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ORIGINAL RESEARCH

The Social Dynamics of Economic Comparisons: A Longitudinal Study on the Effects of Relative Wages on Subjective Well-Being Using Linked Survey and Register Data

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Abstract
The implications of wage distributions within firms have garnered increasing attention in recent research, particularly concerning their impact on employees' subjective well-being. The existing literature, however, presents mixed findings, which may be attributed to the interplay of two opposing forces: social status comparison and the tunnel effect. In this paper, we aim to address this issue by examining the mechanisms underlying these forces. To accomplish this, we leverage a combination of panel study data and comprehensive register data on wage distributions within firms. Our primary hypotheses posit that higher average establishment wages contribute to improved subjective well-being (tunnel effect), whereas decreases in individual ranks lead to reduced well-being (social status comparison). Using fixed effects regressions, we explore these effects and their implications on both job satisfaction and life satisfaction. Our results highlight the complex dynamics surrounding wage distributions, indicating that they serve as indicators of future success and markers of social status within the specific organizational context. These findings shed light on the intricate relationship between wage distributions and subjective well-being, providing valuable insights for understanding the implications of wage disparities within firms.

Keywords Social comparison · Well-being · Job satisfaction · Fixed effects

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1 Introduction

Wages and wage distributions within firms are among the major drivers of employee motivation and subjective well-being (SWB). Accordingly, a large body of literature has focused on the relationship between (relative) wages and subjective well-being in the organizational context (Breza et al., 2018; Card et al., 2012; Clark & Oswald, 1996; Cohn et al., 2015; Dube et al., 2019; Long & Nasiry, 2020; Ockenfels et al., 2015; Shaw, 2014). Socio-economic theorizing suggests that wages do not operate in isolation but rather concern social comparisons in the context of the particular work environment (Duesenberry, 1949; Easterlin, 1974, 1995, 2001; Easterlin et al., 2010; Festinger, 1954; Hirsch, 1976; Merton, 1968; Veblen, 1973). The reasoning is that, in terms of SWB, not only one's own wage and change thereof but also the wages of colleagues and the resulting status ranking play a central role. A common assumption is thereby that earning more (less) than colleagues positively (negatively) affects SWB (Clark et al., 2008; Wolbring et al., 2013). However, a second mechanism might be simultaneously at work in case of earning less than relevant others: Increasing wages of colleagues could signal own future earnings prospects in a company. As a result, this so-called "tunnel effect" (Hirschman & Rothschild, 1973) could counterbalance the negative effect of status rankings on SWB.

While both mechanisms are theoretically plausible, examining and disentangling them in practice is challenging and has been rarely done so far. To the best of our knowledge, Clark et al. (2009) are the only ones so far who used panel data with direct information on co-workers' wages to put these theories to the test. One major reason for this lack of studies investigating both mechanisms is the scarce availability of data which allows us to measure and empirically separate with sufficient statistical power the social comparison and the tunnel effect. Most studies so far rely on cross-sectional data while the proposed mechanisms hypothesize dynamics over time and, thus, require a longitudinal perspective. Moreover, cross-sectional models cannot account for unobserved heterogeneity which might lead to biased estimates (Allison, 2009; Ferrer-i-Carbonell & Frijters, 2004). For example, it is important to control for time-invariant variables like personality traits which might affect – both absolute and relative – wages and SWB.

In this paper, we aim to add to the existing literature on the effects of (relative) wages on SWB by disentangling the effects of social status comparison from the so-called tunnel effect. We use data from the German Panel Study Labor Market and Social Security (PASS) for the years 2007 to 2018 (11 waves) and link them to register data from the German Federal Employment Agency. This approach allows us to operationalize within-firm wage inequalities and changes thereof based on administrative data and then relate it longitudinally to measures of SWB such as job and life satisfaction. Our unique dataset provides us with enough statistical power to dissect the effects of social comparison from the tunnel effect. To address issues of unobserved heterogeneity, we estimate linear panel models with individual fixed effects. Lastly, official register data is used to measure income in order to overcome potential measurement errors that are typically associated with survey data.

2 Theoretical and Empirical Background

It is a frequently asked question whether money buys happiness and leads to a satisfying life. At first glance, one might think so, because money is the central medium of exchange in most societies and allows buying amenities such as essential and non-essential goods and services. However, the Easterlin Paradox (Easterlin 1974) – which states that in advanced economies, there is no connection between income growth and SWB at the aggregate level – shows that the relationship is more complex and points to the importance of relative wages. The finding suggests that individuals gain utility not only from their individual income but also from their position within an income distribution. Thus, under the implicit assumption of the Easterlin paradox that the effects of gains and losses are symmetric, pay raises for some individuals are a zero-sum game in this manner because some individuals profit from higher positions in the income distribution, while others suffer from losing their position.

This phenomenon sparked a wide range of literature on the relationship between relative wages and SWB, with most studies finding increasing satisfaction along with increases in relative pay (Clark et al., 2008; Collischon, 2019; Dolan et al., 2008; Ferrer-i-Carbonell, 2005; Kifle, 2014; Montero & Vásquez, 2015; Senik, 2004; Wolbring et al., 2013) but others finding opposite or null effects (Clark et al., 2009; Collischon & Eberl, 2021; FitzRoy et al., 2014). These heterogeneous results suggest that the relationship between relative wages and job and life satisfaction depends on various factors such as individual aspirations, reference groups, and the statistical method used for analyses. Furthermore, two different mechanisms can lead to a link between (relative) wages and SWB, which can be simultaneously at work and which we discuss in the following.

2.1 Social Comparison Processes and Status Rankings

Besides psychological processes of adaptation (Brickman & Campbell, 1971; Lykken & Tellegen, 1996) which are not the focus of this paper, the literature proposes social status comparison as a potential explanation for the Easterlin paradox. The main argument is that humans tend to compare themselves with a reference group of relevant others and that earning more (less) than those relevant others positively (negatively) affects SWB (Clark et al., 2008). This human tendency of social comparison and status ranking might have an evolutionary origin or could be the result of socialization processes. Irrespective of its origin, one implication of the social status ranking argument which contributes to partly solving the puzzle raised by Easterlin is that increases in individual wages do not necessarily translate into higher SWB if the reference group experiences a similar wage change. The theory of status (Blau, 1964) suggests that wages are an indicator of social status where individuals who earn higher wages are often perceived as having higher social status and are accorded greater respect and influence in society. Thus, individuals tend to be more satisfied with their jobs when they perceive their social status (particularly their relative wage) to be higher than that of their co-workers, and this perception can influence their attitudes and behaviors toward their job and their co-workers (Clark & Oswald, 1996; Wolbring et al., 2013). This status effect may contribute to the positive relationship between income and job satisfaction, as individuals with higher incomes feel more respected and influential.

A logical next question concerns who compares to whom. While the literature is unanimous in emphasizing the importance of social comparisons (Clark & Oswald, 1996; Clark & Senik, 2010; Ferrer-i-Carbonell, 2005; Wolbring et al., 2013), it is less clear who serves as a reference group for social comparisons. Individuals might compare themselves with relevant others who surround them (in the form of physical proximity or social closeness), with relevant others whom they perceive as similar concerning certain traits and characteristics such as age, gender, education, and occupation, or with the general population in a country or region. Family members, neighbors, distant acquaintances, close friends, work colleagues or abstract others might hence all serve as a reference group.

While multiple comparison groups might simultaneously serve as a reference, we argue that the workplace is a natural place to look at when studying social comparison processes. First, working earnings are the main sources of income for most individuals of working age and carry, in addition to the mere financial gain, a symbolic meaning of social recognition. Second, most individuals of working age spend a substantial share of their time with paid work and often closely interact with their work colleagues and supervisors. Finally, many of those work colleagues and supervisors are relevant others in the sense that they often work in the same or similar occupations, have similar educational backgrounds, and have the same gender.

In line with these theoretical considerations, empirical studies highlight the importance of wage comparisons in the workplace. For example, Clark & Senik (2010), Clark et al. (2022), and Wolbring et al. (2013) asked respondents in Europe and Japan with whom they compare their income. All three studies found that work colleagues are the most frequently self-assessed comparison group – far more often than family members, friends, and other social groups – and all three studies show systematic links between these income comparisons with SWB. Moreover, in an early but influential contribution, Clark & Oswald (1996) used a large sample of workers in the United Kingdom and found that people who earned more than their peers were generally more satisfied with their jobs than those who earned less. Another study for the UK finds that individuals who earn less than their peers in similar jobs experience lower job satisfaction, while those who earn more than their peers experience higher job satisfaction (Kifle, 2014). In a similar study, Senik (2004) included individuals from several European countries and finds a negative relationship between relative income and job satisfaction. Specifically, the study found that individuals who earned lower relative incomes compared to their reference group (i.e., individuals with similar education and occupation) reported lower job satisfaction. Thus, these social status-related comparison processes assume that workers use their colleagues' wages as indicators to determine their own social status. Accordingly, workers with lower wages are assumed to have lower SWB compared to workers with higher wages, ceteris paribus.

2.2 The Tunnel Effect – Wages as Signals

However, social comparison processes at the workplace do not necessarily need to have the effects suggested by the social-status argument. There is a potentially opposing effect of social comparison processes which might be simultaneously at work. Hirschman & Rothschild (1973) describe this mechanism using the example of a traffic jam in a tunnel with two lanes in the same direction where one lane begins to move while the cars in the other lane

are still stuck. Nonetheless, the drivers in the latter lane might see the progress in the other lane as a positive sign for themselves. Likewise, such a tunnel effect may lead co-workers to interpret colleagues' increasing wages in anticipation of one's own wage increases in the future. As such, wage differences at the workplace can also work as a signal which helps employees to anticipate future earnings prospects at the company. In one influential contribution on this matter, Clark et al. (2009) investigate whether and how a worker's job satisfaction is influenced by their co-workers'wages. Using data from a large-scale survey of Danish employees with linked employer-employee data, which includes wages of co-workers, they find support for the signaling hypothesis, i.e., co-workers' increasing wages serve as a signal for one's own potential future earnings. Another study that examines the effects of both rank and reference wages on job satisfaction is Montero & Vásquez's (2015) analysis of the Chilean labor market. Their results showed that both rank and reference wages were significant predictors of job satisfaction, but that the effect of reference wages was stronger than the effect of rank. Specifically, they found that a 1% increase in reference wages was associated with a 0.24% increase in job satisfaction, while a 1% increase in rank was associated with a 0.09% increase in job satisfaction. Thus, there is empirical evidence that workers may also use their colleagues' wages as signals of potential own earning prospects. In their longitudinal study on Germany and the UK, FitzRoy et al. (2014) find a positive effect of comparison income on happiness for respondents aged under 45 and a negative effect for respondents 45 and older. The authors conclude that young workers may interpret increasing wages in their reference group as signals of their own opportunities, while older workers may not. Although using age as a proxy for career aspirations is not ideal, it sheds light on the processes at work.

In the context of job satisfaction and the impact of rank and relative wages, the tunnel effect suggests that individuals may be more focused on their potential for upward mobility, rather than their current level of income or status when evaluating their job satisfaction. For example, an individual who is currently in a lower-rank position may be more satisfied with their job if they believe there is a high potential for upward mobility, even if their current income or status is relatively low. Similarly, an individual who is in a higher rank position may be less satisfied with their job if they believe there is little potential for further upward mobility, even if their current income or status is relatively high. This, of course, implies that respondents actually think they may benefit from a specific upward trend in their reference group.

2.3 Hypotheses

We argue that, theoretically, both aforementioned mechanisms (i.e., status comparison and tunnel effect) could simultaneously be at work. This means that workers could use their respective position within a reference group (usually their colleagues within their firm) as a proxy for their social status while using changes in their colleagues' wages as a signal for their potential own wage prospects. In the relevant literature, however, the concepts of rank and relative wage are often used interchangeably, even if they refer to two different constructs. Rank refers to a person's position in the wage distribution, while relative wage refers to the difference or ratio of a person's wage to the wages of their reference group. Understanding the difference between these two concepts is important for understanding the underlying mechanisms. Accordingly, our hypotheses are as follows:

H1: Increasing positional change within the comparison group of co-workers increases subjective well-being, ceteris paribus. (social status comparison effect)

Thus, according to theories of social comparison, when comparing themselves to their colleagues, workers take their relative position into account.

H2: Mean wage increases in the comparison group of co-workers lead to higher job satisfaction, ceteris paribus. (tunnel effect)

In line with reasoning based on the tunnel effect, workers use increases (decreases) in the average wage as a signal for their own future income prospects.

To test these hypotheses, it is necessary to examine both mechanisms simultaneously, as increases in average wages often go hand in hand with positional changes within the given comparison group. Thus, testing one mechanism while controlling for the other is essential.

3 Data and Methods

3.1 Data

For our analyses, we combine longitudinal data from the Panel Labour Market and Social Security (PASS) with official register data from the German Federal Employment Agency. For this purpose, we use the PASS population sample and rely on information of employed individuals only.

The survey collects information on job satisfaction from wave 7 onwards, thus, we use wave 7 (2013) to 12 (2018) in our analyses. Overall, waves 7 to 12 contain 80,853 observations. However, due to the sampling design, a large share of the sample is out of employment and thus, we have information on job satisfaction for 39,135 observations. Of these observations, we can link 32,920 to administrative records from the social security data. We further only keep individuals with at least one co-worker that we have information on to calculate the relative income position in the firm and we do not use cases with missing values in relevant variables for the regression analysis in our sample, leaving us with 21,137 observations. As we use changes of the relative income position in our analysis, we further require individuals to be surveyed at least twice, and we do not use the first wave for each individual in our analysis. Lastly, we restrict our analyses to observations without gaps between waves. Our final estimation sample, thus, consists of 5,271 individuals with 15,270 observations.

We operationalize SWB as job and overall life satisfaction. Job satisfaction ("How satisfied are you currently with your work?") and life satisfaction ("Overall, how satisfied are you with your life right now?") are dependent variables directly drawn from the PASS, both measured on an 11-point Likert scale ranging from 0–10.

As the main independent variables, we use gross daily wage, mean establishment wage (the average daily pay within a given firm), and own wage rank within the firm (constructed from the earnings spells of all individuals working in a given establishment). All of these variables are constructed using administrative information on gross daily wages, for wages above the contribution assessment ceiling we use imputed wages provided by the IAB (Drechsler et al., 2023) In line with status-based social comparison processes, we expect a positive effect of respondent's rank on job and life satisfaction (H1). Based on the tunnel

effect, we predict that increases in mean establishment wages lead to increases in SWB, net of individual wage. We use the register data to calculate mean establishment wage and own rank (both log-transformed), i.e., each respondent's individual wage rank within his/her respective firm. The rank is calculated by drawing colleagues' wages from the register data and then estimating each individual's standardized rank within the firm, ranging from 0 (lowest rank within the firm) to 1 (highest rank within the firm).

$$Rank_i = \frac{n_{ij}}{(N_j - 1)}$$

where n_{ij} is the number of colleagues with wages lower than the respondent's in his/her respective firm and N_j is the total number of employees within the firm j.[1] In order to minimize the bias towards larger firms, we only include rank changes larger than 1%, as small changes cannot occur in small firms a priori (Appendix Fig. 1 shows the distribution of rank changes in the data). Also, especially in big firms, it is rather unlikely the average worker will notice small changes in the rank distribution, e.g., the hiring of an additional person. Thus, we account for these salience issues by only including rank changes of more than 1% that go along with pay changes of more than 2%. To rule out collinearity issues, we code these rank changes as a variable with three categories. 1 indicates a rank increase of 1% or larger, –1 a rank decrease of 1% or larger, and 0 no rank change or a rank change of less than 1%. Rank changes are constructed by using consecutive spells of individuals, i.e., from interview to the subsequent interview. In robustness checks, we vary this threshold and also look at the effects of 5%, 10%, and 20% rank changes.

3.2 Estimation Approach

To examine our hypotheses empirically, we run fixed effects regressions because this allows us to eliminate all time-invariant (unobserved) heterogeneity and thus eliminates biases through time-constant, unobservable characteristics like personality traits (Allison, 2009; Brüderl & Ludwig, 2015). We estimate the following model

$$\begin{aligned} Jobsat_{it}/Lifesat_{it} = &\alpha_i + \beta_1 Rank_{it} + \beta_2 \ln(wage_{it}) + \beta_3 \ln(mean\ est.wage_{it}) \\ &+ \beta_4 age_{it} + \beta_5 age_{it}^2 + \beta_6 wave'_t + \beta_7 working\ hours_{it} + \varepsilon_{it} \end{aligned}$$

where $Jobsat_{it}$ and $Lifesat_{it}$ represent individual job satisfaction and life satisfaction at time t. $\beta_1, \beta_2$and β_3 are the coefficients of interest and denote the effects of intraindividual changes in rank, wages and mean establishment wages.

One concern could be that separating and thus identifying these effects is hard due to collinearity. However, this poses no major problem: the correlation between rank and the natural logarithm of daily pay is 0.48, and the correlation between the logarithms of mean establishment wage and own wage is 0.76. Thus, there is sufficient variation to separate these effects. α_i are individual fixed effects to account for time-constant unobserved heterogeneity. While we do not control for firm-level characteristics, time-constant characteristics are completely absorbed if individuals do not change their employer.

[1] In an ideal world, we would also be able to construct the rank measure within teams, for example, as it is likely that one's comparison group are the individuals directly working and interacting with the individual. However, we do not have this information in the data. Additionally, this implies that our results are conservative, as we may underestimate the true effects due to this type of measurement error.

Table 1 Variable overview

	Mean	Std. Dev	Minimum	Maximum
Job satisfaction	7.25	1.83	0.00	10.00
Life satisfaction	7.42	1.36	0.00	10.00
Age (years)	44.80	10.67	18.00	65.00
ln(own wage)	4.30	0.60	2.31	6.57
ln(mean est. wage)	4.33	0.51	2.34	5.90
Rank	0.49	0.29	0.00	1.00
1% Rank change	0.14	0.47	−1.00	1.00
5% Rank change	0.11	0.43	−1.00	1.00
10% Rank change	0.08	0.37	−1.00	1.00
20% Rank change	0.04	0.28	−1.00	1.00
Female	0.52	0.50	0.00	1.00
Contractual weekly working hours	34.18	8.18	4.00	80.00
Years of schooling	12.52	2.65	7.00	21.00
Child under 15 in Household	0.31	0.46	0.00	1.00
Partner living in same Household	0.64	0.48	0.00	1.00
Agricultural sector	0.02	0.12	0.00	1.00
Basic resources sector	0.03	0.18	0.00	1.00
Machinery sector	0.12	0.32	0.00	1.00
Automobile sector	0.08	0.27	0.00	1.00
Energy sector	0.06	0.25	0.00	1.00
Retail sector	0.15	0.36	0.00	1.00
Communication sector	0.09	0.29	0.00	1.00
Economic Service sector	0.16	0.36	0.00	1.00
Health/Social sector	0.25	0.43	0.00	1.00
Else (sector)	0.04	0.19	0.00	1.00
Blue-collar worker	0.26	0.44	0.00	1.00
Establishment size	564.33	2744.36	2.00	65468.00
Observations	15270			
Individuals	5271			

We omit the first wave in order to mirror the estimation sample

We also control for time-varying factors that we expect to correlate with the dependent variables and our regressors of interest, namely age[2] and working hours. We additionally control for survey wave fixed effects to account for global trends in the outcomes. Table 1 shows the variables used with mean and standard deviation.

We abstain from controlling for more variables on the individual level, such as health, because these variables could be on the causal pathway from the treatment variables and the outcomes and, as such, be part of the effect of interest.

[2] In the reported models, we control for age and age square. Being aware that this specification only offers limited flexibility to nonlinear age effects, we also ran three robustness checks: one treating age as categorical variable (age deciles), separate models for respondents below 40 and above 39; and a model with age, age square and age cubic. For none of these robustness checks any of our results substantially changed. Results are available upon request.

4 Results

To replicate previous research on the effects of wage inequality on job and life satisfaction, we first run models with wage and mean est. wage (both in natural logarithms). Next, we include individual firm rank in the regressions to investigate whether there are effects of rank that go beyond mere income effects and to distinguish between the tunnel effect, measured by mean establishment wages (e.g., increasing firm success), and effects of status-based social comparison, measured by rank.

Table 2 shows results for fixed effects models regressing job satisfaction and life satisfaction on wage and mean establishment wage (models 1 and 3), and, additionally, rank (models 2 and 4). The results in all models show an income effect that exerts its influence on both job and life satisfaction. A 10% increase in one's own wage equates roughly to a 0.04-point increase on the 11-point job satisfaction scale, and roughly 0.03 points on the 11-point life satisfaction scale. Similarly, increasing mean est. wages by 10% results in a 0.04-point increase in job satisfaction and a 0.01-point increase in life satisfaction (the latter effect, however, being statistically insignificant), thus providing empirical support for H2. For both wage and mean establishment wage, the effect is stronger for job satisfaction than it is for life satisfaction. This is not surprising, considering many more factors have an impact on life satisfaction compared to job satisfaction and assuming that job satisfaction is one component of the broader concept of life satisfaction.

In models 2 and 4, we include rank as an additional predictor. While the effect of rank on life satisfaction is weak and insignificant, we find a significant positive effect on job satisfaction, thus partially supporting H1. The rank effect shows that while holding individual wages and mean est. wages constant, increases in the relative rank also increase job satisfaction. This finding is consistent with the hypothesized effect of social comparison. Experiencing a rank increase of at least 1% points (compared to the t –1 rank) translates into an increase on the job satisfaction scale of 0.09. Compared to the mean est. wage effect, the rank effect is relatively strong: to compensate for a 1% point (or more) decrease in rank, the mean est. wage would have to increase by roughly 24%. Moreover, including rank as an

Table 2 Outcomes: Job satisfaction and life satisfaction (0–10)

	Job Satisfaction	Job Satisfaction	Life Satisfaction	Life Satisfaction
ln(own wage)	0.447**	0.304*	0.283***	0.288**
	(0.137)	(0.150)	(0.083)	(0.091)
ln(mean est. wage)	0.348*	0.397**	0.120	0.118
	(0.144)	(0.147)	(0.077)	(0.078)
Rank change (1%)		0.094**		−0.003
		(0.035)		(0.021)
Observations	15270	15270	15270	15270
Individuals	5271	5271	5271	5271
R^2 within	0.009	0.010	0.005	0.005
R^2 overall	0.662	0.663	0.728	0.728

Robust standard errors in parentheses

Controls for: age, age squared, wave dummies, working hours

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3 Outcomes: Job satisfaction (different rank thresholds)

	1% rank change	5% rank change	10% rank change	20% rank change
ln(own wage)	0.304*	0.306*	0.275†	0.298*
	(0.150)	(0.147)	(0.144)	(0.141)
ln(mean est. wage)	0.397**	0.401**	0.415**	0.419**
	(0.147)	(0.146)	(0.146)	(0.146)
Rank change	0.094**	0.108**	0.160***	0.219***
	(0.035)	(0.037)	(0.044)	(0.063)
Observations	15270	15270	15270	15270
Individuals	5271	5271	5271	5271
R^2 within	0.010	0.010	0.011	0.011
R^2 overall	0.663	0.663	0.663	0.663

Robust standard errors in parentheses

Controls for: age, age squared, wave dummies, working hours

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4. Outcomes: Job satisfaction (robustness checks)

	Same employer	Small employers	Large employers
ln(own wage)	0.342*	0.433*	0.314
	(0.161)	(0.219)	(0.244)
ln(mean est. wage)	0.128	0.325†	0.324
	(0.177)	(0.189)	(0.351)
Rank change (1%)	0.085*	0.113*	0.051
	(0.036)	(0.056)	(0.044)
Observations	13855	7253	8017
Individuals	4982	2883	2972
R^2 within	0.010	0.013	0.013
R^2 overall	0.688	0.690	0.706

Robust standard errors in parentheses

Controls for: age, age squared, wave dummies, working hours

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

independent variable does not change the wage and mean est. wage effects in a substantial way, indicating the variables are not strongly collinear to each other. For negative rank changes, we have a much smaller number of observations (only 5% of the sample) and find no significant effects (see Table 6 in the Appendix). Perhaps surprisingly, the sign of the coefficient is positive. However, this effect disappears and is very close to zero when we only include individuals who did not change their jobs, thus showing that the positive sign is likely driven by selection into job changes.

Next, we run our analyses on job satisfaction with 5%, 10%, and 20% thresholds for rank changes. Effects on life satisfaction remain insignificant even for higher rank thresholds but become larger in size (see Appendix Table 9). Our results for job satisfaction show that ceteris paribus larger rank changes have a larger effect on job

satisfaction. Effects of own wage and mean est. wage remain largely the same, providing further evidence for distinct processes being at work. Thus, respondents seem to respond to larger changes in rank with corresponding changes in their job satisfaction. This provides further evidence for hypothesis H1, namely that positional changes transform into changes in job satisfaction (Table 3).

To further corroborate our results, we investigate specific subgroups to analyze whether the effects we found are caused by a specific group of workers, again using the 1% threshold for rank changes (Table 4.). Looking at people who stayed with the same employer for the observed time and the size of the establishment, small employer (< 50 people) or large employers (50 people or more), we find similar effects compared to our main results. However, it is noteworthy that the effect of rank changes is roughly double in size for employees in smaller than in larger establishments. This is consistent with the theoretical idea that rank changes should be more salient in smaller establishments. However, our findings are not limited to a specific group of workers. This is particularly relevant here, as workers who change their employer change their reference group. Interestingly, for this group, the effect of one's own wage on job satisfaction is higher than the effect of mean establishment wage, implying that the overall effect of mean establishment wage is also partly driven by switching jobs.

Lastly, we look at the effects of rank changes conditional on specific thresholds of individual wage changes (Table 5), i.e., we only consider rank changes that go along with a 5% wage change of the individual observation. Here, the effect of rank more than doubles compared to the specification in Table 2, while the effects of own wage and mean est. wage remain largely the same. This indicates that rank changes are more salient to the individual if they happen in the process of a pay rise or cut. This result further supports the argument of a more salient rank change when it simultaneously occurs with a pay change. Moreover, running the same model as in Table 2 but

Table 5 Outcomes: Job satisfaction and life satisfaction (0–10), rank change simultaneous with wage change only

	Job Satisfaction 5% wage change	Life Satisfaction 5% wage change	Job Satisfaction, more controls	Life Satisfaction, more controls
ln(own wage)	0.312*	0.290**	0.334*	0.300***
	(0.145)	(0.089)	(0.151)	(0.089)
ln(mean est. wage)	0.389**	0.117	0.402**	0.095
	(0.145)	(0.078)	(0.151)	(0.080)
Rank change (1%)	0.149*	−0.008	0.087*	−0.009
	(0.058)	(0.035)	(0.035)	(0.022)
Observations	15270	15270	14901	14901
Individuals	5271	5271	5159	5159
R^2 within	0.010	0.005	0.015	0.010
R^2 overall	0.663	0.728	0.665	0.730

Robust standard errors in parentheses

Controls for: age, age squared, wave dummies, working hours

Additional controls Models 3 and 4: years of schooling, child under 15 in household, partner living in same household, economic sector, blue-collar worker

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

including additional controls (years of schooling, child under 15 in household, partner living in same household, economic sector, blue-collar worker) does not change results significantly, providing further robustness to our main results (see Appendix Table 12 for full results).

5 Discussion

Our study provides new evidence on the implications of wage distributions within firms and their impact on workers' subjective well-being. Particularly, we disentangle the tunnel effect from the social-status comparison effect. We do so by including three dimensions in our analyses: logged individual wage, logged mean establishment wage, and relative rank. We argue that the tunnel effect of increasing average wages is measured by logged mean establishment wages, while effects of social-status comparison are measured by each respondent's individual rank within his/her respective firm. Lastly, each respondent's own logged wage is included to control for direct nonlinear effects of wage increases (without rank increases). In line with status-based social comparison processes, we expect a positive effect of each respondent's respective rank on his/her job and life satisfaction (H1). Based on the tunnel effect, we also predict that increases in mean establishment wages lead to increases in SWB despite controlling for both absolute wage and relative rank (H2).

In our analyses, we find support for both hypotheses: Our results show that relative ranks, as well as relative wages, play a role in predicting job satisfaction. Controlling for own wage and mean est. wage, we find a positive relationship between rank and job satisfaction. Thus, if individuals climb up the relative wage ladder in their respective firms, their job satisfaction increases as well. Wage rank refers to the position of an individual's wage compared to the position of others in the same reference group, such as co-workers or workers in similar positions. This positive effect of wage rank on job satisfaction can be explained by the social-status comparison theory. According to this theory, individuals evaluate their own social status by comparing themselves to others in the same reference group. In the context of job satisfaction, workers may evaluate their own rank by comparing themselves to those of their peers. When their ranks are higher than those of their co-workers, they may experience higher job satisfaction. This is because higher wages may be a sign of prestige, power, and status, which in turn contribute to workers' overall sense of well-being. Moreover, we show that larger rank changes also translate into larger changes in job satisfaction. At the same time, we show that mean establishment wages also have a positive effect, which in turn shows that colleagues' wages can lead to the so-called tunnel effect. Thus, even if workers do not benefit from the increase in average earnings in their firm (because we control for individual wage and rank), their job satisfaction increases. Both effects, however, are only statistically significant for job satisfaction, not life satisfaction.

Our results contribute to the existing literature in two ways: firstly, it is one of the few longitudinal perspectives on the wage-job/life satisfaction link, particularly with actual wage distributions drawn from register data. And, secondly, it contributes to the debate on whether and how rank serves as a measure of social status and comparison. We provide evidence to the perspective that both social status comparison and the tunnel effect may be at work at the same time. It shows that the effect

of relative wages on subjective well-being is the result of a complex interplay of social dynamics. They are complex because different mechanisms are simultaneously at work and may serve both as a signal of future success and a sign of one's own social status. They are dynamic because wages are embedded within the respective environment and are conditional on wage changes of the relevant comparison group. Accordingly, this paper contributes to a better understanding of the social embeddedness of wages. While neoclassical theories assume that subjective well-being is a direct function of absolute income, we show that wages always work within a given socio-economic environment. Therefore, wages should be seen not only as a simple means of exchange for resources but also as a core factor shaping social hierarchy. These findings have important implications for firms and organizations in general: The most important insight is that wages and changes thereof (such as pay rises) do not operate in isolation but rather have implications for co-workers as well. Thus, decision makers should keep in mind how changing the wage structure, for example, through pay raises might have both positive and negative implications for the individual directly affected as well as co-workers.

It is worth noting that the positive effects of both wage rank and relative wage on job satisfaction may be subject to certain conditions, nonetheless. For example, the effect of wage rank may be stronger for workers who are more focused on their social status or who are working in competitive or hierarchical work environments (Clark & Senik, 2010). Similarly, the effect of relative wage may be stronger for workers who are more motivated by financial incentives or who place greater importance on their income relative to their peers (Wolbring et al., 2013). Thus, future studies should look more deeply at the personal motivations, attitudes, and subjective perceptions of the respective workers analyzed. Similarly, a focus on job changers could provide further insights into the dynamics of relative wages and the incentives, such as higher wages and better benefits, that motivate workers to look for a new employer.

There are some limitations to our analyses, however. Firstly, we do not have any attitudinal information on our observations. Thus, we cannot directly test the theories of social status comparisons and the tunnel effect but infer them by using rank and mean establishment wages as proxies. Accordingly, there might be another explanation for the positive relationship between mean est. wages and job satisfaction as this might also serve as an indicator of increasing overall success within a firm (success signaling hypothesis) (Clark et al., 2009). Moreover, we cannot control for other effects that might be related to social status and relative wages, such as promotions at the workplace. Similarly, non-wage processes like job autonomy, power hierarchies, and general working conditions might be other relevant factors we cannot control for. Furthermore, specifying the reference group in more detail, for example, direct co-workers instead of the entire firm, would increase the precision of the estimations. This issue mainly concerns underestimating the actual effect, however, as we assume the real effects to be larger than the current estimates. In addition, it is well known that people adapt to changes over time which further complicates the picture. While models like time-distributed fixed-effects model could capture such dynamics over time, both data restrictions and issues of collinearity across the three key theoretical constructs led us to decide against using such a model specification. Lastly, we want to point out that while we are confident that our results are not strongly biased, we do not use exogenous variation, i.e., a natural experiment, to estimate the effects of both the status and the tunnel effect. However, it is also hard to come up with potential natural experiments, even in theory.

Appendix

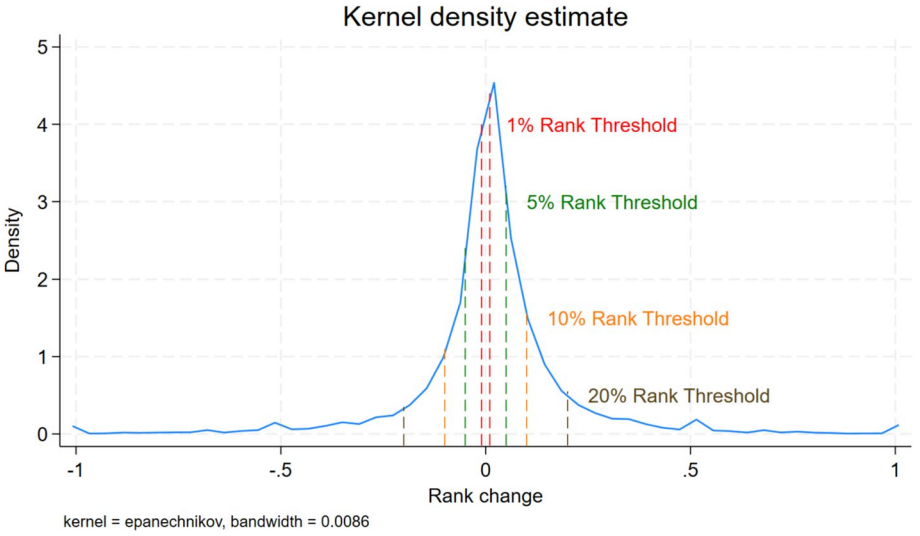

Fig. 1 Kernel Density Estimate for Rank changes from wave to wave

Table 6 Outcomes: Job and Life satisfaction, asymmetric effects for rank change

	Asymmetric Job Satisfaction	Asymmetric Life Satisfaction	Asymmetric Job Satisfaction, no Job changes	Asymmetric Life Satisfaction, no Job changes
ln(own wage)	0.349*	0.286**	0.365*	0.290**
	(0.152)	(0.091)	(0.163)	(0.103)
ln(mean est. wage)	0.387**	0.119	0.121	0.089
	(0.147)	(0.078)	(0.177)	(0.092)
negative rank change	0.093	-0.004	0.011	-0.034
	(0.080)	(0.044)	(0.083)	(0.049)
positive rank change	0.160***	-0.006	0.118**	-0.022
	(0.040)	(0.026)	(0.041)	(0.028)
Observations	15270	15270	13855	13855
Individuals	5271	5271	4982	4982
R2 within	0.011	0.005	0.010	0.005
R2 overall	0.663	0.728	0.688	0.737

Robust standard errors in parentheses

Controls for: age, age squared, wave dummies, working hours

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7 Outcomes: Job satisfaction and life satisfaction (including control variables), extended results corresponding to Table 2

	Job Satisfaction	Job Satisfaction	Life Satisfaction	Life Satisfaction
ln(own wage)	0.447**	0.304*	0.283***	0.288**
	(0.137)	(0.150)	(0.083)	(0.091)
ln(mean est. wage)	0.348*	0.397**	0.120	0.118
	(0.144)	(0.147)	(0.077)	(0.078)
Rank change (1%)		0.094**		-0.003
		(0.035)		(0.021)
Age (years)	-0.041	-0.034	-0.102*	-0.102*
	(0.066)	(0.066)	(0.043)	(0.044)
Age^2 (years) * 100	0.105*	0.097*	0.113***	0.113***
	(0.047)	(0.047)	(0.030)	(0.030)
Wave 8 (2014)	-0.132*	-0.126†	-0.026	-0.026
	(0.065)	(0.065)	(0.042)	(0.042)
Wave 9 (2015)	-0.377***	-0.368**	-0.004	-0.005
	(0.112)	(0.112)	(0.073)	(0.073)
Wave 10 (2016)	-0.398*	-0.381*	-0.024	-0.024
	(0.163)	(0.163)	(0.106)	(0.106)
Wave 11 (2017)	-0.498*	-0.477*	-0.017	-0.017
	(0.214)	(0.214)	(0.139)	(0.139)
Wave 12 (2018)	-0.661*	-0.636*	-0.049	-0.050
	(0.264)	(0.264)	(0.171)	(0.171)
Contractual weekly working hours	-0.019*	-0.017*	0.001	0.001
	(0.008)	(0.008)	(0.004)	(0.004)
Observations	15,270	15,270	15,270	15,270
Individuals	5271	5271	5271	5271
R2 within	0.009	0.010	0.005	0.005
R2 overall	0.662	0.663	0.728	0.728

Robust standard errors in parentheses

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8 Outcomes: job satisfaction (including control variables), different rank thresholds, extended results corresponding to Table 3

	1% rank change	5% rank change	10% rank change	20% rank change
ln(own wage)	0.304*	0.306*	0.275†	0.298*
	(0.150)	(0.147)	(0.144)	(0.141)
ln(mean est. wage)	0.397**	0.401**	0.415**	0.419**
	(0.147)	(0.146)	(0.146)	(0.146)
Rank change	0.094**	0.108**	0.160***	0.219***
	(0.035)	(0.037)	(0.044)	(0.063)
Age (years)	-0.034	-0.034	-0.033	-0.034
	(0.066)	(0.066)	(0.066)	(0.066)
Age^2 (years) * 100	0.113*	0.113*	0.113*	0.114*
	(0.030)	(0.030)	(0.030)	(0.030)
Wave 8 (2014)	-0.126†	-0.127*	-0.126†	-0.126†
	(0.065)	(0.065)	(0.065)	(0.065)
Wave 9 (2015)	-0.368**	-0.368**	-0.367**	-0.369***
	(0.112)	(0.112)	(0.112)	(0.112)
Wave 10 (2016)	-0.381*	-0.382*	-0.378*	-0.381*
	(0.163)	(0.163)	(0.163)	(0.163)
Wave 11 (2017)	-0.477*	-0.478*	-0.473*	-0.474*
	(0.214)	(0.214)	(0.214)	(0.214)
Wave 12 (2018)	-0.636*	-0.638*	-0.633*	-0.636*
	(0.264)	(0.264)	(0.264)	(0.264)
Contractual weekly working hours	-0.017*	-0.017*	-0.017*	-0.017*
	(0.008)	(0.008)	(0.008)	(0.008)
Observations	15,270	15,270	15,270	15,270
Individuals	5271	5271	5271	5271
R2 within	0.010	0.010	0.011	0.011
R2 overall	0.663	0.663	0.663	0.663

Robust standard errors in parentheses

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9 Outcomes: life satisfaction (including control variables), different rank thresholds

	1% rank change	5% rank change	10% rank change	20% rank change
ln(own wage)	0.288**	0.291**	0.300***	0.319***
	(0.091)	(0.089)	(0.088)	(0.086)
ln(mean est. wage)	0.118	0.117	0.113	0.103
	(0.078)	(0.078)	(0.078)	(0.078)
Rank change	-0.003	-0.006	-0.016	-0.053
	(0.021)	(0.023)	(0.027)	(0.035)
Age (years)	-0.102*	-0.102*	-0.103*	-0.104*
	(0.044)	(0.044)	(0.044)	(0.043)
Age^2 (years) * 100	0.113***	0.113***	0.113***	0.114***
	(0.030)	(0.030)	(0.030)	(0.030)
Wave 8 (2014)	-0.026	-0.026	-0.027	-0.027
	(0.042)	(0.042)	(0.042)	(0.042)
Wave 9 (2015)	-0.005	-0.005	-0.005	-0.006
	(0.073)	(0.073)	(0.073)	(0.073)
Wave 10 (2016)	-0.024	-0.025	-0.026	-0.028
	(0.106)	(0.106)	(0.106)	(0.106)
Wave 11 (2017)	-0.017	-0.018	-0.019	-0.022
	(0.139)	(0.139)	(0.139)	(0.139)
Wave 12 (2018)	-0.050	-0.050	-0.052	-0.055
	(0.171)	(0.171)	(0.171)	(0.171)
Contractual weekly working hours	0.001	0.001	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Observations	15270	15270	15270	15270
Individuals	5271	5271	5271	5271
R2 within	0.005	0.005	0.005	0.005
R2 overall	0.728	0.728	0.728	0.728

Robust standard errors in parentheses

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10 Outcome: Job satisfaction (including control variables), extended corresponding to Table 3

	Same employer	Small employer	Large employer
ln(own wage)	0.342*	0.433*	0.314
	(0.161)	(0.219)	(0.244)
ln(mean est. wage)	0.128	0.325†	0.324
	(0.177)	(0.189)	(0.351)
Rank change (1%)	0.085*	0.113*	0.051
	(0.036)	(0.056)	(0.044)
Age (years)	-0.023	-0.058	-0.037
	(0.072)	(0.109)	(0.094)
Age^2 (years) * 100	0.092†	0.110	0.119†
	(0.051)	(0.075)	(0.069)
Wave 8 (2014)	-0.132†	-0.167	-0.144
	(0.067)	(0.102)	(0.090)
Wave 9 (2015)	-0.349**	-0.415*	-0.390*
	(0.117)	(0.184)	(0.153)
Wave 10 (2016)	-0.389*	-0.393	-0.456*
	(0.171)	(0.274)	(0.218)
Wave 11 (2017)	-0.496*	-0.479	-0.625*
	(0.225)	(0.367)	(0.285)
Wave 12 (2018)	-0.693*	-0.669	-0.846*
	(0.277)	(0.450)	(0.350)
Contractual weekly working hours	-0.016†	-0.019†	-0.013
	(0.008)	(0.010)	(0.011)
Observations	13855	7253	8017
Individuals	4982	2883	2972
R2 within	0.010	0.013	0.013
R2 overall	0.688	0.690	0.706

Robust standard errors in parentheses

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11 Outcomes: Life satisfaction (including control variables)

	Same employer	Small employer	Large employer
ln(own wage)	0.300**	0.433**	0.202
	(0.103)	(0.143)	(0.139)
ln(mean est. wage)	0.085	0.084	-0.150
	(0.092)	(0.103)	(0.185)
Rank change (1%)	-0.008	-0.011	0.009
	(0.023)	(0.035)	(0.028)
Age (years)	-0.102*	-0.157*	-0.069
	(0.047)	(0.076)	(0.056)
Age^2 (years) * 100	0.123***	0.144**	0.088*
	(0.033)	(0.049)	(0.044)
Wave 8 (2014)	-0.049	0.014	-0.044
	(0.045)	(0.072)	(0.053)
Wave 9 (2015)	-0.033	0.052	-0.024
	(0.075)	(0.127)	(0.086)
Wave 10 (2016)	-0.076	0.040	-0.050
	(0.110)	(0.187)	(0.124)
Wave 11 (2017)	-0.079	0.069	-0.077
	(0.145)	(0.247)	(0.166)
Wave 12 (2018)	-0.119	0.056	-0.130
	(0.178)	(0.305)	(0.203)
Contractual weekly working hours	0.005	-0.001	0.008
	(0.004)	(0.005)	(0.007)
Observations	13855	7253	8017
Individuals	4982	2883	2972
R2 within	0.005	0.007	0.003
R2 overall	0.737	0.753	0.745

Robust standard errors in parentheses

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12 Outcomes: Job satisfaction and life satisfaction (including control variables), extended corresponding to Table 5

	Job Satisfaction 5% wage change	Life Satisfaction 5% wage change	Job Satisfaction, more controls	Life Satisfaction, more controls
ln(own wage)	0.312*	0.290**	0.334*	0.300***
	(0.145)	(0.089)	(0.151)	(0.089)
ln(mean est. wage)	0.389**	0.117	0.402**	0.095
	(0.145)	(0.078)	(0.151)	(0.080)
Rank change (1%)	0.149*	-0.008	0.087*	-0.009
	(0.058)	(0.035)	(0.035)	(0.022)
Age (years)	-0.033	-0.102*	-0.050	-0.110*
	(0.066)	(0.044)	(0.066)	(0.044)
Age^2 (years) * 100	0.098*	0.113***	0.099*	0.118***
	(0.047)	(0.030)	(0.048)	(0.031)
Wave 8 (2014)	-0.126†	-0.026	-0.118†	-0.027
	(0.065)	(0.042)	(0.065)	(0.043)
Wave 9 (2015)	-0.371***	-0.005	-0.351**	-0.019
	(0.112)	(0.073)	(0.113)	(0.073)
Wave 10 (2016)	-0.386*	-0.024	-0.347*	-0.039
	(0.163)	(0.105)	(0.165)	(0.106)
Wave 11 (2017)	-0.481*	-0.017	-0.443*	-0.029
	(0.215)	(0.139)	(0.217)	(0.140)
Wave 12 (2018)	-0.640*	-0.050	-0.589*	-0.069
	(0.264)	(0.171)	(0.267)	(0.172)
Contractual weekly working hours	-0.017*	0.001	-0.019*	0.001
	(0.008)	(0.004)	(0.007)	(0.004)
Years of schooling			-0.133	0.009
			(0.106)	(0.074)
Child under 15 in Household			0.068	-0.092†
			(0.076)	(0.049)
Partner in Household			-0.118	0.281***
			(0.097)	(0.079)
Agricultural sector			1.163	0.440
			(0.835)	(0.589)
Basic resources sector			-0.434	-0.729**
			(0.614)	(0.259)
Machinery sector			-0.511	-0.245
			(0.461)	(0.245)
Automobile sector			-0.006	0.009
			(0.424)	(0.232)
Energy sector			-0.458	-0.147
			(0.533)	(0.268)
Retail sector			0.177	-0.337
			(0.462)	(0.216)
Communication sector			-0.114	-0.272
			(0.466)	(0.254)

Table 12 (continued)

	Job Satisfaction 5% wage change	Life Satisfaction 5% wage change	Job Satisfaction, more controls	Life Satisfaction, more controls
Economic Service sector			-0.174	-0.216
			(0.417)	(0.216)
Health/Social sector			0.593	-0.041
			(0.468)	(0.231)
blue-collar worker			-0.426†	-0.148
			(0.223)	(0.116)
Observations	15270	15270	14901	14901
Individuals	5271	5271	5159	5159
R2 within	0.010	0.005	0.015	0.010
R2 overall	0.663	0.728	0.665	0.730

Robust standard errors in parentheses

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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Data Availability Stata code is available upon request. Access to the register data and the PASS requires a formal application through the Institute for Employment Research (IAB) in Nuremberg.

Declarations

Conflicts of interest The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

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