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Biased Expectations and Labor Market Outcomes: Evidence from German Survey Data and Implications for the East-West Wage Gap

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Abstract

Using a large and representative panel survey of German households, we document sizable and persistent biases in workers' expectations regarding job stability and job finding. Workers in East Germany are substantially more pessimistic than workers in West Germany. Motivated by this evidence, we incorporate biased expectations into a frictional labor market model and analytically study their implications for wage bargaining, equilibrium unemployment and vacancies, and welfare. We explicitly model the duration of wage contracts and show that this contract length plays a crucial role in shaping how expectation biases affect wages and equilibrium outcomes. Using a calibrated version of the model, we show that expectation biases at West German levels would increase wages and expected lifetime income in East Germany and lead to a substantial reduction in the East-West German wage gap.

Keywords: Labor market risk, biased beliefs, wages, wage differentials
JEL-Codes: E24, J31, D84

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1 Introduction

It is generally believed that economic agents form expectations about future labor market outcomes and that these expectations, in turn, shape their current economic decision making. A common assumption in the literature is that agents have rational expectations, that is, they correctly perceive the probability with which specific labor market transitions, such as finding or losing a job, will occur. In this paper, we document systematic differences between perceived and actual labor market transition rates among workers using a long panel data set for Germany. We then extend an equilibrium labor market model by allowing workers' expectations of labor market transition rates to differ from actual rates. We use this framework to theoretically and quantitatively address the questions of how workers' biased expectations about job finding and job separation shape the labor market equilibrium and wages, and whether differences in expectation biases across workers are a quantitatively important driver of observed wage differentials.

For our empirical analysis, we use the German Socio-Economic Panel (SOEP), which regularly elicits individuals' expectations about separating from a job when employed or finding a job when unemployed. We compare these expectations with the actual job separation and job-finding rates, which we compute based on individuals' realized labor market transitions. We refer to a bias in labor market expectations when individuals' perceived probabilities of a given labor market transition systematically differ from the corresponding actual probabilities on average.

We find that, on average, workers in Germany are pessimistic regarding job stability, as they significantly overestimate the risk of separating from their job within two years by about 6 percentage points (45 percent). In contrast, unemployed individuals in Germany are, on average, optimistic, as they significantly overestimate the probability of finding a job within two years by about 6 percentage points (11 percent). A striking finding is that East Germans are substantially more pessimistic than West Germans, both in terms of job stability and job finding prospects. This pattern holds even after accounting for compositional differences between East and West Germany. We establish that these

differences in biases between East and West Germany are largely driven by cohorts who were already in the labor market at the time of German reunification. Moreover, we uncover a number of additional insights. For example, we find that individuals update their expectations about transition rates over time, but the biases remain sizable and do not vanish. Furthermore, we establish that at the individual level, deviations between perceived and actual transition rates do not help predict subsequent outcomes, indicating that potentially rational individual information does not play a significant role in the biases we measure.

For the theoretical and quantitative analyses, we extend the workhorse Diamond-Mortensen-Pissarides (DMP) framework of frictional labor markets in two ways: First, we assume that workers base their valuations of labor market states and job matches, and consequently their decisions, on their perceived labor market transition probabilities rather than actual probabilities. We assume common knowledge in the bargaining process, meaning that workers and firms truthfully report their (perceived) values of the job match and their outside options and agree to disagree. Our model is not meant to explain the origins of biased expectations, but rather focuses on their consequences for the labor market equilibrium. Second, we depart from the conventional assumption that wages are bargained every period. Instead, in our framework, workers and firms bargain over a wage that is paid for T periods. If the match continues beyond that, the parties rebargain the wage. Importantly, we establish that the contract length T is crucial for how workers' job separation expectations affect the wage.

In our theoretical analysis, we show that optimistic job finding expectations induce workers to attribute a higher value to the state of unemployment. This leads to a higher (perceived) outside option in the bargaining process, which increases the reservation wage and the negotiated wage. We also show that pessimistic job separation expectations induce workers to discount future payoffs more strongly. This affects the bargained wage via two opposing channels: On the one hand, workers discount future wage payments within the current contract more strongly, leading them to accept a lower wage. On the other hand,

workers discount the continuation value of future contracts more strongly, requiring a higher wage in order for them to stay in the match. For short contract durations (low T), the second effect dominates, implying a higher wage for more pessimistic job separation expectations. Conversely, when the contract is sufficiently long (large T), the first effect dominates, implying that more pessimistic job separation expectations lead to a lower wage.

Using the model, we conduct a quantitative analysis in order to assess how workers' expectation biases affect wages and the labor market equilibrium. Of particular interest in this analysis is the question of how the East-West differences in expectation biases can contribute to the observed sizable gap in wages between East and West Germany. We first calibrate the model to the East German economy. Then, in a counterfactual exercise, we assign to workers in the model the job separation and job finding biases that we measure for West Germany. That is, we counterfactually make East German workers less pessimistic about job separation and more optimistic about job finding. As a key result, we establish that both, the smaller pessimistic job separation bias and the larger optimistic job finding bias lead to a substantial increase in wages in East Germany. According to our analysis, with West-German expectation biases, the observed conditional wage gap between East and West Germany of 23.2 percent would decrease by 6.1 percent. Even though the increase in wages would induce higher equilibrium unemployment, East German workers would be better off and enjoy 1.02 percent higher expected lifetime income if their expectation biases were at West German levels.

Our study relates to a growing literature on the effect of biased labor market beliefs on individual-level and macroeconomic outcomes. One strand of the literature studies households' expectations about aggregate labor market outcomes, such as the unemployment rate (e.g. Souleles, 2004), and relates these expectations to individual choices, such as savings decisions (e.g. Broer et al., 2021). In contrast, we study households' expectations about individual-level outcomes, which captures both aggregate and idiosyncratic risk and may provide a better reflection of the risk that households face in the labor

market. Mueller and Spinnewijn (2023) contains a recent and comprehensive overview of the literature on individual bias in labor market expectations. This literature typically documents an optimistic bias of job seekers in various countries, including the U.S. and the U.K. (e.g. Mueller et al., 2021, or Conlon et al., 2018). This is consistent with our results for Germany. Emmler and Fitzenberger (2022) use early waves of the SOEP and document convergence in pessimism in job loss expectations between East and West Germany in the period following the German reunification. We also show pessimism with respect to job stability based on a different measure of the bias, and we likewise document convergence in our measure between East and West Germany, but refer to a later time period. However, our study is more comprehensive as it addresses bias in both job finding and job separation while also theoretically and quantitatively examining the implications of these biases in a frictional labor market model.

While most of the literature on frictional labor markets relies on the assumption of rational expectations, there are a few notable exceptions which relate to our work. Kennan (2010) and Menzio (2023) propose non-rational expectations as a mechanism to endogenously generate wage rigidity and thereby improve the model's ability to explain fluctuations of unemployment and vacancies over the business cycle. Kennan (2010) introduces private information, while Menzio (2023) assumes that workers have biased beliefs about the aggregate state of the economy. Our paper does not address aggregate fluctuations, but studies biased expectations in a stationary environment with a focus on wage bargaining outcomes. While we depart from rational expectations, we assume public information, and therefore use the concept of generalized Nash bargaining. Our study is the only one to examine the link between bias in job separation rates and the length of wage contracts.

The theoretical analysis of our model provides insights into how biased expectations about job finding and job separation rates affect wages. Two earlier empirical studies have explored the relationship between perceived job separation risk and wages or earnings, typically finding a negative correlation (see Campbell et al., 2007, or Hübler and Hübler, 2006). The literature on bias in job finding mostly investigates the relationship

with job search behavior, linking optimism to higher reservation wages (see Mueller and Spinnewijn, 2023, or Conlon et al., 2018). In line with these results, Drahs et al. (2018) show that job seekers overestimate their future re-employment wage. Jäger et al. (2024) investigate bias in beliefs about outside wage options and argue that these beliefs shape current wage outcomes. These findings are consistent with our model. In addition, we provide evidence on the link between biased expectations about labor market transition rates, wages, and reservation wages in our sample.

We relate differences in expectation bias between groups to wage differentials.Cortés et al. (2023) address a similar question and discuss the relationship between optimism about post-graduation earnings and the gender earnings gap. By examining differences between East and West Germany, our study also links to the literature addressing factors such as human capital or mobility costs (Fuchs-Schündeln and Izem, 2012) or productivity differences and worker representation (Bachmann et al., 2022) as potential drivers of the East-West German wage gap.

The paper is organized as follows. Section 2 introduces the data, discusses measurement, and presents the facts about labor market expectations. Section 3 presents the model and derives the effect of biased expectations on wage bargaining outcomes and the labor market equilibrium. Section 4 calibrates the model to the East German economy and quantifies how biased expectations affect wages and the East-West German wage differential. Section 5 concludes.

2 Data and measurement

The goal of this section is to empirically study the expectations of German workers regarding individual labor market transitions and to compare these expectations with actual transition rates. In our empirical analysis, we use individual-level data taken from the German Socio-Economic Panel (SOEP) which is an annual nationally representative

longitudinal survey of private households in Germany.[1] The SOEP started in 1984 in West Germany and was enlarged in 1990 to include a representative sample of households from East Germany. In each survey wave, around 30,000 participants are interviewed to provide detailed individual-level information about a wide range of topics including demographic characteristics, housing, education, health, family composition, as well as economic and labor market outcomes.

2.1 Expected and actual labor market transitions

Since 1999, respondents in the SOEP are asked biennially to report their expectations about various future labor market transitions. In particular, employed workers are asked about their expectation of separating from their current job, while non-employed individuals are asked about their expectation of finding a job. The specific question in the survey asked to employed workers is: *"How likely is it that you will experience the following career changes within the next two years?"*, upon which respondents are asked to provide their perceived probabilities, expressed in percent, associated with the following events (i) *losing the current job*, (ii) *seeking a new job at own initiative*, and (iii) *receiving a promotion at the current employer*.[2] We use the respondents' answer to (i) as our measure of an individual's perceived job separation probability. Answers are given on a scale from 0 to 100 percent (in steps of 10 percentage points). In this context, it should be noted that the term "job loss" in the survey question may not be entirely unambiguous. Respondents might interpret it narrowly as an involuntary job termination or more broadly as any job separation leading to a transition from employment to non-employment. We address this potential ambiguity below when comparing job separation expectations and realizations by considering different definitions of job separation.

Regarding job finding, the non-working respondents in the survey (i.e., those who are unemployed or out of the labor force) are asked the question: *"How likely is it that one or*

[1] See Goebel et al. (2019) for an introduction to the SOEP. The SOEP data are available to researchers upon application from `https://www.diw.de/en/diw_01.c.601584.en/data_access.html`

[2] Appendix A.1 presents the original question text from the survey questionnaire.

more of the following occupational changes will take place in your life within the next two years?", upon which the respondents are asked to specify the probabilities associated with (i) *taking up a paid job*, (ii) *become self-employed*, and (iii) *attend additional qualifications or training*. Again, answers are given on a scale from 0 to 100 percent (in steps of 10 percentage points). We use the answer to (i) as our measure of an individual's perceived job finding probability.

We restrict the sample of individuals to the working-age population (25 to 65 years old) and consider the period from 1999 to 2017. This gives us the responses of a total of the nine survey waves 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, and 2015. We do not consider the waves prior to 1999 since in the early years the survey has used a qualitative question format and this prevents a meaningful aggregation of responses across individuals.[3] Moreover, we restrict our sample to respondents for whom we measure both expected labor market transitions and the realization.

We aggregate the individual responses and report the average job finding and job separation expectations in the first row of Table 1. In the full sample (the column labeled "All") we find that, on average, employed workers expect to separate from their current job with a 19.8 percent probability within two years, whereas unemployed workers expect to find a job with a probability of 57%. These averages mask a substantial amount of heterogeneity in expectations across individuals and between regions.[4] Importantly, when splitting the sample by region, we find that expectations differ substantially between East and West Germany. As can be seen in Table 1, workers in East Germany have much higher job separation expectations and lower job finding expectations than workers in West-Germany.

Given the focus of our analysis, we are primarily interested in how individuals' job finding and job separation expectations compare to their actual transition probabilities. There-

[3] We do not use the responses of the 2018 wave, since the 2-year period over which we compute realized labor market transitions includes the onset of the Covid-pandemic – which we consider a very particular type of unforeseen worldwide disruption over and above a typical economic downturn.

[4] Appendix A.1 contains histograms of respondents' perceived job separation and job finding expectations.

Table 1: Perceived and actual labor market transition probabilities

	Job separation			*Job finding*		
	All	East	West	All	East	West
Perceived	20.0	27.6	17.8	57.0	51.8	60.8
Actual	13.8	15.5	13.3	51.3	52.4	50.4
Bias	6.2***	12.1***	4.5***	5.7***	-0.6	10.4***
Obs.	85,136	19,022	66,114	6,515	2,768	3,747

Notes. Perceived: Expectations of employed workers (job separation) and unemployed individuals (job finding). Actual: Realized transitions. Bias = Perceived – Actual. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ refer to t-test of mean bias equal to zero.

fore, in the next step, we compute measures of actual job finding and job separation probabilities. For this purpose, we exploit the panel structure of the SOEP data to identify actual job separation and job finding events of the individuals in our sample within a period of two years following their interview. We identify job separations from the participants' responses to the retrospective question whether they have left their job since end of December two years before the survey year and, if so, in what month and for what reason. Our baseline measure of job separation includes all separations irrespective of the reason for the ending of an employment relation. We refer to this measure as *General*. We consider alternative and more narrow definitions of job separation in the robustness analysis below.

To identify job finding, we use information on labor market spells contained in the so-called activity calendar in the SOEP. The activity calendar for a given respondent records the respondents' labor market state (employment, unemployment, out of the labor force) for each month since the last survey.[5] Using these spell data, we measure job finding as an individual experiencing at least one transition into employment within 24 months after the interview. As our baseline measure, we consider the job finding transitions of unemployed respondents, and explore the robustness to including also respondents who

[5] Our definition of employment (E) includes: full-time, part-time and marginal employment, short-time work, second job and mini-job, as well as vocational training, first job training and apprenticeship. Unemployment (U) includes individuals registered as unemployed. Out of the labor force (O) includes individuals in retirement, on parental leave, taking care of the household or attending school or college.

are out of the labor force.

Table 1 reports the sample averages of realized job separation and job finding transitions in the row labeled "Actual".[6] We refer to these sample averages as the actual labor market transition probabilities. In addition, we compute for each individual in the sample, the difference between the perceived transition rate and the actual transition. A bias in expectations arises when these individual-level differences do not average out in the population. The results in Table 1 show that in the full sample, employed workers substantially overestimate, on average, the probability of job separation. According to our findings, workers expect to separate from their job within two years with a probability of 20.0 percent, while the actual probability of separation is 13.8 percent. The difference of 6.2 percentage points is statistically significant and we refer to it as a pessimistic bias in individuals' job separation expectations. In contrast, our results indicate that unemployed individuals have a substantial optimistic bias in their job finding expectation. Specifically, we find that unemployed individuals expect to find a job within two years with a 57 percent probability, overestimating the actual probability by 5.7 percentage points on average.[7]

Table 1 documents substantial differences in both expectation biases between East and West Germany. While the actual job separation probabilities are relatively similar in both regions – with 15.5 percent in the East and 13.3 percent in the West – workers in East Germany have substantially higher job separation expectations than workers in the West. As a results, the pessimistic bias in the job separation expectation is much higher in the East with 12.1 percent compared to 4.5 percent in West Germany. The difference is even stronger for job finding. According to our results, the actual job finding probability differs by only 2 percentage points between East and West Germany. However, West German workers overestimate the job finding probability by a large margin whereas the expectations of workers in the East are very close to their actual probability. As a result,

[6] Actual transition takes a value of either 0 (no transition) or 100 (transition).

[7] Appendix A.1 presents bin-scatter plots of expected labor market transitions and actual realizations, along with the corresponding regression lines. The slopes of these lines are all clearly flatter than the 45-degree line, which supports the notion that expectations are biased.

the optimistic bias in the job finding expectation is substantially more pronounced in the West with 10.4 percent compared to no significant bias in the East. Overall, our findings suggest that East Germans are generally more pessimistic about future labor market transitions than West Germans as they are more pessimistic about job separation and less optimistic about job finding.

2.2 Robustness and discussion

The purpose of this section is to examine the robustness of our baseline results across time periods and for alternative definitions of job separation and job finding. Moreover, we address the question of individual learning, the sources of the expectation biases, and potential concerns related to private information, and outliers.

First, we analyze the extent to which the expectation biases in East and West Germany are stable over the period of observation. For this purpose, we show the perceived and actual job separation and finding rates for each survey wave and compute the corresponding biases separately for each wave. Figure 1 shows the results for both regions. The vertical bars in the figure represent the two standard errors of the year-specific biases. As shown in the figure, the expectation biases tend to be relatively stable over time with no clear-cut trend during the sample period. Interestingly, the actual transition rates all follow a downward trend. This is especially true for the job separation rate and more moderately also the job finding rate in East Germany.[8] However, the expectations move almost in parallel with the actual rates leading to a remarkably stable path for the expectation biases. If anything, the pessimistic job-separation bias in the East declines somewhat over time, while the optimistic job-finding bias increases. Also remarkable is the consistently small value of the optimistic job finding bias in the East indicating that workers in East Germany tend to have relatively accurate perceptions about job finding.

It is well known that labor market outcomes, including transition rates, vary substantially

[8] This pattern reflects an overall downward trend in the German unemployment rate over the sample period, which is well documented in the literature. See e.g. Hochmuth et al. (2021) or Hartung et al. (2018).

Figure 1: Bias in labor market expectations over time

Notes: Panels show average perceived (solid) and actual (dashed) job separation and job finding rates for East and West Germany at each survey date. Red dashed lines show average difference between perceived and actual together with two standard errors of the respective annual mean (vertical bars). Figures A.5 and A.6 show the corresponding graphs for all measures of job separation and job finding.

across population groups (see e.g. Hall and Schulhofer-Wohl, 2018, among many others). Therefore, the observed differences in expectation biases between East and West Germany could be due to differences in the composition of the labor force. To account for such compositional differences, we regress the individual-level difference between the perceived transition probabilities and the actual transition on a large set of co-variates and a dummy variable for East-Germany. The detailed estimation results are shown in Tables A.13 and A.14. Importantly, the coefficient on the East Germany dummy in both regressions (job separation and job finding) is highly significant and similar in magnitude to the difference between East and West Germany in the raw bias as reported in Table 1. We therefore conclude that the baseline results for the expectation biases are robust and continue to hold even after accounting for compositional differences between East and West Germany.

The previous regression analysis allows us to examine, in the cross-section, the extent to which expectation biases are related to individuals' age, job tenure and unemployment experience. For conciseness, we report the detailed results in Tables A.13 and A.14. Overall, we find that the biases in job separation and job finding decrease with age, on average, but these changes are economically small. Moreover, we find that the pessimistic job separation bias decreases with job tenure and increases with unemployment experience. Lastly, our results indicate that individuals with more unemployment experience have a lower optimistic bias regarding job finding. However, as before, the relationship is quantitatively weak.

Given the striking difference in labor market expectations between East and West Germany, the question naturally arises as to what can explain the relatively greater pessimism of East German workers. Our data does not allow for a deeper and perhaps even causal analysis of the mechanisms driving the differential expectation structure between the two regions. Nevertheless, we aim to shed some light on this question by conducting a simple cohort analysis. The purpose of this analysis to explore the extent to which the larger pessimism in East Germany may be related to the previous exposure of workers in the East to a communist system. This analysis is inspired by the findings of a large literature exploring the long lasting effects of communism and the shocks related to the reunification (see, for example, Fuchs-Schündeln and Schündeln 2020 or Laudenbach et al. 2020). To account for cohort differences in expectation bias, we augment the regression from the earlier composition analysis with interaction terms between the East Germany dummy and indicators for cohorts born in different decades. Table 2 shows the coefficients for these interaction terms. The coefficient on the East Germany dummy represents the bias for cohorts born before 1950.

Importantly, we find that there are substantial differences in the bias across birth cohorts in East Germany (while controlling for age, demographic and economic characteristics). Relative to the oldest cohorts in the sample, i.e. those born before 1950, the pessimistic bias in job separation first increases and then decreases for later born cohorts. That

Table 2: Expectation bias in East Germany, by cohort

	Job separation	Job finding
East-Germany	8.228***	-15.28***
	(13.80)	(-8.55)
East × cohort1950	1.079*	7.138***
	(1.66)	(3.87)
East × cohort1960	-0.259	9.972***
	(-0.39)	(4.99)
East × cohort1970	-1.704**	11.21***
	(-2.35)	(4.91)
East × cohort1980	-4.629***	6.951**
	(-5.05)	(2.55)
East × cohort1990	-5.928*	20.53**
	(-1.74)	(2.06)
Observations	77,373	6,154

Notes: t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Measure of actual job separation from retrospective question including all reasons (general). Measure of actual job finding out of unemployed (out of U). Regression equations are identical to output shown in Tables A.13 and A.14 adding interaction between East Germany indicator and cohorts born in different decades.

is, the pessimism is substantially more pronounced among cohorts born in the 1950's and 1960's which have actively experienced life in the communist German Democratic Republic as well as the reunification with West Germany. Moreover, the job finding bias in East Germany also becomes significantly more optimistic for later born cohorts with the largest change for the youngest cohort. Overall, the results indicate that younger cohorts in East Germany tend to be less pessimistic about job separation and more optimistic about job finding than older cohorts.

Our baseline measure of actual job separation includes all separations irrespective of the reason for the ending of an employment relation (voluntary and involuntary). However, the survey question in the SOEP asks respondents about future job loss. As discussed previously, the term "job loss" may be interpreted by the respondent as reflecting an involuntary termination of employment. Therefore, we examine in the next step the robustness of the results to two alternative and more narrow definitions of job separation. In each wave, respondents are asked retrospectively whether they left their previous job

and, if so, for what reason. The list of possible reasons for having left a job, includes: (1) Place of Work Closed, (2) Resigned, (3) Dismissed by Employer, (4) Mutual Agreement, (5) Temporary Employment Ended, (6) Reached Retirement Age, (7) Leave of Absence, Maternity/Parental Leave, (8) Gave Up Self-Employment. As an alternative to our baseline measure, we first consider a very narrow definition of job separation which includes only separations due to (1) Place of Work Closed, and (3) Dismissed by Employer. These two reasons are most closely related to involuntary job loss. We will refer to this type of job separations as *Dismissals*. Moreover, we also consider a slightly broader definition which, in addition to (1) and (3) also includes (4) Mutual Agreement and (5) Temporary Employment Ended. Although not involuntary, these reasons could be included in an individual's assessment of future job separation. We refer to this measure as *Selected*.

Table 3 presents the results for these two alternative measures of job separation (rows labeled "Dismissals" and "Selected"). The more narrow definitions of job separation naturally imply lower actual transition probabilities and, hence the difference between the perceived and the actual job separation probabilities are larger than in the baseline case. However, the pessimistic bias remains larger in the East also for both alternative definitions of job separation parallel to our baseline results.

Next, we consider an alternative approach to computing job separation. First, we use information on labor market spells provided through the respondent's monthly activity calendars. Using these spell data, we measure job separation as an individual experiencing at least one transition from employment to unemployment within 24 months after the interview. The results are in Table 3 in the row labeled "Spell". Unsurprisingly, the implied actual job separation probability is substantially lower than the baseline measure since we consider only transitions from employment into unemployment. Hence, this measure disregards, for example, job separations which are followed by an immediate transition to a new employer. However, importantly, we find a more pronounced pessimistic job separation bias in East Germany which is consistent with the baseline results.

In the next step, we turn to the job finding probability and examine the robustness of our baseline measure to alternative definitions. In the baseline, we use the sample of unemployed individuals to compute perceived and actual job finding rates (*out of U*). This approach disregards the transitions and expectations of individuals who are out of the labor force at the time of the interview. Now, we relax this sample restriction and consider a broader measure of job finding which is based on all non-employed individuals irrespective of whether they are unemployed or out of the labor force (*out of U or O*). The results can be found in the respective rows in Table 3. Interestingly, the perceived job finding rate obtained through this measure is more similar between East and West-Germany implying a smaller but still sizable difference in the optimistic gap between both regions.

An important concern relates to the presence of measurement error in the responses to the expectation questions. We address this concern by considering a common type of measurement error: extreme response bias. An extreme response bias occurs when participants consistently choose the most extreme options irrespective of their actual perception. In our case, this bias would likely result in the maximum or minimum values for the reported expectations such as 0 percent or 100 percent. We account for this by removing observations at the minimum and maximum value for both job loss and job finding expectations from our sample. As can be seen from the row *"Trimmed"* in Table 3, this adjustment leads to an increase in the separation bias in the full sample but also across regions. However, the difference between East and West Germany declines. This means that low (and less biased) job separation expectations in the West relative to the East are important to understand the East-West difference. The job finding bias decreases in value relative to the baseline, but the difference between regions is preserved.

Another concern relates to the observation that realized individual job separation and job finding transitions may be affected by time-varying aggregate factors (such as business cycles). To the extent that these factors were not anticipated by individuals at the time of the interview, they could explain part of the average difference between individuals'

Table 3: Robustness

		Job separation			*Job finding*		
		All	East	West	All	East	West
	Perceived	20.0	27.6	17.8	57.0	51.9	60.8
Baseline	Actual	13.8	15.5	13.3	51.3	52.4	50.4
	Bias	6.2***	12.1***	4.5***	5.7***	-0.6	10.4***
Dismissal	Actual	3.8	5.4	3.4			
	Bias	16.2***	22.2***	14.5***			
Selected	Actual	6.5	9.0	5.8			
	Bias	13.5***	18.5***	12.1***			
Spell	Actual	5.6	8.9	4.7			
	Bias	14.3***	18.7***	13.1***			
	Perceived				54.2	53.5	54.6
out of U or O	Actual				48.5	52.8	46.7
	Bias				5.7***	0.7	7.8***
	Perceived	32.2	35.4	31.0	49.2	45.9	51.8
Trimmed	Actual	14.4	15.0	14.1	46.5	48.7	44.8
	Bias	17.8***	20.3***	16.9***	2.6***	-2.8**	7.0***
	Perceived	19.8	27.2	17.5	57.0	51.9	60.8
Probit	Predicted	13.3	15.1	12.8	48.8	49.9	47.9
	Bias	6.4***	12.1***	4.7***	8.2***	2.0***	12.9***

Notes: The Baseline measure refers to the General measure of job separation and the measure out of U of job finding rates, respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ refer to t-test of mean bias equal to zero. Means of perceived job separation and job finding are different across measures due to differences in the respective sample. Tables A.17-A.22 in Appendix A contain more results.

expected and realized transitions. As our data cover a long time horizon, it is reasonable to assume that time-varying factors (anticipated and unanticipated) average out over time. Furthermore, our main focus in the analysis is on East-West differences in the expectation bias. Therefore, unanticipated time-varying factors that are common to both regions affect the level of transitions equally but not the difference in the bias between East and West Germany.

In the baseline, we use the sample mean of observed transitions as a measure of the actual transition probabilities. Here, we employ an alternative approach to compute the transition probabilities. Specifically, we estimate probit models to predict the job

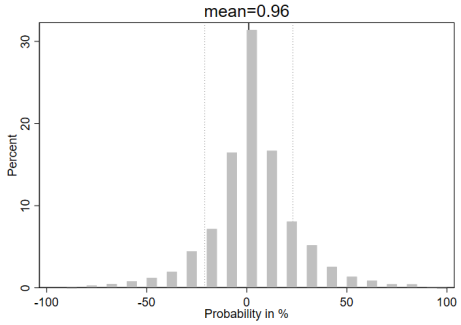
separation probabilities for employed workers and the job finding probabilities for unemployed individuals in the sample. Each model includes a large set of individual and job characteristics, as well as survey-year fixed effects. The survey-year fixed effects control for common time-varying factors such as business cycles affecting actual labor market transitions. For the job separation model, we also add employer characteristics. Our specification aims to maximize the models' predictive power according to a range of information criteria. To ensure consistency, we estimate each probit model on the same sample of individuals for whom we also observe the expected transition probabilities. See Appendix A.2 for details of the estimation and the results.

Using the estimated probit coefficients, we then calculate for each individual in the sample the predicted job separation and job finding probability. The last row of Table 3 shows that, on average, the predicted transition probabilities are very close to the actual probabilities. If anything, the predicted job finding probabilities are somewhat lower than actual realizations which leads to a larger job finding bias. However, overall, the East-West Germany gap in expectations biases obtained for predicted transition probabilities is very similar to those for actual probabilities.

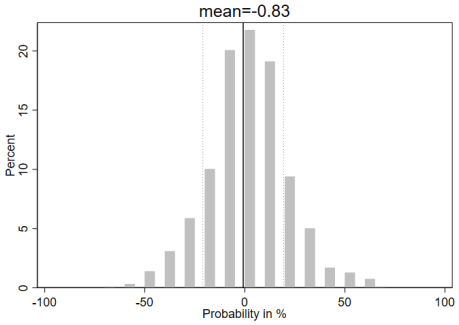
We can use the predicted transition probabilities to analyze the important question of whether individuals learn over time and form increasingly accurate labor market expectations. For this purpose, we consider the sample of individuals who responded to the expectation questions in two consecutive survey waves and calculate, for each wave and each individual, the absolute difference between individuals' perceived transition probabilities and their predicted probabilities. We interpret this difference as a measure of the accuracy of individuals' expectations, and a decline in the difference between two consecutive waves as learning. The histogram in Figure 2 depicts the individual-level changes in the absolute difference between perceived and predicted transition probabilities for East and West Germany. Positive (negative) values indicate that individuals' perceived probabilities have become less (more) accurate between two consecutive waves. The vertical solid line in each panel represents the mean and the dotted lines indicate the standard

Figure 2: Learning about transition probabilities

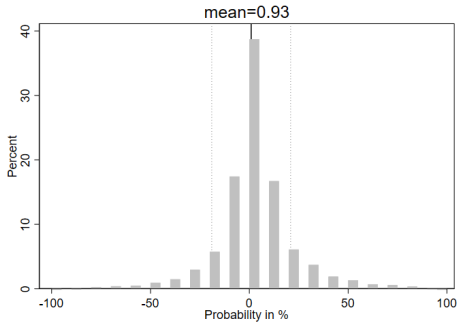
(a) Job separation, East



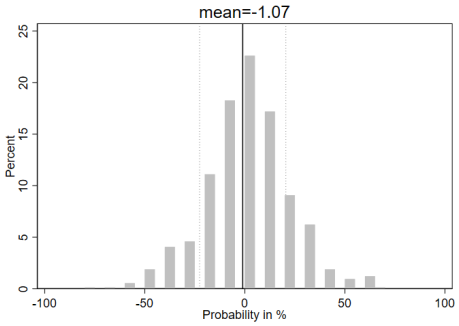
(b) Job finding, East



(c) Job separation, West



(d) Job finding, West



Notes: Panels show the change in the absolute difference between individuals' perceived job separation or job finding probabilities and their predicted probabilities for East and West Germany. Vertical solid lines: means; dotted lines: standard deviation.

deviation. The histograms display a substantial degree of dispersion across individuals but no systematic pattern. Interestingly, the mean values in each panel are small, indicating that employed and unemployed individuals in both, East and West Germany do not systematically learn. If anything, the negative mean value for unemployed individuals indicates that, on average, they form more accurate expectations about job finding rates, whereas the expectations of employed individuals about job separation become less precise over time.

Another advantageous feature of the predicted transition probabilities is that they allow to analyze the importance of private information contained in expectations for predicting subsequent labor market transitions. If private information were an important factor,

then including individual-level differences between perceived and predicted transition probabilities as an additional explanatory variable in the probit models should result in large and statistically significant coefficient estimates. We show in Appendix A.2 that this is not the case.

3 A labor market model with biased expectations

In this section, we present a general equilibrium labor market model in which workers have biased expectations about labor market transition rates. We use this framework to analytically and quantitatively study the implications of biased expectations for wage bargaining, equilibrium unemployment and vacancies, and expected lifetime income. Our model builds on the workhorse Diamond-Mortensen-Pissarides (DMP) framework of frictional labor markets widely used in the literature.[9] Crucially, we depart from the conventional assumption of rational expectations and, consistent with our empirical findings, allow workers in the model to hold biased expectations about future realizations of individual labor market transitions. This includes the transition from unemployment to employment (job finding) and the transition from employment to unemployment (job separation). Additionally, we explicitly model the duration of wage contracts within a job match and show that this contract length shapes the propagation mechanism through which expectation biases affect the bargained wage and equilibrium outcomes.

3.1 Setup

Time is discrete. The economy is populated by a measure one of workers and a continuum of active firms. Workers are homogeneous, risk-neutral, and infinitely lived, and receive a period wage ω when employed and income $b \geq 0$ when unemployed. Each active firm has one job that can be vacant or filled with a worker. A vacant job costs $\kappa > 0$ per period and a filled job produces output $z > b$ per period.

[9] See Diamond (1981) and Mortensen and Pissarides (1994) or Pissarides (2000), Chapter 1.

Unemployed workers and firms with vacant jobs are randomly matched according to an aggregate matching function, denoted by $M(u, v)$, where u is the measure of unemployed workers and v is the measure of vacant jobs. We refer to $\theta \equiv v/u$ as the labor market tightness.[10] The probability of an unemployed worker to match with a vacant job is defined as $p(\theta) \equiv M(u, v)/u$, and the probability of a vacancy to match with an unemployed worker as $q(\theta) \equiv M(u, v)/v = p(\theta)/\theta$. Existing worker-firm matches separate each period with exogenous probability $0 < \sigma < 1$.

The common approach in the literature is to assume that firms and workers have rational expectations about the underlying matching and separation probabilities. In line with the empirical findings presented in Section 2, we depart from this assumption by allowing workers to have biased expectations about the job finding and job separation probabilities.[11] Concretely, we assume that workers expect to find a job with probability $\lambda_w(\theta)$ when unemployed, and to separate from their job with probability σ_w when employed.[12] If $\lambda_w(\theta) = p(\theta)$ and $\sigma_w = \sigma$, workers have rational expectations. Instead, when $\lambda_w(\theta) > p(\theta)$, workers have an optimistic bias in their job finding expectations, as they expect to find a new job with a higher probability than the actual job finding probability. Conversely, the case $\sigma_w > \sigma$ reflects a pessimistic job separation bias, as workers expect to separate from their job with a higher probability than the actual job separation probability. We assume that there is no heterogeneity across workers in the magnitude of the bias, and that the expectations (and any potential biases therein) are constant over time and taken as exogenous by workers. We leave it to future work to relax these assumptions and study the case where workers are heterogeneous in their biases, and learn about actual transition probabilities over time.

As in the canonical DMP model, we assume that the wage ω is determined by generalized Nash bargaining between the firm and the worker. However, we depart from the conventional assumption that wages are bargained every period. Instead, in our framework,

[10] As is standard, we assume that $M(\cdot, \cdot)$ is homogeneous of degree 1, increasing and concave in both arguments, continuously differentiable, and satisfies $M(0, u) = M(v, 0) = 0$ and $M(u, v) \leq \min[u, v]$.
[11] See Section B.4 for an extension of the model where workers and also firms have biased expectations.
[12] Concretely, we use $\lambda_w(\theta) = (1 + \Delta_\lambda)p(\theta)$ and $\sigma_w = (1 + \Delta_\sigma)\sigma$, with $\Delta_\lambda, \Delta_\sigma \in (-1, 1)$.

workers and firms bargain over a wage that is paid for $T \geq 1$ periods. After that, if the match continues to hold, the parties re-bargain. Thus, a job match consists of a sequence of consecutive wage contracts of length T. Even though the wage is set for T periods, the match can dissolve in the meantime due to exogenous separation.

Despite the similarity in wording, our wage contracts do not impose wage rigidity in the model as, for example, in Gertler and Trigari (2009). In our framework, the wage remains constant for the duration of a match, even if it is renegotiated after T periods. This result follows from the stationarity of the model economy and the absence of factors that would lead to wage changes within a match, such as productivity growth, human capital accumulation, or wage ladders. An extension of the model, for example by allowing for productivity changes, would condition a wage schedule on realizations of productivity and thus allow wages to change within a given contract.

Our representation of wage bargaining nests, as a special case, the conventional specification in which the firm and the worker negotiate the wage every period. This case, referred to as period-by-period bargaining, is obtained for $T = 1$ and is often used in quantitative models of frictional labor markets. A limiting case is $T = \infty$, which means that the contract runs for the duration of the match.

3.2 Value functions

The value to the worker of a job paying wage ω for a contract of length T is given by

$$E(\omega) = \big(\omega + \beta\sigma_w U\big) \sum_{t=1}^{T} \big[\beta(1-\sigma_w)\big]^{t-1} + \big[\beta(1-\sigma_w)\big]^{T} E(\omega') \ , \tag{1}$$

where $\beta \in (0,1)$ is the discount factor. With probability σ_w, the worker expects to separate from the job and receive the value of unemployment, U, next period. If the match persists after T periods, the wage is renegotiated. Let ω' denote the wage in the next contract within the match, and let $E(\omega')$ represent the corresponding job value.

The value of unemployment for a jobless worker is given by

$$U = b + \beta\lambda_w E(\omega') + \beta(1-\lambda_w)U \ . \tag{2}$$

Henceforth, we use λ_w instead of $\lambda_w(\theta)$ for ease of notation. With probability λ_w, an unemployed worker expects to be matched with a vacant job. Once matched, the firm and the worker bargain over the wage ω'. Importantly, E and U are the workers' perceived values of employment and unemployment. With biased expectations, E and U can differ from the actual values.

We can use Equation (1) to express the match surplus to a worker as

$$E(\omega) - U = \underbrace{[\omega - (1-\beta)U] \sum_{t=1}^{T} [\beta(1-\sigma_w)]^{t-1}}_{\text{Discounted sum of period surplus}} + \underbrace{[\beta(1-\sigma_w)]^T [E(\omega') - U]}_{\text{Discounted continuation value}} . \tag{3}$$

The worker obtains a given wage ω for a total of T periods. Thus, the first term represents the discounted sum of period surplus, $\omega-(1-\beta)U$, that accrues from these wage payments. The second term reflects the discounted future surplus of the match that the worker obtains from a new contract with ω' starting in $T+1$. It is straightforward to see that when $T = 1$, the worker obtains the period surplus only for one period and the continuation value of the new contract thereafter. In the limiting case, when $T \to \infty$, the wage is fixed for the duration of the job match, and thus, the continuation value vanishes, since $\lim_{T\to\infty} [\beta(1-\sigma_w)]^T = 0$. It is important to note that the worker discounts future payoffs using the effective discount factor $\beta(1-\sigma_w)$. The sooner the worker expects to separate from the job (higher σ_w), the more heavily future payoffs are discounted.

By setting $E(\omega)-U = 0$ in the previous expression, we can derive the worker's reservation wage, $\underline{\omega}$, in the standard way as the wage for which the worker is indifferent between working and being unemployed. It follows that

$$\underline{\omega} = (1-\beta)U - \frac{[\beta(1-\sigma_w)]^T [E(\omega') - U]}{\sum_{t=1}^{T} [\beta(1-\sigma_w)]^{t-1}} \ . \tag{4}$$

The worker's reservation wage has two terms: the per-period value of unemployment, $(1-\beta)U$, and the expected net surplus from continuing the match with a new contract. It is straightforward to see that the reservation wage increases if the worker becomes more pessimistic about job stability (for given values of E and U). This is intuitive as for higher values of σ_w the worker expects a shorter duration of the current job and thus, the expected net surplus from continuing the match with a new contract is lower. Moreover, the longer the contract length T, the less important the continuation value becomes for the reservation wage. The worker's job separation expectations also affect the reservation wage indirectly through the effect on the value of unemployment U. In particular, a pessimistic worker considers future employment less attractive, which lowers U and implies a lower reservation wage. Hence, the effect of σ_w on the reservation wage depends on the relative importance of the value of unemployment and the continuation value of the match.

Furthermore, the worker's job finding expectation, λ_w, affects the reservation wage through its effect on the value of unemployment U. An optimistic bias in the job finding rate leads unemployed workers to attribute a higher value to U as they expect to leave unemployment earlier. A higher value of unemployment then increases the reservation wage.

Next, we define the value to a firm of a match with wage ω and contract length of T periods as

$$J(\omega) = [z - \omega + \beta\sigma V] \sum_{t=1}^{T} [\beta(1-\sigma)]^{t-1} + [\beta(1-\sigma)]^{T} J(\omega') \ , \tag{5}$$

where z is match output. The match dissolves with probability σ, in which case the firm obtains the value of a vacant job denoted by V. The latter is defined as

$$V = -\kappa + \beta q(\theta) J(\omega') + \beta(1 - q(\theta))V \ . \tag{6}$$

We combine the worker's and the firm's value functions (1), (2), (5), and (6) to define the joint surplus of the match as $S(\omega) \equiv J(\omega) - V + E(\omega) - U$. Importantly, and unlike in the

canonical DMP-framework, in this model the wage ω not only divides the joint surplus between the firm and the worker, but also determines the size of the joint surplus. To understand this relationship, consider a marginal change in the wage and note that this change has a differential impact on the worker's and the firm's surplus as long as $T > 1$ and $\sigma_w \neq \sigma$. For example, when the worker has pessimistic job separation expectations ($\sigma_w > \sigma$), the joint surplus is negatively related to the wage:

$$\frac{\partial S(\omega)}{\partial \omega} = \frac{\partial J(\omega)}{\partial \omega} + \frac{\partial E(\omega)}{\partial \omega} = -\sum_{t=1}^{T} \Big(\beta(1-\sigma)\Big)^{t-1} + \sum_{t=1}^{T} \Big(\beta(1-\sigma_w)\Big)^{t-1} < 0 \; . \tag{7}$$

That is, a marginal increase in the wage ω raises the worker's value $E(\omega)$ by less than it decreases the firm's value $J(\omega)$. This is because the separation probability determines the expected duration for which the wage is paid. Thus, if the worker expects a shorter duration than the firm, then the perceived gain for the worker from a higher wage is smaller than the loss for the firm. This relationship will be key in understanding how the worker's expectation bias affects the wage bargaining. Note that for this relationship to hold, firms do not need to have rational expectations. In an extension to the model, we show that if the firm also has biased separation expectations, then the relationship holds as long as the firm's bias is smaller than worker's bias.[13]

3.3 Wage determination

The period wage ω that a worker receives in a contract of length T is determined by (generalized) Nash bargaining between the worker and the firm and solves

$$\omega = \arg\max \big[E(\omega) - U\big]^{\gamma} \big[J(\omega) - V\big]^{1-\gamma} \; , \tag{8}$$

where $\gamma \in (0,1)$ denotes the worker's bargaining power. Regarding the bargaining procedure, we assume that the respective job values, $E(\omega)$ and $J(\omega)$, and of the outside options, U and V, are known to and accepted by both parties (common knowledge).

[13] See Appendix B.4 for the model extension.

This means that the worker and the firm know each other's perceived values and agree to disagree.[14] The optimality condition associated with the maximization problem in (8) is given by

$$\gamma\Big[J(\omega)-V\Big]\underbrace{\frac{\partial E(\omega)}{\partial\omega}}_{\sum_{t=1}^{T}[\beta(1-\sigma_w)]^{t-1}}+(1-\gamma)\Big[E(\omega)-U\Big]\underbrace{\frac{\partial J(\omega)}{\partial\omega}}_{-\sum_{t=1}^{T}[\beta(1-\sigma)]^{t-1}}=0\ . \tag{9}$$

If $T>1$, two important observations follow. First, the derivatives of the worker's and the firm's value functions with respect to the wage are larger than unity (in absolute value). This is because a marginal change in ω affects not only the current period value of the match (as with period-by-period bargaining), but also future values. Second, as mentioned before, if $\sigma_w \neq \sigma$, then a marginal change in the wage affects the worker's value differently than the firm's value. For example, a pessimistic worker (with $\sigma_w > \sigma$) discounts future wage payments more than the firm does, and thus the worker gains less from an increase in the wage than the firm loses. This is also reflected in the implied surplus sharing rule which can be obtained by rearranging the optimality condition (9).

$$\frac{E(\omega)-U}{J(\omega)-V}=\frac{\gamma}{1-\gamma}\frac{\sum_{t=1}^{T}\big[\beta(1-\sigma_w)\big]^{t-1}}{\sum_{t=1}^{T}\big[\beta(1-\sigma)\big]^{t-1}}\ . \tag{10}$$

The worker's share of the total surplus depends not only on the bargaining weight γ, as in the standard DMP model, but also on the worker's separation expectations. As can be seen from the previous expression, the worker's share of the surplus is equal to γ when $\sigma_w=\sigma$, but less than γ when the worker is pessimistic about the duration of the match.

3.4 Labor market equilibrium

In the next step, we derive two conditions that jointly characterize the equilibrium of the model: the job creation condition and the wage curve. First, we combine the firm's value

[14] Although workers do not form rational expectations, there is no private information in our model. Under these conditions, the alternating-offer bargaining protocol of Binmore et al. (1986) yields the same solution as Nash bargaining, thus offering a micro foundation of the bargaining procedure also in our setting. See Section B.3 in the Appendix for the derivations.

functions (5) and (6), and use free entry (implying that $V = 0$) together with the fact that in a stationary equilibrium $J(\omega) = J(\omega')$ to obtain the job creation condition:

$$\frac{z-\omega}{1-\beta(1-\sigma)} = \frac{\kappa}{\beta q(\theta)} \ . \tag{11}$$

Equation (11) is identical to the job creation condition in the model with rational expectations: The left-hand side represents the present discounted value of the future stream of period profits, while the right-hand side represents the firm's expected hiring costs. In equilibrium, the firm's expected profits and expected costs are equalized, so that an entering firm expects to earn zero profits.

Second, combining the optimality condition (9) with the worker's and the firm's value functions (1), (2), (5) and (6), and accounting for the fact that $V = 0$ in equilibrium yields the wage equation:

$$\omega = b+\gamma\left[z-b+\kappa\frac{\theta}{p(\theta)}\left(\underbrace{\frac{\sum_{t=1}^{T}\left[\beta(1-\sigma_w)\right]^{t-1}}{\sum_{t=1}^{T}\left[\beta(1-\sigma)\right]^{t-1}}}_{\frac{\partial\cdot}{\partial\sigma_w}\leq 0}\lambda_w(\theta)+\beta^{T-1}\underbrace{\frac{(1-\sigma)^T-(1-\sigma_w)^T}{\sum_{t=1}^{T}\left[\beta(1-\sigma)\right]^{t-1}}}_{\frac{\partial\cdot}{\partial\sigma_w}>0}\right)\right] . \tag{12}$$

It is straightforward to verify that, in the absence of expectation biases, (12) is identical to the familiar rational expectations solution, $\omega = b+\gamma(z-b+\kappa\theta)$, which is independent of the contract length T.

The equilibrium of the model is described by the pair (ω, θ) that jointly solves the job creation condition (11) and the wage equation (12). The equilibrium unemployment rate is given by the standard expression for the Beveridge curve, $u = \frac{\sigma}{\sigma+p(\theta)}$. Whether an equilibrium exists and is unique depends, unlike in the standard model, on the length of the wage contract (T) and on the workers' job finding and separation expectations, (λ_w, σ_w). The following proposition makes a formal statement about the existence and

uniqueness of equilibrium.[15]

Proposition 1 *In the presence of biased expectations and wage contracts of length $T \geq 1$, an interior equilibrium with $\theta > 0$ exists if and only if the condition*

$$-\beta^{T-1}\left[(1-\gamma)(1-\sigma)^T + \gamma(1-\sigma_w)^T\right] \leq (1-\gamma)\frac{z-b}{\kappa}\sum_{t=1}^{T}\left[\beta(1-\sigma)\right]^{t-1} - \frac{1}{\beta}$$

(i) holds with strict inequality, or

(ii) holds with equality and $\gamma\lambda_w/p(\theta) = \gamma(1+\Delta_\lambda) = 0$ and $\lim_{\theta\to 0^+}\theta p'(\theta) = 0$.

If (i) holds and $\gamma\lambda_w/p(\theta) > 0$ or $p(\theta)/\theta$ is strictly decreasing, then the equilibrium is unique.

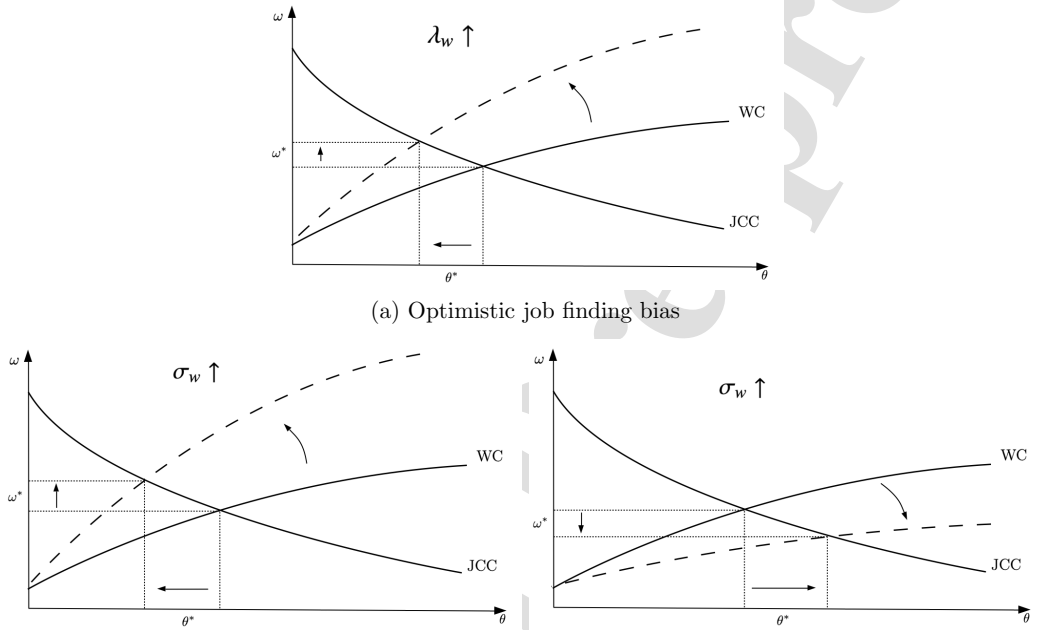
Next, we conduct comparative statics analyses to build intuition for how workers' expectation biases affect equilibrium outcomes. First, consider the job finding bias. An optimistic unemployed worker, with $\lambda_w > p(\theta)$, overestimates the probability of finding a job. Thus, according to Equation (2), the value of unemployment, U, as perceived by the worker is higher than without the optimistic bias. With a more valuable outside option in the bargaining process, both the worker's reservation wage and the bargained wage are higher (compared to the rational expectations case). This situation is depicted in Panel (a) of Figure (3) by an upward-rotation of the wage curve. Since the job creation condition is unaffected by workers' expectations, the optimistic job finding bias leads to a higher equilibrium wage ω, a lower market tightness θ, a higher unemployment rate u, and a longer average duration of unemployment $1/p(\theta)$.

Next, consider the job separation bias. As can be seen from the wage curve in (12), the overall effect of the separation bias on the wage depends on two opposing effects, represented by the two terms inside the parentheses. The first term is negatively related to the bias. The intuition is as follows: A pessimistic worker, with $\sigma_w > \sigma$, expects the match to dissolve sooner than the firm does. Therefore, the worker discounts future wages

[15] The proof of Proposition 1 is in Section B.1 in the Appendix.

paid in the current contract more heavily than the firm does. Consequently, the worker is willing to accept a lower wage. In contrast, the second term inside the parentheses is positively related to the bias. A pessimistic worker discounts the continuation value associated with a future contract more heavily than the firm. Thus, it is less attractive for the worker to stay in the match. As a result, the firm must offer a higher wage to keep the worker in the match.

Figure 3: General equilibrium effects of bias



(a) Optimistic job finding bias

(b) Pessimistic job separation bias, $T < T^*$

(c) Pessimistic job separation bias, $T > T^*$

Notes: JCC: Job creation condition, WC: Wage curve

Crucially, the length of the wage contract T determines the relative strength of these two effects. For low values of T, the current wage is paid for only a few periods, and hence the differential discounting of the current contract plays a minor role. In this case, the positive effect dominates and, thus, the wage increases in the pessimistic bias, $\frac{\partial \omega}{\partial \sigma_w} > 0$. This situation is depicted in Panel (b) of Figure 3 by an upward-rotation of the wage curve. As the contract length T increases, the current wage is paid for a longer period of time, and therefore the negative effect of the separation bias on the wage becomes stronger, while the positive effect diminishes. For a sufficiently long duration of the wage

contract, the derivative $\frac{\partial \omega}{\partial \sigma_w}$ becomes negative, as illustrated in Panel (c) of Figure 3.

One can show that there exists a unique contract length T^* such that the wage increases with the separation bias for all $T < T^*$ and decreases with the bias for all $T \geq T^*$. This value is given by the smallest integer $T^* > 0$ which satisfies the following condition for a fixed θ:[16]

$$\frac{T^*}{\lambda_w(\theta)} < \beta \sum_{t=1}^{T^*-1} (T^* - t) \Big[\beta(1-\sigma_w)\Big]^{-t}. \tag{13}$$

Importantly, the job creation condition (11) is not affected by the contract length T. Thus, for $T < T^*$, a pessimistic job separation bias raises the equilibrium wage ω and lowers the market tightness θ, whereas the opposite effect occurs for $T > T^*$.

4 Quantitative analysis

In this section, we conduct a quantitative analysis in order to assess how workers' expectation biases affect wages, unemployment, and expected lifetime income. Of particular interest in this analysis is the extent to which the more pessimistic expectations of East German workers can contribute to the observed wage gap between East and West Germany. To investigate this, we first calibrate the model to match data targets for the East German economy. We then perform a counterfactual exercise where we make East German workers more optimistic by assigning to them the expectation biases of West German workers. Then, we compare the wages and other labor market outcomes of this counterfactual East-Germany to the outcomes of the baseline economy.

4.1 Calibration

In our baseline calibration, we set the model period to one quarter. The discount factor, β, is chosen to match an annual interest rate of 4 percent. Unemployment income, b, is set to match the average German replacement rate of 65 percent. For the matching

[16] See Appendix B.2 for the derivation of T^*.

process, we use the function $M(u, v) = \chi u^{\eta} v^{1-\eta}$, where the parameter η governs the elasticity of matches with respect to labor market tightness. Following the literature, we set $\eta = 0.65$ (see e.g. Balleer et al., 2016, or Kohlbrecher et al., 2016). The scale parameter, χ, is calibrated to match the quarterly job-finding rate of unemployed workers, which we compute using our baseline sample (see Table A.3).[17] The vacancy cost, κ, is set such that the model generates a steady-state labor market tightness of $\theta = 1$. The separation probability, σ, is set to match the quarterly separation rate (based on the general separation measure) in our baseline sample. To calibrate the biases in job finding and job separation rates, we rely on our empirical findings from Section 2. Since these biases are computed from biennial data, we convert them to quarterly frequencies (see Appendix C.2.1 for details). Lastly, we normalize match output z to one.

A key parameter in the model is the contract length T. As shown in Section 3.4, T shapes the relationship between workers' separation expectations and wages. Using the expression in (13) and the calibrated parameter values, we obtain a critical value of $T^* = 10$ quarters. When $T > T^*$, more pessimistic separation expectations lead to lower wages, whereas for $T < T^*$, they result in higher wages. To calibrate T, we use information from the data on the average length of work contracts in East Germany. Specifically, we consider the sample of employed East-German workers in the SOEP (excluding the self-employed). Among them, 88 percent hold permanent contracts, while 12 percent are in temporary contracts. Guided by official statistics provided by the German Statistical Office, we assume a duration of one year for temporary contracts.[18]

The SOEP does not contain information on duration, only on the type of contracts

[17] On average, 1.7 percent of employed workers separate from their job due to general reasons, and 22 percent of unemployed workers find a job within one quarter. Klinger and Rothe (2012), Hochmuth et al. (2021), or Hartung et al. (2018) span a range of quarterly job separation rates from 1.4 percent to 4.7 percent and quarterly job finding rates from 16.9 percent to 40.7 percent. Hence, our sample reflects rates at the lower bound of rates from administrative data sources that are documented in the literature.

[18] For temporary contracts, Destatis reports that 57 percent of these contracts hold for less than a year in 2022, while 20 percent hold between 1 and 2 years, 13 percent between 2 and 3 years and about 10 percent for longer than 3 years. Destatis does not report significant differences between East and West Germany with respect to the length of temporary contracts. See https://www.destatis.de/DE/Themen/Arbeit/Arbeitsmarkt/Qualitaet-Arbeit/Dimension-4/befristet-beschaeftigte.html.

Table 4: Baseline calibration

Parameter	Description	Value	Source/Target
β	Discount factor	0.99	Annual interest rate (4%)
η	Matching fnct elasticity	0.65	Kohlbrecher et al. (2016)
b	Unemployment income	0.60	Replacement rate of 65%
κ	Vacancy costs	0.52	$\theta = 1$ (Normalization)
χ	Matching fnct efficiency	0.21	JF rate (SOEP)
σ	Separation rate	0.0185	JS rate (SOEP)
$\sigma_w - \sigma$	Job separation bias	0.0187	Own estimate (JS general, SOEP)
$\lambda_w(\theta) - p(\theta)$	Job finding bias	-0.0012	Own estimate (JF out of U, SOEP)
γ	Workers' bargaining power	0.45	Elasticity of wages to σ_w
T	Duration of wage contract	106	Own estimate

Notes: The model is calibrated to East Germany at a quarterly frequency. JF refers to job finding out of unemployment only, JS refers to the general measure of job separation.

(temporary or permanent). Therefore, we adopt the following approach to approximate contract duration and consider alternative methods as a robustness check. First, we set the total length of permanent contracts to 30 years, which corresponds to workers entering a contract at age 37 and retiring at age 67.[19] Using the shares of permanent and temporary contracts in our sample (88 percent and 12 percent), along with a duration of one year for temporary contracts, we compute an average contract length for East Germany of 26.5 years ($T = 106$). We use this value in our baseline calibration. In addition, we consider two alternative values for robustness. As a lower bound on T, we approximate duration using the remaining length of permanent contracts in our sample. Specifically, we compute this remaining duration as the difference between the effective retirement age and the worker's current age. The average effective retirement age in our sample is approximately 63 years, yielding an average remaining length of permanent contracts of about 19 years. As an upper bound on T, we set the total length of permanent contracts to 45 years which corresponds to workers entering a contract at age 22 and retiring at 67. These alternative values yield average contract lengths of $T = 67$ and $T = 159$ quarters, respectively. Since, these values exceed the critical value of $T^* = 10$, our calibrated model predicts that more pessimistic workers earn lower wages.

[19] See www.demografie-portal.de. The legal retirement age is currently at 67, but was 65 for most of the sample. For older cohorts and specific occupations, lower legal retirement ages apply. In addition, early retirement is widely applied in Germany.

Another important parameter is the bargaining power of workers, γ. In much of the literature, this parameter is commonly set to 0.5 (see e.g. Balleer et al., 2016). In our model, the workers' bargaining power plays a crucial role in determining how strongly biased expectations affect wages. According to Equation (12), a lower bargaining power reduces the equilibrium wage (keeping everything else equal). However, since lower wages spur job creation, the model requires a higher vacancy cost, κ, to match the empirical job-finding rate. This, in turn, increases the elasticity of wages with respect to the bias (see Equation (12)). We exploit this relationship to calibrate workers' bargaining power. In particular, we use SOEP data to estimate the empirical relationship between individuals' job separation expectations and wages, and use this estimate as a calibration target for γ. Specifically, we regress log hourly wages on the individual-level difference between perceived job separation rates and actual transitions, controlling for various factors and including individual fixed effects. We also allow this relationship to differ between East and West Germany. Details of the estimation and results are provided in Appendix C.1. Importantly, we find that the empirical relationship between individual wages and perceived job separation rates is significant and negative (and more negative in East Germany). Our estimates imply that if East German workers' pessimism about job separation were at the West German level, hourly wages in the East would be about 0.9 percent higher.[20] Using this value as a target in the calibration yields $\gamma = 0.45$. The implied lower bargaining power (below 0.5) may be a particularly realistic assumption for East Germany, where collective worker representation is significantly weaker than in West Germany (see e.g. Bachmann et al., 2022, for supporting evidence). Given the quantitative importance of γ for the effects of biases on wages in our model, we consider a range of alternative values as a robustness check.

Table 4 presents the calibrated parameter values. Our calibration implies a steady-state unemployment rate of 8.0 percent for East Germany and an average unemployment

[20] Appendix C.1 also presents comparable evidence for the U.S. and examines the relationship between job-finding expectations and reservation income in Germany. Consistent with our model, greater optimism about job finding is associated with higher reservation income.

duration of 4.7 quarters.[21] Moreover, the model generates a relationship between job finding expectations and the reservation wage that is quantitatively very similar to that we estimate in the data. Specifically, the calibration implies that if Eastern German workers were as optimistic about job finding as West German workers, the reservation wage would be about 0.8 percent higher. This is very close to the value of 0.7 percent that we estimate in the data (see Appendix C.1.3 for details).

4.2 Results and discussion

As a next step, we conduct the counterfactual experiment, in which we make East German workers less pessimistic about job separation and more optimistic about job finding. Specifically, we assign to them the job separation and job finding biases that we measure for West Germany, by setting the job separation and job finding biases to West German levels (see Appendix C.2.1 for details). Importantly, in this experiment, we adjust only these bias parameters while keeping all other parameters unchanged.

The first row in Table 5 presents the implied changes of the equilibrium relative to the baseline economy.[22] Making East German workers less pessimistic overall leads to a substantial increase in the East German reservation wage by 2.8 percent. As shown in the theoretical analysis in Section 3.4, both an increase in the optimistic job-finding bias and a decrease in the pessimistic job-separation bias lead to an upward rotation of the wage curve. Consequently, the equilibrium wage increases by 1.42 percent. To put this number into perspective, notice that in the data, the unconditional East-West German wage gap is approximately 30 percent, or 23 percent after accounting for controls (see Table A.4 in Appendix A). The predicted increase in East German wages by 1.42 percent

[21] According to the German Federal Employment Agency, the average annual unemployment rate between 1999 and 2015 equals 8.8 percent for Germany as a whole, while the corresponding average unemployment rate in East Germany equals 14.5 percent. The time series are publicly available on the homepage of the Federal Statistical Office of Germany (www-genesis.destatis.de), Table 13211-0001. Hence, the unemployment rate implied by transition rates in the SOEP is substantially lower than the officially reported figures. We explore robustness to setting the job separation rate in the East to a higher value in line with the officially reported unemployment rate below.

[22] Table C.6 in Appendix C.2 also report the results when adjusting only one bias (job separation or job finding).

implies a reduction of the unconditional wage gap between East and West Germany by 4.8 percent and of the conditional wage gap by 6.1 percent. These findings suggest that a substantial part of the observed East-West German wage gap can be attributed to differences in expectation biases between East and West Germany.

Table 5: Quantitative results

	$\Delta\underline{\omega}$	$\Delta\omega$	$\Delta\mathbb{E}(D_u)$	Δu	$\Delta\mathbb{E}(\mathcal{I})$	$\Delta\frac{\omega_{East}}{\omega_{West}}$
Baseline	2.80	1.42	11.4	0.88	1.02	6.1
$\gamma = 0.20$	4.97	3.71	9.0	0.69	3.25	16.0
$\gamma = 0.50$	2.58	1.19	11.7	0.90	0.79	5.1
$T = 67$	2.47	1.19	10.1	0.78	0.84	5.1
$T = 159$	2.94	1.52	11.9	0.92	1.10	6.6
Biennial	4.98	2.33	8.0	1.44	1.38	10.0
FIRE	3.08	1.56	12.7	0.98	1.11	6.7

Notes: Baseline model calibrated to East Germany. Results show changes in equilibrium values relative to the initial steady state. Reported are log differences for the reservation wage, $\underline{\omega}$, the equilibrium wage, ω, average unemployment duration, $\mathbb{E}(D_u)$, and expected lifetime income, $\mathbb{E}(\mathcal{I})$, and changes in percentage points for the equilibrium unemployment rate, u. The last column reports the implied change in the conditional East-West wage gap when assigning Western biases in job separation and job finding rates.

The upward rotation of the wage curve also leads to a decline in equilibrium labor market tightness which results in higher unemployment and longer unemployment duration. Our counterfactual implies that, with West German biases, unemployment duration in the East would increase by 11.4 percent and the unemployment rate by 0.88 percentage points, thereby widening the observed East-West unemployment gap of about 7 percentage points.

Since wages and unemployment move in opposite directions, the net effect of reducing East German workers pessimism on income is ambiguous. To quantify the net effect, we compute the expected lifetime income of an individual entering the economy as $\mathbb{E}(\mathcal{I}) = (1-u)\mathcal{I}_W + u\mathcal{I}_U$ [23] Importantly, the calculation of expected incomes is based on actual (unbiased) job separation and job finding probabilities. With West German biases,

[23] where $\mathcal{I}_W = \omega + \beta(1-\sigma)\mathcal{I}_W + \beta\sigma\mathcal{I}_U$, and $\mathcal{I}_U = b + \beta\big[1-\theta q(\theta)\big]\mathcal{I}_U + \beta\theta q(\theta)\mathcal{I}_W$

expected lifetime income in East Germany would increase by 1.02 percent, implying that East German workers would be better off if their expectation biases were at West German levels.

Given importance of γ and T for the wage effects of biases in our model, as well as the uncertainty surrounding their exact values, we explore a range of values for these parameters in a robustness exercise. Specifically, for T, we consider the two alternative values $T \in \{67, 159\}$ discussed above. Moreover, for γ we consider the values $\gamma \in \{0.2, 0.5\}$. While $\gamma = 0.5$ is typically used in quantitative work, $\gamma = 0.2$ implies a more negative relationship between wages and individual separation expectations than our baseline calibration target, but one that is comparable to the relationship we estimate for the U.S. (see Appendix C.1.2 for details). For each value of γ and T, we calibrate unemployment income b and vacancy costs κ to match a replacement rate of 65 percent and to obtain an equilibrium tightness of $\theta = 1$. For the resulting values for b and κ see Appendix C.2. Then we conduct the same counterfactual experiment as before. As shown in Table 5, the bargaining power γ plays a crucial role in shaping the response of wages to changes in biases. For the lower value $\gamma = 0.2$, wages react more strongly to changes in the bias. With West German biases, wages of East German workers would increase by 3.71 percent, which would reduce the conditional East-West German wage gap by 16.0 percent and raise the expected lifetime income of East German workers by 3.25 percent.

Our baseline results are less sensitive to the value of T. We find that for a higher value of T, wages react more strongly to changes in expectation biases, which is in line with the theoretical analysis, However, quantitatively the results for $T \in \{67, 159\}$ are similar to the baseline findings.

In addition to our baseline experiment, we also consider an alternative counterfactual in which we remove all expectation biases and assign East German workers the conventional full-information rational expectations (FIRE). As shown in the last row of Table 5 under FIRE, East German wages would be 1.56 percent higher and lifetime income would

increase by 1.11 percent compared to the baseline economy.

We also examine the sensitivity of our baseline results to various alternative specifications, with details provided in Appendix C.2.3. One variation adopts a narrower definition of job separation, considering only dismissals, in line with the definition used in the empirical analysis. Other variations include using the East German unemployment rate (as reported by the official statistics) as a calibration target, calibrating the model at a biennial frequency, and using estimated (instead of actual) transition rates using Probit models. Across these cases, the results remain quantitatively similar to our baseline findings, with one exception: in the biennial calibration, wages increase much stronger – by up to 2.33 percent. In this scenario, the conditional East-West German wage gap narrows by about 10 percent, while the unconditional wage gap declines by up to 7.9 percent. Lifetime income rises by as much as 1.38 percent.

5 Conclusion

We study how biased expectations of workers about labor market transitions affect labor market outcomes, in particular wages and wage differentials. We use survey data from the German Socio-Economic Panel (SOEP) and document systematic differences between perceived and actual job finding and job separation rates. East Germans are substantially more pessimistic regarding job stability and less optimistic regarding job finding than their Western counterparts.

We incorporate biased expectations about labor market transitions into the workhorse macroeconomic model of frictional labor markets and investigate their implications for wage bargaining and the labor market equilibrium. If workers are pessimistic regarding job stability, higher effective discounting of future wages in ongoing contracts relative to lower values of consecutive contracts within a match lead to lower wages. If workers are optimistic regarding job finding, they overestimate the value of unemployment, their reservation wages increase and they need to be compensated accordingly through higher

wages. Low bargaining power on the side of the workers intensifies these effects.

We calibrate our model to East Germany and quantify the importance of bias differences to West Germany for the wage differential between the two regions. Less pessimism regarding job stability and more optimism regarding job finding in line with West German bias levels decrease the conditional East-West German wage gap by 6.1 percent and increase East German expected lifetime income by 1.02 percent. Our results therefore suggest that it might be desirable to reduce pessimistic bias in expectations, e.g., through information treatment. Our analyses show that the contribution of biased expectations to wage differences is larger if the bargaining power of workers is low. Since union representation in East Germany is low, our results suggest that it might be beneficial to strengthen unions in East Germany. This is especially the case if unions are able to form more accurate expectations than individuals. This insight is related to the discussion in Bachmann et al. (2022).

Our results also suggest that policy makers need to take existing expectation biases about labor market outcomes into account when assessing the effectiveness of labor market policy. This is potentially relevant for policies that affect the reservation wage such as unemployment insurance or minimum wage, but also for policies that affect separation rates such as firing costs. The presence of biased expectations may affect the labor market equilibrium under these policies differently than under rational expectations. For example, higher firing costs can lead to an increase in equilibrium unemployment in an economy with pessimistic workers, whereas unemployment declines in an economy with optimistic workers. It will be insightful to explore the interaction of biased expectations and labor market policy in future research.

References

Bachmann, R., C. Bayer, H. Stueber, and F. Wellschmied (2022). Monopsony makes firms not only small but also unproductive: Why East Germany has not converged.

CEPR Discussion Paper 17302.

Balleer, A., B. Gehrke, W. Lechthaler, and C. Merkl (2016). Does short-time work save jobs? A business cycle analysis. *European Economic Review 84*, 99–122.

Binmore, K., A. Rubinstein, and A. Wolinsky (1986). The Nash Bargaining Solution in Economic Modelling. *The RAND Journal of Economics 17*(2), 176–188.

Broer, T., A. Kohlhas, K. Mitman, and K. Schlafmann (2021). Information and Wealth Heterogeneity in the Macroeconomy. CEPR Discussion Paper 15934.

Campbell, D., A. Carruth, A. Dickerson, and F. Green (2007). Job Insecurity and Wages. *The Economic Journal 117*(518), 544–566.

Conlon, J. J., L. Pilossoph, M. Wiswall, and B. Zafar (2018). Labor Market Search With Imperfect Information and Learning. NBER Working Paper 24988.

Cortés, P., J. Pan, L. Pilossoph, E. Reuben, and B. Zafar (2023). Gender Differences in Job Search and the Earnings Gap: Evidence from the Field and Lab. *The Quarterly Journal of Economics 138*(4), 2069–2126.

Diamond, P. A. (1981). Mobility Costs, Frictional Unemployment, and Efficiency. *Journal of Political Economy 89*(4), 798–812.

Drahs, S., L. Haywood, and A. Schiprowski (2018). Job Search with Subjective Wage Expectations. DIW Berlin Discussion Paper 1725.

Emmler, J. and B. Fitzenberger (2022). Temporary overpessimism: Job loss expectations following a large negative employment shock. *Economics of Transition and Institutional Change 30*(3), 621–661.

Fuchs-Schündeln, N. and R. Izem (2012). Explaining the low labor productivity in East Germany - A spatial analysis. *Journal of Comparative Economics 40*(1), 1–21.

Fuchs-Schündeln, N. and M. Schündeln (2020). The Long-Term Effects of Communism in Eastern Europe. *Journal of Economic Perspectives 34*(2), 172–91.

Gertler, M. and A. Trigari (2009). Unemployment Fluctuations with Staggered Nash Wage Bargaining. *Journal of Political Economy 117*(1), 38–86.

Goebel, J., M. M. Grabka, S. Liebig, M. Kroh, D. Richter, C. Schröder, and J. Schupp (2019). The German Socio-Economic Panel Study (SOEP). *Journal of Economics and Statistics 2*(239), 345–360.

Hall, R. E. and S. Schulhofer-Wohl (2018). Measuring Job-Finding Rates and Matching Efficiency with Heterogeneous Job-Seekers. *American Economic Journal: Macroeconomics 10*(1), 1–32.

Hartung, B., P. Jung, and M. Kuhn (2018). What Hides behind the German Labor Market Miracle? Unemployment Insurance Reforms and Labor Market Dynamics. IZA Discussion Paper 12001.

Hochmuth, B., B. Kohlbrecher, C. Merkl, and H. Gartner (2021). Hartz IV and the decline of German unemployment: A macroeconomic evaluation. *Journal of Economic Dynamics and Control 127*, 104–114.

Hübler, D. and O. Hübler (2006). Is There a Trade-off Between Job Security and Wages in Germany and the UK? IZA Discussion Paper 2241.

Jäger, S., C. Roth, N. Roussille, and B. Schoefer (2024). Worker Beliefs About Outside Options. *The Quarterly Journal of Economics 139*(3), 1505–1556.

Kennan, J. (2010). Private Information, Wage Bargaining and Employment Fluctuations. *Review of Economic Studies 77*(2), 633–664.

Klinger, S. and T. Rothe (2012). The Impact of Labour Market Reforms and Economic Performance on the Matching of the Short-term and the Long-term Unemployed. *Scottish Journal and Political Economy 59*(1), 90–114.

Kohlbrecher, B., C. Merkl, and D. Nordmeier (2016). Revisiting the matching function. *Journal of Economic Dynamics and Control 69*, 350–374.

Laudenbach, C., U. Malmendier, and A. Niessen-Ruenzi (2020). The Long-lasting Effects of Living under Communism on Attitudes towards Financial Markets. NBER Working Paper 26818.

Menzio, G. (2023). Stubborn Beliefs in Search Equilibrium. *NBER Macroeconomics Annual 37*, 239–297.

Mortensen, D. T. and C. A. Pissarides (1994). Job Creation and Job Destruction in the Theory of Unemployment. *The Review of Economic Studies 61*(3), 397–415.

Mueller, A. I. and J. Spinnewijn (2023). Expectations data, labor market, and job search. In R. Bachmann, G. Topa, and W. van der Klaauw (Eds.), *Handbook of Economic Expectations*, pp. 677–713. Elsevier.

Mueller, A. I., J. Spinnewijn, and G. Topa (2021). Job Seekers' Perceptions and Employment Prospects: Heterogeneity, Duration Dependence, and Bias. *American Economic Review 111*(1), 324–63.

Pissarides, C. A. (2000). *Equilibrium Unemployment Theory, 2nd Edition*. The MIT Press.

Souleles, N. S. (2004). Expectations, Heterogeneous Forecast Errors, and Consumption: Micro Evidence from the Michigan Consumer Sentiment Surveys. *Journal of Money, Credit and Banking 36*(1), 39–72.

- German workers exhibit large and persistent biases in job-finding and separation expectations
- East Germans are substantially more pessimistic about job stability and job finding prospects
- Biased expectations shape equilibrium wages, unemployment, and vacancies
- Duration of wage contracts crucially governs how separation expectations affect wages
- East German pessimism accounts for a sizable part of the East–West wage gap