



Wage Structures, Fairness Perceptions, and Job Satisfaction: Evidence from Linked Employer-Employee Data

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Abstract

The paper investigates the impact of firms' wage structures and workers' wage fairness perceptions on workers' well-being. For this purpose, worker and establishment surveys are linked with administrative social security data. Four variables are generated, using approximately half a million worker-year observations, that describe firms' wage structures and workers' positions within the wage structures: own absolute wages, internal reference wages within firms, external reference wages, and the wage dispersion in firms. The interrelations between these wage structure variables, workers' perceived wage fairness, and job satisfaction are then analyzed using regressions. Interpersonal wage comparisons between co-workers in the same firm and across firms as well as wage fairness perceptions are found to be significant determinants of workers' well-being. The overall findings suggest that equity and social status considerations as well as altruistic preferences towards co-workers and inequality aversion are more important than signal considerations in this context.

Keywords Fairness · Income Comparison · Inequality · Job Satisfaction · Worker Well-Being

JEL codes D63 · J28 · J31

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1 Introduction

Research and public discussion about income structures traditionally account for means or percentiles as well as for variances of the income distribution, which is plausible from a macro perspective (Lazear & Shaw, 2009). From a micro perspective relative income is also important, because individuals are placed in the income distribution and are not impartial spectators, which stresses the importance of interpersonal comparisons (Clark et al., 2008). Higher income of others can, for example, reduce own well-being due to a loss in relative standing (social status). In such a case, an income increase for one person can result in negative externalities for another person (Luttmer, 2005). But consequences of unequal income distributions and interpersonal comparisons are not only important from a general welfare perspective. They also lead to questions about the perceptions of firms' wage structures by workers and their effects on workers' job satisfaction. However, relatively few studies analyze the effects of wage structures of firms, because administrative linked employer-employee data are necessary that include wage information about all workers and their characteristics to compute conditional wage structure variables. Even fewer studies look at the nexus between wage structures, fairness perceptions, and job satisfaction, because linked employer-employee data need to be supplemented with worker surveys.

In this paper, we use data for Germany that allow us to link worker and establishment surveys with administrative social security data for all workers in the surveyed establishments. From these data, we can generate four wage structure variables which also account for interpersonal comparisons and inequality at the workplace: workers' own absolute wages, workers' conditional internal reference wages within firms, workers' conditional external reference wages across firms, and the conditional wage dispersion within each firm. First, we are interested in the impact of these wage structure variables on workers' perceived wage fairness as an important organizational justice variable. Second, we are interested in the impact of the wage structure variables and workers' perceived wage fairness on workers' job satisfaction as a common proxy for utility or well-being.

The remainder of the paper is organized as follows. In the next section, we discuss related literature and theoretical considerations. It follows a section with information about the data, variables, and estimation approach. We then report and discuss our estimation results. The paper concludes with a short summary and discussion of the main findings.

2 Theoretical Background and Related Literature

Firms' wage structures (e.g., Lazear and Shaw, 2009) and organizational justice (e.g., Colquitt et al., 2001; Colquitt, 2012) are likely to affect workers' well-being, attitudes, and behavior, which have consequences for firms' performance. The standard economic framework traditionally only accounted for a person's own income and not for her relative income within a group (e.g., Clark and Oswald, 1996; Luttmer, 2005; Clark et al., 2008), i.e., in our context, only for the worker's own absolute wage and not for co-workers' wages. The development of principal-agency theory and personnel economics has then emphasized that it is also important how hierarchy and pay are structured within firms in order to set incentives (e.g., performance pay, deferred compensation, tournament theory, efficiency wages). Inspired by research from psychology and sociology, economics has further included

relative wages and wage compression in a modern behavioral economic framework (e.g., Clark et al., 2009; Clark and D'Ambrosio, 2015). This modern framework incorporates, for example, considerations about equity, relative deprivation, aspiration levels, status, signals, altruism, and inequality aversion. In order to illustrate the underlying and sometimes counteracting mechanisms of these theoretical considerations, we use a simple utility framework.¹ Afterwards, we discuss the effects of wage structures on workers' fairness perceptions and job satisfaction. We consider four variables that describe the wage structure and affect a worker's utility level: the worker's own absolute wage, the worker's internal reference wage within the firm, the worker's external reference wage across firms, and the wage dispersion in the worker's firm.

As the worker generates consumption from her own absolute wage, it is positively related to utility. In terms of equity theory (Adams, 1965), which is concerned with a fair relation between outcome and input compared to some reference level, a higher own absolute wage can be interpreted as a higher outcome. Equity theory leads us directly to the importance of relative wages within the firm, as a worker compares her wages (and inputs) with co-workers' wages (and inputs), which serve as reference levels. Such reference levels can also be interpreted as aspiration levels, which a worker wants to achieve and compares herself with (Stutzer, 2004). Relative deprivation theory predicts that a negative deviation of the current own wage from the current aspiration level reduces utility, even if the own wage does not change. Higher wages of peers might further indicate lower own social status within the firm (Frank, 1984a, b; Clark et al., 2009), as the own relative standing is lower if co-workers earn more. Thus, in a *ceteris paribus* perspective, i.e., holding the own absolute wage constant, a higher reference wage within the firm should decrease utility, because it indicates higher relative outcomes for peers, higher relative depreciation from aspiration levels, and lower status. However, a counteracting "tunnel" effect exists, because a higher internal reference wage might signal higher own future income (Hirschman & Rothschild, 1973; Clark et al., 2009), i.e., the reference wage serves as a future and not as the current aspiration level and provides information about future prospects in the firm. In such a long-term career perspective, a higher reference wage might be positively valued and increase utility. Another counteracting effect might be that a worker has altruistic preferences and, therefore, higher wages and utility levels of co-workers also increase the own utility level.

If we leave the within firm perspective and consider workers' external reference wages across firms, higher external reference wages are likely to decrease utility. From an equity perspective, better outcomes for comparable workers in other firms might be interpreted as an unfair wage setting by the own firm and such a fairness violation might decrease utility. Moreover, a worker's social status in the society – and not just in the own firm – is lower, if comparable workers in other firms earn more. Unlike the internal reference wage within the own firm, the external reference wage does not signal better future prospects in the same firm, because the worker would need to switch to a higher paying firm. Thus, we should not expect a counteracting signal effect. Altruistic preferences are also more likely to be prevalent for the internal reference wage than for the external reference wage, i.e., for known co-workers than for unknown workers in other firms. Finally, we consider more or less compressed wage structures. A higher wage dispersion indicates a higher degree of

¹ Note that we do not aim to present a consistent economic model or unified theory in this section. We only use the reference to the utility concept, which reflect workers' well-being or job satisfaction, in order to provide a structured overview of the different theoretical arguments.

wage inequality in a firm, which might reduce a worker's utility if she has preferences for equality (inequality aversion) (Clark & D'Ambrosio, 2015).

These expected effects of our four wage structure variables on workers' utility and the underlying theories are the basis for a further discussion of the correlations between firms' wage structures, workers' fairness perceptions, and job satisfaction. First, we are interested in the nexus between the wage structure variables and perceived fairness of own rewards in the firm, which we label, for simplicity, perceived wage fairness and which is related to workers' preferences. If we take perceived wage fairness literally, status and signal considerations should be less important than explicit justice considerations such as equity theory, altruistic preferences, and inequality aversion. However, in the context of equity theory, status might be considered as a current outcome and signals as potential future outcomes, which might be taken into account by workers in addition to their current own wage when making fairness judgements about their wages. Second, we are interested in the nexus between the wage structure variables, perceived wage fairness, and workers' job satisfaction. As job satisfaction is a proxy for utility from work, the above theoretical considerations for utility are the same for job satisfaction. If we additionally condition job satisfaction on perceived wage fairness, we would expect that part of the wage structure effects is absorbed (mediated) by perceived wage fairness, which should be positively correlated with job satisfaction. Note again that if we take perceived wage fairness literally, controlling for wage fairness should rather absorb explicit justice considerations than status and signal considerations.

Previous studies using survey data without information about co-workers within the same firm and consequently without internal wage structure variables have reported that unfair perceived wages, the gap between fair and actual wages, and external reference wages are negatively correlated with job satisfaction (e.g., Clark and Oswald, 1996; Kersting and Pfeifer, 2013; D'Ambrosio et al., 2018). But to study properly the consequences of firms' wage structures, linked employer-employee data are required. Clark et al. (2009) match the Danish sample of the European Community Household Panel (ECHP) with administrative data and find that, holding the own wage constant, the average wage in an establishment is positively correlated with job satisfaction, whereas the average wage of workers in the same occupation and establishment is negatively correlated with job satisfaction. Brown et al. (2008) report for the UK Workplace Employee Relations Surveys positive correlations of the mean wage and the wage rank within the firm with pay satisfaction. Godechot and Senik (2015) match a worker survey with administrative data for France and use different reference wage variables. Even though all internal reference wage variables are positively correlated with wage satisfaction, only the median wage and the 75th percentile wage in the entire firm or establishment are statistically significant. The ordinal wage rank, median and average internal reference wages for comparable co-workers in the same occupation and age group are not statistically significant, if analyzed separately. But if jointly analyzed in one regression, wage satisfaction is significantly larger for higher wage ranks, higher median wages, lower regional reference wages, and lower top earnings. Card et al. (2012) find in a field experiment with an information treatment among employees of the University of California that workers, who know they earn lower relative wages, have significantly lower job and pay satisfaction and, in turn, a higher probability to search for a new job.

To sum up, previous studies using linked employer-employee data (Brown et al., 2008; Clark et al., 2009; Godechot & Senik, 2015) have mainly found that internal reference wages are on average positively correlated with pay and job satisfaction, from which one

might conclude that the signal effect (higher reference wage indicates better future career prospects) dominates the status effect (higher reference wage indicates lower own status) or that workers have strong altruistic preferences towards co-workers. But none of these studies has taken into account workers' perceived wage fairness, which we analyze as mediator variable. Moreover, previous studies have in common that they accounted for more or less unconditional reference wages (e.g., average, median, 75th percentile) in the entire firm, whereas we use more narrowly defined reference wages conditional on education, occupation, and age. The importance of conditional reference wages of comparable co-workers within the same firm is illustrated by Clark et al. (2009), who report for job satisfaction a positive correlation with the average wage in the entire firm and a negative correlation with the average wage of workers in the same occupation in the same firm. Thus, for more comparable workers the status effect seems to dominate the signal effect, and not vice versa as it is the case for the average wage in the entire firm.

3 Data, Variables, and Estimation Approach

3.1 Data Set and Data Preparations

We use the Linked Personnel Panel (LPP) merged with the social security records of all employees working in the LPP firms in Germany (Kampkoetter et al., 2016; Mackeben et al., 2021). The LPP consists of questionnaires for the employer and a questionnaire for the employees. The employee questionnaire asks about job characteristics, attitudes, personality, and socio-demographic background. The employer questionnaire, answered by the owner or top managers of the establishment, entail questions about HRM practices and general firm policies. Note that the LPP asks additional questions to a subsample of the IAB Establishment Panel firms, a representative annual survey of German establishments (Fischer et al., 2009). The LPP establishment survey focuses more on HR policies, while the IAB Establishment Panel focuses more on general management and employment structure issues. Hence, the data entail the IAB Establishment Panel survey and the LPP survey for employers.

The LPP is a representative sample of private sector establishments with 50 or more employees in manufacturing and service industries. The establishment sample is stratified according to four establishment size classes (50–99, 100–249, 250–499, and 500 and more employees), five industries (metalworking and electronic industries, further manufacturing industries, retail and transport, services for firms, and information and communication services) and four regions (North, East, South, and West). The sampling of employees was conditioned on all employees working in the participating establishments on December 30th in the preceding year. Employees were randomly drawn and contacted via telephone interview. Hence, the stratification of the data is at the establishment-level not at the employee-level. We use the waves 2012 and 2014 consisting of 10,175 individuals nested in 869 establishment, who gave consent to merge the required data.

The analysis is based on the individual level (LPP employee survey) pooled cross-section data augmented with establishment level characteristics (LPP establishment survey/ IAB Establishment Panel survey) and wage structure variables (social security records). We dropped individuals from our estimation sample with reported earnings below and above

the social security thresholds (€400 and €5600 per month in 2012), because we do not have precise wage information for them. As the social security records only include daily wage information, we only consider full-time employees in our estimation sample. Moreover, we exclude observations with no comparable co-workers in the same occupation and establishment cell as well as with item non-responses in variables used, which leaves us with 8,483 worker-year observations nested in 867 establishments for the analysis.

3.2 Workers' Perceived Wage Fairness and Job Satisfaction

Our two dependent variables of interest stem from the LPP employee survey. Workers' perceived wage fairness (*WFAIR*) relates to the question: "I believe that I am being rewarded fairly at work", answered on a five-point ordinal scale ranging from 1 to 5 (1: "does not apply at all", 2: "does rather not apply", 3: "neutral", 4: "largely applies", 5: "fully applies"). Higher values indicate that the individual regards the rewards at work as fairer. The variable focusses on the individual perception of fair rewards at work and originates from the distributional fairness scale developed by Kim and Leung (2007). Table 1 shows that the mean perceived wage fairness is 3.5 measured on a five-point scale from 1 to 5. In more detail, about 7% of the surveyed workers give the lowest fairness rating ("does not apply at all"), 14% give a low fairness rating ("does rather not apply"), 19% give a neutral rating, 41% give a high fairness rating ("largely applies"), and 19% give the highest fairness rating ("totally applies"). Even though our five-point scale fairness rating is not directly comparable to binary fairness judgements in other data sets, workers seem on average to perceive their rewards as rather fair. For example, D'Ambrosio et al. (2018) report for the German Socio-Economic Panel that about one-third of the workers in their sample perceives their wages as unfair, whereas in our sample only 21% give low fairness ratings and additional 19% give a neutral rating.

Workers' job satisfaction (*JSAT*) relates to the question: "How satisfied are you today with your job? Please answer on a scale from 0 to 10, where 0 means "totally unhappy" and 10 means "totally happy"." Thus, a higher value represents a higher job satisfaction level. Table 1 shows that mean job satisfaction is relatively high with 7.6 measured on an eleven-

Table 1 Definitions, descriptive statistics, and correlations for variables of interest

Variable	Definition	Mean	Std. dev.	<i>JSAT</i>	<i>WFAIR</i>	<i>WABS</i>	<i>WREF</i>	<i>WEXT</i>
<i>JSAT</i>	Job Satisfaction (0: low; 10: high)	7.555	1.706	1				
<i>WFAIR</i>	Perceived fairness of rewards (1: low; 5: high)	3.525	1.143	0.323	1			
<i>WABS</i>	Log own daily wage	4.709	0.410	0.135	0.412	1		
<i>WREF</i>	Predicted log daily reference wage in firm	4.695	0.370	0.114	0.400	0.904	1	
<i>WEXT</i>	Predicted log daily reference wage outside firm	4.775	0.279	0.048	0.243	0.635	0.702	1
<i>WSER</i>	Wage dispersion in firm (standard error of regression)	0.192	0.056	-0.018	-0.088	-0.140	-0.167	0.087

Notes: 8483 worker-year observations in 867 establishments. All correlation coefficients are statistically significant different from zero at $p < 0.01$. Descriptive statistics for all variables are presented in Appendix Table A.1.

point Likert scale from 0 to 10. Mean job satisfaction and the distribution of job satisfaction is comparable between the LPP and the German Socio-Economic Panel (Kampkoetter et al., 2016). Table 1 further indicates that workers' perceived wage fairness and job satisfaction are significantly positively correlated with each other.

3.3 Wage Structure Variables

We regress the two dependent variables (wage fairness and job satisfaction) on four wage structure variables, which we generate from social security records of all (not only the surveyed) full-time employees working in a LPP establishment on June 30th in 2012 and 2014: the worker's own absolute wage (*WABS*), the worker's conditional internal reference wage within the firm (*WREF*), the worker's conditional external reference wage across firms (*WEXT*), and the conditional wage dispersion in the worker's firm (*WSER*). Note that it does not matter for the estimated coefficients and standard errors of the reference wage variables, if we regress the dependent variables on the internal and external reference wages or on their gaps to the own absolute wage. Because we control for the absolute own wage in the regressions, the absolute reference wages reflect the gaps to the absolute own wage in a *ceteris paribus* perspective. For example, a one unit increase of the absolute reference wage increases the gap by one unit, holding the absolute own wage constant. Formally, we estimate Eq. (1) and Eq. (2) would be the specification with gaps, which result in the same coefficients *b* and *c* for the reference wage variables.

$$Y = a * WABS + b * WREF + c * WEXT + d * WSER \quad (1)$$

$$\begin{aligned} Y &= a * WABS + b * (WREF - WABS) + c * (WEXT - WABS) + d * WSER \\ &= (a - b - c) * WABS + b * WREF + c * WEXT + d * WSER \end{aligned} \quad (2)$$

The worker's own absolute wage (*WABS*) is simply the log of individual nominal gross earnings per day. As the average wage in a complete establishment is a very broad comparison income for workers with different characteristics and productivity levels, we predict a worker's reference wage within the firm (*WREF*) based on the results of Mincer type earnings regressions estimated separately for each establishment and year. The regressions explain log daily earnings of full-time employees with individual schooling level (three categories), quadratic age function and dummies for one-digit occupation codes. The predicted internal reference wage within the firm is consequently the average wage in each cell of the considered explanatory variables. We use the same approach to generate the worker's conditional external reference wage across firms (*WEXT*) by predictions from a Mincer type earnings regression for all workers across all firms in the sample instead of separate regressions for each establishment. Our approach to estimate reference wages closely follows Clark and Oswald (1996), who included predicted wages conditional on schooling, occupation, sector, region, and other variables from their entire sample in satisfaction equations. Note that we use Tobit models for all earnings regressions, because the earnings in the social security data are bottom and top coded at the social security thresholds. In total, we use approximately half a million worker-year observations from administrative social security data to predict internal and external reference wages.

The wage dispersion in a firm (*WSER*) can also be generated from the social security records. The simplest approach would be to use the standard deviation of workers' daily wages in a given establishment, which would measure the unconditional wage dispersion. This unconditional wage dispersion has however the disadvantage that it does not account for differences in worker characteristics such as qualifications and occupations, which affect productivity and wage classifications. Therefore, we generate a conditional wage dispersion measure following the approach of Winter-Ebmer and Zweimüller (1999), who analyzed the effect of intra-firm wage dispersion on establishment performance. This approach has been widely used with linked employer-employee data in order to study the effects of wage inequality on firm performance measures such as productivity and profits (Mahy et al., 2011) as well as the effects of wage compression on cost coverage of training (Pfeifer, 2016). Based on the results from the above Mincer type earnings regressions for each establishment and year, the standard error of the Tobit regression is generated. The standard error of the regression in an establishment can be interpreted as the standard deviation of workers' individual error terms in an estimated earnings function for this establishment in a given year. A larger standard error of the regression indicates a larger conditional intra-firm wage dispersion and consequently larger wage inequality in an establishment.

Table 1 presents means, standard deviations, and correlations for our four wage structure variables. The own absolute daily wage (*WABS*) is on average 4.709 log points and the predicted reference daily wage within the firm (*WREF*) is on average 4.695 log points. *WABS* and *WREF* are strongly correlated ($r=0.904$), as the latter is a prediction from regressions for the former at the firm level. The predicted external reference daily wage across firms (*WEXT*) is on average 4.775 log points and positively correlated with *WABS* ($r=0.635$) and *WREF* ($r=0.702$). The wage dispersion in firms (*WSER*) is on average 0.192 with a standard deviation of 0.056, which are comparable in size with other studies using the same approach (e.g., Winter-Ebmer and Zweimüller, 1999; Mahy et al., 2011; Pfeifer, 2016). *WSER* is negatively correlated with *WABS* ($r=-0.140$), *WREF* ($r=-0.167$), and *WEXT* ($r=0.087$). Moreover, *WABS*, *WREF*, and *WEXT* are positively correlated with perceived wage fairness and job satisfaction, whereas *WSER* is negatively correlated with perceived wage fairness and job satisfaction. These are, however, only raw correlations and a more elaborated analysis follows using ordered probit regressions, in which the own absolute wage is held constant.

3.4 Control Variables

We control for differences in a wide range of socio-demographic characteristics (age, education, gender, having a partner, having kids, German citizenship), personality (Big Five, trust), individual employment and job characteristics (permanent contract, working hours, shift work, flexible working time, managerial responsibilities, out-of-hours demand, decision autonomy, task autonomy, interdependence with co-workers, physical loading), and establishment characteristics (works council, collective agreement, workforce composition, limited company, foreign-owned company, state-of-the-art technology, firm-size categories, sector and regional dummies) to capture confounding factors that are correlated with the wage structure variables, fairness perceptions, and job satisfaction. Thereby, we also extend previous studies by including the job level in the analysis, which is particularly relevant in analyzing fairness perceptions. The complete list of control variables and their descriptive statistics are displayed in the Appendix Table A.1.

3.5 Estimation Approach

Both dependent variables in our regression analysis are ordinally measured. Workers' perceived wage fairness (*WFAIR*) is measured on a five-point ordinal scale and job satisfaction (*JSAT*) is measured on an eleven-point ordinal scale. Therefore, we estimate pooled cross-section ordered probit regressions for the years 2012 and 2014 and calculate average marginal effects for a quantitative interpretation. Unfortunately, worker random or fixed effects models are not a feasible estimation strategy in our application to deal with individual unobserved heterogeneity, because more than 25% of workers are only observed once in the data. But at least the survey data allow us to include many control variables such as personality traits, job and firm characteristics. Moreover, reverse causality seems rather unlikely in our application with a logical link from wage structures to perceived wage fairness to job satisfaction. But if more satisfied workers would perform better, job satisfaction might increase job performance and, in turn, increase the own absolute wage. So, the interpretation of our estimated conditional correlations as causal effects should be made with caution. Because we use aggregated and predicted wage variables at the establishment level as regressors, we report robust standard errors clustered at the establishment level. Note, however, that such clustered standard errors are rather conservative, i.e., we might produce too low statistical significance levels.

We have performed several robustness checks not presented in the subsequent result section.² First, we have estimated additional specifications, in which we have excluded either the internal reference wage, the external reference wage or the firm's wage dispersion, because of potential multicollinearity problems. As the results do not change noteworthy, multicollinearity seems not to be problematic for the estimates of the wage structure variables. Second, we have estimated specifications without controlling for differences in personality traits and trust, as they might be affected by wage comparisons. But the results are quite robust to these changes. Third, we have repeated the regressions for subsamples (small vs. large firms, East vs. West, Men vs. Women) without finding noteworthy differences.

4 Regression Results

4.1 Workers' Perceived Wage Fairness

The ordered probit regression results for workers' perceived wage fairness (*WFAIR*) in Table 2 show that all estimated coefficients for the wage structure variables are statistically significant.³ On the one hand, workers with higher own absolute wages (*WABS*) and with higher internal reference wages within the firm (*WREF*), that is with higher paid peers, are on average significantly more likely to perceive their wages as fairer. On the other hand, workers with higher external reference wages across firms (*WEXT*) and workers in firms with higher wage dispersion (*WSER*) are on average significantly less likely to perceive

² The complete results can be requested from one of the authors.

³ Note that we only present and discuss the results for our variables of interest in the main text. The complete ordered probit regression results are displayed in the Appendix Table A.2. Further note that we estimate conditional correlations and not necessarily causal effects. The used term "effects" in our text and tables refers to marginal effects in order to quantitatively interpret the ordered probit results.

Table 2 Ordered probit regression results for perceived wage fairness (*WFAIR*)

	Coefficients	Average marginal effects on ordinal outcomes from 1 (“does not apply at all”) to 5 (“totally applies”) [frequency] ...				
		(p-values)	1 [6.6%]	2 [14.0%]	3 [18.9%]	4 [41.4%]
<i>WABS</i>	0.895*** (<0.01)	-0.095 [-194.7%]	-0.121 [-114.6%]	-0.082 [-53.1%]	0.081 [28.0%]	0.218 [138.4%]
<i>WREF</i>	0.485*** (<0.01)	-0.051 [-105.6%]	-0.066 [-62.1%]	-0.045 [-28.8%]	0.044 [15.2%]	0.118 [75.0%]
<i>WEXT</i>	-0.464*** (<0.01)	0.049 [101.0%]	0.063 [59.5%]	0.043 [27.6%]	-0.042 [-14.5%]	-0.113 [-71.8%]
<i>WSER</i>	-0.520* (0.08)	0.055 [113.1%]	0.071 [66.6%]	0.048 [30.9%]	-0.047 [-16.3%]	-0.126 [-80.4%]

Notes: 8483 worker-year observations in 867 establishments. Dependent variable is perceived wage fairness (*WFAIR*) rated on a five-point ordinal scale. Ordered probit regression includes all control variables. Descriptive statistics for all variables are displayed in [Appendix Table A.1](#) and the complete regression results in [Appendix Table A.2](#). We have computed robust standard errors clustered at the establishment level. Coefficients are statistically significant different from zero at * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$. Relative marginal effects (semi-elasticities) below the absolute marginal effects and frequency of each output variable category in brackets.

their wages as fairer. For a quantitative assessment, we have computed average marginal effects on the probability of each of the five ordinal outcomes. In addition to absolute marginal effects, we also present relative marginal effects, which are in principle semi-elasticities. For brevity reasons, we only give an example for the interpretation of the wage variables measured in log points and refer to the result tables for all marginal effects. A 0.1 log point (approximately 10%) higher own absolute wage is associated with a 0.95% point or 19.5% lower probability to give the lowest fairness rating and with a 2.18% point or 13.8% higher probability to give the highest fairness rating.⁴ Without going into further details, the marginal effects suggest that our four wage structure variables have a sizeable impact on perceived wage fairness.

Our results indicate that relative wages matter for fairness perceptions. In our *ceteris paribus* interpretation, the coefficient and marginal effects of the reference wage inside the firm (*WREF*) have about half the size of the own absolute wage (*WABS*). If we assume that explicit justice considerations such as equity, altruistic preferences, and inequality aversion are more important than status and signal considerations when making fairness judgements, we can draw the following conclusions. Because the internal reference wage is positively correlated with the perceived wage fairness, equity considerations (higher reference wages indicate higher relative outcome for comparable co-workers) seem to be less important than altruistic preferences (workers care for co-workers) when comparing wages with peers inside the same firm. Moreover, outside comparisons in form of equity considerations (higher reference wages indicate higher relative outcome for comparable workers in other firms) matter, because the external reference wage (*WEXT*) is negatively correlated with the perceived wage fairness. The opposing signs for external and internal reference wages indicate that altruistic preferences are more important in closer interpersonal relations, i.e., they

⁴ The estimated coefficients and marginal effects in [Table 2](#) refer to a one log point change of the wage variable, which would mean doubling the size of the wage (100% increase). For the quantitative interpretation, we have decided to use a more “marginal” interpretation with a 0.1 log point (i.e., 10%) increase of the wage.

are more directed to co-workers in the same firm than to unknown workers in other firms. Finally, the results support the notion of inequality aversion of workers, because wages are perceived as less fair if the firm’s wage dispersion is higher.

4.2 Workers’ Job Satisfaction

We estimate two specifications for workers’ perceived job satisfaction (*JSAT*) in Table 3, one without (upper part of the table) and one with perceived wage fairness (lower part of the table) as additional control variable and mediator. The first specification reveals that only the own absolute wage and the external reference wage are statistically significantly correlated with job satisfaction. A higher own absolute wage (*WABS*) is on average associated with higher job satisfaction and a higher external reference wage (*WEXT*) is on average associated with lower job satisfaction, which supports the view that outside comparisons matter due to equity (higher reference wages indicate higher relative outcome for comparable workers in other firms) and status considerations (higher reference wages indicate higher social status of comparable workers in other firms). The coefficients and marginal effects of the own wage and the external reference wage have approximately the same size but opposing signs, which is in line with the Easterlin Paradox and strong relative income concerns

Table 3 Ordered probit regression results for job satisfaction (*JSAT*)

	Coefficients (p-values)	Average marginal effects on ordinal outcomes from 0 (“totally unhappy”) to 10 (“totally happy”) [frequency] ...				
		0 [0.6%]	2 [0.7%]	5 [6.4%]	8 [38.2%]	10 [16.6%]
<i>WABS</i>	0.262*** (<0.01)	-0.004 [-81.4%]	-0.004 [-65.0%]	-0.020 [-39.6%]	0.013 [4.1%]	0.038 [51.0%]
<i>WREF</i>	-0.030 (0.76)	<0.001 [9.4%]	<0.001 [7.5%]	0.002 [4.6%]	-0.001 [-0.5%]	-0.004 [-5.9%]
<i>WEXT</i>	-0.353*** (<0.01)	0.005 [109.5%]	0.005 [87.5%]	0.027 [53.3%]	-0.017 [-5.6%]	-0.051 [-68.7%]
<i>WSER</i>	-0.225 (0.44)	0.003 [69.9%]	0.003 [55.8%]	0.017 [34.0%]	-0.011 [-3.6%]	-0.033 [-43.9%]
<i>WFAIR</i>	0.281*** (0.00)	-0.004 [-89.9%]	-0.004 [-72.3%]	-0.021 [-44.1%]	0.013 [4.6%]	0.039 [56.3%]
<i>WABS</i>	0.026 (0.73)	<0.001 [-8.5%]	<0.001 [-6.8%]	-0.002 [-4.2%]	0.001 [0.4%]	0.004 [5.3%]
<i>WREF</i>	-0.175* (0.07)	0.003 [55.9%]	0.002 [44.9%]	0.013 [27.4%]	-0.008 [-2.8%]	-0.025 [-34.9%]
<i>WEXT</i>	-0.238** (0.01)	0.004 [76.1%]	0.003 [61.2%]	0.018 [37.3%]	-0.011 [-3.9%]	-0.033 [-47.6%]
<i>WSER</i>	-0.117 (0.67)	0.002 [37.5%]	0.002 [30.2%]	0.009 [18.4%]	-0.005 [-1.9%]	-0.016 [-23.5%]

Notes: 8483 worker-year observations in 867 establishments. Dependent variable is perceived job satisfaction (*JSAT*) rated on an eleven-point ordinal scale. The first specification in the upper part of the table does not include perceived wage fairness (*WFAIR*), whereby the second specification in the lower part does. Ordered probit regressions include all control variables. Descriptive statistics for all variables are displayed in Appendix Table A.1 and the complete regression results in Appendix Table A.2. We have computed robust standard errors clustered at the establishment level. Coefficients are statistically significant different from zero at * p<0.10, ** p<0.05, and *** p<0.01. Relative marginal effects (semi-elasticities) below the absolute marginal effects and frequency of each output variable category in brackets.

in a society (Clark & Oswald, 1996; Clark et al., 2008). Internal reference wages (*WREF*) and wage dispersion (*WSER*) do not seem to be relevant in determining job satisfaction in this first specification. Note, however, that counteracting effects of internal reference wages might balance each other (e.g., altruism and signal vs. equity and status).

The picture changes once we include the perceived wage fairness (*WFAIR*) in the second specification, which is positively correlated with job satisfaction. More interestingly is the mediation role it plays, i.e., how strongly perceived wage fairness affects the correlations of the wage structure variables with job satisfaction. First, the own absolute wage (*WABS*) is not significant anymore after controlling for differences in perceived wage fairness in the second specification. Hence, almost the entire positive correlation between the own absolute wage and job satisfaction from the first specification can be explained by wage fairness perceptions, which are positively correlated with own wages (see results in last section). Second, the internal reference wage (*WREF*) becomes significantly and negatively correlated with job satisfaction after controlling for differences in perceived wage fairness in the second specification, whereby it was not significant in the first specification. Thus, after taking the fairness effect out, the status effect seems to dominate in the second specification so that higher reference wages of peers reduce own job satisfaction in a *ceteris paribus* perspective, i.e., holding the own wage constant.

Third, the external reference wage (*WEXT*) is still negatively correlated with job satisfaction in the second specification. When comparing the results between the two specifications, approximately a third of the correlation between the external reference wage and job satisfaction can be explained by perceived wage fairness. If we assume that the perceived wage fairness absorbs equity considerations, the remaining correlation of the external reference wage in the second specification is likely to represent social status considerations due to comparisons with workers in other firms. Fourth, the firm's wage dispersion (*WSER*) as a proxy for inequality within firms is not significantly correlated with job satisfaction in either specification. But it should be noted that its coefficients have the expected negative signs according to inequality aversion and are significantly negatively correlated with perceived wage fairness (see results in last section).

The overall findings suggest that own and reference wages are relevant in determining job satisfaction due to the importance of fairness preferences and social status considerations. But we neither find evidence for a signal effect due to higher wages of peers in the same firm, which should lead to a positive correlation between internal reference wages and job satisfaction, nor for inequality aversion in workers' evaluation of job satisfaction.

5 Conclusion

We could show in our empirical analysis that it matters for the well-being of people how they are paid in absolute and relative terms and that fairness perceptions are important mediators. For such analysis linked employer-employee data with subjective fairness perceptions and wage information from administrative data are necessary and should be used more often in order to get an even better understanding of well-being at the workplace. But it should be kept in mind that conditional correlations in our non-experimental setting are not necessarily causal effects, although we are quite confident that we do not have a strong bias due to reverse causality or omitted variables. For example, many studies in happiness research

include individual fixed effects because unobserved personality might affect answers. We cannot use individual fixed effects, but we control instead for a range of personality characteristics (agreeableness, conscientiousness, neuroticism, openness, extraversion, trust), which have indeed highly significant coefficients (see Table A.2).

In more detail, the empirical analysis has shown that (1) own wages, internal and external reference wages, as well as wage inequality at the workplace are significant determinants of workers' perceived wage fairness and (2) that own wages, internal and external reference wages, as well as workers' perceived wage fairness are significant determinants of workers' job satisfaction. The overall findings support fairness (altruism, equity) and social status considerations, if workers compare their wages with comparable workers inside and outside the own firm. However, co-workers' wages as signals do not seem to be very important in determining job satisfaction, which contradicts in part previous findings in the literature that the signal effect (ambition) dominates on average the status effect (jealousy). But if compared to our empirical analysis, previous studies have not used conditional reference wages, have not included further wage structure variables, and have not taken into account workers' perceived wage fairness as mediator. With respect to conditional reference wages, our findings are consistent with Clark et al. (2009) who report that job satisfaction is positively correlated with the average wage in the entire firm (signal dominates status) and negatively correlated with the average wage of workers in the same occupation in the same firm (status dominates signal). Furthermore, our findings suggest that altruistic preferences towards co-workers and inequality aversion towards the own firm's wage distribution are prevalent among workers when it comes to fairness perceptions.

Our findings have implications for firms' wage policies and labor market policies. Even if unequal pay structures and comparisons at the workplace might be beneficial from an incentive point of view (e.g., performance pay, rank-order tournaments), they can have negative effects on workers' fairness perceptions and job satisfaction. For example, higher internal reference wages of co-workers can result in positive incentive effects and are seen as fair due to altruistic preferences. But higher internal reference wages can also reduce job satisfaction due to status considerations, if fairness considerations are put aside. Moreover, external reference wages have neither a signaling character nor a strong altruistic component so that status is the main force in social comparisons with workers in other firms. If in total the status effect dominates the signal effect as suggested by our findings, this might explain why many workers and firms insist on pay secrecy rules and one might question policies of pay transparency within and across firms.

6 Appendix

Table A.1 Descriptive statistics for all variables

	Mean	Std. dev.
<i>JSAT</i>	7.555	1.706
<i>WFAIR</i>	3.525	1.143
<i>WABS</i>	4.709	0.410
<i>WREF</i>	4.695	0.370
<i>WEXT</i>	4.775	0.279

Table A.1 Descriptive statistics for all variables

	Mean	Std. dev.
<i>WSE</i>	0.192	0.056
Age	45.136	10.522
Male	0.816	0.388
Partner	0.841	0.366
Kids	0.370	0.737
University degree	0.319	0.466
German citizenship	0.979	0.145
Permanent contract	0.955	0.208
Working hours	42.378	7.076
Shiftwork	0.323	0.468
Flexible working hours	0.149	0.356
Manager	0.339	0.474
Available outside working time	2.059	1.143
Decision autonomy	4.019	0.993
Task variety	4.256	0.919
Dependence on co-worker	3.870	1.195
Co-worker depend on me	3.374	1.301
Physical work environment	2.370	1.456
Works council	0.808	0.394
Collective agreement	0.706	0.456
Share females	0.254	0.198
Share university graduates	0.129	0.146
Share apprenticeship degree	0.645	0.221
Firm managed by owner	0.192	0.394
Limited company	0.908	0.289
Foreign majority ownership	0.201	0.401
Modern technique	0.772	0.420
Agreeableness	4.047	0.577
Conscientiousness	4.368	0.476
Neuroticism	2.689	0.755
Openness	3.660	0.627
Extraversion	3.704	0.726
Trust	3.472	0.781
<i>Firm size categories (ref. 50–99)</i>		
100–249 employees	0.258	0.437
250–499 employees	0.254	0.436
500 and more employees	0.349	0.477
<i>Industry (ref. other manufacturing)</i>		
Metal, electro, vehicles	0.413	0.492
Retail, logistics, communication	0.098	0.297
Service for firms	0.111	0.314
IT and other services	0.050	0.217
<i>Region</i>		
North	0.158	0.365
East	0.270	0.444
South	0.260	0.439

Table A.1 Descriptive statistics for all variables

	Mean	Std. dev.
West	0.311	0.463
Year 2014	0.453	0.498

Notes: N=8483 worker-year observations in 867 establishments.

Table A.2 Complete ordered probit regression results

	(1) <i>WFAIR</i>		(2) <i>JSAT</i>		(3) <i>JSAT</i>	
	Coef.	P>z	Coef.	P>z	Coef.	P>z
<i>WFAIR</i>					0.281	<0.01
<i>WABS</i>	0.895	<0.01	0.262	<0.01	0.026	0.73
<i>WREF</i>	0.485	<0.01	-0.030	0.76	-0.175	0.07
<i>WEXT</i>	-0.464	<0.01	-0.353	<0.01	-0.238	0.01
<i>WSER</i>	-0.520	0.08	-0.225	0.44	-0.117	0.67
<i>Individual level variables</i>						
Age	0.001	0.42	0.006	<0.01	0.006	<0.01
Male	-0.104	0.01	-0.037	0.33	-0.013	0.72
Partner	-0.099	0.01	0.017	0.64	0.042	0.26
Kids	-0.002	0.92	-0.003	0.86	-0.003	0.87
University degree	-0.131	<0.01	-0.120	<0.01	-0.087	<0.01
German citizenship	0.057	0.52	-0.069	0.45	-0.084	0.36
<i>Job level variables</i>						
Permanent contract	-0.210	<0.01	-0.123	0.04	-0.073	0.23
Working hours	-0.008	<0.01	-0.007	<0.01	-0.005	0.01
Shiftwork	0.125	<0.01	0.050	0.12	0.022	0.50
Flexible working hours	0.090	0.01	-0.009	0.80	-0.030	0.39
Manager	-0.042	0.16	0.039	0.17	0.050	0.08
Available outside work	-0.044	<0.01	-0.049	<0.01	-0.040	<0.01
Decision autonomy	0.096	<0.01	0.220	<0.01	0.203	<0.01
Task variety	0.011	0.45	0.086	<0.01	0.087	<0.01
Dependent on co-worker	-0.001	0.90	0.016	0.16	0.017	0.13
Co-worker depend on me	0.015	0.16	-0.024	0.02	-0.028	0.01
Physical work environment.	-0.030	0.01	-0.050	<0.01	-0.044	<0.01
<i>Firm level variables</i>						
Works council	-0.088	0.09	-0.033	0.45	-0.012	0.77
Collective agreement	0.176	<0.01	0.023	0.52	-0.024	0.49
Share females	0.087	0.41	-0.060	0.55	-0.086	0.38
Share university graduates	0.093	0.43	0.012	0.93	-0.008	0.95
Share apprenticeship degree	0.051	0.51	0.037	0.61	0.024	0.72
Firm managed by owner	0.018	0.69	-0.001	0.98	-0.005	0.91
Limited company	-0.110	0.07	-0.128	0.02	-0.101	0.05
Foreign majority owner	-0.051	0.24	-0.054	0.15	-0.041	0.27
Modern technique	-0.003	0.94	0.064	0.08	0.066	0.06
Agreeableness	0.059	0.02	0.095	<0.01	0.086	<0.01
Consciousness	0.089	0.01	0.217	<0.01	0.207	<0.01
Neuroticism	-0.070	<0.01	-0.203	<0.01	-0.194	<0.01
Openness	-0.015	0.54	0.057	0.01	0.064	<0.01
Extraversion	0.030	0.16	0.076	<0.01	0.073	<0.01

Table A.2 Complete ordered probit regression results

	(1) <i>WFAIR</i>		(2) <i>JSAT</i>		(3) <i>JSAT</i>	
Trust	0.184	<0.01	0.186	<0.01	0.144	<0.01
<i>Firm size (ref. 50–99)</i>						
100–249 employees	0.001	0.98	0.047	0.32	0.049	0.28
250–499 employees	0.112	0.04	0.061	0.22	0.032	0.50
500 and more employees	-0.021	0.73	0.045	0.41	0.054	0.30
<i>Industry (ref. other manufacturing)</i>						
Metal, electro, vehicles	0.015	0.71	-0.011	0.76	-0.014	0.69
Retail, logistics, communication	0.081	0.18	0.062	0.29	0.045	0.44
Service for firms	-0.059	0.34	0.010	0.86	0.032	0.55
IT and other services	-0.290	<0.01	-0.219	0.01	-0.150	0.06
<i>Region (ref. west)</i>						
North	0.061	0.23	0.005	0.92	-0.011	0.82
East	-0.156	0.01	-0.095	0.07	-0.058	0.25
South	0.006	0.88	0.073	0.06	0.075	0.04
Year 2014	-0.017	0.53	-0.047	0.05	-0.041	0.08
Cut point 1	3.234		-0.844		-1.228	
Cut point 2	4.052		-0.652		-1.031	
Cut point 3	4.708		-0.413		-0.787	
Cut point 4	6.000		-0.090		-0.454	
Cut point 5			0.193		-0.161	
Cut point 6			0.648		0.312	
Cut point 7			0.950		0.626	
Cut point 8			1.568		1.269	
Cut point 9			2.693		2.440	
Cut point 10			3.452		3.228	
Pseudo R squared	0.085		0.055		0.075	

Notes: 8483 worker-year observations in 867 establishments. Ordered probit regressions. Robust standard errors clustered at establishment level.

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