The Effect of Unemployment Benefits and Nonemployment Durations on Wages*

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Abstract

We estimate that Unemployment Insurance (UI) extensions reduce reemployment wages using sharp age discontinuities in UI eligibility in Germany. We show this effect combines two key policy parameters: the effect of UI on reservation wages and the effect of nonemployment durations on wage offers. Our framework implies if UI extensions do not affect wages conditional on duration, then reservation wages do not bind. We derive resulting instrumental variable estimates for the effect of nonemployment durations on wage offers and bounds for reservation wage effects. The effect of UI on wages we find arises mainly from substantial negative nonemployment duration effects.

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1 Introduction

At the peak of the Great Recession, Congress extended unemployment insurance durations to 99 weeks, almost four times the usual duration. While a substantial literature has assessed the potential consequences of such UI extensions on employment (e.g. Meyer, 1990; Rothstein, 2011; Kroft and Notowidigdo, 2010; Schmieder et al., 2012a,b; Farber and Valletta, 2013), fewer papers have studied the effect of UI extensions on reemployment wages. Recent studies find that UI extensions have small effects on reemployment wages with typically negative point estimates (e.g. Lalive, 2007; Card et al., 2007; Centeno and Novo, 2009). In this paper we show that these estimates represent the sum of several potentially offsetting components: Firstly, UI extensions increase the outside option of workers and thus may push up equilibrium wages of individuals who find jobs (either due to an increase in reservation wages or a stronger bargaining position). Secondly, UI extensions may lead to a reduction in search effort and hence longer duration of nonemployment. If individuals face lower wage offers as their time out of work increases, say due to stigma or human capital depreciation, this would lead to a reduction in reemployment wages among workers facing UI extensions.[1]

The net effect of these channels on wages is important for understanding the effects of UI policy. However, disentangling the channels is crucial for assessing the policy responses to long-term nonemployment as well as the potential macroeconomic effect of the UI system. On the one hand, understanding the decline of wage offers throughout the nonemployment spell – what we call the causal effect of unemployment duration on wages – is important for understanding the costs and consequences of long-term nonemployment. Partly because this is generally difficult to separate from reservation wage effects, there are few causal estimates of the effect of nonemployment duration on wages, earnings, or other outcomes.[2] Yet, this question has

[1] Throughout the paper, we use nonemployment duration instead of unemployment duration to refer as the time between jobs because it is what we can measure in our data and what is manipulated by our estimation strategy. It is widely thought that long nonemployment durations can lower reemployment wages and other job outcomes of workers via depreciation of skills or because of stigma (e.g. Acemoglu, 1995; Machin and Manning, 1999). As a result, long-term nonemployment can affect the aggregate labor market and economic recovery (e.g. Pissarides, 1992; Ljungqvist and Sargent, 2008; Ball, 2009).

[2] While uneployment duration is a choice variable and hence endogenous, it may be manipulated by policies that affect job search intensity, among others. We found essentially no studies estimating the effect of long-term unemployment on any outcome using quasi-experimental variation or within-spell variation from panels. This is reflected in Bernanke (2012), who does not cite a single empirical study in support of the claim that unemployment duration is costly. As discussed below, several studies estimate the depreciation of human capital as one of several parameters in models of life-cycle earnings.

received increasing attention during the Great Recession, as historically unprecedented levels of long-term unemployment renewed the concern that increasing duration between jobs may worsen workers' job outcomes, and hence worsen the impact of the recession and prolong the recovery (e.g. Bernanke, 2012). On the other hand, if UI by increasing wages raises the cost of job creation, UI may further raise unmployment rates and prolong the recovery. This channel has been debated in a series of high-profile papers (e.g. Marinescu, 2015; Landais et al., 2015; Hagedorn et al., 2013). Yet, the effect of UI durations on reemployment wages does not reflect the true labor cost to employers, which also depends on workers' skill level. Hence, in so far as there is skill depreciation, the effect of UI durations on wages understates the true effect of the outside option on increases in labor costs. Understanding the separate effect of the reservation wage and nonemployment duration channels is also relevant for assessing policies addressing long-term nonemployment. Longer UI durations are often thought to help workers find a better job. Yet, if the positive reservation wage effects is small and negative duration effect is large, then optimal UI policy would aim at shortening nonemployment spells.

This paper provides new empirical estimates of the effect of UI extensions on wages using quasi-experimental variation and data from Germany, which has several features that are ideal for our purposes. During the 1980s and 1990s, UI durations for middle aged workers in Germany were a step function of exact age at benefit claiming, such that the causal effect of UI durations on job outcomes can be estimated using a regression discontinuity design. A key feature of the German environment is that we have access to the universe of social security records with information on day-to-day nonemployment spells, exact dates of birth, as well as a broad range of worker and job characteristics. The large sample and high quality data allow us to obtain estimates of the effect of UI durations on reemployment outcomes with higher precision than previous studies.

The paper then provides a conceptual framework for disentangling the channels underlying the effect of UI extensions on wages. Based on the canonical partial-equilibrium model of job search with heterogeneous workers, we clarify how the effect of UI durations on reemployment wages combines the effect on wages through reservation wages (a labor supply response) and the effect from changes in wage offers, either due to human capital depreciation or stigma (a labor demand response). A classic prediction from the model is that if workers value their outside option, a rise in potential UI durations leads to a decline in job search intensity and a rise in reservation wages. A key insight we exploit is that one can learn about the behavior of reservation wages from observed reemployment wages at different nonemployment durations. In particular, we show that if the path of observed reemployment wages does not shift outward in response to a rise in UI durations, this implies that reservation wages do not bind, at least in the part of the wage offer distribution relevant for workers' employment decisions.

If the condition on reemployment wages is satisfied in the data, the only effect of nonemployment durations on wages must arise from a change in the wage-offer distribution over the duration of nonemployment. We derive an expression of the resulting instrumental variables (IV) estimator, show that it obtains a local average treatment effect of nonemployment duration on wages for individuals whose nonemployment duration responds to the UI extension, and derive an estimable expression of the corresponding weighting function. Based on the theory, we then derive bounds for the causal effect of nonemployment duration on wages in case the condition on reemployment wages does not hold exactly because reservation wages do seem to affect job prospects in response to UI extensions.

We obtain three main empirical findings. First, we find small but precisely estimated negative effects of UI extensions on wages, job duration, and other job outcomes of middle aged workers, such as the probability of full-time work and working in the same industry and occupation. Second, we show that the path of average reemployment wages at different nonemployment durations does not shift, implying that reservation wages do not bind in our setting. As a result, reservation wages do not contribute to declining wages over the nonemployment spell, and one can use UI extensions as valid manipulation of nonemployment durations. Third, we obtain IV estimates of the causal effect of nonemployment durations on wage offers. We find that for each additional month in nonemployment duration, average daily wages decline by a bit less than one percent. These results are robust to bounds implied by small effects of reservation wages consistent with our wage data. If one extrapolates linearly over the course of six months, this effect can explain about a third of the average wage loss of unemployed workers. The effect fades after people have been on a job for a few years and is statistically indistinguishable from zero after five years. The wage decline can arise from multiple sources, including skill depreciation, stigma effects, or changes in job characteristics, something we address in our empirical analysis.

The parameter we estimate is important for policy. Our findings can be used to assess with more confidence the potential cost of rising unenmployment durations for middle aged workers. Since we show that our IV estimate puts weight on all workers exiting nonemployment from one to 18 months, our results suggest that even shorter increases in nonemployment duration may be costly. Our estimates can be used to calibrate models in macroeconomics or in public finance in which the causal effect of nonemployment plays an important role. In public finance, a growing theoretical literature shows how the optimal structure of labor market policies depends on the degree of wage decline with nonemployment. For example, Pavoni and Violante (2007) show that this parameter plays a key role when multiple labor market policies are chosen jointly. In macroeconomics, Ljungqvist and Sargent (2008) show that skill depreciation in conjunction with generous UI benefits has led to rising unemployment rates in Europe in the 1980s. For the 2008 recession in the U.S., Katz et al. (forthcoming) argue that negative duration dependence may explain part of the lasting rise in long-term unemployment. In an extension of our main findings, we show that the effect of nonemployment durations on wages appears to be larger in recessionary environments. Hence, a negative causal effect of nonemployment duration on wage offers may indeed be a reason for this duration dependence.

Our paper is related to several strands of literature. Foremost, it presents both a framework for interpreting the effect of UI duration on wages, and for obtaining causal estimates of the effect of nonemployment durations on wage offers. The current literature has found mixed results regarding the effects on wages and other job outcomes. More recent studies by Lalive (2007), Card et al. (2007), and Centeno and Novo (2009) used regression discontinuity designs to more clearly identify the effects and find negative impacts on wages. While these results are relatively imprecisely estimated and hence not statistically significantly different from zero, confidence intervals contain possible negative and positive values that are economically meaningful.[3] Our regression discontinuity results contribute a new set of well-identified and precise estimates to this literature.

Given our results indicate that reservation wage effects are very small, we also provide estimates of the causal effect of nonemployment duration on wages. Existing estimates are

[3]Consistent with a negative effect of nonemployment durations, Black et al. (2003) find positive effects on reemployment and quarterly earnings of UI recipients who are randomly assigned to (but not necessarily participate in) more intensive job search services. Meyer (1995) reports imprecisely estimated positive effects on earnings for UI recipients who receive a bonus upon faster reemployment. Degen and Lalive (2013) find negative earnings effects from a reduction in potential UI benefit durations in Switzerland in a difference-in-difference design.

typically based on cross-sectional analyses of nonemployment durations and wages (e.g., Addison and Portugal 1989), or derived from structural models (e.g., Keane and Wolpin 1997).[4] While our ordinary-least squares estimates are of similar magnitude as in the existing literature, our IV estimates are about two-thirds to a half of the basic correlation, suggesting a potential role of negative selection in standard estimates. Our paper is also related to two recent papers using random assignment. Autor et al. (2015) uses random assignment of Social Security Disability Insurance (SSDI) benefit applicants to judges with different mean decision times to instrument for the effect of nonemployment duration on annual earnings. Our framework helps to clarify that the resulting causal estimate is a combination of labor supply and labor demand responses. While their population differs substantially from our sample of unemployed with high labor force attachment (e.g., Rothstein et al. (forthcoming)), their results also point so substantial earnings losses with nonemployment duration. In a recent paper, using an audit study Kroft et al. (2013) provided experimental evidence showing that there is a negative causal effect of nonemployment durations on call back rates for job interviews. By imposing additional structure, our paper is able to extend these findings by studying the effect of nonemployment on actual outcomes of the employment process, including wages and job characteristics, that are difficult to analyze in the context of an audit study.

Our findings also relate to a long literature examining the properties and effects of reservation wages based on survey data (e.g. DellaVigna and Paserman 2005, Krueger and Mueller 2011, 2014). In contrast, here we show that it is possible to infer about the effect of and changes in reservation wages directly when quasi-experimental variation of workers' outside option is available. As in other areas of economics, such a revealed-preference approach allows one to side step important measurement issues and hence provides an important complement to analyses of stated preferences. This is in a similar spirit as Hornstein et al. (2011), who infer about reservation wages using data on worker flows, and who find, consistent with our results, that in a broad range of search models unemployed workers' must place a low value on their outside option.[5] The best evidence on reported reservation wages comes from Krueger

[4]In an exception, Edin and Gustavsson (2008) document a significant negative effect of nonemployment spells on direct measures of skills in Sweden. Estimates of the earnings losses of displaced workers have also been used to infer the correlation of nonemployment duration and wages (Neal, 1995).

[5]Lalive et al. (2013) replicate our approach of analyzing reemployment wage paths for Austria and find similar results. In contrast, Nekoei and Weber (2013) find a larger spike in wages at UI exhaustion that induces a slight positive overall effect of UI extensions on wages. This may be related to the fact that the

and Mueller (2014), who find that while reservation wages appear to influence employment decisions among UI recipients in New Jersey, they are neither affected by unemployment duration nor by UI duration. Hence, as in our setting, changes in reservation wages are unlikely to be responsible for reductions in reemployment wages over the unemployment spell.

Our paper is also related to a recent literature concerned with the effects of UI on employment due to general equilibrium adjustments (e.g., Landais et al., 2015; Hagedorn et al., 2013; Marinescu, 2015). Our estimates are based on variation within labor markets, and hence obtain microeconomic elasticities. Macroeconomic elasticities that also take into account general equilibrium effects can only be directly identified using variation in policies on the level of the labor market (such as in Lalive et al. (2013) or Crépon et al. (2013)) . Yet, since our findings imply that the outside option does neither affect the wage setting process workers reservation wages neither through the bargaining process nor due to changes in reservation wages of workers, our results rule out two channels frequently emphasized in the macroeconomic literature. It might still be possible that equilibrium wages adjust due to the decrease in average search effort. If it takes longer to fill vacancies, firms may post fewer vacancies and post higher wages to attract workers to apply. This would affect workers on either side of our age discontinuity and would thus not be identified in our design. While this seems possible it is unclear whether the decrease in search effort noticeably affects vacancy fill rates, especially in recessions when firms likely have too many applicants anyways.

The paper proceeds by describing the institutional background and data, as well as our core regression discontinuity design. Section 3 then documents the direct effects of UI extensions on wages and other measures of job quality. In section 4 we then develop the conceptual framework to disentangle the reservation wage channel from the effect of nonemployment durations on wages and show how the latter can be either estimated using an IV strategy or bounded in case of a violation of the exclusion restriction. We then explore dynamic estimates of the effect of UI extensions on selection and wages throughout the nonemployment spell in section 5 and implement the IV / Bounding estimators of the effect of nonemployment durations on wages. Section 6 concludes.

UI extensions studied by Nekoei and Weber occur much earlier in the spell where individuals may be more responsive.

2 Institutions, Data and Empirical Methods

2.1 Institutional Background

After working for at least 12 months in the previous three years, workers losing a job through no fault of their own in Germany are eligible for UI benefits that provide a fixed replacement rate of 63 percent for an individual without children.[6] This paper focuses on the time period between 1987 and 1999, which is the longest period for which the UI system was stable, and during which the maximum duration of benefits was tied to the exact age of the start of benefit receipt and to prior labor force history. Between July 1987 and March 1999, the maximum potential UI duration for workers who were younger than 42 years old was 12 months.[7] For workers age 42 to 43 maximum potential UI duration increased to 18 months and for workers age 44 to 48, the maximum duration further rose to 22 months. Workers with lower prior labor force attachment also experienced increases in potential UI durations at the 42 and 44 age cutoffs, albeit smaller. Our main identification strategy is to use the variation in potential UI durations at the age thresholds to analyze the effect of UI extensions on wages and the reemployment wage path.[8]

Collective bargaining between employers and labor unions has traditionally played an important role in the wage setting process in Germany, leading to substantial wage compression. However, these institutions have become weaker over time with a substantial decline in collective bargaining (Dustmann et al. (2014)). Together with various labor market reforms in the 1990s and early 2000s (such as the Hartz reforms) wage setting has became significantly more decentralized. In fact the recent literature has documented a large amount of wage dispersion and an evolution of inequality comparable to the US (e.g. Dustmann et al. (2009), Card et al. (2013)). For our analysis this suggests that at least a priori UI benefits could affect post-nonemployment wages through a variety of channels, such as wage changes due to

[6]For individuals with children the replacement rate is 68 percent. There is a cap on earnings insured, but it affects only a small number of recipients. Since they are derived based on net earnings, in Germany UI benefits are not taxed themselves, but can push total income into a higher income tax bracket.

[7]For a description of other cutoffs present in the system and recent reforms, see Schmieder et al. (2012a).

[8]In Germany individuals who exhaust regular UI benefits are eligible for means tested unemployment assistance benefits (UA), which do not have a limited duration. The nominal replacement rate is 53%, but UA payments are reduced substantially by spousal earnings and other sources of income, which may explain why only about 50% of UI exhaustees take up UA benefits. See Schmieder et al. (2012a) for more details on the role of UA.

changes in the individual bargaining situation or movements across different types (qualities) of employers, for example due to reservation wage changes. During the period we study, the incidence of long nonemployment spells and effect of UI extensions on nonemployment duration in Germany (Schmieder et al., 2012a), as well as the the size and structure of wage losses of job losers (Schmieder et al., 2009) were similar to comparable estimates from the United States.

2.2 Data

We have obtained access to the universe of social security records in Germany from 1975 to 2008. The data covers day-to-day information on every instance of employment covered by social security and every receipt of UI benefits, as well as corresponding daily wage and benefit levels. We observe several demographic characteristics, namely gender, education, birth date, nationality, place of residence and work, as well as detailed job characteristics, such as occupation, industry, and characteristics of the employer.[9]

For our analysis sample, we extracted all unemployment insurance spells where the claimant was between age 40 and age 46 on the claim date. We consider nonemployment spells starting any time between July 1987 and April 1999. For each UI spell we created variables about the previous work history (such as job tenure, labor market experience, wage, industry and occupation at the previous job), the duration of UI benefit receipt in days, the UI benefit level, and information about the next job held after non-employment.

Since we do not directly observe whether individuals are unemployed we follow the previous literature and, in addition to duration of UI benefit receipt, we use length of nonemployment as a measure for nonnemployment durations. The duration of nonemployment is measured as the time between the start of receiving UI benefits and the date of the next registered period of employment. Our analysis period ensures that we can follow individuals for at least 9 years after the start of the UI spell.

We calculate each individual's potential UI duration at the beginning of the UI spell,

[9] Individual workers can be followed using a unique person identifier. Since about 80 percent of all jobs are covered by the social security system (the main exceptions are self-employed, students, and government employees) this situation results in nearly complete work histories for most individuals. Each employment record also has a unique establishment identifier that can be used to merge establishment characteristics to individual observations.

using information about the law together with information on exact birth dates and work histories. This method yields exact measures for workers who have been employed for a long continuous time and hence are eligible for the maximum potential benefit durations for their age groups. However, the calculation is not as clear cut for workers with intermittent periods of nonemployment because of complex carry-forward provisions in the law. We thus define our core analysis sample to be all nonemployment spells of workers who have been employed for at least 36 months (44 months at the age 44 cutoff) of the last seven years and who did not receive UI benefits during that time period.[10] In addition, in our sensitivity analysis we also consider results when we use all workers affected by the two age cutoffs, irrespective of prior labor force history. While for these we cannot obtain the marginal effect of an additional month of UI extension, we can obtain consistent IV estimates of the effect of nonemployment duration under the same conditions as in our main sample.

2.3 Estimation

The institutional structure and data allow us to estimate the causal effect of large extensions in UI benefit durations on non-employment duration, reemployment wages and other outcomes for workers with previously stable employment using a regression discontinuity design. We first show non-parametric figures to visually examine discontinuities at the eligibility thresholds. To obtain estimates for the main causal effects, we follow standard regression discontinuity methodology and estimate variants of the following regression model:

$$y_i = \beta + \gamma \times \Delta P \times D_{a_i \geq a^*} + f(a_i) + \epsilon_i, \tag{1}$$

where y_i is an outcome variable, such as non-employment duration (D) or reemployment wages (w), of an individual i of age a_i. $D_{a_i \geq a^*}$ is a dummy variable that indicates that an individual is above the age threshold a^*. These estimates are discrete analogues of the marginal effect of potential UI durations P on non-employment durations and expected wages or $\frac{dD}{dP}$ and $\frac{dE[w]}{dP}$.

For our main estimates, we focus on the period from July 1987 - March 1999 and use the sharp threshold at age 42. We estimate equation (1) locally around the two cutoffs and

[10] Individuals who have quit their jobs voluntarily are subject to a 12 weeks waiting period. To focus on individuals who lost their job involuntarily and minimize selection concerns due to quitting we restrict our sample to individuals who claimed UI benefits within 12 weeks after their job ended.

specify $f(a_i)$ as a linear function while allowing different slopes on both sides of the cutoff. We use a relatively small bandwidth of two years on each side of the cutoff. In order to obtain additional power we also estimate a pooled regression model, where we take the estimation samples for the age 42 and the age 44 cutoffs together.[11] For this procedure we normalize the age for all individuals within two years of the age 42 (44) threshold to the age relative to age 42 (44) (i.e. the rescaled age variable is set to 0 for someone who is exactly age 42 (44) at the time of claiming UI). We estimate the following model on the pooled sample: $y_i = \beta + \gamma \times \overline{\Delta P} \times D_{a_i \geq a^*} + f(a_i) + \epsilon_i$, where a_i is the normalized age variable and $\overline{\Delta P}$ is the average change in potential UI durations at the age threshold. With this specification $\hat{\gamma}$ is a direct estimate of the rescaled marginal effect, forcing it to be equal at the two cutoffs. We always present regression discontinuity robust standard errors based on Calonico et al. (2014).[12]

2.4 Validity of RD Design

The regression discontinuity method only yields consistent results if factors other than the treatment variable vary continuously at the threshold. In our setting, both UI claimants and their employers face potential incentives to manipulate the age of claiming. We have examined this issue at length in our related paper (Schmieder et al., 2012a), and conclude that sorting around the threshold is not a concern in this case. We only summarize the main findings here and refer the interested reader to our precursor paper for a more detailed discussion of manipulation, including potential reasons for its absence.

A standard test for sorting around the threshold is to investigate whether the density of observations shifts near the threshold. Figure 1 (a) shows the number of nonemployment spells in two-week age intervals around the cutoff. There is a small shift in observations from two weeks before to two weeks after the age cutoffs, that affects only about 200 individuals relative to about 500,000 observations in the sample close to the age cutoff. Further investigation showed that this increase is not driven by individuals who postpone their claim,

[11] We also estimated all results at the age 44 cutoff separately. The point estimates are very similar but lack precision.

[12] Optimal bandwidth computations (as in Imbens and Kalyanaraman, 2012; Calonico et al., 2014) are computationally quite demanding due to the large number of observations, especially when we calculate dynamic effects. We therefore keep the bandwidth at 2 years, but report optimal bandwidth estimates for the main results in our robustness analysis summarized in the Web Appendix.

but that, if at all, the incidence of separations rises slightly at the eligibility age. To investigate the nature of sorting further we assessed whether predetermined characteristics vary discontinuously at the threshold. Figure 1 (b) shows the pre-unemployment log wage in 2 month bins around the thresholds and shows no discernible discontinuity. We investigated many other baseline characteristics and found that only the fraction of UI recipients who are female is estimated to increase statistically significantly by about 0.8 percentage points. All other variables show essentially no (economically or statistically) meaningful difference at the threshold. In smaller datasets, such minor discontinuities and density shifts would almost certainly not be detectable.[13] While these findings point to a minor violation of the RD identification assumptions, these should have a relatively small impact on the overall results. In fact, neither trimming observations close to the eligibility thresholds nor directly controlling for observable characteristics affects our results. To ensure that our results are not affected by sorting around the threshold and by particular implementation choices of the RD estimator, we performed multiple robustness checks that are summarized in the Web Appendix.

3 The Average Effect of UI Extensions

3.1 The Effects of UI Extensions on Nonemployment Durations

We begin by replicating the findings on the effect of UI extensions on UI duration and nonemployment duration from Schmieder et al. (2012a), where we documented that increases in potential UI durations substantially change behavior of unemployed individuals. Figure 2 (a) shows average months spent on UI benefits by two-months age windows, implying that increases in potential UI durations at the two age thresholds lead to substantial increases in UI durations. This effect is partly mechanical, since individuals who would have exhausted their benefits at 12 months or 18 months are now covered for up to 6 more months, and partly behavioral, since individuals may reduce their search effort and thus stay unemployed longer. The behavioral effect of an increase in potential UI durations is demonstrated in Figure 2 (b), which shows the effect on nonemployment durations.

In Table 1, columns (1) and (2) confirm the visual impression. The effects on actual UI

[13] There is a tiny difference in the years of education variable at the first threshold of about 0.03 years (or 10 days) of education.

duration and nonemployment duration are very precisely estimated. The table also shows the marginal effect of an increase in potential UI durations by 1 month, i.e. the estimated RD coefficient rescaled by the increase in potential UI durations. For one additional month of potential UI benefits unemployed individuals receive about 0.3 months of additional benefits and remain unemployed for about 0.15 months longer. These marginal effects are similar to findings from previous research including Meyer (1990), Card et al. (2007) or Lalive (2007), although much more precisely estimated.

Finally, as further discussed in Schmieder et al. (2012b), column (3) of Table 1 shows that the probability of ever again working in a social security liable job decreases by about 0.16 percentage points per additional month of UI at the age 42 threshold, only about 1% relative to the mean. In our robustness analysis, we assessed whether this could lead to a bias from sample selection in our main wage estimates.

3.2 The Effect of UI Extensions on Reemployment Wages

Longer nonemployment durations in response to higher potential UI durations could either raise wages as individuals have more time to search for a better job, or lower wages if the negative effect from longer nonemployment durations dominates. Figure 3 (a) shows the effect on the log wage at the first job after the period of nonemployment. There is a small decline by about 0.01 log points in the post-unemployment wage at the age 42 threshold. At the age 44 threshold, the lines (fitted quadratic polynomials) also seem to indicate a small drop in the post-unemployment wage. Figure 3 (b) shows the difference between the pre-unemployment log wage and the post-unemployment log wage. This difference essentially removes an individual fixed effect and hence can be viewed as a way to both control for possible selection into employment and to obtain more precise estimates by controlling for predetermined characteristics. The figure shows that the average wage loss for the unemployed in our sample is substantial, ranging from 13% to 16%. While the gain in precision is modest, Figure 3 (b) indicates that selection along the previous wage has little impact on the results, and again clearly points to a negative effect of a rise in potential UI durations on post-unemployment wages.

The corresponding regression estimates in Table 1 columns (4) and (5) show that increases in potential UI durations lead to precisely estimated negative effects on post-unemployment wages. Panel A shows that the post-unemployment wage is about 0.8 percent lower in both levels and first differences when potential UI durations increase by six months. Panel B shows the results from pooling both cutoffs and reveals similar estimates with a small gain in statistical precision. The estimate from the pooled model implies that an increase in potential UI durations by one month decreases post-unemployment wages by about 0.1 percent. As a check that selection around the age discontinuity does not drive our results, Column (6) of Table 1 shows how the wage estimates change when we control for a rich set of observables, including year, state, and industry fixed effects, as well as human capital and experience measures. For the age 42 cutoff, the effects on the post-unemployment wage are almost identical to the estimates using the log wage difference. For the pooled specification we find a slightly smaller point estimate, where an additional month of UI reduces wages by about 0.09 percent, but still clearly implying negative match effects from UI extensions.

Although the effect on the initial wage obtained after reemployment shown in Table 1 is small, the losses can add up to more substantial effects if individuals remain in lower paying jobs for a long period of time. Table 2 shows the effect on the log wage one, three, and five years after the start of the new employment spell. The estimates decline from one to five years since the start of employment, consistent with the result in column 1 of Table 2 that there is a small positive (yet insignificant) effect of potential UI durations on wage growth. Yet, although the longer-term effects are not estimated precisely, the point estimates after 5 years are suggestive of potentially substantial cumulated wage losses.

Other papers that have estimated the wage effect of increases in potential UI durations have found similar point estimates, although generally with less precision than we do. For example Card et al. (2007) found a negative point estimate of UI durations on wages, quite comparable when rescaled to a marginal effect. Similarly, van Ours and Vodopivec (2008) and Centeno and Novo (2009) find negative effects of similar magnitude of UI extensions. In contrast to the prior literature, the fact that we have significantly more power and thus precision allows us to reject that the effect is positive. As we show below even such a relatively small effect can imply substantial negative effects of nonemployment durations on wages.

3.3 The Effect of UI Extensions on Other Job Outcomes

In Table 2 we show that individuals do not simply accept lower wages in return for other desirable job characteristics – i.e., jobs tend to be worse among all the dimensions we can measure here. The first outcome is the completed job tenure at the post-unemployment job, which is often used as an indicator of the quality of the job match. Column (1) of Panel B shows that for each month of additional UI duration there is a small decrease in the duration of the post-unemployment job of about 0.0081 years in Panel A, which is a decline of about 0.2% relative to mean post-unemployment job tenure (it is statistically significant at a 10% when pooling both thresholds). This confirms findings in Table 1 that higher potential UI durations reduce job stability even beyond the initial spell. Hence, it does not appear individuals with longer UI durations trade lower wages for more stable jobs or jobs that appear to represent better matches.

We analyzed several additional indicators of job quality. Longer potential UI durations decrease the probability of finding a full time job, but although precisely estimated the effect is small. For 6 months of additional UI duration, it is less than 1% relative to the mean of 89% (column (2) of Panel B).[14] An important finding of the literature on displaced workers is that those switching to another industry or occupation experience much larger declines in earnings (e.g. Neal, 1995; Addison and Portugal, 1989). Hence, one would expect that longer UI durations may help individuals to find jobs in their previous line of work. Columns (3) and (4) of Panel B of Table 2 show that this is not the case. Longer potential UI durations increase the probability of switching to a different industry and a different occupation by about 0.12 to 0.18 percentage points, respectively.

Overall, At least based on this limited set of job characteristics, it does not appear that workers with longer UI durations accept lower wages in return to better job outcomes along other dimensions. The analysis of other job outcomes also provides insights into the potential channels underlying the reduction in wages and the role of nonemployment durations, which we further discuss below.

[14]We also analyzed changes in firm size as proxy for employer quality, as well as the probability of a rise in commuting, and found no significant change.

4 A Framework for Estimating the Effect of Nonemployment Duration on Wages

To show how results from UI extensions can be used to infer about the effect of nonemployment durations on wages and the importance of reservation wage responses, we develop a discrete time, non-stationary search model (similar to van den Berg 1990, but in discrete time). We derive our main findings in three steps: We begin by showing how the effect of UI extensions on reemployment wages can be decomposed into changes in reservation wages and changes in the wage offer distribution over the nonemployment spell. This clarifies how in the presence of reservation wage responses the effect of UI duration on wages cannot be used to infer about the effect of nonemployment durations on wage offers. Conversely, the potential presence of skill depreciation implies that the wage response to UI does not represent the true change in wage costs to employers from a rise in reservation wages. To make inferences about these separate channels, we then use the model to show how the effect of UI extensions on the reemployment wage *path* (i.e., reemployment wages conditional on the time of exiting nonemployment) can be used to infer about the response of reservation wages to UI extensions. Finally, we show that if the reemployment wage path is unaffected, it is possible to identify the average change in the wage offer distribution over the nonemployment spell – and hence the causal effect of nonemployment durations on wages – using UI extensions as a source of exogenous variation.

A key empirical implication of these results is that if workers value the outside option (in our case UI benefits), the response of reemployment wages at each nonemployment duration provides a test for the importance of the outside option. This has two important implications. If the path of reemployment wages is not affected by a change in the outside option, then the decline in wages through the nonemployment spell cannot be due to a labor supply response, but must be due to declining wage offers. Our analysis of reemployment wage paths can also be used to construct bounds on the importance of reservation wage effects on accepted wages.

The main results do not depend on the particular model of wage setting. While we illustrate this insight in a model of wage posting, a symmetric intuition applies in wage bargaining models and models of directed search, in which wages are affected by the choice in which segment of the labor market to search in. If the wage conditional on nonemployment duration does not respond to UI benefit changes, then the bargained wage or the choice of which segment to search in, respectively, is not responding to changes in the outside option and the outside option cannot explain the decline in wages over the nonemployment spell.

4.1 Setup of Model

Workers become unemployed in period $t = 0$, are risk neutral and maximize the present discounted value of income. In each period workers receive UI benefits b_t and choose search intensity λ_t, which is normalized to be equal to the probability of receiving a job offer in that period. Without loss of generality we focus on the case of a two-tiered UI system, where UI benefits are at a constant level b up to the maximum potential duration of receiving UI benefits P. After benefit exhaustion, individuals receive a second tier of payments indefinitely, so that $b_t = b$ for all $t \leq P$ and $b_t = \underline{b}$ for all $t > P$. The cost of job search $\psi(\lambda_t)$ is an increasing, convex and twice differentiable function.

Jobs offer a wage w_t^* and wage offers are drawn from a distribution with cumulative distribution function $F(w^*; \mu_t)$, which may vary with the duration of nonemployment t, for example due to skill depreciation or stigma. To simplify the exposition we assume that the distribution can be summarized by its mean in period t: μ_t.[15] In this case we can write $w_t^* = \mu_t + u_t$, where $E[u_t|t] = 0$ such that u_t reflect random draws from the wage offer distribution. If a job is accepted, the worker starts working at the beginning of the next period and stays at that job forever. Optimal search behavior of the worker is described by a search effort path λ_t and a reservation wage path ϕ_t, so that all wage offers $w_t^* \geq \phi_t$ are accepted. In the appendix we provide details on the value functions, the first order conditions, as well as the derivations for the following results.

4.2 The Causal Effect of Nonemployment Durations on Wages

Since nonemployment duration is a choice variable in the model, it is useful to explicitly define what we mean by its causal effect. Given our set up, the expected wage of an individual exiting nonemployment in month t is $w^e(t; P) = \frac{\int_{\phi_t}^{\infty} w^* dF(w^*; \mu_t)}{1 - F(\phi_t)}$, which given the above assumptions can be written as: $w^e(\phi_t, \mu_t) \equiv w^e(t; P) = \mu_t + E[u_t | u_t \geq \phi_t(P) - \mu_t]$. Note that the change in $w^e(t; P)$ over time can be either due to changes in ϕ_t or due to changes in μ_t. Using this notation, we define the **slope of the reemployment wage path** as the total (right)

[15] This is easily generalizable to more flexible distribution functions characterized by a vector of parameters $\boldsymbol{\mu_t}$.

derivative of the reemployment wage with respect to nonemployment duration:[16]

$$\frac{dw^e(t;P)}{dt} = \frac{\partial w^e(\phi_t, \mu_t)}{\partial \phi_t}\frac{\partial \phi_t}{\partial t} + \frac{\partial w^e(\phi_t, \mu_t)}{\partial \mu_t}\frac{\partial \mu_t}{\partial t} \tag{2}$$

Based on this we can provide a precise definition of the **causal effect of nonemployment duration on wages** as the part of the slope of the reemployment wage path that is due to changes in the wage offer distribution over time:

$$\frac{\partial w^e(\phi_t, \mu_t)}{\partial \mu_t}\frac{\partial \mu_t}{\partial t} \tag{3}$$

The causal effect of nonemployment duration on wages is thus the change in expected reemployment wages that would result from exogenously increasing nonemployment duration by one month while holding the reservation wage constant over time. Note that if the reservation wage is not binding at t, i.e., $F(\phi_t) = 0$, then $w^e(\phi_t, \mu_t) = \mu_t$ and $\frac{\partial w^e(\phi_t,\mu_t)}{\partial \mu_t}\frac{\partial \mu_t}{\partial t} = \frac{\partial \mu_t}{\partial t}$, that is the causal effect of nonemployment duration on the reemployment wage is simply the **change in mean offered wages over time**. We will argue below that this seems plausible in the light of our empirical results. Therefore, for simplicity, we will alternatively refer to $\frac{\partial w^e(\phi_t,\mu_t)}{\partial \mu_t}\frac{\partial \mu_t}{\partial t}$ in (3) as the causal effect of nonemployment durations on wages or as the change in the wage offer distribution in the rest of the paper.

Regressing w on nonemployment durations t using OLS will not recover the parameters in (2) or (3) for two reasons: First, since the duration of nonemployment t itself is determined by the search intensity and reservation wage of an individual, both t and w are affected by individual characteristics (such as human capital) and the correlation between the error term of the wage equation and t leads to the standard omitted variable bias in the estimate of the slope of the reemployment wage path $\frac{dw^e(t;P)}{dt}$. Second, even if we could fully condition on individual heterogeneity, due to changes in reservation wages over the spell we would obtain an estimate of (2) but not of the causal effect of nonemployment duration on wages as defined

[16]Our model is a discrete model in time, but for the following the notation will be simpler if we can work with time derivatives. In the model only the values of ϕ_t, μ_t and $w^e(t, P)$ at discrete values of time $\{0, 1, 2, ...\}$ are necessary to describe the relevant environment for an individual and the optimal search strategy. Without loss of generality we can therefore define the values of ϕ_t, μ_t and $w^e(t, P)$ for the time values between these discrete values such that they are linear between the discrete points. For example for $0 < t < 1$ let $w^e(t, P)$ be defined as: $w(0) + [w(1) - w(0)]t$. This means that ϕ_t, μ_t and $w^e(t, P)$ are piecewise linear, with kinks at the integer values. All time derivatives below are right derivatives so that by construction we have that: $\frac{df(t)}{dt} = f(t+1) - f(t)$,where $f(t)$ is any function $\phi_t, \mu_t, w^e(t, P)$.

in (3).

4.3 The Effect of Increasing Potential UI Durations on Wages

To simplify the exposition we will first analyze the model under the additional assumption that workers are homogeneous and that the expected reemployment wage is a linear function of nonemployment duration: $w^e(t;P) = \xi + \frac{dw^e(t;P)}{dt}\,t$, where we assume that $\frac{dw^e(t;P)}{dt}$ is a constant. Below we will show that our result generalizes to the nonlinear case with heterogenous workers.

The expected reemployment wage of an individual at the start of the nonemployment spell can be calculated by summing the reemployment wage conditional on exiting nonemployment at t over the distribution of nonemployment durations. In particular, if $g(t)$ is the probability mass function of the nonemployment distribution, we have that $E[w^e(t;P)] = \sum_0^\infty w^e(t;P)\,g(t)$. An extension in potential UI durations P affects the expected reemployment wage through two components:

$$\frac{dE[w^e(t;P)]}{dP} \quad = \quad \sum_{t=0}^{\infty}\left[\frac{\partial w^e(t,P)}{\partial P}g(t)\right] + \sum_{0}^{\infty}\left[w^e(t,P)\,\frac{\partial g(t)}{\partial P}\right] \tag{4}$$

The first term $E\left[\frac{\partial w^e(t,P)}{\partial P}\right] = \sum_{t=0}^{\infty}\left[\frac{\partial w^e(t,P)}{\partial P}g(t)\right]$ represents the average (weighted by the distribution of nonemployment durations) *shift* in the reemployment wage path that is caused by the benefit extension. The second term is due to the shift in the distribution of nonemployment durations *along* the reemployment wage path. Note that the expected nonemployment duration is $D = \sum_{t=0}^{\infty}[t\,g(t)]$ and the effect of extending UI benefits is: $\frac{dD}{dP} = \sum_{t=0}^{\infty}\left[t\,\frac{dg(t)}{dP}\right]$. Given our assumption of linearity for $w^e(t;P)$, Equation (4) can then be written as:

$$\frac{dE[w^e(t;P)]}{dP} = E\left[\frac{\partial w^e(t,P)}{\partial P}\right] + \frac{dw^e(t;P)}{dt}\;\frac{dD}{dP} \tag{5}$$

where $\frac{dD}{dP}$ is the marginal effect of an increase in P on the expected non-employment duration D. This formula holds independently from our model and shows how in general the reemployment wage effect can be decomposed into shifts of the reemployment wage path and movement along the reemployment wage path due to increases in nonemployment durations.

While the decomposition in equation (5) is mechanical, results from the search model provide insights into *how* changes in the outside option (in this case UI durations) affect wages. Combining equations (5) and (2) it follows that the reemployment wage effect can then be written as a combination of the reservation wage effect and the change in the wage offer distribution over time:

$$\frac{dE[w^e(t;P)]}{dP} = E\left[\frac{\partial w^e(\phi_t,\mu_t)}{\partial \phi_t}\frac{\partial \phi_t}{\partial P}\right] + \left[\frac{\partial w^e(\phi_t,\mu_t)}{\partial \phi_t}\frac{\partial \phi_t}{\partial t} + \frac{\partial w^e(\phi_t,\mu_t)}{\partial \mu_t}\frac{\partial \mu_t}{\partial t}\right]\frac{dD}{dP} \tag{6}$$

where $E[.]$ again takes the expectation over nonemployment durations. The reservation wage response affects the reemployment wage in two ways: through a shift in the reservation wage and through movements along the reservation wage path. A key implication of equation (6) is that in order to identify the causal effect of nonemployment duration on wages $\left(\frac{\partial w^e(\phi_t,\mu_t)}{\partial \mu_t}\frac{\partial \mu_t}{\partial t}\right)$ it is necessary to isolate it from these two reservation wage effects. Direct estimates of the effect of UI extensions (or other changes in the outside options) capture all three components.

A final point of equation (6) is that the sign of the effect of extending UI benefits on the reemployment wage is ambiguous, reflecting the contrasting hypotheses about the effect of UI mentioned in the introduction: The first component – due to an upward shift in the reservation wage – will tend to increase the reemployment wage. The second component – longer nonemployment durations leading to more job offers drawn from a different wage offer distribution with lower reservation wages – will tend to decrease the reemployment wage.

4.4 Estimating the Causal Effect of Nonemployment Durations on Wages

The search model has clear implications as to how reservation wages change with UI durations and over the nonemployment spell. Hence, to obtain an estimate of the effect of nonemployment durations on the wage offer distribution, we need to infer about the effect of reservation wages on reemployment wages conditional on exiting at time t, $\frac{\partial w^e(\phi_t,\mu_t)}{\partial \phi_t}$. If $\frac{\partial w^e(\phi_t,\mu_t)}{\partial \phi_t} = 0$, i.e., if reservation wages do not bind, then we can estimate the causal effect of nonemployment duration on wages directly from equation (6).

To learn about $\frac{\partial w^e(\phi_t,\mu_t)}{\partial \phi_t}$ we can exploit the fact that in a search model the response of the reemployment wage at any nonemployment duration to increases in UI duration (i.e., shifts in the reemployment wage path) directly dependes on shifts in the reservation wage:

$$\frac{\partial w^e(t,P)}{\partial P} = \frac{\partial w^e(\phi_t,\mu_t)}{\partial \phi_t}\frac{\partial \phi_t}{\partial P} = \frac{\partial w^e(\phi_t,\mu_t)}{\partial \phi_t}\frac{dV_t^u}{dP}\rho \tag{7}$$

Rearranging this, one can see that the response in the path of reemployment wages to UI extensions can be used to infer about the effect of reservation wages on accepted wages: $\frac{\partial w^e(\phi_t,\mu_t)}{\partial \phi_t} = \frac{\partial w^e(t,P)}{\partial P} / \left(\frac{dV_t^u}{dP}\rho\right)$.[17] This holds as long as $\frac{dV_t^u}{dP}$ is not equal to 0, i.e. as long as the UI extension does in fact affect the value of the outside option. Yet, the valuation of the outside option is a key determinant of the hazard rate of exiting nonemployment $\frac{dh_t}{dP}$.[18] This leads to a straightforward test for whether or not reservation wages affect reemployment wages. If the exit hazard is changing ($\frac{dh_t}{dP} < 0$) and there is no effect of UI durations on reemployment wages ($\frac{\partial w^e(t,P)}{\partial P} = 0$), then changes in the reservation wage do not affect reemployment wages.

Note that if reservation wages do not affect reemployment wages, then an increase in UI durations affects wages only through a rise in nonemployment durations and a corresponding decline in wage offers (the third term in equation 6). In this case, UI extensions satisfy all conditions of a valid instrumental variable. From equation (6), the *causal effect of nonemployment durations on wages* is simply the ratio between the effect of UI extensions on the average wage and the effect of UI extensions on nonemployment durations, which is the formula of the standard IV estimator. In other words, if the conditions on the reemployment hazard and the path of reemployment wages hold, then the change in the wage offer distribution can be estimated by regressing wages on nonemployment durations using UI extensions as an instrument.

Note that the result that the reemployment wage path does not shift in response to UI extensions does not necessarily imply that the reservation wage is not binding for the entire wage distribution. In the Web Appendix we show that all that is required for our empirical strategy to hold is that for small changes reservation wages have no effect *locally* in the distribution. This can be the case if for example the wage offer distribution is bimodal, with a mode for very low wage jobs, and a mode for higher wage jobs, with little density in between. If the reservation wage lies in between two modes – as is likely to be realistic in our empirical

[17]Note that we have implicitly assumed that there is no direct effect of UI extensions on the wage offer distribution itself, i.e., $\frac{\partial \mu_t}{\partial P} = 0$. This would fail for example if firms set wages taking a worker's outside option into account, in which case $\frac{\partial \mu_t}{\partial P} > 0$. However as long as wage offers respond weakly positive to the value of the outside option $\frac{\partial \mu_t}{\partial P} \geq 0$ our approach is robust: $\frac{\partial w^e(t,P)}{\partial P} = \frac{\partial w^e(t,P)}{\partial \phi_t}\frac{dV_t^u}{dP}\rho + \frac{\partial w^e(t,P)}{\partial \mu_t}\frac{\partial \mu_t}{\partial P}$. Since both terms on the right hand side are weakly positive, if $\frac{\partial w^e(t,P)}{\partial P} = 0$ and $\frac{dV_t^u}{dP} > 0$ this implies that both $\frac{\partial \mu_t}{\partial P} = 0$ and $\frac{\partial w^e(t;P)}{\partial \phi_t} = 0$.

[18]$\frac{dh_t}{dP} = -\frac{dV_{t+1}^u}{dP}\left[\frac{(1-F_t(\phi_t))^2}{(1+\rho)\psi''(\lambda_t)} + \rho\lambda_t f(\phi_t)\right]$, where the part in the brackets is positive.

application of middle aged workers with high labor force attachment – then reservation wages are binding, but small changes therein will not affect the mean of accepted wages.

4.5 Heterogeneity and Nonlinearity

The results generalize to the case of heterogeneous workers and nonlinear changes in reemployment wage path. Allowing for heterogeneity in our context is important since it makes it clear that our estimates of the effect of UI extensions on the path of reemployment wages may be affected by dynamic selection. As we further discuss in Section 5.2, selection may entail either higher or lower ability individuals searching longer or responding more strongly to UI incentives.

Heterogeneity is also important because in its presence our IV estimates will be a weighted average of the individual-specific treatment effects. Moreover, since skill depreciation is not necessarily linear throughout the nonemployment spell, the IV estimates will also be an average over different parts of the potentially nonlinear skill depreciation schedule. To be able to interpret the IV estimate, we derive an expression for the IV estimator and its weighting function.

Let subscripts i denote heterogeneity in terms of the model parameters (such as the cost of job search, the wage offer distribution, preferences, etc.). In the Web Appendix we show that in the presence of heterogeneity and nonlinearity, the effect of UI extensions on average reemployment wages shown in equation (5) can be generalized to:

$$\frac{dE[w_i^e(t_i,P)]}{dP} = E\left[\frac{\partial w_i^e(t,P)}{\partial P}\right] + \int_0^\infty E_i\left[\frac{\partial w_i^e(t)}{\partial t}\middle|\frac{\partial S_i(t)}{\partial P}>0\right]\frac{\frac{\partial S(t)}{\partial P}}{\frac{dD}{dP}}dt\,\frac{dD}{dP} \tag{8}$$

where $E_i[.]$ is the expectation taken over i, and $E[.]$ denotes the expectation taken over both i and t. Equation (8) shows that the basic intuition of equation (5) still holds even in the heterogeneous and nonlinear case. The average effect of extending UI benefits on wages can be decomposed into the shift of reemployment wages conditional on nonemployment durations, which depends on the shift in reservation wages, and movement along the reemployment wage path, which depends on the change in reservation wages and wage offers with nonemployment duration. The movement along the reemployment wage path can again be expressed as the product of the overall increase in nonemployent durations $\frac{dD}{dP}$ and what is now a weighted average of the individual slopes of the reemployment wage path $\frac{\partial w_i^e(t)}{\partial t}$. At each nonemployment duration t, the average is taken over the (possibly heterogeneous) slope of wages at that nonemployment duration of all individuals whose nonemployment durations are in fact responding to the UI extension. The average slopes at each month t then receive a weight proportional to the overall change in the survivor function in that month.

As in the linear, homogenous case, if the reemployment wage path is not affected by changes in potential UI durations, then we can infer that the reservation wage does not affect reemployment wages. Thus, the first term is equal to zero and the second term in equation (8) would reduce to a weighted average of causal effects of nonemployment duration on wages for different individuals at different durations, $\frac{\partial w_i^e(\phi_{it},\mu_{it})}{\partial \mu_{it}}\frac{\partial \mu_{it}}{\partial t}$. In this case, we can derive an IV estimator of the causal effect of nonemployment durations on wages. The following proposition states the exact interpretation of this IV estimator for the case that potential UI durations P take on discrete values (as it does in our empirical application):

Proposition 1. *Suppose the reservation wage is not binding for all individuals for whom the duration of nonemployment is responding to changes in UI durations. If potential UI durations P take on exactly two values (P, P'), then the IV estimand, defined as the ratio of the difference in average wage at two values of the durations instrument, to the difference in average durations at the same two values of the durations instrument,*

$$\beta^* = \frac{E[w_i(t,P')] - E[w_i(t,P)]}{D(P') - D(P)}$$

equals the following weighted average of the derivative of the wage function:

$$\beta^* = \int_0^\infty E\left[\frac{\partial w_i^e(\phi_{it},\mu_{it})}{\partial \mu_{it}}\frac{\partial \mu_{it}}{\partial t}\middle| t_i^e(P') > t > t_i^e(P)\right]\omega^*(t)dt$$

where the weights

$$\omega^*(t) = \frac{Pr(t < t_i^e(P')) - Pr(t < t_i^e(P))}{\int_0^\infty Pr(t < t_i^e(P')) - Pr(t < t_i^e(P))dt} = \frac{S(t;P') - S(t;P)}{D(P') - D(P)}$$

are nonnegative and integrate to one.

Proposition 1 states that the IV estimator from a regression of wages on nonemployment durations using UI extensions as an instrument has an interpretation of a local average treatment effect of nonemployment durations on wages. The weighting function $\omega^*(t)$ is proportional to the differences in survivor functions. The IV estimator puts more weight on those individuals whose nonemployment durations respond more strongly to the instrument (i.e., whose survival functions are shifting). This is akin to the standard result in linear models with heterogeneous parameters (Angrist et al., 1996), but is here derived for the general case in which wages may be a nonlinear function of nonemployment durations (Angrist et al., 2000). Hence, as in the more standard linear case, the weighting function can be estimated from the data.

4.6 Bounds if the Exclusion Restriction does not hold.

The interpretation of our IV estimates as causal effect of nonemployment duration on wages relies on the exclusion restriction restriction that $\frac{\partial w_i^e(t,P)}{\partial P}$ isapproximately zero at all durations. While we provide several pieces of evidence below that this seems to hold, it is difficult to establish this result with certainty. It is however straightforward to derive bounds for the effect of nonemployment durations on wage offers for the case that there are small shifts in the reemployment wage path, $\frac{\partial w_i^e(t,P)}{\partial P}$. In the Web Appendix, we show that for the homogeneous and linear case for small shifts $\delta \equiv E\left[\frac{\partial w_i^e(t,P)}{\partial P}\right]$ in the reemployment wage path the IV estimate obtains

$$\frac{\frac{dE[w^e(t;P)]}{dP}}{\frac{dD}{dP}} = \delta\frac{1}{\frac{dD}{dP}} + \delta\frac{\frac{dV_t^u}{dt}}{\frac{dV_t^u}{dP}} + \frac{\partial w^e(t;P)}{\partial \mu_t}\frac{\partial \mu_t}{\partial t}. \tag{9}$$

Comparing this expression to equation (6), it is clear that the first of the two additional terms measures the direct effect of reservation wages on the reemployment wage path (akin to a direct effect of an instrument on the outcome). The second term captures a bias that arises from the fact that if reservation wages matter, longer nonemployment durations also induce wage changes due to changes in reservation wages. Hence, the two terms combined capture the effect of UI extensions on wages through changes in reservation wages (the labor supply response), whereas the last term captures the effect of changes in the wage offer distribution.[19]

[19]The intuition of the various terms is hard to see from the final equation, but clear from the derivation in the Web Appendix, to which we defer the interested reader.

The fact that the two terms relating to reservation wages and the wage offer effect offset each other may explain why several papers find that the effect of UI duration on mean wages is close to zero. Below we use this formula to calculate bounds for the contribution of changes in the wage offer distribution using estimates of δ, dD/dP, and a range of values for the ratio of derivatives of the flow value of nonemployment. As we discuss next, if is difficult to directly estimate the effect of δ in the presence of dynamic selection. If less able individuals take longer to find jobs, we show our estimates obtain an upper bound of δ. Hence, the first two terms taken together in the expression constitute an upper bound of the effect of the reservation wage on accepted wages in response to UI durations. It is important to realize that under conservative assumptions on behavior, the sum of the two terms is *positive*. That is, the effect of nonemployment duration on wage offers is likely to be more negative than indicated by the IV esimator. In the Web Appendix we show that the main intuition generalizes to the case with non-linear human capital depreciation and heterogeneity for small effects of reservation wages on reemployment wages.

4.7 Empirical Implementation and Identifying Assumptions

The theory suggests a straightforward empirical strategy. A first step is to establish the premise that individuals value their outside option holds. We do so by confirming that hazard rates of exit from nonemployment change at all durations in response to an extension in UI benefits. We then assess whether the path of reemployment wages shift in response to UI extensions. To do so, we have to address the nature of selection, something we discuss at length in the next section. To interpret the absence of a mean shift in the reemployment wage path as indicating a no change in reservation wages and the instrumental variable estimates as only representing the causal effect of nonemployment duration on wages, the key identifying assumption is that conditional on observable characteristics there is no change in the distribution of unobserved characteristics over the nonemployment spell. Finally, we provide bounds of the effect of nonemployment duration on wages that account for small shifts in reservation wages. These bounds are valid even in the presence of selection, but require assuming that individuals with worse unobservable attributes have longer nonemployment spells.[20]

[20]See Section 5.1 and Section 5.6. As explained in Section 5.6, we also require that the contribution of UI exhaustion on nonstationarity in the value of nonemployment is not too small.

5 Bounding the Effect of Nonemployment Durations on Reemployment Wages

5.1 Estimating the Shift in the Path of Reemployment Wages and Hazards

The first step in obtaining estimates of the effect of nonemployment durations on wages and to assess the presence of shifts in reservation wages is to assess whether the reemployment hazards and the path of reemployment wages shift in response to the UI extensions. While estimating the shift is in principle straightforward, a central issue is the potential presence of selective exit throughout the nonemployment spells, which we will refer to as dynamic selection. It is commonly believed that less productive workers are more likely to have longer nonemployment durations. In addition, low skilled workers may be more credit constrained, and hence respond more strongly to UI extensions. Such a shift in the distribution of worker characteristics across the nonemployment spell would make it difficult to directly compare reemployment wages for workers with the same nonemployment duration, even though UI duration is randomly assigned.[21]

In the absence of selection, we could directly estimate the average shift in the reemployment wage path and test whether it is equal to zero. Let $\delta = E\left[\frac{\partial w_i^e(t,P)}{\partial P}\right]$ be the average shift in the reemployment wage path. To obtain an estimate of δ, one would estimate the following regression on the sample above and below the respective age cutoffs

$$w_i^* = \delta P_i + \sum_{t=1}^{T} \theta_t + f(a_i) + \epsilon_i \tag{10}$$

where w_i^* is the observed reemployment wage, θ_t are time dummies for the duration of nonemployment, and $f(a_i)$ is a polynomial in age. Yet, although $cov(P, \epsilon) = 0$ from the RD assumptions, the resulting estimate for δ from this regression is inconsistent because nonemployment durations may be correlated with unobserved productivity (i.e., $cov(t, \epsilon) \neq 0$). However, under the common assumption that $cov(t, \epsilon) \leq 0$, we show in the Web Appendix that the estimated OLS coefficient $\hat{\delta}$ is an *upper bound* for the true δ. The assumption that less able individuals tend to have longer nonemployment durations is supported by two findings. Our analysis of an unusually rich set of observable determinants of potential wages of individuals

[21]Note that a long literature has presented estimates of the effect of UI durations on reemployment hazards without specifically addressing this selection issue.

exiting at different durations confirms that there is a moderate amount of negative selection over the nonemployment spell.[22] Our contrast of the IV and OLS estimators of the effect of nonemployment on wages in Section 5 also supports the assumption that selection over the nonemployment spell is negative. We also find that the distribution of observable characteristics does not respond to UI extension, speaking against a strong role of dynamic selection in our case.

Obtaining an upper bound estimate of δ is sufficient for our purposes, because from the theory we know that the reservation wage has to rise or stay constant and hence that $\frac{\partial w^e(t,P)}{\partial P} \geq 0$ for all t. Since δ is a weighted average of the effect of UI extensions at all nonemployment durations (with positive weights), if $\delta \approx 0$ then it must be that $\frac{\partial w^e(t,P)}{\partial P} = 0$ at all nonemployment durations t. In other words, if we find that the estimated $\hat{\delta}$ is close to zero, given that $\hat{\delta}$ is an upper bound of the true δ, we can conclude that the entire reemployment wage path and hence reservation wages have not shifted. Below, we will also use the confidence interval for the estimate $\hat{\delta}$ in the derivation of our bounds for our causal estimates for small shifts in reservation wages.

5.2 Selection Throughout the Nonemployment Spell

To assess the potential for dynamic selection we begin with a descriptive analysis of the evolution of observable characteristics throughout the nonemployment spell. Figure 4 (a) to (e) shows how education, gender, experience, tenure, and pre-unemployment wages vary by time of exit and potential UI durations. Furthermore as an informative summary measure, panel (f) shows the mean of predicted reemployment wages, based on a broad range of predetermined characteristics by month of nonemployment duration.

Vertical bars indicate that the point estimates at time t are statistically significant at the 5 percent level. As expected, there is some correlation between pre-determined characteristics and nonemployment duration, but the gradient is not very strong. Except for schooling there thus appears to be a modest amount of negative selection throughout the nonemployment spell and the positive selection in terms of schooling is dominated by other characteristics.

[22] We can go significantly beyond the typical variables used in canonical human capital earnings functions (age, gender, education) and include prior job tenure, prior industry and occupational tenure, prior wages, as well as occupation and industry.

For example, mean pre-unemployment wages fall by about 5% and mean predicted wages fall by about 7% in the first year of nonemployment duration. In contrast, and more importantly for our analysis, in both of these figures the pre-unemployment wage paths and the predicted reemployment wage path are essentially unaffected by changes in potential UI durations. While there are a few statistically significant point estimates in each figure (and in the figures of single characteristics not shown here), given that each figure is created from 24 separate point estimates, it is expected that about one to two of the estimates are statistically significant on the 5 percent level purely because of sampling variation.[23] Overall, these figures therefore support the notion that the distribution of observable characteristics over the nonemployment spell is essentially uncorrelated with potential UI durations, suggesting that it is unlikely that potential UI durations exert a strong effect on the distribution of unobservable characteristics.

5.3 The Shift of Reemployment Hazards and Wages

Figure 5 shows estimates of the shift in the hazard rate at the age 42 discontinuity. We clearly see that the hazard rate shifts downward in response to increasing P for all nonemployment durations t smaller than the maximum potential UI duration P. This is statistically significant for nearly all point estimates, even in the first period ($t = 0$), so individuals are clearly forward looking and responding to the increase in P a long time before they are running out of benefits. Hence, these findings confirm the results of a long literature that individuals are forward looking and value future UI extensions.

Standard search theory predicts that in this case reservation wages shift outwards, leading to a rise in reemployment wages throughout the nonemployment spell. Figure 6 Panel (a) shows the effect of changes in P on the reemployment wage conditional on t. On average, wages decline by about 25 percent within the first year. However, we do not observe a change in the path of reemployment wages over the nonemployment spell in response to rising UI durations. In the notation of the model of Section 2, it appears that indeed $\frac{\partial w_i^e(t,P)}{\partial P} = 0$ for all nonemployment durations $t < P$. In the Web Appendix we show an almost unchanged

[23] The one exception appears to be the spikes at the exhaustion point for fraction female. Individuals who are exiting from nonemployment at the exhaustion points are significantly more likely to be female. This is consistent with larger labor supply effects of UI benefits for women. The fact that the spikes in fraction women cancel each other out, seems to indicate that some women are simply waiting until their benefits expire before going back to work. To address this aspect, we show in the Web Appendix that our results also hold within gender groups.

pattern when we control for individual heterogeneity by plotting the difference in post and pre-unemployment log wage.

The only statistically significant changes in the reemployment wages are at the exhaustion points for the two groups, when reemployment wages go down relative to the other group. It is noteworthy that the two downward spikes are of very similar magnitude and essentially cancel each other out. These differences are reduced when we look at women and men separately, indicating that the negative wage spikes are partly driven by more women exhausting UI benefits. Overall, extending UI benefits does not appear to shift the reemployment wage path upwards.

The evidence in Section 5.2 suggests it is unlikely that these findings are overturned by a change in the distribution of worker characteristics over the nonemplyoment spell. As outlined in Section 5.1, relying on our RD assumptions, we can estimate an upper bound of the mean shift in the reemployment wage path even in the presence of selection, as shown in Table 3. . Column (1) of Table 3 shows the results from implementing equation (10) controlling for a linear effect of nonemployment duration. This yields an estimate for δ for the 12 to 18 month discontinuity very close to zero (point estimate -0.0093% with a standard error of 0.075%). If we control more flexibly for the nonemployment duration effect (Column 2), the point estimate is even closer to 0. Given that the estimates in Table 3 are very close to zero, and that theory excludes cases for which $\frac{\partial w_i^e(t,P)}{\partial P} < 0$, this confirms the strong visual impression of Figure 6 that $\frac{\partial w_i^e(t,P)}{\partial P} = 0$ for all nonemployment durations $t < P$.

The results in the figure and table show that the value of the outside option, in this case the potential UI duration, does not affect reservation wages sufficiently to affect the mean reemployment wage. This implies that the effect of UI durations on wages found in Section 3 arises mainly due to a rise in nonemployment durations.

Our findings are consistent with related findings in the literature. For example, DellaVigna and Paserman (2005) calibrate a model similar to ours and find that very few wage offers fall below the reservation wage. Our results are also consistent with structural estimates in van den Berg (1990) who found that most job offers are indeed accepted and that unemployed workers do not seem to reject many jobs based on wages. Similarly, Hornstein et al. (2011) show that in broad classes of search models, the value of non market time – and hence the reservation wage – has to be low to be able to reconcile why despite high wage dispersion, and hence a high option value of searching, workers in practice accept jobs quickly. Following our approach, Lalive et al. (2013) also find that the path of reemployment wages does not respond to increases in UI durations in Austria.

In contrast, Krueger and Mueller (2014) find that jobs with wages above the self-reported reservation wage are more likely to be accepted, although a substantial fraction of jobs paying below the reservation wage are accepted as well. However, they also find that reservation wages neither change significantly throughout the nonemployment spell within individuals, nor do they respond to UI exhaustion. Hence, in our notation these results imply $\frac{\partial w_i^e(t,P)}{\partial \phi_{it}} > 0$ but $\frac{\partial \phi_{it}}{\partial P} = \frac{\partial \phi_{it}}{\partial t} = 0$. In this case the first two terms in equation (6) are still equal to zero and the IV estimator discussed below recovers the causal effect of nonemployment duration on wages.

5.4 Analysis of Wage Distribution

Another way to assess whether reservation wages bind is to analyze the response of reemployment wages at the bottom of the wage distribution, where reservation wages should matter most. Hence, we used our large sample sizes to analyze the effect of UI extensions on the full distribution of wages at each nonemployment duration. Note that the effect on the path of mean reemployment wages is the relevant measure for our statistical analysis, but the analysis of the distribution adds further plausibility to our findings. The percentiles of the wage distribution by nonemployment duration for those above and below the 12 month cut off point are shown in Figure 6 (b) (as before those RD estimates that are significant are shown with vertical bars). The figure shows how the wage distribution with nonemployment duration as it shifts downwards and fans out. Turning to the bottom of the distribution where the effect of reservation wages should be strongest, Figure 6 (b) indeed shows that there appears to be a significant rise in the lower quantiles of the wage distribution in response to UI extensions. However, the rise at the first cutoff and appears to be again offset by a decline at the second cutoff. As in case of mean wages in Figure 6 (a), this crossing of the reemployment wage path is likelyt to be explained by a selective shifting of individuals from one exhaustion point to the next. To directly assess this possibility, we applied the same procedure as outlined for the mean wage in Section 5.1 to the cumulative density function (CDF) of reemployment wages for all durations. Columns 3 to 5 of Table 3 show estimates of the mean shift of selected points of the CDF in response to UI extensions.[24] These estimates suggest that the effect of UI extensions on the CDF of wages for the entire sample is very close to zero. Recall that the effect on the entire CDF is a weighted average of the effect of the CDF at each nonemployment duration. Hence, since the theory suggests that reservation wages (and hence the CDF) should rise, the finding of a zero response implies that the effect of UI extensions on the CDF at each nonemployment duration must be zero. This provides direct evidence that the pattern in Figure 6 (b) are likely to be due to selection, and that the reservation wage effects are minor at the bottom of the distribution as well.

5.5 IV Estimates of the Causal Effect of Nonemployment Durations on Wages

Even with large extensions that clearly affect the hazard rate and a large administrative dataset Table 3 and Figure 6 (a) show the implied effect of changes in the reservation wage on the mean reemployment wage is a precisely estimated zero. Hence, reservation wages do not bind, and the observed decline in reemployment wages is entirely due to the decline in the wage offer distribution (equation 2), and the effect of UI durations on wages is only due to a rise in nonemployment durations (equation 6). Proposition 1 then allows us to obtain a valid estimate of the average slope of the reemployment wage path by using UI durations as instrumental variables for nonemployment durations: $\pi = \frac{\frac{dE[w]}{dP}}{\frac{dD}{dP}}$.

Note that the first stage and reduced form of this IV specification corresponds to columns (2) and (4) of Table 1.[25] Table 4 column (1) therefore directly shows the corresponding 2SLS results for the effect of nonemployment durations on reemployment wages using extensions in potential UI durations as an instrument. We find that $\pi = -0.80\%$, which is precisely estimated. Thus, an additional month of nonemployment reduces average reemployment wages of middle aged workers by about 0.8 percent.

Proposition 1 states that in the presence of heterogeneity and nonlinearity in the slope of the reemployment wage function, the IV estimator obtains the local average treatment effect of wage declines for compliers to the UI extensions that underlie our regression discontinuity (RD) estimates. Those compliers whose nonemployment durations are most affected by the

[24]These estimates use the identical specification as in equation (10) in Section 3.2 with using a dummy for being above the respective wage cutoff as a dependent variable. The CDFs at each nonemployment duration are shown in the Web Appendix, and contain similar results as the percentiles in Figure 6 (b).

[25]The first stage is very precisely estimated and thus easily passes weak instrument concerns.

instrument receive larger weights. As seen from the survival functions in Panel (b) of Figure 5 the compliers come from the entire range of nonemployment durations, with the largest weight being between 12 and 18 months. Hence, the IV estimator estimates an average of the effect of nonemployment duration on wages over a broad spell of nonemployment durations.

Column (2) of Table 4 shows the naive OLS estimator of regressing reemployment wages on nonemployment durations. The point estimate of -0.67% is actually somewhat lower than the IV estimate. As Figure 6 shows, the non-parametric relationship between wages and nonemployment durations is relatively steep initially but then flattens out (perhaps because there are limits to how far wages can fall). The OLS estimate will fit a linear relationship for all nonemployment durations, putting relatively large weights on individuals with very long durations.

To compare estimates based on similar durations, we reestimated the OLS estimator excluding individuals with spells longer than 18 months. The resulting estimate (Column 3) corresponds more closely to what is shown in Figure 6, and is approximately double the IV estimate.

Our point estimates imply a loss in daily wages of 4.8% (9.6%) for 6 (12) additional months of nonemployment duration. Based on Figure 6, this represents about a third of the average wage loss at 6 and 12 months, respectively. Thus, the causal effect of nonemployment explains a substantial fraction of the average wage loss at job loss. Since the effect we estimate here is likely due to multiple channels – including skill depreciation, discouragement, or stigma – it is not clear what magnitude to expect. While it is hard to compare our estimate with previous findings based on non-experimental estimates, the findings fall in the same broad range. Estimates based on the correlation of nonemployment duration of displaced workers with reemployment wages suggest effects bigger than our IV estimate, and similar to our censored OLS estimate (e.g. Addison and Portugal, 1989), but as explained above may be affected by selection.[26] Estimates of the rate of depreciation of human capital during unemployment based on structural models show results of similar order of magnitude as our findings (e.g. Keane and Wolpin, 1997). Using a direct instrument for nonemployment durations, Autor et al. (2015) find somewhat larger percentage effects of nonemployment duration for SSDI ap-

[26]Absent quasi-experimental evidence or detailed worker characteristics, Addison and Portugal (1989) address selection using a Heckman correction term.

plicants on annual earnings. There are several potential reasons for the difference, including that we focus on workers with higher labor force attachment, use daily wages, and that we may understate the effect on wage offers due to selection. In addition, as shown by our model, their method captures effects of labor supply responses through reservation wage changes.

We have pursued a broad range of sensitivity checks of our reduced form and our IV estimates. These are summarized in our Web Appendix. Our estimates are very robust. Among others, we show that classic sample selection on the extensive margin does not play a role. In addition, as explained in Section 2.2, we also extend our IV strategy and use the age cutoff itself as instrument for nonemployment duration for the broader sample of workers with any labor force attachment prior to unemployment for whom we cannot calculate potential UI durations precisely. Column 4 of Table 4 reports this IV estimate, suggesting even larger negative effects of nonemployment on wages for this broader group of workers.

5.6 Bounding Analysis

The evidence from the mean and the distribution of reemployment wages uniformly suggest that reservation wages do not bind. Moreover, given the nature of the regression discontinuity design, selection cannot offset an upward shift in reservation wages in response to UI durations as predicted by the textbook model. However, we cannot rule out completely that there are responses in reservation wages completely masked by offsetting selection based on unobservable characteristics. Even in the presence of selection, under plausible assumptions we can provide bounds for the effect of reservation wage and hence on the causal effect of nonemployment duration. As explained in Section 4, given that we can estimate δ, $\frac{dE[w]}{dP}$ and $\frac{dD}{dP}$, to obtain bounds for the causal effect $\pi \equiv \frac{\partial w^e(t;P)}{\partial \mu_t}\frac{\partial \mu_t}{\partial t}$ we have to say something about the ratio $\frac{dV_t^u}{dt} / \frac{dV_t^u}{dP}$. Since $\frac{dV_t^u}{dt} < 0$, this ratio is negative. Since $\frac{1}{\frac{dD}{dP}} \approx 7$, only for a very strong decline in the value function $\frac{dV_t^u}{dt} / \frac{dV_t^u}{dP} < -7$ would the IV estimate be biased downward. If everything were stationary except for the benefits expiring at time P, then $\frac{dV_t^u}{dt} = -\frac{dV_t^u}{dP}$ for $t < P$, since reducing benefits by one month has the same effect on the value function as moving forward one more month (in nonemployment). In practice it is probably true that $\frac{dV_t^u}{dt} < -\frac{dV_t^u}{dP}$, that is the value function declines faster than what one would expect simply from moving one month closer to the exhaustion date. This would be because skills are depreciating, people run out of savings, the cost of job search may increase, etc. On the other other hand these additional sources of non-stationarity are probably of similar or lesser importance for the value function as the finite duration of UI benefits. If so, then a plausible, very conservative range for $\frac{\frac{dV_t^u}{dt}}{\frac{dV_t^u}{dP}}$ would be -1 to around -4 (if, say, UI accounts for only one fourth of the non-stationarity).

In Table 5, we calculate the implied π given various values of $\frac{dV_t^u}{dt}/\frac{dV_t^u}{dP}$ and δ. Overall, as long as δ is close to the estimated range in Table 3 (which is always clearly less then 0.1%) or $\frac{dV_t^u}{dt}/\frac{dV_t^u}{dP}$ is not too high (between -1 and -8) we get values for the change in the slope of the wage offer distribution that are quite close to the IV estimate or even smaller. For example for the upper bound of the confidence interval for the pooled estimate in Column (3) of Table 3, $\hat{\delta}$= 0.095%, the range of slopes for the wage offer distribution is between -1.4% (actually even smaller than the IV estimate) to -0.7%, just slightly larger than the IV estimate of -0.8% decline in mean wage offers per month.[27]

5.7 Discussion of Interpretation and Potential Channels

Our findings have two main implications. The parameter we estimate can be used to gauge the costs of uneployment duration and for assessing the optimal policy mix in response to unemployment. At the same time, our bounds imply the contribution of reservation wages to wage changes from UI extensions appears small, suggesting that reservation wage responses to UI extensions are unlikely to raise employers labor costs and hence unlikely to be responsible for strong macroeconomic effects of UI.

Several channels of changing wage offers over the nonemployment spell have been suggested in the literature. Using longitudinal data on explicit skill measures from Sweden, Edin and Gustavsson (2008) report that one year of nonemployment duration reduces skills by an equivalent of 0.7 years of schooling, pointing to the potential of skill decline. Krueger and Mueller (2011) show some evidence that the unemployed become increasingly unhappy throughout the nonemployment spell, suggesting another source why the long-term unemployed may be less desireable employees. Alternatively, Kroft et al. (2013) find using an audit study approach that employers discriminate against younger long-term unemployed, even holding information

[27]Another source of potential bias in the IV estimator arises if $\frac{dh_t}{dP} = 0$, which in our sample occurs for nonemployment durations greater than two years, when benefit durations are exhausted on both sides of the age threshold. In that case, even though $\frac{\partial w_i^e(t,P)}{\partial P} = 0$, for $t > 24$ it may be that reservation wages affect accepted wages (i.e., the second term in equation (6) is not zero). Given our results imply no response in reservation wages for $t < 24$, and given the findings in the literature on the role of reservation wages, we find it safe to assume that the reservation wage effect at $t > 24$ is likely to be small and this source of bias minor.

on education and career progression constant. They find the effect varies with the state of the labor market, suggesting stigma may play a role.

Our analysis is not geared to uncover the channels underlying the causal effects we find. Nevertheless, our RD analysis reported in Section 3.3 of job outcomes other than the wage provides some tentative findings about some potential channels. To assess the potential impact of these effects on reemployment wages, we included these outcomes as additional explanatory variables in our main RD estimates (not shown). In addition controlling for an indicator capturing industry and occupation changes leads to a slight drop in the effect of UI extensions on reemployment wages of 20-25%. Controlling for a part-time indicator and completed tenure at the new job leads to a bit larger decline of 30-40%. Including proxies for employer quality made no difference. Overall, while such regressions have to be interpreted with caution, they imply some prima facie evidence of role of industry and occupation changes, which have been associated with losses in (industry or occupation) specific skills in the literature (e.g., Neal 1995). Similarly, the rise in part-time employment and the reduction in completed job tenure could reflect a decline in job quality. Note that in so far as job quality is related to the wage, our findings imply this decline has to be associated either with lower skills or stigma, and cannot be due to a change in search strategy in response to a change in UI benefits.

To learn more about potential channels, we have also analyzed differences in the effect of UI extensions on reemployment wages over the business cycle. On the one hand, if there is statistical discrimination and employers correctly update their priors, the rise in expected mean quality of job applicants during recessions should lead to lower stigma of nonemployment duration. On the other hand, it is plausible that the effect of nonemployment duration on wage offers is stronger in recessions. For example, there is ample evidence of both a decline in job quality and of a reduction of wages within jobs in recessions, which could hurt in particular workers with longer nonemployment spells. When we compare our findings in periods with high and with low unemployment rates, the results are very robust in recessions, but imprecise and ambiguous in expansions (not shown).[28]

On balance, while far from conclusive, we interpret our evidence as pointing towards a role for skill losses. It is plausible that the market has received a sufficient amount of signals

[28] The ideal test would hold the distribution of job types constant (comparable to what is done in audit studies), but is not feasible in our quasi-experimental setting because of small sample sizes and endogeneity problems.

for mature and older workers in our age range, and hence that any additional signal is less important for these workers. This is consistent with findings by Farber et al. (2015), who do not find an effect of nonemployment duration on call back rates for older workers using a similar approach as Kroft et al. (2013). Clearly, our results are consistent with both stigma and human capital depreciation playing a role.

6 Conclusion

The effect of nonemployment durations on job outcomes has important implications for policy at the micro and macro level. Using an IV strategy based on quasi-experimental extensions in UI benefits we find that for middle aged workers each additional month of nonemployment duration leads to a statistically significant and substantial reduction in wage offers of 0.8%. We show that this estimate identifies a weighted average of the slope of the wage offer distribution for individuals whose nonemployment durations are affected by the UI extensions. Given that UI durations lead to a decline in reemployment probabilities throughout the nonemployment spell, it is relevant for a broad group of unemployed workers. In our setting, over six to twelve months this can explain about a third of wage losses from nonemployment. These estimates are smaller than existing estimates with non-experimental controls for selection.

Our strategy is based on the insight that the response of reemployment wages to UI extensions throughout the nonemployment spell is informative about the role of reservation wages even if the degree of selection is arbitrarily affected by UI durations. Our finding that the path of reemployment wages over nonemployment duration does not shift in response to UI extensions implies that reservation wages do not bind. This is an important result for understanding the effects of UI policy, since it suggests UI extensions do not affect equilibrium wages through the reservation wage channel and thus ruling out at least one channel through which UI extensions could affect vacancy creation. Furthermore the lack of a reservation wage effect implies that UI extensions only affect wages through a rise in nonemployment durations and therefore can be used as an instrument for non-employment durations. These conclusions are borne out when we construct upper bounds for the reservation wage responses compatible with our data. We also analyzed the effect of UI extensions at different points in the wage distribution to UI extensions. While we do observe some small shifts in the lower quantiles estimates in response to UI extensions, these changes appear to be due to selection. The framework we develop here for the analysis of the channels of UI effects on wages will be useful for other studies that analyze the effects of exogenous changes in wokers outside options on worker outcomes.

Our findings can be used to help quantify the earnings losses from long nonemployment spells for workers, a key policy concern especially during recessions. They also affect the optimal policy mix in response to long-term nonemployment and suggest that both at the micro- and macro-level policies should be front loaded to avoid the substantial cost associated with long-term nonemployment. In so far as workers may indeed be receiving worse job matches or have lower productivity, our findings imply a significant cost to society going beyond the direct cost of nonemployment to workers. However, since by construction our regression discontinuity analysis is partial equilibrium in nature, a full evaluation of the implications of causal effects of nonemployment we document here would require specifying the source of the losses and a macroeconomic model.

While we find nonemployment duration has potentially large effects on wages, the small underlying effect of UI extensions on wages may not substantially affect the welfare consequences of UI extensions. If individuals get all the surplus from higher match quality, then they will have internalized the effect of their search behavior on match quality, and the effects of potential UI durations on match quality can be ignored from a social welfare perspective. This situation is different, if workers do not reap all the benefits of better matches—for example, because the surplus is shared with the employer or because the government receives taxes. Even in the latter case, the small direct effects of UI extensions on wages we find are unlikely to imply a substantial rise in costs of UI extensions.[29]

Our results are also related to the value of leisure. Rational individuals incur the costs of additional wage reductions above and beyond foregone earnings during nonemployment in favor of additional leisure. A back-of-the-envelope calculation suggests that the present discounted value of the cost from lower wages due to higher nonemployment durations is about half a month of average earnings per additional month of nonemployment duration. This may indeed be rational, in so far fixed costs of working or fixed costs of leaving a job

[29]This is essentially an application of the envelope theorem. See Chetty (2008) and Schmieder et al. (2012a) for details. Nekoei and Weber (2013) show that foregone tax revenues from lower earnings can also play a role.

put a wedge between the value of leisure and foregone earnings. Yet, it also could be that individuals do not fully foresee the wage penalty they incur.

Last but not least, by the nature of our regression discontinuity design and institutional framework, our estimates are based on middle age workers. While this is the core constituency of unemployment insurance in Germany, the United States and other countries, it does not speak to the potential effects of UI durations and nonemployment durations for a broader population. Studies with data and research designs encompassing broader groups of workers and other countries will help to obtain additional information on how the effects we measure here differ in the population, what the likely effect on the macroeconomy is, and what the underlying channels may be.

References

Acemoglu, Daron, "Public Policy in a Model of Long-Term Unemployment," *Economica*, *62* (1995), 161–178.

Addison, John T. and Pedro Portugal, "Job Displacement, Relative Wage Changes, and Duration of Unemployment," *Journal of Labor Economics*, *7* (3), (1989), 281.

Angrist, Joshua D., Guido W. Imbens, and Donald Rubin, "Identification of Causal Effects Using Instrumental Variables," *Journal of the American Statistical Association*, *91* (1996), 444-472.

_, Kathryn Graddy, and Guido W. Imbens, "The Interpretation of Instrumental Variables Estimators in Simultaneous Equations Models with an Application to the Demand for Fish," *Review of Economic Studies*, *67* (2000), 499-527.

Autor, David H, Nicole Maestas, Kathleen J Mullen, and Alexander Strand, "Does delay cause decay? The effect of administrative decision time on the labor force participation and earnings of disability applicants," Working Paper 20840, National Bureau of Economic Research (2015).

Ball, Laurence M., "Hysteresis in Unemployment: Old and New Evidence," *NBER Working Papers No. 14818*, (2009).

Bernanke, Ben S., "Recent Developments in the Labor Market," *Speech at National Association for Business Economics Annual Conference (http://www.federalreserve.gov/newsevents/speech/bernanke20120326a.pdf)*, (2012).

Black, Dan A., Jeffrey A. Smith, Mark C. Berger, and Brett J. Noel, "Is the Threat of Reemployment Services More Effective than the Services Themselves? Evidence from Random Assignment in the UI," *American Economic Review*, *93* (4), (2003), 1313–1327.

Calonico, Sebastian, Matias D Cattaneo, and Rocio Titiunik, "Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs," *Econometrica*, *82* (6), (2014), 2295–2326.

Card, David, Jörg Heining, and Patrick Kline, "Workplace Heterogeneity and the Rise of West German Wage Inequality*," *The Quarterly Journal of Economics*, (2013).

—, Raj Chetty, and Andrea Weber, "Cash-On-Hand and Competing Models of Intertemporal Behavior: New Evidence from the Labor Market," *Quarterly Journal of Economics*, *122* (4), (2007), 1511–1560.

Centeno, Mario and Álvaro A. Novo, "Reemployment wages and UI liquidity effect: a regression discontinuity approach," *Portuguese Economic Journal*, *8* (1), (2009), 45–52.

Chetty, Raj, "Moral hazard versus liquidity and optimal unemployment insurance," *Journal of political Economy*, *116* (2), (2008), 173–234.

Crépon, Bruno, Esther Duflo, Marc Gurgand, Roland Rathelot, and Philippe Zamora, "Do Labor Market Policies have Displacement Effects? Evidence from a Clustered Randomized Experiment," *The Quarterly Journal of Economics*, *128* (2), (2013), 531–580.

Degen, Kathrin and Rafael Lalive, "How Does a Reduction in Potential Benefit Duration Affect Medium-Run Earnings and Employment?," *mimeo*, (2013).

DellaVigna, Stefano and M. Daniele Paserman, "Job search and impatience," *Journal of Labor Economics*, *23* (3), (2005), 527.

Dustmann, Christian, Bernd Fitzenberger, Uta Schönberg, and Alexandra Spitz-Oener, "From Sick Man of Europe to Economic Superstar: Germany's Resurgent Economy," *Journal of Economic Perspectives*, *28* (1), (2014), 167-88.

—, Johannes Ludsteck, and Uta Schönberg, "Revisiting the German wage structure," *The Quarterly Journal of Economics*, *124* (2), (2009), 843–881.

Edin, Per-Andres and Magnus Gustavsson, "Time Out of Work and Skill Depreciation," *Industrial Labor Relations Review*, *61* (2), (2008), 163–180.

Farber, Henry, Daniel Silverman, and Till von Wachter, "Do Employers Consider Unemployment Duration, Low-Quality Interim Employment, and Age in Hiring? Evidence from an Audit Study," *Mimeo*, (2015).

Farber, Henry S. and Robert G. Valletta, ""Do Extended Unemployment Benefits Lengthen Unemployment Spells? Evidence from Recent Cycles in the U.S. Labor Market," *NBER Working Paper No. 19048*, (2013).

Hagedorn, Marcus, Fatih Karahan, Iourii Manovskii, and Kurt Mitman, "Unemployment Benefits and Unemployment in the Great Recession: The Role of Macro Effects," Working Paper 19499, National Bureau of Economic Research October (2013).

Hornstein, Andreas, Per Krusell, and Giovanni L. Violante, "Frictional Wage Dispersion in Search Models: A Quantitative Assessment," *American Economic Review*, *101* (7), (2011), 2873–2898.

Imbens, Guido and Karthik Kalyanaraman, "Optimal Bandwidth Choice for the Regression Discontinuity Estimator," *Review of Economic Studies*, *79* (3), (2012), 933–959.

Katz, Lawrence F., Kory Kroft, Fabian Lange, and Matt J. Notowidigdo, "Long-Term Unemployment and the Great Recession: The Role of Composition, Duration Dependence, and Non-Participation," *Journal of Labor Economics*, (forthcoming).

Keane, Michael P. and Kenneth I. Wolpin, "The Career Decisions of Young Men," *Journal of Political Economy*, *105* (3), (1997), 473-522.

Kroft, Kory and Matt J. Notowidigdo, "Should Unemployment Insurance Vary With the Local Unemployment Rate? Theory and Evidence," *mimeo*, (2010).

—, Fabian Lange, and Matthew Notowidigdo, "Duration Dependence and Labor Market Conditions: Evidence from a Field Experiment," *Quarterly Journal of Economics*, *123* (3), (2013), 1123-1167.

Krueger, Alan B. and Andreas Mueller, "Job Search, Emotional Well-Being and Job Finding in a Period of Mass Unemployment: Evidence from High-Frequency Longitudinal Data," *Brookings Papers on Economic Activity*, *Spring* (2011), 1-81.

_ and _ , "A Contribution to the Empirics of Reservation Wages," *NBER Working Paper 19870*, (2014).

Lalive, Rafael, "Unemployment benefits, unemployment duration, and post-unemployment jobs: A regression discontinuity approach," *American Economic Review*, *97* (2), (2007), 108–112.

_ , Camille Landais, and Josef Zweimueller, "Market Externalities of Large Unemployment Insurance Extension Programs," *Mimeo*, (2013).

Landais, Camille, Pascal Michaillat, and Emmanuel Saez, "A Macroeconomic Theory of Optimal Unemployment Insurance," *NBER Working Paper*, *16526* (2015).

Ljungqvist, Lars and Thomas J. Sargent, "Two Questions about European Unemployment," *Econometrica*, *76* (1), (2008), 1–29.

Machin, Stephen and Alan Manning, "The causes and consequences of longterm unemployment in Europe," *Handbook of labor economics*, *3* (1999), 3085–3139.

Marinescu, Ioana, "The General Equilibrium Impacts of Unemployment Insurance: Evidence from a Large Online Job Board," Technical Report (2015).

Meyer, Bruce D., "Unemployment Duration and Unemployment Spells," *Econometrica*, *58* (1990), 757–82.

_ , "Lessons from the US Unemployment Insurance Experiments," *Journal of Economic Literature*, *33* (1), (1995), 91–131.

Neal, Derek A., "Industry-Specific Human Capital: Evidence from Displaced Workers," *Journal of Labor Economics*, *13* (4), (1995), 653-677.

Nekoei, Arash and Andrea Weber, "Does Extending Unemployment Benefits Improve Job Quality?," *Mimeo*, (2013).

Pavoni, Nicola and Giovanni L. Violante, "Optimal Welfare-to-Work Programs," *Review of Economic Studies*, *74* (1), (2007), 283–318.

Pissarides, Christopher A., "Loss of Skill During Unemployment and the Persistence of Employment Shocks," *Quarterly Journal of Economics*, *107* (4), (1992), 1371–1391.

Rothstein, Jesse, "Unemployment Insurance and Job Search in the Great Recession," *Brookings Papers on Economic Activity*, *Fall* (2011), 143-210.

_ , Andreas Mueller, and Till von Wachter, "Unemployment Insurance and Disability Insurance in the Great Recession," *Journal of Labor Economics*, (forthcoming).

Schmieder, Johannes F., Till von Wachter, and Stefan Bender, "The Long-Term Impact of Job Displacement in Germany During the 1982 Recession on Earnings, Income, and Employment," *Columbia University, Department of Economics Discussion Paper Series*, *DP0910-07* (2009).

Schmieder, Johannes F, Till von Wachter, and Stefan Bender, "The Effects of Extended Unemployment Insurance over the Business Cycle: Evidence from Regression Discontinuity Estimates over 20 years," *The Quarterly Journal of Economics*, *127* (2), (2012a), 701–752.

_ , _ , and _ , "The Long-Term Effects of UI Extensions on Employment," *The American Economic Review*, *102* (3), (2012b), 514–519.

van den Berg, Gerard J., "Nonstationarity in job search theory," *The Review of Economic Studies*, *57* (1990), 255–277.

van Ours, Jan and Milan Vodopivec, "Does reducing unemployment insurance generosity reduce job match quality?," *Journal of Public Economics*, *92* (3-4), (2008), 684–695.

Table 1: The Effect of Potential UI Durations on Non-employment Duration and the Post Unemployment Wage

	(1) UI Benefit Duration	(2) Non-Emp Duration	(3) Ever emp. again	(4) Log Post Wage	(5) Log Wage Difference	(6) Log Wage Controlling for Observables
Increase in Potential UI Dur. from 12 to 18 Months						
RD Estimate (Age $\geq$ cutoff)	1.77	0.95	-0.0094	-0.0078	-0.0070	-0.0072
	[0.048]**	[0.19]**	[0.0033]**	[0.0036]*	[0.0034]*	[0.0032]*
Marginal Effect $\frac{dy}{dP}$	0.29	0.16	-0.0016	-0.0013	-0.0012	-0.0012
	[0.0080]**	[0.032]**	[0.00046]**	[0.00060]*	[0.00058]*	[0.00057]*
Effect relative to mean	0.23	0.065	-0.011	-0.0019	0.050	-0.0018
Observations	510955	437899	510955	437182	420311	422635
Mean of Dep. Var.	7.57	14.7	0.86	4.01	-0.14	4.01
Pooling both Thresholds (12 to 18 Months and 18 to 22 Months)						
RD Estimate (Age $\geq$ cutoff)	1.44	0.72	-0.0082	-0.0051	-0.0055	-0.0045
	[0.041]**	[0.14]**	[0.0021]**	[0.0024]*	[0.0025]*	[0.0021]*
Marginal Effect $\frac{dy}{dP}$	0.29	0.14	-0.0016	-0.0010	-0.0011	-0.0009
	[0.0081]**	[0.029]**	[0.00042]**	[0.00048]*	[0.00050]*	[0.00049]*
Effect relative to mean	0.17	0.048	-0.0097	-0.0013	0.038	-0.0012
Observations	947068	799105	947068	797752	767161	771197
Mean of Dep. Var.	8.33	15.8	0.84	4.00	-0.15	4.00

Notes: * P<.05, ** P<.01. Robust standard errors based on the method of Calonico et al. (2014).
The sample are individuals who started receiving unemployment insurance between 1987 and 1999 within 2 years from the age thresholds. Each coefficient is from a separate regression discontinuity model with the dependent variable given in the column heading. The first panel shows the increase at the discontinuity at the age 42 threshold (where potential UI durations increase from 12 to 18 months). The second panel shows pooled estimates using the age 42 threshold as well as the increase at the age 44 threshold (where potential UI durations increase from 18 to 22 months). The models control for linear splines in age with different slopes on each side of the cutoff. The number of observations vary across specifications due to missing observations for right hand side variables: UI benefit durations (column 1) are defined for everyone in our sample (UI recipients) by definition, non-employment duration is the duration until reemployment, which is missing if individuals are never employed again within 9 years after UI entry, reemployment is defined for everyone, post wage and wage difference are slightly smaller than column 2 due to missing wage observations.

Table 2: The Effect of Potential UI Durations on Other Match Quality Outcomes (First Age cutoff)

Panel A: Other Wage Variables	Log Wage Growth 5 Years	Log wage 1 year after reemployment	Log wage 3 years after reemployment	Log wage 5 years after reemployment
Marginal Effect $\frac{dy}{dP}$	0.00026	-0.0014	-0.00093	-0.00089
	[0.00085]	[0.00069]*	[0.00077]	[0.00091]
Observations	311568	382089	345073	311833
Mean of Dep. Var.	-0.084	3.95	3.95	3.97

Panel B: Other Job Quality Measures	Duration of post unemp job in years	Post unemp job is full time	Post unemp job is different industry	Post unemp job is different occupation
Marginal Effect $\frac{dy}{dP}$	-0.0081	-0.0011	0.0012	0.0018
	[0.0067]	[0.00045]*	[0.00057]*	[0.00071]**
Observations	437899	437182	425131	437899
Mean of Dep. Var.	4.10	0.89	0.69	0.61

Notes: * P<.05, ** P<.01. Robust standard errors based on the method of Calonico et al. (2014). The sample are individuals who started receiving unemployment insurance between 1987 and 1999 within 2 years from the age 42 thresholds. Each coefficient is from a separate regression discontinuity model with the dependent variable given in the column heading.

Table 3: The Effect of Potential UI Durations on Reemployment Wages Conditional on Nonemployment Duration

	(1) $log(w)$	(2) $log(w)$	(3) $P(log(w) > 3.5)$	(4) $P(log(w) > 3.75)$	(5) $P(log(w) > 4)$
Increase in Potential UI Dur. from 12 to 18 Months					
Marginal Effect $\frac{dy}{dP}$	0.000093	-0.000042	0.00027	-0.00021	-0.00030
	[0.00075]	[0.00068]	[0.00049]	[0.00062]	[0.00073]
Observations	437182	437182	437182	437182	437182
Mean of Dep. Var.	4.01	4.01	0.88	0.75	0.56
Pooling both Thresholds (12 to 18 Months and 18 to 22 Months)					
Marginal Effect $\frac{dy}{dP}$	0.00021	0.00015	0.00024	0.00029	-0.00022
	[0.00067]	[0.00059]	[0.00042]	[0.00061]	[0.00069]
Observations	797752	797752	797752	797752	797752
Mean of Dep. Var.	4.02	4.02	0.86	0.76	0.56
Controlling for Nonemp. Duration:					
Cubic polynomial:	Yes	No	No	No	No
Full set of dummies:	No	Yes	Yes	Yes	Yes

Notes: * P<.05, ** P<.01. Robust standard errors based on the method of Calonico et al. (2014). Coefficients from RD regressions. Local linear regressions (different slopes) on each side of cutoff. We report the estimated marginal effect of a one month increase in potential UI durations controlling for actual UI duration.

Table 4: The Effect of Time Out of Work on Log Reemployment Wages, OLS and IV Estimates

	(1) 2SLS Main Sample	(2) OLS Main Sample	(3) OLS Nonemp Dur $\leq$ 18 months	(4) 2SLS Reemp Wage No Experience Restrictions
Increase in Potential UI Dur. from 12 to 18 Months				
Nonemp. Duration	-0.0080	-0.0067	-0.017	-0.013
	[0.0033]*	[0.000053]**	[0.00018]**	[0.0026]**
Observations	437182	437182	332063	1717597
Mean of Dep. Var.	4.01	4.01	4.08	3.91
Pooling both Thresholds (12 to 18 Months and 18 to 22 Months)				
Nonemp. Duration	-0.0070	-0.0069	-0.016	-0.015
	[0.0031]*	[0.000039]**	[0.00013]**	[0.0025]**
Observations	797752	797752	599408	3321622
Mean of Dep. Var.	4.02	4.02	4.09	3.91

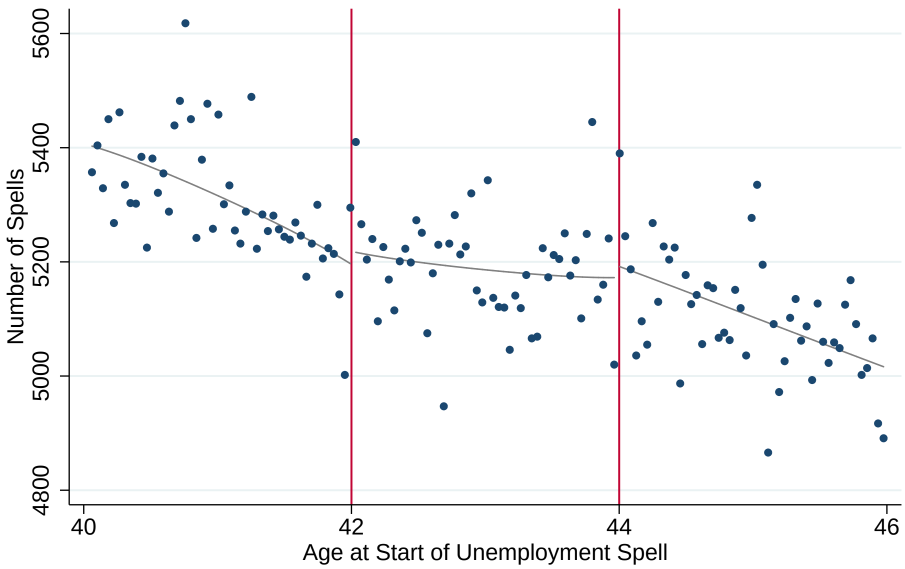
Notes: * P<.05, ** P<.01 Standard errors clustered on day level. Columns 1-3 show the slope coefficient of a regression of log reemployment wages on nonemployment durations. Column 1 for the main RD sample of individuals eligible to the maximum potential UI durations from Table 1, Column 2 for the same sample but with the restriction that nonemployment duration is less than 18 months, and Column 3 for the full sample without experience restrictions. Columns 4 and 5 show the two-stage least squares estimator of the effect of nonemployment duration on wages using UI extensions as instrument variable. Column 4 shows the main RD sample, while Column 5 the full sample without experience restrictions.

Table 5: Slope of Mean Wage Offers as Function of $\frac{dVu/dt}{dVu/dP}$ and the effect of UI extensions conditional on duration of nonemployment $dE[w|t]/dP$

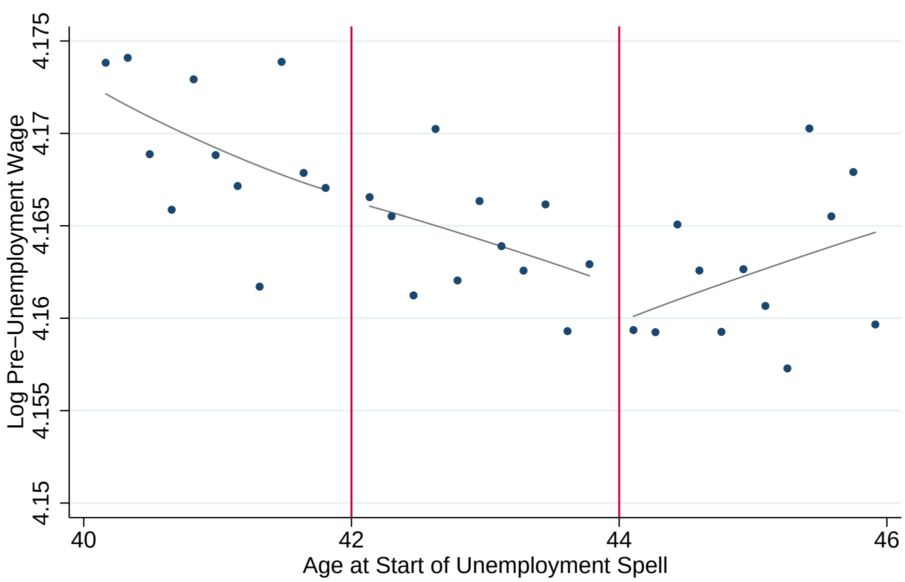
			$\frac{dVu/dt}{dVu/dP}$		
$\delta = E[dE[w|t]/dP]$ in percent	-1	-3	-5	-7	-8
0	-0.008	-0.008	-0.008	-0.008	-0.008
0.095	-0.014	-0.012	-0.010	-0.008	-0.007
0.1	-0.014	-0.012	-0.010	-0.008	-0.007
0.2	-0.020	-0.016	-0.012	-0.008	-0.006
0.4	-0.032	-0.024	-0.016	-0.008	-0.004
0.6	-0.045	-0.033	-0.021	-0.009	-0.003
0.8	-0.057	-0.041	-0.025	-0.009	-0.001
1.0	-0.069	-0.049	-0.029	-0.009	0.001

Notes: The table shows the implied slope of the mean wage offer distribution if the effect of potential UI durations on reemployment wages conditional on nonemployment durations is not equal to zero $dE[w|t]/dP$. Rows show the implied slope for different values of $dE[w|t]/dP$ and columns for different values of $\frac{dVu/dt}{dVu/dP}$. The preferred point Estimate for $dE[w|t]/dP$ is 0.015% (from Table 3, column (2), bottom panel).
The upper bound of the 95% confidence interval for $dE[w|t]/dP$ is 0.095%.

Figure 1: Validity of Regression Discontinuity Design - Continuity of Density and Baseline Wages



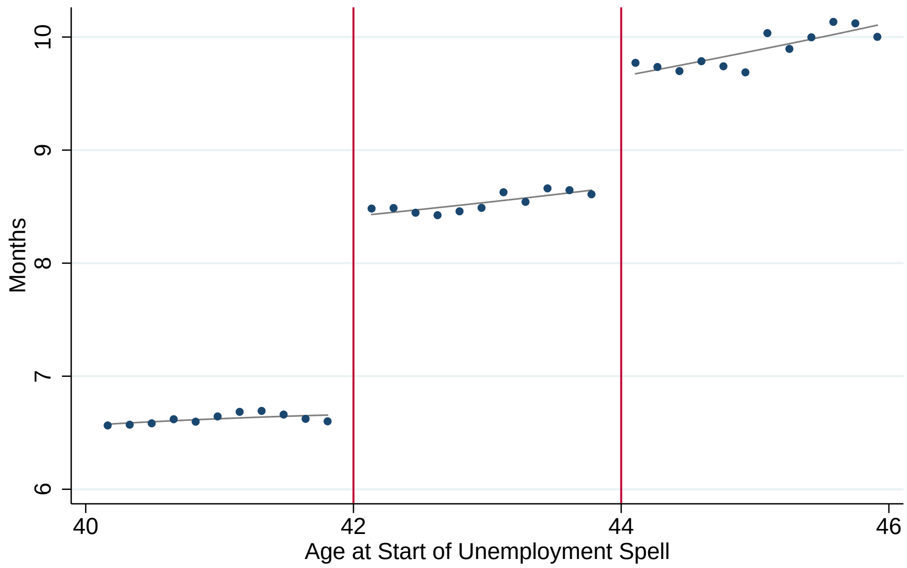
(a) Frequency of Observations Around Age Cutoffs



(b) Log Pre-Unemployment Wage

Notes: The top figure shows density of spells by age at the start of receiving unemployment insurance (i.e. the number of spells in 2 week interval age bins). The bottom figure shows the log pre-unemployment wage of individuals in 2 month age bins. The vertical lines mark age cutoffs for increases in potential UI durations at age 42 (12 to 18 months) and age 44 (18 to 22 months). The sample are unemployed workers claiming UI between July 1987 and March 1999 who had worked for at least 44 months in the last 7 years without intermittent UI spell.

Figure 2: The Effect of Extended Potential UI Durations on Benefit and Nonempoyment Durations

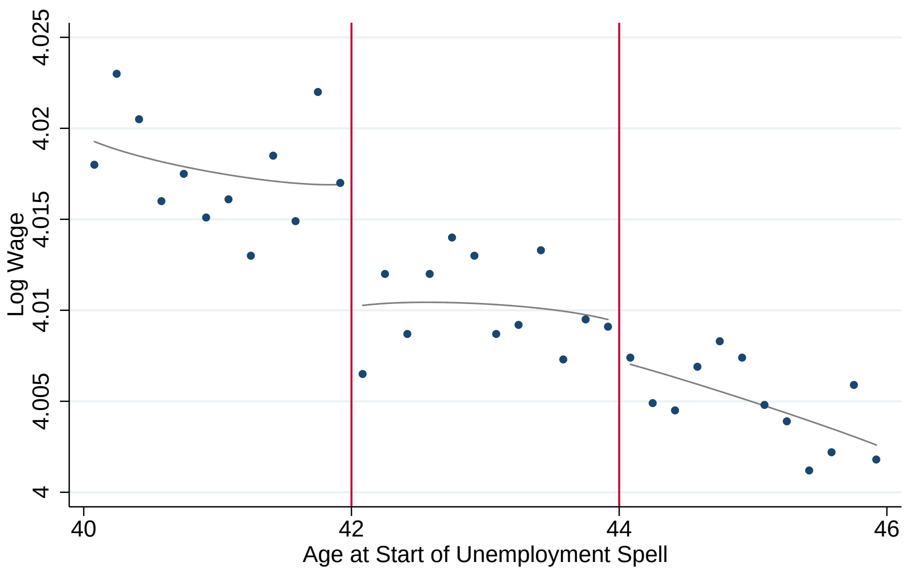


(a) Months of receiving UI benefits

(b) Months of Nonemployment

Notes: The top figure shows average durations of receiving UI benefits by age at the start of unemployment insurance receipt. The bottom figure shows average nonemployment durations for these workers, where nonemployment duration is measured as the time until return to a job and is capped at 36 months. Each dot corresponds to an average over 60 days. The continuous lines represent quadratic polynomials fitted separately within the respective age range. The vertical lines mark age cutoffs for increases in potential UI durations at age 42 (12 to 18 months), 44 (18 to 22 months).

Figure 3: The Effect of Extended Potential UI Durations on Post Unemployment Wages

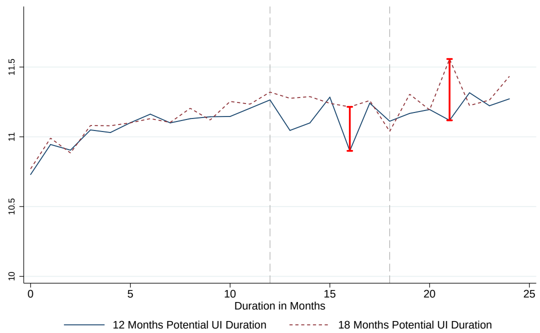


(a) Log post unemployment wage

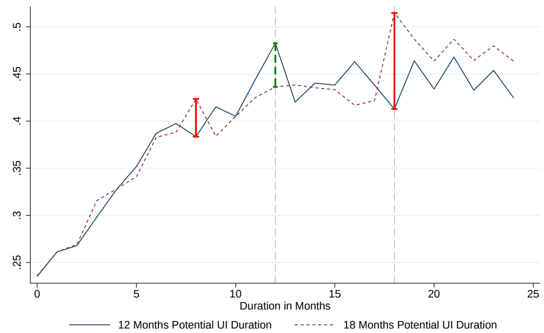
(b) Log wage difference (pre unemployment minus post unemployment)

Notes: The top figure shows average post unemployment log wages by age at the start of unemployment insurance receipt. The bottom figure shows average difference in the pre and post unemployment log wage for these workers. Each dot corresponds to an average over 60 days. The continuous lines represent quadratic polynomials fitted separately within the respective age range. The vertical lines mark age cutoffs for increases in potential UI durations at age 42 (12 to 18 months), 44 (18 to 22 months).

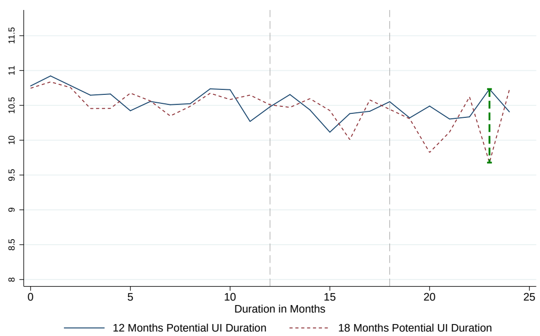
Figure 4: The Effects of Extended Potential UI Durations on Selection throughout the Spell of Non-employment



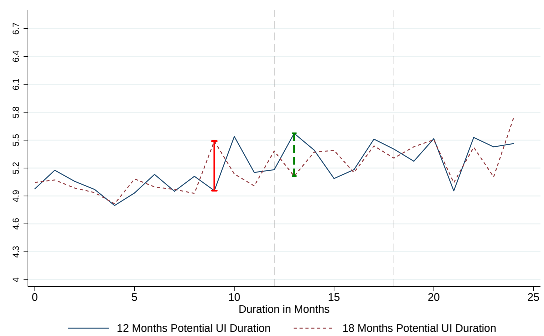
(a) Years of schooling



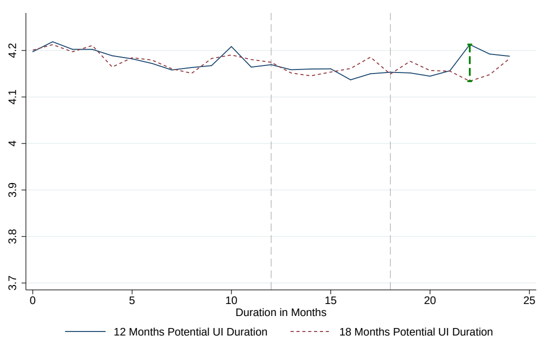
(b) Female



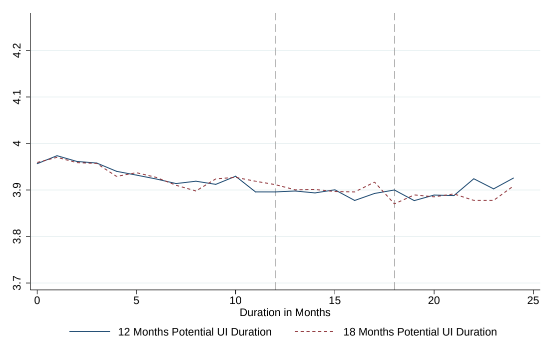
(c) Pre-unemployment experience



(d) Pre-unemployment tenure



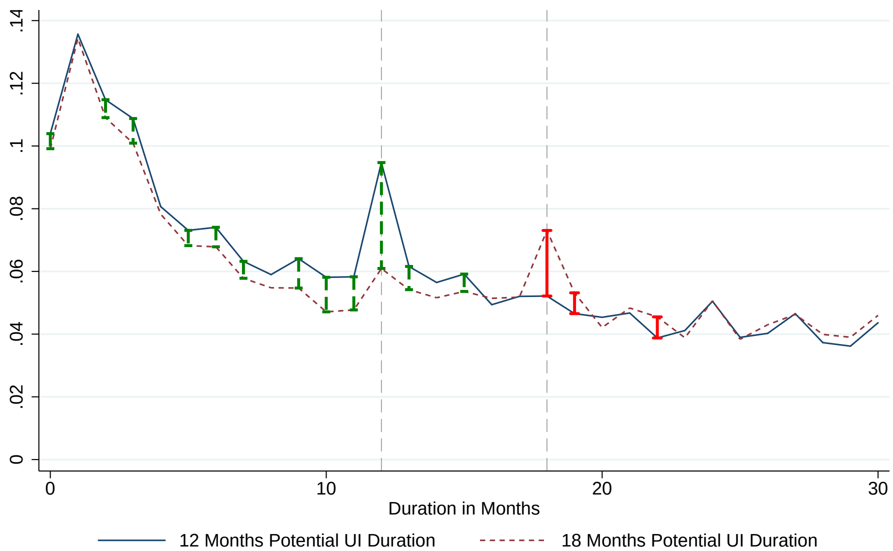
(e) Pre-unemployment log wage



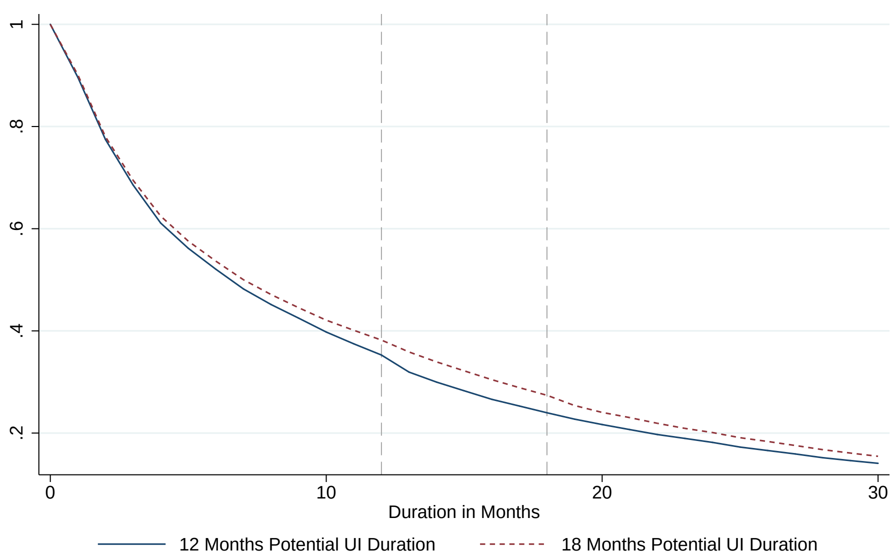
(f) Predicted reemployment log wage

Notes: The difference between the lines is estimated pointwise at each point of support using regression discontinuity estimation. Vertical bars indicate that the differences are statistically significant from each other at the five percent level. The sample are unemployed worker claiming UI between July 1987 and March 1999 who had worked for at least 36 months in the last 7 years without intermittent UI spell. Panel (f) shows predicted reemployment wages, which are the predicted values from a regression of log wages on pre-unemployment wage, tenure, education, experience, and gender, as well as year, industry and occupation dummies.

Figure 5: Effect of Increasing Potential Unemployment Insurance (UI) Durations from 12 to 18 Months on the Hazard and Survival Functions - Regression Discontinuity Estimate at Age 42 Discontinuity



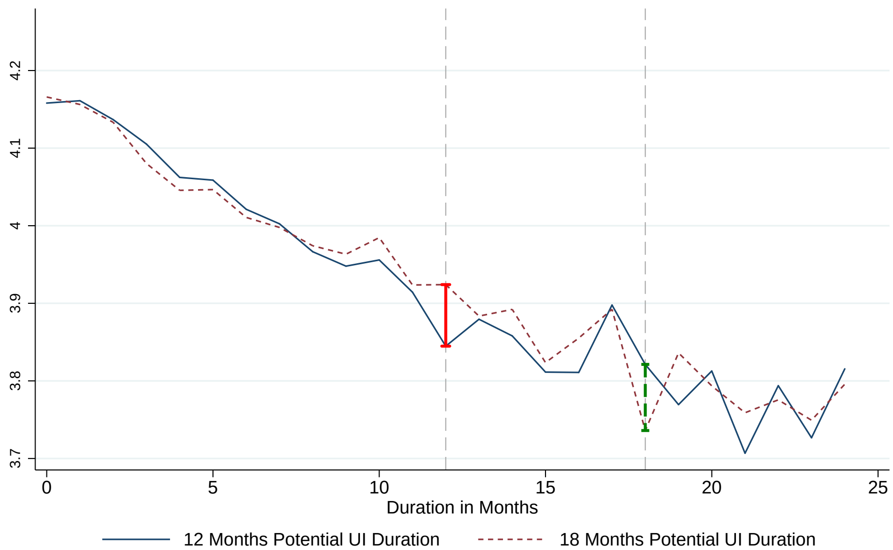
(a) Unemployment Exit Hazard



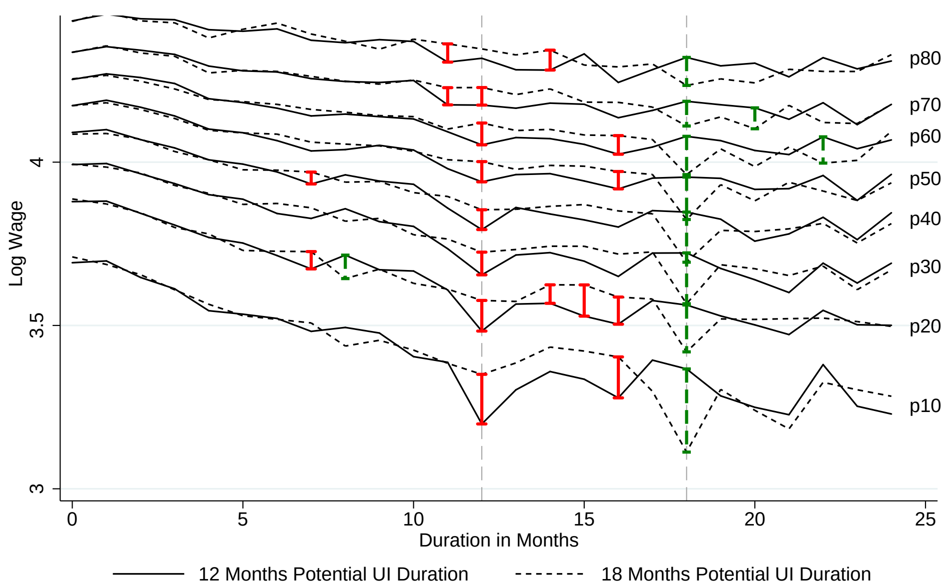
(b) Survival Functions

Notes: The difference between the hazard functions is estimated pointwise at each point of support using regression discontinuity estimation. Vertical bars indicate that the hazard rates are statistically significant from each other at the five percent level. The sample are unemployed worker claiming UI between July 1987 and March 1999 who had worked for at least 36 months in the last 7 years without intermittent UI spell. For details see text.

Figure 6: The Effects of Extended Potential UI Durations on Reemployment Wages throughout the Spell of Non-employment



(a) Post-unemployment log wage



(b) Post-unemployment log wage

Notes: The difference between the reemployment wage paths is estimated pointwise at each point of support using regression discontinuity estimation. Vertical bars indicate that the differences in the reemployment wages are statistically significant from each other at the five percent level. The sample are unemployed worker claiming UI between July 1987 and March 1999 who had worked for at least 36 months in the last 7 years without intermittent UI spell. For details see text.