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ABSTRACT

Worker Beliefs about Outside Options*

Workers wrongly anchor their beliefs about outside options on their current wage. In particular, low-paid workers underestimate wages elsewhere. We document this anchoring bias by eliciting workers' beliefs in a representative survey in Germany and comparing them to measures of actual outside options in linked administrative labor market data. In an equilibrium model, such anchoring can give rise to monopsony and labor market segmentation. In line with the model, misperceptions are particularly pronounced among workers in low-wage firms. If workers had correct beliefs, at least 10% of jobs, concentrated in low-wage firms, would not be viable at current wages.

JEL Classification: D91, E03, E24, J3, J31, J42, J6

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1 Introduction

Firms differ substantially in the wages they pay to similar workers (Slichter, 1950; Abowd, Kramarz, and Margolis, 1999; Card, Heining, and Kline, 2013). Following in the tradition of Stigler (1961), canonical models of the labor market assume that workers have accurate beliefs about the differences in wages paid by different firms (including in bargaining and wage posting models with search as in Burdett and Mortensen, 1998; Mortensen and Pissarides, 1999; Cahuc, Postel-Vinay, and Robin, 2006; Manning, 2011; Hornstein, Krusell, and Violante, 2011). While this fundamental assumption remains untested, its violation—in the form of worker misperceptions about the wage distribution—could lead to worker misallocation and act as a source of monopsony power (Robinson, 1933).¹

In this paper, we assess the accuracy of workers' beliefs about their outside options and the external labor market. We design and implement a representative survey in the German Socio-Economic Panel (SOEP), which asks each employed respondent about the expected wage change accompanying a switch to their next-best employer. Since our question evokes a forced switch (within three months), the answer reveals a worker's subjective wage at their current outside option. We also elicit a variety of additional beliefs about the external labor market. To compare these beliefs with empirical proxies for actual outside options, we draw on a link of the survey to administrative matched employer-employee data (SOEP-ADIAB) covering the universe of employment subject to social security.

To approximate outside options, we construct firm-level proxies that draw on the realized wage changes of respondents' coworkers who leave their firm.² In our main specification, we draw on wage changes of coworkers who experienced at least a brief unemployment spell before transitioning to a new employer, to isolate arguably involuntary moves (consistent with our survey question) and to produce a conservative benchmark.

Our main finding is that workers anchor their beliefs about wages with other employers on their current wage: workers believe their outside option is much closer to their current

¹Robinson (1933), p.296, describes the sources of frictions in the labor market: "There may be a certain number of workers in the immediate neighbourhood and to attract those from further afield it may be necessary to pay a wage equal to what they can earn near home plus their fares to and fro; or there may be workers attached to the firm by preference or custom and to attract others it may be necessary to pay a higher wage. Or ignorance may prevent workers from moving from one to another in response to differences in the wages offered by the different firms." (Our emphasis.)

²Identifying workers' outside options is notoriously challenging. See Lachowska (2016); Caldwell and Harmon (2019); Caldwell and Danieli (2018); Jäger et al. (2020); Schubert, Stansbury, and Taska (2021); Di Addario et al. (2021) for recent work on the effect of outside options on wages.

wage than it actually is. Workers' expectations for their own wage change are tightly compressed around zero—even for workers in low-wage firms, where coworkers actually experience large positive wage changes upon leaving. We estimate a slope of 0.089 (SE 0.045) between predicted own wage changes and actual coworker wage changes. This slope is, first, far from the benchmark slope of 1 that would emerge if workers' beliefs exactly tracked the actual wage changes of movers and, second, much closer to a slope of 0, which would emerge if workers' beliefs were completely anchored in their current wages and not responsive to outside options as identified by coworker wage changes.

Workers' widespread beliefs that they would earn a very similar wage at their outside option are hard to square with the large body of evidence on substantial between-firm wage differentials (see, e.g., [Card et al., 2018](#); [Bonhomme et al., 2020](#), for overviews of the literature), as well as the large and heterogeneous wage effects of job loss ([Jacobson, LaLonde, and Sullivan, 1993](#); [Schmieder, von Wachter, and Heining, 2018](#); [Lachowska, Mas, and Woodbury, 2020](#)). Our findings also stand in contrast to predictions by academic experts in labor economics (following [DellaVigna and Pope, 2018](#)), who predicted workers' beliefs to be much more in line with actual coworker wage changes, with an implied slope of 0.708.

A series of robustness checks confirm our main result on anchoring. To reduce the influence of measurement error, our preferred specification uses an Empirical Bayes shrinkage procedure of coworker wage changes, and we provide further robustness checks with split-sample IV measurement error correction ([Drenik et al., forthcoming](#)). Our results are also robust to restricting to observably similar coworker movers and to including all moves rather than just “involuntary” moves. In addition, while our main design relies on firm-level outside option proxies, we also account for individual-specific outside options drawing on a richer set of covariates. To do so, we use a machine learning model to predict respondents' wage changes if they switched firms, drawing on the universe of employment-to-employment transitions involving an intermediate unemployment spell in the German labor market (again to proxy for forced moves and identify outside options). We still find a slope close to zero between beliefs and this alternative proxy for objective outside options.

We next turn to beliefs about the external labor market, which we can directly compare to objective benchmarks. We measure respondents' beliefs about the wage change experienced by the typical coworker leaving their firm—which we can directly compare to its empirical counterpart in the administrative data. We confirm our main result on

the anchoring of beliefs, with an estimated slope of 0.14 (SE 0.051) between workers' beliefs and actual coworker wage changes, relative to the perfect-accuracy benchmark of 1. Corroborating the interpretation of coworker wage changes as a relevant signal for workers' outside options, we also verify that workers' beliefs about own and coworker wage changes are highly correlated, and that our SOEP sample's previous wage change upon switching was predicted by their previous firms' coworkers' wage changes upon leaving. We also uncover biases in beliefs about the external labor market, which are consistent with anchoring in beliefs: too many workers rank themselves roughly in the middle of the occupation-specific wage distribution. Finally, workers on average underestimate the median salary in their occupation, even in a robustness check with an incentivized belief elicitation.

Our findings raise and substantiate the possibility that workers' biased beliefs about outside options may help sustain wage markdowns and wage dispersion, as hypothesized by [Robinson \(1933\)](#). We formalize this mechanism in a simple equilibrium model of the labor market where a fraction of workers face costs of acquiring information about the wage distribution. As a result, workers' prior beliefs about outside options affect whether they search, which firms anticipate and strategically exploit. Intuitively, if workers underestimate the wages at other firms, low-wage firms can keep more (biased) workers and push down their wage. We show that anchoring can lead to unraveling of the competitive, single-wage equilibrium and give rise to a segmented labor market equilibrium with a high- and a low-wage sector. The model further features sorting: workers who underestimate their outside options are concentrated in the low-wage sector while workers with accurate beliefs move to the high-wage sector. This model is in the spirit of the product market model of [Salop and Stiglitz \(1977\)](#), which we adapt to the labor market and enrich with the possibility of biased beliefs about the external wage distribution in the form of anchoring.

We provide several empirical tests to assess whether the misperceptions we document have allocative consequences in line with the model's predictions. First, we show that as predicted by the model, the most biased workers sort into the low-wage sector: workers employed in firms with low [Abowd, Kramarz, and Margolis \(1999\)](#) firm effects (low-AKM firms) strongly underestimate mover wage gains, while workers in high-AKM firms hold relatively more accurate beliefs.

Second, misperceptions may be key to sustaining the viability of many jobs, in particular in the low wage sector: a back-of-the-envelope calculation reveals that between 10%

and 17% of employment relationships would not be viable at current wages if workers had accurate beliefs. The fraction increases to about between 21% and 35% among those in the bottom quintile in terms of their AKM firm effect, where workers underestimate their outside option the most.

Third, we confirm that worker beliefs predict intended search and bargaining behavior—even when controlling for the objective outside option (coworker wage changes). This validation supports the crucial role of beliefs for search decisions in the model. Relatedly, misperceptions are not exclusive to non-searchers, but extend to—and hence plausibly affect behavior of—respondents who recently switched firms, report high job search intentions, or work in firms with high turnover. In sum, our evidence shows that misperceptions are pervasive and have allocative consequences in line with our model’s predictions.

Several pieces of existing evidence about worker beliefs are consistent with our main finding, that workers anchor their beliefs about the outside labor market on their current employment conditions and insufficiently adjust away from this baseline, consistent with an anchoring-and-adjustment heuristic (Kahneman and Tversky, 1974). First, unemployed job seekers anchor their reservation wages on their own pre-job-loss salary (Feldstein and Poterba, 1984; Krueger and Mueller, 2016; Le Barbanchon, Rathelot, and Roulet, 2019; Koenig, Manning, and Petrongolo, 2020), and insufficiently update their beliefs as their duration of unemployment grows (Spinnewijn, 2015; Mueller and Spinnewijn, 2021), though they sometimes do so in response to realized wage offers (Conlon et al., 2018), again consistent with imperfect knowledge about outside options.³ Second, workers anchor on their own wage when forming beliefs about the wage distribution in their firm or sector (Cullen and Perez-Truglia, 2018b; Hvidberg, Kreiner, and Stantcheva, 2020) or at different locations (Baseler, 2019). Third, the effects of information treatments regarding the wages of others in the same firm or labor market (Card et al., 2012; Cullen and Perez-Truglia, 2018a; Roussille, 2021) or of pay transparency laws (Baker et al., 2019; Perez-Truglia, 2020) suggest the existence of systematic worker misperceptions.

Relative to the existing literature, our key novelty lies in directly measuring beliefs about outside options in the labor market, in comparing quantitative beliefs with objective benchmarks for actual outside options, and in investigating the equilibrium consequences of misperceptions of outside options among employed workers.

Our study can be viewed as an update of Reynolds’s (1951) survey of about 1,000

³See also Skandalis (2018); Altmann et al. (2018); Belot, Kircher, and Muller (2019); DellaVigna et al. (2017, 2020); and Abebe et al. (2020) for evidence on the role of beliefs and information among unemployed job seekers, and Mueller and Spinnewijn (2021) for a survey of the literature.

manual workers in New Haven between 1946 and 1948. He concludes that “very few [workers] knew [...] how much they could expect to earn per week [at other plants], or what the nonwage conditions of employment were like” (p. 84). Similarly, the typical worker “has no idea of the full range of jobs, wage rates, and working conditions prevailing in the area” (p. 85). Consistent with our finding that workers in low-paying firms believe that a substantial share of employers have yet lower wage policies, Reynolds also finds that, contrary to reality, workers in low-paying firms overwhelmingly believe that their employers’ wages are higher than wages elsewhere.

Section 2 summarizes the data. Section 3 compares subjective and objective outside options. Section 4 sketches a simple equilibrium model of inattentive workers and the associated monopsony power, and Section 5 provides evidence consistent with the model’s predictions. Section 6 concludes.

2 Data

Section 2.1 describes our survey measure of workers’ beliefs about the wage change if switching to their outside option. Section 2.2 explains the German Socio-Economic Panel, into which we integrated our questionnaire, along with the additional information collected. Section 2.3 describes the merge with administrative matched employer-employee data. We also conducted a robustness survey and an expert survey (for an overview of our surveys, see Appendix Table A.1), which we describe as we draw on them when describing our results in Section 3.

2.1 Survey Measure of Outside Option

Wage at Outside Option Our main question elicited employed respondents’ expected wage change if forced to switch out of their current job:

Imagine that you were forced to leave your current job and that you had 3 months to find a job at another employer in the same occupation. Do you think that you would find a job that would offer you a higher overall pay, the same pay or a lower pay?

For respondents who did not choose “Same pay,” we elicited the size of the expected

increase/decrease.⁴ In Section 3.4, we show that our results are robust to different belief elicitation formats (e.g. eliciting the level of the wage at the outside option) and to a different way of framing the reason for the worker’s separation.

Beliefs About the External Labor Market In addition to this measure of the perceived personal outside option, we collected a rich set of beliefs about the external labor market, specifically about (i) wage changes of coworkers moving away from the current employer, (ii) the respondent’s within-occupation rank in the wage distribution, and (iii) the median wage in the respondent’s occupation. We discuss these questions in Section 3.3.

2.2 The German Socio-Economic Panel (SOEP)

SOEP Innovation Sample We implemented these survey questions in cooperation with the Innovation Sample of the German Socio-Economic Panel (SOEP-IS). The SOEP-IS is a longitudinal study that surveys a representative sample of the German population on a wide range of topics once a year. The sample design and core fieldwork are identical to that of the SOEP-Core samples (see Richter and Schupp, 2015, Zweck and Glemser, 2020, and Zweck and Rathje, 2021, for details on sampling methods). Our questionnaire was fielded in the samples I1/IE, I2 and I5, and its members had been part of the panel since 2009/2012, 2012, and 2016, respectively.

The SOEP is a probability-based sample with high representativeness and response rates through multi-month recontact strategies. For our questionnaire, face-to-face interviews were conducted in private with each member of a household by trained interviewers (and about 30% of interviews in the 2020 wave were conducted over the phone; Zweck and Rathje, 2021). The face-to-face nature of the interviews results in higher quality of responses by allowing for clarifying questions, and decreasing non-response rates. Our module took on average 5 minutes. The full questionnaire is in Appendix G.1 (English translation) and Appendix G.2 (original German version).

2.3 Administrative Data on Objective Outside Option

Our paper is part of a project linking SOEP data and individual-level administrative labor market data from the IAB covering at most 1975 to 2019. As part of the 2018 wave, SOEP

⁴The brackets (in Euro) our respondents could choose from are given as follows: [0-50; 50-100; 100-200; 200-300; 300-400; 400-500; 500-750; 750-1000; 1000-1500; 1500-2000; 2000-300; >3000]

respondents were asked for consent to link their SOEP data with IAB data. The linkage procedure used respondents' names, gender, date of birth, and address (see [Antoni, 2021](#), for a detailed description).

Sample Our sample condition is full-time or part-time employment. Our survey was fielded as part of the Innovation Sample in September 2019 and September 2020 (for details see [Zweck and Glemser, 2020](#), and [Zweck and Rathje, 2021](#)). Table [1](#) describes the main analysis sample which relies on the matched SOEP-IAB sample. The match rate among consenters was 87.2%, leaving 516 individuals (606 observations) in our matched sample. We use the universe of the IAB data to construct proxies for outside options for the SOEP respondents, using wage changes of coworker movers, AKM firm effects, and predictions based on a machine learning procedure; we describe these outside option proxies in Section [3](#). In some of our analyses we rely on the SOEP-IS sample with 1,896 observations from 1,222 individuals (described in Appendix Table [A.2](#)). We winsorize all continuous variables at the bottom 2% and top 2% of the distribution.

3 Biases in Beliefs About Outside Options: Evidence

In this section, we describe the distribution of workers' beliefs about wages at their outside options. We then compare workers' beliefs to empirical proxies for their actual outside options. We find that workers employed in objectively low-wage firms underestimate their outside options, while workers in high-wage firms have more accurate beliefs. Workers also similarly misperceive broader features of the external labor market: the wage changes experienced by coworkers leaving their firm, their own rank within their occupation's pay distribution, and the median salary in their occupation.

3.1 Research Design

Figure [1](#) displays hypothetical relationships between workers' subjective wage changes at their outside options and the actual wage change at these outside options.

Homogeneous Bias Panel (a) of Figure [1](#) shows scenarios which share a slope of 1, meaning that in each scenario all workers share the same degree of bias. The scenarios differ, however, in the value of the intercept. When the intercept is at zero, workers' beliefs about the wage changes at their outside options are unbiased—workers throughout the outside

option distribution know exactly what they would make if they were to switch to their next-best employer. A negative intercept with a slope of 1 means that workers homogeneously underestimate their outside options, no matter their current firm's pay premium, while a positive intercept with a slope of 1 corresponds to homogeneous overestimation.

Heterogeneous Bias: The Role of Anchoring In Panel (b) of Figure 1, the slope is less than 1. Here, workers believe their outside option is closer to their current wage than it actually is: workers *anchor* their belief about their outside option on the wage they receive at their current firm. Lower slopes mean stronger anchoring. If the intercept is 0, this leads workers with a positive actual wage change to underestimate it, while workers with a negative actual wage change overestimate it. The intercept governs the cutoff point above which workers switch from underestimating to overestimating their outside options.

A Simple Interpretative Framework: Bayesian Updating In Appendix C, we present one potential, simple framework describing workers' belief formation, to rationalize the belief structure depicted in Figure 1 Panel (b). Workers do not know the shape (mean) of the (normally distributed) wage distribution and use the current wage as a signal about the mean—which results in anchoring. Workers' subjective wage changes if moving to the outside option are a linear function of the objective wage change, with the slope of this relationship shaped by the extent of anchoring on the current wage, given by the relative (subjective) precision of the signal—compared to the precision of the prior. While the framework in Appendix C illustrates how anchoring can arise in a Bayesian learning model, anchoring can also arise with non-Bayesian belief formation (Tversky and Kahneman, 1973).

3.2 Beliefs About Own Wage Changes Following Job Switches

The graphical illustration of our research design in Section 3.1 drew on two concepts: beliefs about wage changes if forced to move to one's outside option, and the corresponding true wage changes. We now report summary statistics of our main outcome variable and construct the empirical analogs to the constructs from Section 3.1.

Cross Sectional Summary Statistics Our survey question elicits workers' beliefs about outside options. Figure 2 report the summary statistics of our main variable: the difference between a worker's current wage and their expected wage if they were forced to leave their

job (i.e., the wage at their outside option). We report this wage difference in Euro and as a fraction of the current salary. (Here, we report on the full SOEP-IS sample, for which Appendix Table [A.2](#) reports broader summary statistics; Table [1](#) reports the corresponding subjective outside option statistics for the sample merged with the administrative IAB data, the analysis sample we draw on in the subsequent sections.)

As a fraction of the salary, the median (mean) wage difference at the subjective outside option is 0% (-0.5%). It is 0 (-601 Euro) in money units at an annual horizon. The distribution is symmetric around zero, with a large mass at or close to zero. The 10th (90th) percentile is -13.5% (11.9%), i.e., workers at those percentiles believe they would make 13.5% less (11.9% more) when switching to the next-best employer. On average as well in the extremes, these numbers are small and reflect a considerable compression around zero.

Validation: Persistence of Beliefs In Appendix Figure [A.5](#), we conduct a simple within-worker assessment of belief persistence by scatterplotting and regressing the first and second waves of the subjective wage change against each other. The slope is statistically significant and between 0.29 (SE 0.03) and 0.46 (SE 0.04) for the percent and Euro specifications, respectively. Worker beliefs thus have a significant persistent component, with the remaining gap to a slope of 1 accounted for by either measurement error or shocks to fundamentals or beliefs at the annual horizon. Since this measure will be our *dependent* variable, classical measurement error in this variable would not attenuate the slope of our main results. (We deal with measurement error in the independent variable with multiple strategies below).

Actual Outside Options Specifying and quantifying workers' outside options is notoriously challenging; we use plausible empirical proxies, and show robustness to several alternative measures of actual outside options. In Section [3.3](#), we additionally examine beliefs we can directly compare to the truth: those about the wage changes experienced by coworker movers, about the median salary in a SOEP respondent's occupation, and about a SOEP respondent's pay rank in their occupation.

Validation: Behavior and Beliefs In Section [5.3](#), we further empirically validate our measure of beliefs about outside options by relating them to respondents' labor market behavior and history.

3.2.1 Main Benchmark: Wage Changes of Involuntary Coworker Movers

Figure 3 Panel (a) presents results using our main outside option proxy: the mean log wage change experienced by the respondent’s coworkers (workers in the same establishment) who left the firm involuntarily in the past 5 years (between 2014 and 2019). We focus on plausibly involuntary co-worker moves because our survey supposed the worker “was forced to leave [their] current job.”

Identifying Involuntary Coworker Moves We identify “involuntary” moves by selecting coworker moves to another employer that involve an intervening unemployment spell. Specifically, we require unemployment insurance receipt beginning within 12 weeks of leaving the original employer, and before joining another employer, as German unemployment law offers unemployment insurance after voluntary separations, but only after a 12-week waiting period (§159 *Sozialgesetzbuch III*)⁵ We also require full-time work at their original and new employers. Our benchmark is likely conservative (i.e., selects more negative wage changes) for the average wage change, as not all involuntary moves involve intermediate unemployment.

Results In Figure 3 Panel (a), we restrict the sample to SOEP respondents with at least one such coworker mover, and plot these respondents’ beliefs against the actual mean wage changes of coworker movers.⁶ In our preferred specification, we use an Empirical Bayes shrinkage of the mean wage changes to account for measurement error and also report the unadjusted slope. As in all following specifications, we calculate standard errors by clustering at the individual level. Compared to a perfect-information benchmark slope of 1, the empirical slope is almost flat, at 0.089 (SE 0.045). That is, worker beliefs about their wage change when forced to leave are, on average, only 0.89 percentage points higher in a firm where out-movers on average experience a large, positive, 10% wage increase, compared to a firm with a zero average wage change for out-movers—indicating substantial underestimation of outside options in such firms. Conversely, in firms where movers experience large wage decreases when leaving, workers are substantially more optimistic than is warranted by the mover benchmark.

⁵In Appendix Figure A.6 Panel (a), we replicate the Card, Cardoso, and Kline (2015) test for the exogeneity of these moves. The absence of pre-trend and the symmetric step-like pattern of wage changes supports the identification assumption required to interpret these fixed effects as firm-level pay premia (rather than being due to sorting or worker-firm match effects).

⁶As a robustness check, Appendix Figure A.8 reports analogous results from a specification using all coworker moves (rather than ones with intermittent unemployment spells) to construct the benchmark.

Benchmark: Expert Survey The estimated slope contrasts starkly with the benchmark unbiased slope of 1, and also contrasts with the prior beliefs of 151 experts, academic economists in labor economics and in behavioral economics, from whom we elicited beliefs about the relationship between actual mover wage changes and workers' belief about their own wage changes when forced to leave. Appendix [D](#) describes the expert sample. Experts think that worker beliefs covary much more strongly with actual mover wage changes than they do, with an implied slope of 0.708.

Robustness: Mass Layoffs In Appendix [F.1](#), we devise an indirect strategy showing robustness of our main results to using wage changes from mass-layoff events (which are plausibly more likely to be exogenous) as the benchmark.

Robustness: Measurement Error The flat slope may reflect attenuation due to measurement error arising from idiosyncratic variation in mover wage changes rather than systematic components that carry over to the respondent. We address this concern with five strategies. First, as mentioned above, our preferred specification draws on an Empirical Bayes procedure to shrink mean coworker wage changes to the sample mean ([Morris, 1983](#); [Chandra et al., 2016](#)). Figure [3](#) also reports the slope without adjustment for measurement error at 0.029 (SE 0.019). Second, we implement a simple split-sample procedure ([Drenik et al., forthcoming](#)) by partitioning each firms' movers into two random samples and using mover wage changes in one sample as an instrument for the other sample's wage changes. We report the first stage relationship in Appendix Figure [A.7](#), with a slope coefficient of 0.50. In Figure [3](#), we report the resulting instrumental variables estimate, with a slope of 0.049 (SE 0.061), thereby leaving our conclusion based on the OLS specification unchanged. Third, we restrict the sample to workers for whom we observe at least 20 coworker out-moves. We report these (quantitatively similar) results in Panel (a) of Appendix Figure [A.9](#). Fourth, as an additional robustness check, we also report mover changes calculated over different horizons (2017 to 2019) and using the median rather than the mean (Appendix Figure [A.13](#)). Fifth, we validate the predictiveness of the coworker move benchmark for the wage changes SOEP respondents did actually experience in the past. We use the administrative panel data to track each SOEP respondent to their previous workplace and regress their wage change when leaving that workplace against the mean log wage changes of involuntary movers out of that previous workplace in the 5 years preceding the SOEP respondent's exit. The results show a strong and statistically

significant slope of 0.24 (SE 0.022) even without an Empirical Bayes or split-sample correction (see Appendix Figure [A.6](#) Panel (b)).⁷ Hence, our core conclusions remain robust across specifications.

Robustness: Alternative Comparison Groups Perhaps the coworkers we select as benchmarks may not be sufficiently representative of the SOEP respondent. Appendix Figure [A.8](#) considers *all* coworker moves rather than just involuntary moves (we find an almost identical slope of 0.083, SE 0.047). In Appendix Figures [A.9](#) and [A.10](#), we then begin with the set of all coworker moves and restrict to coworker movers that are similar to the SOEP respondent: within the same occupation, education band, earnings quintile, or age band. (Imposing these restrictions as well as our “involuntary moves” restriction would result in insufficiently large sample sizes.) Again, the results are very similar to our main results.

Robustness: Excluding Zeroes Our main survey question asks whether workers would find a job with “higher pay,” “the same pay,” or “lower pay,” and then only asks about the size of the wage change for respondents choosing the first or third option. Perhaps these initial discrete answers bias people towards reporting “the same pay” and hence zero. However, our main results are robust to excluding respondents who answered “the same pay” (Appendix Figure [A.10](#) Panel (c)).

3.2.2 Additional Benchmark: Individual-Level Machine Learning Predictions

As an alternative benchmark, in Panel (b) of Figure [3](#) we draw on a machine learning model to predict SOEP respondents’ wage changes, based on a rich set of covariates.

Methodology In our overall sample of “involuntary” movers in the administrative data (omitting SOEP respondents), we estimate a Lasso model where the dependent variable is the log wage change of the mover. As predictors, we use individual- and firm-level covariates and their interactions.⁸ Calculations of partial R^2 values indicate that the key

⁷Previous moves of the worker include both voluntary and involuntary moves, while the co-worker moves are restricted to involuntary moves. We found a larger slope, 0.82, when using both voluntary and involuntary moves for co-workers as well.

⁸The covariates are workers’ own wage at the initial firm, the firm effect of the initial firm, age (cubic), gender, tenure (cubic), education categories, size of initial firm, separation rate of initial firm, standard deviation of wages at initial firm, employment growth at initial firm, industry (NACE Level 1), state (16 *Bundesländer*), occupation (1-digit), and interactions of age \times education and industry \times region.

covariates are the mover’s wage at their initial firm, initial firm’s AKM effect, and gender, occupation, industry, and age \times education. The Lasso procedure has moderately strong out-of-sample fit based on a test where we split our set of movers into random training and evaluation samples and estimate the model purely on the training sample; the model explains 40% of the variance in log wage changes in the evaluation sample. Appendix E presents the full results of the prediction model, including out-of-sample performance and the partial R^2 values of selected covariates.

Results Panel (b) of Figure 3 reports results using this benchmark. We find quantitatively similar results to those using the wage changes of involuntary coworker movers, with a slope of 0.067 (SE 0.014).

3.3 Beliefs About the Wage Distribution

As an additional assessment of misperceptions about the external labor market, we elicit beliefs about objective aggregate statistics, the accuracy of which we can assess more directly than when proxying for personalized outside options. We document similar anchoring phenomena, i.e., workers believe they are in the middle of the wage distribution in their labor market.

Coworker Wage Changes First, we ask SOEP respondents about the wage changes experienced by typical coworkers moving out of their firm.⁹ For this belief, we can directly calculate the benchmark in the matched survey-administrative data by looking at the wage changes of all movers leaving the SOEP respondent’s firm in the past 5 years—our previous outside option proxy, but looking at all moves instead of just involuntary ones. Figure 4 Panel (a) reports the same specification as Figure 3 Panel (a) but with SOEP respondents’ beliefs about non-hypothetical coworker wage changes as the y-axis variable, and the mean log wage change of all coworker movers as the x-axis variable.

We find patterns similar to the bias we found in beliefs about own wage changes. In the data, workers in firms where coworkers fare well when leaving (i.e., on the right of the graph) underestimate wages increases among movers: their beliefs are substantially below the diagonal. By contrast, workers in firms where coworkers experience small

⁹Specifically, we ask: “Think of the typical employee with work experience that switches from your current employer to another employer. Would this employee receive a lower, higher or the same pay compared to his previous employer?” We then give respondents not answering “same pay” specific bins of average wage changes as before.

decreases or no changes in wages have more accurate beliefs. The slope is 0.140 (SE 0.051), a substantial departure from the unbiased slope of 1. As before, we correct for measurement error in movers' wage changes with an Empirical Bayes procedure; we also report the similar slope from a split-sample IV strategy. Finally, we report the standard battery of robustness checks—restricting to groups of observably similar coworkers, or dropping respondents who predict zero wage changes for movers—in Appendix Figures [A.9](#) and [A.10](#), finding consistent results.

Figure [4](#) Panel (b) also shows a strong correlation between workers' beliefs about their own wage change and their beliefs about coworker wage changes, with a slope of 0.416 (SE 0.042). This fact additionally corroborates our use of coworker wage changes as a proxy for workers' outside options, as evidently workers believe that the wage changes of typical coworker movers are informative about the wage change they themselves would experience if leaving.

Rank Within Occupation We next draw on a question about worker's subjective salary rank within their occupation, and compare this belief to their objective rank (calculated from the administrative data, at the four-digit occupation level (*Berufsuntergruppe*) using workers' daily salary and a lower bound of minimum wage earnings at 6 hours per work day).¹⁰ The histogram in Figure [5](#) Panel (a) reports the distribution of respondents' beliefs (blue solid bars) and the empirical objective benchmark (light red). In an additional robustness experiment, we show that we find similar patterns in beliefs about the firms' wage rank when these beliefs are not occupation-specific (see Section [3.4](#)).

Once again, we find evidence consistent with workers anchoring their beliefs about the external labor market in the wages of their current employer. Workers' subjective ranks are substantially compressed towards the 50th percentile, with over half of respondents believing themselves to be within the 40th and 60th percentile. In the data, only 19% of workers actually rank in that interval. Similarly, there is a missing mass of beliefs at the tails: only about 5% of workers believe that they rank in the top or bottom decile of wages in their occupation, even though the data suggests that 17.6% of workers are in those categories. (Discrepancies from 20% may reflect sampling or measurement error.) In sharp contrast to the bell-shaped distribution of beliefs, the empirical distribution is nearly uniform thanks to the representativeness of the SOEP sample. Panel (b) of Figure [5](#)

¹⁰The exact question was: "Think of all employees in Germany that work in the same occupation as you, but work at a different employer. What do you think: what percent of these employees receive a [lower pay/same pay/higher pay]?"

plots worker's subjective salary rank within their occupation against their objective rank. Once again, we find evidence for anchoring as low-ranked workers overestimate their rank and high-ranked workers underestimate their rank. Rather than a slope of 1 that would obtain if beliefs accurately tracked the objective rank, we find a slope of 0.185 (SE 0.028), so that an increase workers' actual pay rank by ten percentile ranks is accompanied by less than a 2 percentile rank increase in their perceived rank.

Median Salary in Occupation Finally, we elicit beliefs about the median salary in a worker's occupation (pre-tax salary of full-time workers).¹¹ Similar to the question about occupational rank, it measures beliefs about the wage distribution in the occupation, but is less vulnerable to issues such as central tendency bias that may arise with bounded scales. In our SOEP survey, we provided a simple explanation of the concept of a median and now compare answers to the most recently available information from the Federal Employment Agency.¹²

Appendix Figure A.4 plots histograms of workers' bias about the median salary in their occupation. On average, workers are overpessimistic: the mean and median biases are -4.12% (SE 0.74ppt) and -6.98% (SE 0.93ppt), with substantial dispersion (SD of 29.06ppt). We also find that the median salary bias is very persistent, with a slope coefficient of 0.61 (SE 0.04) in a regression of the 2020 bias on the 2019 bias measure (implying an SD of 21.25ppt of the permanent component of the bias, e.g., net of transitory measurement error).

3.4 Robustness: Survey with Alternative Elicitations

A potential concern with our main evidence could be that it is driven by the particular wording of our survey questions. While our main result on the anchoring of beliefs, i.e., the flatness of beliefs about outside options with respect to objective outside options, should not be affected by question wording, we still gauge robustness to alternative question formulations by running an online survey. We did so by surveying a sample of 902 workers broadly representative of the German population in full-time and part-time employment

¹¹The exact question was: "Think of all employees in Germany that are full-time employed and work in the same occupation as you. What do you think is the typical monthly pay of these employees before taxes (in Euro)?"

¹²The SOEP-IS 2019 was fielded in September and October of 2019; the salary information is based on a reference date of December 31, 2018. The salary information was provided to us by the Federal Employment Agency's Statistics Group based on the universe of full-time employment subject to social security and corresponds to median monthly salaries for five-digit occupations (*KldB 2010*).

in terms of age, income, education, gender and region (see Table [A.8](#)). The data collection took place in July 2021 and was conducted with Dynata, a professional survey company widely used in the social sciences ([Haaland, Roth, and Wohlfart, 2021](#)). Appendix [F.2](#) provides details on these data, and Appendix [G.3](#) presents the survey instructions.

Level versus Change Elicitation We confirm robustness to eliciting the wage level at the outside option rather than the change relative to the current wage. We randomized half of our respondents to receive the same belief elicitation as in the SOEP (wage change), the other half was asked about the level of earnings at the outside option. We also cross-randomized whether we included a reminder of the respondent’s current pay. Appendix Figure [A.21](#) Panel (a) plots the distributions of responses under the two elicitations; the distribution under the “levels” elicitation is only somewhat less compressed compared to the SOEP-style elicitation and the mean and median subjective beliefs are virtually identical. The interquartile range under this alternative elicitation is between -9% and 4%, compared to -4% and 0% under the SOEP elicitation (see Appendix Table [A.8](#)).

Coworker Changes In the robustness survey question which measures beliefs about coworker wage changes, we also randomly varied whether we offered the “Same pay” category as a response option. For some respondents, we did not offer any discrete response categories, but instead asked them directly to enter the percentage wage change. Even though this alternative elicitation deliberately pushes people away from zero by forcing them to express a decrease or an increase, we still find a large mass of data around zero, with the median belief about leavers’ wage changes at 5% (see Appendix Table [A.8](#)). The interquartile range under this alternative elicitation is between -5% and 10%, though naturally this is far less compressed compared to the original elicitation which offers the “Same pay” option to respondents (see Appendix Figure [A.21](#) Panel (b)).

Time Window Our SOEP survey specified 3 months for the time to find another job. In our robustness survey, we show that randomizing this duration between 3 months or 12 months makes little difference for respondents’ subjective outside options (Appendix Figure [A.21](#) Panel (c)).

Reason for the Separation Our SOEP question evoked an exogenous, involuntary separation, but did not specify a specific context or reason. Our robustness survey specifies

an unexpected company closure, which barely affects responses (Appendix Figure [A.21](#) Panel (d)).

Occupation-Specific Search Our SOEP survey elicited respondents’ outside options conditional on staying in the same occupation. Our robustness survey reveals that randomizing the occupation conditioning versus permitting occupation switches has almost no effects on beliefs (Appendix Figure [A.21](#) Panel (e)).

Perceived Employer Rank and Occupation-Conditioning Measurement error in workers’ perceived occupations could push us to find an increased mass in the middle of the distribution, for example, if workers think of finer occupational categories compared to the official occupational classification.¹³ The robustness survey reveals that randomizing whether these beliefs were elicited conditional on occupation make relatively little difference for beliefs about the fraction of other employees who receive a lower pay (Appendix Figure [A.21](#) Panel (f)).

Robustness to Prediction Incentives To assess the role of effort in shaping response quality, we cross-randomized 5 Euro prediction incentives in the robustness survey for the question about the median pay in the occupation (for which we had an objective non-confidential benchmark). This prediction incentive makes little difference (Appendix Figure [A.22](#)), suggesting that inattention and low effort are unlikely to drive our results, at least for the occupational wage question.

4 Misperceptions in Action: A Simple Equilibrium Model

In standard labor market models, all workers have unbiased beliefs about the wage distribution in the external labor market. Monopsony power usually arises either from search or mobility frictions ([Burdett and Mortensen, 1998](#)), or because of idiosyncratic tastes among workers for firm-specific amenities ([Card, Cardoso, Heining, and Kline, 2018](#)). Motivated by our Section [3](#) findings, we explore ignorance and biases in beliefs about the wage distribution as another source of monopsony power. In our model, firms set wages

¹³To illustrate, two workers might correctly respond that they earn the median pay of restaurant or bank managers, respectively. If our occupation category is coarser (managers), then we would erroneously conclude that made a mistake by classifying themselves as median earners as the restaurant manager is a low and the bank manager is high earner within the coarser category of overall managers.

competing for imperfectly informed workers, who may misperceive the wage distribution. Specifically, workers form beliefs about their outside option based on their current employer’s wage—generating the kind of anchoring we document in the data. When search is largely costless, a competitive equilibrium with a single wage emerges. Worker search makes paying a lower wage unprofitable. However, when search is costly for a substantial share of workers, firms can mark down wages.¹⁴ Workers’ misperceptions about outside options further aggravate markdowns by biasing their reservation wages. A segmented, or dual, labor market emerges, with a competitive high-wage sector and a low-wage sector in which low-wage firms employ uninformed workers who underestimate their outside options. Misperceptions in the form of anchoring on the current wage increases the size of the low-wage sector and pushes down its wage. In Section 5, we show evidence that supports several key ingredients of the model.

4.1 Setup

Environment The timing of our model is as follows. First, N homogeneous firms enter the labor market and decide what wage to post. We take firm count N as given. Second, L workers are randomly assigned to firms and supply labor inelastically (but may switch firms), learn the wage w_f paid by their initial firm f , and potentially update their beliefs about the external wage distribution. Third, workers choose whether to stay at their current firm, or pay an information acquisition cost c (which differs across otherwise homogeneous workers) to perfectly learn the wages paid by other firms and move to the highest paying firm, which pays w^{\max} . Finally, production occurs and wages are paid.

¹⁴This aspect of our model can be read as taking the spirit of the Salop and Stiglitz (1977) model of monopolistic competition in product markets and adapting it to the labor market, as well as augmenting it to feature biased beliefs of workers. The Salop and Stiglitz (1977) model is a model of monopolistic competition in the product market with frictions featuring two types of consumers, who differ only in the cost of information gathering. Depending on the level of the search costs, a two-price equilibrium can emerge. Consumers have accurate beliefs in Salop and Stiglitz (1977), lacking knowledge of which specific firms charge which specific prices but correctly understanding the statistics of the price distribution. Like the Salop and Stiglitz (1977) model, ours features workers subject to two different information acquisition cost levels, which govern their decision to search. But, in our model, misperceptions may also affect the decision to search by determining workers’ reservation wages. Employers take advantage of potential misperceptions in setting wages. Moreover, our model is a labor market model with an aggregate labor supply and demand curve rather than a product market model, which changes several key intuitions (e.g., a competitive equilibrium emerges for standard Walrasian reasons, and the production function is entirely standard). Our leading example takes the firm count as given and sidesteps free entry.

Workers and Search Each of L risk-neutral workers is initially randomly assigned to one of N firms. A worker assigned to firm j observes its wage policy w_j . After arriving in their initial firm, each worker decides whether to search for a new job or stay put in their initial job.

Workers can pay a cost c_τ to gather complete information about the labor market. Informed workers can switch to their outside option, in this case a job at the highest paying firm. (When there are multiple firms paying the highest wage, we assume searchers distribute themselves equally among them.) A share α of workers are experts ($\tau = E$): they can learn about the labor market at no cost, i.e., $c_E = 0$. The remaining share $1 - \alpha$ of workers are amateurs ($\tau = A$), face a positive cost $c_A > 0$.

Experts always become informed and move to the highest-paying firm. Amateurs' information decision depends on their belief about the benefit of searching, i.e., the difference between their current wage and their belief about the highest wage, denoted $\tilde{w}^{\max}(w_j, \mathbf{w}_{-j})$. Amateurs search if:

$$\tilde{w}^{\max}(w_j, \mathbf{w}_{-j}) - w_j > c_A. \quad (1)$$

The dependence of \tilde{w}^{\max} on w_j captures the fact that workers' own wage can influence their belief about other wages on offer in the market, including the anchoring we document (or belief updating more broadly).

Beliefs We specify beliefs in a simple parametric form that nests accurate beliefs as well as misperceptions—specifically the kind of anchoring our empirical evidence revealed. (Appendix C presents an updating model.) Specifically, a worker earning wage w_j perceives the highest wage to be a weighted average of the actual highest wage and the worker's current wage.

$$\tilde{w}^{\max} = \delta + \gamma \cdot w_j + (1 - \gamma) \cdot w^{\max}. \quad (2)$$

Here, $\gamma \in [0, 1]$ captures the degree of anchoring on the current wage. $\gamma = 0$ implies that beliefs are insensitive to w_j , while $\gamma = 1$ implies full anchoring. Beliefs are accurate if $\gamma = \delta = 0$.

That γ captures the degree of anchoring as in our empirical framework can be seen by reformulating the expression in wage changes (to the outside option, here, the highest

wage):

$$\tilde{w}^{\max} - w_j = \delta + (1 - \gamma) \cdot (w^{\max} - w_j). \quad (3)$$

Our theoretical framework remains qualitative.¹⁵ Below, we consider the case of $\delta = 0$ to isolate the role of anchoring ($\delta = 0$ is quite consistent with our empirical findings).

Firms and Wage Setting Firms produce a homogeneous good using a decreasing-returns production function $f(\ell) = \ell(w)^\eta$, with decreasing returns parameter $\eta \in (0, 1]$. A firm's employment $\ell(w_j | \mathbf{w}_{-j})$ depends on the wage it pays along with those paid by other firms; the shape of this firm-specific labor supply curve will govern firms' wage setting. Given its own wage w_j and the external wage structure of other firms \mathbf{w}_{-j} , firm j 's profits are

$$\pi(w_j | \mathbf{w}_{-j}) = \ell(w_j | \mathbf{w}_{-j})^\eta - w_j \ell(w_j | \mathbf{w}_{-j}). \quad (4)$$

Firm count N is fixed for exposition, so equilibrium profits are positive.¹⁶

4.2 Competitive (Single-Wage) Equilibrium

Expert workers, who become informed at no cost, support a competitive equilibrium. Intuitively, if their share is $\alpha = 1$, the model follows the standard neoclassical competitive equilibrium logic: aggregate labor supply is inelastic, and labor demand is downward sloping (with fixed N given $\eta < 1$). The competitive wage w^* then clears the market subject to the standard profit-maximizing condition of firms, that the marginal product of labor equal the wage:

$$\eta(\ell^*)^{\eta-1} = w^*. \quad (5)$$

Standard Walrasian arguments apply: firms would be unwilling to hire this amount of workers at higher wages (it would be profitable to lay some off) and the market would not clear, hence the wage falls to this level to obtain full employment; similarly, a lower

¹⁵Our empirical specification as percent would simply set δ in percent of the current wage. Hence, estimating our empirical model in this setting recovers a regression coefficient that identifies $1 - \gamma$ in the sample of amateurs in an equilibrium where they do not become informed; a pooled regression across types will require scaling up γ by $\frac{1}{1-\alpha}$ to recover γ .

¹⁶Every firm count N could be rationalized by an upfront entry cost (e.g., for entrepreneurial effort) that will equal ex-post equilibrium profits, which depend on N .

wage is not an equilibrium as some firms could then profitably poach workers by offering slightly higher wages.

Moreover, labor market clearing pins down equilibrium firm size ℓ^* (with labor optimally spread equally across the N homogeneous, decreasing-returns firms):

$$N \cdot \ell^* = L \quad (6)$$

$$\Leftrightarrow \ell^* = \frac{L}{N}. \quad (7)$$

4.3 Conditions for Competitive Equilibrium

A competitive equilibrium obtains if and only if no individual firm wants to deviate from paying the competitive wage w^* . Deviating to a higher wage $w' > w^*$ is surely unprofitable. This leaves $w' < w^*$ as the only feasible strategy. The optimal lower wage such a deviant would pay depends on information costs c , the share of amateur workers $1 - \alpha$, and—our main focus—their beliefs about their outside option, \tilde{w}^{\max} .

By offering a lower wage, a deviant firm immediately loses its expert workers. If its amateur workers also search, employment and profits fall to zero. Hence, a profitable deviation requires wage below w^* but high enough to retain a firm's stock of amateur workers. (We assume that indifferent amateurs stay put.) The reservation wage of amateurs to not become informed (and hence leave the deviant) is given by Equation (1), and depends on both beliefs and search costs:

$$w^r(w_j, \mathbf{w}_{-j}, c_A) = \tilde{w}^{\max}(w_j, \mathbf{w}_{-j}) - c_A. \quad (8)$$

The most profitable deviation is therefore to exactly pay the reservation wage, $w' = w^r(w', \mathbf{w}^*, c_A)$. Using the specification of worker beliefs in Equation (3) and maintaining $\delta = 0$ gives:

$$w' = w^* - \frac{c_A}{1 - \gamma}. \quad (9)$$

For intuition, consider $\gamma = 0$, i.e., accurate beliefs. Here, the deviant's wage pushes the amateur worker to their reservation wage, which is entirely given by the search cost c_A . Now consider the role of anchored beliefs, i.e., $\gamma > 0$. The search cost c_A again enables the deviant to mark down the wage while retaining amateur workers. However, anchoring implies that workers facing a marked down wage become endogenously more pessimistic

about the benefits of search. This further depresses workers' reservation wage, as reflected in Equation (9).

Deviants' profits also depend on scale; since a deviant keeps its amateur workers only, its employment is:

$$\ell(w') = (1 - \alpha) \frac{L}{N}. \quad (10)$$

Together with the optimal wage deviation given by Equation (9), we can write deviant profit as

$$\pi(w') = \left((1 - \alpha) \frac{L}{N} \right)^\eta - \left(w^* - \frac{c}{1 - \gamma} \right) (1 - \alpha) \frac{L}{N}. \quad (11)$$

The competitive equilibrium obtains when deviation is unprofitable, i.e., when employing ℓ^* workers at wage w^* yields higher profits than the best deviation $\pi(w')$:

$$\left(\frac{L}{N} \right)^\eta - \eta \left(\frac{L}{N} \right)^\eta > \left((1 - \alpha) \frac{L}{N} \right)^\eta - \left(\eta \left(\frac{L}{N} \right)^{\eta-1} - \Leftrightarrow \frac{c_A}{1 - \gamma} \right) (1 - \alpha) \frac{L}{N} \quad (12)$$

$$\frac{c_A}{1 - \gamma} < \frac{1 - \alpha \eta - (1 - \alpha)^\eta}{1 - \alpha} \left(\frac{N}{L} \right)^{1-\eta}. \quad (13)$$

Higher search costs c_A tip the economy away from the competitive equilibrium (holding the share of amateurs $1 - \alpha$ fixed). Misperceptions, the degree of anchoring γ , play the same role—consistent with the hypothesis by [Robinson \(1933\)](#) we cited in Footnote 1. Below, we characterize the alternative, segmented equilibrium which arises when the condition (13) does not hold.

4.4 Segmented (Two-Wage) Equilibrium

When information costs or anchoring are sufficiently large to violate the condition (13), a two-wage, or segmented, labor market equilibrium takes its place, with a high wage sector and a low wage sector. Misperceptions, the degree of anchoring γ , support this segmentation.

The logic of the two-wage equilibrium differs qualitatively from the competitive one. As condition (13) is violated, some firms find it profitable to deviate to a low wage w_l . As more firms begin to deviate, more experts flock to the remaining high wage firms. In

equilibrium, the share of firms paying the high wage, denoted β , adjusts so that firms in each sector are equally profitable¹⁷

Firm Size and Turnover by Wage Low wage firms lose their expert workers (who costlessly move to high-wage firms), but retain their amateur workers. Since high wage firms employ their original amateur workers and all expert workers (those initially placed in the high-wage firm plus those separating from the low-wage firms, spread equally across the high-wage firms), the equilibrium employment levels for low- and high-wage firms are:

$$\ell_l = (1 - \alpha) \frac{L}{N} \quad (14)$$

$$\ell_h = \left(1 - \alpha + \frac{\alpha}{\beta}\right) \frac{L}{N}. \quad (15)$$

That is, the model features more turnover in the low-wage sector, consistent with empirical evidence that workers in low-paying industries or firms search and quit more (Krueger and Summers, 1988; Bassier, Dube, and Naidu, forthcoming; Drenik et al., forthcoming; Faberman et al., 2017).

The Wage in the High-Wage Sector *Within* the high wage sector, a sectoral competitive equilibrium emerges: the sector's wage w_h equals the MPL at employment ℓ_h . The reason is that high wage firms' marginal unit of labor is an informed, expert worker, whose ability to search costlessly prevents firms from marking down wages relative to marginal product, much as in the competitive equilibrium above. Any higher wage leads to excess labor supply, and any lower wage entails losing expert workers. This observation, together with firm-level employment from Equation (15) implies

$$w_h = \eta \left(\left(1 - \alpha + \frac{\alpha}{\beta}\right) \frac{L}{N} \right)^{\eta-1}. \quad (16)$$

This equation clarifies that the more firms are in the low-wage sector (i.e., the lower β), the more experts separate from that sector, search, and get spread across the β high-wage firms, pushing down their marginal product and hence the wage they pay, w_h .

¹⁷Because there are only two types of workers, there can be no alternative non-competitive equilibria with more than two wages. Any firm that pays a wage $w \in (w_l, w_h)$ would employ the same number of workers as firms paying w_l but earn lower profits. Paying more than w_h means lower profits than paying w_h , which, we explain below, equals the MPL at high-wage firms.

The Wage in the Low-Wage Sector By contrast, non-competitive forces shape the low-wage sector. Here, as in the discussion of deviation from the competitive equilibrium above, firms simply pay the reservation wage that fulfills workers' participation constraints (now against a maximum wage of w_h rather than w^*):

$$w_l = w_h - \frac{c_A}{1 - \gamma}. \quad (17)$$

Plugging in the high-wage sector's wage w_h from Equation (16) gives the level of the low wage.

The Size of the Low-Wage Sector The equilibrium conditions remain conditional on the share of high-wage firms, β . We pin down β through an indifference condition: the marginal firm—due to ex-ante homogeneity, each individual firm—must be indifferent between entering as a low- or as a high-wage firm, trading off wage savings against loss in scale. Intuitively, β governs the relative profitability of high wage firms by affecting the number of searching workers each high wage firm stands to gain from the low wage sector. The more firms enter the low-wage sector, the more (expert) workers flow into the high-wage sector, scaling up production at each high-wage firm, and raising profits there.

Concretely, profits in the low-wage and high-wage sectors are:

$$\pi(w_l) = \left((1 - \alpha) \frac{L}{N} \right)^\eta - w_l (1 - \alpha) \frac{L}{N} \quad (18)$$

$$\pi(w_h) = \left(\left(1 - \alpha + \frac{\alpha}{\beta} \right) \frac{L}{N} \right)^\eta - w_h \left(1 - \alpha + \frac{\alpha}{\beta} \right) \frac{L}{N}. \quad (19)$$

Profit equalization then implies

$$\pi(w_l) = \pi(w_h) \quad (20)$$

$$\Leftrightarrow 1 - \eta = \left(\frac{1 - \alpha}{1 - \alpha + \frac{\alpha}{\beta}} \right)^\eta \left[\frac{c_A (1 - \alpha)^{1 - \eta}}{1 - \gamma} \left(\frac{L}{N} \right)^{1 - \eta} + 1 \right] - \eta \left(\frac{1 - \alpha}{1 - \alpha + \frac{\alpha}{\beta}} \right), \quad (21)$$

which implicitly gives β as a function of model parameters. In fact, this equation has a solution whenever Equation (13) is violated, i.e., a competitive single-wage equilibrium cannot obtain.

With β in hand, the share of jobs (rather than firms) in the low wage sector is given by:

$$\begin{aligned} S_l &= \frac{(1 - \beta)\ell_l}{\beta\ell_h} \\ &= \frac{1 - \beta}{\alpha/(1 - \alpha) + \beta}. \end{aligned} \tag{22}$$

4.5 The Role of Misperceptions in the Low-Wage Sector and Monopsony

In Figure 6, we illustrate the role of anchoring in amplifying labor market segmentation. The figure plots the share of workers in the low-wage sector as well as the wages paid in each sector.

Panel (a) does so as a function of the degree of anchoring, γ . For low γ , the competitive labor market equilibrium obtains. Here, misperceptions are irrelevant: the competitive equilibrium is sustained by the subset of expert workers, who are informed, and discipline's firms' ability to take advantage of amateurs. However, the higher γ , the larger the temptation to deviate and rip off amateur workers with a lower wage, as their reservation wage falls in the degree of anchoring, γ .

There exists a threshold level γ^* after which the equilibrium becomes segmented, for a given set of other parameters η , c_A , and α , defined in the profitable-deviation condition (13). For higher values of γ , a two-wage, segmented equilibrium emerges. The share of workers in the low wage sector becomes positive. As γ rises, more firms choose to pay a low wage (β falls) and each high wage firm gains a larger number of experts exiting the low wage sector as a result. The high wage then falls to match the declining marginal product of labor. The low wage declines more rapidly however, with the gap between the high and low wage increasing in γ according to Equation (17).

4.6 The Interaction of Standard Frictions and Misperceptions

The left-hand side of condition (13) clarifies an important insight: in generating labor market segmentation and monopsonistic behavior by firms, misperceptions, γ , require some search costs, c_A (otherwise no worker stays put and misinformed), and search costs c_A are amplified by misperceptions (which facilitate firms' gouging of immobile workers). In fact, there is a direct relationship between c_A and γ on the left-hand side of the condition.

Figure 6 Panel (b) illustrates the labor market patterns as in Panel (a), but as a function

of amateurs' search cost c_A , for two economies: a no-anchoring economy ($\gamma = 0$), where workers have accurate beliefs about the wage distribution, and for an anchored economy that mimics, loosely, a very large degree of anchoring as in our data ($\gamma \approx 0.9$). In both cases, there is a cutoff level of c_A before which the economy is competitive, and above which it is segmented, again given by the condition (13).

However, the cutoff value of the search cost c_A required to tilt the economy falls dramatically, by 90%, when $\gamma = 0.9$. Hence, in our model economy, an economist ignoring anchoring and estimating a model with standard search/information costs c only, would dramatically overestimate the level of c_A when seeking to explain the amount of wage dispersion.

4.7 Key Assumptions and Testable Predictions

We close by summarizing three key testable assumptions and predictions of the model, which we test in Section 5. First, the model is motivated by and allows for anchoring of workers' beliefs about their outside option on their current wage. Our empirical evidence in Section 3 presented evidence for this property.

Second, the model assumed that these beliefs shape worker behavior, reservation wage formation, and search decisions. In the next section, we test whether workers' behavior is driven by stated beliefs about outside options rather than objective outside options.

Third, the model shows that even if workers hold biased beliefs and their behavior follows those beliefs, labor market allocations may be indistinguishable from a standard competitive equilibrium if search costs are low. We test this quantitatively by measuring the share of jobs in our data that would be nonviable if workers held correct beliefs—effectively, we check whether misperceptions have bite.

Fourth and relatedly, we test whether segmentation of the labor market equilibrium, a possibility illustrated by the model, is borne out in the data. Specifically, we test whether uninformed workers in our data sort into low-wage firms and underestimate their outside options, and whether workers in high-wage firms hold more accurate beliefs.

5 Misperceptions in Action: Evidence

We now empirically trace the key channels and testable implications of the simple equilibrium model in Section 4. First, we document sorting as predicted by the model. Second, we

calculate the share of employment relationships that would cease to be viable if workers' beliefs were accurate. Finally, we investigate the worker-level link between labor market beliefs and behavior that the model posited.

5.1 Sorting: Do Misinformed Workers Work in Low-Wage Firms?

The model predicted sorting of workers with misperceptions into the low-wage sector. We test for this prediction as follows. First, we measure worker-level misperceptions as the error between subjective and objective labor market statistics, for each of four bias measures. Second, we identify low-wage firms by drawing on [Abowd, Kramarz, and Margolis \(1999\)](#) (AKM) firm effects, a standard measure of firm-specific pay premia. In the German labor market, employer pay policies are an increasingly important determinant of earnings ([Card, Heining, and Kline, 2013](#)). They are also a powerful predictor of wage changes after forced displacement ([Schmieder, von Wachter, and Heining, 2018](#)).¹⁸ Indeed, in our sample, we find a large negative slope of -0.474 (SE 0.099) when we plot actual (SOEP coworker) mover wage changes against AKM firm effects. We visualize this relationship in Figure 7 Panels (a) (red hollow squares and dashed line). That is, in a firm with a 10% higher AKM effect compared to another firm, movers out of the first firm on average experience a 4.7ppt larger wage decline when separating from their original employer. To approximate a forced move, the movers in Figure 7 Panel (a) are restricted to those who experience an intermediate unemployment spell.

Misperceptions Measure I: Own Outside Options As our first and most direct misperceptions measure, we additionally plot worker beliefs about their own wage change against AKM firm effects, adding this gradient (blue solid circles and solid line) into Figure 7 Panels (a) alongside the empirical objective benchmark. Compared to the empirical benchmark slope of -0.474, workers' beliefs trace out a much flatter slope of -0.136 (SE 0.030). The estimated slope implies that a 10 log point increase in the AKM firm effect is

¹⁸We think of a firm's AKM effect as a measure of its overall wage premium, while "average coworker wage changes" are a measure of an individual worker's outside option. There are several differences between the two. First, AKM effects need not be representative of outside options (e.g., if most worker moves are between firms with a similar wage premium). Second, AKM effects are calculated from both *entries* and *exits* (while only exit-induced wage changes are relevant for a worker's outside option). Third, our measure of coworker wage changes restricts to *involuntary* moves, to represent a worker's outside option if forced to leave their firm. Fourth, in robustness checks we restrict to movers who are "similar" to SOEP respondents in terms of occupation, age, income, or education. Fifth, we explicitly convert mover wage changes into individual-level outside option predictions in our machine-learning model.

associated with a roughly 1.4ppt decrease in the expected wage change when switching, compared to a 4.7ppt effect in reality. The scatter plot reveals that workers in high-AKM firms hold roughly accurate beliefs, perceiving that their outside option would pay slightly lower wages. In stark contrast, workers in low-AKM firms report that their outside option would pay only moderately higher wages, while the data suggest that those workers are “underpaid” and stand to substantially gain by switching. Hence, consistent with the model, workers in low-wage firms strongly underestimate their outside options. In contrast, workers employed at high-paying firms hold more accurate beliefs about their outside options.

Panels (c) illustrates this sorting directly, by plotting individual-level errors (beliefs minus coworker wage changes) against AKM effects. Workers in low-AKM firms dramatically underestimate their outside options, while workers at higher-AKM firms either correctly estimate or slightly overestimate the wage at their outside option.

Misperceptions Measure II: Coworker Outside Options (Wage Changes) In Panel (b), we present the same exercise but study respondents’ beliefs about coworker wage changes against the AKM effect, and again find similar results, with a slope of -0.102 (SE 0.023). For consistency, the objective proxy is now constructed on the basis of all coworker movers (rather than involuntary moves only), which yields a similarly steep, negative slope of -0.352 (SE 0.057), and an upward shift (as we add voluntary moves up the job ladder). Panel (d) repeats this exercise for respondents’ beliefs about coworkers wage changes (as in Panel (c)).

Misperceptions Measure III: Rank in Occupation Figure 7 Panel (e) plots the difference between the perceived and the actual rank in the occupational wage distribution, against the employer’s AKM firm effect. The slope is strongly negative, -38.767 (SE 7.187), meaning that a ten log point increase in the AKM firm effect lowers the difference between beliefs and actual rank by 3.9 percentile ranks. In line with our previous findings, workers in the low-wage sector sharply overestimate their own position vis-à-vis the external labor market or, stated alternatively, underestimate external wages. We also find some evidence consistent with underestimation of workers’ own position for workers employed by high-AKM firms.

Misperceptions Measure IV: Median Salary in Occupation Finally, we document similar sorting across firms by biases about occupational median wage. Figure 7 Panel (f)

shows that workers in low-AKM firms substantially underestimate the median salary in their occupation. By contrast, workers in high-AKM firms have, on average, correct beliefs. The figure reports a slope of 0.222 (SE 0.078). Therefore, a ten log point increase in the AKM firm effect is associated with an approximately 2ppt reduction in the bias (compared to a mean bias of -3.56ppt).

Summary Our four bias measures reveal that as predicted by our simple model, workers employed in low-wage firms underestimate wage changes they or their coworkers experience when moving and also underestimate the wages in the external labor market in their occupation. Workers in high-wage firms appear to have, on average, more accurate beliefs, with two of the four specifications even indicating some overestimation of outside options. Taken together, these results are directly in line with worker beliefs being anchored in current wages and with sorting as predicted by the model.

5.2 What Share Of Jobs Would Not Be Viable If Workers Had Correct Beliefs About Wages Elsewhere?

A direct implication of the model is that some workers would leave their current employers if they had accurate beliefs about their outside options. In a counterfactual world with correct beliefs, these workers would realize that their current job match carries negative worker-side surplus and the match would therefore no longer be viable at the prevailing wage. In this section, we conduct a simple back-of-the-envelope calculation to measure the share of jobs that would not be viable if workers' beliefs coincided with objective benchmarks for outside options.

Survey Measurement of Subjective Worker Surplus To measure the total size of subjective worker surplus, we use the following question from our SOEP-IS questionnaire:

Imagine that your current employer permanently cut wages. This wage cut results from a change of the CEO in the company and is independent of the economic conditions in your industry. At which wage cut would you quit your job within one year?

I would quit my job if my current employer cut wages by more than $X\%$.

Respondents specify the wage cut, X , in an open-ended elicitation (rather than intervals),

which minimizes concerns about framing effects.¹⁹ The scenario fixes beliefs about the duration of the wage cut by explicitly stating that the wage cut is permanent. We also fix the time frame within which the respondent would leave their job. We contextualize the wage cut as due to an idiosyncratic, firm-level shock, rather than an aggregate or industry-specific shock, to keep outside options unaffected. By construction (as the reservation wage cut must be weakly positive), all existing jobs have weakly positive subjective worker surplus.

Appendix Figure A.2 reports a histogram of reservation wage cuts as a percentage of their salaries. On average, workers are willing to forego 14.0% of their wage to remain in their current job compared to the next-best alternative. The median surplus is 10.0%, consistent with an average expert prediction of the median worker surplus of 10.88% (SD 9.12ppt). We also find substantial dispersion, with a standard deviation of 10.63ppt; the 10th percentile is 1.0% and the 90th percentile 30.0%.²⁰

Constructing the Corrected Worker Surplus We decompose the surplus of worker i , \tilde{S}_i , into the (subjective) wage component, \tilde{W}_i , and non-wage, amenity component, \tilde{A}_i (where \sim denotes their subjective nature):²¹

$$\underbrace{\tilde{S}_i}_{\text{Worker Surplus}} = \underbrace{\tilde{W}_i}_{\text{Wage Component}} + \underbrace{\tilde{A}_i}_{\text{Amenity/Non-Wage Component}} \quad (23)$$

By definition, the wage component is the salary gain (or loss) of worker i from working at their current firm rather than their outside option. Therefore, the subjective wage component is simply the negative of the worker's belief about their own wage change (in Euro levels, obtained by multiplying the percent change we elicited with their current salary) if switching to their outside option. Having identified the wage component (and implicitly the amenity component), we can then directly obtain a benchmark-corrected worker surplus by replacing, in Equation (23), the (subjective) wage change with the

¹⁹Mui and Schoefer (2021) present a similar reservation wage cut in the context of employment/nonemployment.

²⁰To assess the sources of overall workers rents, we included a question in our survey to shed light on the reasons that keep workers from seeking better-paying jobs (Appendix Figure A.3). These data reveal that workers perceive non-wage-amenities to be more important than the difficulty of finding a higher-paid job in keeping them from accepting other better-paying jobs. Appendix F.3.1 provides additional details.

²¹Such a decomposition is feasible in models with additive separability between the wage and the non-wage components of worker rents (see, e.g., Card et al. 2018; Berger, Herkenhoff, and Mongey 2019; Lamadon, Mogstad, and Setzler 2021).

objective benchmark for the wage change to the outside option, which we here denote by \widehat{W}_i (obtained by multiplying worker i 's salary with the percent change benchmark we measure):

$$\underbrace{S_i}_{\text{Worker Surplus: Corrected}} = \underbrace{\widetilde{S}_i}_{\text{Worker Surplus: Belief}} + \overbrace{\left(\underbrace{\widehat{W}_i}_{\text{Wage Change: Objective Benchmark}} - \underbrace{\widetilde{W}_i}_{\text{Wage Change: Belief}} \right)}^{\text{Belief Correction}}. \quad (24)$$

We draw on two measures. First, we use a (smoothed) version of the coworker wage changes^[22] Second, we use our machine-learning prediction at the worker level.

We classify a job as nonviable if this correction renders the worker surplus negative. This exercise holds wages at the current job fixed (i.e., abstracting from renegotiation) and only corrects beliefs about wages, not amenities.

Back-of-the-Envelope Calculation: Share of Nonviable Jobs with Corrected Beliefs

We construct two variants, using our two proxies for objective outside options: wage changes of involuntary coworker movers, and machine-learning predictions for individual workers' wage changes. Using the coworker wage changes benchmark, the overall share of nonviable jobs is 17.4% (SE 2.6); with the machine-learning benchmark, we find a share of 10.5% (SE 1.1). Hence, misperceptions have the potential to play a large role in sustaining some specific jobs at current wages.

Our model has a specific prediction: that this share is concentrated in the low-wage sector. Figure 8 plots the fraction of workers in nonviable jobs against the firm AKM effect, for both objective benchmarks. The blue solid line presents a cumulative moving average (from the left) as a function of firm AKM effect, with the grey hollow circles representing ventiles-bin-specific averages. The red dashed line/x-marks represent the ML-based proxies. Both approaches confirm that the share of nonviable jobs is strongly declining with the firm AKM effect, and nearly all jobs in the top few ventiles of firm effects are viable.

²²We apply some smoothing to attenuate the effect of spurious surplus changes from small-sample averages for this exercise. We again draw on a conservative wage-change benchmark by using the average wage changes of coworkers who moved out of the firm and experienced an intermittent unemployment spell before finding new employment and also shrinking average wage changes to the sample mean with an Empirical Bayes procedure. To further reduce spurious corrections to the worker surplus, we feed in the coworkers wage change within the same ventile of AKM firm effects in this SOEP-IAB sample (rather than at their individual firm level), and hence depart from the firm-specific outside option.

Discussion and Robustness Checks Of course, our calculation is a coarse indicator of the degree of misallocation due to misperception. First, our correction draws on proxies for workers’ outside options. That said, we find that a sizeable share of jobs are not viable for *either* benchmark we consider. Second, jobs that would be nonviable given current wages may still be viable if the joint surplus remains positive, if wage negotiation occurs (although there may be limits on efficient renegotiation as in Jäger, Schoefer, and Zweimüller, 2019).²³ Third, our exercise sidesteps equilibrium wage adjustment, e.g., because better-informed workers search more or negotiate more aggressively. We shed light on the links between beliefs and behavior in Section 5.3 below.

Rational Inattention: When Are Biases Allocative? Finally, our calculation would overstate the share of nonviable jobs if workers can only search sporadically and *are* well-informed while searching, while remaining ill-informed when not searching. (Below, in Section 5.3, we will provide evidence for the link from beliefs to behavior in a horse race against objective benchmarks, assuming that workers’ search behavior is endogenous.) Here, we discuss the case in which misperceptions are not consequential for most workers (as they cannot search), which also implies that correcting their beliefs would not have allocative consequences. (Moreover, in rational inattention frameworks, workers unable to search would not gather information that cannot be used, predicting misperceptions among non-searchers in the first place.) In such a world, our finding that, on average, employed workers are biased may stem from the non-searchers, and may mask the small share of searchers that hold accurate beliefs.

Given that we find a slope between beliefs and objective benchmarks that is close to zero for our main results, a prediction of this view is that workers more likely to search exhibit dramatically more accurate beliefs. In Appendix Figure A.16, we provide several pieces of evidence to evaluate the plausibility of such an account. First, we separately analyze our data by comparing workers with shorter tenure who more recently transitioned employers and have fresher access to information about the external labor market (Panel (a)). Second, we also analyze beliefs separately among workers in high- versus low-turnover firms (Panel (b)). For both measures, we find significant biases among workers with more exposure to

²³To account for wage adjustment, in unreported results, we also calculated the fraction of jobs that would not be viable in terms of joint job surplus, drawing on our question eliciting the worker’s belief about the firm’s (maximum) reservation wage. The question is: “Imagine that you were contemplating to switch your employer. What do you think: how much more would your current employer be willing to pay to ensure that you stay in your current position?” We have found qualitatively similar results (as workers do not believe that firms can raise their wages much, at least idiosyncratically).

the labor market.

As an additional robustness check, we also discard observations from workers who may be less confident in their answers. First, we split the sample by workers' self-assessed confidence in their answers and find significant biases among workers who report a high confidence in their answer (Panel (c)). Second, in Appendix Figure [A.10](#) Panel (c), we also conducted a robustness check in which we discarded answers from respondents who responded that they would have the "same" wage at their next-best employer, perhaps the cognitively simplest answer to the question. Yet, even when stacking the odds against the hypothesis of anchoring in such a way, we still find virtually identical evidence for anchoring. In sum, we provide evidence against the possibility that misperceptions are confined only to workers for whom they may be irrelevant.

We also provide new evidence that jobs in low-AKM firms are subjectively less desirable. Our evidence that workers in low-AKM firms underestimate wages elsewhere suggests that existing evidence on higher search and quit rates from low-AKM firms still understates the worker surplus differential between low- and high-AKM firms. As a new subjective measure on the differences in the desirability of different jobs, we also compare satisfaction with personal income, work, and life across workers in the AKM firm effect distribution (Appendix Figure [A.15](#)). We find that, even when controlling for individual fixed effects, workers in high-AKM firms report higher satisfaction along these three dimensions.

Overall, we therefore conclude that worker misperceptions appear to play an important role in the size of the German low-wage sector.

5.3 Do (Biased) Beliefs Drive Worker Behavior?

Our model assumes that worker beliefs about outside options shape search behavior: workers more optimistic about wages elsewhere ought to search, while pessimism thwarts search. We analyze whether this relationship is borne out in our data.

Search and Reservation Wages To shed light on these mechanisms, we analyze whether worker beliefs predict intended search leveraging two additional questions from our SOEP survey (referenced in Appendix [G.1](#), under "Intended Labor Market Behaviors" and "Reservation Wage 2"). The first asks respondents about the probability that they will look for a new job at a different company over the next 12 months. The second asks

respondents about the minimum pay cut at their current job that would induce them to quit and search for a new job.

Figure 9 shows the relationship between these intended labor market behaviors and respondents' beliefs about their outside options. To isolate the role of potential biases in beliefs, we provide both the raw slope of this relationship as well as the slope controlling for objective benchmarks for outside options. We also relate outcomes to these objective benchmarks directly.

Figure 9 Panel (a) shows that intentions to search are strongly positively correlated with belief about own wage change: a 10ppt increase in the belief about own wage change is associated with a 5.2ppt increase in the stated probability to look for a new job. Strikingly, this correlation barely changes, and if anything strengthens, when controlling for objective benchmarks, whether it is the wage changes of coworker movers (see Figure 9 Panel (a)) or the ML predictions derived in Section 3.2 (Appendix Figure A.17 Panel (a)).

In contrast, Figure 9 Panel (b) shows that intentions to search are uncorrelated with actual coworker wage changes (both unconditionally and controlling for belief about own wage change) and Appendix Figure A.17 Panel (b) shows that intentions to search are similarly uncorrelated with ML predicted wage change.

In short, intentions to search are mostly driven by respondents' perceptions of their outside options rather than their actual outside options. A very similar pattern holds for the minimum pay cut required to induce a quit, reported in Panels (c) and (d) of Figure 9. Panel (c) shows that a 10ppt increase in the belief about own wage change if forced to separate is associated with a 3.0ppt decrease in the minimum pay cut required to induce a quit. In contrast to these results, there is no clear relationship between the reservation wage cut and the objective benchmarks in Panel (d). Identical patterns are evident when we instead control for ML predicted wage changes (Appendix Figure A.17).

Wage Bargaining While our model featured wage posting, a related mechanism through which beliefs about outside options might affect behavior is bargaining. We additionally consider two SOEP questions relating to wage bargaining. The first question asks about the probability over the next 12 months that the respondent will ask their boss for a pay raise. The second asks about the intended magnitude of the pay raise for the negotiation. Figure 10 reports these results, again separately for beliefs and for objective benchmarks as the independent (x-axis) variables. Panels (a) and (c) of Figure 10 show that a 10ppt increase in the belief about own wage change is associated with a 7.7ppt increase in the stated

probability to negotiate for a pay raise and a 2ppt increase in the intended magnitude of raise to bargain for. Further, controlling for the coworker wage change barely changes any of these relationships. By contrast, Figure 10 Panels (b) and (d) document that objective benchmarks do not drive behavior (unlike beliefs). These results are robust to using the machine learning benchmark (Appendix Figure A.18).

Information Treatment We had planned a simple information treatment in the SOEP-IS, informing workers about their outside options in the 2019 wave of our survey. Due to legal challenges we were only able to give information about the median wage in the occupation (but not about the other, more granular benchmarks). The survey randomly chose 50% of respondents to receive accurate information about the median salary in their occupation after they reported their belief. Our core descriptive beliefs about coworker wage changes after a switch, median pay in occupation, and perceived pay rank were all elicited before the information intervention. We aimed to study effects on beliefs about outside options and intended search and bargaining behavior. We report results in Appendix Table A.6. The treatment affected beliefs in the expected direction: treated workers that initially underestimated the median salary in their occupation upward-adjust their expected wage at the next-best employer (by 2ppt). However, we found no clear effects on intended bargaining or job search behaviors, with positive but statistically insignificant reduced-form coefficients. We also did not find any realized effects of the 2019-wave treatment on 2020-wave outcomes such as wage growth. One interpretation is that the mild information treatment may not have sufficiently shifted respondents' beliefs about the external labor market to also ignite behavioral change, or that the national wage median may not give actionable information for labor market behavior. We leave for future research to test whether personalized, actionable information about outside options may spur behavioral changes, specifically from workers in low-wage jobs.

6 Conclusion

We have measured workers' beliefs about wages at their outside options and compared them with proxies for their objective outside options. Workers believe that wages at their outside option are much closer to their current wage than they actually are. Using an equilibrium model, we show that such anchoring of beliefs about outside options can give employers monopsony power and lead to labor market segmentation with a high-

and a low-wage sector. Consistent with the model, we uncover systematic sorting with objectively low-paying firms employing workers that strongly underestimate their outside options. If workers had correct beliefs about wages paid by other employers, at least 10% of jobs would not be viable at current wages, concentrated among workers employed at firms with the lowest wage premia.

Why might these biases persist? On the worker side, perhaps privacy norms keep workers from sharing their salary information (Cullen and Perez-Truglia, 2018b). On the employer side, Ellison and Wolitzky (2012) describe a model in which oligopsonistic firms may have an incentive to obfuscate their prices (wages). Relatedly, a large literature in behavioral industrial organization documents and analyzes the consequences of consumers persistently misperceiving prices and often failing to choose the best option (see Ellison, 2006; Grubb, 2015; Heidhues and Kőszegi, 2018, for overviews). Our evidence for similar patterns among workers choosing between firms raises the possibility that broader lessons from behavioral industrial organization may carry over to labor markets.

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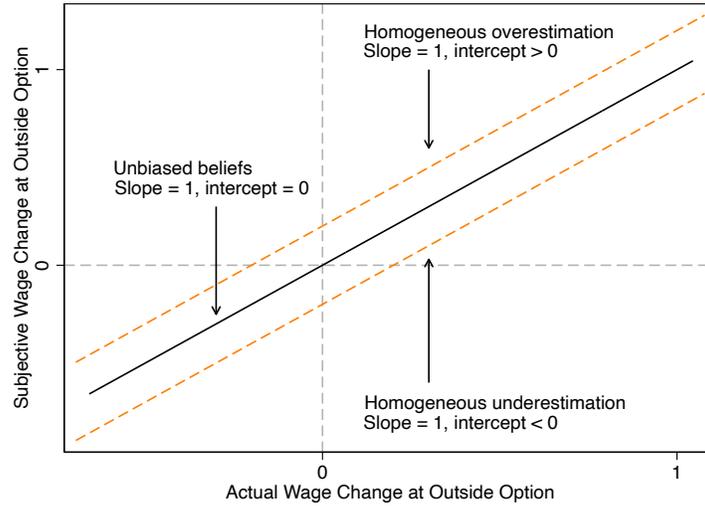
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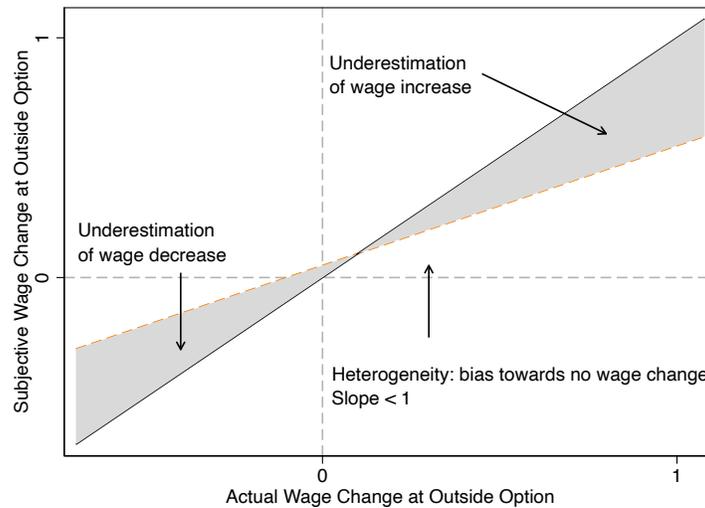
Figures

Figure 1: Research Design—Visualizing Bias About Outside Options

(a) Baseline Cases

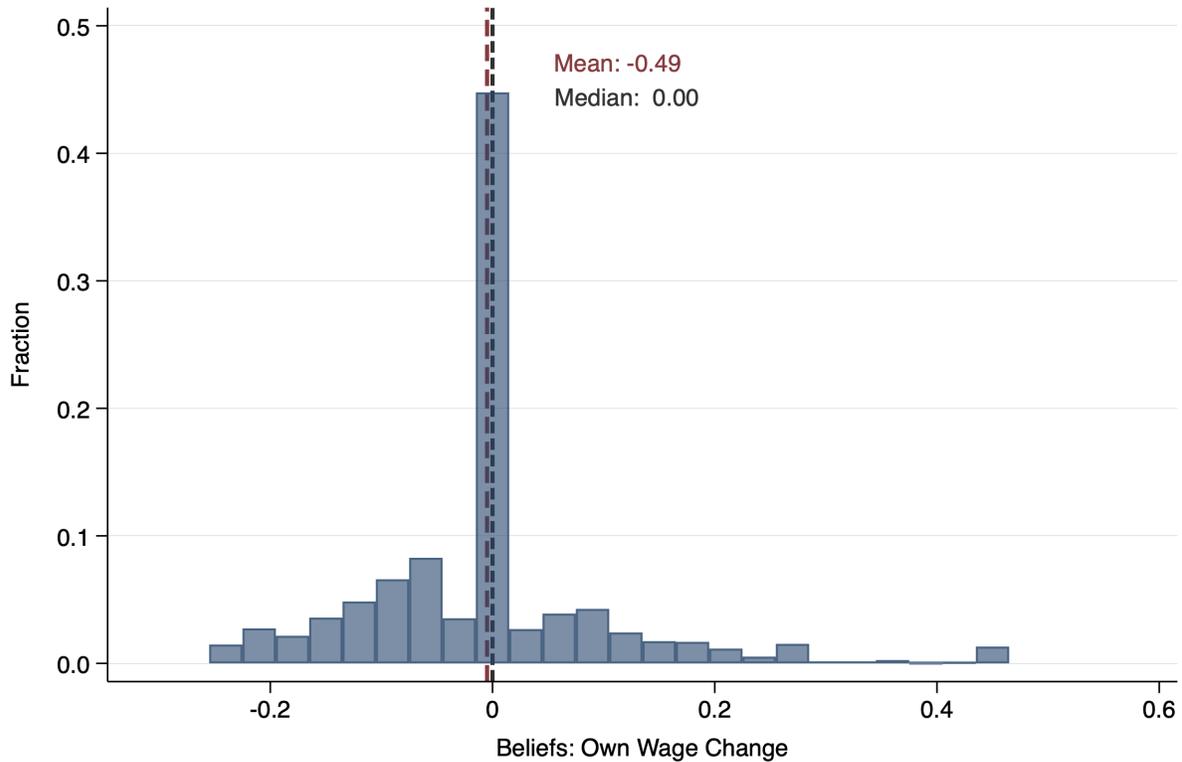


(b) Heterogeneity: Bias Towards No Wage Change at Outside Option



Note: This figure presents example graphs that illustrate our research design of plotting worker beliefs about outside options against (proxies for) their objective outside options. Panel (a) illustrates the baseline case where worker beliefs are (on average) in perfect correspondence with their actual outside options, as well as cases where workers homogeneously overestimate or underestimate wages at their outside options. Panel (b) illustrates the case where the slope is strictly less than 1, showing that it corresponds to workers being systematically biased towards thinking their wage at their outside option is similar to their current wage.

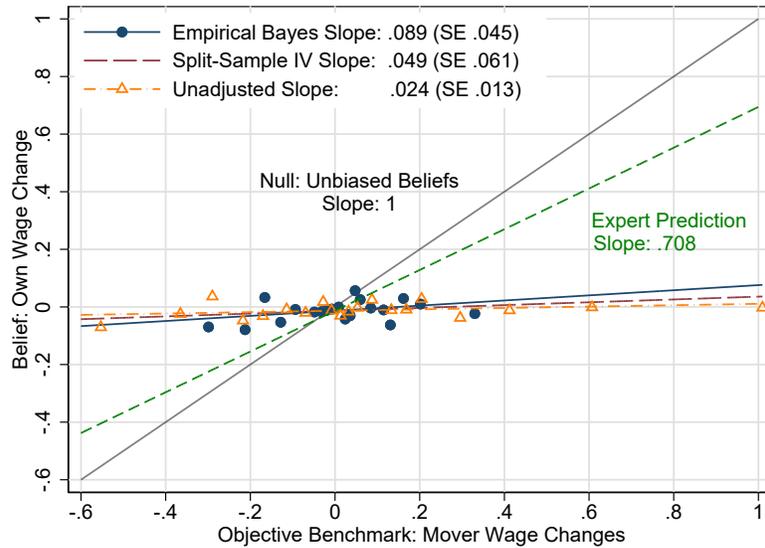
Figure 2: Distributions of Beliefs About Own Wage Change as Fraction of Salary



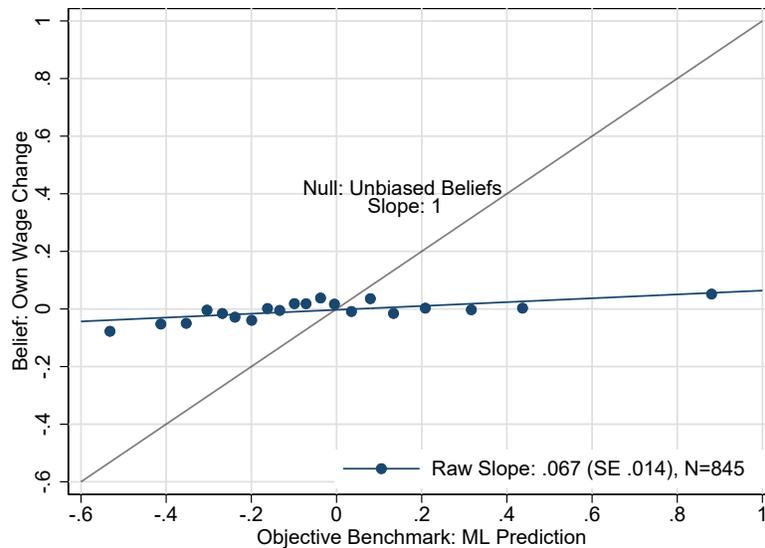
Note: This figure reports data from the 2019 and 2020 waves of the German Socio-Economic Panel. It presents a histogram of workers' beliefs about their own wage change when switching employers as a percent of workers' current salaries. The displayed beliefs are winsorized at the 1 percent level. The width of each bin is 3 percent and is centered around its respective mean. Workers' beliefs about their own wage change is calculated based on workers' responses to a question about their expected wage change if forced to leave their job.

Figure 3: Beliefs About Own Wage Change versus Objective Benchmarks

(a) Benchmark: Wage Changes of Coworkers Involuntarily Leaving Firm

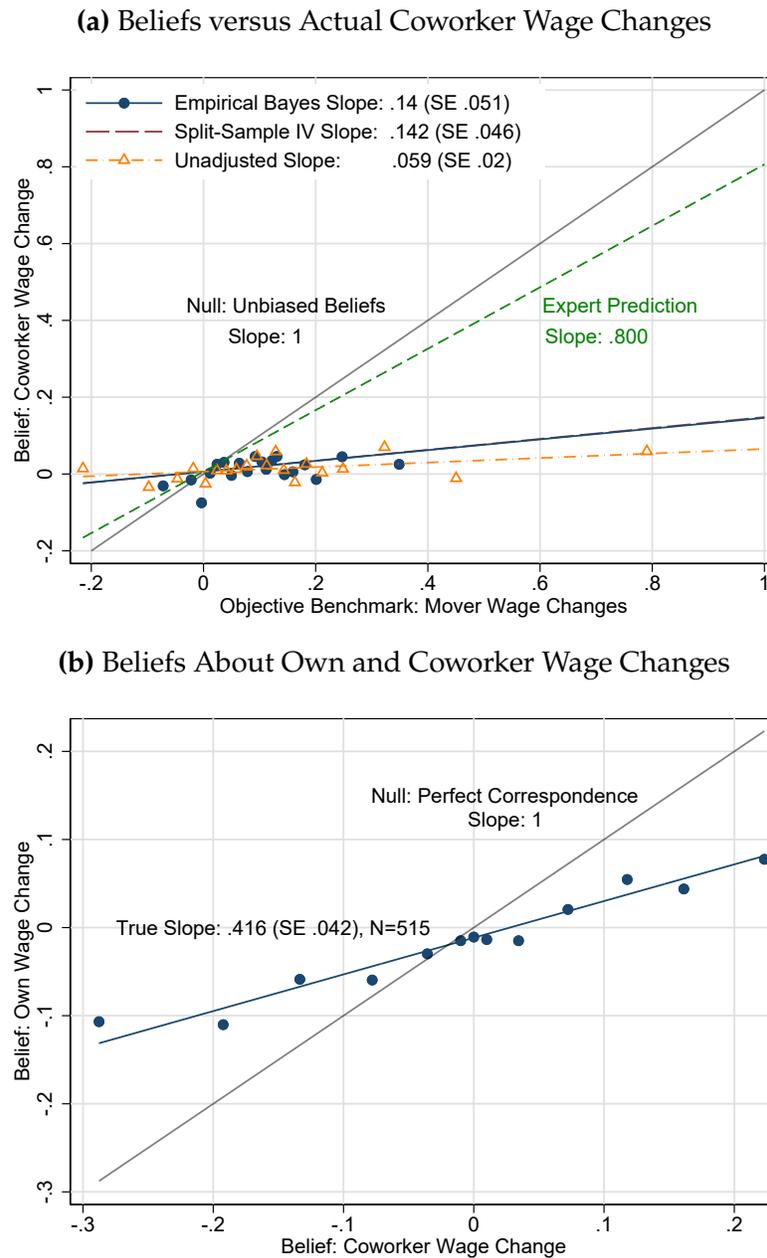


(b) Benchmark: Machine Learning Predictions



Note: This figure presents binned scatter plots of SOEP respondents' beliefs about their own wage change if forced to leave their firm against two objective benchmarks for the actual wage changes they would experience. In Panel (a), the benchmark is the mean log wage changes experienced by workers who left the SOEP respondent's firm in the past 5 years (between 2014 and 2019). We restrict to movers working fulltime both before and after the move, and to movers who experience an intermediate unemployment spell before finding their next job, to narrow our attention to "involuntary" separations. Specifically, we require that the mover begin receiving unemployment insurance within the first 12 weeks following the end of the initial employment spell, as voluntary separations carry a 12-week waiting period before UI eligibility. In Panel (b), the benchmark is based on machine-learning predictions for the wage changes SOEP respondents would experience if leaving their firm, with a model trained on the universe of "involuntary" moves in the German labor market ("involuntary" defined as above). The machine-learning methodology is fully described in Appendix E. As in all our specifications, we use all observations from the 2019 and 2020 SOEP waves and cluster standard errors at the individual level. The sample size in Panel (a) is 232 observations (222 individuals), and in Panel (b) is 845 observations (446 individuals).

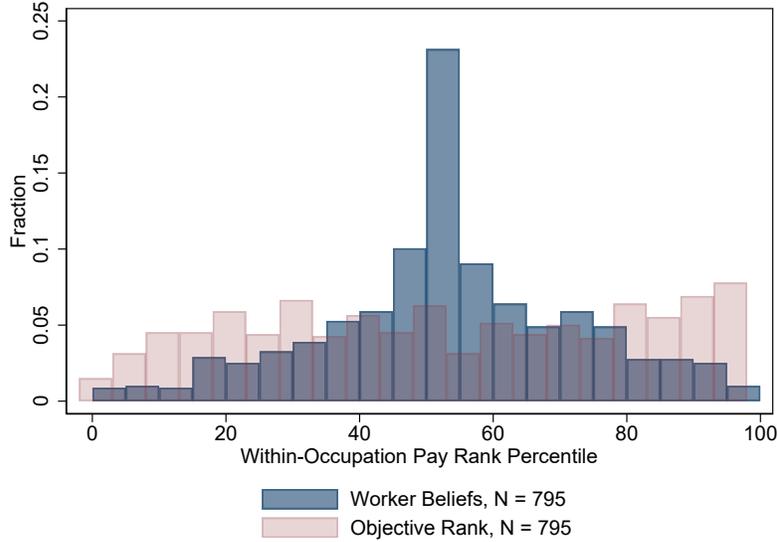
Figure 4: Beliefs About Mover Wage Changes versus Actual Mover Wage Changes



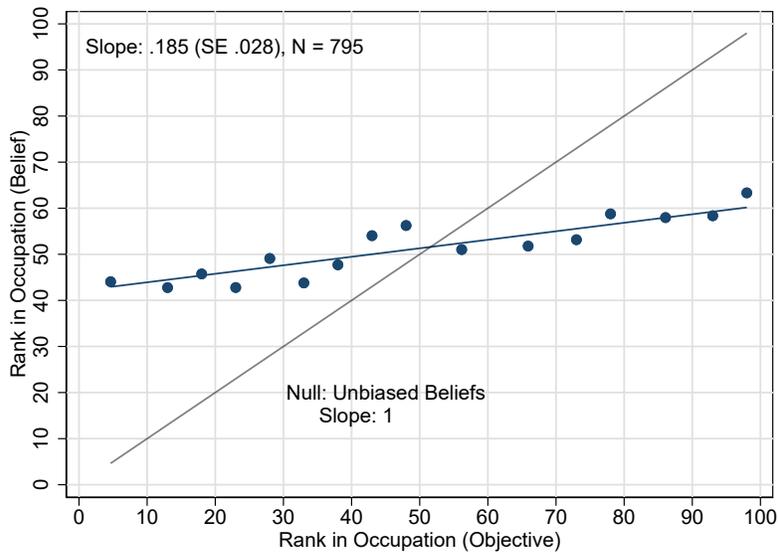
Note: Panel (a) plots workers' beliefs about the average wage change of coworkers who leave their firm, against the actual mean log wage changes of coworkers who left their firm between 2015 and 2019. It is analogous to Figure 3, except the y-axis is workers' beliefs about the typical wage changes of coworkers, and the x-axis is calculated from all coworker moves (not just involuntary ones). Panel (b) plots the correlation between workers' beliefs about their own wage change if forced to leave their firm and their beliefs about the average wage changes of coworkers leaving their firm. The sample size in Panel (a) is 471 observations (428 individuals).

Figure 5: Beliefs About Own Pay Rank in Occupation

(a) Histogram of Own Pay Rank in Occupation (Beliefs and Objective Benchmark)

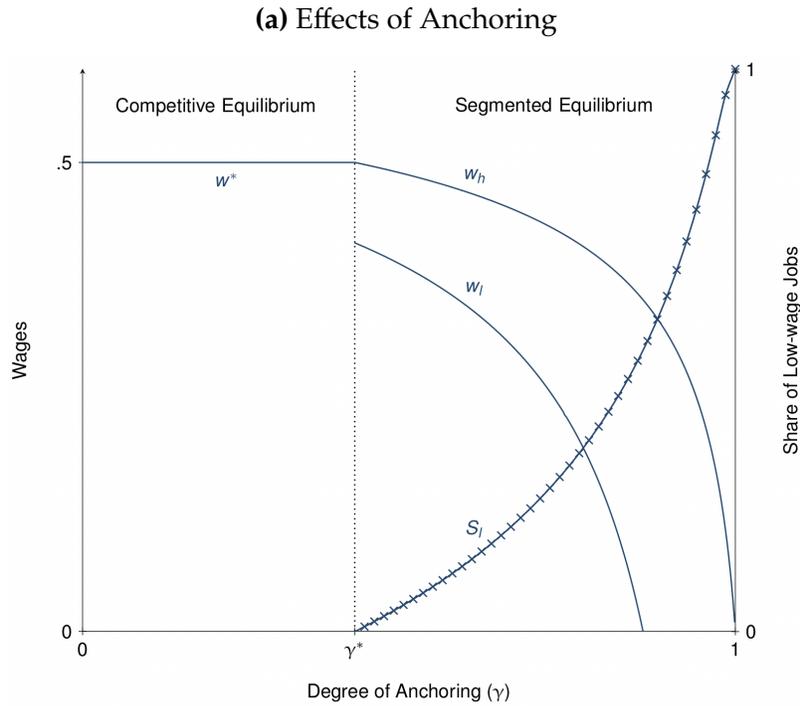


(b) Beliefs About Pay Rank in Occupation Against Objective Benchmark

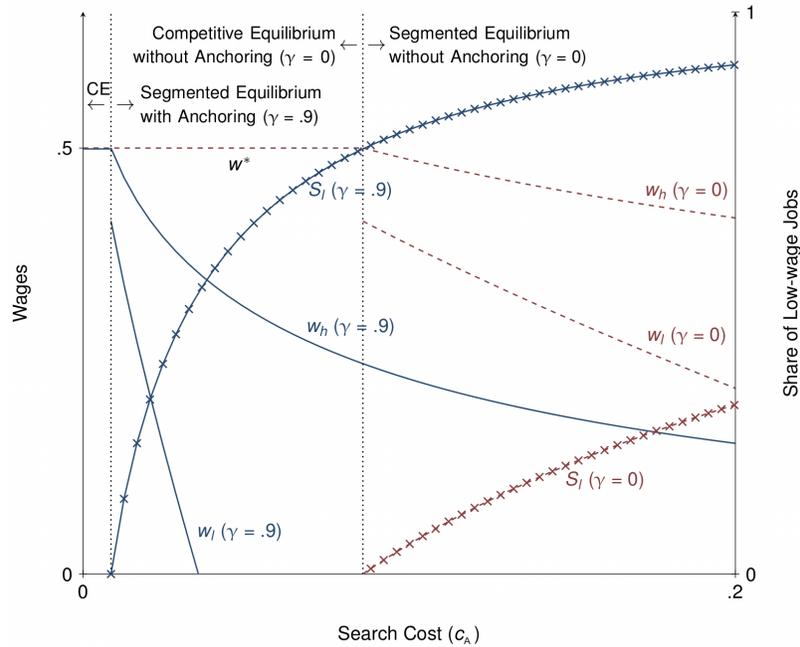


Note: This figure reports worker beliefs about their pay rank within their occupation and the median salary in their occupation. Panel (a) shows a histogram of workers' beliefs about their own pay rank in their occupation, compared to workers in other firms within the same occupation. This histogram is overlaid on a histogram displaying the *actual* pay ranks of workers, calculated at the 4-digit occupation level. Panel (b) shows a binned scatterplot from a regression of workers' beliefs about their own pay rank on their actual pay rank.

Figure 6: Labor Market Equilibria with Misperceptions



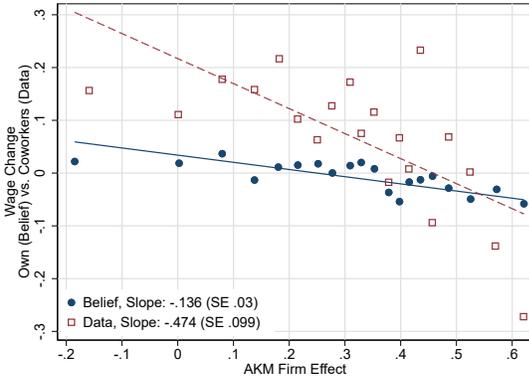
(b) Effects of Information Costs, With and Without Anchoring



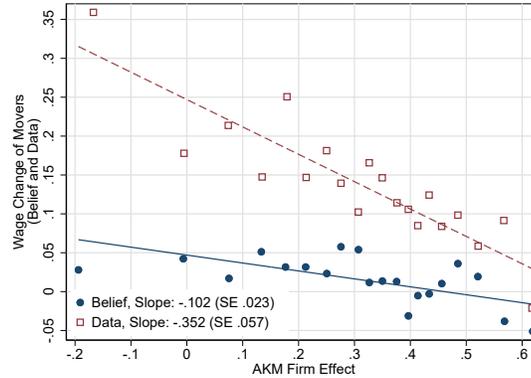
Note: Panel (a) plots equilibrium wages and the share of low wage jobs as a function of the degree of anchoring, with amateur workers' search cost $c_A = .05$. Dotted vertical line marks the cutoff value of anchoring that induces a switch from a competitive to a segmented labor market. Panel (b) plots the same quantities as a function of the search cost, without anchoring (dashed red lines), and with anchoring (solid navy lines). In both panels, $\eta = 1/2$, $\alpha = 1/2$, and $L/N = 1$.

Figure 7: Beliefs and Errors versus AKM Firm Effects

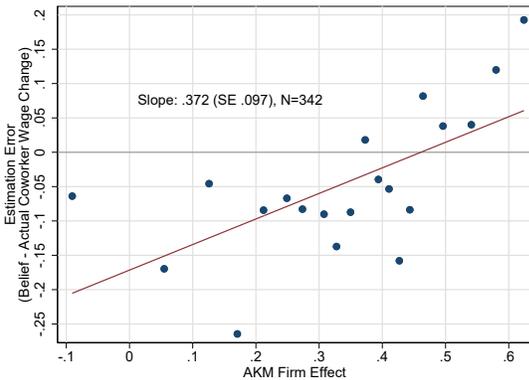
(a) Belief About Own Wage Change and Actual Coworker Wage Changes



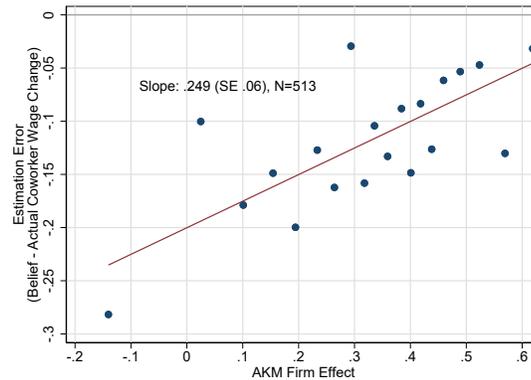
(b) Belief About Coworker Wage Changes and Actual Coworker Wage Changes



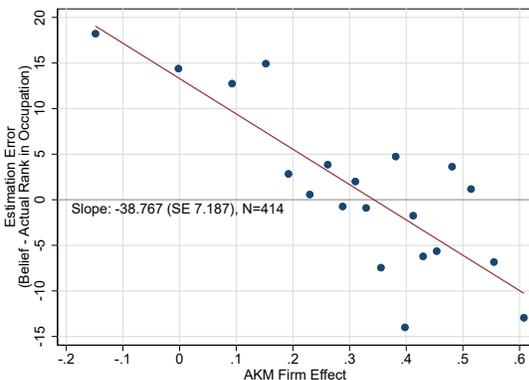
(c) Error About Own Wage Change



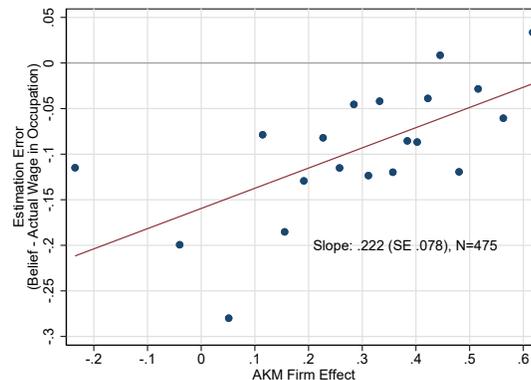
(d) Error About Coworker Wage Change



(e) Error About Rank in Occupation

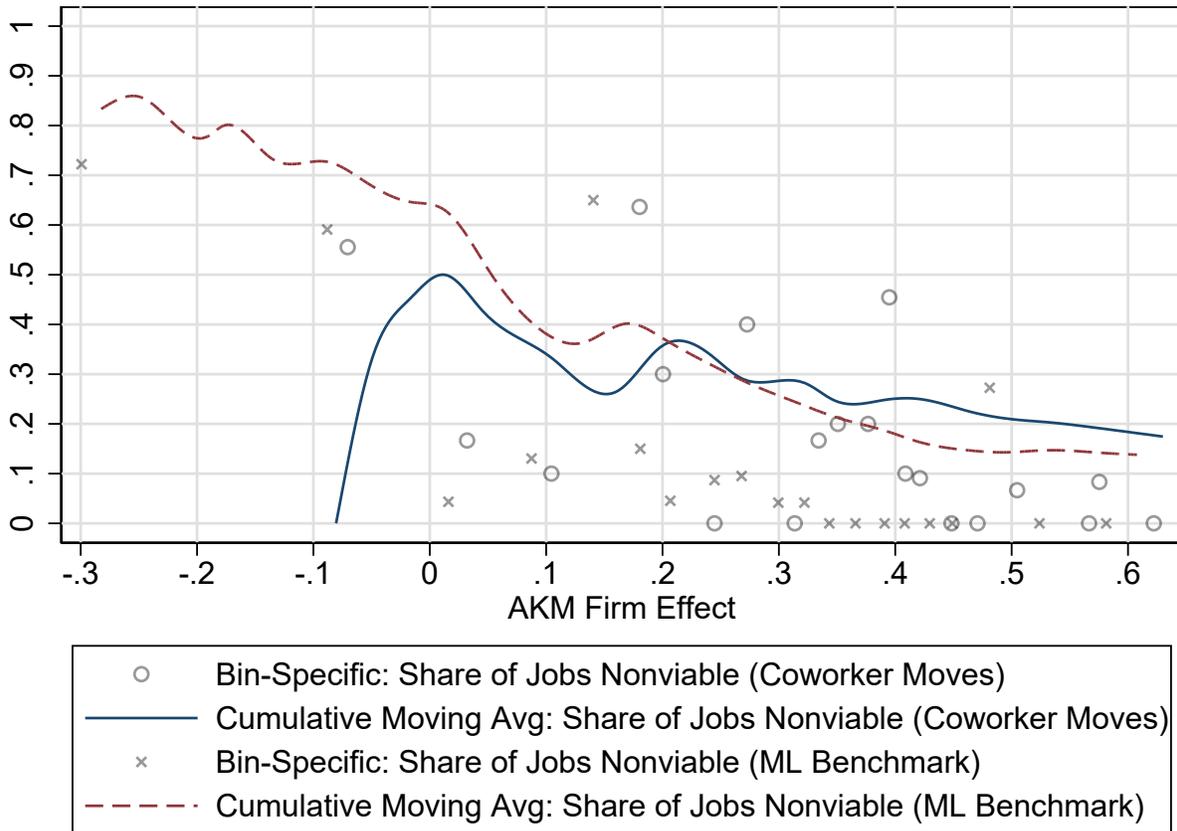


(f) Error About Median Salary in Occupation



Note: Panels (a) and (b) plot worker beliefs (blue solid lines, beliefs about own wage change in Panel (a)/about coworker wage changes in Panel (b)) and the actual coworker wage changes of SOEP respondents (red dashed lines) against AKM firm effects. To map most directly to the two respective questions, the red line in Panel (a) restricts to “involuntary” movers experiencing intermediate unemployment, while in Panel (b) the red line incorporates all movers (as long as they are working fulltime both before and after the move). Panels (c) and (d) plot individual-level errors (beliefs minus actual coworker wage changes) against AKM effects, analogous to the difference between the red and blue lines in Panels (a) and (b). Panel (e) plots workers’ error about their salary rank in their occupation (belief minus actual, both of which are plotted in Figure 5) against their AKM firm effect. Panel (f) plots workers’ error about the median salary in their occupation (belief minus actual) against their AKM firm effect. The sample size in Panel (a) is 224 observations (214 individuals) and in Panel (b) is 515 observations (454 individuals).

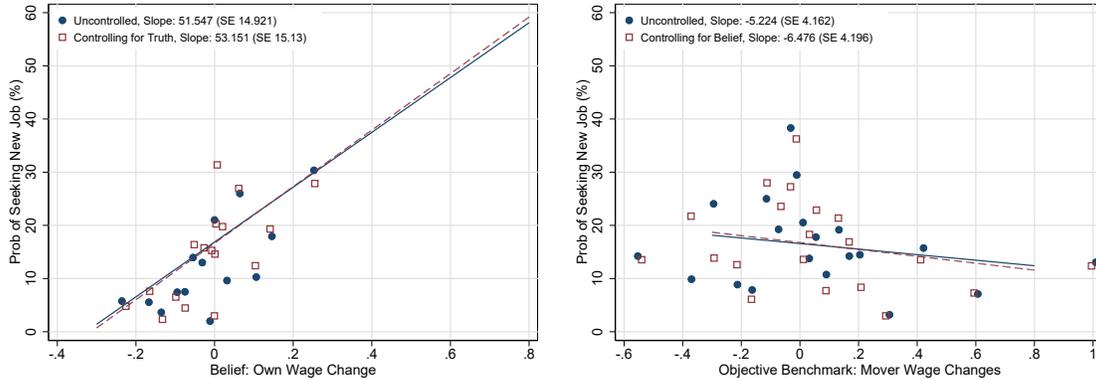
Figure 8: Share of Jobs with Negative Worker Surplus (Imputation)



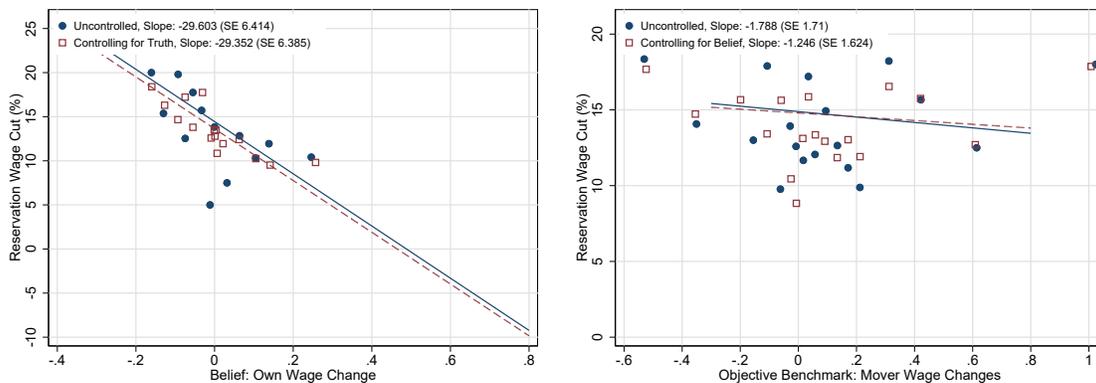
Note: The figure reports the share of employment relationships with negative estimated surplus against the AKM firm effect. To calculate worker rent we add together the subjective non-wage component of worker surplus plus our estimate of the objective wage component of the worker surplus, calculated by substituting the subjective wage component of the worker surplus of workers with the actual wage changes of coworker movers (blue solid line/hollow circles) or our machine-learning prediction for the respondent's wage change (red dashed line/x-marks).

Figure 9: Worker Beliefs, Mover Wage Changes, and Intentions to Search or Quit

(a) Intentions to Search on Beliefs About Own Wage Change **(b) Intentions to Search on Mover Wage Changes**



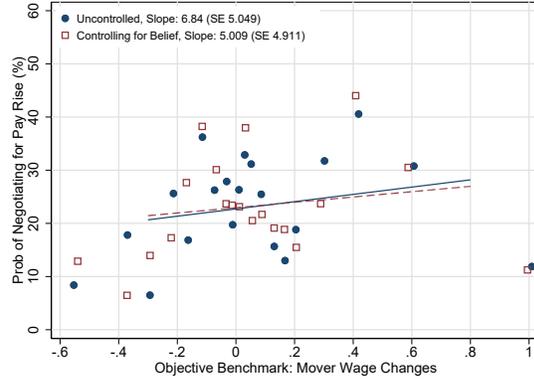
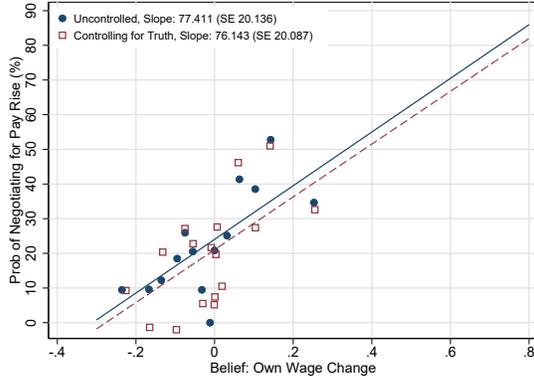
(c) Reservation Wage Cut on Beliefs About Own Wage Change **(d) Reservation Wage Cut on Mover Wage Changes**



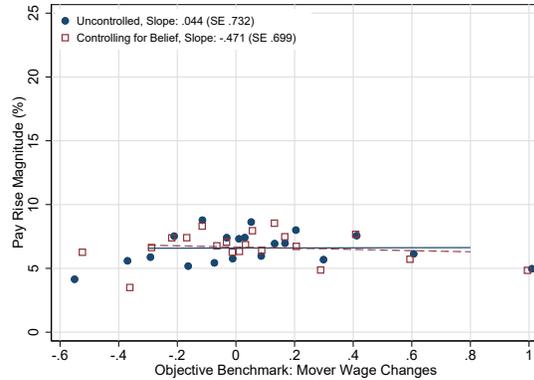
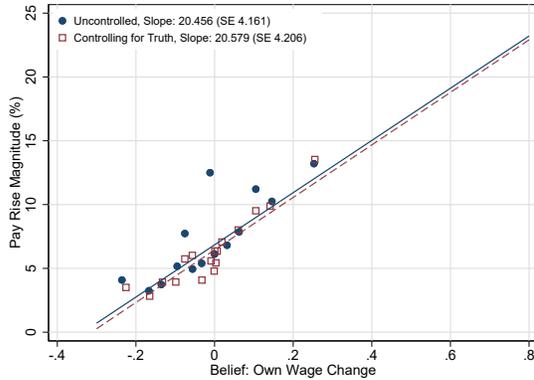
Note: Panels (a) and (c) presents binned scatter plots (solid blue lines) of workers’ self-reported labor market behaviors against their beliefs about their own wage change if forced to leave their firm. Panels (b) and (d) present binned scatter plots (solid blue lines) of workers’ intentions against the average wage changes of coworker leavers (our objective benchmark for workers’ beliefs). In Panels (a) and (b), the intended behavior is intentions to search for a new job in the next 12 months. In Panels (c) and (d), it is the minimum pay cut at their current job that would induce them to quit the job. Red dashed lines are an alternative version of the blue lines that additionally controls for the opposite panel’s x-axis variable; so, in Panels (a) and (c), the red dashed line represents the coefficient on “beliefs” from a regression of intentions on beliefs and mover wage changes, while in Panels (b) and (d) the red dashed line represents the coefficient on “mover wage changes” from the same regression. Appendix Figure [A.17](#) uses machine-learning predictions for individual wage changes instead of the average wage changes of coworker movers; and Appendix Figure [A.19](#) uses beliefs about coworker wage changes instead of beliefs about own wage changes.

Figure 10: Worker Beliefs, Mover Wage Changes, and Bargaining Intentions

(a) Intentions to Negotiate on Beliefs About Own Wage Change **(b) Intentions to Negotiate on Mover Wage Changes**



(c) Intended Magnitude of Negotiation on Beliefs About Own Wage Change **(d) Intended Magnitude of Negotiation on Mover Wage Changes**



Note: This figure follows the same structure as Figure 9. In Panels (a) and (b), the labor market behavior is the probability of asking one’s boss for a pay raise in the next 12 months. In Panels (c) and (d), it is the magnitude of the pay raise one would suggest (asked even of respondents who reported zero probability of asking for a pay raise). Appendix Figure A.18 uses machine-learning predictions for individual wage changes instead of the average wage changes of coworker movers; and Appendix Figure A.20 uses beliefs about coworker wage changes instead of beliefs about own wage changes.

Tables

Table 1: Summary Statistics: IAB-SOEP Matched Sample

	Mean	SD	P10	P25	Median	P75	P90	Share 0	Obs.	Nb ind.
Panel A: Demographics										
Age	43.89	11.73	28.00	34.00	45.00	53.00	60.00	0.00	606	516
Salary (in Euro, per Year)	37978	20951	14640	24000	34710	45600	68400	0.00	606	516
Tenure	10.19	10.83	0.00	1.00	6.00	17.00	28.00	0.16	606	516
Female	0.50	0.50	0.00	0.00	1.00	1.00	1.00	0.50	606	516
Full-time Employed	0.70	0.46	0.00	0.00	1.00	1.00	1.00	0.30	606	516
Part-time Employed	0.30	0.45	0.00	0.00	0.00	1.00	1.00	0.70	606	516
Panel B: Beliefs										
Own Wage Change as % of Salary	0.15	11.57	-12.86	-6.25	0.00	1.00	13.16	0.41	606	516
Own Wage Change in Euro	-335	4839	-5400	-1800	0	300	4200	0.41	606	516
Own Salary Rank in Same Occupation	51.23	18.27	27.50	45.00	50.00	60.00	75.00	0.00	593	505
Panel C: Biases in Beliefs (as % of Salary)										
Belief (Own Wage Change) Minus Coworker Wage Changes	-2.33	16.74	-23.28	-12.46	-2.17	8.79	15.93	0.00	232	222
Belief (Own Wage Change) Minus ML Prediction	3.21	31.96	-37.29	-11.32	9.56	24.48	36.21	0.00	845	446
Belief (Coworker Wage Change) Minus Coworker Wage Changes	-11.87	22.19	-37.38	-21.49	-9.40	1.91	10.10	0.00	515	454

Note: This table reports data for our IAB-SOEP matched sample with the data from the 2019 and 2020 waves of the German Socio-Economic Panel (see Appendix Table A.2 for the full SOEP-IS sample). Panel A reports demographic characteristics. Panel B reports worker beliefs. “Own Wage Change as % of Salary” is calculated based on workers’ responses to a question about their expected wage change if forced to leave their job relative to their current salary. “Own Salary Rank in the Same Occupation” is based on a question where respondents are asked about the fraction of other workers who receive a lower pay. Panel C reports biases in beliefs about outside options based on the matched-employer employee data, namely the difference workers’ beliefs about their own outside options and two objective benchmarks, and the difference between the wage changes of coworkers existing the firm and the objective benchmark.

Online Appendix: Worker Beliefs about Outside Options

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A Appendix Tables

Table A.1: Overview of Data Collections

Data collection	Sample	Timing
SOEP IS Wave 1 (N=1,068)	In-person interviews with full-time and part-time employed workers in Germany as part of SOEP-IS	September 2019 – December 2019
SOEP IS Wave 2 (N=828)	In-person and telephone interviews with full-time and part-time employed workers in Germany as part of SOEP-IS	September 2020 – December 2020
Robustness Survey (N=902)	Online surveys with with full-time and part-time employed workers in Germany with Dynata	July 2021
Expert Survey (N=151)	Experts in labor economics and behavioral economics recruited via email invitation	July 2021

Table A.2: Summary Statistics: SOEP-IS Sample

	Mean	SD	P10	P25	Median	P75	P90	Share 0	Obs.	Nb ind.
Panel A: Demographics										
Age	44.81	11.76	29.00	35.00	46.00	55.00	60.00	0.00	1896	1222
Years of education	13.17	2.74	10.50	11.50	12.00	15.00	18.00	0.00	1802	1145
Salary (in Euro, per Year)	40502	27241	15000	24000	35400	50400	69600	0.00	1896	1222
Tenure	11.45	10.97	1.00	2.00	8.00	18.00	29.00	0.10	1896	1222
Female	0.48	0.50	0.00	0.00	0.00	1.00	1.00	0.52	1896	1222
Full-time Employed	0.71	0.45	0.00	0.00	1.00	1.00	1.00	0.29	1896	1222
Part-time Employed	0.28	0.45	0.00	0.00	0.00	1.00	1.00	0.72	1896	1222
Panel B: Beliefs										
Own Wage Change as % of Salary	-0.49	11.23	-13.46	-6.25	0.00	0.00	11.90	0.44	1896	1222
Own Wage Change in Euro	-601	4800	-5400	-1800	0	0	4200	0.44	1896	1222
Own Salary Rank in Same Occupation	51.94	18.55	27.50	45.00	50.00	62.50	75.00	0.00	1826	1187

Note: This table replicates Table 1 (which covers the merged IAB-SOEP-IS data) for data from the 2019 and 2020 waves of the SOEP-IS, i.e., the survey sample irrespective of whether it has been merged to the IAB data. Panel A reports demographic characteristics. Panel B reports worker beliefs. “Own Wage Change as % of Salary” is calculated based on workers’ responses to a question about their expected wage change if forced to leave their job relative to their current salary. “Own Salary Rank in the Same Occupation” is based on a question where respondents are asked about the fraction of other workers who receive a lower pay.

Table A.3: Characteristics of SOEP Respondents versus "Involuntary" Coworker Movers versus Other Coworkers

Variable	$\mu(\text{SOEP})$	$\mu(\text{Movers})-\mu(\text{SOEP})$	$\mu(\text{Others})-\mu(\text{SOEP})$
Log wage	4.311 (0.764)	-0.008	-0.124
Age	41.258 (10.850)	-5.010	-3.900
Tenure	7.028 (7.987)	-3.658	-4.789
<i>Education</i>			
No Education	0.064	0.087	0.027
Vocational Training	0.466	-0.037	0.015
University Education	0.198	-0.048	-0.031
Missing Education	0.271	-0.003	-0.012
<i>Occupation</i>			
Agriculture & Forestry Professions	0.005	0.009	0.003
Mining, Industry, & Manufacturing Profs.	0.224	0.051	0.005
Construction & Infrastructure Profs.	0.039	0.005	0.017
Academic & Technical Profs.	0.052	-0.001	-0.018
Transportation, Logistics, & Cleaning Profs.	0.157	0.001	0.029
Sales Profs.	0.101	-0.007	0.010
Managerial Profs.	0.177	-0.026	0.000
Medical, Childcare, & Educational Profs.	0.215	-0.045	-0.045
Marketing, Artistic, & Athletic Profs.	0.031	0.013	-0.000

Note: This table compares the characteristics of SOEP respondents to the characteristics of their coworkers who moved "involuntarily" out of their firm sometime between 2015 and 2019 and the characteristics of their other coworkers. The first column, $\mu(\text{SOEP})$, presents the means (and, if applicable, SDs) of each variable for the SOEP respondents. The second column, $\mu(\text{Movers})-\mu(\text{SOEP})$ presents the average within-firm difference between the value of the variable for non-SOEP "involuntary" movers and the average value of the variable for SOEP respondents. The third column, $\mu(\text{Others})-\mu(\text{SOEP})$, presents the average within-firm difference between the value of the variable for non-SOEP other coworkers and the average value of the variable for SOEP respondents. The characteristics are the worker's log wage, age (in years), tenure (in years), education category dummies, and 1-digit occupation category dummies.

Table A.4: Summary Statistics: Expert Survey

	Mean	Median	SD	Min	Max	Obs.
Share of Respondents: Female	21.85					151
Share of Respondents: Professor	47.02					151
Share of Respondents: Associate Professor	17.22					151
Share of Respondents: Assistant Professor / Lecturer	24.50					151
Share of Respondents: US based	61.59					151
Share of Respondents: Germany based	16.56					151
Share of Respondents: UK based	9.27					151
Age	42.82	40	9.59	27	80	149
h – index	22.12	21.92	22.32	0	118	151

Note: The table reports summary statistics for respondents' characteristics of the conducted expert survey eliciting the expert beliefs about the beliefs of the participants in the SOEP survey. The share of respondents are reported as percentages and age is reported in years.

Table A.5: Summary Statistics: Median Expert Predictions

Variable: as % of Salary	Typical Worker	By wage Δ of movers		By firm AKM pctile	
		10% decrease	10% increase	40th pctile	60th pctile
Belief About Own Wage Δ	0%	-5.5%	7.5%	0%	0%
Belief About Mover Wage Δ	3.5%	-3.5%	12.5%	1%	2.25%
Objective Wage Δ	0%	-7.5%	7.5%	1%	-3.5%

Note: The Table reports results from our survey of experts ($N = 151$). Each cell reports the median expert prediction about a certain quantity. The rows vary the *variable* being predicted, while the columns vary the *population* being asked about. The first row reports expert predictions about workers' subjective wage change if forced to separate from their current job; the second, about workers' beliefs about the wage changes experienced by coworkers who separate from their firm; and the third reports experts belief about the objective wage changes workers would actually experience if they separated from their firm. The first column reports experts' prediction of the relevant value for the typical or median worker in the whole labor market; the second column, for the median worker in a firm where coworker movers experienced on average a 10% pay decrease; the third column, for the median worker in a firm where coworker movers experienced on average a 10% pay increase; the fourth column, for the median worker in a firm at the 40th percentile of AKM firm effects; and the fifth column, for the median worker in a firm at the 60th percentile of AKM firm effects.

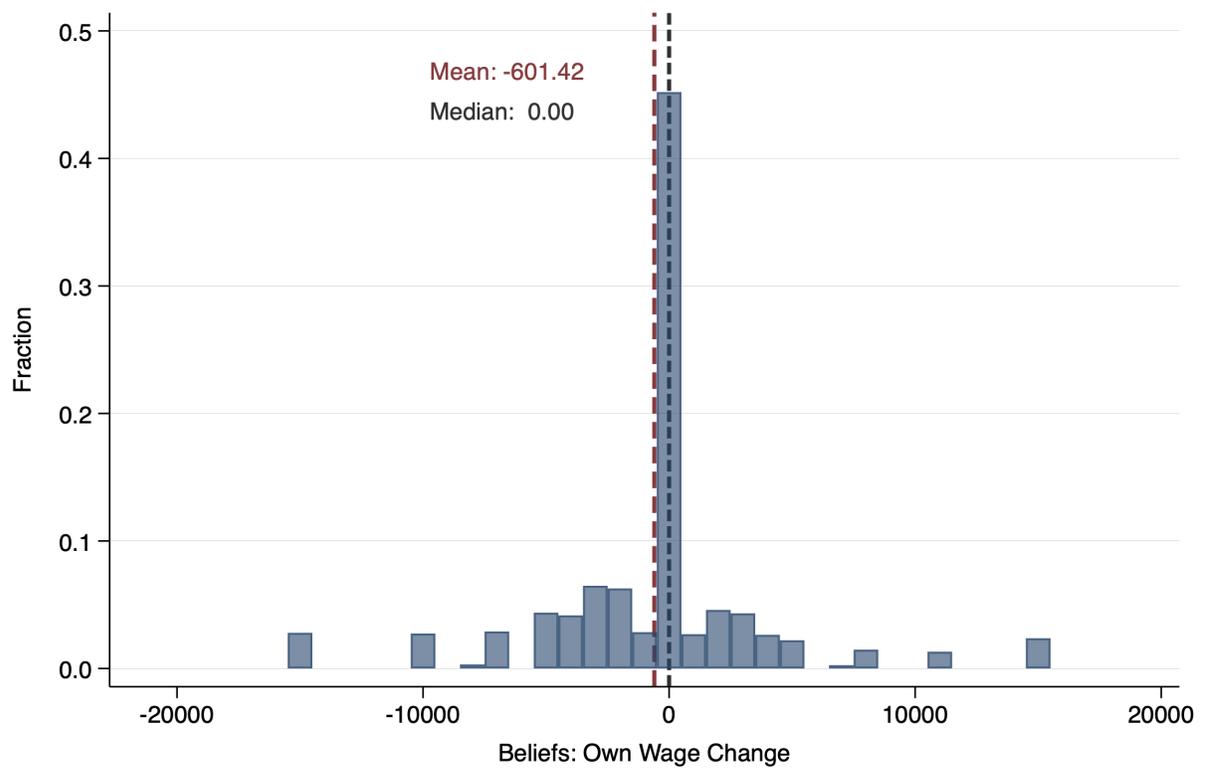
Table A.6: Treatment Effect on Beliefs About Outside Options and Labor Market Behavior

	(1) Beliefs: Own Wage Change	(2) Intended Quit Probability	(3) Intended Negotiation Probability
Treatment - Underestimate	1.925** (0.858)	2.515 (2.434)	0.333 (2.860)
Treatment - Overestimate	0.813 (0.986)	0.258 (2.597)	0.813 (3.294)
Control - Overestimate	1.678 (1.121)	0.547 (2.558)	4.797 (3.440)
Constant	-1.958*** (0.598)	15.13*** (1.684)	20.55*** (2.149)
Obs.	1241	1236	1234

Note: This table presents estimates of the effect of our information treatment about the median wage in the occupation (described in Appendix [G.1](#)) on the beliefs about workers' own wage change (in Column (1)), as well as on the probability to find a job at another firm (Column (2)) or to negotiate the wage at the current firm (Column (3)) in the next 12 months. The beliefs and rent are all expressed as flow, % of salary. Overestimators are defined as respondent who guess a median salary above the true median salary, and vice-versa for underestimators. The omitted category is "Control - underestimate". Standard errors are clustered at the individual level and reported in parentheses with * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

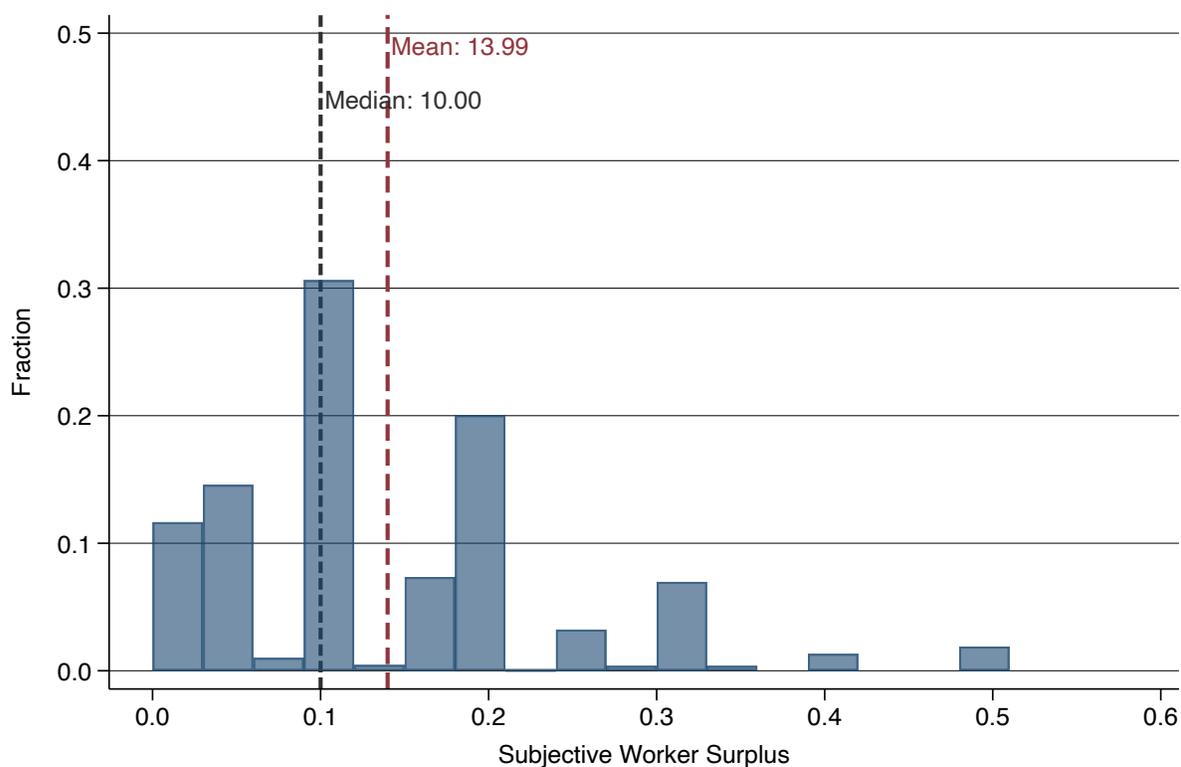
B Appendix Figures

Figure A.1: Distributions of Beliefs About Own Wage Change in Euro



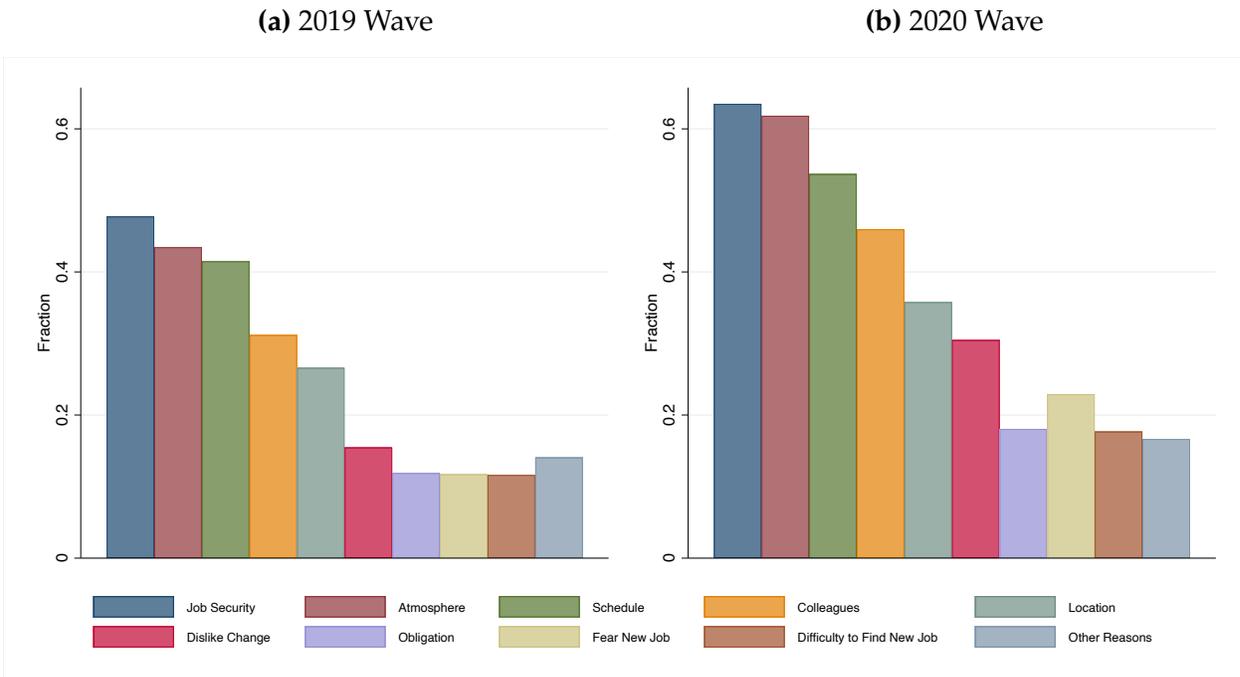
Note: This figure replicates Figure 2 but presents beliefs in monetary amounts (Euro) instead of as a percentage of workers' salaries.

Figure A.2: Distributions of Subjective Worker Surplus as Fraction of Salary



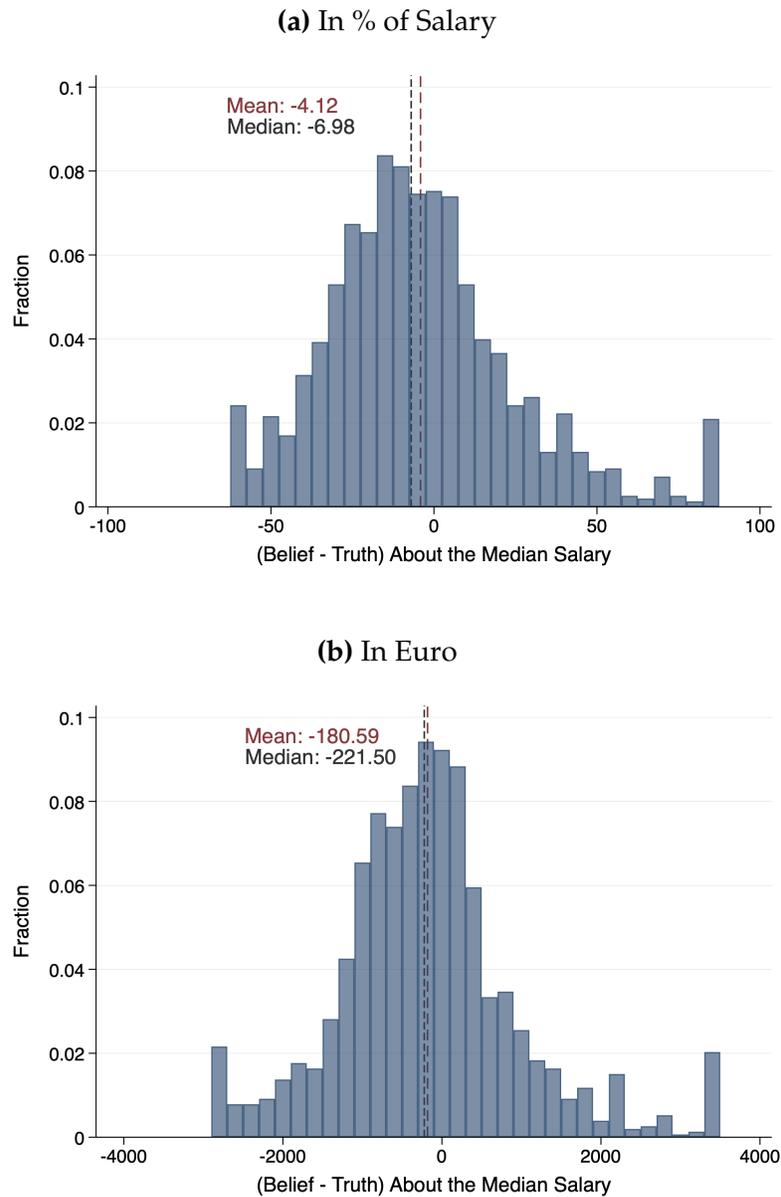
Note: This figure reports data from the 2019 and 2020 waves of the German Socio-Economic Panel. It presents a histogram of workers' perceived surplus at their current employer, calculated from workers' responses to the following question: "Imagine that your current employer would permanently cut wages. This wage cut results from a change of the CEO in the company and is independent of the economic conditions in your industry. At which wage cut would you quit your job within one year?". A worker's subjective surplus is defined as the percentage wage cut they report in response to this question. This figure presents the resulting surplus as fraction of workers' salary. Bins are 3 percentage point wide.

Figure A.3: Reasons for Not Switching Employers



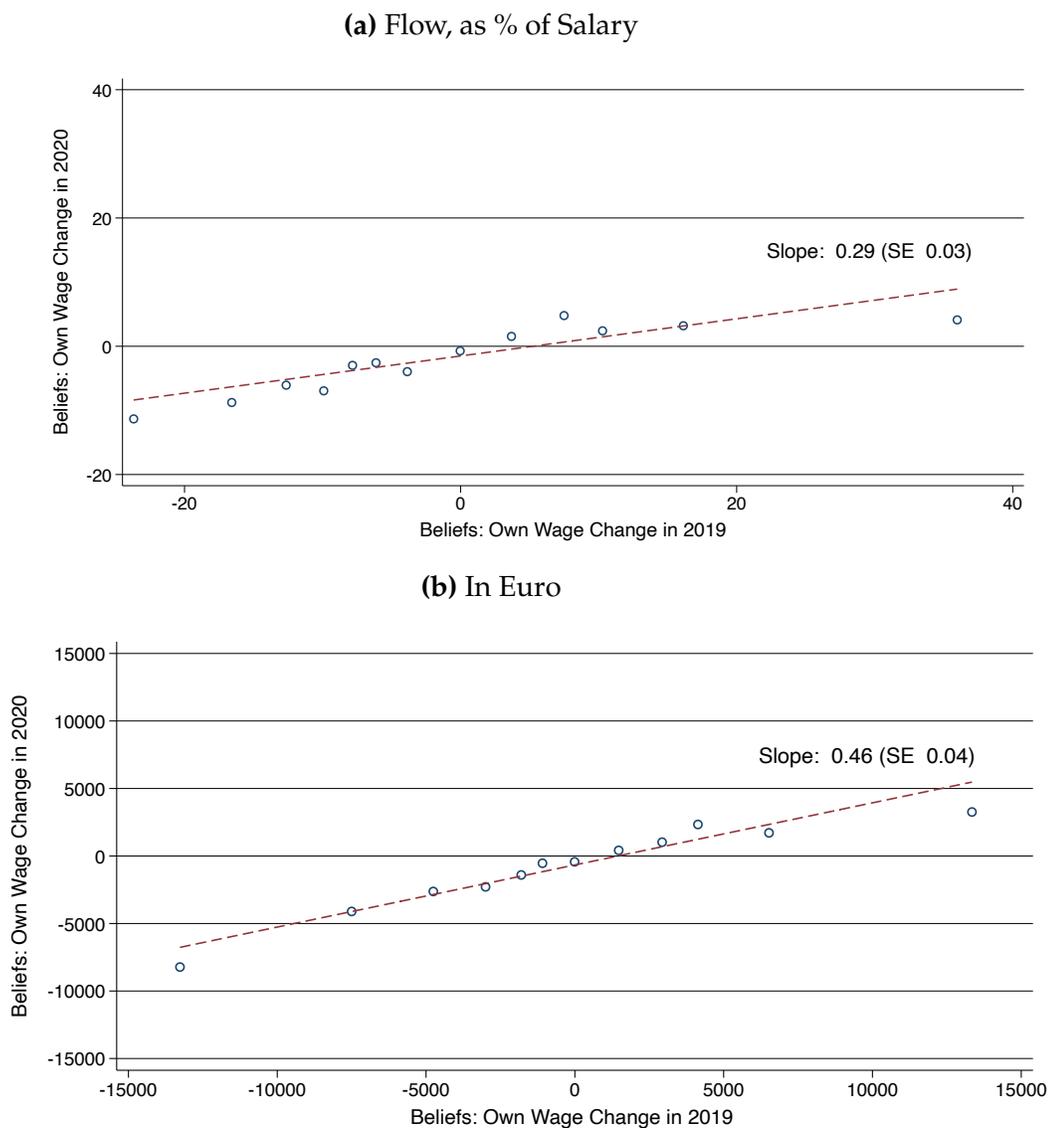
Note: This figure reports data from the 2019 and 2020 wave of the German Socio-Economic Panel. The figure plots the main reasons given for not switching to a higher-paying employer from a predetermined list of potential reasons. The precise question we asked was: "You told us that you think that X% of employees in Germany that are employed at a different employer, but work in the same occupation as you receive a higher salary. What are the main reasons for why you are currently (still) employed at your current employer even though other employers may offer you a higher salary?" Panel (a) shows data from the 2019 wave of the SOEP panel, while Panel (b) shows data from the 2020 of the SOEP panel.

Figure A.4: (Belief - Truth) About the Median Salary in Euro



Note: This figure reports data from the 2019 and 2020 wave of the German Socio-Economic Panel. The panels report histograms of bias in worker beliefs about the median salary in their occupation, where “bias” is defined as the worker’s belief minus the true salary in their occupation (calculated at the 4-digit occupation level). Panel (a) presents the histogram of biases as a percent of workers’ salaries, and Panel (b) plots biases in Euro.

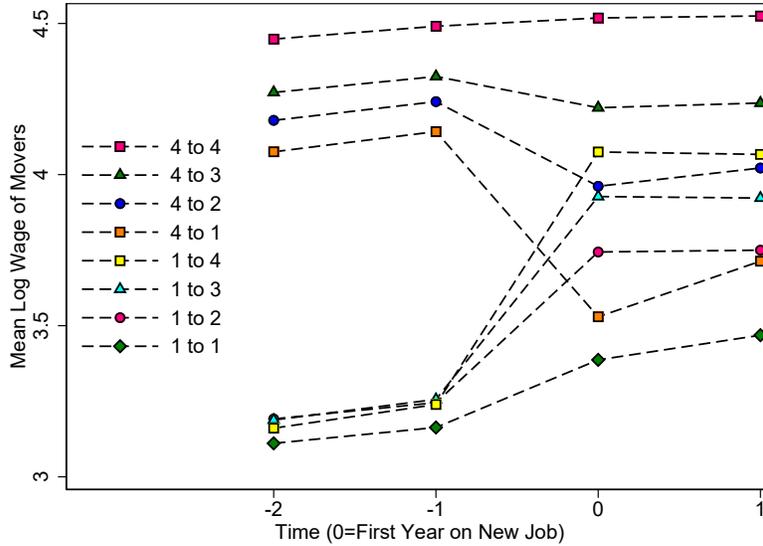
Figure A.5: Persistence of Beliefs About Own Wage Change



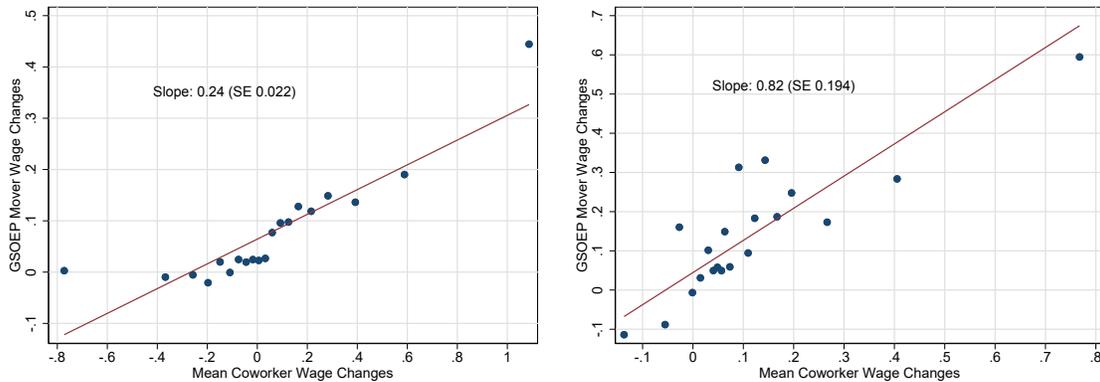
Note: This figure reports data from the 2019 and 2020 wave of the German Socio-Economic Panel. To assess the potential concern that part of the survey measures reflect noise or measurement error (see, e.g., [Gillen, Snowberg, and Yariv, 2019](#)) this figure displays the relationships between workers' beliefs about own wage changes in the years 2019 and 2020 among workers who did not switch jobs. Panel (a) plots workers' beliefs in percent of salary while Panel (b) plots them in Euros.

Figure A.6: Exogeneity and Predictiveness of Mover Wage Changes

(a) Mover Wage Changes by Firm Pay Quartile

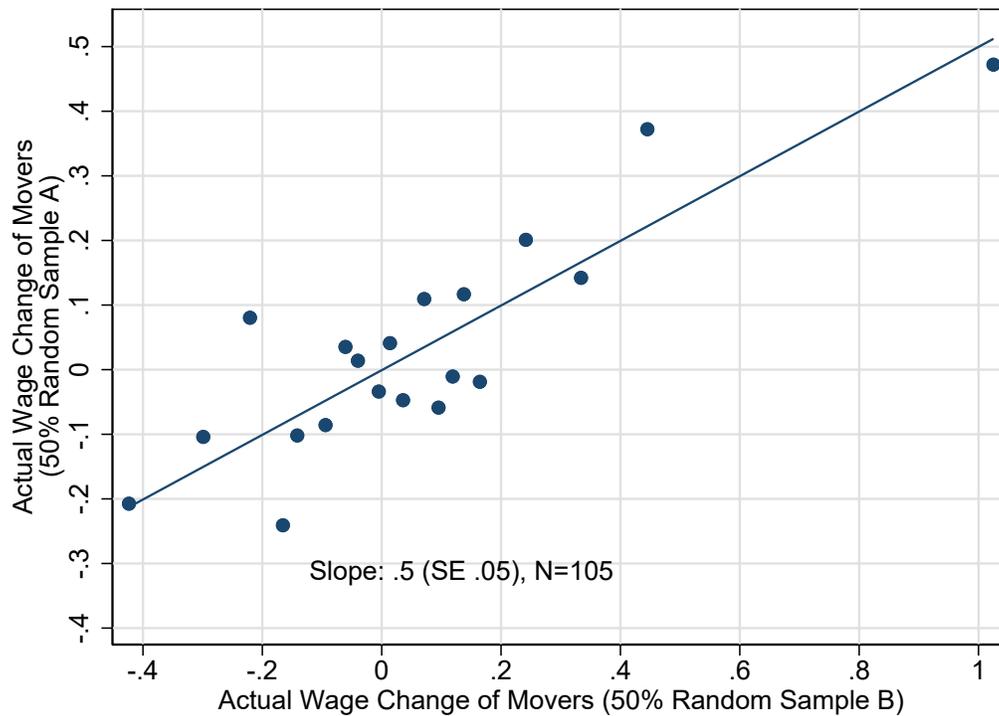


(b) Predictiveness of Mover Wage Changes for SOEP Respondents' Past Wage Changes (Involuntary Moves) **(c) Predictiveness of Mover Wage Changes for SOEP Respondents' Past Wage Changes (All Moves)**



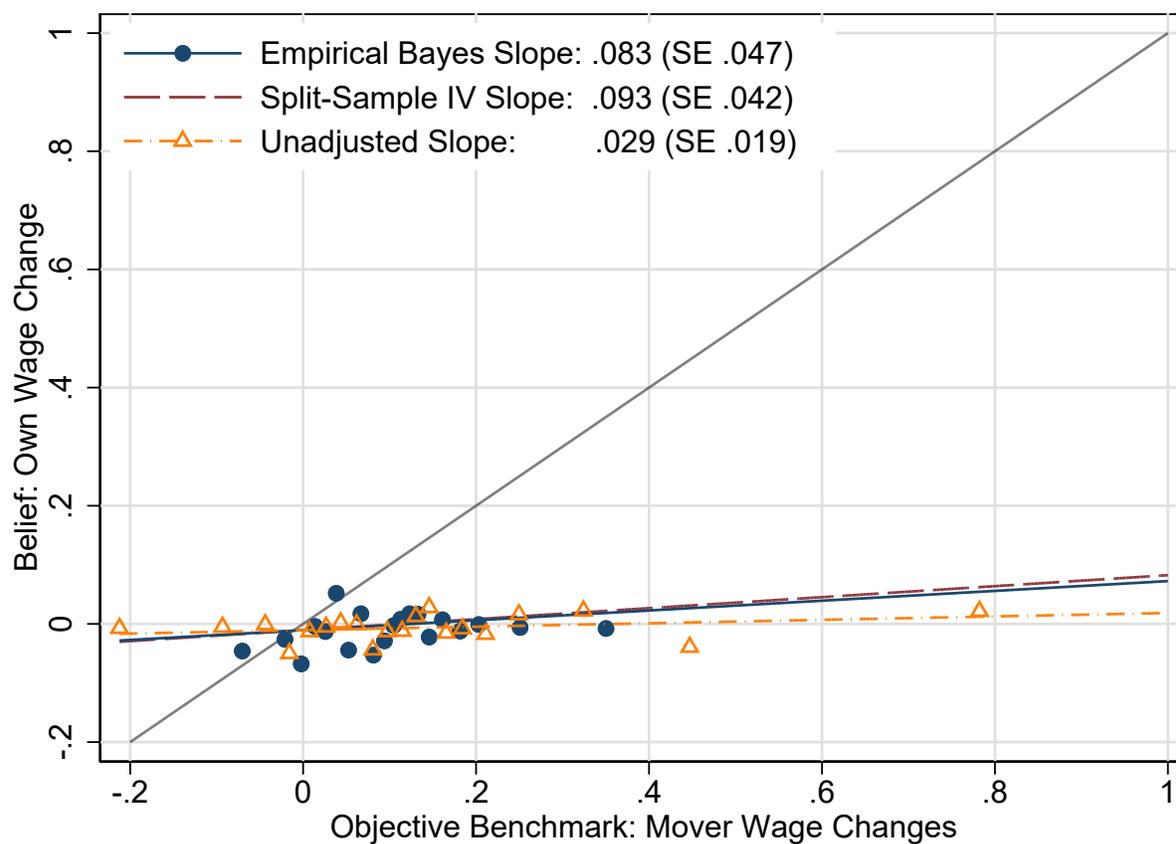
Note: Panel (a) replicates Figure 1 of [Card, Cardoso, and Kline \(2015\)](#), in the full sample of “involuntary” intermediate-unemployment movers in the German labor market over the time period for which we have data. The graph plots the mean wages of involuntary movers in the two years preceding their move ($t = -2$ and $t = -1$) and their first and second years at their new firm ($t = 0$ and $t = 1$). Workers are grouped in the plot based on the wage quartiles of their origin and destination firms. Firms are sorted into quartiles based on the mean wages of their employees. Origin firm wage quartiles are calculated at $t = -1$ and destination firm wage quartiles are calculated at $t = 0$. Panels (b) and (c) track GSOEP respondents in our main sample to their previous workplace. It then regresses the SOEP respondents’ wage changes when leaving those firms on the mean log wage changes of “involuntary” (Panel (b)) or all (Panel (c)) coworkers moving out of those firms in the five years preceding the SOEP respondent’s move.

Figure A.7: Split Sample IV First Stage



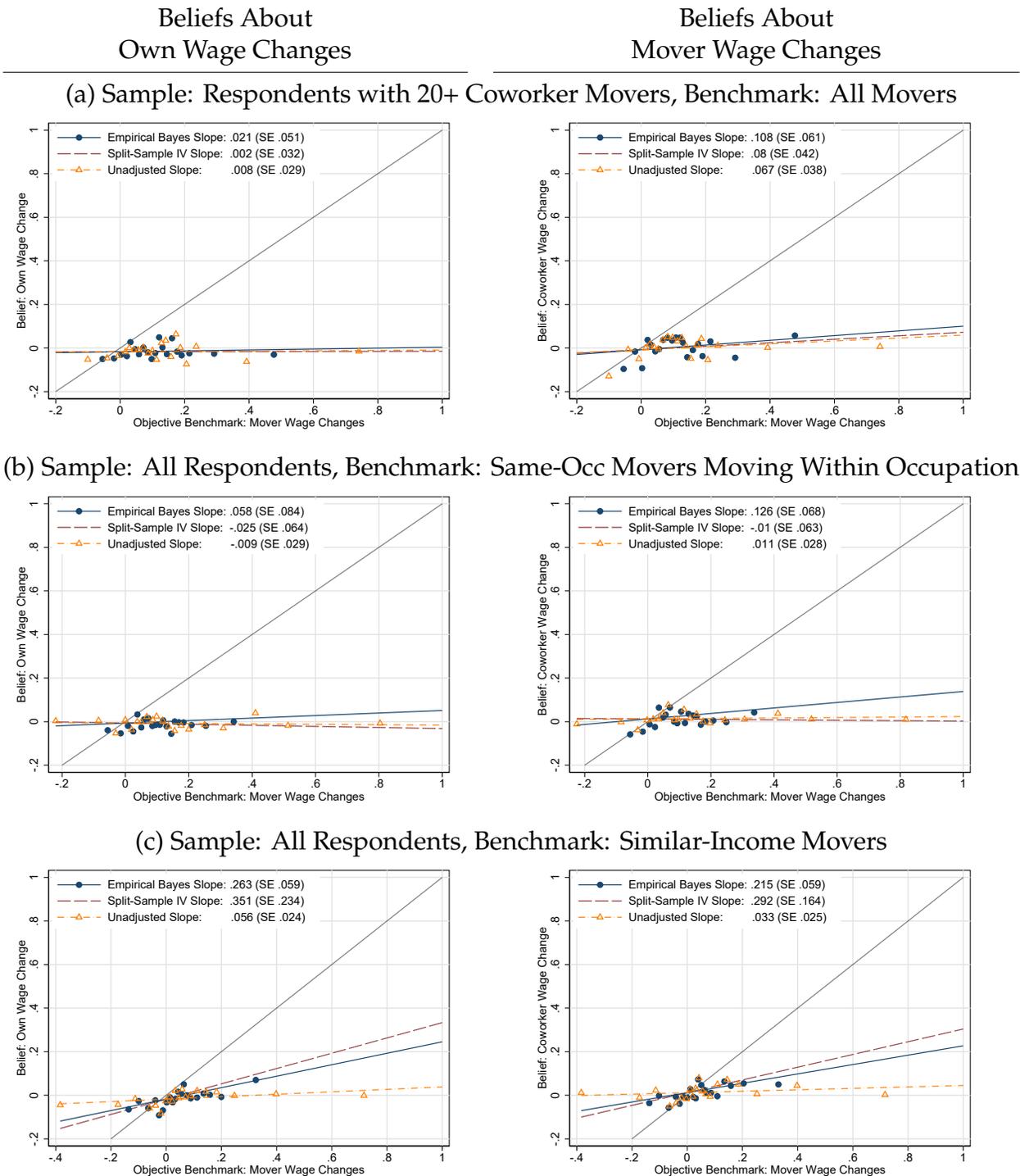
Note: This figure displays the first stage of the split-sample IV procedure used to correct for errors in measurement of coworker wage changes; the estimated coefficient and standard error from the second stage of this procedure are reported in Figure 3 as the dashed red line. The procedure splits each worker’s set of exiting coworkers into two 50% random samples; this figure displays the correlation between the wage changes of movers in the two random samples, across the workers in our main sample.

Figure A.8: Beliefs About Own Wage Change versus All Mover Wage Changes



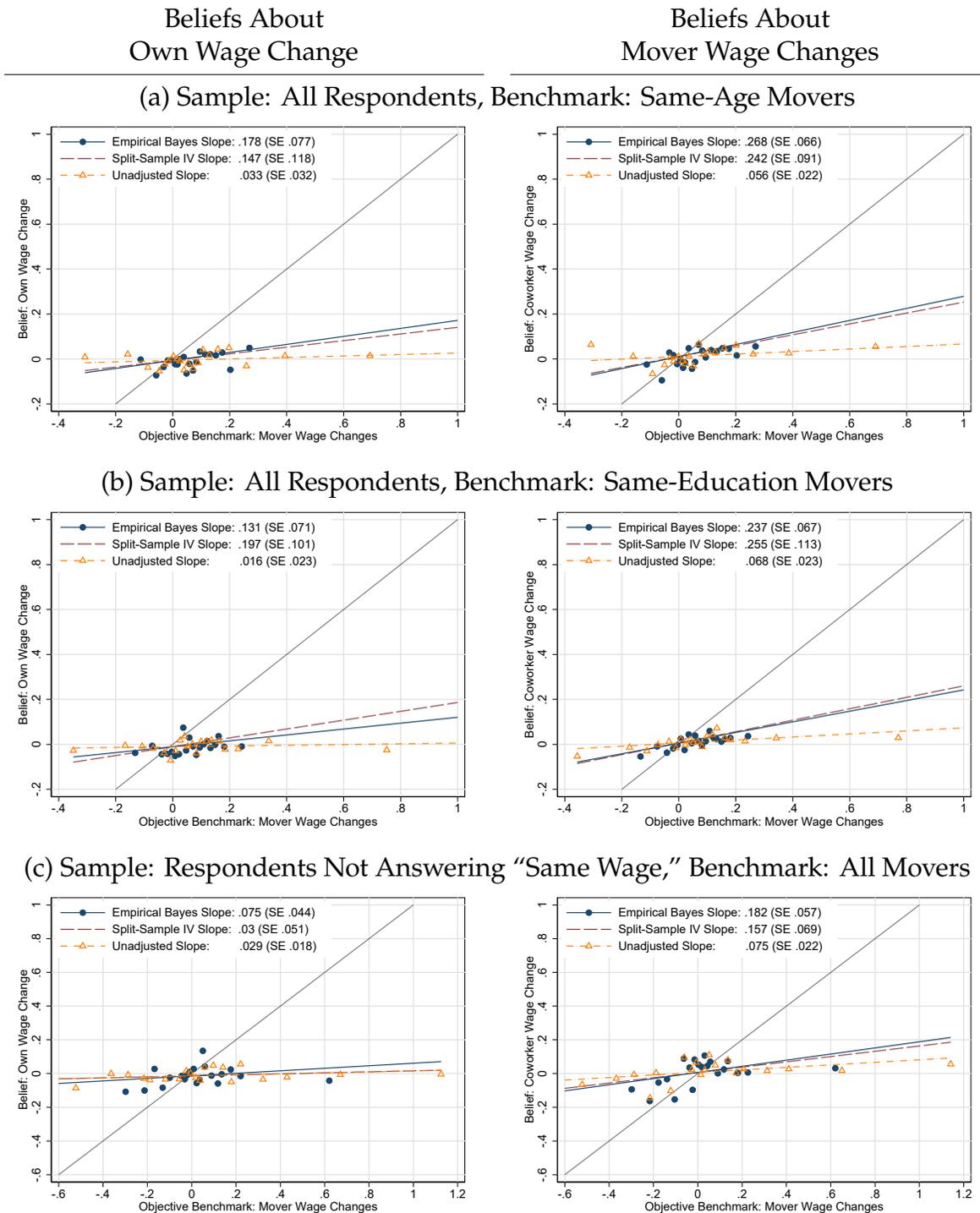
Note: This figure replicates Panel (a) of Figure 3 except we consider *all* fulltime-to-fulltime coworker moves rather than just “involuntary” moves.

Figure A.9: Beliefs versus Mover Wage Changes: Alternative Specifications I



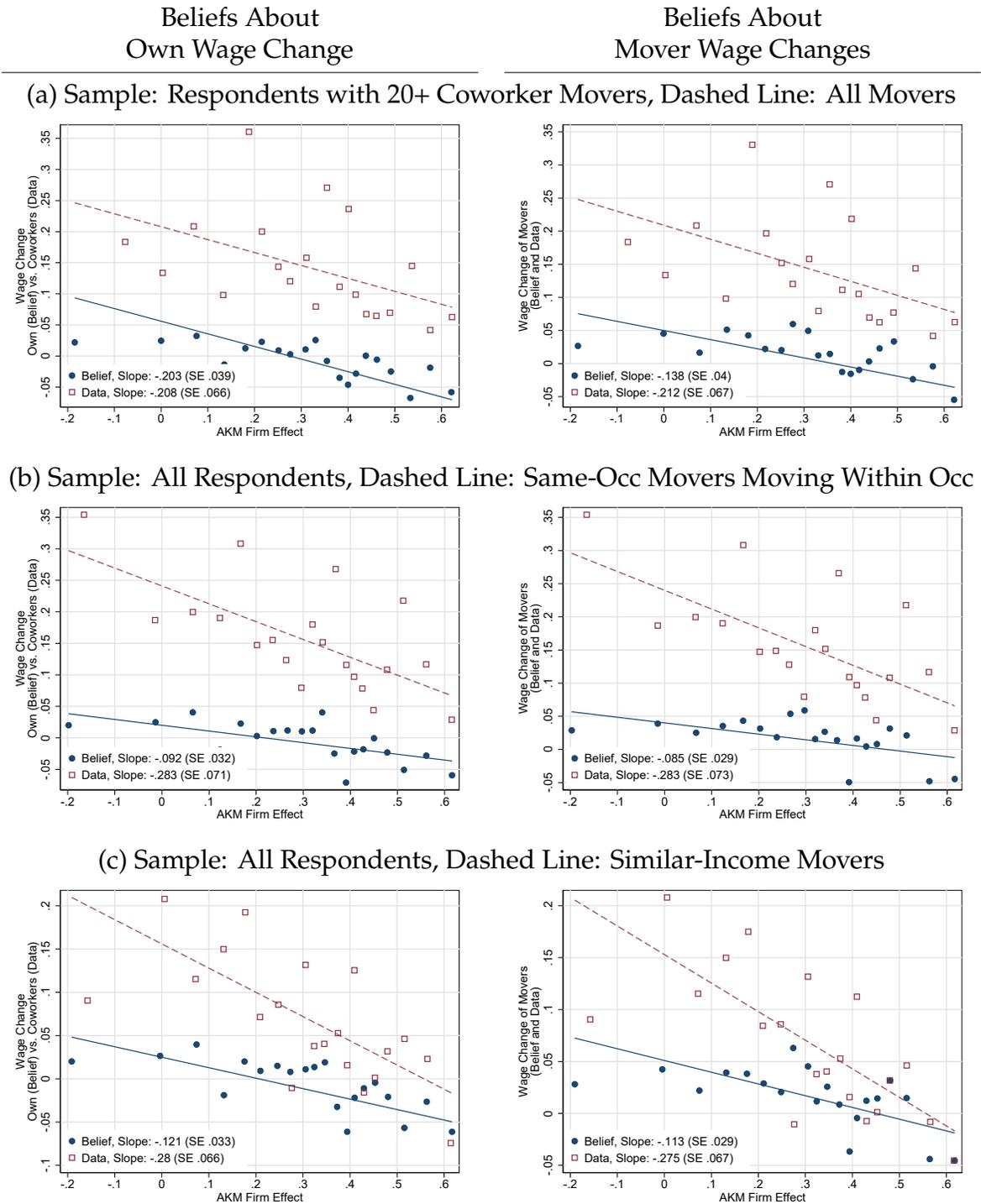
Note: This figure presents alternative versions of Panel (a) Figure 3 in the left column and Panel (a) of Figure 4 in the right column. It restricts to SOEP respondents with at least 20 coworker movers (Panel (a)), to movers in the same occupation as the SOEP respondent who remain within the same occupation when moving (Panel (b)), and to movers in the same income quintile as the SOEP respondent (Panel (c)). Income quintiles are calculated in the overall labor market dataset. Note that for the left-hand column, to preserve sufficient observations, we do *not* restrict to “involuntary” moves and instead consider all coworker moves out of SOEP respondents’ firms, analogously to Appendix Figure A.8.

Figure A.10: Beliefs versus Mover Wage Changes: Alternative Specifications II



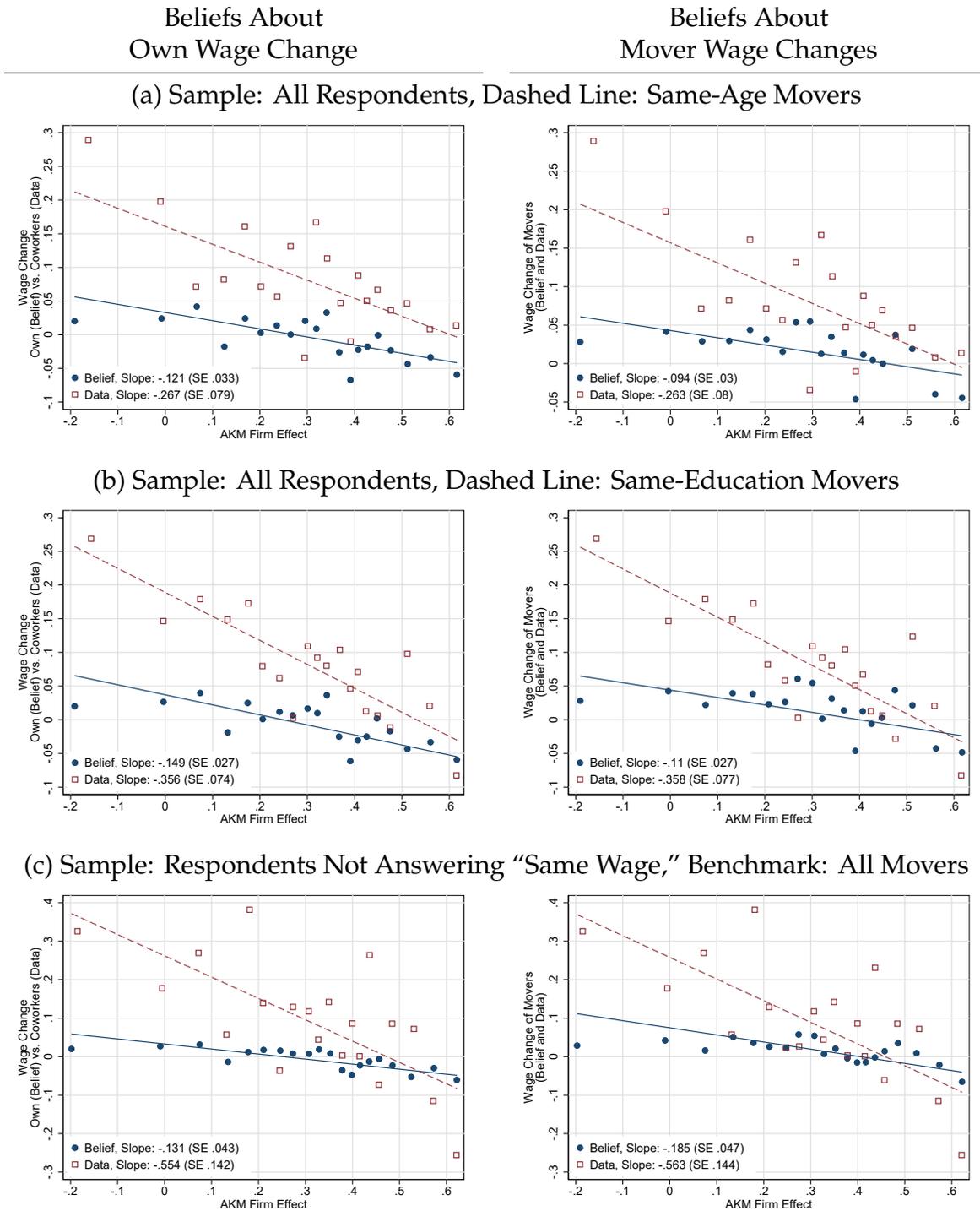
Note: This figure presents alternative versions of Panel (a) of Figure 3 in the left column and Panel (a) of Figure 4 in the right column. It restricts to movers within the same age category as the SOEP respondent (Panel (a), age categories are <20, 20-29, 30-39, 40-49, 50-59, 60-69, 70+) or within the same education category as the SOEP respondent (Panel (b), education categories are no education, vocational training, university degree, or missing education). Panel (c) restricts to SOEP respondents who do not answer "same wage" to the question about what wage they would earn at their outside option. Note that for the left-hand column, to preserve sufficient observations, we do *not* restrict to "involuntary" moves and instead consider all coworker moves out of SOEP respondents' firms, analogously to Appendix Figure A.8

Figure A.11: Beliefs and Mover Wage Changes versus AKM Firm Effects: Alternative Specifications I



Note: This figure presents alternative versions of Panels (a) and (b) of Figure 7 that restrict to SOEP respondents with at least 20 coworker movers (Panel (a)), to movers in the same occupation as the SOEP respondent who remain within the same occupation when moving (Panel (b)), and to movers in the same income quintile as the SOEP respondent (Panel (c)). Income quintiles are calculated in the overall labor market dataset. Note that for the left-hand column, to preserve sufficient observations, we do *not* restrict to “involuntary” moves and instead consider all coworker moves out of SOEP respondents’ firms.

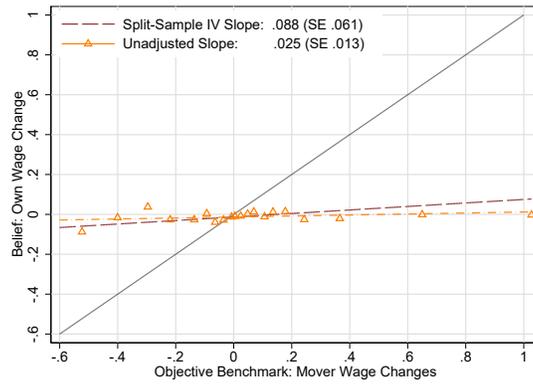
Figure A.12: Beliefs and Mover Wage Changes versus AKM Firm Effects: Alternative Specifications II



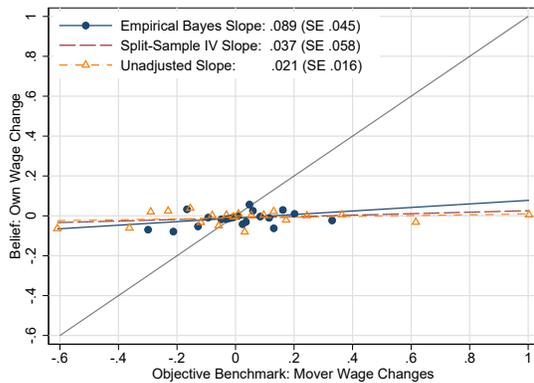
Note: This figure presents alternative versions of Panels (a) and (b) of Figure 7. It restricts to movers within the same age category as the SOEP respondent (Panel (a), age categories are <20, 20-29, 30-39, 40-49, 50-59, 60-69, 70+) or within the same education category as the SOEP respondent (Panel (b), education categories are no education, vocational training, university degree, or missing education). Panel (c) restricts to SOEP respondents who do not answer "same wage" to the question about what wage they would earn at their outside option. Note that for the left-hand column, to preserve sufficient observations, we do *not* restrict to "involuntary" moves and instead consider all coworker moves out of SOEP respondents' firms.

Figure A.13: Beliefs About Own Wage Change Versus Actual Coworker Wage Changes: Alternative Parameters and Horizons

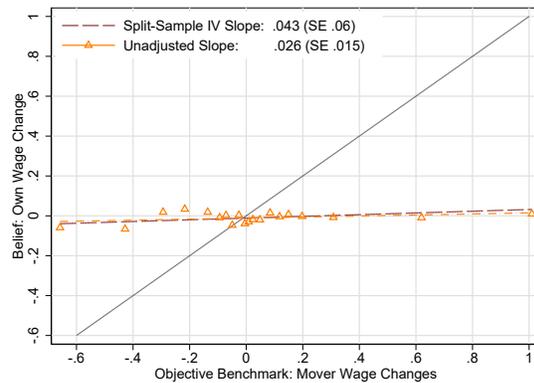
(a) Beliefs Versus Median Coworker Wage Changes (2015-2019)



(b) Beliefs Versus Mean Coworker Wage Changes (2017-2019)



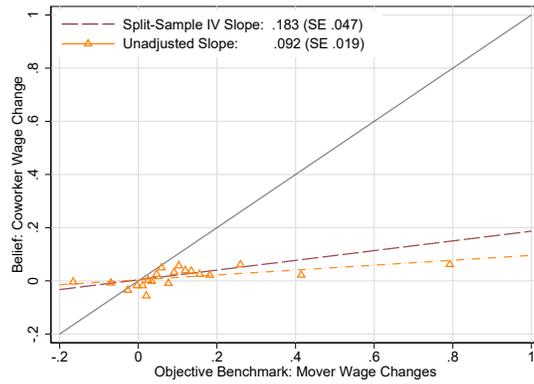
(c) Beliefs Versus Median Coworker Wage Changes (2017-2019)



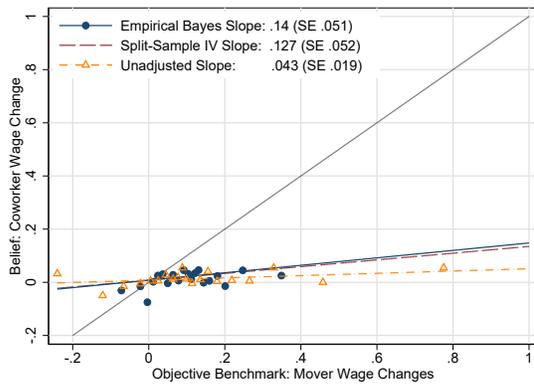
Note: This figure presents alternative versions of Figure 3 Panel (a). Figure 3 Panel (a) plots the relationship between a worker’s belief about their own wage change if leaving their firm against the *mean* actual log wage changes of movers who moved out of their firm *during the period 2015-2019*. Panel (a) of this figure plots the relationship with the *median* actual log wage changes of coworkers who moved out during the same 2015-2019 period. Panel (b) plots the relationship with the *mean* actual wage changes of coworkers who moved out *during the period 2017-2019*. Finally, Panel (c) plots the relationship with the *median* actual wage changes of workers who moved out *during the period 2017-2019*.

Figure A.14: Beliefs About Coworker Wage Changes Versus Actual Coworker Wage Changes: Alternative Specifications

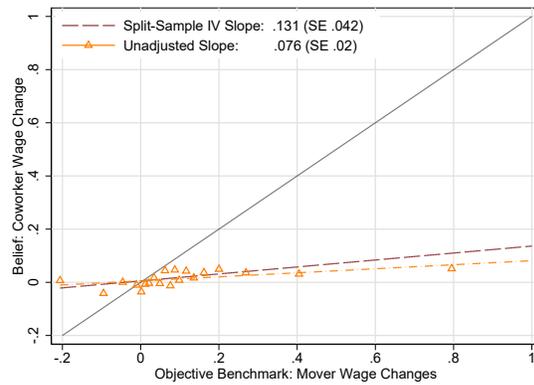
(a) Beliefs Versus Median Coworker Wage Changes (2015-2019)



(b) Beliefs Versus Mean Coworker Wage Changes (2017-2019)

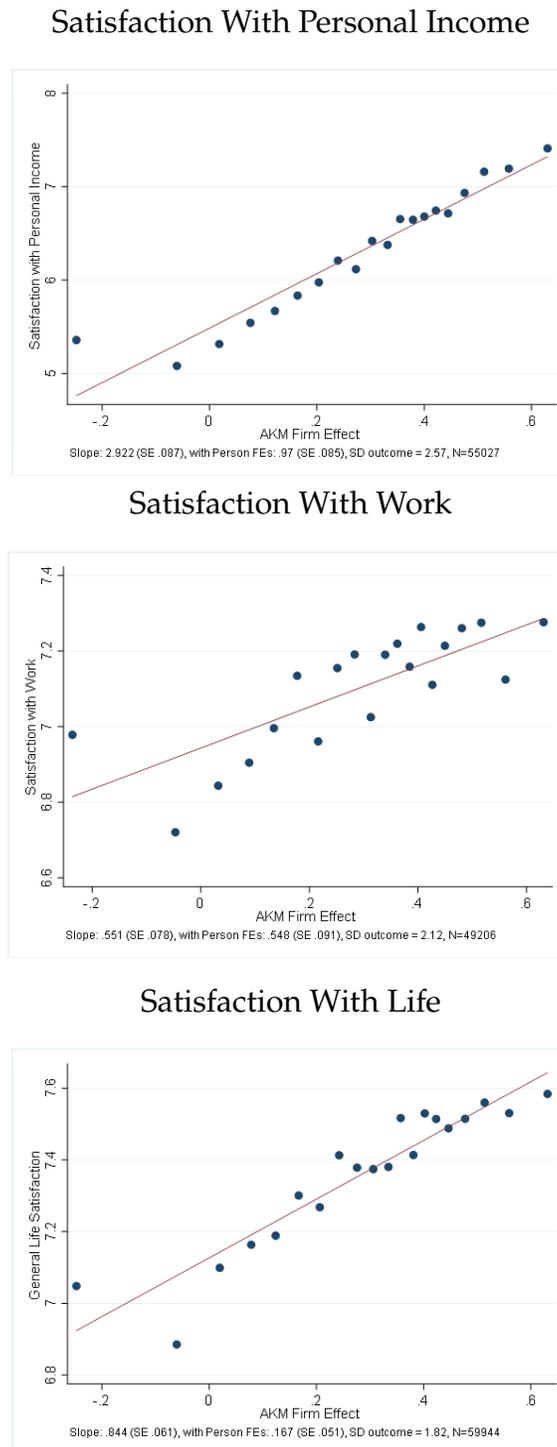


(c) Beliefs Versus Median Coworker Wage Changes (2017-2019)



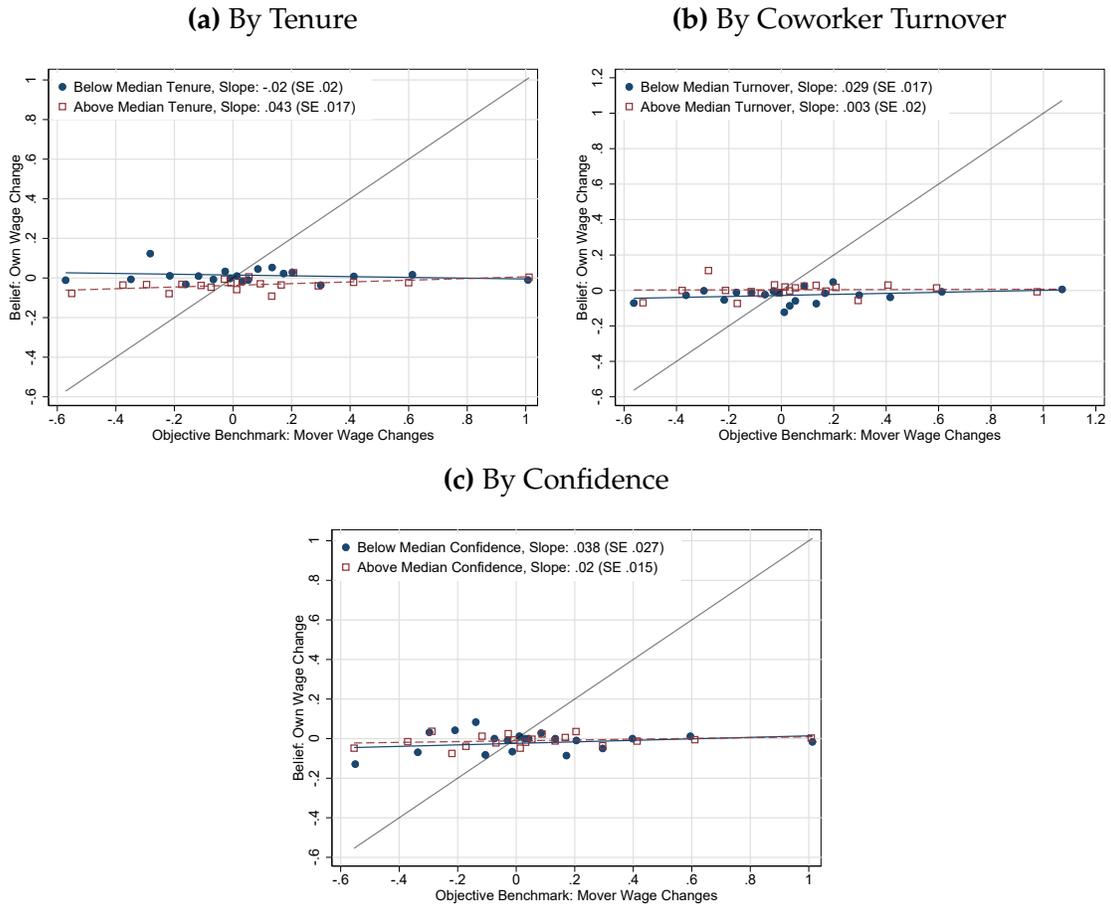
Note: This figure presents alternative versions of Figure 4 Panel (a). Figure 4 Panel (a) plots the relationship between a worker’s belief about the wage changes of coworkers who leave their firm against the *mean* actual log wage changes of movers who moved out of their firm *during the period 2015-2019*. Panel (a) of this figure plots the relationship with the *median* actual log wage changes of coworkers who moved out during the same 2015-2019 period. Panel (b) plots the relationship with the *mean* actual wage changes of coworkers who moved out *during the period 2017-2019*. Finally, Panel (c) plots the relationship with the *median* actual wage changes of workers who moved out *during the period 2017-2019*.

Figure A.15: Satisfaction Measures and AKM Pay Premia



Note: The figure reports measures of satisfaction with personal income, work, and life in general from SOEP plotted against AKM establishment effects. The figures report binned scatterplots and draws on the SOEP-ADIAB dataset. The AKM establishment effects are the [Card, Heining, and Kline \(2013\)](#) establishment pay premia estimated over three different multi-year horizons (1985 to 1992, 1993 to 1999, 1998 to 2004, 2003 to 2010, and 2010 to 2017). For years for which we have multiple AKM estimates, we take the most recent one. For the specifications with changes (right-hand side), we omit years in which the AKM estimation window changes. The SOEP satisfaction questions range from 1984 (satisfaction with work and with life) and 2004 (satisfaction with personal income) to 2018.

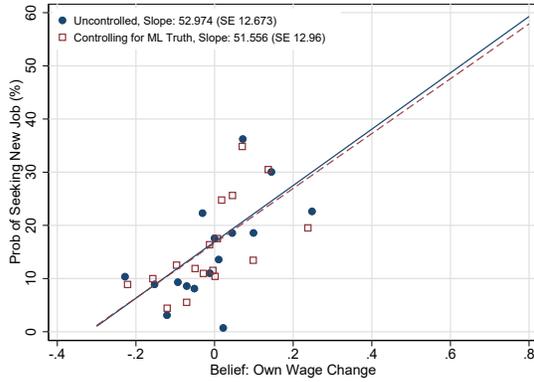
Figure A.16: Heterogeneity in Biases About Own Wage Change



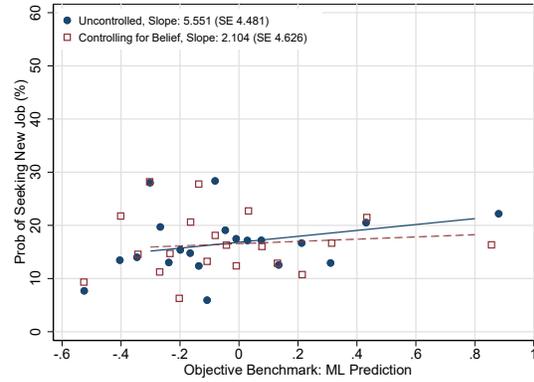
Note: This figure reports versions of our main exhibit (Figure 3 Panel (a)) except splitting the slope by whether the respondent is above/below the median of a heterogeneity variable, and using unadjusted coworker wage changes. In Panel (a), the variable is tenure (in years); in Panel (b), it is the annual coworker separation rate; and in Panel (c), it is self-assessed confidence in response to the median wage in occupation question. We use only unadjusted coworker wage changes here, for visual parsimony.

Figure A.17: Worker Beliefs, Machine Learning Predictions, and Intentions to Search/Quit

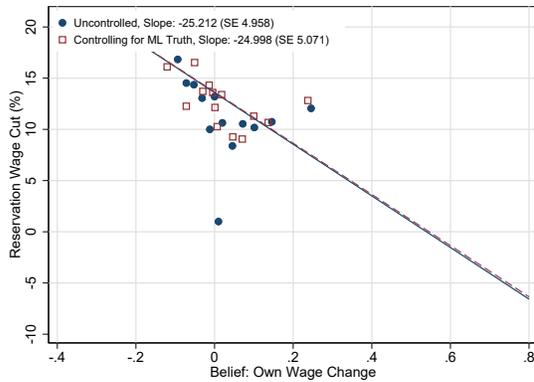
(a) Intentions to Search on Beliefs About Own Wage Change



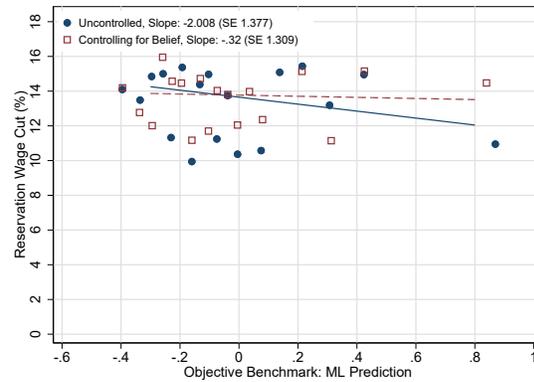
(b) Intentions to Search on ML Predictions



(c) Reservation Wage Cut on Beliefs About Own Wage Change



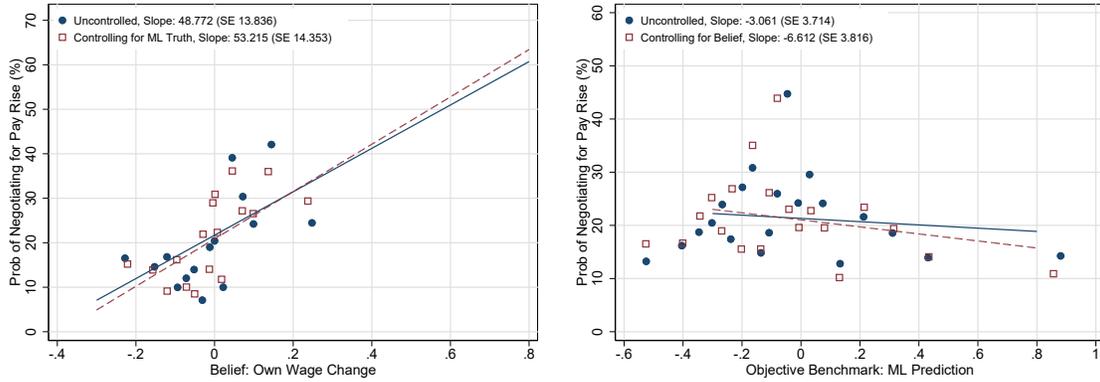
(d) Reservation Wage Cut on ML Predictions



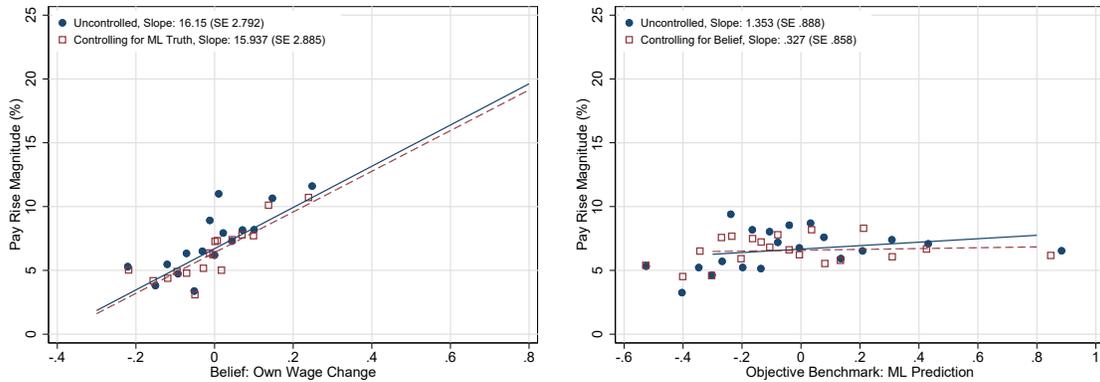
Note: This figure is an alternative version of Figure 9 that uses machine-learning predictions for individual wage changes instead of actual mean coworker wage changes.

Figure A.18: Worker Beliefs, Machine Learning Predictions, and Intentions to Bargain

(a) Intentions to Negotiate on Beliefs About Own Wage Change **(b) Intentions to Negotiate on ML Predictions**



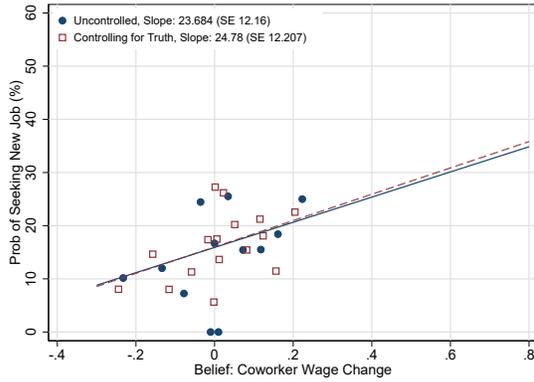
(c) Intended Magnitude of Negotiation on Beliefs About Own Wage Change **(d) Intended Magnitude of Negotiation on ML Predictions**



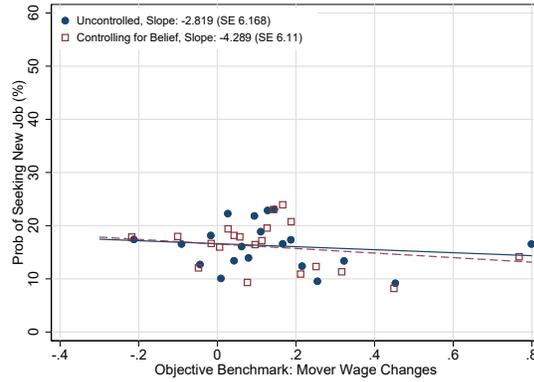
Note: This figure is an alternative version of Figure 10 that uses machine-learning predictions for individual wage changes instead of actual mean coworker wage changes.

Figure A.19: Beliefs About Coworker Wage Changes, Actual Coworker Wage Changes, and Intentions to Search/Quit

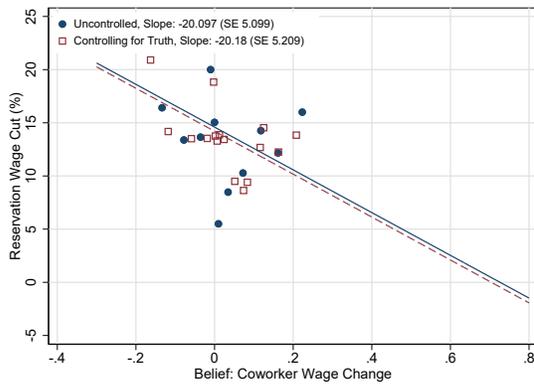
(a) Intentions to Search on Beliefs About Mover Wage Changes



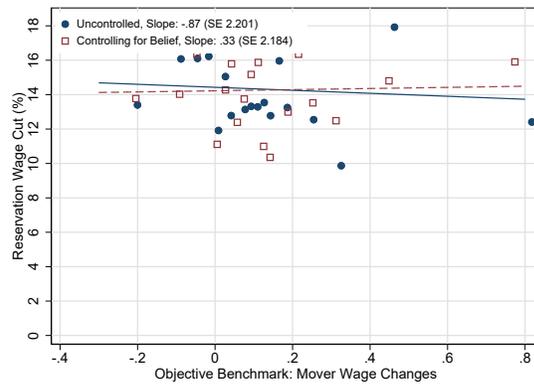
(b) Intentions to Search on Mover Wage Changes



(c) Reservation Wage Cut on Beliefs About Mover Wage Changes



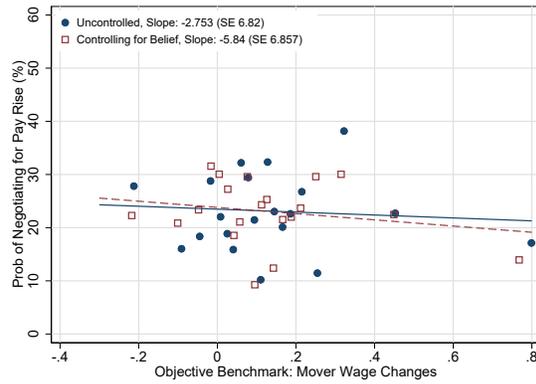
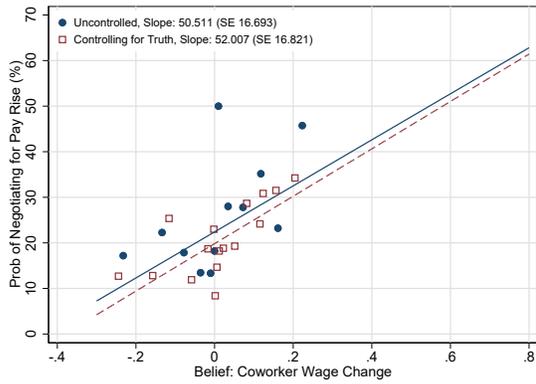
(d) Reservation Wage Cut on Mover Wage Changes



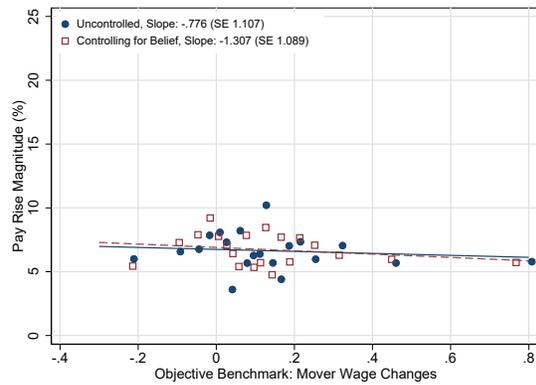
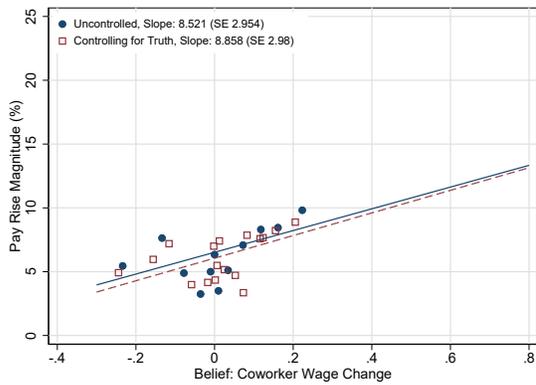
Note: This figure is an alternative version of Figure 9 that uses beliefs about coworker wage changes instead of beliefs about own wage changes.

Figure A.20: Beliefs About Coworker Wage Changes, Actual Coworker Wage Changes, and Intentions to Bargain

(a) Intentions to Negotiate on Beliefs About Mover Wage Changes **(b)** Intentions to Negotiate on Mover Wage Changes



(c) Intended Magnitude of Negotiation on Beliefs About Mover Wage Changes **(d)** Intended Magnitude of Negotiation on Mover Wage Changes



Note: This figure is an alternative version of Figure 10 that uses beliefs about coworker wage changes instead of beliefs about own wage changes.

C Conceptual Framework: Anchoring in a Learning Model

In this section, we offer a simple model of belief formation that gives one potential way to interpret our patterns structurally. Our model assumptions depart from standard search models in that workers do not know the shape of the wage distribution and therefore have to form beliefs about it using as signal the wage they receive at their current employer. We embed our analysis in a normal learning model, which has a long tradition in labor economics for *employer* learning about worker productivity (Farber and Gibbons, 1996; Altonji and Pierret, 2001). We derive an expression for workers' subjective beliefs about the expected wage change when moving to the outside option. This expression consists of a linear function of their objective wage premium, with the addition of two potential misperceptions.

C.1 Model

Environment There are N firms, with firm wage policies given by a normal distribution $N(\theta, 1/\pi)$ with mean θ and precision (inverse variance) π . Workers do not know these firm wage policies, instead they hold a subjective prior over θ given by $N(\mu, 1/\tau)$, while π is common knowledge. Wages are independent conditional on θ . In summary, the worker's beliefs about wages at firm j are given by

$$w_j|\theta \sim N(\theta, 1/\pi) \quad \forall j \in N \quad (\text{A1})$$

$$\theta \sim N(\mu, 1/\tau) \quad (\text{A2})$$

Belief Formation A worker hired by firm j observes the wage w_j . This provides a costless signal about the wage distribution. We first want to understand how the worker's posterior expectation about θ changes as a function of w_j , i.e., $\theta|w_j$. Bayesian updating

implies:¹

$$\theta|w_j \sim N\left(\frac{w_j\pi + \mu\tau}{\pi + \tau}, \frac{1}{\pi + \tau}\right). \quad (\text{A3})$$

Intuitively, the posterior mean of $\theta|w_j$ is a precision-weighted average of the prior mean μ and the received wage w_j . So long as w_j is informative about wages, i.e. π is non-zero, the posterior belief about θ will be increasing in the received wage w_j .

¹To see this, note that the marginal posterior for θ is given by integrating over the wage w_k :

$$\begin{aligned} f(\theta|w_j) &= \int f(w_k, \theta|w_j)dw_k \\ &\propto \int f(w_j|\theta)f(w_k|\theta)f(\theta)dw_k \\ &= f(w_j|\theta)f(\theta) \int f(w_k|\theta)dw_k \\ &= f(w_j|\theta)f(\theta) \\ &= \phi(w_j; \theta, 1/\pi)\phi(\theta; \mu, 1/\tau) \\ &= \phi(\theta; w_j, 1/\pi)\phi(\theta; \mu, 1/\tau) \end{aligned}$$

where the last step follows from symmetry of the normal distribution. We next rely on the fact that the product of two normal pdfs is proportional to a normal pdf whose mean is a precision weighted average of the original means, and whose precision is equal to the sum of the original precisions. Specifically,

$$\phi(x; \mu_1, \tau_1)\phi(x; \mu_2, \tau_2) = \underbrace{\phi(\mu_1; \mu_2, \tau_1^{-1} + \tau_2^{-1})}_{\text{constant w.r.t. } x} \phi\left(x; \frac{\mu_1\tau_1 + \mu_2\tau_2}{\tau_1 + \tau_2}, \frac{1}{\tau_1 + \tau_2}\right).$$

Applying this to $f(\theta|w_j)$ implies:

$$\theta|w_j \sim N\left(\frac{w_j\pi + \mu\tau}{\pi + \tau}, \frac{1}{\pi + \tau}\right).$$

Similarly, Bayesian updating about wages at another firm k implies²

$$w_k|w_j \sim N\left(\frac{w_j\pi + \mu\tau}{\pi + \tau}, \frac{2\pi + \tau}{\pi(\pi + \tau)}\right). \quad (\text{A4})$$

Since the conditional belief in Equation (A1) is a normal distribution centered at θ , the posterior belief about w_k is centered at the same point as the posterior belief about θ . Therefore, so long as $\pi > 0$, the posterior mean of $w_k|w_j$ is increasing in w_j : workers earning higher wages will have more optimistic posteriors about wages at other firms. However, the w_k posterior is less precise than the θ posterior whenever there is dispersion in wages, i.e., π is finite. Indeed:

$$\frac{\pi(\pi + \tau)}{2\pi + \tau} < \pi + \tau \quad (\text{A5})$$

Intuitively, this is because the posterior $w_k|w_j$ incorporates both uncertainty in θ and uncertainty in the wage conditional on θ .

Belief About Outside Options Our empirical design elicits worker's subjective expectation about the wage change accompanying an involuntary move to their outside option. The essence of our research design is that workers form expectations about their outside option on the basis of their beliefs about the wage distribution. In the current setup, workers form beliefs about the expected wage. To formalize the link between the wage change in our model and our empirical design, suppose that, with probability x , the worker finds a job paying the same wage as their current employer; with (complementary) probability

²To see this, note that we can write the marginal over w_k (for $k \neq j$) as:

$$\begin{aligned} f(w_k|w_j) &= \int f(w_k, \theta|w_j)d\theta \\ &= \int f(w_k|\theta)f(\theta|w_j)d\theta \\ &= \int \phi(w_k; \theta, 1/\pi)\phi\left(\theta; \frac{w_j\pi + \mu\tau}{\pi + \tau}, \frac{1}{\pi + \tau}\right)d\theta \\ &= \int \phi(\theta; w_k, \pi)\phi\left(\theta; \frac{w_j\pi + \mu\tau}{\pi + \tau}, \frac{1}{\pi + \tau}\right)d\theta \\ &= \phi\left(w_k; \frac{w_j\pi + \mu\tau}{\pi + \tau}, \frac{2\pi + \tau}{\pi(\pi + \tau)}\right) \int \phi(\theta; \cdot, \cdot)d\theta \\ &= \phi\left(w_k; \frac{w_j\pi + \mu\tau}{\pi + \tau}, \frac{2\pi + \tau}{\pi(\pi + \tau)}\right), \end{aligned}$$

i.e.,

$$w_k|w_j \sim N\left(\frac{w_j\pi + \mu\tau}{\pi + \tau}, \frac{2\pi + \tau}{\pi(\pi + \tau)}\right).$$

$1 - x$ the worker takes a random draw from the wage distribution, and hence in expectation receives the average expected wage. As a result, the wage change the worker would experience if transitioning to their outside option is given by:

$$\Delta_j = (1 - x)(\mu_j^0 - w_j), \quad (\text{A6})$$

where μ_j^0 is the average wage at other firms, that is $\mu_j^0 = \frac{1}{N} \sum_{k \neq j} w_k$. Assuming x is common knowledge, the worker's subjective *belief* about the wage difference, $\tilde{\Delta}_j$, is given by:

$$\begin{aligned} \tilde{\Delta}_j &= (1 - x)(E_j[w_k | w_j] - w_j) \\ &= (1 - x) \left(\frac{w_j \pi + \mu \tau}{\pi + \tau} - w_j \right) \end{aligned} \quad (\text{A7})$$

where we get Equation (A7) by replacing $E_j[w_k | w_j]$ with the mean of the distribution of $w_k | w_j$ from Equation (A4).

Biased Belief About Outside Option In order to measure potential biases in beliefs about outside options, we need to compare the worker's subjective belief about their outside option with an objective benchmark. Our empirical strategy to measure this objective benchmark is described in Section 3.2. Here, we assume that we have access to the true wage change the worker would experience at their outside option. The worker's bias is then defined as the difference between the worker's subjective wage change and the true wage:

$$B_j = \tilde{\Delta}_j - \Delta_j \quad (\text{A8})$$

$$= (1 - x) \left(\frac{\pi w_j + \tau \mu}{\pi + \tau} - \mu_j^0 \right), \quad (\text{A9})$$

where Equation (A9) is obtained by replacing Δ_j using Equation (A6) and $\tilde{\Delta}_j$ using Equation (A7).

It follows that workers will underestimate outside options, i.e., $B_j < 0$, if:

$$w_j < \mu_j^0 + \frac{\tau}{\pi}(\mu_j^0 - \mu) \quad (\text{A10})$$

The direction of the inequality reflects the fact that workers paid lower wages are led to believe the external wage distribution is less favorable. The cutoff wage at which workers start to underestimate outside options relative to the truth depends on the prior mean μ . The lower the prior mean relative to the empirical average, the more workers will underestimate, and vice versa. In the special case when priors are correctly centered, $\mu = \mu_j^0$, Equation (A10) reduces to $w_j > \mu_j^0$: Workers with above average wages will

overestimate wages at their outside options, and those with below average wages will underestimate wages at their outside options. Further, the impact of the relative precision of the signal $\frac{\pi}{\tau}$ depends on the sign of $\mu_j^0 - \mu$. Intuitively, the relative precision of the signal governs the anchoring to priors relative to the adjustment to current wage: if the prior is below the true mean and anchoring is strong (i.e. τ is high relative to π), a high w_j is needed for the adjustment to lead to overestimation of outside options. Conversely, if the prior is above the true mean and anchoring is strong, a low w_j is needed for the adjustment to lead to underestimation of outside options.

C.2 Correspondence to Empirical Strategy

Equations (A6) and (A7) allow us to express the coefficient in the regression of subjective beliefs ($\tilde{\Delta}_j$) on objective beliefs (Δ_j) in terms of the model parameters:

$$\tilde{\Delta}_j = \alpha + \beta \Delta_j + \epsilon_j \quad (\text{A11})$$

Slope β The coefficient of interest can then be written as:

$$\begin{aligned} \beta &= \frac{\text{Cov}(\tilde{\Delta}_j, \Delta_j)}{\text{Var}(\Delta_j)} \\ &= (1-x)^2 \frac{\text{Cov}\left(\left(\frac{w_j \pi + \mu \tau}{\pi + \tau} - w_j\right), (\mu_j^0 - w_j)\right)}{\text{Var}(\Delta_j)} \\ &= (1-x)^2 \frac{\tau}{\pi + \tau} \frac{\text{Cov}((\mu - w_j), (\mu_j^0 - w_j))}{\text{Var}(\Delta_j)} \\ &= (1-x)^2 \frac{\tau}{\pi + \tau} \frac{(1 - (N-1)^{-1}) \text{Var}(w_j)}{\text{Var}(\Delta_j)} \\ &= \frac{N-2}{N-1} \frac{\tau}{\pi + \tau}, \end{aligned} \quad (\text{A12})$$

where the last line follows from the fact that $\text{Var}(\Delta_j) = (1-x)^2 \text{Var}(w_j)$.³ When N is large,

$$\beta \approx \frac{\tau}{\pi + \tau}. \quad (\text{A13})$$

When θ is uninformative about wages, i.e., when wage dispersion is high and π is low relative to τ , current wages do not generate differential posterior over- or under-estimation

³The coefficient $\frac{N-2}{N-1}$ arises due to the mechanical negative correlation between w_j and μ_j^0 . This attenuates the positive correlation between subjective and objective wage changes.

and the slope approaches one. Meanwhile, when θ and wages are tightly linked (π is high relative to τ), overall sentiment about the wage distribution is highly sensitive to the current wage. Workers underestimate the magnitude of wage changes, leading to a lower β .

Intercept α The intercept is the subjective wage change for a worker at the average firm ($w_j = \mu_j^0$), and is given by

$$\begin{aligned}
 \alpha &= \bar{\Delta}_j - \beta \bar{\Delta}_j \\
 &= (1-x) \left(\frac{\bar{w}\pi + \mu\tau}{\pi + \tau} - \bar{w} \right) - \frac{\tau}{\pi + \tau} (1-x) (\mu_j^0 - \bar{w}) \\
 &= \frac{\tau}{\pi + \tau} (1-x) (\mu - \mu_j^0), \tag{A14}
 \end{aligned}$$

where \bar{w} is the sample mean of w_j , which may differ from μ_j^0 when the SOEP sample is not perfectly representative. Equation (A14) shows that the intercept is proportional to the difference between the posterior and population means $\mu - \mu_j^0$. When this difference is non-zero, the intercept induces a homogenous shift in subjective wage changes.

D Details on Expert Survey

We conducted an expert survey with leading academic economists in labor economics and in behavioral economics. In total, we invited 479 economists; 151 responded to our survey, corresponding to a response rate of 29.9%. Table [A.4](#) provides some summary statistics about the sample: 22% of experts are female, half of the sample are full professors, 63% of the sample are from a U.S. institution, while 16% are from a German institution. The median expert's h-index is 17.

Our expert survey had two parts. In the first part, we elicited experts' beliefs about the wage changes of workers who are forced to leave their job within 3 months, separately for a worker at a typical, high-paying, and low-paying firm. In the second part, we randomly assigned our experts into one of three blocks. In the first block, we measured experts' beliefs about workers' reservation wage changes. In the second block, we measured experts' beliefs about workers' subjective outside options $\tilde{\Delta}_j$. In the third block, we asked experts to predict workers' beliefs about the wage changes experienced by coworker movers. In each of these three blocks, we elicited expert predictions about the median respondent, the 25th percentile of the response distribution, the 75th percentile of the response distribution, as well as for the median respondent employed at high-paying or low-paying firms. In the results section, we will contrast expert beliefs with our findings. Appendix Table [A.5](#) summarizes the expert predictions; for a full set of the instructions used, see Appendix [G.4](#).

E Machine Learning Predictions

In this Appendix, we describe the methodology used to produce our machine learning wage change predictions.

We begin by taking the universe of annual employment spells between 2015 and 2019 in the IAB data. For each person, we narrow down to that person’s “main spell” within each year by taking the spell with the highest earnings that year. A “firm-to-firm transition” is defined as a case where person i ’s main spell is in firm j_1 during year t and in firm $j_2 \neq j_1$ in year $t + 1$. Using this definition, we restrict our attention to the full set of firm-to-firm transitions occurring between 2015 and 2019 in which the person worked full-time both at their origin firm and their destination firm, and experienced an intermediate spell of unemployment insurance receipt beginning within 12 weeks after the termination of the original job. We omit firm-to-firm transitions corresponding to SOEP respondents.

For each firm-to-firm transition, we calculate the log wage change associated with that transition as the difference between the log daily earnings associated with firm j_2 in year $t + 1$ minus the log daily earnings associated with firm j_1 in year $t + 1$. We also calculate a comprehensive set of covariates for the person-transition observation, with all covariates calculated during the person’s last spell at the origin firm—so firm-level characteristics are characteristics of the *origin* firm, and age, education, etc., are calculated during the last spell at that firm. The full set of covariates is listed in Table [A.7](#).

We then run a lasso regression at the person-transition level where the dependent variable is the log wage change associated with the transition and the independent variables are the covariates listed in Table [A.7](#). We use the Stata command `elasticregress` ([Townsend, 2017](#)), as the administrative data environment we worked in did not have newer versions of Stata with built-in machine learning packages.

Once the lasso regression selects a set of covariates and estimates coefficients for them, we use those covariates and coefficients to generate a predicted wage change for each SOEP respondent. We do this by matching the SOEP respondent IDs into the 2019 administrative IAB data and calculating the values of each covariate for the SOEP respondents using the IAB data.

The lasso regression selects all of the covariates we include, with the exception of some of the dummies within the sets of region/industry dummies and interactions. Table [A.7](#) presents estimated coefficients, and partial R^2 values, for each selected coefficient. Partial R^2 values are calculated by regressing the “transition wage change” variable on the relevant covariate, with all of the other covariates partialled out; the R^2 value from this regression is the relevant covariate’s partial R^2 value.

We test the fit of the lasso model by estimating the model on a randomly selected 50% sample of firm-to-firm transitions, using the estimated coefficients to generate predictions for the remaining 50% of observations, and then regressing the true wage changes for those observations on the predicted wage changes. This latter “evaluation” regression results in a coefficient of 1.017 (SE 0.006) on the “predicted wage change” dependent variable and an R^2 value of 0.40.

Table A.7: Machine Learning Predictors

Variable	Description	Included?	Coefficient	Partial R^2
Wage	Mover's log wage at initial firm.	Y	-0.647	0.232
Firm effect	AKM fixed effect of initial firm.	Y	0.192	0.003
Age	Cubic in mover's age (linear coef reported).	Y	0.008	0.000
Tenure	Cubic in mover's number of years spent at initial firm (linear coef reported).	Y	0.008	0.001
Gender	Female dummy.	Y	-0.075	0.008
Firm size	Cubic in number of employees at initial firm (coef on cubic, the only included dummy, reported).	Y	0.000	0.001
Turnover	Annual separation rate at initial firm.	Y	0.060	0.001
Wage dispersion	SD of wages at initial firm	Y	0.073	0.001
Employment growth	Annual growth rate in number of employees at initial firm	Y	0.037	0.000
Education	Dummies for: no education, vocational education, university education, omitted = missing education. Coef on "university" reported, the other two are very close to zero.	Y	0.312	0.000
Region	16 <i>Bundesländer</i> (German states)	Y	NA	0.000
Occupation	1-digit occupation categories	Y	NA	0.023
Industry	NACE Level 1 codes	Y	NA	0.000
Industry \times Region	Industry dummies interacted with region dummies	Y	NA	0.013
Age \times Education	Cubic in age interacted with education dummies	Y	NA	0.062

F Additional Results

F.1 Literature-Based Benchmark: Estimates of Wage Losses from Displacement Events

We also consider estimates of wage changes from the job displacement literature as an additional benchmark. For the context of Germany, [Schmieder, von Wachter, and Heining \(2018\)](#) study a large set of job displacements during mass layoff events and relate the concomitant wage changes to the AKM firm effects of the displaced workers' origin firm. They find a slope of log wage changes with respect to firm fixed effects of -0.30 (SE 0.03).⁴ Similarly, they find that displaced workers from low-AKM firms end up working at firms with, on average, higher AKM effects, while displaced workers from high-AKM firms see substantial declines in the firm effects at their new employer (the slope of the change in the AKM effect with respect to the origin firm's AKM effect is -0.35, SE 0.02). Therefore, the comparison of worker beliefs to this alternative benchmark from mass layoffs again reveals that workers' predicted wage changes are less sensitive to their employers' firm effects than actual wage changes in the data.

However, using mass layoffs as a benchmark comes with several caveats. First, the sample of firms and workers in mass layoffs naturally differs from the overall labor market. The difference arises both from a selection of firms into closure or mass layoff and from necessary methodological choices in the literature that skew the sample towards larger firms. These sample differences may account for the overall negative wage effects across the wage distribution in [Schmieder, von Wachter, and Heining \(2018\)](#) (as mass layoff samples tend towards larger and higher-paying firms, see also [Gathmann, Helm, and Schönberg, 2020](#)). Taking the level changes in wages as a benchmark at face value would hence lead us to classify almost all workers as overestimating wages at their outside options. Second, mass layoffs may lead to more negative wage effects, e.g., due to congestion in the local labor market ([Crépon et al., 2013](#); [Lalive, Landais, and Zweimüller, 2015](#); [Mercan, Schoefer, and Sedláček, 2021](#)) or agglomeration effects ([Gathmann, Helm, and Schönberg, 2020](#)), compared to the wage changes of individual workers leaving a firm.⁵ Such mechanisms would lead us to wrongly classify too many workers as overestimating wages at outside options. In conclusion, while the mass layoff benchmark corroborates our main finding of undersensitivity of workers' beliefs about outside options as a function of their firm's pay, the uncertainty about whether mass layoffs constitute a valid benchmark for wage level changes impedes the reliable classification of workers into overestimators and underestimators of wages at outside options.

⁴We are very grateful to Johannes Schmieder for calculating log wage changes of job losers during displacement events as a benchmark for our study. In the most recent subsample of their data, 2001 to 2007, the slope is a bit smaller at -0.20 (SE 0.027) in a specification with only year effects.

⁵See [Gibbons and Katz \(1991\)](#) for a mechanism operating in the opposite direction.

F.2 The Robustness Survey

Sample Definition and Data Quality In what follows, we describe how the dataset from the robustness survey was cleaned. We only consider respondents who completed all of our survey questions. Out of 1,173 respondents who qualified for and started our study, 179 (or 15%) did not complete the full survey, which is a common attrition rate in online surveys. This leaves us with a sample of 994 respondents.

At the start of the survey, we elicited people’s pre-tax earnings using both a question with categorical responses and open-ended responses. We exclude 69 respondents who give inconsistent or implausible responses (monthly labor income larger than 25,000 Euro or lower than 170 Euro) to the initial wage questions, which may be a reflection of inattention in online surveys. Moreover, we asked all of our respondents about their outside option in case of a job loss, and removed those that either state that their outside option pays less than 100 Euro monthly wage or more than 25,000 Euro monthly wage (23 respondents). This leaves us with a sample of 902 respondents. All of our results from the robustness survey are robust to including these 92 dropped respondents. The median response time in the survey is approximately 10 minutes.

Winsorization Some of our response scales more naturally give rise to outliers than others. Since we want to compare responses across response scales, we winsorize our outcomes to make our comparisons less sensitive to outliers:

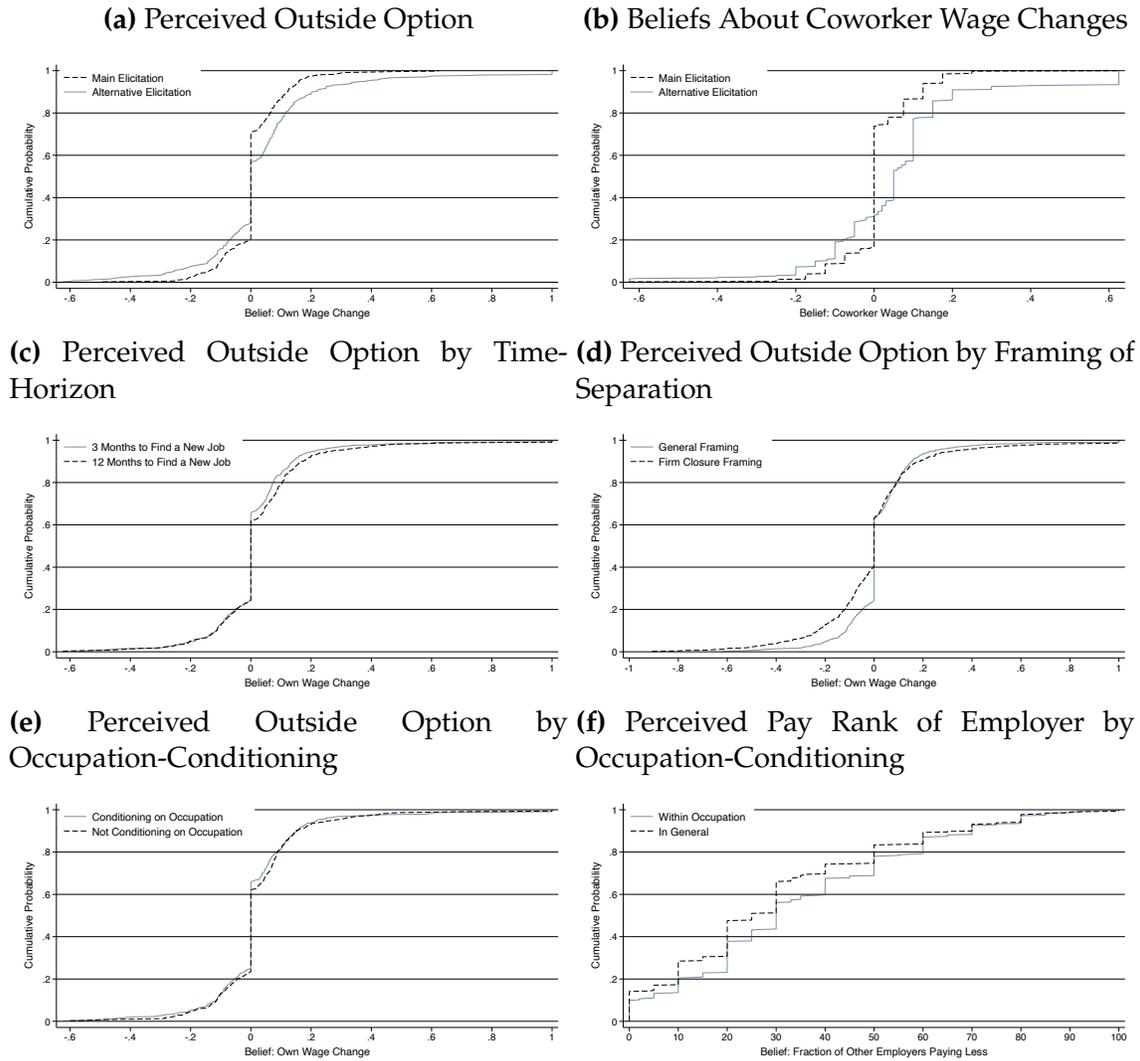
- For the question on outside options, we winsorize responses at a 3500 wage increase or decrease (as this is the maximum implied by our categorical response scale). This affects 4 responses.
- For the question on co-worker wage changes, we winsorize responses at a 62.5% wage increase or decrease (as this is in practice the maximum categorical response scale chosen by respondents). This affects 13 responses.
- For all of our variables on wage changes as a fraction of salary, based on the question on outside options, we further winsorize responses at -100% and +100% of salary. This affects 8 responses for our “generally framed” main outside option question and 11 responses for the outside option question framed in terms of a mass layoff.

Table A.8: Summary Statistics: Robustness Survey

	Mean	Median	P25	P75	Obs.
Panel A: Demographics					
East	0.20	0.00	0.00	0.00	902
University Degree	0.36	0.00	0.00	1.00	902
Age	48.70	51.00	40.00	58.00	902
Female	0.44	0.00	0.00	1.00	902
Gross Monthly Labor Income	3566.95	3200.00	2280.00	4450.00	902
Full-time Employed	0.78	1.00	1.00	1.00	902
Panel B: Beliefs					
Own Wage Change as % of Salary: Main Elicitation	0.01	0.00	0.00	0.04	461
Own Wage Change as % of Salary: Alt. Elicitation	0.05	0.00	-0.04	0.09	441
Own Wage Change as % of Salary: Mass Layoff	-0.00	0.00	-0.09	0.06	902
Own Wage Change as % of Salary: Occupation-specific	0.02	0.00	-0.00	0.06	439
Own Wage Change as % of Salary: Not Occupation-specific	0.03	0.00	0.00	0.08	463
Own Wage Change as % of Salary: 3-Month Horizon	0.02	0.00	0.00	0.06	457
Own Wage Change as % of Salary: 12-Month Horizon	0.03	0.00	0.00	0.08	445
Wage Change of Coworkers: Main Elicitation	0.01	0.00	0.00	0.04	461
Wage Change of Coworkers: Alt. Elicitation	0.06	0.05	-0.05	0.10	441
Fraction of Other Employers Paying Less: Occupation-specific	29.95	25.00	10.00	50.00	439
Fraction of Other Employers Paying Less: General	34.35	30.00	20.00	50.00	463

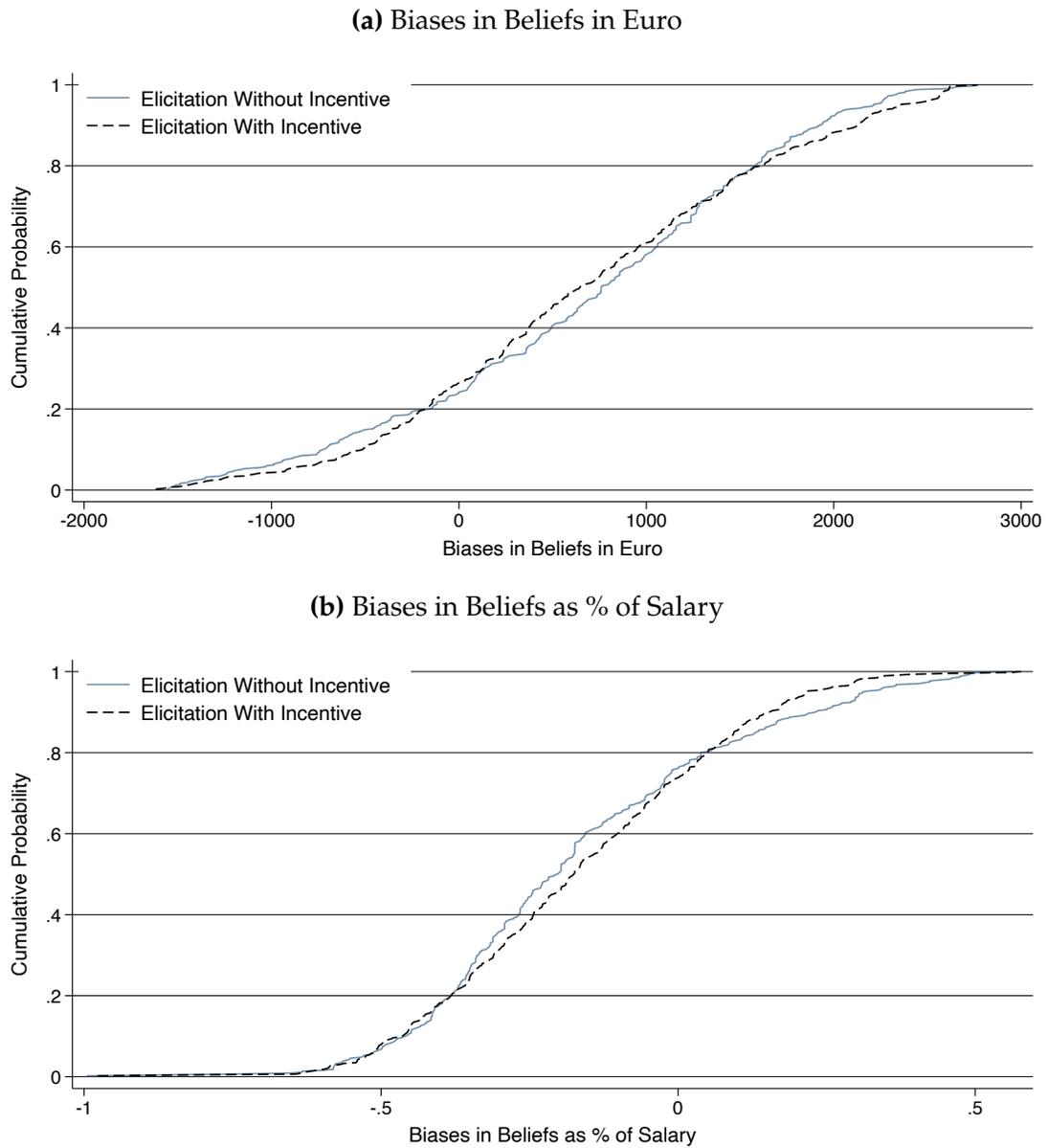
Note: The Table reports data from the robustness experiment conducted in July 2021. “Own Wage Change as % of Salary: Main Elicitation” reports the cumulative distribution function of the subjective wage change (defined as the difference between subjective outside option and current wage divided by the current wage) for the main elicitation (which we employed in our main surveys from SOEP). “Own Wage Change as % of Salary: Alt. Elicitation” is the subjective wage change which directly measured the belief about the wage level at the outside option. “Own Wage Change as % of Salary: Mass Layoff” is the subjective wage change for an alternative framing, which explicitly states that the separation is due to an unexpected company closure. “Own Wage Change as % of Salary: Occupation-specific” is the subjective wage change in the case of occupation-specific search. “Own Wage Change as % of Salary: Not Occupation-specific” is the subjective wage change in the case of search that is not restricted by one’s occupation. “Own Wage Change as % of Salary: 3-Month Horizon” is the subjective wage change with a 3-month time horizon to find a new job. “Own Wage Change as % of Salary: 12-Month Horizon” is subjective wage change with a 12-month time horizon to find a new job. “Wage Change of Coworkers: Main Elicitation” is the belief about co-workers wage changes for the main elicitation (which we employed in our main surveys from SOEP). “Wage Change of Coworkers: Alt. Elicitation” is the belief about co-workers wage changes for an alternative elicitation which did not offer the “same pay” option and was open-ended in the second step of the elicitation. “Fraction of Other Employers Paying Less: Occupation-specific” is the perceived fraction of other employers paying less than the current employer among people in the own occupation. “Fraction of Other Employers Paying Less: General” is the perceived fraction of other employers paying less than the current employer in general.

Figure A.21: Robustness of Belief Measurement to Various Design Features



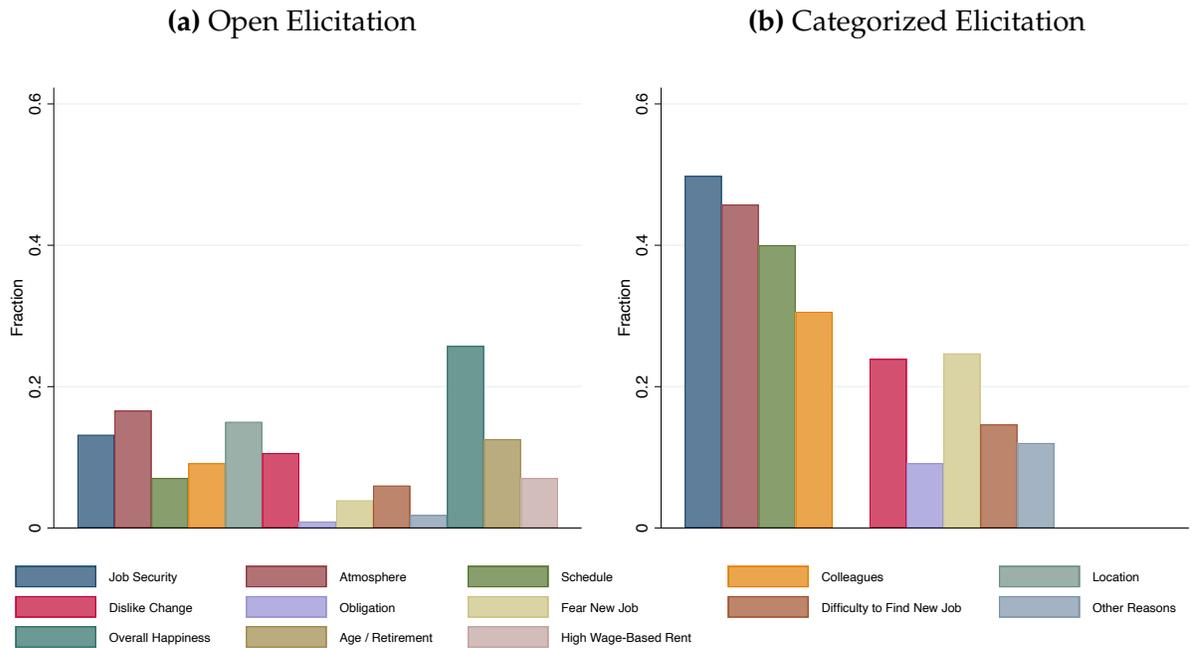
Note: Panel (a) reports the cumulative distribution function of the subjective wage change (defined as the difference between subjective outside option and current wage divided by the current wage) separately for the main elicitation (which we employed in our main surveys from SOEP) and the alternative elicitation (which directly elicited the belief about the wage level at the outside option). Panel (b) reports the CDF of beliefs about co-workers wage changes separately for the main elicitation (which we employed in our main surveys from SOEP) and the alternative elicitation (which did not offer the “same pay” option and was open-ended in the second step of the elicitation). Panel (c) reports the CDF of the subjective wage change (defined as the difference between subjective outside option and current wage divided by the current wage) separately for elicitation conditioning on people staying in the same occupation or not. Panel (d) reports the CDF of the subjective wage change (defined as the difference between subjective outside option and current wage divided by the current wage) separately for a 3 month and 12 month time horizon to find a new job. Panel (e) reports the CDF of the subjective wage change (defined as the difference between subjective outside option and current wage divided by the current wage) at the outside option separately for our main question framing and for an alternative framing, which explicitly states that the separation is due to an unexpected company closure. Panel (f) reports the CDF of perceived fraction of other employers paying less than the current employer depending on whether beliefs are conditional on the own occupation or not.

Figure A.22: Biases in Beliefs about Median Wage in Occupation by Incentives



Note: This figure reports the cumulative distribution function of biases in beliefs about the median pay in one's occupation separately for respondents in the incentive and no-incentive elicitation groups.

Figure A.23: Reasons for Staying



Note: This figure reports the reasons for staying at the current employer. Panel (a) shows the reasons based on the open-ended elicitation, while Panel (b) shows the reasons based on the structured elicitation. The categorization of the reasons in Panel A was done manually—for a description of this categorization see section [F.3](#), and for explanations and examples of the categories see Table [A.9](#)

F.3 Description of the Coding Scheme

The open-ended text responses are assigned into those response type categories that are also used in the categorical elicitation: i) "Job Security", capturing responses indicating that they seek security in staying with their current employer ; ii) "Atmosphere", categorizing answers that list the working atmosphere as reason to remain in their job ; iii) "Schedule", denoting flexible working time regulations and home-office options ; iv) "Colleagues", representing an excellent relationship with co-workers ; v) "Dislike Change", including all responses stating convenience or general dislike of change as reasons for staying ; vi) "Obligation", classifying emotional attachment and/or loyalty to the employer. ; vii) "Fear New Job", indicates that participants dislike adapting to new working environments. ; viii) "Difficulty to Find New Job", grouping those participants who indicate that they do not believe in finding a higher paying job for themselves.

Next, four frequently occurring responses that do not fit in any of the initial categories or justify a separate classification are categorized separately: i) "Location", summarizing all responses that list proximity to current workplace as a reason why to stay, as well as family reasons ; ii) "Happiness", categorizing all answers that state a not justified level of happiness at their current job iii) "Age/Retirement", indicating that an advanced age makes switching jobs less attractive iv) "High Wage-Based" Rent, indicating responses

which mention high fringe benefits, income, and excellent company pension plans.

Last, all residual reasons are captured by the category “Other Reasons”. Table A.9 summarizes these categories in the order used in Figure A.9 and provides example responses.

Table A.9: Reasons for Not Switching Jobs: Open Elicitation

Category	Explanation	Examples
Job Security	The job at the current employer is secure. Switching jobs will increase the risk of being unemployed.	- <i>At the moment, I am not yet ready to give up the security of my current employment relationship</i> - <i>my job is safe and that is worth a lot</i>
Atmosphere	The working atmosphere at the current employer is enjoyable.	- <i>I like the working atmosphere</i> - <i>Family business</i>
Schedule	The working time regulation at the current employer is flexible. Home-Office is possible.	- <i>good working hours</i> - <i>good work-life balance</i>
Colleagues	Enjoy working alongside my peers.	- <i>Have a great work colleague and I wouldn't want to miss her.</i> - <i>I don't think I would find a team like that again</i>
Location	The location of the employer is close to home / No need to commute / Family prevents participant from moving	- <i>Then I would have to commute</i> - <i>3 children</i> - <i>family reasons, proximity of the workplace</i>
Dislike Change	Being too convenient to apply for new jobs or disliking change in general	- <i>No desire to write applications</i> - <i>The only reason is convenience.</i>
Obligation	Participant feels emotionally obligated to stay at current employer.	- <i>Loyalty</i> - <i>Am loyal to my employer.</i>

Note: see end of the table

Category	Explanation	Examples
Fear New Job	Dislike to adapt to new tasks / colleagues / superiors	- <i>It is too cumbersome to take a new job</i> - <i>In addition, I might have to familiarize myself with new topics.</i>
Difficulty to find new Job	Difficulty to find higher paying job.	- <i>Am a civil servant</i> - <i>I think it's the same in every nursing home as it is with us</i>
Other Reasons		- <i>personal goals, career prospects in current job</i> - <i>Just recently switched</i>
Overall Happiness	Not further justified version of "I am happy in my job"	- <i>am completely satisfied</i> - <i>why should i? i am highly satisfied with my current professional situation</i>
Age / Retirement	Being at an age / close to retirement / in retirement so that switching jobs is not worth it	- <i>retiring soon</i> - <i>my age, would not like to switch jobs so close to retirement</i>
High Wage-Based Rent	Having high income / fringe benefits / company pension plan	- <i>I get the best salary here. At other jobs I get less than here</i> - <i>I am particularly satisfied with the fringe benefits and the company pension plan.</i>

Note: This table provides an overview of the categories, their explanations and examples used in the manual categorization creating Panel (a) of Figure [A.23](#).

F.3.1 Reasons for Not Switching to Better-Paid Jobs

To assess the sources of overall workers rents, we also draw on the worker-level survey to shed light on the reasons that keep workers from switching to other, better-paying jobs. Only 11% of workers in 2019 and 18% of workers in 2020 (in the midst of the coronavirus recession) report that they would have a difficulty finding a higher-paid job, further indicating that workers believe that jobs with similar (higher) wages are relatively easy to find. Instead, workers claim that non-wage components such as job security and the work atmosphere at their current employer are the reasons that prevent them from switching, rather than wage change. These results are reported in Appendix Figure [A.3](#).

Open-Ended Elicitation of Reasons for Switching In the SOEP survey question on why workers would not switch to employers that might pay a higher wage, we restricted answers to a structured list of options. In the robustness survey, we instead used an unstructured elicitation using a text box (following work by [Stantcheva \(2020\)](#)), in addition to the same structured elicitation as in the SOEP. Appendix Figure [A.23](#) shows the distribution of reasons based on both the unstructured open-ended question and the structured question. Both elicitations indicate an overwhelming importance of non-wage motivations in explaining why workers stay put.

G Questionnaires

G.1 Questionnaire: Innovation Sample (2019 Wave)

Beliefs About Ranking in the Wage Distribution Think of all employees in Germany that work in the same occupation as you, but work at a different employer. What do you think: what percent of those employees receive a

(Please note: these numbers need to add up to 100%).

lower pay __%

same pay __%

higher pay __%

Beliefs About Ranking in Terms of Non-Pecuniary Benefits We will now ask you a question about your working conditions. By working conditions we mean: work climate, relationship to colleagues, flexibility regarding work hours and work place, educational opportunities and family-friendly work conditions. Important: do not include the pay in your considerations.

Think of all employees in Germany that work in the same occupation as you, but work at a different employer. What do you think: what percent of those employees have....

(Please note: these numbers need to add up to 100%).

worse working conditions __%

similar working conditions __%

better working conditions __%

Beliefs About Firm Pay Think of the typical employee with work experience that switches from another employer to your employer. Would this employee receive a lower, higher or the same pay compared to his previous employer?

- Higher pay
- Same pay
- Lower pay

[Asked only if previous answer is not "Same pay"] How much lower/higher would the monthly pay before taxes of this employee be (in percent) after the switch compared to his/her prior employer?

Between 0% and 2%

Between 2% and 5%

Between 5% and 10%

Between 10% and 15%

Between 15% and 20%

Between 20% and 30%
Between 30% and 50%
Between 50% and 75%
More than 75% (in data normalized to 87.5%)

Think of the typical employee with work experience that switches from your current employer to another employer. Would this employee receive a lower, higher or the same pay compared to his previous employer?

- Higher pay
- Same pay
- Lower pay

[Asked only if previous answer is not "Same pay"] How much lower/higher would the monthly pay before taxes of this employee be (in percent) after the switch compared to his/her prior employer? Between 0% and 2%

Between 2% and 5%
Between 5% and 10%
Between 10% and 15%
Between 15% and 20%
Between 20% and 30%
Between 30% and 50%
Between 50% and 75%
More than 75% (in data normalized to 87.5%)

Beliefs About Median Wage Within Occupation Think of all employees in Germany that are full-time employed and work in the same occupation as you. What do you think is the typical monthly pay of those employees before taxes (in Euro)?

Here, we refer to the "typical" monthly earnings as the median monthly earnings, i.e. the earnings that the average full-time employee earns in their job, so that half of the full-time employees earn more in their job and the other half less than this earnings in the occupation according to the 2010 occupation classification.

How confident are you about this estimate? (Very unsure; unsure; neither unsure nor sure; sure; very sure)

Information Treatment You think the typical monthly pay of full-time employees in Germany that work in the same occupation [ParticipantOccupation] as you is Y dollars. According to official statistics of the Federal Employment Agency, we calculated the monthly wage of such employees. The typical monthly pay in your occupation is X Euro.

Intended Labor Market Behaviors We now have a series of questions about your labor market behavior.

Over the next 12 months, what is the probability that you will look for a new job at a different company? (scale 0 to 100)

Over the next 12 months, what is the probability that you will ask your boss for a pay raise? (scale 0 to 100)

[Asked even if previous answer is 0] Imagine that you negotiated your salary with your boss for the next year. Which pay raise would you suggest to your boss?

Between 0-2%

Between 2-5%

Between 5-10%

Between 10-15%

More than 15% (in data normalized to 17.5%)

Reservation Wage 1 Imagine that you considered switching to a different employer. What do you think: how much more would your current employer be willing to pay you to prevent that you switch to a different employer?

My current employer would be willing to pay me up to ___% more to prevent that I switch to a different employer.

Outside Offer Imagine that you received a job offer with a 30% higher salary from another employer and that the job is otherwise identical to your current job. Do you think you could use this outside offer in your salary negotiations with your current employer? (Y/N)

Frictions for Switching to Better-Paying Employer You told us that you think that X% of employees in Germany that are employed at a different employer, but work in the same occupation as you receive a higher salary. What are the main reasons for why you are currently (still) employed at your current employer even though other employers may offer you a higher salary?

- I would not want to lose the colleagues of my current employer.
- I do not like change.
- I would not want to learn the ropes in a new job.
- I like the working environment at my current employer.

- I like the regulation of working hours at my current employer.
- I have a very safe job at my current employer. If I start at a different company the risk of losing the job would be higher.
- I feel obliged to stay with my current employer.
- I would have difficulties finding a job that would pay a higher wage.
- I would have to move to another city or region for this.
- Other _____

Reservation Wage 2 Imagine that your current employer permanently cut wages. This wage cut results from a change of the CEO in the company and is independent of the economic conditions in your industry. At which wage cut would you quit your job within one year?

I would quit my job if my current employer cut wages by more than ____%.

Reservation Wage 3 Imagine that you received a job offer from a different employer in your labor market region that would provide you with a comparable work environment. What wage would this other employer have to offer to you to ensure that you would leave your current employer?

This other employer would have to offer me a ____% higher salary for me to leave my current employer.

Posterior About Outside Option: Point Belief Imagine that you were forced to leave your current job and that you had 3 months to find a job at another employer in the same occupation.⁶ Do you think that you would find a job that would offer you a higher overall pay, the same pay or a lower pay?

- Higher pay
- Same pay
- Lower pay

⁶The original German version of this question used the following wording in German. “Stellen Sie sich vor, Sie müssten Ihre derzeitige Stelle kündigen und hätten drei Monate Zeit, eine Stelle bei einem anderen Arbeitgeber im selben Beruf zu finden.” In German it is clear that the separation that workers should imagine is exogenous. In the first version of our expert survey we used a somewhat different translation from German, which may have been somewhat less clear in conveying that the imagined separation should be exogenous. In particular, we used the wording: “Imagine that you had to quit your current job”.

[Asked only if previous answer is not "Same pay"] What do you think: how much more/less would you earn in that new job?

Between 0 and 50 Euro

Between 50 and 100 Euro

Between 100 and 200 Euro

Between 200 and 300 Euro

Between 300 and 400 Euro

Between 400 and 500 Euro

Between 500 and 750 Euro

Between 750 and 1000 Euro

Between 1000 and 1500 Euro

Between 1500 and 2000 Euro

Between 2000 and 3000 Euro

More than 3000 Euro (in data normalized to 3500 Euro)

Posterior About Outside Option: Probabilistic Belief What do you think is the likelihood that you would earn...

- more than in your current job
- as much as in your current job
- less in your current job.

G.2 Questionnaire: Original German Version

Beliefs About Ranking in the Wage Distribution Denken Sie an alle Erwerbstätigen in Deutschland, die bei einem anderen Arbeitgeber beschäftigt sind, aber im gleichen Beruf wie Sie arbeiten.

Was glauben Sie: Wie viel Prozent dieser Erwerbstätigen haben...
(Bitte beachten Sie: die Zahlen müssen sich auf 100% aufsummieren).
einen niedrigeren Lohn als Sie __%
einen ähnlichen Lohn wie Sie __%
einen höheren Lohn als Sie __%

Beliefs About Ranking in Terms of Non-Pecuniary Benefits Wir stellen ihnen nun eine Frage zu Ihrem Arbeitsumfeld. Mit Arbeitsumfeld meinen wir die folgenden Dinge: Arbeitsklima, Verhältnis zu Kollegen, Flexibilität bezüglich Arbeitszeiten und Arbeitsort, Möglichkeiten für Fortbildungen und familienfreundliche Arbeitsbedingungen. Wichtig: Das Gehalt bitten wir Sie hier jedoch nicht einzubeziehen. Denken Sie an alle Erwerbstätigen in Deutschland, die bei einem anderen Arbeitgeber beschäftigt sind, aber im gleichen Beruf wie Sie arbeiten. Was glauben Sie: Wie viel Prozent dieser Erwerbstätigen arbeiten bei einem Arbeitgeber, der...

(Bitte beachten Sie: die Zahlen müssen sich auf 100% aufsummieren).
ein schlechteres Arbeitsumfeld bietet als Ihr Arbeitgeber __%
ein ähnliches Arbeitsumfeld bietet wie Ihr Arbeitgeber __%
ein besseres Arbeitsumfeld bietet als Ihr Arbeitgeber __%

Beliefs About Firm Pay Denken Sie an einen typischen Erwerbstätigen, der mit Berufserfahrung von einem anderen Arbeitgeber zu Ihrem Arbeitgeber wechselt. Würde dieser Erwerbstätige nach dem Stellenwechseln bei Ihrem Arbeitgeber im Durchschnitt einen niedrigeren, höheren oder den gleichen Lohn erhalten als bei seinem vorherigen Arbeitgeber?

- Einen niedrigeren Lohn
- Den gleichen Lohn
- Einen höheren Lohn
- Keine Angabe

[Asked only if previous answer is not "Den gleichen Lohn"] Wie viel niedriger/ höher wäre der monatliche Bruttolohn (d.h. vor Steuerabzug) dieses Erwerbstätigen nach dem Stellenwechsel im Vergleich zu seinem vorherigen Arbeitgeber im Durchschnitt in Prozent? Zwischen 0% und 2%

Zwischen 2% und 5%
Zwischen 5% und 10%
Zwischen 10% und 15%
Zwischen 15% und 20%
Zwischen 20% und 30%
Zwischen 30% und 50%
Zwischen 50% und 75%
Mehr als 75% [in data normalized to 87.5%]

Denken Sie an den typischen Erwerbstätigen, der von Ihrem Arbeitgeber zu einem anderen Arbeitgeber wechselt. Würde dieser Erwerbstätige bei seinem nächsten Arbeitgeber im Durchschnitt einen niedrigeren, höheren oder den gleichen Lohn erhalten?

- Einen niedrigeren Lohn
- Den gleichen Lohn
- Einen höheren Lohn

[Asked only if previous answer is not "Den gleichen Lohn"] Wie viel niedriger/ höher wäre der monatliche Bruttolohn (d.h. vor Steuerabzug) im Durchschnitt in Prozent beim neuen Arbeitgeber? Zwischen 0% und 2%

Zwischen 2% und 5%
Zwischen 5% und 10%
Zwischen 10% und 15%
Zwischen 15% und 20%
Zwischen 20% und 30%
Zwischen 30% und 50%
Zwischen 50% und 75%
Mehr als 75% [in data normalized to 87.5%]

Beliefs About Median Wage Within Occupation Denken Sie an alle Erwerbstätigen in Deutschland, die im gleichen Beruf wie Sie arbeiten. Was, glauben Sie, ist der typische Monatsverdienst von Vollzeitbeschäftigten in Ihrem Beruf vor Steuerabzug (in Euro)?

Wie sicher sind Sie sich mit Ihrer vorherigen Schätzung? (Sehr unsicher; unsicher; weder unsicher noch sicher; sicher; sehr sicher)

Information Treatment Sie glauben, dass der typische Monatsverdienst von Vollzeiterwerbstätigen in Deutschland, die im gleichen Beruf wie Sie arbeiten, [participant's belief] Euro sind. Basierend auf offiziellen Statistiken der Bundesagentur für Arbeit haben wir berechnet, wie hoch der typische Monatsverdienst tatsächlich ist. Vor Steuern beträgt der typische Monatsverdienst in Ihrem Beruf [true amount] Euro.

Intended Labor Market Behaviors In den folgenden Fragen schätzen Sie die Wahrscheinlichkeit ein, dass ein bestimmtes Ereignis in der Zukunft eintreten wird. Ihre Antworten können zwischen 0% und 100% liegen, wobei 0% bedeutet, dass etwas definitiv nicht passieren wird, und 100% bedeutet, dass es absolut sicher ist.

Zum Beispiel eine Prozentangabe wie...

...2% oder 5% bedeutet, dass etwas sehr unwahrscheinlich ist.

...18% bedeutet, dass etwas unwahrscheinlich ist.

...47% oder 52% heißt, dass etwas mit ziemlich gleicher Chance eintreten wird oder nicht.

...83% heißt, dass etwas wahrscheinlich ist.

...95% oder 98% heißt, dass etwas fast sicher ist.

Wie wahrscheinlich ist es, dass Sie in den nächsten 12 Monaten einen anderen Job bei einem anderen Unternehmen suchen werden? Bitte geben Sie die Wahrscheinlichkeit in Prozent an.

Wie wahrscheinlich ist es, dass Sie Ihren Chef in den nächsten 12 Monaten nach einer Gehaltserhöhung fragen werden? Bitte geben Sie die Wahrscheinlichkeit in Prozent an.

[Asked even if previous answer is 0] Stellen Sie sich vor, dass Sie mit Ihrem Chef Ihr Gehalt für das nächste Kalenderjahr verhandeln. Welche Gehaltserhöhung würden Sie vorschlagen? Keine Gehaltserhöhung

Gehaltserhöhung zwischen 0% und 2%

Gehaltserhöhung zwischen 2% und 5%.

Gehaltserhöhung zwischen 5% und 10%.

Gehaltserhöhung zwischen 10% und 15%.

Gehaltserhöhung von mehr als 15%. [in data normalized to 17.5%]

Reservation Wage 1 Stellen Sie sich vor, Sie überlegen sich, die Stelle zu wechseln. Was glauben Sie: wieviel mehr wäre Ihr derzeitiger Arbeitgeber bereit, Ihnen zu zahlen, damit Sie nicht die Stelle wechseln?

Mein derzeitiger Arbeitgeber wäre bereit, mir bis zu __% mehr zu zahlen, um mich von dem Wechsel abzuhalten.

Outside Offer Stellen Sie sich vor Sie erhielten ein Angebot mit einer deutlich höheren Bezahlung von einem anderen Arbeitgeber, und die Stelle ist Ihrer derzeitigen sonst praktisch identisch. Könnten Sie dieses Angebot in Gehaltsverhandlungen mit Ihrem Arbeitgeber nutzen, um ein höheres Gehalt auszuhandeln?(Ja/Nein)

Frictions for Switching to Better-Paying Employer Sie haben uns gesagt, dass [XX]% der Erwerbstätigen in Deutschland, die bei einem anderen Arbeitgeber beschäftigt sind,

aber im gleichen Beruf wie Sie arbeiten, ein höheres Gehalt als Sie erhalten.

Was sind die Hauptgründe, warum Sie zurzeit (noch) bei Ihrem derzeitigen Arbeitgeber beschäftigt sind, obwohl andere Arbeitgeber Ihnen gegebenenfalls ein höheres Gehalt zahlen würden?

- Ich will meine Kollegen bei meinem derzeitigen Arbeitgeber nicht verlieren.
- Ich mag keine Veränderungen.
- Ich will mich nicht in einen neuen Job einarbeiten.
- Ich mag das Betriebsklima bei meinem derzeitigen Arbeitgeber.
- Ich mag die Arbeitszeitregelung bei meinem derzeitigen Arbeitgeber.
- Ich habe bei meinem derzeitigen Arbeitgeber eine sichere Stelle. Wenn ich bei einer Firma neu anfangen würde, ist das Risiko, die Stelle wieder zu verlieren, größer.
- Ich fühle mich meinem derzeitigen Arbeitgeber gegenüber verpflichtet zu bleiben.
- Ich würde bei den anderen Arbeitgebern, die ein höheres Gehalt zahlen würden, nur sehr schwer eine Stelle finden.
- Ich müsste hierfür in eine andere Stadt oder Region ziehen.
- Andere _____

Reservation Wage 2 Stellen Sie sich vor, dass bei Ihrem derzeitigen Arbeitgeber die Löhne dauerhaft gekürzt werden. Die Lohnkürzung ist die Folge eines Wechsels in der Unternehmensführung und unabhängig von der wirtschaftlichen Entwicklung in Ihrer Branche. Ab welcher Lohnsenkung würden Sie Ihre Stelle innerhalb eines Jahres kündigen?

Ich würde kündigen, wenn bei meinem derzeitigen Arbeitgeber die Löhne um mehr als ___% gesenkt werden würden.

Reservation Wage 3 Stellen Sie sich vor Sie erhielten ein Angebot von einem anderen Arbeitgeber in Ihrer Arbeitsmarktregion, der Ihnen ein vergleichbares Arbeitsumfeld wie Ihr derzeitiger Arbeitgeber bieten würde. Bezogen auf Ihr monatliches Bruttogehalt: wie viel % müsste Ihnen dieser Arbeitgeber mehr zahlen, damit Sie Ihren derzeitigen Arbeitgeber verlassen würden?

Dieser Arbeitgeber müsste mir ___% im Monat mehr Bruttogehalt zahlen, damit ich meinen derzeitigen Arbeitgeber verlassen würde.

Posterior Personal Outside Option: Point Belief Stellen Sie sich vor, Sie müssten Ihre derzeitige Stelle kündigen und hätten drei Monate Zeit, eine Stelle bei einem anderen Arbeitgeber im selben Beruf zu finden. Glauben Sie, dass Sie im Schnitt monatlich brutto mehr oder weniger verdienen würden als in Ihrem jetzigen Job?

- Mehr als in Ihrem jetzigen Job
- Gleich viel wie in Ihrem jetzigen Job
- Weniger als in Ihrem jetzigen Job

[Asked only if previous answer is not "Same pay"] Was glauben Sie: wie viel mehr / weniger würden Sie wahrscheinlich monatlich brutto verdienen als in Ihrem jetzigen Job?
Zwischen 0 und 50 Euro mehr / weniger verdienen als in meinem jetzigen Job
Zwischen 50 und 100 Euro mehr / weniger verdienen als in meinem jetzigen Job
Zwischen 100 und 200 Euro mehr / weniger verdienen als in meinem jetzigen Job
Zwischen 200 und 300 Euro mehr / weniger verdienen als in meinem jetzigen Job
Zwischen 300 und 400 Euro mehr / weniger verdienen als in meinem jetzigen Job
Zwischen 400 und 500 Euro mehr / weniger verdienen als in meinem jetzigen Job
Zwischen 500 und 750 Euro mehr / weniger verdienen als in meinem jetzigen Job
Zwischen 750 und 1000 Euro mehr / weniger verdienen als in meinem jetzigen Job
Zwischen 1000 und 1500 Euro mehr / weniger verdienen als in meinem jetzigen Job
Zwischen 1500 und 2000 Euro mehr / weniger verdienen als in meinem jetzigen Job
Zwischen 2000 und 3000 Euro mehr verdienen als in meinem jetzigen Job
Mehr als 3000 Euro mehr verdienen als in meinem jetzigen Job [in data normalized to 3500 Euro]

Posterior About Outside Option: Probabilistic Belief Was ist die Wahrscheinlichkeit, dass Sie...

(Bitte beachten Sie: die Zahlen müssen sich auf 100% aufsummieren).

- mehr verdienen als in Ihrem jetzigen Job ___%
- gleich viel verdienen wie in Ihrem jetzigen Job ___%
- weniger verdienen als in Ihrem jetzigen Job ___%

G.3 Questionnaire: Robustness Check Survey

Belief About Outside Option: SOEP Elicitation (50% of sample) Imagine that you were forced to leave your current job and that you had 3 months⁷ to find a job at another employer in the same occupation.⁸ Do you think that you would find a job that would offer you a higher overall pay, the same pay or a lower pay?

- Higher pay
- Same pay
- Lower pay

[Asked only if previous answer is not "Same pay"] What do you think: how much more/less would you earn in that new job?

Between 0 and 50 Euro

Between 50 and 100 Euro

Between 100 and 200 Euro

Between 200 and 300 Euro

Between 300 and 400 Euro

Between 400 and 500 Euro

Between 500 and 750 Euro

Between 750 and 1000 Euro

Between 1000 and 1500 Euro

Between 1500 and 2000 Euro

Between 2000 and 3000 Euro

More than 3000 Euro (in data normalized to 3500 Euro)

How confident are you in your previous estimate? (very certain, certain, uncertain, very uncertain)

Belief About Outside Option: Alternative Elicitation (50% of Sample) Imagine you were forced to leave your current job and had 3 months⁹ to find a job with another employer in the same occupation.¹⁰

In the job with another employer, how much would you receive per month as gross employment income in Euro? ___ Euro

[Only if randomised to "reminder treatment"] Reminder: Your current gross monthly income is [amount answered before] Euro.

How confident are you in your previous estimate? (very certain, certain, uncertain, very uncertain)

⁷For 50% of respondents the time horizon is instead 12 months.

⁸For 50% of respondents the instructions do not condition on occupation and are instead given as follows: [...] months to find a job at another employer.

⁹For 50% of respondents the time horizon is instead 12 months.

¹⁰For 50% of respondents the instructions do not condition on occupation and are instead given as follows: [...] months to find a job at another employer.

Beliefs Coworker Wage Changes: SOEP Elicitation (50% of Sample) Think of the typical employee with work experience that switches from another employer to your employer. Would this employee receive a lower, higher or the same pay compared to his previous employer?

- Higher pay
- Same pay
- Lower pay

[Asked only if previous answer is not “Same pay”] How much lower/higher would the monthly pay before taxes of this employee be (in percent) after the switch compared to his/her prior employer?

Between 0% and 2%

Between 2% and 5%

Between 5% and 10%

Between 10% and 15%

Between 15% and 20%

Between 20% and 30%

Between 30% and 50%

Between 50% and 75%

More than 75% (in data normalized to 87.5%)

Think of the typical employee with work experience that switches from your current employer to another employer. Would this employee receive a lower, higher or the same pay compared to his previous employer?

- Higher pay
- Same pay
- Lower pay

[Asked only if previous answer is not “Same pay”] How much lower/higher would the monthly pay before taxes of this employee be (in percent) after the switch compared to his/her prior employer?

Between 0% and 2%

Between 2% and 5%

Between 5% and 10%

Between 10% and 15%

Between 15% and 20%

Between 20% and 30%

Between 30% and 50%

Between 50% and 75%

More than 75% (in data normalized to 87.5%)

Beliefs Coworker Wage Changes: Alternative Elicitation (50% of Sample) Consider a typical employed person with work experience who switches from another employer to your employer. After switching jobs, would this worker receive, on average, a lower or higher wage at your employer than at her previous employer?

- a higher wage
- a lower wage

How much lower / higher would this worker's gross monthly wage (i.e., before taxes) be, on average, as a percentage, after the job change compared to her previous employer?
___%

Consider a typical employed person with work experience who switches from your employer to another employer. After switching jobs, would this worker receive, on average, a lower or higher wage at another employer than at your employer?

- a higher wage
- a lower wage

How much lower / higher would this worker's gross monthly wage (i.e., before taxes) be, on average, as a percentage, after the job change compared to her previous employer?
___%

Reservation Wage 1 Imagine that your current employer permanently cut wages. This wage cut results from a change of the CEO in the company and is independent of the economic conditions in your industry. At which wage cut would you quit your job within one year? ___%

Reservation Wage 2 Imagine that you considered switching to a different employer. What do you think: how much more would your current employer be willing to pay you to prevent that you switch to a different employer? ___%

Reservation Wage 3 Imagine that your current employer laid you off because your company closes unexpectedly. The company closing is independent of the economic development in your industry. How many months would you expect to remain unemployed until you found a new job? ___ months

Outside Option in Response to Mass Layoff Imagine that your current employer laid you off because your company closed unexpectedly and you had to find a job with another employer within 3 months.

In the job with another employer, how much would you receive monthly as gross employment income in Euro? ___Euro

General Beliefs About Outside Option Think of all employees in Germany that work in the same occupation as you, but work at a different employer. What do you think: What do you think these other workers earn on average per month before taxes (in Euro)?

[Only if randomised to “incentive treatment” (50% of respondents) If your estimate does not differ from the actual value by more than 5%, then you will receive a bonus of 5 Euro in panel points.

___ Euro

Beliefs About Ranking in the Wage Distribution Think of all employees in Germany that work in the same occupation as you, but work at a different employer.¹¹ What do you think: what percent of those employees receive a
(Please note: these numbers need to add up to 100%).

lower pay ___%

same pay ___%

higher pay ___%

¹¹50% of our respondents were instead shown the following introductory sentence to this question without conditioning on occupation: Think of all employees in Germany that work that work at a different employer.

G.4 Questionnaire: Expert Survey

G.4.1 Randomised Sample Including AKM Questions

Expert Belief About Benchmark (AKM) Are you familiar with the estimation of AKM (Abowd, Kramarz, and Margolis, 1999) firm fixed effects on wages? (Y/N)

Abowd, J. M., Kramarz, F., & Margolis, D. N. (1999). High Wage Workers and High Wage Firms. *Econometrica*, 67(2), 251-333.

Part 1: Wage Changes of Switchers

We will now ask you some questions about the actual wage changes workers experience when switching jobs in the context of the German labor market over the years 2015 to 2019.

Beliefs About Wage-Based Rent Consider a typical worker at a typical firm and the following scenario: the worker is forced to leave her current job within three months and is looking to find a job at another employer.¹² We define wage change as the percentage change between the wage at the next employer and the wage at the original employer.

What wage change would you expect for this worker?

Beliefs About Heterogeneous Wage-Based Rent (AKM) [Asked only if AKM is known] Now consider the same scenario, except that the worker is originally employed not in a typical firm, but in a firm with an AKM firm effect 10% lower / higher than the median firm (i.e. a 0.1 lower / higher firm effect).

Note: Firm effects are estimated by regressing log wages on individual and firm effects and are identified from workers switching across firms (Abowd, Kramarz, and Margolis, 1999). For our implementation in the German administrative data, we use the firm effects estimated following the methodology in Card, Heining, and Kline (2013).

What wage change would you expect for this worker?

[For all questions the answer possibilities are:]

More than 75% increase (in data normalized to 87.5%)

Between 50% and 75% increase

Between 30% and 50% increase

Between 20% and 30% increase

Between 15% and 20% increase

Between 10% and 15% increase

Between 5% and 10% increase

Between 2% and 5% increase

Between 0% and 2% increase

¹²Here we cross randomized conditioning on occupation by asking half of respondents the following instead: [...] and is looking to find a job in the same occupation at another employer.

Same pay
Between 0% and 2% decrease
Between 2% and 5% decrease
Between 5% and 10% decrease
Between 10% and 15% decrease
Between 15% and 20% decrease
Between 20% and 30% decrease
Between 30% and 50% decrease
Between 50% and 75% decrease
More than 75% decrease (in data normalized to 87.5%)

G.4.2 Randomised Sample Excluding AKM Questions

Part 1: Wage Changes of Switchers

We will now ask you some questions about the actual wage changes workers experience when switching jobs in the context of the German labor market over the years 2015 to 2019.

Beliefs About Wage-Based Rent (no AKM) Consider a typical worker at a typical firm and the following scenario: the worker is forced to leave her current job within three months and is looking to find a job at another employer.¹³ We define wage change as the percentage change between the wage at the next employer and the wage at the original employer.

What wage change would you expect for this worker?

Beliefs About Heterogeneous Wage-Based Rent (no AKM) Now consider the same scenario, except that the worker is originally employed not in a typical firm, but in a firm in which workers who leave the firm, e.g., due to a quit or a layoff, experience on average a 10% wage increase / decrease (comparing wages at the next employer with wages at the original employer).

What wage change would you expect for this worker?

[For all questions the answer possibilities are:]

More than 75% increase (in data normalized to 87.5%)
Between 50% and 75% increase
Between 30% and 50% increase
Between 20% and 30% increase
Between 15% and 20% increase
Between 10% and 15% increase

¹³Here we cross randomized conditioning on occupation by asking half of respondents the following instead: [...] and is looking to find a job in the same occupation at another employer.

Between 5% and 10% increase
Between 2% and 5% increase
Between 0% and 2% increase
Same pay
Between 0% and 2% decrease
Between 2% and 5% decrease
Between 5% and 10% decrease
Between 10% and 15% decrease
Between 15% and 20% decrease
Between 20% and 30% decrease
Between 30% and 50% decrease
Between 50% and 75% decrease
More than 75% decrease (in data normalized to 87.5%)

Part 2

We are interested in your predictions of workers' perceived rents and outside options in the labor market.

In our original data collection, we measured workers' subjective rents and their perceived outside options in the labor market.

Sample

Our sample is drawn from the German Socio-Economic Panel, which is a probability-based sample of the German population.

Our survey only includes respondents who are either in full-time or part-time employment and is representative of the population of interest.

The main wave of our study was conducted between September 2019 and December 2019.

G.4.3 Reservation Wage Cut

We will now ask you to predict the reservation wages of workers.

We asked the participants in our sample the following question:

Imagine that your current employer permanently cut wages. This wage cut results from a change of the CEO in the company and is independent of the economic conditions in your industry. At which wage cut would you quit your job within one year?

I would quit my job if my current employer cut wages by more than ___%

We will now ask you to make a guess about the 25th percentile, the median, and the 75th percentile of the response distribution. Note that your estimate for the 25th percentile should be smaller or equal to the estimate for the median, which in turn should be smaller or equal to the estimate for the 75th percentile.

Median Wage What do you think was the median respondent's answer? ___%

25th Percentile Wage What do you think was the 25th percentile of the response distribution? ___%

75th Percentile Wage What do you think was the 75th percentile of the response distribution? ___%

Heterogeneity: Rent 10% Wage Change [Only asked if randomised into the sample including AKM question and AKM is known]

What do you think was the median respondent's answer among respondents employed at a firm with an AKM firm effect 10% lower / higher than the median firm (i.e. a 0.1 lower / higher firm effect)? ___%

[Only asked if randomised into the sample excluding AKM question or randomised into the sample including AKM question and AKM is unknown]

What do you think was the median respondent's answer among respondents employed at a firm where workers who left the firm, e.g., due to a quit or a layoff, experienced a ten percent wage decrease / increase at their next job on average? ___%

G.4.4 Expert Belief About Perceived Personal Outside Option

We will now ask you some questions about what you think workers expect about their wage changes when quitting their job.

Belief about Wage Change when Quitting

We asked the participants in our sample the following question:

Imagine that you were forced to leave your current job and that you had 3 months to find a new job at another employer. Do you think that you would find a job that would offer you a higher overall pay, the same pay or a lower pay?

Higher pay

Same pay

Lower pay

[Asked only if previous answer is not Same pay] What do you think: how much more/less would you earn in that new job? Between 0 and 50 Euro

Between 50 and 100 Euro

Between 100 and 200 Euro

Between 200 and 300 Euro

Between 300 and 400 Euro

Between 400 and 500 Euro

Between 500 and 750 Euro

Between 750 and 1000 Euro

Between 1000 and 1500 Euro
Between 1500 and 2000 Euro
Between 2000 and 3000 Euro
More than 3000 Euro

Based on the responses to the above question, we construct implied percent wage changes by dividing the expected wage change in Euro (given by the midpoint of the above ranges) by the respondent's current wage.

Median Wage Change What do you think was the median respondent's implied expected percent wage change?

25th Percentile Change What do you think was the 25th percentile of the response distribution (where lower expected wage changes are lower in the distribution, and higher expected wage changes are higher in the distribution)?

75th Percentile Change What do you think was the 75th percentile of the response distribution (where lower expected wage changes are lower in the distribution, and higher expected wage changes are higher in the distribution)?

Heterogeneity: Rent 10% Wage Change [Only asked if randomised into the sample including AKM question and AKM is known]

What do you think was the median respondent's implied expected percent wage change among respondents employed at a firm with an AKM firm effect 10% lower / higher than the median firm (i.e. a 0.1 lower / higher firm effect)?

[Only asked if randomised into the sample excluding AKM question or randomised into the sample including AKM question and AKM is unknown]

What do you think was the median respondent's implied expected percent wage change among respondents employed at a firm where workers who leave the firm, e.g., due to a quit or a layoff, experience a ten percent wage decrease / increase at their next job on average?

[For all questions the answer possibilities are:]

More than 75% increase (in data normalized to 87.5%)
Between 50% and 75% increase
Between 30% and 50% increase
Between 20% and 30% increase
Between 15% and 20% increase
Between 10% and 15% increase
Between 5% and 10% increase
Between 2% and 5% increase

Between 0% and 2% increase
Same pay
Between 0% and 2% decrease
Between 2% and 5% decrease
Between 5% and 10% decrease
Between 10% and 15% decrease
Between 15% and 20% decrease
Between 20% and 30% decrease
Between 30% and 50% decrease
Between 50% and 75% decrease
More than 75% decrease (in data normalized to 87.5%)

G.4.5 Expert Belief About Pay Change of Co-Workers

We will now ask you some questions about what you think workers expect about the wage changes of coworkers switching jobs.

Beliefs About Coworker Pay Changes when Switching Jobs

We asked the participants in our sample the following question:

Think of the typical employee with work experience that switches from your current employer to another employer. Would this employee receive a lower, higher or the same pay compared to his previous employer?

Higher pay

Same pay

Lower pay

[Asked only if previous answer is not "Same pay"] How much lower/higher would the monthly pay before taxes of this employee be (in percent) after the switch compared to his/her prior employer? Between 0% and 2%

Between 2% and 5%

Between 5% and 10%

Between 10% and 15%

Between 15% and 20%

Between 20% and 30%

Between 30% and 50%

Between 50% and 75%

More than 75%

For participants choosing "Same pay" we assume that their answer is zero.

Median Wage Change What do you think was the median respondent's answer?

25th Percentile Change What do you think was the 25th percentile of the response distribution (where lower expected wage changes are lower in the distribution, and higher

expected wage changes are higher in the distribution)?

75th Percentile Change What do you think was the 75th percentile of the response distribution (where lower expected wage changes are lower in the distribution, and higher expected wage changes are higher in the distribution)?

Heterogeneity: Rent 10% Wage Change [Only asked if randomised into the sample including AKM question and AKM is known]

What do you think was the median respondent's implied expected percent wage change among respondents employed at a firm with an AKM firm effect 10% lower / higher than the median firm (i.e. a 0.1 lower / higher firm effect)?

[Only asked if randomised into the sample excluding AKM question or randomised into the sample including AKM question and AKM is unknown]

What do you think was the median respondent's implied expected percent wage change among respondents employed at a firm where workers who leave the firm, e.g., due to a quit or a layoff, experience a ten percent wage decrease / increase at their next job on average?

[For all questions the answer possibilities are:]

More than 75% increase (in data normalized to 87.5%)

Between 50% and 75% increase

Between 30% and 50% increase

Between 20% and 30% increase

Between 15% and 20% increase

Between 10% and 15% increase

Between 5% and 10% increase

Between 2% and 5% increase

Between 0% and 2% increase

Same pay

Between 0% and 2% decrease

Between 2% and 5% decrease

Between 5% and 10% decrease

Between 10% and 15% decrease

Between 15% and 20% decrease

Between 20% and 30% decrease

Between 30% and 50% decrease

Between 50% and 75% decrease

More than 75% decrease (in data normalized to 87.5%)