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Article — Published Version

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Kyklos

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Suggested Citation: Baktash, Mehrzad B. (2025) : Does Performance Pay Increase the Risk of Worker Loneliness?, *Kyklos*, ISSN 1467-6435, Wiley, Hoboken, NJ, Vol. 79, Iss. 1, pp. 129-148, <https://doi.org/10.1111/kykl.70018>

This Version is available at:

<https://hdl.handle.net/10419/334862>

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ORIGINAL ARTICLE OPEN ACCESS

Does Performance Pay Increase the Risk of Worker Loneliness?

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Correspondence: Mehrزد B. Baktash (baktash@uni-trier.de)**Received:** 12 June 2025 | **Revised:** 28 August 2025 | **Accepted:** 3 September 2025**Funding:** The author received no specific funding for this work.**Keywords:** loneliness | performance pay | social life | SOEP | well-being

ABSTRACT

Increased wages and productivity associated with performance pay can be beneficial to both employers and employees. However, performance pay can also entail unintended consequences for workers' well-being. This study is the first to systematically examine the association between performance pay and loneliness, a significant policy-relevant social well-being concern. Using representative survey data from Germany, I show that performance pay is significantly associated with increased loneliness. Correspondingly, performance pay is negatively associated with the social life satisfaction of workers. Investigating the transmission channels reveals work hours, earnings, conflict with coworkers, and conflict with the life partner as important mediators. The key findings also hold in sensible instrumental variable estimations, addressing the potential endogeneity of performance pay and in various robustness checks. Finally, implications are discussed.

JEL Classification: J33, I31, J32, I10

1 | Introduction

Theoretical and empirical evidence show that performance pay aligns objectives of workers and firms. Performance pay is linked with both increased wages and productivity.¹ However, recent studies motivated by Adam Smith's (1776) discussion of piece rates demonstrate that performance pay can have unintended costs for workers' health (see Bender and Skåtun [forthcoming](#)). Nonetheless, the unintended costs of performance pay may even go far beyond health concerns and encompass the social life and well-being of the workers. This study uniquely examines the social well-being consequences of performance pay by investigating the following question: *Does performance pay increase the risk of worker loneliness?*

Investigating whether performance pay leads to loneliness stands as an important policy issue due to several reasons. First, the feeling of loneliness is on the rise globally and is

acknowledged as a rising public health and well-being concern (e.g., Sirois and Owens [2023](#)).² Second, loneliness is associated with numerous negative consequences for individual health and well-being (Hakulinen et al. [2018](#); Hawkey et al. [2010](#); James et al. [2011](#); Cacioppo et al. [2002, 2006](#); Holt-Lunstad et al. [2010, 2015](#); Fawaz and Mira [2023](#); Horigian et al. [2021](#); Matthews et al. [2017](#)). Third, in addition to its detrimental consequences for individuals, loneliness also entails negative consequences for firms, families, society, democracy, and the economy as a whole (Bowers et al. [2022](#); Firoz and Chaudhary [2022](#); Gerst-Emerson and Jayawardhana [2015](#); Langenkamp [2021](#); Langenkamp and Stepanova [2024](#); Mihalopoulos et al. [2020](#); Ozcelik and Barsade [2018](#); Putnam [2000](#); Valtorta et al. [2018](#)).

Accordingly, the rapid growth and recognition of numerous negative consequences of loneliness have triggered governments to develop strategies against loneliness. Thus, tackling loneliness and developing social participation is in line with the "leave no

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one behind” commitment of the United Nation’s 2030 Agenda for Sustainable Development. In 2018, the UK government was first to build a strategy to reduce loneliness with a funding of £20 million (Department of Digital, Culture, Media and Sport 2018). In 2023, German Federal Government launched the *Strategy Against Loneliness* as part of the German Sustainability Strategy (Federal Ministry for Family Affairs, Senior Citizens, Women and Youth 2023). In 2023, US Senator Murphy also introduced legislation to the *National Strategy for Social Connection Act* in order to combat the loneliness epidemic in the United States. Likewise, the European Commission’s *Loneliness Project* is aiming to provide intervention policies for loneliness across EU-27 since 2023 (Casabianca et al. 2023).

Nonetheless, despite the broad literature on the rapid rise and the negative consequences of loneliness, economists have paid less attention to establishing a relationship between different job designs and worker loneliness. Considering the spread of performance pay among firms in Europe and the United States over the last decades (Bender and Skåtun forthcoming; Lemieux et al. 2009; Zwysen 2021), it becomes increasingly crucial and timely to investigate whether and how performance pay increases the risk of worker loneliness. The present study is the first to examine this question.

There are at least three channels through which performance pay may increase the risk of worker loneliness. First, workers receiving performance pay are less likely to be cooperative and exert helping effort to colleagues (Drago and Garvey 1998). This, in turn, may decrease the probability of building social capital with colleagues, and hence, increase the risk of loneliness. Second, performance pay is associated with an increased mental focus on work (Hur et al. 2021). This may not allow workers to psychologically detach from work during non-work time, and hence, enjoy quality time with family and friends. A heightened mental focus on work also suggests prioritization of work over private life, which in turn, limits the workers’ opportunities to participate in activities involving interaction with others and building new connections outside the workplace. Thus, it leads to an increased risk of loneliness. Third, performance pay causes higher stress by increasing worker effort, expectations, and workload pressure (Baktash et al. 2022a). This could further increase the probability of feeling lonely. Overall, all these channels hint at a positive association between performance pay and loneliness.

I use the German Socio-Economic Panel (SOEP) to investigate the association between performance pay and loneliness. First, I examine whether workers receiving performance pay have an increased risk of loneliness. Second, I investigate the role of work hours, income, coworker conflict, and partner conflict as underlying mechanisms. Third, I account for a possible omitted variable bias, and hence, address the potential endogeneity of the performance pay variable using an instrumental variable (IV) strategy. I also provide sensible and intuitive justifications, increasing confidence in the credibility of the IV. Finally, I perform several robustness checks such as using alternative measures of loneliness, using social life satisfaction as a proxy for loneliness, examining whether the results are robust after excluding workers who switched their jobs in between observed waves, investigating whether performance pay intensity matters

for the association between performance pay and loneliness, and exploring whether the association exists when workers receive collective performance pay.

2 | Setting the Stage

2.1 | Performance Pay and Physical Well-Being

An extensive body of literature study the consequences of performance pay on physical well-being based on Adam Smith’s (1776) concern that piece rates incentivize workers to “ruin their health.” The initial case studies indicate that performance pay increases accidents and injuries at workplace (e.g., Freeman and Kleiner 2005; Johansson et al. 2010; Saha et al. 2004). Recent studies using survey data also match with case studies and show a positive association between performance pay and workplace injuries (e.g., Bender et al. 2012; Artz and Heywood 2015).

Moreover, the negative consequences of performance pay on physical well-being extend beyond the elevated risk of accidents and injuries at the workplace. There exists evidence that performance-related pay deteriorates physical health (Bender and Theodossiou 2014; Foster and Rosenzweig 1994), increases sickness-related absences (DeVaro and Heywood 2017; Frick et al. 2013), and increases the probability of higher blood pressure (Andelic et al. 2023).

2.2 | Performance Pay and Mental Well-Being

Available evidence points not only at negative consequences of performance pay on physical health and well-being, but also on mental well-being. Habel et al. (2021) show that the relative importance of commissions increases the emotional exhaustion of sales workers. Davis (2016) indicates that piece rates negatively impact the emotional health of garment workers in Vietnam. Using laboratory experiments, Cadsby et al. (2016) find a positive association between performance pay and self-reported stress. In recent laboratory experiments, Allan et al. (2020, 2021) also show that performance pay increases the stress level measured by cortisol hormone levels. These findings are also complemented by survey evidence. Baktash et al. (2022a) show that performance pay increases the stress level of workers using representative survey data from Germany. Consecutively, the stress associated with performance pay can lead to the use of medication. Workers increase the usage of prescribed anti-anxiety and anti-depressant drugs when the employer adopts performance pay (Dahl and Pierce 2020). Accordingly, workers receiving performance pay are even more likely to consume illicit drugs and different types of alcohol as a coping mechanism (Artz et al. 2021; Baktash et al. 2022b).

2.3 | Performance Pay and Loneliness

The World Health Organization (WHO) suggests that well-being has the following key dimensions: “physical, mental and social well-being” (WHO 1948). While the literature on adverse consequences of performance pay for workers’ physical and mental well-being is ample, almost no attention has been paid on social

well-being consequences of performance pay. This study is the first to examine whether and how performance pay affects the social well-being of workers by focusing on loneliness. Loneliness is a dimension of social well-being that corresponds to the “subjective psychological discomfort people experience when their network of social relationships is significantly deficient in either quality or quantity” (Perlman and Peplau 1998, 571).

Principally, work and workplace are often considered as the main mechanisms to achieve such social relationships (Ferris et al. 2009; Wright and Silard 2021). In their conceptual theoretical model of loneliness in the workplace, Wright and Silard (2021, 1071) argue that developing social relationships is more likely in “organizations with a mastery climate compared to organizations with a performance culture.” Organizations using time-rate and seniority-based pay may encourage collaboration and learning, while organizations using performance-related pay may encourage competitiveness and social comparison (Bunderson and Sutcliffe 2003). Thus, workers receiving performance pay have a lower probability of cooperation and engaging in helping-efforts to their coworkers (e.g., Burks et al. 2009; Encinosa et al. 2007; Lombardi et al. 2020). Drago and Garvey (1998) show that promotion incentives are negatively related with worker helping-efforts and positively related with individual worker effort. Indeed, Gläser et al. (2017) argue that performance pay can even induce interpersonal deviance such as harming behavior toward coworkers. Thus, performance pay has been shown to trigger detrimental and aggressive facets of competitiveness (Lazear 1989; Gläser et al. 2022). Against this background, the uncooperativeness associated with performance pay reduces the likelihood of creating strong bonds with colleagues, and hence, opens doors to the feeling of loneliness.

Moreover, performance pay is also associated with increased working hours both in cross-sectional and worker fixed effects estimations (Artz and Heywood 2024; Baktash et al. (forthcoming); DeVaro 2022; Green and Heywood 2023). Greater working hours associated with performance pay, in turn, reduce the available time and energy for leisure activities, sleep, physical activities, and household activities (Andelic et al. 2022). The increased work-related mental focus of workers receiving performance pay even suggests that performance pay entails a higher willingness to prioritize work over family and friends (Hur et al. 2021). Thus, workers receiving performance pay increase their work commitment to a level that it induces “over-work.”³ The higher commitment to the job even adversely affects workers' family life. Baktash et al. (forthcoming) provide evidence that performance pay is associated with increased risk of marital instability and divorce.

Therefore, increased mental focus on work associated with performance pay may further contribute to an increased risk of loneliness. An increased work-related mental focus suggests that performance pay may not allow the workers to psychologically detach from work during non-work time and to enjoy quality time socializing with family and friends. At the same time, it suggests prioritization of work over private life. This would result in limited opportunities to get involved in social and leisure activities outside the workplace, which may possibly allow the workers to meet and bond with new people who share similar interests as themselves (see Pagan 2021).

Finally, performance pay leads to higher stress by increasing worker effort, expectations, and workload pressure (e.g., Allan et al. 2020, 2021; Baktash et al. 2022a). A series of studies has shown that loneliness has a biological and stress-related origin (Campagne 2019; Glaser et al. 1985; Moshtael et al. 2024; Wang et al. 2024). Accordingly, elevated stress associated with performance pay can be another important channel through which the risk of worker loneliness can be increased. Overall, all these channels hint at a positive association between performance pay and loneliness.

To summarize, previous studies have shown that performance pay not only harms workers' physical and mental well-being, but also impacts their relationships with coworkers, commitment to work, work-life balance, and activities outside the workplace. Therefore, these studies build the theoretical framework of the present study and raise the important question of whether and how performance pay increases the risk of worker loneliness.

3 | Data and Variables

3.1 | Dataset

I use the SOEP to empirically test the relationship between performance pay and loneliness. The SOEP is a broad representative longitudinal survey of private households in Germany and one of the largest and enduring multidisciplinary surveys across the globe (Goebel et al. 2019). Thus, 30,000 individuals from around 15,000 households are annually interviewed. The questionnaire consists of routine demographic and socio-economic questions every year and asks ‘special’ topic questions in specific waves. Information on performance pay comes from the waves 2011 and 2016. I pool the data so independent variables are taken from these waves. The analysis focuses on employees aged 18 to 67 years, as it reflects the typical working-age population in Germany. Moreover, I exclude apprentices and marginally employed individuals (monthly earnings of below €450), as they are not facing a choice of sorting into performance pay. Thus, the empirical analysis uses an unbalanced sample with 13,143 observations from 10,670 employees.

The explanatory variables in the respective period t ($t = 2011, 2016$) are used to explain a feeling of loneliness in the subsequent period for which the data is available (i.e., either in $t + 1$ or in $t + 2$). This not only considers that performance pay may not immediately lead to the feeling of loneliness, but also mitigates the risk of any reverse causation. Thus, predetermined explanatory variables reduce the problem of endogeneity. Nevertheless, I still address the potential endogeneity of receiving performance pay using an IV approach. As a further robustness check, I use a subjective score of social life satisfaction, which is available for the same waves t , as the outcome variable instead of the loneliness variables that come from the subsequent waves.

3.2 | Variables

Table 1 presents the definitions and descriptive statistics of the key variables. The key explanatory variable is a dummy variable

TABLE 1 | Definition and descriptive statistics of key variables.

Variable	Definition	Mean	Std. dev.
Performance pay	Dummy equals 1 if the worker faces a regular performance appraisal that has consequences for his or her earnings.	0.28	0.45
Loneliness index	Sum of the three ordered variables (with each variable ranging from 0 [<i>never</i>] to 2 [<i>often/very often</i>]) for the frequency of feeling lonely for each type of loneliness (lack companionship, feel isolated, feel left out). The index ranges from 0 (<i>never feel lonely</i>) to 6 (<i>often/very often lack companionship, feel isolated and feel left out</i>).	2.06	1.27
Social life satisfaction	Overall social life satisfaction scored on an 11-point Likert scale ranging from 0 (<i>completely dissatisfied</i>) to 10 (<i>completely satisfied</i>).	7.67	1.70
Lack companionship	Score of lacking companionship ranging from 0 (<i>never</i>) to 2 (<i>often/very often</i>).	0.88	0.50
Feel isolated	Score of feeling isolated ranging from 0 (<i>never</i>) to 2 (<i>often/very often</i>).	0.42	0.55
Feel left out	Score of feeling left out ranging from 0 (<i>never</i>) to 2 (<i>often/very often</i>).	0.76	0.53
Number of types of loneliness	Number of different types of loneliness (lack companionship, feel isolated, feel left out) the worker feels ranging from 0 (<i>none</i>) to 3 (<i>all the three types</i>).	1.91	1.05
Performance pay share by occupation	The share of workers receiving performance pay calculated for 257 detailed four-digit occupations excluding the worker's own contribution to the share of each survey year.	0.25	0.19

Note: Number of observations = 13,143. For the performance pay share by occupation and social life satisfaction, the number of observations equal to 13,117 and 13,111, respectively.

indicating *performance pay* earned by the individual worker in the respective year. Building from Cornelissen et al. (2011) and Grund and Sliwka (2010), a worker is considered to earn performance pay if he or she is subject to regular and formalized performance appraisals by the superior at work, and the performance appraisals have consequences for his or her earnings (i.e., consequences for monthly gross wage, annual bonus, future wage growth, and/or potential promotion). In this study, 28% of the employees are subject to performance pay.⁴

The outcome variable, loneliness, is based on the following three items: (1) “How often do you miss the company of other people?” (2) “How often do you feel socially isolated?” (3) “How often do you feel left out?” For each item, interviewees respond on a 5-point scale with categories *never*, *seldom*, *sometimes*, *often*, and *very often*. It is important to note that feeling of loneliness is not equivalent to feeling alone. However, it involves feelings of “disconnectedness,” “isolation,” and “not belonging” (Hughes et al. 2004). These feelings are consequently considered to demonstrate the gap between an individual’s desired and actual social relationships (Peplau and Perlman 1982).

Thus, I use the short-scale *loneliness index* developed by Hughes et al. (2004) as the main outcome variable. Following the procedure of Hughes et al. (2004), I first rearrange the 5-point scale of the three items to a 3-point Likert scale as follows: *never*, *seldom/sometimes*, and *often/very often*. Next, the loneliness index is constructed by summing the three rearranged items, with larger scores demonstrating a higher loneliness level. The intercorrelation of the items is suitably high with a Cronbach’s alpha of 0.75. The mean loneliness score on the single combined index is 2.06 with a 1.27 standard deviation. While I initially focus on the

loneliness index, in extensions I also use alternative measures of loneliness as robustness checks. First, I investigate the link between performance pay and each single item separately: (1) *Lack companionship*, (2) *feel isolated*, and (3) *feel left out*. Second, I examine the association between performance pay and the *number of types of loneliness* felt by a worker.

As the feeling of loneliness and satisfaction with social life are very closely related, I exploit this advantage and use the *social life satisfaction* score as a further outcome variable. The social life satisfaction score is asked in the same waves as the performance pay variable (i.e., 2011 and 2016). The score is based on the following questions: “How satisfied are you today with the following areas of your life? - How satisfied are you with your social life?” Thus, the social life satisfaction is scored on an 11-point Likert scale ranging from 0 (*completely dissatisfied*) to 10 (*completely satisfied*). This allows examining the broader association between performance pay and social well-being. Additionally, it also tests whether performance pay has a direct impact on the social life satisfaction of the workers within the same wave, or the results are driven by the predetermined nature of explanatory variables. The mean social life satisfaction score of the estimation sample is 7.67 with a 1.70 standard deviation.

The richness of the SOEP allows including a comprehensive selection of control variables for the worker and job characteristics that may potentially influence loneliness and sorting into performance pay (e.g., Almlund et al. 2011; Bandiera et al. 2005; Barreto et al. 2021; Böckerman et al. 2012, 2020; De Jong-Gierveld et al. 2016; Heywood et al. 2017; Lepinteur et al. 2022). Table A1 presents the definitions and descriptive statistics of

the control variables. I control for socio-demographic characteristics such as age, gender, education, marital status, migration status, household size, children in household, dwelling size, bereavement status, financial problems, state of residence, presence of siblings, parents, and close friends. I also control for work-related factors such as work experience, unemployment experience, public sector, tenure, permanent contract, part-time employment, job insecurity, industries, and occupations. Importantly, I also control for the workers' personality traits such as the Big Five personality traits (conscientiousness, extraversion, agreeableness, openness, and neuroticism), risk tolerance, and locus of control.

4 | Results

4.1 | Initial Estimates

Table 2 presents the initial estimates. The determinants of the loneliness index are estimated using pooled OLS and random effects (RE) models, as well as ordered probit and RE ordered probit models, which account for the categorical nature of the outcome variable. The cross-period correlation of worker-specific error terms is taken into account using RE models. Moreover, the standard errors are clustered at the worker level. All four estimation strategies yield highly similar results.

According to all four models, performance pay emerges as a statistically significant determinant of the loneliness index. It is associated with a significant increase in loneliness by 0.05 of a point on the loneliness scale. As the mean loneliness scale equals 2.06, performance pay increases the risk of loneliness by about 3%. This magnitude can be interpreted partly by comparing it to the significant coefficient on the number of close friends. It suggests that the loneliness associated with the performance pay variable is equivalent to having 10 lesser close friends. Alternatively, performance pay increases loneliness by approximately the same amount that 4 years of tenure decreases it. Thus, while not as strong a statistical determinant as having a life partner, the effect of performance pay on loneliness is notably substantial. Thus, the initial findings conform to the hypothesis that the decreased cooperation, higher pressure and stress, reduced family quality, and prioritization of work associated with performance pay could lead to worker loneliness.

Most of the explanatory variables also emerge as significant determinants of loneliness. Women are more likely to feel loneliness, while household size, fit dwelling, and dwelling size are negative determinants of loneliness. Loneliness follows a U-shape in tenure, reaching a minimum point in 30 years. Moreover, having a permanent contract decreases loneliness, while job and financial insecurity increase it. The presence of siblings increases the feeling of loneliness, while the presence of a mother decreases loneliness. Finally, personality traits of the workers play important roles in determining the feeling of loneliness. On the one hand, risk-tolerant workers and those high on neuroticism have an increased risk of loneliness. On the other hand, conscientiousness, extraversion, agreeableness, and internal locus of control scores are significant negative determinants of loneliness.

4.2 | Transmission Channels

In the next step, I empirically examine the possible transmission channels that drive the pattern of results. As highlighted in the background discussion, performance pay increases work hours, earnings, conflict with coworkers, and conflict with the life partner or spouse. Thus, I investigate the mediating roles of these four variables. Table 3 presents the definitions and descriptive statistics of the four mediator variables. To perform multiple mediator analysis, I use a seemingly unrelated regression approach, decomposing the influence of performance pay into a direct effect and indirect effects through work hours, earnings, coworker conflict, and partner conflict. The full set of control variables is also included at each step of the analysis.

Figure 1 presents the mediator analysis. First, performance pay is significantly associated with increased work hours, and work hours are significantly associated with increased loneliness. The total indirect effect is about 0.001 ($0.302 \times 0.004 = 0.0012$). Second, performance pay increases income significantly, and income is positively associated with loneliness. This total indirect effect equals about 0.007 ($0.107 \times 0.069 = 0.0073$). Third, performance pay increases the likelihood of burdensome conflict with coworkers, and this conflict also increases loneliness. The indirect effect of performance pay through coworker conflict is about 0.002 ($0.013 \times 0.124 = 0.0016$). Fourth, performance pay increases the probability of burdensome conflict with the partner or spouse, and this type of conflict also intensifies loneliness. The indirect influence of performance pay through partner conflict equals about 0.002 ($0.020 \times 0.094 = 0.0019$).

Overall, the total indirect influence of performance pay through the four mediator variables jointly is 0.012 and is significant at the 1% level (z-stat 3.14). The magnitude of this indirect influence is large and equals 25% of performance pay's direct effect. Thus, these findings conform to the theoretical expectations emphasized in the background discussion. Importantly, the mediator analysis indicates that there also remains a significant direct effect of 0.048. This direct influence may capture other transmission mechanisms such as increased stress, alcohol and drug use, and expected future job commitments and earnings.

4.3 | The Issue of Endogeneity

While the initial estimates show a consistent and significant positive effect of performance pay on loneliness, the performance pay variable may nonetheless suffer from endogeneity. Including a long list of other determining factors of loneliness may reduce the risk of omitted variable bias. However, there may still exist unobservable factors impacting both sorting into jobs with performance pay and feelings of loneliness. Thus, I test for the omitted variable bias using the Oster (2019) and Diegert et al. (2025) (DMP) tests.⁵ The first test assumes that the included controls are exogenous, while the latter one does not impose this assumption. The Oster test suggests that the unobservable factors need to be 139.4% as strong as the observables to overturn the findings. However, the DMP test shows that a ratio of 5% could transform the performance pay variable into insignificant. Together, these tests suggest that endogeneity may play a role, and hence, the estimated effect of performance pay may

TABLE 2 | Determinants of loneliness index: Initial estimates.

	(1)	(2)	(3)	(4)
	OLS	RE	Ordered probit	RE ordered probit
Performance pay	0.055 (0.024)**	0.050 (0.024)**	0.049 (0.022)**	0.062 (0.029)**
Age	-0.001 (0.003)	-0.002 (0.003)	-0.001 (0.002)	-0.002 (0.003)
Female worker	0.056 (0.028)**	0.046 (0.028)	0.047 (0.026)*	0.053 (0.034)
Education	-0.001 (0.006)	-0.001 (0.006)	-0.002 (0.005)	-0.002 (0.007)
Married	-0.260 (0.033)***	-0.245 (0.033)***	-0.239 (0.030)***	-0.303 (0.040)***
German	-0.015 (0.044)	-0.021 (0.044)	-0.016 (0.041)	-0.029 (0.054)
Children in HH (d)	0.036 (0.030)	0.016 (0.030)	0.032 (0.028)	0.023 (0.036)
Size of HH	-0.024 (0.012)*	-0.016 (0.012)	-0.022 (0.011)*	-0.021 (0.015)
Fit dwelling	-0.099 (0.022)***	-0.084 (0.022)***	-0.091 (0.020)***	-0.106 (0.027)***
Living space	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***
Bereaved	0.050 (0.056)	0.015 (0.055)	0.047 (0.052)	0.025 (0.068)
Work experience	0.002 (0.003)	0.002 (0.003)	0.001 (0.002)	0.003 (0.003)
Unemployment experience	0.002 (0.007)	0.004 (0.007)	0.001 (0.006)	0.004 (0.008)
Public sector	0.036 (0.030)	0.036 (0.029)	0.032 (0.027)	0.046 (0.036)
Tenure	-0.012 (0.003)***	-0.012 (0.003)***	-0.011 (0.003)***	-0.014 (0.004)***
Tenure ²	0.0002 (0.000)**	0.0002 (0.000)**	0.0002 (0.000)**	0.0002 (0.000)**
Permanent	-0.068 (0.038)*	-0.073 (0.038)*	-0.061 (0.035)*	-0.085 (0.046)*
Part-time	-0.026 (0.029)	-0.017 (0.029)	-0.023 (0.027)	-0.021 (0.035)
Job insecurity	0.176 (0.024)***	0.160 (0.024)***	0.161 (0.022)***	0.198 (0.029)***
Financial insecurity	0.204 (0.024)***	0.200 (0.023)***	0.192 (0.022)***	0.252 (0.029)***
Sister	0.049 (0.021)**	0.046 (0.021)**	0.044 (0.020)**	0.056 (0.026)**
Brother	0.046 (0.022)**	0.044 (0.021)**	0.046 (0.020)**	0.060 (0.026)**

(Continues)

TABLE 2 | (Continued)

	(1)	(2)	(3)	(4)
	OLS	RE	Ordered probit	RE ordered probit
Mother	-0.045 (0.028)*	-0.058 (0.028)**	-0.042 (0.025)*	-0.069 (0.034)**
Father	0.010 (0.025)	0.014 (0.025)	0.006 (0.023)	0.012 (0.030)
Number of close friends	-0.006 (0.003)*	-0.005 (0.003)*	-0.006 (0.003)*	-0.007 (0.004)*
Risk tolerance	0.022 (0.005)***	0.018 (0.005)***	0.020 (0.005)***	0.023 (0.006)***
Conscientiousness	-0.108 (0.014)***	-0.110 (0.014)***	-0.102 (0.013)***	-0.139 (0.017)***
Extraversion	-0.142 (0.011)***	-0.134 (0.011)***	-0.130 (0.010)***	-0.165 (0.014)***
Agreeableness	-0.068 (0.012)***	-0.068 (0.012)***	-0.065 (0.011)***	-0.085 (0.015)***
Openness	0.016 (0.010)	0.012 (0.010)	0.015 (0.010)	0.015 (0.013)
Neuroticism	0.190 (0.010)***	0.190 (0.010)***	0.174 (0.009)***	0.232 (0.013)***
Locus of control	-0.255 (0.016)***	-0.237 (0.015)***	-0.237 (0.015)***	-0.297 (0.020)***
Occupation dummies	Included	Included	Included	Included
Industry dummies	Included	Included	Included	Included
State dummies	Included	Included	Included	Included
Year dummy	Included	Included	Included	Included
R ² /pseudo R ²	0.191	0.191	0.067	0.060
Number of observations	13,143	13,143	13,143	13,143
Number of employees	10,670	10,670	10,670	10,670

Note: Dependent variable: Loneliness index. The table shows estimated coefficients. Standard errors in parentheses are clustered at the individual level.
*Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

TABLE 3 | Definition and descriptive statistics of mediator variables.

Variable	Definition	Mean	Std. dev.
Work hours	The number of weekly hours the worker actually works including any possible overtime.	38.61	10.42
Gross income	The natural log of gross wage received last month.	7.81	0.63
Coworker conflict	Dummy equals 1 if the worker experiences burdensome conflict with his/her coworkers.	0.12	0.33
Partner conflict	Dummy equals 1 if the worker experiences burdensome conflict with his/her partner/spouse.	0.34	0.47

Note: Number of observations = 12,216.

be biased. The estimated effect of performance pay on feelings of loneliness is overestimated if the unobservable factors impact both performance pay and loneliness in the same direction.

Alternatively, the estimated effect of performance pay on feelings of loneliness is underestimated if the unobservable factors impact performance pay and loneliness in opposite directions.

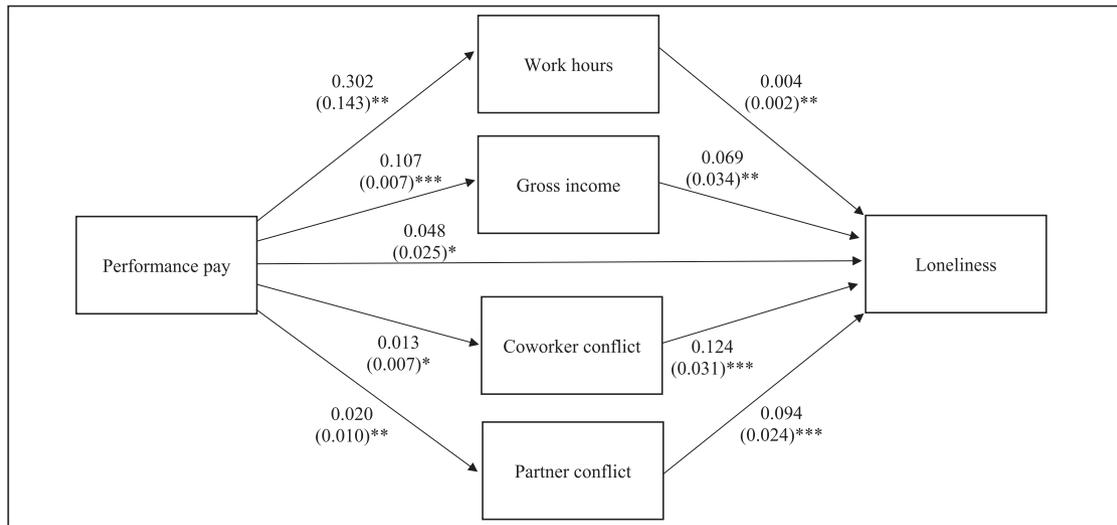


FIGURE 1 | The mediating roles of work hours, gross income, coworker conflict, and partner conflict. Number of observations=12,216. The figure shows estimated coefficients. Standard errors in parentheses are clustered at the individual level. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level. Control variables are included at each step, but suppressed to save space.

One approach to address endogeneity could be to use a fixed effects model. However, I refrain from using this approach due to the following reasons. First, this study uses an unbalanced panel containing a large number of singleton observations that are not possible to be used for estimating within-worker effects. Dropping the singleton observations largely diminishes the number of observations as the singletons account for more than half of the original observations (64%). Second, the fixed effects model only tackles the issue of unobserved time-invariant effects. However, it does not address the issue of unobserved time-varying effects. Plümer and Troeger (2019) indicate that a fixed effects method is likely to intensify the bias caused by omitted time-varying factors as dropping the between variation enlarges the impact of time-varying misspecification on parameter estimates.

Instead, an IV approach is used to address the issue of endogeneity. This approach has the advantage of not only addressing the unobservable time-invariant effects but also the unobservable time-varying effects. The essential condition of the IV approach is the exclusion restriction, which implies that IVs do not influence the outcome variable directly but only indirectly through the key explanatory variable. Nonetheless, it has always been challenging to find convincing exclusion restrictions. Just-identifying exclusion restrictions are based on conditions that cannot be justified empirically (Heckman 2000; Keane 2010). Their justification relies solely on reasoning and an appeal to intuition. Section 4.4 examines the credibility of the used IV in detail and shows the exclusion restrictions imposed by the model are likely plausible in the context of performance pay and loneliness.

I follow an IV strategy grounded on aggregation (for examples see Andelic et al. 2023; Baktash et al. 2022a; Baktash forthcoming; Bilanakos et al. 2018; Cornelissen et al. 2011; Fisman and Svensson 2007; Lai and Ng 2014; Lee 2004; Machin and Wadhvani 1991; Woessmann and West 2006). Thus, the IV is the *share of workers receiving performance pay* calculated

for 257 detailed 4-digit occupations. When the share of those receiving performance pay for each worker's occupation is calculated, I exclude the respective worker. The performance pay share by occupation demonstrates the general tendency within a narrowly determined job that workers are on performance pay. For instance, a high performance pay share by occupation may show that worker output is monitored without difficulty in that job, and consecutively, raises the individual worker's likelihood of receiving performance pay (Bayo-Moriones et al. 2013).

Table 4 shows a series of IV regressions addressing the endogeneity issue. Column (1) presents the 2-stage least squares (2SLS). The first stage estimates the individual worker's likelihood of receiving performance pay using a linear probability model. The IV, performance pay share by occupation, emerges as a statistically significant positive determinant of the individual worker's likelihood of receiving performance pay. Both the robust *F* test and the Anderson-Rubin test statistic reject the hypothesis of a weak instrument. The second stage replaces the performance pay variable with the predicted values obtained from the first stage estimation to address the endogeneity issue. The 2SLS regression confirms the key pattern of results and suggests that performance pay is associated with a significant increase in loneliness by 0.243 of a point. Given the mean loneliness score in the sample is 2.06, this would imply a 12% increase. Column (2) presents the RE IV results. While RE IV follows the same procedure as in the 2SLS regression, it additionally considers the cross-period correlation of worker-specific error terms. Nonetheless, this approach also yields similar results as the simple 2SLS regression.

Column (3) presents the findings of the treatment effects model (Maddala 1983; Vella and Verbeek 1999). This approach takes into account that the endogenous variable, performance pay, is binary. It jointly estimates a probit equation explaining performance pay and a linear equation explaining the loneliness index using maximum likelihood. The correlation of the error terms (ρ) shows that the error terms of the two equations are

TABLE 4 | Determinants of loneliness index: Endogeneity issue.

	(1)	(2)	(3)	(4)
	2SLS	RE IV	Treatment effects; ML	Ordered probit IV
<i>Loneliness</i>				
Performance pay	0.243 (0.122)**	0.220 (0.124)*	0.404 (0.181)**	0.325 (0.137)**
<i>Performance pay</i>				
Performance pay share by occupation	0.560 (0.027)***	0.545 (0.027)***	1.635 (0.089)***	1.642 (0.086)***
Robust F	426.61***	—	—	—
Anderson-Rubin test statistic	3.95**	—	—	—
ρ	—	—	-0.186 (0.094)**	-0.169 (0.083)**
Number of observations	13,117	13,117	13,117	13,117
Number of employees	10,653	10,653	10,653	10,653

Note: The table shows estimated coefficients. Standard errors in parentheses are clustered at the individual level. Control variables are included but suppressed to save space.

* Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

negatively correlated, and hence, performance pay must be treated as endogenous. This indicates that there are unobservable factors that impact receiving performance pay and loneliness in opposite directions, and hence, the performance pay effect is underestimated when endogeneity is not addressed. For example, one unobservable factor could be physical attractiveness inducing the negative correlation. More attractive workers have a higher likelihood of sorting into jobs with performance pay. Simultaneously, more attractive individuals have a lower probability of feeling lonely.⁶ Another unobservable factor could be health consciousness. The likelihood of sorting into performance pay jobs could be higher for health-conscious workers who have an initially good health status. Concurrently, the healthy lifestyle of health-conscious workers would reduce the probability of feeling lonely.⁷ Thus, addressing the endogeneity issue using the treatment effects model elicits again a much larger influence of performance pay on the risk of loneliness.

Column (4) presents the ordered probit IV results, which jointly estimates a probit equation explaining performance pay and an ordered probit equation explaining the loneliness index using maximum likelihood. Again, ordered probit IV also confirms the key findings and shows that workers receiving performance pay are scoring significantly higher in the loneliness index. Overall, according to all four models, performance pay is a statistically significant positive determinant of loneliness.

4.4 | Credibility of the IV

The study uses performance pay share by occupation (excluding own contribution of the respective worker to the share) as an IV to account for the endogeneity of the performance pay variable. The validity of the IV requires that performance pay share by occupation has no direct effect on the individual worker's loneliness, but

only an indirect effect through the individual worker's likelihood of receiving performance pay. However, one may argue that the performance pay share by occupation may also directly influence the loneliness level of the individual workers.

This study takes the exclusion restriction imposed by the model as plausible for two reasons. First, the credibility of an IV can depend on the covariates included (Angrist and Pischke 2009). An instrument may lack validity per se but may only be valid after conditioning on covariates. The richness of the SOEP enables including a long list of control variables. Particularly, it still allows the inclusion of 11 broadly defined two-digit occupation dummies. As the included covariates capture significant aspects of the working conditions, it increases confidence in the credibility of the IV. Therefore, as long as important controls for working conditions are included, no direct effect but only an indirect effect of the IV through the individual worker's probability of receiving performance pay should be expected.

Second, I calculate the loneliness share by occupation and include it as an additional covariate in the IV estimations. By conditioning on the loneliness share by occupation, I switch off all the channels through which the IV may affect worker loneliness. Table 5 shows the results. In the first-stage regression, loneliness share by occupation emerges as an insignificant determinant of an individual worker's likelihood of receiving performance pay, while performance pay share by occupation continues emerging as a positive and highly significant determinant. The second-stage regression shows that performance pay increases the loneliness score by 0.248 points even when the loneliness share by occupation is controlled for. The performance pay coefficient is very similar to the one found in Table 4 and the loneliness share by occupation takes an insignificant negative coefficient. Therefore, switching off all the channels through which the IV may affect worker loneliness does not change the key findings and increases confidence in the credibility of the IV.

TABLE 5 | Determinants of loneliness index: Credibility of the instrumental variable.

	(1)	(2)	(3)	(4)
	2SLS	RE IV	Treatment effects; ML	Ordered probit IV
<i>Loneliness</i>				
Performance pay	0.248 (0.122)**	0.238 (0.123)*	0.404 (0.178)**	0.327 (0.136)**
Loneliness share by occupation	-0.099 (0.137)	-0.093 (0.136)	-0.108 (0.137)	-0.090 (0.125)
<i>Performance pay</i>				
Performance pay share by occupation	0.562 (0.027)***	0.555 (0.027)***	1.641 (0.089)***	1.648 (0.087)***
Loneliness share by occupation	0.003 (0.049)	0.005 (0.048)	0.071 (0.175)	0.070 (0.175)
Robust F	421.66***	—	—	—
Anderson-Rubin test statistic	4.12**	—	—	—
ρ	—	—	-0.185 (0.093)**	-0.169 (0.082)**
Number of observations	13,085	13,085	13,085	13,085
Number of employees	10,631	10,631	10,631	10,631

Note: The table shows estimated coefficients. Standard errors in parentheses are clustered at the individual level. Control variables are included but suppressed to save space.

* Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

4.5 | Alternative Measures of Loneliness

The study so far established a strong link between performance pay and loneliness index. At issue is whether performance pay influences each of the three dimensions of loneliness and whether performance pay increases the number of types of loneliness felt by workers. Table A2 presents the key estimates for the three dimensions of loneliness, i.e., lacking companionship, feeling isolated, and feeling left out using the IV strategy. The findings suggest that performance pay is significantly associated with two out of three dimensions of loneliness, lacking companionship and feeling left out. While performance pay is also positively associated with feeling isolated, this effect is not statistically significant. Further, Table A3 shows the key IV estimates for the number of types of loneliness. Both the treatment effects and Poisson IV regressions suggest that performance pay increases the number of types of loneliness by 0.13 to 0.20 types. As the mean number of types of loneliness equals 1.91, this could be translated into a 10% increase in the types of loneliness.

The study so far used explanatory variables from the respective period t , to explain the feeling of loneliness in the subsequent closest wave that information is available. At issue is whether performance pay has a direct impact on the social well-being of the workers within the same wave, or the results are driven by the predetermined nature of explanatory variables. The SOEP asks a question about the social life satisfaction of the respondents in the respective period t ($t = 2011, 2016$) that explanatory variables come from. Thus, this gives the opportunity to exploit the social life satisfaction score as a proxy for the feeling of loneliness and examine the robustness of the findings. Indeed, Peplau

and Perlman (1982) argue that the feeling of loneliness indicates the gap between a person's desired and actual social relationships. Accordingly, workers who are satisfied with their social relationships and social life are less likely to experience the feeling of loneliness, and vice versa. Additionally, investigating the association between performance pay and social life satisfaction presents a broader understanding of the social well-being consequences of performance pay. Table A4 presents the IV estimates for social life satisfaction. Both the treatment effects and ordered probit IV models suggest a significant negative association between performance pay and social life satisfaction. Performance pay decreases the social life satisfaction of the worker by about 2 points. Therefore, these robustness checks using alternatives measures of loneliness provide additional evidence on the association between performance pay and loneliness.

4.6 | Further Robustness Checks

As another robustness check, I rerun the key loneliness regressions excluding workers who changed their jobs in 2012, 2013, or 2017. As the performance pay variable is predetermined, it may raise the question of whether workers in the subsequent years that loneliness measures are available still received performance pay or not. Keeping only the workers who have not changed their jobs in between these periods allows addressing this problem. Table A5 shows the IV estimates for the loneliness index excluding switchers. The results are similar to the ones presented above. Excluding switchers even leads to slightly higher coefficients and statistically significant levels. Altogether, the additional estimates suggest robustness of the key findings.

A further question is whether the association between performance pay and loneliness depends on the intensity of performance pay. Bender et al. (2012) show that the physical well-being consequences of performance pay depend on performance pay types. The SOEP allows distinguishing between four types of performance pay by the financial consequences of performance appraisal. Thus, I build an intensity measure of performance pay that ranges from 0 (do not receive any of the 4 types) to 4 (receive all the 4 types simultaneously). Table A6 provides the endogeneity-corrected estimates. One additional type of performance pay is associated with a 0.116 point increase in the loneliness index. This indicates that performance pay intensity matters for the feeling of loneliness and increases the risk significantly.

Next, at issue is whether individual-based performance pay has a larger effect on the risk of loneliness than team- or organizational-based performance pay. On the one hand, team- and organizational-based performance pay may increase the risk of loneliness due to higher stress and peer pressure (Kandel and Lazear 1992). On the other hand, these collective types of performance pay may mitigate the risk of loneliness as they are associated with increased teamwork and cooperativeness as well as decreased worker conflict (Heywood et al. 2005a, 2005b; Wageman and Baker 1997). No direct information on these aspects of performance pay is available in the SOEP. However, there is an indirect question asking whether the employees received any profit-sharing, premiums, or bonuses as extra pay from their employers. I use this variable as a proxy for collective performance pay and rerun the initial estimates by additionally including this variable.⁸ Table A7 presents the results. While the initial measure of individual performance pay remains unchanged and continues to take a significantly positive coefficient of 0.055, the proxy for collective performance pay takes a smaller positive but insignificant coefficient of 0.025. This finding supports the theoretical expectations that the two facets of collective performance pay—cooperation and stress/peer pressure—work in opposite directions.

Finally, while the analysis included a comprehensive set of control variables that influence loneliness and sorting into performance pay, employer characteristics may not be sufficiently accounted for. This is a potential limitation shared with other economic studies using survey data (e.g., SOEP). Thus, I also experimented with alternative specifications that included additional controls for employer characteristics in the treatment effects regression. I included three dummies for the firm size. These dummies neither emerged as statistically significant nor did their inclusion change the key results. Additionally, I also controlled for the presence of a works council. This variable also emerged as an insignificant determinant of loneliness, and its inclusion did not change the key results.⁹ These findings suggest that the IV strategy may already capture unobserved characteristics in a sufficiently comprehensive way.

5 | Discussion and Conclusions

Performance pay aligns the interests of employers with those of the employees by improving profits and earnings. However, performance pay can also entail negative consequences that affect

employees, employers, and society as a whole. These negative consequences can be particularly crucial when they affect factors that are external to employment relations, such as families, social circles, and civil societies. Thus, performance pay may cause such externalities if it leads to an increased risk of worker loneliness.

I used German survey data to investigate the association between performance pay and loneliness. The key findings showed that performance pay increases the risk of loneliness significantly and reduces social life satisfaction. IV estimations addressing the potential endogeneity of performance pay supported these findings with even larger magnitudes. Interestingly, work hours, earnings, conflict with coworkers, and conflict with the partner emerged as important transmission channels.

This study was motivated by the extensive findings that performance pay has unintended costs for workers' physical and mental well-being. The association between performance pay and workers' social well-being was not previously studied. Thus, the finding that performance pay increases the risk of worker loneliness contributes an additional factor to be considered in any assessment of performance pay. As performance pay has spread among firms worldwide, especially in the United States and Europe, mitigating the loneliness level of workers receiving performance pay becomes crucial for employers, organizations, and policymakers.

Of course, at issues is what kind of interventions may help mitigate the loneliness level of such workers. To diminish the loneliness level of employees receiving performance pay, interventions by managers and organizations, for instance, may play an important role (Knight et al. 2022; Sullivan and Bendell 2023). On the one hand, managers and organizations may encourage socializing in the office and set up peer buddy systems (e.g., mentorship opportunities) for those receiving performance pay. This would help workers receiving performance pay cultivate meaningful bonds among colleagues and coworkers, which in turn would diminish their loneliness level. On the other hand, managers and organizations may also provide better job autonomy to those receiving performance pay. This would not only allow workers receiving performance pay to align their workplace activities with those of their colleagues, but also allow them to align their free time with those of their families and friends outside the workplace. Thus, resulting in a lower risk of loneliness. Future research may empirically investigate whether these interventions could be beneficial in reducing the loneliness level of those receiving performance pay.

Thus, the finding that performance pay increases the risk of loneliness has several implications. First, intervention programs may be organized to reduce the loneliness level of workers receiving performance pay. This is crucial not only for the employees, but also for the employer and the economy as a whole. Second, as the costs of loneliness are not fully borne by firms, public intervention to monitor the performance pay intensity may be warranted. Third, documenting the link between performance pay and loneliness not only sheds light on the mechanisms through which performance pay deteriorates health and well-being, but it also emphasizes that economists should pay more attention to the unexplored dimensions of worker loneliness.

Finally, I propose avenues for future research. While loneliness remains an issue globally, the degree of loneliness varies by country (European Commission 2023; Ipsos 2021). Thus, studying the association between performance pay and loneliness for different countries with different degrees of loneliness stands as crucial future research. Furthermore, while the present study used a broad indicator of individual performance-related pay and a proxy for collective performance pay, future studies may distinguish between different types of performance pay in detail (e.g., piece rates, commissions, individual-based performance pay, team-based performance pay, organizational-based performance pay). Lastly, as the SOEP has limited information on employer characteristics, future studies may fruitfully examine the association between different types of performance pay and loneliness using linked employer-employee datasets.

Acknowledgments

The author thanks the Editor, Benno Torgler, one anonymous reviewer, Uwe Jirjahn, Anthony Lepinteur, Jens Mohrenweiser, Milena Nikolova, conference and seminar participants at the American Economic Association (2025), Royal Economic Society (2025), Warsaw International Economic Meeting (2025), International Society for Quality-of-Life Studies (2025), European Health Economics Association (2024), Colloquium on Personnel Economics (2024), Global Labor Organization (GLO) Virtual Young Scholars Program (2024), International German Socio-Economic Panel User Conference (2024), and Young Economists' Meeting (2024) for valuable comments and feedback. Open Access funding enabled and organized by Projekt DEAL.

Conflicts of Interest

The author declares no conflicts of interest.

Data Availability Statement

The data of the SOEP are publicly available at the German Institute for Economic Research (DIW Berlin), Mohrenstraße 58, 10117 Berlin, Germany (<https://www.diw.de/en/soep>).

Endnotes

¹ It has been shown that performance pay raises the performance of the firm by attracting highly talented workers and fostering increased worker effort (Bandiera et al. 2005; Banker et al. 1996; Cadsby et al. 2007; Dohmen and Falk 2011; Gielen et al. 2010; Heywood et al. 2011; Jirjahn 2016; Lazear 2000; Paarsch and Shearer 2000; Shaw 2015; Shearer 2004). Abundant evidence also exists on the link between performance pay and increased wages (Baktash forthcoming; Booth and Frank 1999; Green and Heywood 2016; Heywood and Parent 2012; Jirjahn and Stephan 2004; Jirjahn and Mohrenweiser forthcoming; Parent 1999; Pekkarinen and Ridell 2008; Seiler 1984).

² According to the Google Trends data, the Google worldwide search for the following statements has been risen dramatically in the last 20 years and reached its peak level in the recent years: (1) "Where to meet people," (2) "How to make friends," and (3) "Where to make friends" (see Google Trends, <http://www.google.com/trends>).

³ This idea goes back to Adam Smith (1776) who argued that piece rates incentivize workers to "ruin their health."

⁴ This is in line with other studies using German data.

⁵ These tests are performed using the *regensitivity* command in Stata (Diegert et al. 2025).

⁶ There exists empirical evidence on the positive association between attractiveness and receiving better performance evaluations as well as earning higher amount of performance pay (Ahmed et al. 2023; Hosoda et al. 2003; Tu et al. 2022). This implies a higher incentive of sorting into performance pay jobs for more attractive individuals. At the same time, there exists several studies showing a negative association between attractiveness and loneliness (see D'Alessandro 2023; Feingold 1992; Jones et al. 1981; Lamm and Stephan 1987; Reis et al. 1982; Stephan et al. 1988; Zakahi and Duran 1988).

⁷ There exists a positive association between physical exercise or sports and sorting into jobs with performance pay (Zhang et al. 2016). At the same time, there is a negative association between healthy lifestyle and loneliness (Richard et al. 2017).

⁸ Note that this variable may also capture any other kinds of non-performance related bonuses and premiums.

⁹ The results are available from the author upon request.

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Appendix

TABLE A1 | Definitions and descriptive statistics of control variables.

Variable	Definition	Mean	Std. dev.
Age	The worker's age by years ranging from 18 to 67.	45.08	10.35
Female worker	Dummy equals 1 if the worker is a woman.	0.50	0.50
Education	The worker's years of education ranging from 7 to 18 years.	12.94	2.75
Married	Dummy equals 1 if the worker is married or has stable partner.	0.85	0.35
German	Dummy equals 1 if the worker has a German citizenship.	0.91	0.28
Children in HH	Dummy equals 1 if there are children under 16 years in the household.	0.45	0.50
Size of HH	The number of persons in the household.	2.93	1.30
Fit dwelling	Dummy equals 1 if the worker thinks that the total size of their dwelling is just right for their household.	0.70	0.46
Living space	The dwelling's total living space in m ² .	111.33	45.57
Bereaved	Dummy equals 1 if the worker's partner/spouse, father, mother, child or a household member died recently.	0.03	0.17
Work experience	The worker's total length of full-time and part-time employment experience in years.	20.86	10.90
Unemployment experience	The worker's total length of unemployment experience in years.	0.68	1.79
Public sector	Dummy equals 1 if the worker is employed in the public sector.	0.28	0.45
Tenure	The number of years the worker is with their current firm.	12.01	10.53
Permanent	Dummy equals 1 if the worker holds a permanent job contract.	0.90	0.30
Part time	Dummy equals 1 if the worker is employed part-time.	0.28	0.45
Job insecurity	Dummy equals 1 if the worker is somewhat concerned or very concerned about his or her job security.	0.39	0.49
Financial insecurity	Dummy equals 1 if the worker is somewhat concerned or very concerned about his or her own economic situation.	0.63	0.48
Sister	Dummy equals 1 if the worker has sister.	0.57	0.50
Brother	Dummy equals 1 if the worker has brother.	0.57	0.50
Mother	Dummy equals 1 if the worker has mother.	0.74	0.44
Father	Dummy equals 1 if the worker has father.	0.55	0.50
Number of close friends	The total number of close friends the worker has.	4.09	3.47
Risk tolerance	Score of risk tolerance. The interviewee answers the question: "Are you generally willing to take risks or do you try to avoid taking risks?" on an 11-point Likert scale. The scale ranges from 0 (<i>not at all willing to take risks</i>) to 10 (<i>very willing to take risks</i>).	4.90	2.22
Conscientiousness	Score of conscientiousness constructed from adding up three survey items measured on a seven-point Likert scale ranging from 1 (<i>does not apply to me at all</i>) to 7 (<i>applies to me perfectly</i>). The sum of items is divided by 3. The items are: I see myself as someone who ... "does a thorough job," "does things effectively and efficiently," "tends to be lazy." The last item was recoded in inverse order before adding up.	5.84	0.86
Extraversion	Score of extraversion constructed from adding up three survey items measured on a 7-point Likert scale ranging from 1 (<i>does not apply to me at all</i>) to 7 (<i>applies to me perfectly</i>). The sum of items is divided by 3. The items are: I see myself as someone who ... "is communicative," "is sociable," "is reserved." The last item was recoded in inverse order before adding up.	4.87	1.14
Agreeableness	Score of agreeableness constructed from adding up three survey items measured on a 7-point Likert scale ranging from 1 (<i>does not apply to me at all</i>) to 7 (<i>applies to me perfectly</i>). The sum of items is divided by 3. The items are: I see myself as someone who ... "is sometimes somewhat rude to others," "has a forgiving nature," "is considerate and kind to others." The first item was recoded in inverse order before adding up.	5.32	0.94

(Continues)

TABLE A1 | (Continued)

Variable	Definition	Mean	Std. dev.
Openness	Score of openness constructed from adding up three survey items measured on a 7-point Likert scale ranging from 1 (<i>does not apply to me at all</i>) to 7 (<i>applies to me perfectly</i>). The sum of items is divided by 3. The items are: I see myself as someone who ... “is original,” values artistic experiences,” “has an active imagination.”	4.57	1.14
Neuroticism	Score of neuroticism constructed from adding up three survey items measured on a seven-point Likert scale ranging from 1 (<i>does not apply to me at all</i>) to 7 (<i>applies to me perfectly</i>). The sum of items is divided by 3. The items are: I see myself as someone who ... “worries a lot,” “gets nervous easily,” “deals well with stress.” The last item was recoded in inverse order before adding up.	3.69	1.20
Locus of control	Score of locus of control constructed from adding up eight items measured on a 7-point Likert scale ranging from 1 (<i>disagree completely</i>) to 7 (<i>agree completely</i>). The sum of items is divided by 8. The items are “How my life takes course is dependent on me,” “Success is gained through hard work,” “Compared to others, I have not achieved what I deserve,” “What one achieves in life is, in the first instance, a question of destiny or luck,” “I often experience that others have a controlling influence over my life,” “When I encounter difficulties in my life, I often doubt my own abilities,” “The opportunities that I have in life are determined by the social conditions,” and “I have little control over things that happen in my life.” Items 4–8 are recoded in inverse order before adding up.	4.97	0.79
State dummies	Fifteen federal state dummies for Hamburg, Lower Saxony, Bremen, North Rhine-Westphalia, Hesse, Rhineland-Palatinate, Baden-Württemberg, Bavaria, Saarland, Berlin, Brandenburg, Mecklenburg-West Pomerania, Saxony, Saxony-Anhalt and Thuringia (reference federal state: Schleswig-Holstein).		
Industry dummies	Six broad industry dummies for manufacturing, construction, trade, transport, banking/insurance and services (reference group: agriculture, energy and mining).		
Occupation dummies	Ten broad two-digit occupation dummies for skilled blue-collar, blue-collar foreman/forewoman, blue- and white-collar master craftsman, semi-skilled white-collar, skilled white-collar, highly skilled white-collar, white-collar with extensive managerial duties, middle-level civil servant, upper-level civil servant and executive-level civil servant (reference group: unskilled blue-collar, semi-skilled blue-collar, unskilled-white-collar and lower-level civil servant).		
Year dummy	One dummy for the year 2016 (reference year: 2011).		

Note: Number of observations = 13,143.

TABLE A2 | Alternative measures: Dimensions of loneliness.

	(1)	(2)	(3)	(4)	(5)	(6)
	Treatment effects; ML	Ordered probit IV	Treatment effects; ML	Ordered probit IV	Treatment effects; ML	Ordered probit IV
	<i>Lack companionship</i>		<i>Feel isolated</i>		<i>Feel left out</i>	
Performance pay	0.144 (0.053)***	0.404 (0.157)**	0.038 (0.094)	0.059 (0.118)	0.127 (0.054)**	0.341 (0.152)**
	<i>Performance pay</i>					
Performance pay share by occupation	1.655 (0.083)***	1.652 (0.084)***	1.653 (0.086)***	1.655 (0.084)***	1.653 (0.084)***	1.651 (0.084)***
ρ	-0.155 (0.065)**	-0.211 (0.095)**	-0.042 (0.114)	-0.030 (0.070)	-0.122 (0.065)*	-0.164 (0.092)*
Number of observations	13,117	13,117	13,117	13,117	13,117	13,117
Number of employees	10,653	10,653	10,653	10,653	10,653	10,653

Note: The table shows estimated coefficients. Standard errors in parentheses are clustered at the individual level. Control variables are included but suppressed to save space.

* Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

TABLE A3 | Alternative measures: Number of types of loneliness.

	(1)	(2)
	Treatment effects; ML	Poisson IV
<i>Number of types of loneliness</i>		
Performance pay	0.204 (0.082)**	0.134 (0.098)**
<i>Performance pay</i>		
Performance pay share by occupation	1.654 (0.083)**	0.560 (0.027)**
ρ	-0.105 (0.050)**	—
First-stage residual	—	-0.115 (0.064)*
Number of observations	13,117	13,117
Number of employees	10,653	10,653

Note: The table shows estimated coefficients. Standard errors in parentheses are clustered at the individual level. Control variables are included but suppressed to save space.

*Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

TABLE A4 | Alternative measures: Social life satisfaction.

	(1)	(2)
	Treatment effects; ML	Ordered probit IV
<i>Social life satisfaction</i>		
Performance pay	-2.186 (0.090)**	-0.520 (0.136)**
<i>Performance pay</i>		
Performance pay share by occupation	1.184 (0.084)**	1.624 (0.089)**
ρ	0.714 (0.023)**	0.281 (0.082)**
Number of observations	13,085	13,085
Number of employees	10,632	10,632

Note: The table shows estimated coefficients. Standard errors in parentheses are clustered at the individual level. Control variables are included but suppressed to save space.

*Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

TABLE A5 | Robustness check: Excluding switchers.

	(1)	(2)
	Treatment effects; ML	Ordered probit IV
<i>Loneliness</i>		
Performance pay	0.452 (0.172)**	0.365 (0.131)**
<i>Performance pay</i>		
Performance pay share by occupation	1.636 (0.091)**	1.644 (0.088)**
ρ	-0.209 (0.090)**	-0.191 (0.080)**
Number of observations	12,435	12,435
Number of employees	10,212	10,212

Note: The table shows estimated coefficients. Standard errors in parentheses are clustered at the individual level. Control variables are included but suppressed to save space.

*Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

TABLE A6 | Robustness check: Performance pay intensity.

	(1)	(2)	(3)
	2SLS	RE IV	Ordered probit IV
<i>Loneliness</i>			
Performance pay intensity	0.116 (0.058)**	0.111 (0.059)*	0.063 (0.037)*
<i>Performance pay intensity</i>			
Performance pay share by occupation	1.176 (0.065)**	1.161 (0.064)**	1.422 (0.073)**
ρ	—	—	-0.058 (0.048)
Number of observations	13,117	13,117	13,117
Number of employees	10,653	10,653	10,653

Note: The table shows estimated coefficients. Standard errors in parentheses are clustered at the individual level. Control variables are included but suppressed to save space.

*Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

TABLE A7 | Determinants of loneliness: Individual vs. collective performance pay.

	(1)	(2)	(3)	(4)
	OLS	RE	Ordered probit	RE ordered probit
Performance pay	0.055 (0.025)**	0.050 (0.024)**	0.049 (0.023)**	0.062 (0.030)**
Collective performance pay	0.025 (0.030)	0.023 (0.029)	0.020 (0.027)	0.023 (0.036)
R^2 /pseudo R^2	0.192	0.191	0.067	0.067
Number of observations	13,047	13,047	13,047	13,047
Number of employees	10,604	10,604	10,604	10,604

Note: The table shows estimated coefficients. Standard errors in parentheses are clustered at the individual level. Control variables are included, but suppressed to save space. Control variables are included but suppressed to save space.

*Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.