 to the output of the team. Thus, it can have an advantage over individual 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 to broader firm performance, it may have a disadvantage over profit sharing.

2.3 | Factors Complicating the Ranking of Variable Payment Schemes

As our discussion makes clear, the possible incentive and sorting effects of the various payment schemes are complex so a ranking of payment schemes is difficult from a theoretical viewpoint. On top of that, there are a series of complicating factors making a ranking even more challenging.

One question is whether the variable pay schemes should be ranked in their pure forms or a mix of the various schemes should be considered. On the one hand, combining individual and collective payment schemes may induce employees to work both

smart and hard (Pendleton and Robinson 2017). While collective performance pay induces employees to engage in multitasking and helping on the job, individual performance pay provides incentives to exert high effort. On the other hand, a combination of pay schemes may lead employees to focus only on the individual incentives and ignore collective schemes (Barnes et al. 2011).

Furthermore, short-term and long-term effects have to be distinguished (Jirjahn et al. 2024). One scenario is that a variable pay scheme has a stronger influence on firm performance in the long run than in the short run. Employees may need time to learn about the functioning of the pay scheme. They may also need time to develop trust that the scheme adequately rewards their efforts. An alternative scenario is that the short run influence on firm performance is stronger than the long-run influence. There may be an initial honey moon effect where employees have high confidence in the payment scheme, but lose their confidence in the long run, so the incentive effect diminishes. The basic point is that the ranking may depend on the dynamic dimension of incentives if the various payment schemes differ in their short-run and long-run effects.

Finally, the effects of variable payment schemes are very likely to depend on contextual factors. If contextual factors play different roles in individual and collective payment schemes, a universal ranking of payment schemes across all firms does not exist. The ranking instead depends on circumstances and type of firm.

An obvious hypothesis is that firm size plays a role in the ranking of variable payment schemes. To the extent profit sharing suffers from a free-rider problem, the incentive effects of this pay scheme progressively dilute as the size of the firm increases (Prendergast 1999). This suggests that the ranking could depend on firm size with profit sharing being more advantageous in smaller than in larger firms. However, if the free-rider problem is mitigated or solved, the influence of profit sharing on firm performance may not depend on firm size (Heywood and Jirjahn 2009), and this payment scheme even can have a positive influence in large firms (Knez and Simester 2001).

As shown by Jirjahn et al. (2024), worker representation can be a further factor moderating the link between management practices and productivity. This also very likely applies to variable payment schemes. Our background discussion suggests that variable pay will only have a positive influence on firm performance if the scheme is perceived as being fair and workers trust that their performance is correctly measured. This implies that the performance effects of variable pay will be stronger if worker representation helps ensure that the variable payment scheme is implemented and operated as agreed upon. However, the need to build trust can differ between the types of variable pay. Thus, the ranking of payment schemes may depend on whether or not there is worker representation in the firm. As discussed, individual performance pay is more likely to be perceived by employees as an expression of coercion and hostility, while profit sharing signals employer benevolence and, hence, has the potential to create trustful employer–employee relations. Thus, one can expect that positive productivity effects of individual performance pay should be found rather in firms with worker representation, whereas the productivity effects of profit sharing should depend less strongly on worker representation.

Against the background of our theoretical discussion, the variety of tasks should play a moderating role in the ranking of payment schemes, too. As individual performance pay provides little incentives for multitasking and flexibility, it may be more appropriate in firms where tasks are to a lesser degree multifaceted. By contrast, collective payment schemes may have a specific advantage in firms where the organization of work requires a higher degree of multitasking and flexibility.

2.4 | Previous Econometric Research on the Ranking of Payment Schemes

In the end only empirical research can answer the question of how to rank individual and collective payment schemes. However, while performance pay has received considerable attention in the empirical literature, econometric studies on individual-based and collective schemes appear to form two different strands of literature that are largely unconnected. On the one hand, some studies show that individual 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 econometric studies on variable pay only consider one type of pay scheme or combine different types in a single indicator (Gielen et al. 2010). 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 relatively small number of econometric studies compare the productivity effects of individual and collective payment schemes. These studies do not indicate that individual 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) show that collective performance pay and particularly profit sharing have a stronger influence on produced value added than individual performance pay. These results fit an early German study by Kraft (1991) who finds a positive influence of profit sharing on total factor productivity, but no influence of piece rates. 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.

In summary, the evidence provided by Kraft (1991), Hamilton et al. (2003), Jirjahn (2016) and Kato and Kauhanen (2018) casts doubt on a ranking that gives individual performance pay a higher weight than collective performance pay.⁴ However, the studies do not consider the dynamic dimension of incentives, a possible mix of payment schemes or the moderating influences

of firm size, worker representation, and task variety. A British study by Pendleton and Robinson (2017) comes closest to our examination. The study considers a mix of payment schemes finding that a combination of profit sharing with individual or group performance pay is associated with higher firm productivity. Pendleton and Robinson also provide evidence of a moderating role of task variety. Individual performance pay appears to be only productive in low task variety settings. However, Pendleton and Robinson have only a subjective indicator of firm performance at hand that is based on managers' perceptions. Moreover, they do not consider the moderating roles of firm size and worker representation. Finally, their cross-sectional dataset does not allow distinguishing between short-term and long-term effects. Furthermore, it should be noted that the available evidence on the combination of variable payment schemes is mixed. Using data from the European Company Survey, Salimi and Della Torre (2022) find that individual and collective scheme have a negative interaction effect on the innovativeness of firms.

Our study contributes in several ways to the sparse econometric literature comparing the influences of individual and collective payment schemes on firm performance. It provides a comprehensive analysis of the factors complicating the ranking of payment schemes by distinguishing between short-run and long-run influences, considering combinations of payment schemes and accounting for the moderating roles of firm size, worker representation, and task variety. Importantly, we use one of the datasets initiated by Bloom and Van Reenen to scrutinize the ad hoc ranking of variable payment schemes assumed in their management index. As emphasized in our introduction, 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 without providing any explanation.

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 United States 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); 1927 establishments participated in the survey. Data collection were 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.

After retaining observations for which full information is available, our analysis is based a total of 1749 observations from 969 establishments.⁵ Thus, the main regressions use an unbalanced 2-year panel that also contains some singleton observations. Some establishments provided information on the relevant variables only for one year, so they enter our estimation sample only once. Nonetheless as a check of robustness, we will also provide estimates with a balanced estimation sample that excludes singleton observations.

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.⁶ 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 Table S1). 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. In the pooled data, we have 30.9% of observations with individual performance pay, 15.7% with group performance pay, and 37.3% with profit sharing.

Figure 1 shows the distribution of individual and collective performance pay (group performance pay and/or profit sharing) for the years 2008 and 2013. The figure shows that 35.9% of establishments did not use any performance pay in the year 2008. This share decreased by roughly 5 percentage points to 30.7% in the year 2013. While this shows an increased use of

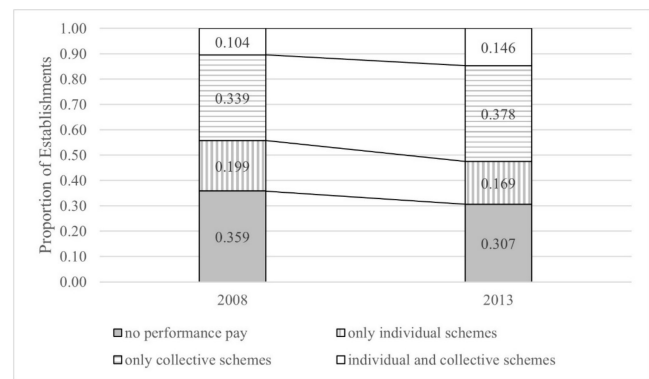


FIGURE 1 | Distribution of individual and collective payment schemes.

TABLE 1 | Variable definitions and descriptive statistics of key variables.

Variable	Definition	Mean	Standard deviation
Ln (productivity)	Log of value added (sales minus costs of intermediate goods and services) in Euro per employee	11.166	0.821
Management score	Score of 16 management practices ranging from 0 to 1. See Table S1 for details	0.567	0.156
Incentives	Subscore of the management score capturing incentives. See Table S1 for details	0.584	0.199
Monitoring	Subscore of the management score capturing monitoring. See Table S1 for details	0.488	0.194
Targets	Subscore of the management score capturing targets. See Table S1 for details	0.655	0.268
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

Note: N = 1749.

performance pay over time, the use of individual and the use of collective schemes exhibit different developments. The share of establishments using only individual performance pay decreased by 3 percentage points from 19.9% to 16.9%. The share of establishments using only collective performance pay increased by almost 4 percentage points from 33.9% to 37.8%. The share of establishments using a combination of individual and collective performance pay increased by about 4 percentage points from 10.4% to 14.6%.

The data allows controlling for a rich set of firm characteristics. Table S2 shows variable definitions and descriptive statistics while Table S3 provides the correlations between all variables used. 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 nonmanagerial employees, and variable pay for managerial employees.⁷ 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

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

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

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

Here, β_4 shows the between-establishment effects, while the within-establishment effects are still given by β_1 . By estimating β_1 and β_4 the reformulated Mundlak approach takes into account that within-establishment and between-establishment effects can differ.⁸ Thus, the reformulated Mundlak approach has an advantage over both the standard fixed effects and the standard random effects model. The standard fixed effects model throws away all the information contained in the between variation of the data. It just estimates

the within-establishment effects, but not the between-establishment effects.⁹ The standard random effects model uses the information contained in both the between and the within variation in the data, but does not take into account that between- and within-establishment effects may differ. It estimates a weighted average of the two.

The within-establishment effects capture the influence of changes in the time-variant variables, while the between-establishment effects account for the influence of the average levels of these variables. Thus, we can give each of the two components a specific interpretation, which, in our context, is particularly interesting when analyzing management practices. The within-establishment effect reflects the influence of a change in the management practices over the 5-year period. The between-establishment effect shows the influence of the average level of management practices for that period. 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. We will illustrate this point in more detail in Endnote 11 with a quantitative evaluation. To summarize, the reformulated Mundlak approach allows distinguishing between short-term and long-term effects with just the two waves of observations we have at hand. This is a distinction we cannot make with a standard fixed effects or random effects model.

While our approach allows a distinction between short-term and long-term effects, we do not address the possible issue of endogeneity.¹⁰ This is a potential limitation we share with other studies examining the management index (Bloom and Van Reenen 2011: p. 1729). On the one hand, from a theoretical viewpoint, the composite index or the single payment schemes are not necessarily endogenous. As explained by Bloom and Van Reenen (2011: p. 1711), incomplete knowledge about management practices and heterogeneity in the costs of implementation can lead to exogenous variation in the use of the practices across firms. Of course, on the other hand, only empirical research can provide an answer to the endogeneity issue. However, we lack a convincing instrument or natural experiment. Thus, even though our large set of control variables in the productivity regressions mitigates endogeneity concerns, we do not draw definite causal inferences. Nonetheless, we emphasize that our analysis provides an important step to scrutinize the a priori assumptions (i.e., the weights assigned to individual and collective payment schemes) underlying an index of so-called best management practices that has received considerable attention in the literature.

4 | Results

4.1 | Initial Regression Results

Table 2 shows the key results of our basic productivity regressions. Control variables are included in the regressions but are suppressed to save space. The table provides both the within-establishment and the between-establishment effects. In Regression (1), we set the stage by estimating the influence of Bloom and Van Reenen's composite management index. The

TABLE 2 | Initial regressions.

Explanatory variables	Influence of the management score (1)	
	Within	Between
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	
Explanatory variables	Influence of the subscores (2)	
	Within	Between
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	
Explanatory variables	Influence of performance pay (3)	
	Within	Between
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	

Note: 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.
 *** $p < 0.01$.
 ** $p < 0.05$.
 * $p < 0.1$.

regression shows a significantly positive within-establishment and a 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.¹¹

In Regression (2), we replace the composite score of management practices by the subindices 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.¹² 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.¹³ Learning and adjustment processes imply that variable payment schemes have an unclear short-run, but instead a long-run, sustaining influence on establishment performance. The magnitudes of the between coefficients show that influences of all three payment schemes are quite substantial and suggest a stronger influence of collective schemes. Profit sharing is associated with a roughly 22%, group performance pay with a 19%, and individual performance pay with an 11% higher productivity. However, the null hypothesis of equality of coefficients cannot be rejected (see Table S6 for the χ^2 statistics). The basic point for our topic remains that the initial regression does not provide support for a ranking that gives individual performance pay a higher weight than collective performance pay. Thus, the next question is whether the ranking depends on a combination of payment schemes or on the role of moderating factors.

Before we turn to that question it may be worthwhile to take a look at the results on the control variables and also discuss some checks we conducted to examine the robustness of our findings. Table S7 provides the full results of the initial regression. While establishment size is negatively associated with productivity, the share of managerial and nonmanagerial university graduates, the establishment's export orientation, subsidiaries abroad, and the presence of a works council are factors having a long-run positive influence on productivity. It is particularly interesting that, in contrast to the variables for nonmanagerial performance pay, the corresponding variables for managerial performance pay do not emerge with significant coefficients.¹⁴ This does not mean that managers are irrelevant for the performance of firms. It just demonstrates that performance pay works differently for managers and nonmanagers. This insight fits two studies by Heywood et al. (2005a, 2005b). The studies show that nonmanagerial profit sharing is associated with more cooperation among employees and less conflicts across hierarchical lines, whereas the opposite holds true for managerial profit sharing. Managers receiving performance pay may use their authority to exert more pressure on subordinates. This induces subordinates to work

harder, but in the end, it also undermines a cooperative work climate within the organization.

So far, we have not controlled for the other components of the management index when examining the influences of performance pay. As a check of robustness, Regression (1) of Table S8 additionally includes the variables for the monitoring score, the target score, and the rest of the incentive score—the practices that are not captured by the dummy variables for nonmanagerial and managerial performance pay. The subindices for targets and monitoring do not emerge with significant coefficients. The incentive index only takes a significant coefficient for the within, but not for the between component. Most salient to our topic, including the additional controls does not change our key results.

As a further check of robustness, we exclude singleton observations from the analysis and use a balanced estimation sample in Regression (2). This reduces the number of observations modestly from 1749 to 1560. The coefficient on individual performance pay now loses statistical significance, while group performance pay and profit sharing remain significant determinants of productivity. Thus, this exercise also confirms our basic insight. We do not find evidence that individual performance pay outperforms collective performance pay.

4.2 | Combining the Payment Schemes

To examine the possible role of a mix of payment schemes, we additionally included interaction variables for the various combinations of the schemes. Table 3 shows the results. 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 the key results on the long-run productivity effects of the payment schemes. While the magnitudes of the coefficients suggest that profit sharing has the strongest, group performance pay a medium, and individual performance pay the least strong influence, the null hypothesis of equal coefficients cannot be rejected. Thus, providing a careful interpretation of the findings, there is no evidence that individual performance pay outperforms collective performance pay even when we consider possible combinations of payment schemes.

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 4, we examine if firm size, innovativeness, and nonunion employee representation play a moderating role. We provide split regressions for smaller and larger establishments, establishments with and without product innovations, and establishments with and without a works council.¹⁵

The potential free-rider problem suggests that the productivity effect of profit sharing should be weaker in larger than

TABLE 3 | Mixed payment schemes.

Explanatory variables	Within	Between
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 × group performance pay	1.308 (1.92)*	0.064 (0.39)
Individual performance pay × profit sharing	−0.796 (1.36)	−0.083 (0.61)
Group performance pay × profit sharing	−0.499 (0.69)	−0.047 (0.32)
Individual performance pay × group performance pay × 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	

Note: 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.

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.1$.

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 coefficients 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. Mechanisms such as repeated games or peer pressure may help mitigate the free-rider problem, so profit sharing has a substantial impact on productivity even in large establishments. Furthermore, while profit sharing emerges as a significantly long-term determinant of productivity for both smaller and larger establishments, individual and group performance pay only have 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. Altogether, our separate estimations for smaller and larger establishments make clear two things. 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

TABLE 4 | Split regressions.

	Panel A: Small vs. large establishments			
	Size ≤ 100 employees		Size > 100 employees	
	(1a)		(1b)	
Explanatory variables	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	
	Panel B: Establishments without and with product innovation			
	No product innovation		Product innovation	
	(2a)		(2b)	
Explanatory variables	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	
	Panel C: Establishments without and with works council			
	No works council		Works council	
	(3a)		(3b)	
Explanatory variables	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	

(Continues)

TABLE 4 | (Continued)

Explanatory variables	Panel C: Establishments without and with works council			
	No works council		Works council	
	(3a)		(3b)	
	Within	Between	Within	Between
Overall R^2		0.142		0.116
Number of observations		1009		740
Number of establishments		559		410

Note: 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.

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.1$.

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 variety 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 higher tasks variety 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. However, the hypothesis of equality of coefficients cannot be rejected. All in all, again, we do not find evidence that individual performance pay outperforms collective performance pay. In establishments with product innovations, the influence of individual performance is not stronger than the influences of group performance pay and profit sharing. 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 and to protect the interests of employees (Jirjahn and Smith 2018; Mohrenweiser 2022a). In Panel C, we provide separate estimations for firms with and without a works council.¹⁶ 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.¹⁷ Considering the influences of the three variable payment schemes in establishments with a works council, the null hypothesis of equal coefficients cannot be rejected. Thus, even the separate regressions for establishments with and without a works council do not provide support for a ranking that gives a higher weight to individual performance pay than to collective performance pay. The influence of individual performance pay in establishment with a works council is not larger than the influences of group performance pay and profit sharing. In establishments without a works council, profit sharing is the only variable pay scheme having a significant influence on productivity.

5 | Discussion of Results

5.1 | Basic Implications

More than 20 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. 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. 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. Quite the contrary, individual performance pay only works under specific circumstances, while the influence of profit sharing on productivity is much broader and can even be found under circumstances where individual performance pay does not show a discernible impact. In those firms where individual performance pay has a significant impact on productivity, the impact is similar to the impact of group performance pay and profit sharing. All in all, our results cast 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.

More generally, our analysis points to another problem of the management index. The index aims at identifying best management practices, which are largely not contingent on contextual factors (Bloom and Van Reenen 2007, 2010; Bloom et al. 2012). While our estimations suggest that profit sharing works for various types of establishments and perhaps may 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.

5.2 | Detailed Interpretation of the Findings

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. 2024). 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 2013). In contrast to individual and group performance pay, profit sharing has a positive influence on productivity in both smaller and larger establishments. This suggests two

interesting interpretations. On the one hand, 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. On the other hand, the finding that profit sharing also has a substantial influence in larger establishments does not support the notion of a decisive role of the free-rider problem. The mechanisms outlined in our background discussion indeed appear to help mitigate the problem.

Finally, we find that individual and group performance pay have significant influences on productivity in innovative, but not in noninnovative firms. The finding for group performance pay fits our theoretical expectation that collective incentives are more important when tasks are more multifaceted. However, the result for individual performance does not conform to the expectation that individual performance pay should rather play a role in firms with less multifaceted tasks. One explanation for the finding might be that innovative firms use subjective performance evaluations for rewarding individual performance. Performance evaluations allow for a more comprehensive measurement of individual employee performance. We cannot dig deeper into this issue as our data do not provide information on different types of individual performance pay.

In contrast to individual and group performance pay, 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 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.

5.3 | Limitations

While our study casts doubt on the ad hoc assumptions underlying an index of management practices that has received considerable attention in the literature, it appears to be appropriate to note some potential limitations. Like other studies using the management index (Bloom and Van Reenen 2011: p. 1729), we do not address the issue of a possible endogeneity of management practices. We already discussed this in Section 3.3. Moreover, the GMOP is based on retrospective questions requiring correct memory of the interviewees. This is a limitation we share with many other studies using firm-level data. Furthermore, we only have a 2-year panel for our analysis at hand. Finally, the GMOP contains only dummy variables for the various payment schemes and does not provide further information on the specific design or the intensity of performance pay.¹⁸ Nonetheless it should be stressed that the ranking of payment schemes is based on these dummy variables, so it is interesting to use the dummy variables and analyze whether the ranking is appropriate.

6 | Conclusions

Altogether, our study suggests that a much more nuanced perspective on variable pay is needed and polarizations driven by a priori 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 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.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Endnotes

¹ The weighting has been most clearly documented by the US Census Bureau for the Management and Organizational Practice Survey, a follow-up study for the US that builds from the initial World Management Survey (see https://www2.census.gov/programs-surveys/mops/tables/2015/mops-survey-tables/mops_survey_tables.pdf). Higher weights are given to what is called “more structured management practices.” The survey considers individual-based schemes as more structured than collective ones.

² Of course, self-sorting requires that employees have information on the payment schemes offered by employers. There are several channels through which employees can obtain this information. On the one hand, employees may learn about an employer's remuneration system during the job interview, so that this information influences their job choice. On the other hand, the sorting into and out of specific payment schemes may simply reflect trial and error. Employees move between jobs until they find a job that matches their preferences.

³ 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.

⁴ Our review of the literature focuses on econometric studies. A recent survey by Wood et al. (2023) makes clear that a series of psychological and management studies have also compared individual and team incentives. These studies mainly consider individual-level (or sometimes team-level) outcomes rather than firm performance. Wood et al. conclude that, in the vast majority of the studies, collective schemes outperform individual ones. Yet, the experimental evidence is more mixed than suggested by the authors. For example, Erev et al. (1993) find that collective schemes lead to lower levels of effort than individual schemes. Corgnet et al. (2015) show that individual performance pay outperforms collective pay with respect to effort when workers have the opportunity to engage in on-the-job leisure activities. Van Dijk et al. (2001) and Bortolotti et al. (2016) obtain that effort provision is similar under individual and collective schemes. Crucially, whatever it may be, effort provision is not only an individual-level (or team-level) phenomenon. It depends on the organizational and institutional context. Thus, it appears to be more appropriate to use firm-level data.

⁵ Compared to the number of establishments that participated in the survey, the number of establishments in our estimation sample is substantially smaller. This is a phenomenon that can also be observed for productivity estimates with other datasets such as the IAB Establishment Panel (Jirjahn and Mueller 2014; Mohrenweiser 2022b). One major reason is that a larger share of establishments does not provide information on the costs of intermediate goods and services. This information is required to calculate value added per employee.

⁶ In order to exclude outliers with implausible values from the analysis, we use Cook's distance. Cook's distance evaluates the effect of each observation on the residual. We follow standard practice and remove all observations for which Cook's distance exceeds 4/N.

⁷ While we control for managerial performance pay, the main focus of our study is on nonmanagerial performance pay for two reasons. First, this focus is in line with the profit sharing literature which overwhelmingly considers broad-based sharing schemes. Only 2.3% of the studies discussed in the meta-analysis by Doucouliagos et al. (2020)

had a particular focus on managerial profit sharing. Second and most importantly, the possibility of a free-rider problem is most obvious for nonmanagerial employees receiving collective performance pay, whereas the interpretation of managerial performance pay is not that clear. Let us consider a team of nonmanagerial employees and a manager who supervises the team, coordinates its activities, and allocates resources to the team. If nonmanagerial team members receive performance pay based on the team's output, there could be clearly a potential free-rider problem among them. By contrast, if the manager receives performance pay based on the team's output, this is rather like individual performance pay influencing the manager's effort to monitor and coordinate the team. A manager with that type of performance pay has some similarities with the residual claimant described by Alchian and Demsetz (1972). The basic point is that there is no obvious free-rider problem.

⁸ If there are singleton observations in the data, the Mundlak approach estimates the between component using both singleton and nonsingleton observations, while the within component is estimated using only the nonsingleton observations.

⁹ Note that the within-establishment effects estimated by the Mundlak estimator are equivalent to those obtained from a fixed effects model. The fixed effects approach is often assumed to be able to solve endogeneity problems (which are due to time-invariant unobserved factors), and some researchers are quick to give unquestioned preference to this approach over OLS or random effects estimations (e.g., Kato and Kauhanen 2018). However, as shown by Plümper and Troeger (2019), the fixed effects model does not solve all types of endogeneity issues and may even aggravate a possible bias. Thus, we are careful and do not claim that our approach addresses possible endogeneity. Instead, the advantage of the reformulated Mundlak estimator is that it allows estimating both the within and the between component. Most importantly, it takes into account that the components can differ (Bell and Jones 2015; Bell et al. 2019).

¹⁰ Endogeneity due to omitted variables would imply that we either have an upward or a downward bias when estimating the productivity effect of a payment scheme. If there are unobserved factors influencing the use of performance pay and productivity positively or negatively in the same direction, the impact of performance pay on productivity would be overestimated. If there are unobserved factors positively influencing the use of performance pay positively and establishment productivity negatively (or vice versa), the impact would be underestimated.

¹¹ Let us consider two scenarios to illustrate this point. In the first scenario, a firm uses none of the management practices in the year 2008 and implements management practices between 2008 and 2013. This scenario shows the influence of management practices newly implemented over the 5-year period. Let us consider an increase in the management score by 0.2 points. Taking Equation (2) into account, the 0.2 increase in the management score over the 5-year period implies an approximately 9% higher productivity in the year 2013 ($0.226 \times (0.2 - 0.1) + 0.637 \times 0.1 = 0.0863$). In the second scenario, a firm with initially no management practices implements the management practices before the year 2008. Let us again consider an increase in the management score by 0.2 points. This implies a 0.2 point higher management score for the subsequent years. While the firms in both scenarios have the same management score in the year 2013, the two scenarios show two different situations. Scenario 1 reflects the impact of practices newly implemented between 2008 and 2013. By contrast, Scenario 2 shows the long-lasting impact of practices, which had been implemented before 2008 and, hence, had more time to live up to their potential. These management practices imply an almost 13% higher productivity in the year 2013 ($0.226 \times (0.2 - 0.2) + 0.637 \times 0.2 = 0.1274$). Hence, comparing Scenario 2 and Scenario 1, the long-lasting productivity influence of management practices is indeed stronger than the influence of newly implemented practices.

¹² As explained in our methodological section, these differences in the within and the between component can only be revealed by using the

reformulated Mundlak approach. The differences would remain obscured in fixed or standard random effects estimations. A Mundlak specification test indeed favors the reformulated Mundlak estimator against the fixed effect estimator ($\chi^2 = 65.54$, $p < 0.01$) and the simple random effect estimator ($\chi^2 = 45.84$, $p < 0.01$).

¹³ As shown in Tables S4 and S5, 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. In our data, 27.1% of the establishments used individual performance pay in both years, while 7.3% changed their use of individual performance pay between the years 2008 and 2013; 11.9% used group performance pay in both years and 6.5% changed their use of group performance pay between 2008 and 2013. Finally, 32% used profit sharing in both years, while 9.5% changed their use of profit sharing between 2008 and 2013.

¹⁴ A study by Belloc (2022) obtains a similar result. In that study, nonmanagerial profit sharing, but not managerial profit sharing has a significantly positive influence on firms' innovativeness.

¹⁵ Of course, it would be interesting to combine the various splits. However, this is hampered by small sample sizes. Thus, we perform the splits separately for each category.

¹⁶ 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.

¹⁷ Building from Jirjahn et al. (2024), we also ran an endogenous switching regression taking into account the possible endogeneity of works council incidence. The endogenous switching regression confirmed the pattern of results. The estimates are available from the authors upon request.

¹⁸ As shown in Table S1, the management index also contains an interval variable indicating the share of employees receiving variable pay. However, this variable does not specify the type of pay. Thus, we have no information on the share of employees receiving individual performance pay, group performance pay, or profit sharing.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.