# Moral Hazard among the Employed: Evidence from a Regression Discontinuity*

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**Abstract**

We leverage discontinuities in Poland that quasi-randomly determine unemployment benefit levels and duration. we report three main findings: (1) The distortionary effects of benefit increases are larger than those of cost-equivalent benefit extensions. (2) The distortionary effects of benefit duration and benefit generosity *interact*: The unemployment effect of generosity nearly doubles when benefit duration is extended. And (3), in addition to delaying re-employment, more generous benefits significantly increase the hazard that employed workers become unemployed. We use the results to build a model of optimal unemployment insurance that accounts for moral hazard among the employed. The results suggest that the total distortion of UI among the employed is larger than that among the unemployed. Accounting for endogenous separations increases the efficiency loss induced by an increase in the benefit level substantially.

JEL: *H55, J20, J65*
Keywords: *Unemployment insurance, spell duration, regression discontinuity, endogenous separations*

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# 1 Introduction

The perennial effort around unemployment insurance (UI) is to properly account for the distortionary costs arising from moral hazard. An excellent body of work measures the intensity of moral hazard among the unemployed (Card et al., 2015a; Dahl and Knepper, 2022; Jessen et al., 2023; Landais et al., 2021). In this paper, we expand the aperture to also consider the *scope* of moral hazard in the labor market.

While it is well-established that UI generates moral hazard among the unemployed, UI may also introduce moral hazard among the employed. This would potentially reduce the effort of employed workers and consequently increase their risk of becoming unemployed (Ejrnæs and Hochguertel, 2013; Lusher et al., 2022). If so, the aggregate effect of unemployment insurance on employment and output may be much larger than what is measured by examining the effect of insurance among the unemployed alone.

We leverage discontinuities that quasi-randomly assign two central UI policy variables—benefit *generosity* (how much the unemployed receive per month) and potential benefit *duration* (how many months workers are permitted to receive payments). We use these discontinuities to measure how benefit generosity and duration affect labor market outcomes for both employed and unemployed workers.

The first discontinuity determines whether claimants receive a 25 percent increase in benefit generosity or not, based on a threshold in how long the worker has been employed in UI-covered employment, what the state calls "contributory years." The second discontinuity determines whether claimants receive benefits for six or twelve months, based on a cutoff in the local unemployment rate relative to the national unemployment rate.

In addition to quasi-randomly assignment to benefit regimes, our setting provides key advantages for understanding UI's influence in the labor market. First, our quasi-experimental variation is salient and known to workers, allowing for us to estimate moral hazard effects among the employed as well as the unemployed (unlike studies where the policy change is not obvious or known to workers, like Johnston and Mas (2018) or Chodorow-Reich et al. (2019)). Another novel contribution is that we can estimate the effect of both benefit generosity and duration in the same setting. This allows for a direct comparison and welfare analysis of the two central policy variables in UI design. Previous estimates arise piecemeal from different places, times, and labor markets, making comparisons difficult. The existence of intersecting discontinuities at the same time and place, moreover, allows us to test for joint effects to understand—how does benefit duration *interact* with benefit generosity in affecting labor supply?

We first use the discontinuities to estimate the effect of benefit generosity and duration among the unemployed. We find that a 10 percent increase in benefit generosity increases unemployment duration by 3 percent, and a 10 percent increase in benefit duration *also* increases unemployment duration by 3 percent. The duration of benefit receipt is significantly more affected by potential benefit duration, with a 10 percent increase causing a 6 percent rise, suggesting higher mechanical costs as exhaustion rates are quite high. The distortions from UI generosity and duration interact. Using a two-dimensional regression discontinuity that allows benefit levels and durations to interact, we find that in low potential benefit duration (PBD) environment, a 10 percent increase in benefits modestly increases unemployment duration by 0.07 months. When paired with longer PBD, the same 10 percent benefit increase substantially raises unemployment duration by 0.24 months. In other words, the elasticity of unemployment duration with respect to benefit generosity is 70 percent higher in the presence of (randomly assigned) longer benefit duration (p-value $\approx 0.001$).

We next turn to understanding whether unemployment insurance introduces moral hazard among the employed. We find that a 10 percent increase in benefit generosity increases inflows into unemployment by 10 percent, suggesting large distortionary costs among the employed. A 10 percent increase in benefit duration increases inflows by 2 percent.

We analyze the characteristics of those who enter unemployment due to more generous benefits.[1] Workers who become unemployed because of higher benefits tend to be somewhat older, more often female, and less educated than the existing unemployed. Surprisingly, we find that these demographic differences do not predict longer unemployment durations across the cutoff. Using all available worker covariates to predict unemployment duration, we find vanishingly small differences in predicted benefit duration based on observable covariates. This suggests that the increase in benefit duration among the unemployed is not likely explained by observable factors. Using past UI experience to proxy for unobserved characteristics, we also find small and mostly statistically insignificant discontinuities (an order of magnitude smaller than the main results).

Distortions to employment have broader social significance because employment generates positive externalities for society. When employed, workers contribute tax revenues, add value to their firms, and generate consumer surplus through production. We extend the Baily-Chetty model of optimal benefits to interpret these effects in a model of social welfare that incorporates moral hazard among the employed (Baily, 1978; Chetty, 2006; Schmieder et al., 2012). In the model, workers maximize their individual utility, while the social planner maximizes aggregate welfare by balancing the benefits of additional consumption smoothing against the cost of additional moral hazard. Whereas prior models assume exogenous separations (unaffected by benefit generosity), we develop the model to incorporate moral hazard among the employed. We account for the social costs associated with additional unemployment from benefits as reduced tax revenue.

We calculate the fiscal externality per additional unit redistributed to the unemployed following Chetty (2008) and Schmieder and von Wachter (2016). In the baseline exogenous layoff model, we calculate the cost of transferring \$1 to the unemployed as \$2.3 in behavioral distortions.[2]

When the model incorporates the social cost of endogenous inflows to unemployment, the calculated cost of transferring additional \$1 to the unemployed via a benefit level increase grows to \$11. The large increase arises from highly responsive inflows in response to benefit levels. The understood cost of endogenous inflows are smaller for benefit duration because it causes a

[1] To accomplish this, we calculate the demographic profile of the marginal entrants that would be necessary to rationalize both the changes in demographic composition at the cutoff given the overall increase in unemployment inflows.

[2] This estimate is higher than the mean in Schmieder and von Wachter (2016) (\$1.3), but in line with estimates found in Card et al. (2015b) (\$2.8–\$5.6).

smaller inflow response. In a model without accounting for endogenous entry unemployment, an additional $1 transfer through benefit duration costs $2.5 in behavioral costs, similar to prior estimates (Centeno and Novo, 2009; Lalive, 2007, 2008; van Ours and Vodopivec, 2008).[3] However, when incorporating the behavioral costs among the employed, the cost of transferring $1 through extended benefit duration increases from $2.5 to $3.6.

The social value of redistributing $1 to benefit recipients via increases of the benefit level or the potential benefit duration depends on the consumption drop at unemployment or benefit exhaustion, respectively, as well as on the degree of relative risk aversion. For various calibrations, the marginal value of public funds (MVPF) of benefit increases or duration increases is clearly below one, implying that a reduction of UI generosity would improve welfare. When accounting for endogenous inflows, the MVPF of level increases is 0.2, even if we assume a relatively high coefficient of relative risk aversion, 2, and a 30% consumption drop at unemployment.

Several authors have shown spikes in layoffs when workers become UI eligible (see, for example, Christofides and McKenna, 1996; Brébion et al., 2022; and Van Doornik et al., 2023). Another branch shows that workers and entrepreneurs reduce effort with greater UI generosity (Ahammer et al., 2023; Ejrnæs and Hochguertel, 2013; Lusher et al., 2022). We add two core contributions: discontinuity evidence on moral hazard among the employed, and discontinuity evidence on how benefit levels and durations interact.

It's worth noting that studies using age cutoffs in Austria and Germany did not report increased separations, possibly due to institutional differences policing entry better than in our setting (see Nekoei and Weber, 2017; Schmieder et al., 2012).

Most similar to our paper are studies finding duration cuts reduced unemployment inflows and separations timed for maximum duration (Gudgeon et al., 2024; Hartung et al., 2022; Tuit and van Ours, 2010). We contribute (1) transparent discontinuity evidence of moral hazard among the employed, (2) comparisons of benefit level and duration elasticities in the same labor market, (3) tests for moral hazard interactions between benefit level and benefit duration,[4] and (4) interpretation through a welfare model highlighting the costs of moral hazard among the employed.

## 2 Institutional background

When a worker becomes unemployed in Poland, the generosity and duration of their unemployment insurance benefits depend on (1) the unemployment rate in the county they live in and (2) their work history UI-covered employment.

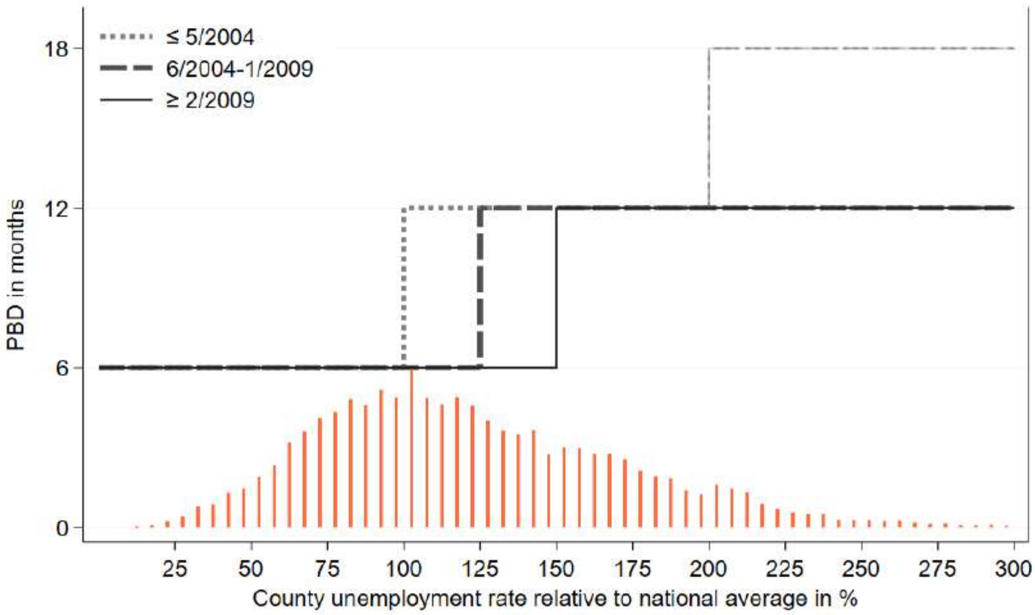
A worker's benefit duration, typically referred to as "potential benefit duration" (PBD) to distinguish it from realized duration of benefit receipt, depends on whether the unemployment rate in their county exceeds Poland's national unemployment rate by 150 percent. A worker's benefit level depends on his contributory years to the UI system when he becomes unemployed.

[3]Behavioral cost calculations provided by Schmieder and von Wachter (2016).

[4]Where we find that moral hazard from benefit generosity (duration) is significantly greater in the presence of greater benefit duration (generosity).

Both policy rules create sharp thresholds that vary UI generosity and duration. We exploit this variation to understand the causal structure of the labor market with respect to UI.

Figure 1: PBD rules




*Notes:* The figure depicts the potential-benefit-duration (PBD) rules for unemployed workers who are below the age of 50 (black lines). The orange bars represent the distribution of relative unemployment rates of counties. The dashed line at 18 months is a policy rule in place until 2009 which only affected the unemployed with at least 20 contributory years. Because just 0.32% (3 in 1,000) of the unemployed were eligible for 18 months, we focus on the other cutoffs in our empirical work.

Counties with higher unemployment rates relative to the national average offer a longer PBD to their unemployed residents. The policy is similar in spirit to the Extended Benefit program in the United States, where states with higher unemployment provide longer-lasting UI benefits. The stated goal is to provide workers additional time to find new employment if they live in less favorable economic conditions. For newly unemployed prime-age workers in a calendar year, the PBD is 6 months if the county's unemployment rate is not high, and 12 months if the county's unemployment rate is at least 150 percent of the national unemployment rate measured on June 30 of the prior calendar year (see Jessen et al., 2023, for further details).[5]

The unemployment-rate threshold triggering longer benefits has changed twice, and illustrated in Figure 1. Before May 2004, the threshold was 100 percent of the national average unemployment rate. From June 2004, the threshold moved to 125 percent. In February 2009, it was further raised to 150 percent, where it has remained since. Consequently, the share of

[5]If the unemployed are 50 years or older, different rules apply, and we focus on younger workers in this paper. Until 2009, the unemployed had a PBD of 12 months if they had contributed at least 20 years to the UI system irrespective of their their counties' unemployment rate. If the relative unemployment rate of their county exceeded 200%, the PBD was extended to 18 months. In the 2009 reform, this exception was dissolved, and all older unemployed workers with at least 20 contributory years have a PBD of 12 months.

counties (and workers) with a longer PBD has naturally decreased over time as the threshold for receiving longer-lasting benefits have been increased.[6]

A curious element of the PBD rule is that it does not depend on relative conditions compared to the national average. Regardless of whether the Polish unemployment rate is high (e.g., 20 percent in the mid 2000s) or at record-low levels of 3 percent in the early 2020s, a similar share of counties have extended PBD.[7]

The PBD for counties is determined by the relative unemployment rate on June 30 of the previous calendar year, and remains constant for all UI claims submitted in that calendar year. Unlike in the US, PBD changes do not apply retroactively and depend on when the claim was submitted, not the current economic climate. The finalized unemployment rates determining the following year's PBD are published in September, three months before a county's duration may change on January 1st of the new year.

Benefit levels in Poland are not affected by a worker's county or the local unemployment rate. Instead, it is determined based on how long a worker has been employed in covered employment. In contrast to most UI systems around the world (see discussion in Schmieder and von Wachter, 2016), benefit payments in Poland are not a fraction of previous earnings (up to a cap), but are fixed amounts that increase each year based roughly on the consumer price index. Monthly benefits increase sharply at the thresholds of 5 and 20 contributory years. Workers with fewer than 5 contributory years receive a benefit amount reflecting an 80 percent replacement rate. Workers with 5 or more years of contributions receive a benefit amount reflecting a 100 percent replacement rate. Those with 20 years of contributions qualify for a 120 percent replacement rate. In 2010, an adjustment reduced the benefit payments by 21 percent after the first three months.[8] We focus our analysis on the threshold at 5 contributory years as other benefit rules for older workers also change at the 20-year threshold. Appendix Figure B.4 shows the two intersecting discontinuities that allow us to test for interactions between benefit levels and benefit durations.

## 3 The Data

We use comprehensive administrative data covering the universe of unemployment spells registered at the public employment offices in Poland from January 2000 to July 2022. Employers notify social security upon job termination and workers have to register at the employment offices in order to collect benefits. We observe the precise start and end date of unemployment and benefit receipt. For each unemployment spell, we observe the cause of unemployment (including layoffs, firings, and quits) as well as the reason for leaving unemployment (mostly due to

[6]In Appendix Figure B.3, panels (a)–(c) we plot the distribution of counties with PBDs of 6 or 12 months in years where different cut-offs were in place. Panel (d) illustrates that, in our sample period (2002–2019), very few countries have the same PBD throughout. Appendix Figure B.2 reports the average benefit and unemployment duration over time. Along with the improved macroeconomic environment, unemployment duration has dropped substantially over time.

[7]See (Appendix Figure B.1).

[8]As an example, the benefit payments in September 2021 for unemployed workers with contributory years from 5 to 20 years were 1240.80 Złoty in the first three months and 974.40 Złoty thereafter. The corresponding amounts for workers with contributions up to 5 years were accordingly 992.70 (1240.80×0.8) and 779.60 Złoty, and for those with over 20 years 1489 and 1169.30 Złoty.

resuming employment, but also when workers claim old-age benefits). The data contains more than 40 million unemployment spells from 14 million individuals. In most of our analyses we restrict the sample to claimants under 50 years of age (for a sample frame of 7 million individuals) among whom the discontinuities produce tidier quasi-experiments.[9] For our estimates, we use unemployment spells starting from 2000 to 2019. As we observe the end dates of unemployment spells until July 2022, none of the benefit spells and only 0.7% of the unemployment spells are right-censored.

The data also contain information on other characteristics relevant to our analysis: date of birth, sex, county of residence, highest education obtained, contributory years to unemployment insurance, and the benefit level a claimant receives (which we observe starting in 2005).

Table 1: Summary statistics of spells of benefit recipients in analytic sample

| Variable | Obs | Mean | Std. Dev. | P50 |
|---|---|---|---|---|
| Age in years | 7,132,885 | 32.77 | 8.506 | 32 |
| Female (0/1) | 7,132,885 | 0.494 | 0.500 | 0.0 |
| Contributory years | 7,132,885 | 9.127 | 7.678 | 6.649 |
| Unemployment duration in months | 7,132,885 | 12.64 | 15.74 | 7.934 |
| Benefit duration in months | 7,132,885 | 6.211 | 3.774 | 6.0 |
| Benefits exhausted (0/1) | 7,130,746 | 0.541 | 0.498 | 1.0 |
| Months until entry into employment | 4,024,815 | 6.283 | 4.601 | 5.394 |
| Employment spell following unemployment (0/1) | 7,132,885 | 0.656 | 0.475 | 1.0 |
| County unemployment rate relative to national average (%) | 7,130,746 | 118.73 | 49.26 | 113.3 |

*Notes: In this table, we present simple summary statistics describing individuals in the analytic sample.*

Table 1 presents summary statistics for the analytic sample we use, UI benefit recipients under 50 years of age. The average unemployed worker in this population is 33 years old and half of the unemployed are women. Unemployment duration is on average about twice as long as the duration of benefit receipt, but looking at the median where unemployment duration is only 25 percent longer than benefit duration reveals that this is driven by a long right tail of a few folks with very long durations. More than half of recipients exhaust their benefits. The average recipient resides in a county with an unemployment rate 20 percent higher than rest of the country.

# 4 Empirical strategy

## 4.1 Estimating the effect of benefits on unemployment durations

When unemployed workers claim benefits, both the potential benefit duration (PBD) and benefit level (BL) depend on rules that produce sharp discontinuities in their benefits. In the former case, the discontinuity depends on county-level unemployment rates; in the later case, the discontinuity

[9] To be eligible for benefits, unemployed workers must have contributed to unemployment insurance for at least 12 of the previous 18 months. Benefit recipients older than 50 years old are excluded from the main analysis because their PBD is 12 months regardless of the relative unemployment rate of their county of residence.

depends on the duration of covered employment. To assess the effects of more generous UI, as characterized by PBD and BL, on benefit and unemployment duration we compare workers near each cutoff by estimating the following equation:

$$y_{ict} = \beta_0 + \beta_1 I(RU_{c/i,t} > 0) + \beta_2 RU_{c/i,t} + \beta_3 RU_{c/i,t} \cdot I(RU_{c/i,t} > 0) + county_c + year_t + \epsilon_{ict} \quad (1)$$

Here, $y_{ict}$ is either the benefit duration or the unemployment duration of individual $i$ in county $c$ in year $t$.[10] The running variable $RU$ is the relative county unemployment rate when estimating the effect of PBD, (subscript $c$) and the running variable is individual contributory years to unemployment (subscript $i$) insurance when estimating the effect of BL. We subtract from each raw running variable the cutoff value so that both running variables are centred with the threshold at zero, such that positive values indicate that the worker has crossed the threshold for a more generous or longer lasting UI. Thus, $I(RU_{c/i,t} > 0)$ equals 1 if claimants have either a longer PBD or higher BL, and 0 otherwise. $\beta_1$ is the primary coefficient of interest, capturing the estimated effect of additional UI generosity. We allow for the outcome to have a different slope in the running variable on either side of the cutoff and additionally include controls for county and year fixed effects throughout the analysis. Standard errors are clustered at the county-level. The results are robust to a variety of alternative controls.

In our main specification, we use a linear specification and tie our hands in the bandwidth selection by using the data-driven approach by Calonico et al. (2020) to recommend the optimal bandwidth. Our findings are robust to using a quadratic polynomial and a wide range of bandwidths and individual covariates. Due to the large average differences in the benefit and unemployment durations in counties with different PBDs, we estimate effects for a higher BL separately for counties with a PBD of 6 and 12 months.

## 4.2 Estimating the effect of benefits on unemployment inflows

In addition to reducing exit from unemployment, more generous UI may also increase the probability that workers enter unemployment to begin with. Moral hazard might not only be an issue for the unemployed, but the employed as well. The evidence on the inflow (or separation) margin is mixed with some studies finding negligible effects (e.g. Nekoei and Weber, 2017; Schmieder et al., 2012) while others find larger effects (e.g. Gudgeon et al., 2024; Hartung et al., 2022; Tuit and van Ours, 2010). In order to assess the effects on inflows, we modify equation (1) as the units of observations are not individual unemployment spells but bins of workers measuring the unemployment rate among those that were employed at baseline along the running variable. The dependent variable $y$ is now the log number of inflows per bin and the subscript $i$ for the running variable for the BL is dropped (see below).

For the PBD threshold we calculate the total number of inflows by county and year. Jessen et al. (2023) found that PBD increases in Poland lead to inter-temporal substitution around the

[10] We present estimates for durations in both levels and logs to enable a comparison to the literature. As the comparison of the effects of a longer PBD and a higher BL is a core element of our paper, we largely focus on estimates in logs which facilitate us to estimate elasticities. This is of particular importance in this context, as at the threshold PBD increases by 100 percent and BL only by 25 percent.

time of the increase and overall higher inflows. To account for this, we calculate inflows over i) the entire calendar, ii) for the period excluding the months with inter-temporal substitution (we only include February to September where there is no measured intertermporal bunching), and iii) only for June, i.e. far away from January when PBD can de- or increase in counties. The point estimate is larger using the first definition, but all approaches lead to similar conclusions.

We adopt a slightly different strategy for the BL threshold as it is not determined at the county-by-year level leading to a natural unit for binning. The number of inflows around the BL threshold are obtained by adding up all inflows per unique value of the running variable (contributory years minus the threshold value of 5 years). As the bandwidth selection procedure by Calonico et al. (2020) yields relatively tight bandwidths of around one year, this binning procedure gives us 565 and 802 bins for a PBD of 6 and 12 months, respectively.

The key identifying assumption for the RDD design is the continuity in potential outcomes around the threshold (Imbens and Lemieux, 2008; Lee and Lemieux, 2010). Or, put differently, that assignment to treatment by the threshold is as good as random conditional on the running varible. Because we show that benefits affect entry into unemployment, we know there is selection to contend with when estimating moral hazard among the unemployed since selection and effect are commingled across the threshold. What we find, somewhat surprisingly, however, is that accounting for this selection has essentially no effect on the estimates of moral hazard. The differences in covariates across the threshold is statistically significant, but these differences do not predict differences in benefit duration or unemployment duration.

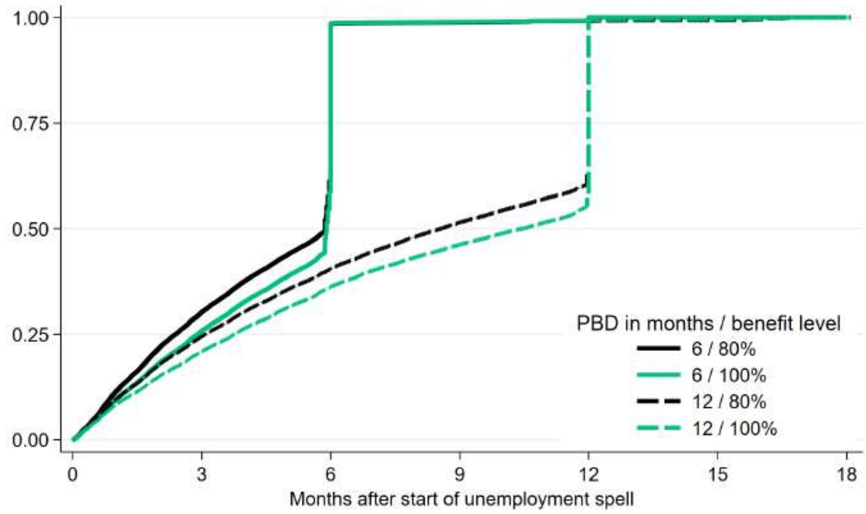
We present a battery of tests to examine the robustness of the results, and these tests suggest that the dimensions of selection we observe cannot nearly explain the estimated effects on benefit and unemployment duration. First, we add a rich set of individual characteristics to our estimates and find that coefficients are completely stable. Second, when assessing the balance of covariates across the threshold we find imbalances but they are small. Third, in the spirit of Card et al. (2007a), we predict benefit duration and unemployment duration with individual characteristics including information on the number and duration of previous unemployment spells. These predicted durations evolve smoothly across the threshold(s) and the RD estimates using predicted durations are extremely small. Fourth, when we focus on workers with prior UI spells, we find that the estimated discontinuity in prior-spell outcomes is small and usually statistically insignificant. In sum, while sizable inflow effects exist, they have little effect on the composition of the unemployed in a way that would affect their predicted durations.

## 5 Graphical evidence

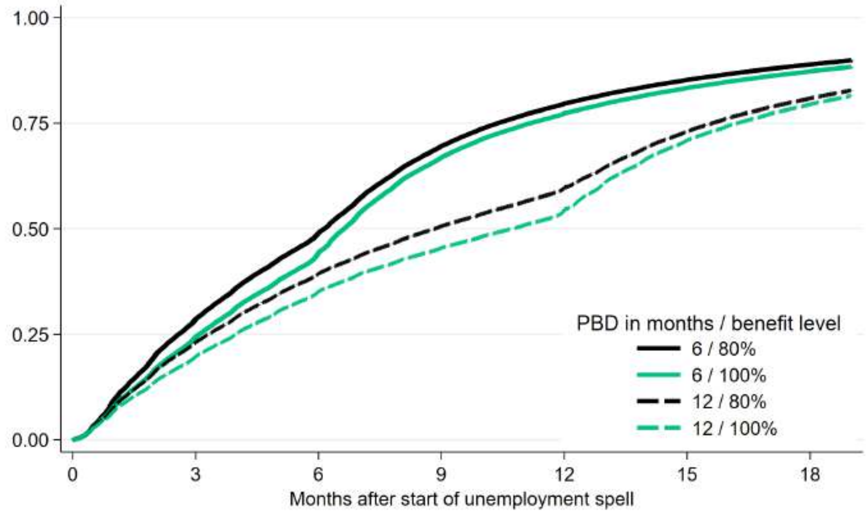
Before turning to formal econometric estimation in the following section 6, we begin our analysis with a visual exploration of unemployment outcomes separately by PBD and BL regime.

In Figure 2 we display unemployment outcomes associated with benefit receipt, panel (a), and in unemployment, panel (b). The solid lines represent unemployed with a PBD of 6 months, dashed lines a PBD of 12 months. BL is distinguished by the color, where black lines represent a BL of 80 percent and green lines a BL of 100 percent.

Figure 2: Outcome evolution by PBD and BL regime




(a) Benefit receipt




(b) Unemployment

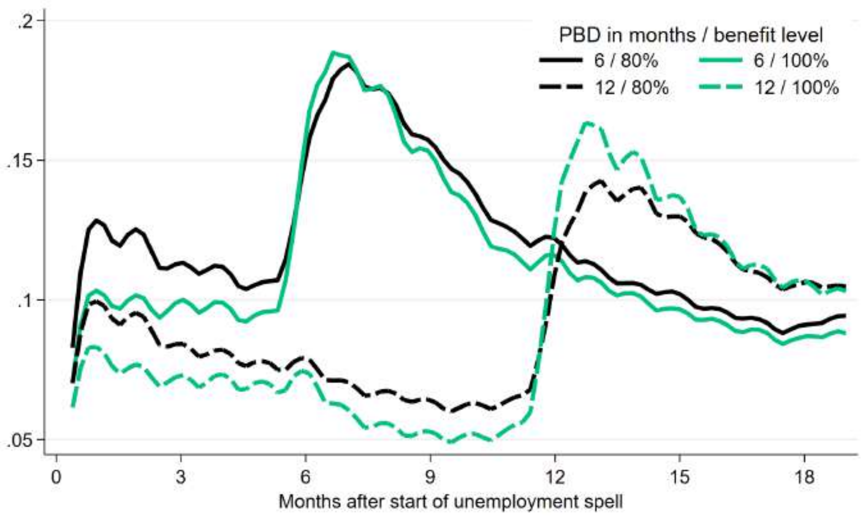
*Notes:* Figure shows failure functions for benefit receipt and unemployed of newly unemployed workers. The four lines distinguish by months of PBD (line pattern, determined by county unemployment rate) and by BL (line color, determined by contributory years). Sample period is 2004 to 2019.

In the first 6 months, when all unemployed are eligible for benefits, the solid lines of both colors (i.e. different BLs) are notably above the dashed ones, meaning that the unemployed with a 6 months PBD exit unemployment earlier than those with a PBD of 12 months. Similarly, black lines of both patterns (different PBDs) are above green ones, showing that recipients with a lower benefit level stay in benefit receipt and unemployment shorter. While the general patterns are perhaps as expected—unemployed with more generous UI determined by both PBD and BL have longer benefit and unemployment durations—they do not allow a causal interpretation of more generous UI reducing search intensity. Unemployed from counties with a 12 months PBD have worse economic conditions and those with a BL of 100 percent are generally older and older workers may have longer unemployment durations (see, e.g., Schmieder et al., 2012).

As unemployment durations are necessarily at least as long as the period of benefit receipt, the curves for exiting unemployment in panel (b) are smoother than the ones for benefit receipt in panel (a). After 18 months, 11.1 percent (PBD 6 months, BL 80 percent) to 20.5 percent (12 months, 100 percent) remain in unemployment. Contrasting exit from unemployment and benefit receipt also reveals that the relatively high benefit exhaustion rate (Table 1) is not due to the unemployed *just* exhausting benefits and exiting unemployment quickly thereafter but in many cases due to long periods of uninsured joblessness.

In Figure 3 we show the hazard rates for exiting unemployment.[11] For all four groups, pronounced spikes around benefit expiry are apparent as has been widely documented in the literature (e.g. Card et al., 2007b; Lalive et al., 2006) but exit rates remain relatively high for several months before starting to plateau.

Figure 3: Hazard rates by PBD and benefit level

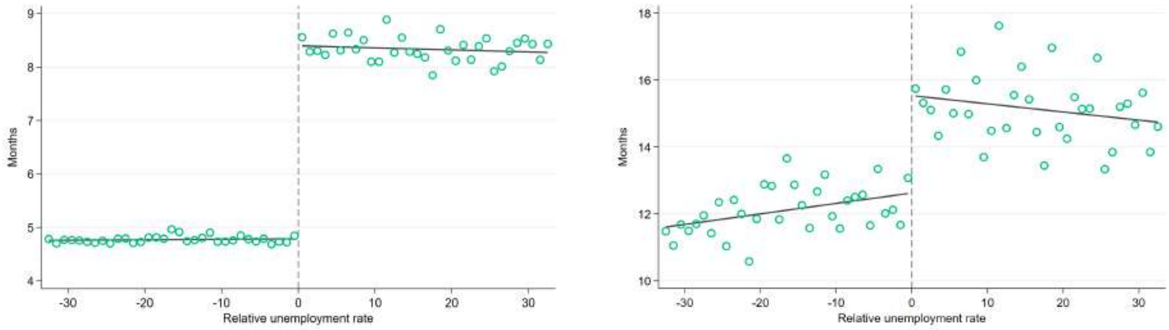



*Notes:*

To get a first assessment of the causal relationship between a longer PBD and higher BL and search behaviour, we move on to show RD graphs where average values for benefit and unemployment duration are plotted along the respective forcing variables. We use the bandwidth selection procedure by Calonico et al. (2020) to determine the bandwidth for our analysis. The identified optimal bandwidth for benefit and unemployment duration differ marginally (by 1.67 percent for the PBD estimation), so to facilitate a full comparability of results the average of these bandwidths is taken to ensure identical estimation samples for the two outcomes. The symmetric bandwidth is 32.47 percentage points for PBD estimation, 0.89 years for BL estimation with a PBD of 6 months, and 1.17 years for BL estimation with a PBD of 6 months. The following RD plots are based on the same bandwidths as the econometric estimates in the following section 6.

[11]Hazard rates for benefit receipt are of very limited insight due as the majority of unemployed exit benefit receipt and exactly the time of expiry (panel (a) of Figure 2).

Figure 4: RD plots around PBD threshold




(a) Benefit duration (b) Unemployment duration

*Notes:* Figures shows months in unemployment in bins of percentage point of county's relative unemployment rate. The bandwidth is determined by using the automatic selection by Calonico et al. (2020). Solid lines linearly fit the scatters. Sample period is 2000 to 2019.

In Figure 4 we show the reduced form relationship between benefit and unemployment duration and the relative unemployment rate. Each point represents a bin of one percentage point and the fitted lines are based on a flexible linear specification that allows for the slope to change at the cutoff. The vertical line indicates the threshold at which the PBD increases from 6 to 12 months. The discontinuity in outcomes induced by the cut-off is apparent: the average benefit duration jumps by three and a half months and unemployment duration by just shy of three months.

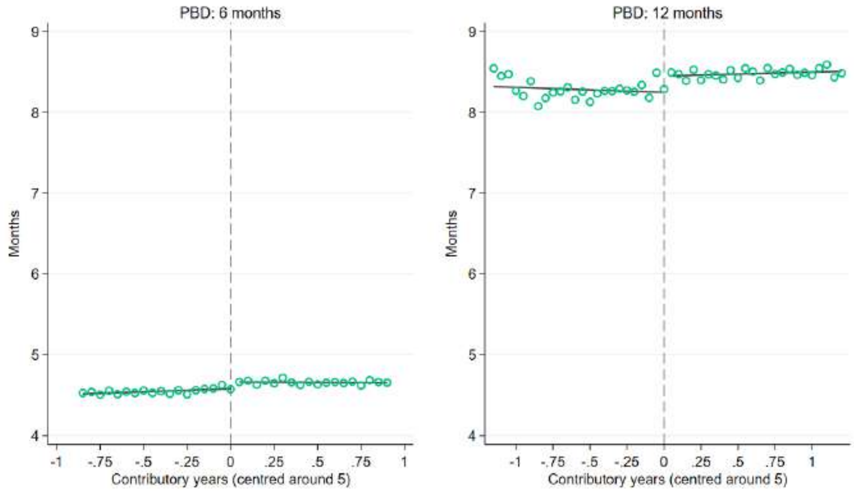
We show how benefits and unemployment duration evolve around the BL threshold in Figure 5. As in the prior analysis, we split the sample by whether the unemployed live in a county with a PBD of 6 or 12 months. We do this split as the average benefit and unemployment duration differs strongly between those counties which plausibly could lead to differential effects of a higher BL. The distribution of durations along the running variable is generally noisier,[12] but it reveals a similar pattern; more generous UI, in this case in the form of a higher BL, leads to longer benefit and unemployment durations.

## 6 Regression discontinuity estimates

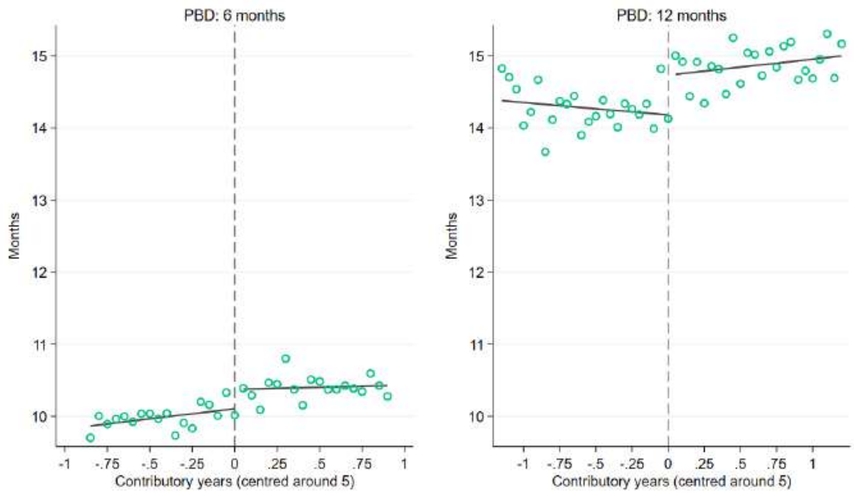
In this section we first present RD estimates of more generous UI on benefit and unemployment durations. Following, we assess the effects on inflows into unemployment and find that these inflow effects do not explain the duration estimates. We go on to find that the estimates are robust to a wide range of specification choices.

[12]The average bin in Figure 4 contains 46,064 observations, but only 13,396 (PBD of 6 months) and 9,342 observations (PBD of 12 months) in Figure 5.

Figure 5: RD plots by BL




(a) Benefit duration




(b) Unemployment duration

*Notes:* Figures shows months in unemployment in bins of 0.05 contributory years. The bandwidth is determined by using the automatic selection by Calonico et al. (2020). Solid lines linearly fit the scatters. Sample period is 2004 to 2019.

## 6.1 Effects on benefit and unemployment duration

Table 2 presents the RD estimates based on equation (1). The first two columns show the discontinuity estimates of a 6 months longer PBD, columns (3)–(6) of a 25 percent higher BL.

A PBD increase by 6 months leads the newly unemployed to collect benefits for an additional 3.46 months and lengthens their unemployment durations by 2.45 months (Panel A). Considering the dependent variables in logs (Panel B) yields elasticities of 0.62 and 0.29 for benefit and unemployment duration, respectively. The elasticity of unemployment duration in our setting is thus somewhat smaller than evidence discussed in the summary article by Schmieder et al. (2016) who report a median elasticity of 0.4 for European studies, but smaller ones for the US (see also the discussion of microelasticities in Landais et al., 2018a).

Point estimates for a 25 percent higher BL in the columns (3)–(6) are substantially smaller with increases in the benefit length by 0.12 to 0.32 months and in unemployment by 0.27 to 0.53 months. However, the relative increase in BL is only 25 percent compared to an increase by 100 percent for PBD. Considering the dependent variables in logs and obtaining the corresponding elasticities, reveals that the elasticities of benefit receipt remain much smaller than those for PBD, but elasticities of the unemployment duration are in the same ballpark and even larger for the unemployed with a PBD of 12 months. Overall we find that unemployment appears to be more responsive to BL when they are eligible to a PBD of 12 rather than 6 months. As for PBD, our BL estimates are slightly smaller than those summarized by Schmieder et al. (2016).

To aid comparisons of PBD and BL estimates, we also present estimates for the sample of unemployment spells contained in both the PBD and BL estimation in Appendix Table C.1. Naturally, this reduces the sample size, but elasticities only differ slightly and suggest larger distortions when more generous BL and more generous PBD interact. The elasticity of benefit duration and unemployment duration with respect to benefit generosity is 30–37 percent larger in the presence of longer benefit duration in Table 2. Once the samples are made more comparable, the elasticity of benefit duration and unemployment duration with respect to benefit generosity is 54–60 percent larger in the presence of longer benefit duration in Appendix Table C.1.

Table 2: Effects of more generous UI on benefit and unemployment durations

| Variation: | 6 months longer PBD | | 25% higher BL | | | |
|---|---|---|---|---|---|---|
| Dependent variable: | Months of | | | | | |
| | benefit receipt | unemployment | benefit receipt | | unemployment | |
| PBD: | | | 6 mo | 12 mo | 6 mo | 12 mo |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Panel A: Levels | | | | | | |
| RD estimate | 3.4675*** | 2.4456*** | 0.1239*** | 0.3218*** | 0.2707*** | 0.5361*** |
| | (0.0501) | (0.1386) | (0.0121) | (0.0298) | (0.0588) | (0.0996) |
| Panel B: Logs | | | | | | |
| RD estimate | 0.4304*** | 0.2001*** | 0.0489*** | 0.0671*** | 0.0573*** | 0.0748*** |
| | (0.0071) | (0.0078) | (0.0049) | (0.0071) | (0.0060) | (0.0080) |
| *Elasticities* | 0.621 | 0.289 | 0.219 | 0.301 | 0.257 | 0.335 |
| Bandwidth | 32.47 | 32.47 | 0.89 | 1.17 | 0.89 | 1.17 |
| Observations | 3,040,286 | 3,040,286 | 385,720 | 258,547 | 385,720 | 258,547 |

*Notes:* Estimates are based on equation (1). For the PBD estimates (columns 1-2) the running variable is the relative county unemployment rate and for BL estimates (columns 3-6) contributory years. All estimates include county and year fixed effects and a linear function of the running variable interacted with the treatment indicator. Sample period for PBD is 2000-2019 for PBD estimates and 2004-2019 for BL estimates. Standard errors clustered at the county-level in parentheses. Significance levels: $^{*} < 10\%$ $^{**} < 5\%$ $^{***} < 1\%$.

In Table 3 we directly gauge the interaction of a longer PBD and a higher BL in a joint estimation.

Table 3: Effects of longer PBD and higher BL and their interaction

| Dependent variable: | Months of | | | |
|---|---|---|---|---|
| | benefit receipt | unemployment | benefit receipt | unemployment |
| | Levels | | Logs | |
| | (1) | (2) | (3) | (4) |
| BL | 0.0833*** | 0.1798* | 0.0351*** | 0.0450*** |
| | (0.0201) | (0.0948) | (0.0067) | (0.0081) |
| PBD | 3.0186*** | 2.0514*** | 0.3833*** | 0.1816*** |
| | (0.0563) | (0.1452) | (0.0108) | (0.0126) |
| PBD x BL | 0.2585*** | 0.4099*** | 0.0354*** | 0.0324*** |
| | (0.0323) | (0.1160) | (0.0086) | (0.0099) |
| Observations | 292,477 | 292,477 | 292,477 | 292,477 |

*Notes:* The estimates include both forcing variables (relative unemployment rate and contributory years) interacted with the respective treatment indicator (PBD and BL, respectively). Additionally the two forcing variables, and the two treatment indicators are interacted with each other. Sample period is 2004-2019. Standard errors clustered at the county-level in parentheses. Significance levels: $^{*} < 10\%$ $^{**} < 5\%$ $^{***} < 1\%$.

Taken together, both PBD extensions and a higher BL lead to prolonged unemployment durations around the respective threshold among newly unemployed workers.

Because the two discontinuities are independent, they afford a rare opportunity to examine how the effects of benefit levels and benefit duration interact. Is the moral hazard effect of higher benefits greater in the presence of longer durations, and vice versa? To answer this question we use a two-dimensional regression discontinuity that allows benefit level and duration to interact.

We exploit these discontinuities in a combined two-dimensional regression discontinuity design, leveraging two distinct running variables determining each treatment assignment. Let $y_{ict}$ be the outcome of interest for individual $i$ in county $c$ at time $t$, $G_i$ be an indicator for having crossed the contributory years threshold to receive higher monthly benefits, and $D_{ict}$ be an indicator for residing in a county that has crossed the threshold to have longer PBD. The two running variables are contributory years $c_{it}$ determining $G_i$ and the county unemployment rate $u_{ict}$ relative to the national rate determining $D_{ict}$. We estimate local polynomial regressions of the form:

$$y_{ict} = \beta_1 G_i + f(c_{it} - c') + \beta_2 Dict + g(u_{ict} - u') + \beta_3 (G_i \times D_{ict}) \varepsilon_{ict} \tag{2}$$

Where $f()$ and $g()$ are continuous functions of the running variable which captures the continuous relationship between each running variable and the outcome of interest. The coefficient $\beta_1$ captures the effect of the greater benefit levels regime alone. The coefficient $\beta_2$ captures the effect of the greater benefit duration alone. The coefficient $\beta_3$ captures the interaction effect of benefit level and benefit duration. The two-dimensional RD identifies $\beta_1$ and $\beta_2$ by comparing individuals marginally above and below each respective threshold, while controlling for the other running variable flexibly. The interaction tests whether the effects of benefit levels and durations are multiplicative rather than additive.

Like the one-dimensional RD before, we use a robust data-driven bandwidth selection procedure to construct the local polynomial estimators around each discontinuity. We also experiment with "donut-hole" specifications that drop observations near the threshold. The results of this design are reported in Table 3.

In low potential benefit duration (PBD) environment, a 10 percent increase in benefits modestly increases unemployment duration by 0.07 months. When paired with longer PBD, the same 10 percent benefit increase substantially raises unemployment duration by 0.24 months. In other words, the elasticity of unemployment duration with respect to benefit generosity is 70 percent higher in the presence of (randomly assigned) longer benefit duration (p-value $\approx$ 0.001).

### 6.2 Effects on inflows into unemployment

Evidence on negative labor supply effects of UI through longer unemployment durations among the unemployed is plentiful, but the role of UI extensions on inflows into unemployment has been less studied in the literature to date. In several papers (e.g. Card et al., 2007a; Nekoei and Weber, 2017; Schmieder et al., 2012), potential inflow effects are discussed briefly in order to support the identifying assumption in RD setting of no selection around the threshold (which is supported in these papers as they identify no meaningful discontinuity in inflows around thresholds in UI generosity). However, more recent evidence from several institutional settings has shown that strategic inflows into unemployment may be of first-order importance (Gudgeon et al., 2024; Hartung et al., 2022; Jessen et al., 2023).

Jessen et al. (2023) have shown for Poland that at the aggregate county-level increases in the PBD lead to intertemporal substitution in entries into unemployment. Recall that cleaned unemployment rates determining the PBD are announced commonly in September and PBDs can change in counties from year to year. If a county is due to change from a PBD of 6 to 12 months, Jessen et al. document fewer inflows from October to December (just before the increase) and a large increase in inflows after the increase at the beginning of the year. To isolate our inflow estimates from these intertemporal substitution effect, in addition to an inflow of measure spanning the i) entire calendar year, we also calculate inflows from ii) February to September and iii) June only. In contrast, for inflow effects around the BL threshold, such seasonal patterns are not at play.

Columns (1)–(3) of Table 4 contain the RD estimates for inflows into unemployment using the variation by PBD using the discontinuity induced by a county's relative unemployment rate. The dependent variable is the (log) total number of inflows at the respective time periods and the unit of observation is at the county by year level. Using all inflows in a year, a 6 months longer PBD increases entry into unemployment by approximately 13 percent. We find that there is intertemporal substitution in claims when a calendar year changes as some workers delay claims in November and December to receive more generous payments by submitting a claim in January when a county crosses the PBD threshold. Excluding the months where intertemporal substitution occurs, results in smaller but still sizeable effects of 8–9 percent.

Inflow effects for a 25 percent higher BL are shown in columns (4)–(5) of Table 4.[13] Entries

[13]Reduced-form RD graphs for inflows into unemployment using the PBD and BL variation are plotted as Appendix Figures B.5 and B.6.

Table 4: Effects of more generous UI on inflows into unemployment

| Variation: | 6 months longer PBD | | | 25% higher BL | |
|---|---|---|---|---|---|
| Dependent variable: | (Log) inflows into unemployment | | | | |
| Sample: | Full year<br>(1) | Feb-Sep<br>(2) | June<br>(3) | 6 mo PBD<br>(4) | 12 mo PBD<br>(5) |
| RD estimate | 0.1321*** | 0.0801*** | 0.0878*** | 0.2398*** | 0.2154*** |
| | (0.0123) | (0.0115) | (0.0186) | (0.0358) | (0.0278) |
| *Elasticity* | 0.191 | 0.116 | 0.127 | 1.074 | 0.965 |
| Bandwidth | 32.47 | 32.47 | 32.47 | 0.89 | 1.17 |
| Observations | 2,980 | 2,980 | 2,980 | 643 | 838 |

*Notes:* Estimates are based on equation (1). For the PBD estimates (columns 1-3) the running variable is the relative county unemployment rate and for BL estimates (columns 4-5) contributory years. Estimates for the PBD include county and year fixed effects. All estimates include a linear function of the running variable interacted with the treatment indicator. Sample period for PBD is 2000-2019 for PBD estimates (excluding 2004 and 2009 where the PBD changed during the year) and 2004-2019 for BL estimates. Unit of observations for PBD estimates are county by year, and unique values of contributory years for the BL estimates. Robust standard errors in parentheses. Standard errors are clustered at the county level for the PBD estimation. Significance levels: $^{*} < 10\%$ $^{**} < 5\%$ $^{***} < 1\%$.

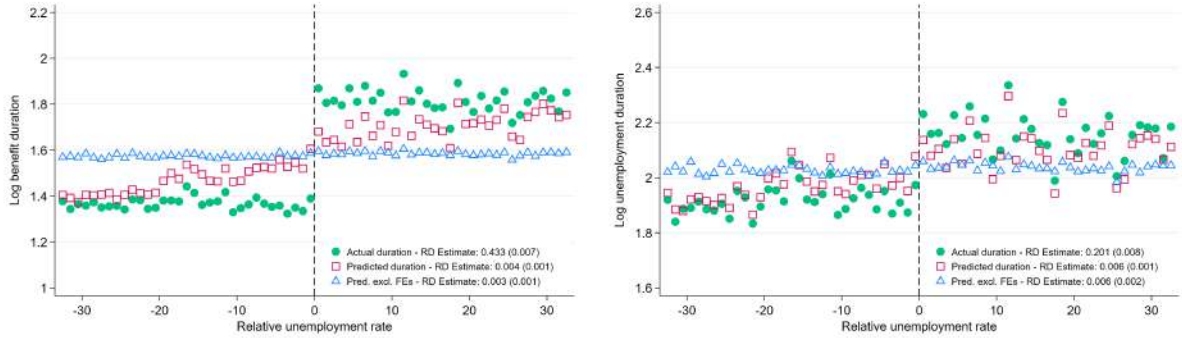
into unemployment respond strongly to the BL: once workers are eligible for the higher BL, inflows increase by more than 20 percent. The elasticities of duration with respect to BL are 1.0–1.2; elasticities of duration with respect to PBD are 0.1-0.2. A few explanations are plausible for the larger worker response with respect to BL: All workers benefit from a higher BL, even those with short unemployment spells. In contrast, only workers who would have exhausted their benefits would benefit from a longer PBD. This may be even more important than suggested by the observed exhaustion rates (see Table 1) as the newly unemployed tend to underestimate their unemployment duration (Caliendo et al., 2023). Another plausible explanation for worker's greater response to BL may be that as an individual-level factor the higher BL may be more salient to workers than county-level unemployment rates determining the PBD.

As we empirically focus on workers who were laid off (in the robustness section we also discuss results including unemployed who have quit), the inflow effects suggests that some collusion may be occurring between workers and their employers. Commonly employers do not have to make any severance payments. The notice period depends on tenure and is shorter than in many other OECD countries. Facing no direct costs in case of a dismissal, employers and workers could collude when it comes to (the timing of) dismissals. Comparable "strategic inflows" have been identified in Brazil by Van Doornik et al. (2023), where upon eligibility to UI formal workers are laid off and recalled when benefits expire. Another reason for the presence of inflows into unemployment due to dismissals is that employers could prefer laying off workers when UI is more generous for them to reduce the hardship associated with a layoff.

### 6.2.1 Assessing the importance of selection for duration estimates

The documented effects on inflows into unemployment could be a threat to the estimates on benefit and unemployment duration if the inflow effects induce a selection in the pool of unemployed around the threshold. For instance, if workers with a higher propensity to have longer unemployment spells are more likely to enter unemployment in response to more generous UI, this would imply a discontinuity in potential outcomes and the estimated duration effects would be a combination of changes in the composition and the effects on the more generous UI itself. We provide several pieces of evidence to support the notion that the inflow effects are unlikely to drive the duration estimates.

Figure 6: Comparison of observed and predicted durations—PBD




(a) Benefit duration

(b) Unemployment duration

*Notes:* Actual durations (circles) correspond to those shown in levels in Figure 4. Predicted durations (hollow squares) are obtained from regressing the observed durations on age, female indicator, number of contributory years, number of unemployment spells, education dummies, previous occupation, county FEs and year FEs. The predictions depicted as hollow triangles exclude county and year FEs. RD estimates as in Table 2.

First, we predict benefit and unemployment durations as in Card et al. (2007a) based on a rich set of covariates.[14] For this, we regress the (log) benefit and unemployment duration onto covariates and then predict the durations based on the estimated coefficients. We compare the actually observed durations to those predicted by covariates in Figure 6 for the PBD estimation and in Appendix Figure B.7 for the BL estimation. Realized durations (represented with green circles) correspond to the estimates reported in Table 2 and indicate a pronounced discontinuity. The characteristics included as covariates are powerful predictors of benefit and unemployment durations, increasing the $R^2$ by 50 percent. But as the predicted durations (hollow red squares and blue triangles)[15] reveal, these are smoothly distributed around the threshold with no economically meaningful discontinuity in the predictions identified.

[14]For the PBD discontinuity, the set of covariates are age, a female indicator, education dummies (six categories), occupation dummies of the previous unemployment spell (42), an indicator for urban counties, contributory years, and county and year FEs. Contributory years are dropped at the BL discontinuity as this defines the cut-off.

[15]Red squares are based on predictions including all of the variables described. The blue triangles exclude county and year effects which determine the treatment assignment. As the gradual increase in durations with a higher relative unemployment rate is due to the unemployed residing in counties with generally worse economic conditions, excluding those in the predictions leads to a flat distribution of

The comparison of observed and predicted durations suggest at most a minor role played by selection effects and we report three additional pieces of evidence to develop the analysis. In Appendix Figure B.8 we present RD estimates from four different specifications, starting with a simple specification including only the interacted running variable. Adding individual characteristics has essentially no effect on the point estimates. In the final specification we add information on previous unemployment spells (number of previous spells and their durations), to help capture the role of "unobserved" unemployment type. But again we see no indication of this affecting our estimates. Appendix Table C.2 indicates how individual characteristics are distributed around the respective threshold.[16] We find statistically significant differences in the demographic profile of claimants across the threshold, but they do not predict differences in benefit duration or unemployment duration. As a final check we focus on workers with previous unemployment spells and compare the RD estimates of the *current* spell with that of the *previous* spell. Estimates on the duration of previous spell are an order of magnitude smaller and typically statistically insignificant.

Taking the evidence of these analyses together, we conclude that while selection into unemployment occurs in absolute numbers when UI becomes more generous, in our context it does not appear to bias estimates of the effect of benefit regime on unemployment durations.

### 6.2.2 Demographics of the induced unemployed

One reasonable question is *what kind of workers are induced into unemployment by more generous benefits? And how do these marginal unemployed differ from the inframarginal unemployed?*

We set out to calculate the demographics of the marginal workers induced into unemployment by more generous benefits using the RD. The key idea is that if we know how mean demographics change at the threshold and how many more workers entered unemployment because of the threshold, we can back out the demographics of the marginal group by assuming that the inframarginal workers have smooth covariates across the threshold.

Imagine for instance that under normal benefits, 6.59 percent of workers enter unemployment and that increases by 13 percent at the threshold from more generous benefits. On the stingier side of the threshold, we see that the average age is 32.1 at the cutoff. On the generous side of the cutoff, the average age is 32.4. It must be that the workers who became unemployed as a result of more generous benefits were somewhat older than the inframarginal. For a given difference in demographics, the marginal unemployed must be very different if the increase in claiming is small, and relatively similar if the increase in claiming is large.

We implement this logic algebraically. Let $c_p$ be the constant in the probability of entering unemployment at the threshold. This is the predicted inflow rate on the left (stingy) side of the RD threshold (estimated without county and year FE). This value tells us the baseline rate at which people enter unemployment. Let $B_p$ signify the predicted effect of the threshold on the probability of entering unemployment because of more generous benefits offered at the cutoff.

predicted durations. In Appendix Figure B.7 predictions excluding those FEs are not included as they play no significant role at the BL threshold.

[16]The raw averages around the thresholds are reported in Appendix Figures B.9- B.11.

For each demographic descriptor of claimants, we use two additional values to calculate the demographic profile of marginal claimants. Let $c_d$ be the constant in the demographic outcome, the predicted age for instance on the left (ungenerous) side of the threshold. This quantity tells us the demographics of the inframarginal unemployed. Let $B_p$ be the predicted discontinuity in probability and the predicted discontinuity $B_d$ in demographics (say age) at the threshold.

To calculate the demographics of the marginal unemployed, we solve for what the demographics of this group must be to explain the change in average demographics at the cutoff:

$$\underbrace{(c_p \times c_d)}_{\text{demographics of inframarginal}} \quad + \quad \underbrace{(B_p \times \mathbf{X})}_{\text{demographics of marginals}} \quad = \quad \underbrace{(c_p + B_p) \times (c_d + B_d)}_{\text{total demographics on generous side}} \tag{3}$$

We solve for $\mathbf{X}$ in an equation of each demographic descriptor to find the mean demographic profile of the marginal unemployed induced into unemployment by additional generosity. To make the idea clear, imagine that claiming doubled at the threshold from 10 percent to 20 percent. Say at the same time, the fraction of claimants that were female went from 0 percent to 20 percent. We know intuitively that marginal claimants must be 40 percent female. The equation formalizes this logic $(0.10 \times 0) + (0.10 \times X) = (0.10 + 0.10) \times (0 + 0.20) \implies X = 0.40$ or 40 percent.

We present the results of this analysis in Table 5. When benefits become longer lasting (quasi randomly offering a higher potential benefit duration), we find that marginally induced unemployed workers tend to be somewhat older and more likely to be women. Specifically, the mean age of the inframarginal group is 32.1 years. We calculate that the mean age of the marginal group is 34.8 years. Consonant with that finding, we find that marginal workers are also more experienced than inframarginal workers. Marginals have 11.3 years of labor market experience (contributory years) where inframarginal workers have 8.8 years of experience. Inframarginal workers, moreover are 45.3 percent female. Marginal workers induced to claim by greater generosity are 60.2 percent female. The marginals look very alike the inframarginals in their numbers of prior spells.

When benefits become more generous (quasi randomly offering higher benefit levels), we find that marginally induced unemployed workers, again, are older and somewhat more likely to be women. We also find that marginals are much less educated than inframarginal claimants and are much more likely to have had previous experience with unemployment insurance.

## 6.3 Robustness

We provide a thorough battery of RD robustness checks in the Appendix to vet our estimates and we find they are robust to a range of specification choices.[17] Appendix Figure B.12 reports estimates from different bandwidth choices including our preferred estimates using the optimal bandwidth selection calculated according to Calonico et al. (2020). Estimates are very stable to the bandwidth variation with, if anything, larger effects for smaller (read: less biased) band-

[17]As discussed in the previous subsection, adding control variables including information on the unemployment history has little effect on the estimates, and adding county and year FEs only improves precision (Appendix Figure B.8).

Table 5: Demographics of inframarginal and marginal claimants

| | PBD Discontinuity | | BL Discontinuity - 6mo | | BL Discontinuity - 12mo | |
|---|---|---|---|---|---|---|
| | inframarg. mean | marginal mean | inframarg. mean | marginal mean | inframarg. mean | marginal mean |
| Age | 32.11 | 34.82 | 28.54 | 36.61 | 28.18 | 38.37 |
| Female (0/1) | 0.453 | 0.602 | 0.511 | 0.532 | 0.514 | 0.564 |
| Higher education (0/1) | 0.493 | 0.517 | 0.580 | 0.447 | 0.565 | 0.446 |
| Number of previous UI spells | 1.371 | 1.345 | 1.485 | 2.140 | 1.422 | 2.212 |
| Contributory years | 8.819 | 11.29 | . | . | . | . |

Note: We would like to know what kind of worker is drawn into unemployment by greater benefits. In this table, we compare the demographic profile of those induced to unemployment by more generous benefits (the *marginal* unemployed) to those that would have claimed even without more generous benefits (the *inframarginal* unemployed). The values in the inframarginal columns are recovered by estimating a regression discontinuity model where the outcome is the demographics of claimants and the running variable is that relevant for each generosity threshold. The inframarginal value is the constant on the stingy side of the cutoff. The values in the marginal columns are calculated. They are what the mean demographics of the marginals must be to rationalize how demographics change at the threshold, using equation (3).

widths in the BL estimation (see panels (e) and (f)). Coefficients are also stable if the interacted running variable is specified linearly or quadratically (Appendix Figure B.13), with similar robustness if we exclude observations close to the cut-off to account for potential attribution error or manipulation near the threshold (also known as the "donut" RD, Appendix Figure B.14). The corollary robustness checks for the inflow effects are reported in Appendix Figure B.15 (bandwidth), Appendix Figure B.16 (polynomial) and Appendix Figure B.17 (donut).[18] These results follow the same pattern of generally stable estimates.

Finally, we also report RD estimates for benefit and unemployment duration as well as inflow effect including workers who are registered as having quit. These unemployed need to wait for 3 months until they receive benefits and the PBD is 3 or 9 months, i.e. the same difference of six months as for the unemployed who were laid off on which the main analysis focuses (and who constitute 85% of the sample). The estimates in Appendix Tables C.4-C.7 indicate that adding these workers to the sample have little influence on the coefficients and also when focusing on quitters, we find pronounced effects on both durations and inflows into unemployment.

# 7 Welfare effects

## 7.1 The model

We consider the welfare effects of changes to the UI system in a model of the labor market with endogenous separations and endogenous job search effort in discrete time. These workers have mass one and are either unemployed, receiving benefits or not, or employed, so that $e$ and $u$ are the shares of employed and unemployed workers and $e + u = 1$. The unemployed receive benefits until benefit exhaustion and then receive social assistance with lower consumption each

[18]Due to the lower number of observations for the inflow estimations, estimates with very narrow bandwidths or large donut holes yield quite large standard errors. To allow the reader to assess the robustness of the estimates more easily from the figures, those imprecise estimates are omitted from the figures, but available from the authors upon request.

period. Denote the share of benefit recipients by $u_b$. At the end of his working life, a worker leaves the work force and a new worker enters, so that the mass of workers is constant in time. In our model, we consider the effect of changes to the benefit level and benefit duration (PBD) on social welfare.

### 7.1.1 The individual's problem

We write a recursive formulation of the worker's problem, similar to Chetty (2008) and Schmieder et al. (2012). The key difference is that employed workers can endogenously become unemployed in response to benefit generosity. Individuals hold assets $A_t$ at time $t$ and there is a lower bound on assets $L_t$.[19] By the end of the model's time horizon, workers have to repay their debt, $A_T \leq 0$. For simplicity we abstract from discounting.

The value function for an employed worker is

$$V_t(A_t, \eta_t) = \max_{A_{t+1}} \left( \nu(A_t - A_{t-1} + w - \tau) - \eta_t + \mathop{\mathbb{E}}_t max\{V_{t+1}(A_{t+1}, \eta_{t+1}), U_{t+1}(A_{t+1})\} \right), \quad (4)$$

where $\nu(c_t^e)$ denotes flow utility from consumption during employment, which is an increasing and concave function. We assume that all production is consumed by workers and firms make zero profits. The notation $\eta_t$ represents the disutility of work and is independently and identically distributed with each individual worker taking a new draw each period. Separations occur whenever the expected value of the outside option of a worker, unemployment, exceeds that found in employment. This can happen due to a large draw from the disutility-of-work distribution or because the value of unemployment is altered by changes to the UI system.[20] We denote the economy-wide job destruction rate with $\delta$, that is, the average probability that a worker becomes unemployed.

The value function for an unemployed individual is

$$U_t(A_t) = \max_{A_{t+1}} \left( u(A_t - A_{t-1} + b) + J_{t+1}(A_{t+1}) \right), \quad (5)$$

where $u(c_t^u)$ reflects the flow utility from consumption in unemployment, where $u()$ is an increasing and concave function. $J_t$ describes the jobs search decision,

$$J_t(A_t) = \max_{s_t} \left( s_t \mathop{\mathbb{E}}_t \max\{V_t(A_t), U_t(A_t)\} + (1 - s_t)U_t(A_t) - \psi(s_t) \right). \quad (6)$$

Search effort $s_t$ determines the probability that an individual receives a job offer and $\psi(s_t)$ is the search cost function, which is increasing and convex. The probability that an unemployed individual enters employment is given by $s_t \times Pr(v_t(A_t) > U_t(A_t))$.

We denote the average rate at which the unemployed transition into employment as $f$.

[19] An alternative way to capture self-insurance is via household production as in Landais et al. (2018b).

[20] An alternative way to generate separations is through productivity shocks as in Mortensen and Pissarides (1994).

### 7.1.2 The labor market equilibrium

If transition rates between states remain constant over time, unemployment converges to its steady state. The steady-state unemployment rate is given:

$$u = \frac{\delta}{\delta + f}, \tag{7}$$

We denote the exit rate from benefit receipt as $f_b$, either into employment or benefit exhaustion. In steady state, outflows from benefit receipt equal inflows, so $f_b u_b = \delta \times e$ and the stock of benefit recipients is given by

$$u_b = \frac{\delta \times e}{f_b} = \frac{\delta \times f}{f_b(f + \delta)}. \tag{8}$$

### 7.1.3 The social planner's problem

The social planner maximizes welfare in the steady state. The social planners chooses benefit levels and maximum durations, $b$ and $P$, in order to maximize social welfare given by

$$W = u_b \nu(c_b) + (u - u_b)\nu(c_x) + ev(c_e) - u\psi(s), \tag{9}$$

Here, the social planner aggregates the combined welfare of the population (benefit recipients, benefit exhaustees, and employed workers), where $c_b$, $c_x$, and $c_e$ denote consumption levels of the three groups, minus the search cost of the unemployed, $\psi$, which depends on the intensity of search effort, $s$.

The government budget constraint is given

$$\mathcal{G} + u_b \mathcal{B} + u_x \mathcal{A} = e\mathcal{T}, \tag{10}$$

where $\mathcal{G}$ is exogenous government spending, $\mathcal{B}$ is transfers to benefit recipients, $\mathcal{A}$ is social assistance paid to the long-term unemployed and $\mathcal{T}$ is the average tax liability of the employed. One can think of $\mathcal{A}$ as a lump-sum transfer. It is convenient to define $\tau = \mathcal{T} + \mathcal{A}$, $b = \mathcal{B} - \mathcal{A}$, and $G = \mathcal{A} + \mathcal{G}$. Then, using $1 = e + u_x + u_b$, we can simplify:

$$G + bu_b = e\tau. \tag{11}$$

The important difference between this problem and those described in Chetty (2006), Chetty (2008), and Schmieder and von Wachter (2016) is that the social planner considers steady-state stocks in an economy with potentially endogenous separations. Instead, the canonical model considers an individual who becomes unemployed and in expectation needs to pay for his unemployment benefit through taxes once she finds a job. Below we show that the canonical model with fixed inflows into unemployment is a special case of ours.

### 7.1.4 The welfare effects of UI changes

We present the formulas for the welfare effects of small changes in the benefit level or the potential benefit duration. We present a detailed derivation in Appendix A.1. Following Chetty (2008), our money metric welfare measure is the ratio of the welfare gain that arises from redistributing one dollar from the employed sector to the unemployed sector via an increase in the benefit levels and a corresponding decrease in wages through taxes.

Labor market behaviors, specifically job separation and job finding rates, are a function of the PBD, denoted $P$, and the benefit level, denoted $b$. Tax increases are used to finance greater $b$. The formula for the welfare effect of an increase in $b$ is obtained by differentiating equations (9) and (11) with respect to $b$, and substituting:

$$\frac{dW}{db}\frac{1}{u_b v'(c_e)} = \underbrace{\frac{\nu'(c_b) - v'(c_e)}{v'(c_e)}}_{\text{Social value of \$1 add. transfer}} - \underbrace{\left(b\frac{du_b}{db} - \frac{de}{db}\tau\right)\frac{1}{u_b}}_{\text{Behavioral cost per \$1 add. transfer}} . \tag{12}$$

To obtain equation (12), we apply the envelope theorem and assume efficient separations, that is that worker-firm matches that separate are those having the lowest joint surplus. Here efficiency means that separations occur only when the joint surplus of the employee and the employer becomes negative. Inefficient separations can occur when wages are rigid. Consider a match with positive employer and employee surplus. Now outside options of the worker improve because of an increase in UI generosity, such that the surplus of the worker becomes negative, but total surplus is still positive. In principle, the match could continue if the wage was increased. But if this is not possible, the worker will quit the job. When separations are inefficient, the efficiency cost of separations is even larger than in our model because an additional externality is introduced, a cost borne by the firm.[21]

Consequently, behavioral reactions matter for welfare only through their impact on the government budget. The intuition is simple: An increase in the benefit level increases welfare if and only if the social value of redistribution exceeds the behavioral cost. The social value represents the increase in utility of consumption of the unemployed induced by the increase in benefit levels relative to the employed. As the utility of consumption is assumed to be a concave function, the social value term is strictly positive (if $b < w - \tau$). The behavioral cost is driven by two elements: the fact that unemployment may increase in response to more generous benefits and the reduction of taxes paid by a smaller employed sector. The behavioral cost of redistributing one dollar to transfer recipients, is also referred to as the BC/MC ratio, the behavioral cost divided through the mechanical cost (Schmieder and von Wachter, 2017).[22]

We write an empirically implementable version of the behavioral-cost part in terms of estim-

[21] Jäger et al. (2023) find evidence for inefficient separations in Austria. Their findings are compatible with a model with wage rigidity.

[22] It is closely related to the marginal value of public funds (MVPF, see Finkelstein and Hendren, 2020; Hendren and Sprung-Keyser, 2020). The MVPF of a \$1 increase in transfers is $MVPF^{\$1} = WTP/(1 + FE)$ (Finkelstein and Hendren, 2020; Hendren and Sprung-Keyser, 2020), where $FE = BC/MC$ denotes the fiscal externality from behavioral reactions, and $WTP$ denotes the willingness to pay for additional insurance. The willingness to pay equals the social value of \$1 additional transfer, derived below.

able elasticities and use $f = 1/D$ and $f_b = 1/D_b$, where $D$ and $D_b$ are average unemployment and benefit receipt durations. We show in Appendix A.2 that these equations hold even if the job finding rate varies during the unemployment spell, as long as separations are somewhat constant. In order to quantify the welfare effect of an increase in the benefit level using our estimates, we write changes in $u_b$ and $e$ in terms of the elasticities $\eta_{D,b} = \frac{dD}{d_b}\frac{b}{D}$, $\eta_{D_b,b} = \frac{dD_b}{d_b}\frac{b}{D_b}$ and $\eta_{\delta,b} = \frac{d\delta}{b}\frac{b}{\delta}$.[23] Now we can write

$$BC/MC^b = e\frac{\tau}{b}\frac{D}{D_b}\left(\eta_{\delta,b} + \eta_{D,b}\right) + \eta_{\delta,b} + \eta_{D_b,b} - \eta_{D,b}u_b. \tag{13}$$

The first term yields the behavioral cost due to the reduction in tax revenues through an increase in the separation rate and an increase in the unemployment duration. The second and third terms capture the increase in transfer payments due to an increase in the separation rate and the benefit duration. The final term is negative. Given the increase in the average benefit duration, an increase in the unemployment duration leads to a *decrease* in the stock of benefit recipients. The reason is that a higher stock of unemployed implies a lower stock of employed. At given job destruction rates this lowers the inflow into benefit receipt.

Similarly, we can obtain the welfare effect of transferring \$1 to unemployed recipients via a marginal increase in the potential benefit duration $P$:

$$\frac{dW}{dP}\frac{1}{\left.\frac{du_b}{dP}\right|_M bv'(c_e)} = \underbrace{\frac{\nu'(c_{u,t>P}) - v'(c_e)}{v'(c_e)}}_{\text{Social value of \$1 add. transfer}} - \underbrace{\frac{1}{\left.\frac{du_b}{dP}\right|_M}\left(\left.\frac{du_b}{dP}\right|_B - \frac{de}{dP}\frac{\tau}{b}\right)}_{\text{Behavioral cost per \$1 add. transfer}}, \tag{14}$$

where $\left.\frac{du_b}{dP}\right|_M$ indicates the mechanical increase in the stock of benefit recipients, i.e. the mechanical increase in the stock of benefit recipients due to the change in $P$ holding the survival function in unemployment constant. $\left.\frac{du_b}{dP}\right|_B$ indicates the increase in benefit recipients due to behavioral reactions. Similarly, Schmieder et al. (2012) decompose the increase in average benefit durations into a mechanical and a behavioral component.

The intuition is similar to that of equation (12). The mechanical increase in total transfer payments due to a marginal increase in the PBD is $\left.\frac{du_b}{dP}\right|_M b$. In contrast to benefit level increases, the beneficiaries of an increase in the PBD are the exhaustees. We denote their marginal utility of consumption by $\nu'(c_{u,t>P})$. Due to lower consumption levels of exhaustees, the social value term of equation (14) is plausibly larger than that of equation (12). The empirically implementable

[23] These elasticities also include the effect of the change in $\tau$ necessary to finance an increase in $b$ on durations and the job destruction rate. This effect is not accounted for in the empirically obtained elasticities, which are therefore slightly smaller than the elasticities needed for the welfare calculation. However, the discrepancy is likely small as the necessary tax increase to finance an increase in $b$ is small relative to the increase in $b$. (Chetty, 2008, footnote 32) verifies in numerical simulations that elasticities are very similar with $\tau$ fixed and $\tau$ variable.

version of the formula for BC/MC is

$$BC/MC^P = \frac{1}{\left.\frac{dD_b}{dP}\right|_M} \left( e\frac{\tau}{b}\left(\frac{d\delta}{dP}\frac{D}{\delta} + \frac{dD}{dP}\right) + \frac{d\delta}{dP}\frac{D_b e}{\delta} + \left.\frac{dD_b}{dP}\right|_B - \frac{dD}{dP}u_b \right), \tag{15}$$

where $\left.\frac{dD_b}{dP}\right|_M$ and $\left.\frac{dD_b}{dP}\right|_B$ indicate mechanical and behavioral increases in the average benefit duration due to an increase in $P$. For marginal changes in $P$, $\left.\frac{dD_b}{dP}\right|_M$ is simply the benefit exhaustion rate.

## 7.2 Parametrization

We use our estimates for the effects of level changes and PBD extensions on unemployment and benefit durations as well as on inflows to calculate the behavioral cost of changes to the UI system. We also use descriptive statistics obtained from our sample. Finally, we set the parameters of the tax-transfer system. We calculate these based on numbers provided by the OECD for individuals with average earnings. For benefit levels, we report separate welfare calculations for counties with 6 or 12 months PBD. They differ somewhat in the estimated elasticities.

The OECD reports average tax rates and replacement rates, which can be used to calculate $\mathcal{T}$ and $\mathcal{B}$. Instead, we directly calculate the ratio $\tau/b$ as follows:

$$\frac{\tau}{b} = \frac{\text{tr} + (1-\text{tr}) \times \text{rr}_{long}}{(\text{rr}_{short} - \text{rr}_{long}) \times (1-\text{tr})} = \frac{0.348 + (1-0.348) \times 0.2}{(0.41-0.21) \times (1-0.348)} = 3.69, \tag{16}$$

where tr denotes the average tax rate and $\text{rr}_{short}$ and $\text{rr}_{long}$ are the replacement rates for short-term unemployed who receive unemployment benefits and long-term unemployed who only receive social assistance, respectively. In Poland, unemployment benefit recipients typically receive social assistance on top. The replacement rate for short-term unemployed therefore includes unemployment benefit and social assistance. Multiplying the nominator of the right-hand side of equation (16) with the average gross earnings yields $\mathcal{T} + \mathcal{A} = \tau$ and multiplying the nominator with average gross earnings yields $\mathcal{B} - \mathcal{A} = b$.

If we ignored the fact that the long-term unemployed receive social assistance $\mathcal{A}$, we would calculate $\tau$ as $\frac{tr}{(1-tr)\text{rr}_{short}} = \frac{0.348}{0.41\times(1-0.348)} = 1.30$, leading to a substantial underestimation of the fiscal cost of increases in UI generosity.

Table 6 reports the parameter values used for the calculation of welfare effects.

Inserting the parameter values reported in Table 6 into the equations for changes in the $BC/MC$ ratio, we can calculate the impact of changes in the UI system on welfare. For instance, using equation (13), we obtain the change in the $BC/MC$ ratio for benefit level increases. At a

PBD of six months, it is

$$
\begin{aligned}
BC/MC^b &= e\frac{\tau}{b}\frac{D}{D_b}\left(\eta_{\delta,b} + \eta_{D,b}\right) + \eta_{\delta,b} + \eta_{D_b,b} - \eta_{D,b}u_b \\
&= 0.92 \times 3.69 \times 2.08 \times (1.07 + 0.26) + 1.07 + 0.24 - 0.24 \times 0.04 \\
&= 10.78.
\end{aligned}
$$

Table 6: Parameters for BC/MC of increases in BL or PBD

| | $e$ | $u_b$ | $\frac{dD_b}{dP}\Big\vert_M$ | $D$ | $D\_b$ | $\delta$ | $\eta_{D,b}$ | $\eta_{D_b,b}$ | $dD/dP$ | $\eta_{\delta,b}$ | $d\delta/dP$ | $\tau/b$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PBD raise | .90 | .05 | .62 | 11.9 | . | .01 | . | . | .41 | . | .00018 | 1.58 |
| BL raise at PBD = 6 | .92 | .04 | . | 9.39 | 4.52 | . | .26 | .24 | . | 1.07 | . | 1.58 |
| BL raise at PBD = 12 | .89 | .07 | . | 12.66 | 7.92 | . | .34 | .32 | . | .97 | . | 1.58 |

*Notes:* Parameters used to calibrate the impact on welfare of marginal increases in UI generosity. Own calculations based on our sample and statistics provided by the OECD.

### 7.3 Welfare effects: results

In this subsection we present calculations for the BC/MC ratio and the MVPF from increases in the potential benefit duration or increases in the benefit level. The second ingredient necessary to evaluate the welfare impact of making the UI system more generous is the social value of an additional transfer, which depends on the difference in the marginal utility of consumption between the beneficiaries and employees. This, in turn, depends on the replacement rate, and other means of consumption insurance including self-insurance via savings or insurance through the household. We present the BC/MC ratio and the MVPF for different values of constant relative risk aversion (CRRA) and consumption drops. To our knowledge, there are no studies on the consumption drop at unemployment for Poland. Therefore we also report the consumption drop at unemployment at which the social value of an additional transfer equals the behavioral cost. At this point, the social planner is indifferent whether to increase or decrease the benefit level by $\varepsilon$. This consumption drop can then be compared to consumption drops at unemployment found for other countries.

Table 7 shows the welfare calculations for PBD increases. BC/MC based on the standard formula by Schmieder et al. (2012) assuming fixed inflows is 2.46 (column 1), which is at the upper end of studies surveyed in Schmieder and von Wachter (2016), who report a median of 1.78. Allowing for endogenous inflows increases the behavioral cost by 46 percent. In columns (2)-(5) we present the MVPF with different CRRAs and consumption losses assumed. The MVPFs of 0.24-0.46 are lower than most MVPFs in Hendren and Sprung-Keyser (2020) (both overall and compared to other social assistance programs). Allowing for endogenous inflows reduces the MVPFs by by 23.9 (column 5) to 26.3 (column 4) percent.

In Appendix Table C.10, Panel A, we report the consumption losses required for a neutral welfare effect of PBD extensions with different CRRAs. With a CRRA of two, consumption losses at benefit exhaustion would have to be around 50%. Evidence for the drop in consumption at exhaustion is scarce, but Ganong and Noel (2019) find that in the US consumer spending after benefit exhaustion is on average 20 percent lower than before becoming unemployed. Even at the quite high CRRA of five, consumption losses would have be as large as 26.2 percent. I.e. unless the drop in consumption in Poland at benefit exhaustion is unusually high, according to our model, shortening PBD would be welfare increasing.

Table 7: BC/MC and MVPF of increases of potential benefit durations (PBD)

| | BC/MC | MVPF | | | |
|---|---|---|---|---|---|
| Coefficient of relative risk aversion (CRRA): | | 1 | 2 | 1 | 2 |
| Consumption loss | | 10% | 10% | 30% | 30% |
| | (1) | (2) | (3) | (4) | (5) |
| Fixed inflows | 2.46 | 0.32 | 0.35 | 0.38 | 0.46 |
| Endogenous inflows | 3.58 | 0.24 | 0.26 | 0.28 | 0.35 |

*Notes:* Own calculations.

Table 8 shows the BC/MC ratio and MVPF per additional dollar transferred via an increase in the benefit level. Panel A contains results for counties with a PBD of 6 months and panel B for counties with a 12 months PBD. Based on the canonical Baily-Chetty formula (fixed inflows), the BC/MC is around 2.2 (regardless of counties' PBD), implying that in order to transfer one dollar, 3.2 dollars need to be raised, 1 dollar to finance the transfer and 2.3 dollars to finance the behavioral cost. This measured behavioral cost is larger than the average of $1.3 in Schmieder et al. (2016), but in line with that found using a regression kink design in Card et al. (2015b) who find behavioral costs per dollar of $2.8–$5.6 or an overlapping team implementing regression kink in the United States (Card et al., 2015a). The MVPFs under different assumptions of CRRA and the consumption losses are 0.33-0.5—in the same ballpark as those for PBD increases reported in Table 7.

Allowing for endogenous separations notably alters the calculus. Now the behavioral cost of transferring one dollar is 8.1-10.7 dollars (3.6-4.9 larger than with fixed inflows) and MVPFs are all below 0.2, even with a CRRA of two and large consumption losses of 30% assumed. The main reason for the large differences in the welfare implications for increases in the BL is that the inflow elasticities for BL increases are substantially larger than for PBD extensions (Table 4). In Appendix Table C.10 we present the consumption losses required for a zero welfare effect (i.e. the Baily-Chetty condition holds). With endogenous inflows, consumption losses would need to be in the range of 36% (CRRA of five, county PBD of 12 months) to 91% (CRRA one, PBD 6). This is larger than the average consumption loss at unemployment found in any of the studies surveyed in Schmieder and von Wachter (2016). The implication is that accounting for endogenous inflows in Poland significantly changes the understood cost of unemployment transfers.

Table 8: BC/MC and MVPF of increases of benefit levels (BL)

| | BC/MC | MVPF | | | |
|---|---|---|---|---|---|
| Coefficient of relative risk aversion (CRRA): | | 1 | 2 | 1 | 2 |
| Consumption loss | | 10% | 10% | 30% | 30% |
| | (1) | (2) | (3) | (4) | (5) |
| *Panel A: 6 months PBD* | | | | | |
| Fixed inflows | 2.2 | 0.34 | 0.38 | 0.41 | 0.5 |
| Endogenous inflows | 10.7 | 0.09 | 0.1 | 0.11 | 0.14 |
| *Panel B: 12 months PBD* | | | | | |
| Fixed inflows | 2.29 | 0.33 | 0.36 | 0.4 | 0.49 |
| Endogenous inflows | 8.14 | 0.12 | 0.13 | 0.14 | 0.18 |

*Notes:* Own calculations.

## 8 Conclusion

In this paper, we examine the implications of unemployment insurance (UI) on labor markets by exploiting a unique institutional setting. In Poland, benefit duration and benefit generosity are quasi-randomly assigned with sharp cutoffs and the two discontinuities intersect. That intersection allows us to estimate how the effects of benefit generosity and benefit duration interact to distort labor supply.

We estimate duration elasticities with respect to benefit generosity and benefit duration, and those estimates are in the range of prior work. Importantly, we also find significant moral hazard among the employed, where employed workers that are eligible for greater benefits are much more likely to become unemployed. Workers that enter unemployment because of more generous or longer lasting benefits tend to be slightly older, more female, and less educated than those that become unemployed under less generous benefit regimes.

We also find that the moral hazard from benefit duration and benefit generosity interact: The elasticity of duration with respect to benefits is more than 50 percent larger in the presence of (randomly-assigned) longer benefit durations. Because both the labor supply distortion and the costs of insurance grow with an increasing PBD and BL, the interaction suggests temperance in policy design.

We incorporate these findings into an extended Baily-Chetty model of optimal benefits, considering the social welfare implications of UI in the presence of endogenous inflows into unemployment (where the baseline Baily-Chetty model assumes that layoffs are endogenous) and the moral hazard interactions of benefit generosity and benefit duration. This model weighs the benefits of consumption smoothing against the costs of moral hazard. We conclude that including the effects of moral hazard among the employed significantly increases the understood fiscal costs of UI, in particular of increases in the benefit level.

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# APPENDIX (FOR ONLINE PUBLICATION)

## A Derivation of model

### A.1 Welfare effects of changes in the UI system

Similar to Schmieder and von Wachter (2016), we derive the welfare effect of a small increase in the benefit level in the steady state by differentiating (9) with respect to $b$:

$$\frac{dW}{db} = u_b \nu'(c_b) - e v'(c_e) \frac{d\tau}{db} \tag{A.1}$$

Due to the envelope theorem, changes in $e$, $u_b$, and $u_x$ have no first-order impact on welfare. Labor market behavior, i.e., separation and job finding rates, are a function of $P$ and $b$. Differentiating the government budget constraint (11) with respect to $b$ and rearranging yields

$$-e\frac{d\tau}{db} + u_b = -(b\frac{du_b}{db} - \frac{de}{db}\tau), \tag{A.2}$$

where we assume that taxes are increased in order to balance the budget (instead of making social assistance less generous), i,e. $\frac{d\tau}{db} \neq 0$. Divide (A.1) through $v'(c_e)$, add $u_b - u_b$ on the right-hand side and substitute (A.2) to obtain

$$\frac{dW}{db}\frac{1}{v'(c_e)} = u_b \frac{\nu'(c_b) - v'(c_e)}{v'(c_e)} - \left(b\frac{du_b}{db} - \frac{de}{db}\tau\right). \tag{A.3}$$

Following Chetty (2008),Schmieder et al. (2012), andSchmieder and von Wachter (2016), we divide through $u_b$ in order to obtain the marginal effect on welfare of increasing the transfers to benefit recipients by 1 Dollar:

$$\frac{dW}{db}\frac{1}{u_b v'(c_e)} = \underbrace{\frac{\nu'(c_b) - v'(c_e)}{v'(c_e)}}_{\text{Social value of \$1 add. transfer}} - \underbrace{\left(b\frac{du_b}{db} - \frac{de}{db}\tau\right)\frac{1}{u_b}}_{\text{Behavioral cost per \$1 add. transfer}}, \tag{A.4}$$

equation (12) in the main paper.

This equation is essentially the Baily-Chetty-Formula. Similarly, we can obtain the welfare effect of transferring 1 additional Dollar to transfer recipients by increasing the potential benefit duration $P$

The formula for the welfare effect of an increase in the PBD, P, is similar in structure. It is obtained by differentiating the social welfare function and the government budget constraint w.r.t. $P$, the PBD:

$$\frac{dW}{dP} = \left.\frac{du_b}{dP}\right|_M b\nu'(c_{u,t>P}) - ev'(c_e)\frac{d\tau}{dP} \tag{A.5}$$

$$-e\frac{d\tau}{dP} + \left.\frac{du_b}{dP}\right|_M b = -\left(b\left.\frac{du_b}{dP}\right|_B - \frac{de}{dP}\tau\right), \tag{A.6}$$

where $\left.\frac{du_b}{dP}\right|_M = \left.\frac{dD_b}{dP}\right|_M \times \frac{u}{D}$ indicates the mechanical increase in the stock of benefit recipients, i.e. the mechanical increase in the stock of benefit recipients due to the change in $P$ holding the survival function in unemployment constant. For marginal changes in $P$, $\left.\frac{dD_b}{dP}\right|_M$ is simply the benefit exhaustion rate.[24]

[24] For instance, if the PBD is 6 and one third of benefit recipients exhaust benefits, then increasing the PBD by one day, one third of benefit recipients will gain another day of receipt. The average benefit

$\left.\frac{du_b}{dP}\right|_B$ indicates the increase in benefit recipients due to behavioral reactions. Similarly, Schmieder et al. (2012) decompose the increase in average benefit durations into a mechanical and a behavioral component.[25] For instance, when the PBD is increased from six to seven months, it is the stock of unemployed who have been unemployed for more than six and up to seven months. $\nu'(c_{u,t>P})$ is the marginal utility of consumption of exhaustees.

Add $\left.\frac{du_b}{dP}\right|_M bv'(c_e) - \left.\frac{du_b}{dP}\right|_M bv'(c_e)$ on the right-hand side of (A.5), divide through $\left.\frac{du_b}{dP}\right|_M bv'(c_e)$, and substitute (A.6) to obtain

$$\frac{dW}{dP}\frac{1}{\left.\frac{du_b}{dP}\right|_M bv'(c_e)} = \underbrace{\frac{\nu'(c_{u,t>P}) - v'(c_e)}{v'(c_e)}}_{\text{Social value of \$1 add. transfer}} - \underbrace{\frac{1}{\left.\frac{du_b}{dP}\right|_M}\left(\left.\frac{du_b}{dP}\right|_B - \frac{de}{dP}\frac{\tau}{b}\right)}_{\text{Behavioral cost per \$1 add. transfer}},$$

equation (14) in the main paper.

## A.2 Relating job finding rates to durations

We want to express aggregate job finding rates—which determine the steady state stocks of unemployment, benefit receipt and employment—in terms of unemployment durations. Similarly to Schmieder et al. (2012), we first write the average unemployment duration in terms of survival functions. Denote by $f_j$ the job finding rate in period $j$ of an unemployment spell, i.e., unemployment spells start in period $j = 0$. Then the average unemployment duration is $D = \sum_{j=0}^{\infty} S_j$, where $S_j$ is the survivor function at the start of period $j$, with $S_0 = 1$ and $\prod_{g=1}^{j}(1 - f_{g-1})$ for $j > 0$. Suppose that inflows into unemployment are somewhat constant. Then the aggregate job finding rate

$$f \approx \sum_{j=0}^{\infty} \frac{S_j}{D} f_j, \tag{A.8}$$

i.e. the average over all $f_j$, weighted by the share of unemployed in their $j$th period of unemployment, $\frac{S_j}{D}$. (A.8) can be written as $f \approx \frac{1}{D}\sum_{j=0}^{\infty} S_j f_j$. The term $\sum_{j=0}^{x} S_j f_j$ is the failure function in the $x$the period of unemployment. For $x = 1$, it necessarily equals one. Therefore,

$$f \approx \frac{1}{D} \tag{A.9}$$

and by the same argument,

$$f_b \approx \frac{1}{D_b}. \tag{A.10}$$

$f_b$ denotes the exit rate from benefit receipt either because of benefit exhaustion (it is one at the exhaustion point) or because of the end of the non-employment spell.

duration thus increases by one third of a day.

[25] The change in the average benefit duration caused by an increase in the PBD from $P^0$ to $P^1$ can be decomposed as follows:

$$\frac{dD_b}{dP} = \sum_{j=0}^{P^1} S_j^1 - \sum_{j=0}^{P^0} S_j^0 = \left(\sum_{j=0}^{P^1} S_j^1 - \sum_{j=0}^{P^1} S_j^0\right) + \left(\sum_{j=0}^{P^1} S_j^0 - \sum_{j=0}^{P^0} S_j^0\right). \tag{A.7}$$

The first term is the behavioral component $\left.\frac{dD_b}{dP}\right|_B$ and the second is the mechanical component $\left.\frac{dD_b}{dP}\right|_M$.

### A.3 Relating steady-state equations to empirical estimates of effects on policy changes on durations and separations

We can now derive the fiscal cost of increasing UI generosity. To this end, we need to relate equations (12) and (14) to the effects of changes in UI generosity on the numbers of benefit recipients, exhaustees, and employed. We assume that changes in job search effort do not impact labour market tightness, such that the job finding rate per unit of search effort is constant as in Hall (2005), in line with evidence for Poland (Jessen et al., 2023).

**Special case with fixed inflows into unemployment** Most of the literature abstracts from separations and considers the case of a worker who has become unemployed (Chetty, 2008; Schmieder and von Wachter, 2016). The resulting equations for welfare effects are equivalent to a special case in our model with exogenous inflows into unemployment, $i = \delta \times e$. In order to express welfare effects in terms of duration elasticities, we use the fact that on aggregate $f = 1/D$, where $D$ is the average unemployment duration.

We denote the aggregate exit rate from benefit receipt as $f_b = 1/D_b$.[26] Using $\frac{df_b}{db} = -f^2\frac{dD}{dB}$, the derivatives of the steady-state stocks are

$$\frac{du}{db} = -\frac{i}{f^2}\frac{df}{dB} = i\frac{dD}{db}, \tag{A.11}$$

$$\frac{de}{db} = -i\frac{dD}{db}, \tag{A.12}$$

$$\frac{du_b}{db} = i\frac{dD_b}{db}, \tag{A.13}$$

where $D_b$ is the average duration of benefit receipt.

Now substitute the formulas for the steady state values as well as (A.11), (A.12), and (A.13) into (12) to obtain

$$\frac{dW}{db}\frac{1}{u_b v'(c_e)} = \underbrace{\frac{\nu'(c_b) - v'(c_e)}{v'(c_e)}}_{\text{Social value of \$1 add. transfer}} - \underbrace{\left(\eta_{D_b,b} + \eta_{Du,b}\frac{D}{D_b}\frac{\tau}{b}\right)}_{\text{Behavioral cost per \$1 add. transfer}}, \tag{A.14}$$

where $\eta_{Du,b} = \frac{dD}{d_b}\frac{b}{D}$ and $\eta_{D_b,b} = \frac{dD_b}{d_b}\frac{b}{D_b}$. Reassuringly, (A.14) is equivalent to Schmieder and von Wachter (2016, eq. 7).

The changes in steady state stocks due to changes in the PBD are equivalent to those due to changes in the benefit level. In particular, $\left.\frac{du_b}{dP}\right|_M = \left.\frac{dD_b}{dP}\right|_M \times i$ and $\left.\frac{du_b}{dP}\right|_B = \left.\frac{dD_b}{dP}\right|_B \times i$. Then we can write

$$\frac{dW}{dP}\frac{1}{\left.\frac{du_b}{dP}\right|_M bv'(c_e)} = \underbrace{\frac{\nu'(c_{u,t>P}) - v'(c_e)}{v'(c_e)}}_{\text{Social value of \$1 add. transfer}} - \underbrace{\frac{1}{\left.\frac{dD_b}{dP}\right|_M}\left(\left.\frac{dD_b}{dP}\right|_B + \frac{dD}{dP}\frac{\tau}{b}\right)}_{\text{Behavioral cost per \$1 add. transfer}}. \tag{A.15}$$

Again, this formula is equivalent to (Schmieder and von Wachter, 2016, eq 8).

**General case with endogenous separations: BC/MC of an increase in benefit level** In the steady state, outflows from benefit receipt equal inflows, $f_b u_b = \delta \times e$ and thus

[26] Steady-state values can be written in terms of the unemployment exit rate and the inflow into unemployment as $u = i/f$, $e = (f-i)/f$, $u_x = i(1-f)^P/f$, and $u_b = i(1-(1-f)^P)/f = i/f_b$.

the stock of benefit recipients is given by

$$u_b = \frac{\delta \times e}{f_b} = \frac{\delta \times f}{f_b(f+\delta)} = \frac{f}{f_b} u = \frac{D_b}{D} u. \tag{A.16}$$

The effects of an increase in $b$ on $u$ is obtained using the quotient rule and simplifying:

$$\frac{du}{db} = \frac{\frac{d\delta}{db} f - \frac{df}{db}\delta}{(\delta+f)^2} = \frac{\delta}{\delta+f}\frac{f}{\delta+f}\frac{\eta_{u,b}+\eta_{\delta,b}}{b} = u \times e\frac{\eta_{u,b}+\eta_{\delta,b}}{b}, \tag{A.17}$$

where $\eta_{\delta,b} = \frac{d\delta}{b}\frac{b}{\delta}$, and the effect on $e$ is simply

$$\frac{de}{db} = -\frac{du}{db}. \tag{A.18}$$

The effect of an increase in $b$ on $u_b$ is given by:

$$\begin{aligned} \frac{du_b}{db} &= \frac{\left(\frac{d\delta}{db} f + \frac{df}{db}\delta\right) f_b(f+\delta) - \delta f\left(\frac{df_b}{db}(f+\delta) + f_b(\frac{df}{db}+\frac{d\delta}{db})\right)}{(f_b(\delta+f))^2} \\ &= \frac{1}{(f_b(\delta+f))^2} \times \left(\frac{d\delta}{db}(f f_b(f+\delta) - \delta f f_b) + \frac{df}{db}((\delta f_b(f+\delta) - \delta f f_b) - \frac{df_b}{db}\delta f(f+\delta)\right) \\ &= \frac{1}{(f_b(\delta+f))^2} \times \left(\eta_{\delta,b}\frac{\delta}{b}(f f_b(f+\delta) - \delta f f_b) - \eta_{D,b}\frac{1}{bD}((\delta f_b(f+\delta) - \delta f f_b)\right. \\ &+ \left.\eta_{D_b,b}\frac{1}{bD_b}(\delta f(f+\delta))\right) \\ &= \eta_{\delta,b}\frac{\delta}{f_b b}\frac{f}{\delta+f}\frac{f}{\delta+f} - \eta_{D,b}\frac{1}{b}(\frac{f_b\delta^2 f}{(f_b(\delta+f))^2}) + \eta_{D_b,b}\frac{\delta}{\delta+f}\frac{D_b}{bD} \\ &= \eta_{\delta,b}\frac{\delta}{f_b b}e^2 - \eta_{D,b}\frac{D_b}{Db}u^2 + \eta_{D_b,b}\frac{u_b}{b}. \end{aligned} \tag{A.19}$$

Note that the second term in the last line is negative; an increase in the unemployment duration, keeping the duration of benefit receipt constant, lowers the number of benefit recipients because it reduces the number of employees—who in turn become transfer recipients once they become unemployed.

Now substitute (A.18) and (A.19) into (12) to obtain the formula for the welfare effect of an increase in the benefit level

$$\begin{aligned} \frac{dW}{db}\frac{1}{u_b v'(c_e)} &= \underbrace{\frac{\nu'(c_b) - v'(c_e)}{v'(c_e)}}_{\text{Social value}} \\ &- \underbrace{\left(b\left(\eta_{\delta,b}\frac{\delta}{f_b b}e^2 - \eta_{D,b}\frac{D_b}{Db}u^2 + \eta_{D_b,b}\frac{u_b}{b}\right) + u \times e(\eta_{D,b}+\eta_{\delta,b})\frac{\tau}{b}\right)\frac{1}{u_b}}_{\text{Behavioral cost}}. \end{aligned} \tag{A.20}$$

The first part of the behavioral cost is the increase in transfers paid and the second part is the loss in tax revenue. Using (A.16), we can rewrite the behavioral cost as

$$BC/MC = \eta_{\delta,b} e\left(\frac{\tau}{b}\frac{D}{D_b} + 1\right) + \eta_{D,b}\frac{D}{D_b}\left(\frac{e\tau}{b} - u_b\right) + \eta_{D_b,b}. \tag{A.21}$$

The equation can be rewritten as

$$BC/MC = e\frac{\tau}{b}\frac{D}{D_b}\left(\eta_{\delta,b} + \eta_{D,b}\right) + \eta_{\delta,b} + \eta_{D_b,b} - \eta_{D,b}u_b,$$

equation (13) in the main paper. The first term captures fiscal cost because the share of employed decreases, both due to an increase in the unemployment duration and an increase in the separation rate. The second and third term capture the increase in the stock of benefit recipients due to an increase in the separation rate and the benefit duration. The final term is the decrease in the stock of unemployed due to an increase in the unemployment duration (given the average benefit duration).[27]

**BC/MC of a PBD extension** To obtain the behavioral cost of an increase in the PBD, again we allow for the separation rate and job finding rates to depend on the PBD:

$$BC/MC = \frac{1}{\left.\frac{du_b}{dP}\right|_M}\left(\left.\frac{du_b}{dP}\right|_B + u \times e(\eta_{D,P} + \eta_{\delta,P})\frac{1}{P}\frac{\tau}{b}\right) \tag{A.23}$$

The change in the stock of benefit recipients due to behavioral adjustments is $\left.\frac{du_b}{dP}\right|_B = \eta_{\delta,P}\frac{\delta}{f_b P}e^2 - \eta_{D,P}\frac{D_b}{DP}u^2 + \left.\frac{dD_b}{dP}\right|_B\frac{u_b}{D_b}$, where $\left.\frac{dD_b}{dP}\right|_B$ is the change in the average benefit duration due to behavioral adjustments. Substituting into (A.23), we obtain

$$BC = \frac{1}{\left.\frac{du_b}{dP}\right|_M}\left(\eta_{\delta,P}\frac{\delta}{f_b P}e^2 - \eta_{D,P}\frac{D_b}{DP}u^2 + \left.\frac{dD_b}{dP}\right|_B\frac{u_b}{D_b} + u \times e(\eta_{D,P} + \eta_{\delta,P})\frac{1}{P}\frac{\tau}{b}\right), \tag{A.24}$$

which, using $\left.\frac{du_b}{dP}\right|_M = \left.\frac{dD_b}{dP}\right|_M \times \frac{u}{D}$, can be rearranged to

$$BC/MC = \frac{1}{\left.\frac{dD_b}{dP}\right|_M}\left(e\frac{\tau}{b}\left(\frac{d\delta}{dP}\frac{D}{\delta} + \frac{dD}{dP}\right) + \frac{d\delta}{dP}\frac{D_b e}{\delta} + \left.\frac{dD_b}{dP}\right|_B - \frac{dD}{dP}u_b\right).$$

equation (15) in the main paper. The structure of the equation is similar to (13). The first term captures the decrease in tax revenue due to an reduction in the stock of employed caused by an increase in the PBD. The second and third term denote the increased benefit payments due to the increase in the stock of recipients due to an increase in the job destruction rate and a behavioral increase in the benefit duration. The final term is negative. It is the decrease in the stock of benefit recipients due to an increase in the average unemployment duration given the benefit duration. It can also be written like this:

$$BC/MC = \frac{1}{\left.\frac{dD_b}{dP}\right|_M}\left(e\frac{\tau}{b}\left(\eta_{\delta,P}\frac{\delta^2}{P}D + \frac{dD}{dP}\right) + \eta_{\delta,P}e\frac{D_b}{P} + \left.\frac{dD_b}{dP}\right|_B - \frac{dD}{dP}u_b\right) \tag{A.25}$$

[27] To fix ideas, consider the case, where all unemployed receive transfers, $u = u_b$. Then $\eta_{D_b,b} = \eta_{D,b}$ and $D = D_b$. We get

$$BC/MC = \eta_{\delta,b}e\left(\frac{\tau}{b} + 1\right) + \eta_{D,b}e\left(\frac{\tau}{b} + 1\right). \tag{A.22}$$

## A.4 Equations with two-step unemployment system

In Poland, the benefit level is higher in the three first months of benefit receipt since 2010. In this case the formulas for the welfare effects of changes in UI differ slightly from those in the standard case.

The government budget constraint can be written as

$$G + bu_b + b(1+\alpha)u_{b_A} = e\tau, \tag{A.26}$$

where $u_{b_A}$ is the stock of recipients who receive benefits that are higher by a factor of $1+\alpha$.

The derivative of the budget constraint with respect to $b$ is

$$-e\frac{d\tau}{db} + u_b = -\left(b\left(\frac{du_b}{db} + \alpha\frac{du_{b_A}}{db}\right) - \frac{de}{db}\tau\right). \tag{A.27}$$

We assume that the consumption level and utility functions of benefit recipients receiving higher benefit levels are the same as those for benefit recipients with lower levels. Moreover, we assume that the elasticities of the durations of receiving higher or lower benefit are the same, $\eta_{D_b,b}$. Then we can write

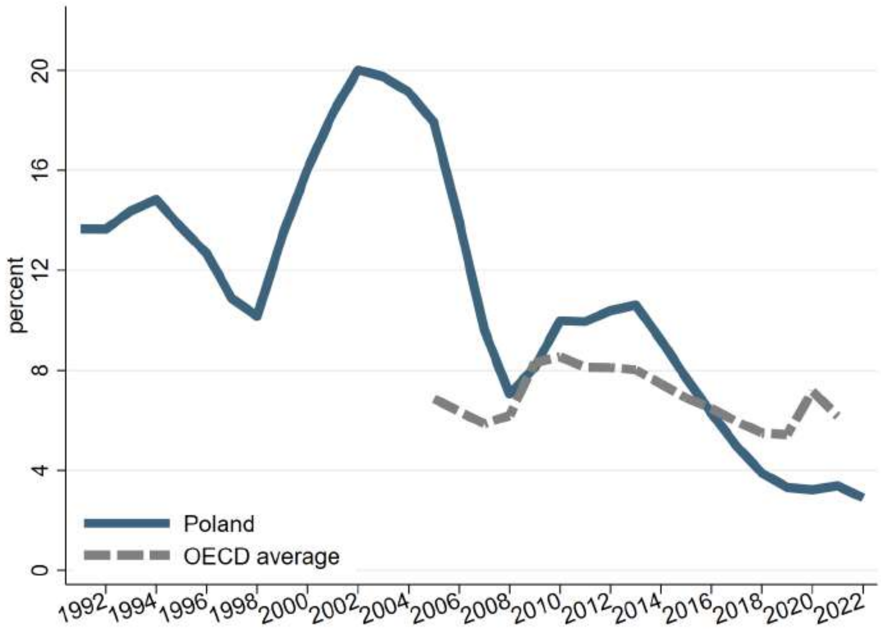
$$\frac{dW}{db}\frac{1}{(D_b + \alpha D_{b_A})v'(c_e)} = \underbrace{\frac{\nu'(c_b) - v'(c_b)}{v'(c_e)}}_{\text{Social value of \$1 add. transfer}} - \underbrace{\left(\eta_{D_b,b} + \times\eta_{D,b}\frac{D}{D_b + \alpha D_{b_A}}\frac{\tau}{b}\right)}_{\text{Behavioral cost per \$1 add. transfer}}. \tag{A.28}$$

$(D_b + \alpha D_{b_A})b$ is simply the average benefit level times the average benefit duration. Write $(D_b + \alpha D_{b_A})b = (D_b + \alpha\beta D_b)b$ and then $(D_b + \alpha D_{b_A})b = D_b(1+\alpha\beta)b = D_b\bar{b}$. Then we have

$$\frac{dW}{d\bar{b}}\frac{1}{D_b v'(c_e)} = \underbrace{\frac{\nu'(c_b) - v'(c_b)}{v'(c_e)}}_{\text{Social value of \$1 add. transfer}} - \underbrace{\left(\eta_{D_b,b} + \times\eta_{Du,b}\frac{D}{D_b}\frac{\tau}{\bar{\bar{b}}}\right)}_{\text{Behavioral cost per \$1 add. transfer}}. \tag{A.29}$$

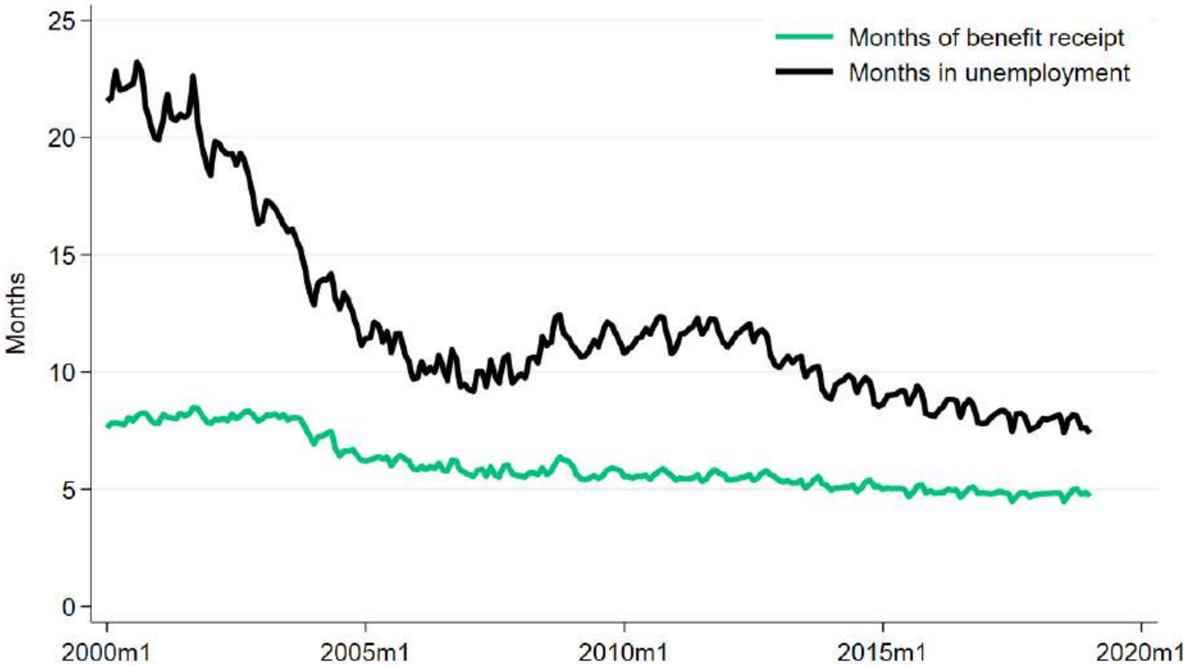
# B Figures

Figure B.1: Unemployment rate over time



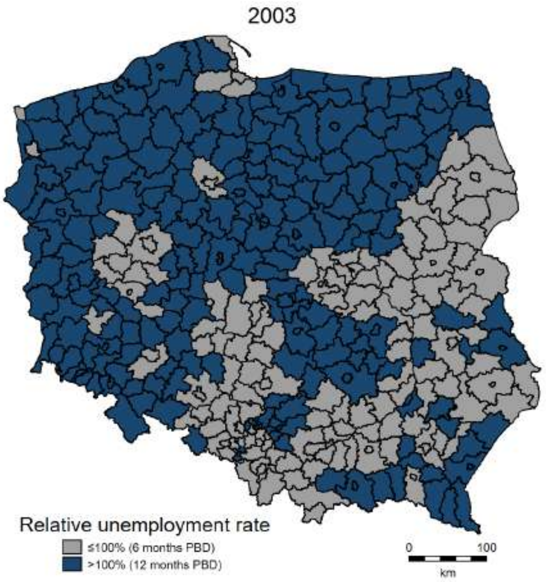

*Notes:* The figure shows how the unemployment rate of Poland and the OECD average over time. Sources: https://data.oecd.org/unemp/unemployment-rate.htm, accessed November 20, 2023, and Polish Labour Force Survey

Figure B.2: Months of benefit receipt and in unemployment over time

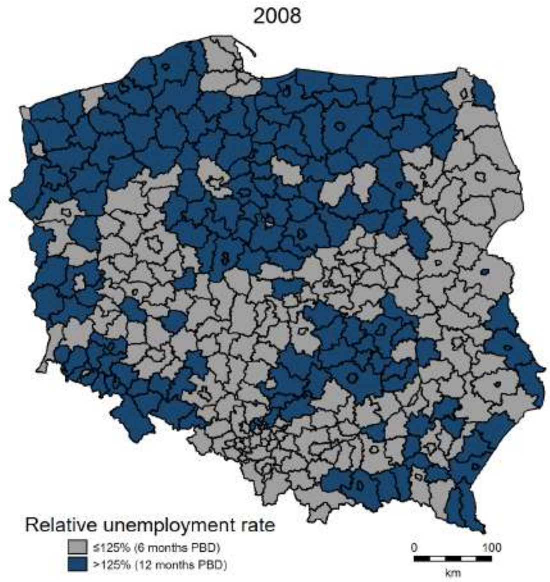



*Notes:*

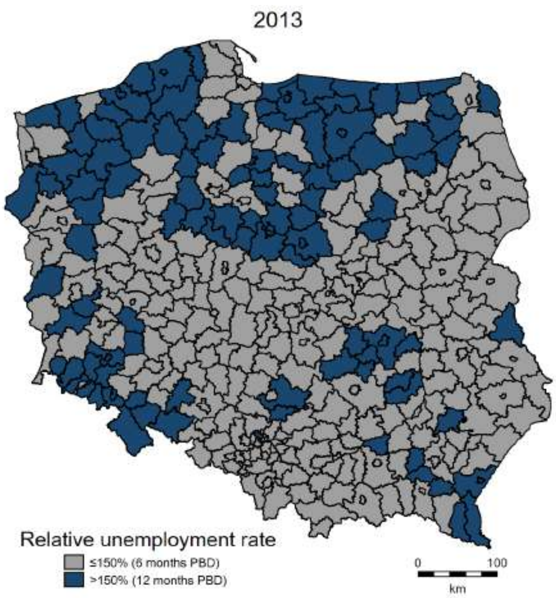
Figure B.3: Potential benefit duration with different cut-offs



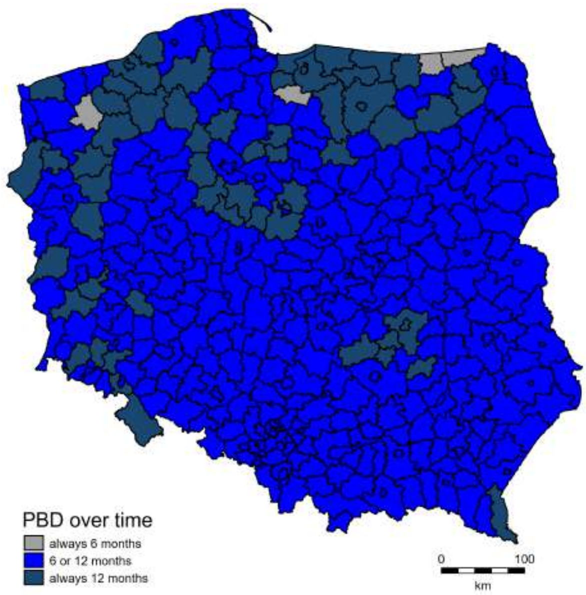

(a) 2003




(b) 2008



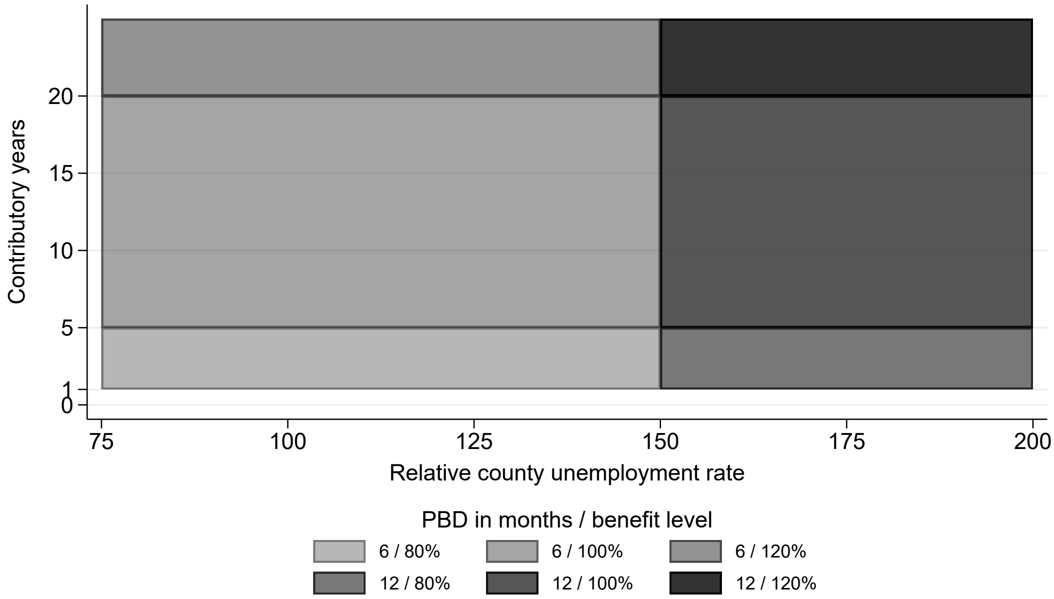

(c) 2013




(d) Changing cut-offs

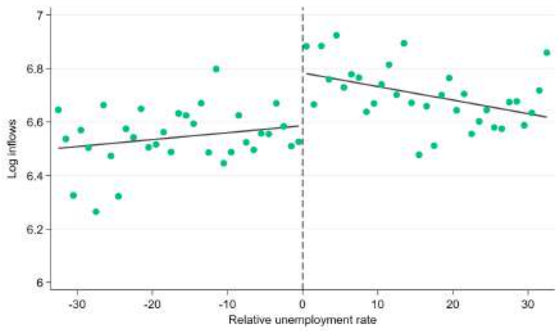
*Notes:* Panels (a)–(c) show the distribution of potential benefit durations in years with different threshold (100%, 125% and 150%, respectively. Panel (d) shows the counties which always have a PBD of 6 or 12 months in our sample period, 2002–2019, and those with different PBDs over time (bright blue).

Figure B.4: Benefit rules

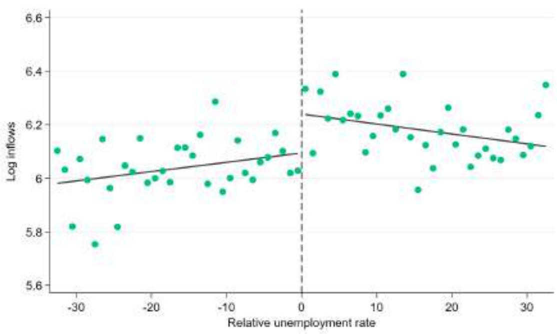



*Notes:* Rules for PBD concern the time period from February 2009 onward.

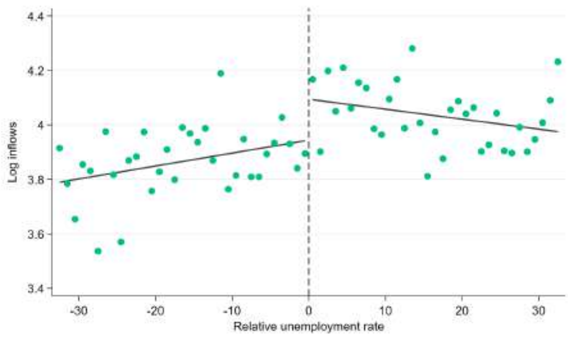
Figure B.5: Inflows into unemployment by PBD




(a) Entire calendar year



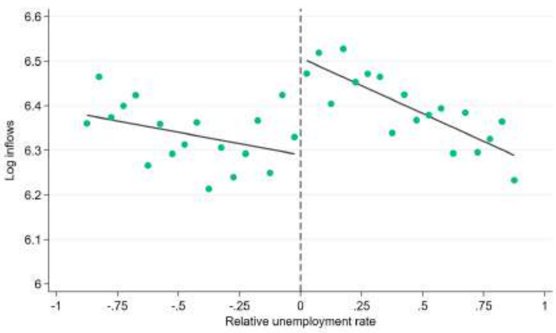

(b) February to September



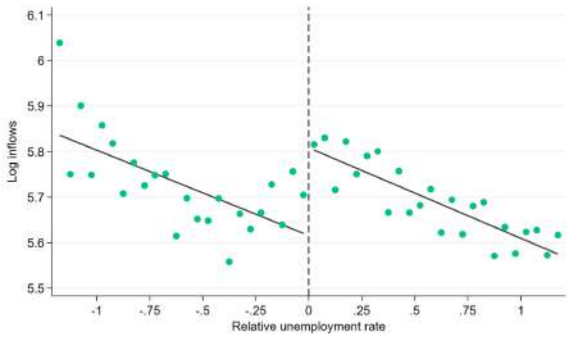

(c) June

*Notes:*

Figure B.6: Inflows into employment by BL



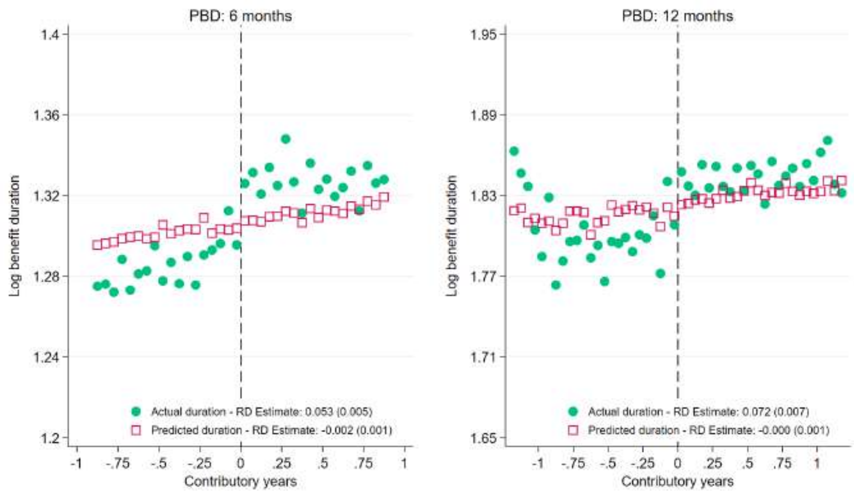

(a) PBD: 6 months



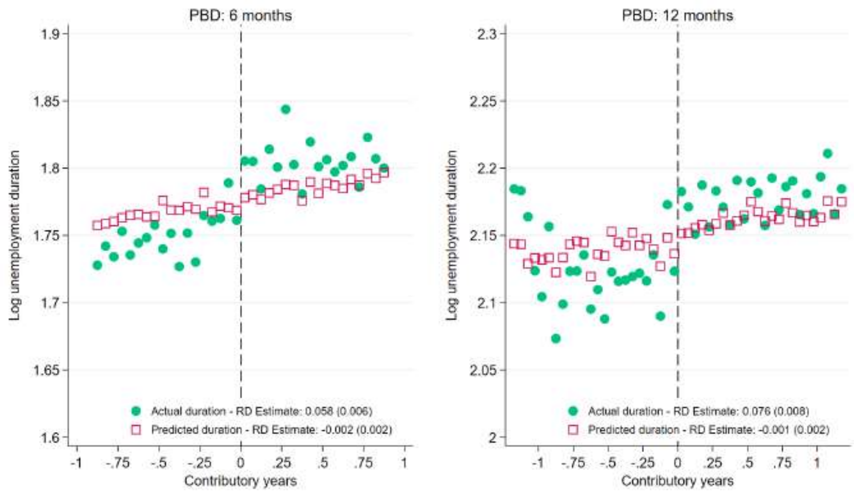

(b) PBD: 12 months

*Notes:*

Figure B.7: Comparison of observed and predicted durations—BL



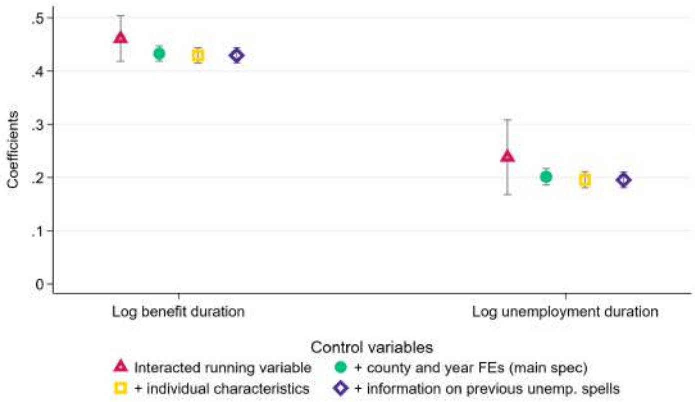

(a) Benefit duration



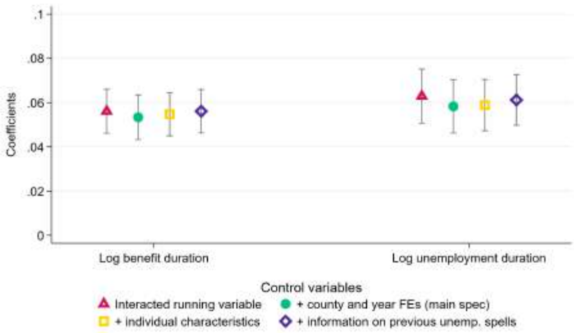

(b) Unemployment duration

*Notes:* Actual durations (circles) correspond to those shown in levels in Figure 5. Predicted durations (hollow squares) are obtained from regressing the observed durations on age, female indicator number of unemployment spells, education dummies, previous occupation, county FEs and year FEs. RD estimates as in Table 2.

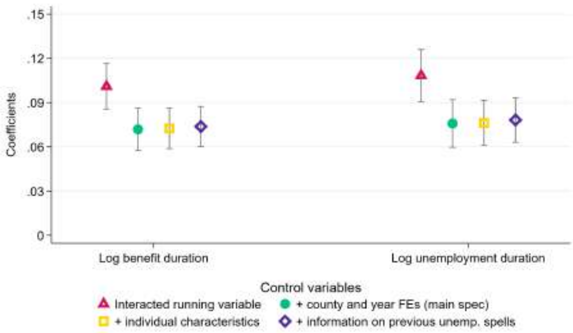
Figure B.8: Stability of coefficients with control variables




(a) PBD




(b) BL, 6 months PBD




(c) BL, 12 months PBD

*Notes:* Red hollow triangles include only the interacted running variables in the estimation. Green circles correspond to RD estimates reported in Table 2. Individual characteristics are age, a female indicator, urban county, contributory years (PBD estimation only), education and previous occupation dummies. In the final specification additionally the number of previous unemployment spells and the length of previous unemployment spells (in 10 categories, including an indicator if the current one is the first). Whiskers indicate 95% confidence intervals.

Figure B.9: Characteristics of inflows into unemployment around PBD threshold

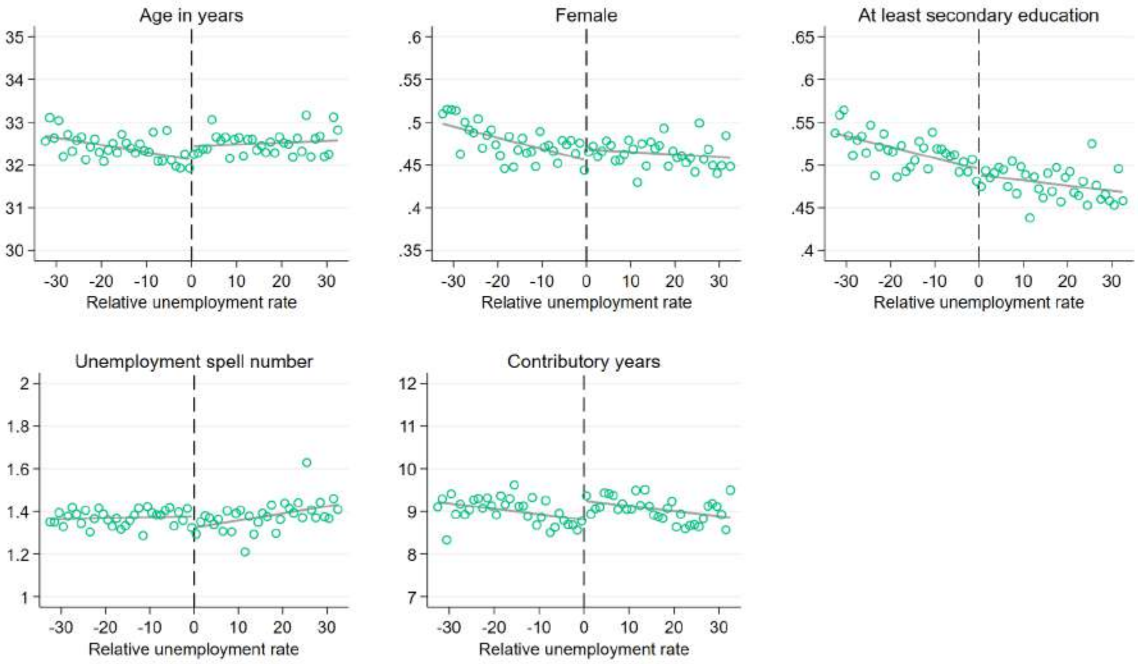



Figure B.10: Characteristics of inflows into unemployment around BL threshold at 6 months PBD

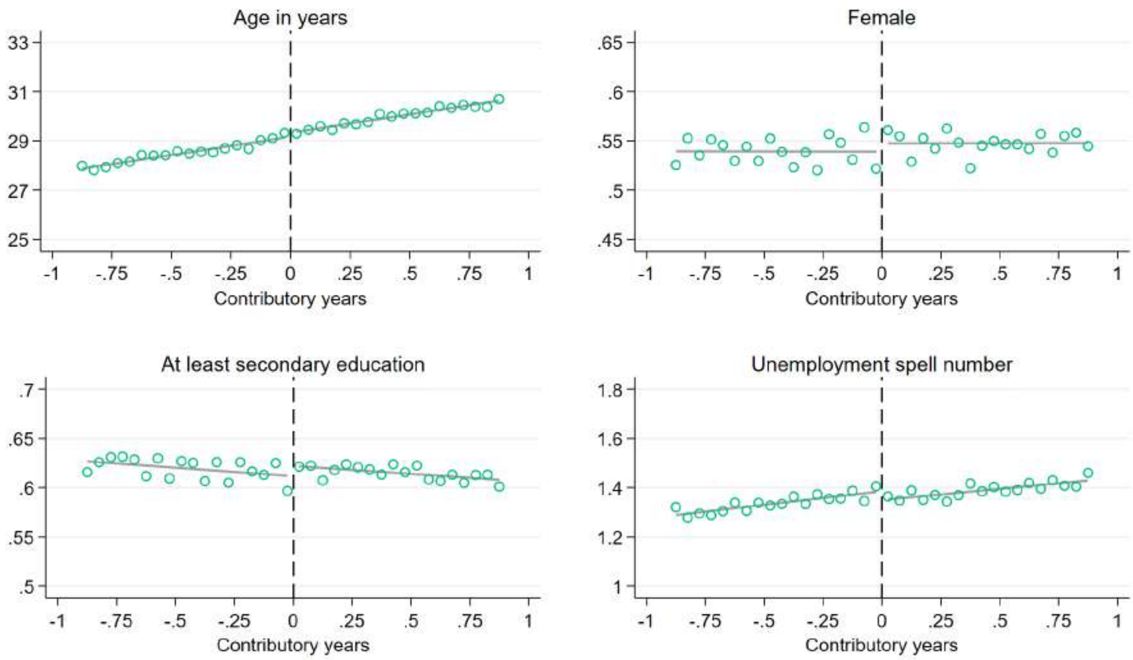


Figure B.11: Characteristics of inflows into unemployment around BL threshold at 12 months PBD

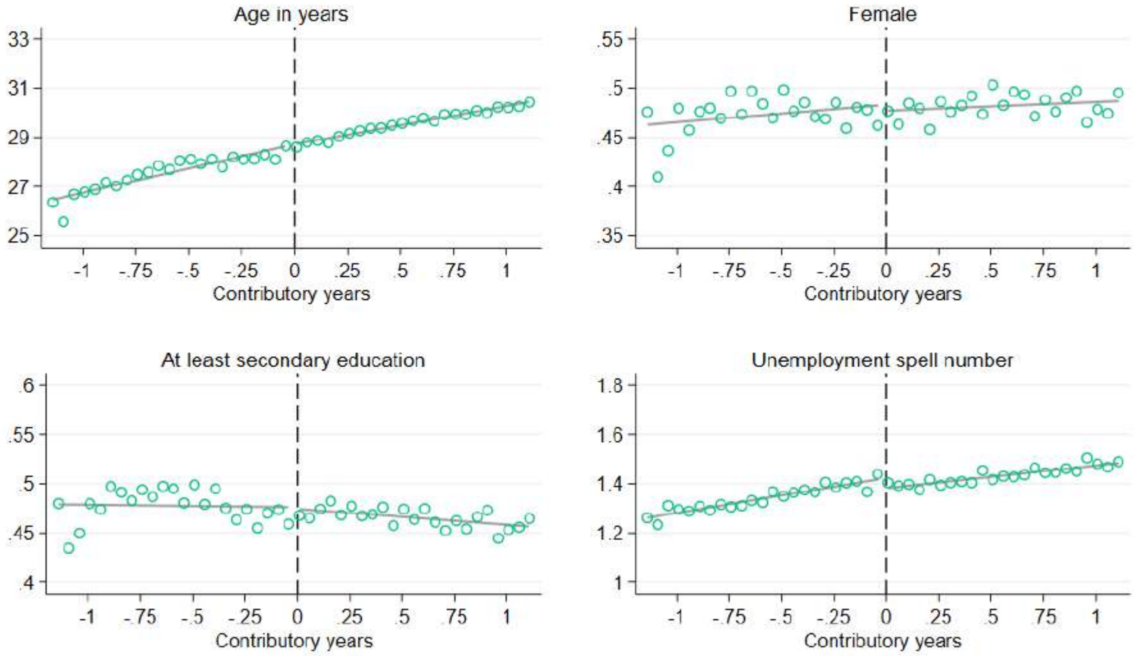
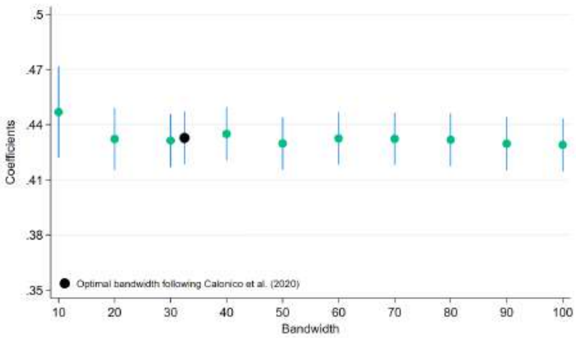
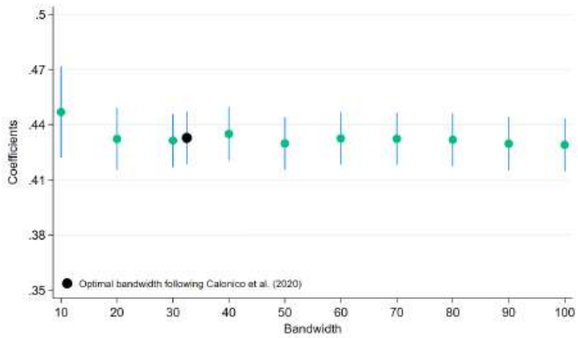


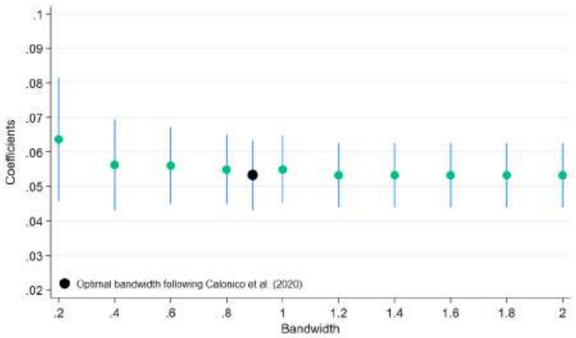
Figure B.12: Robustness to choice of bandwidth



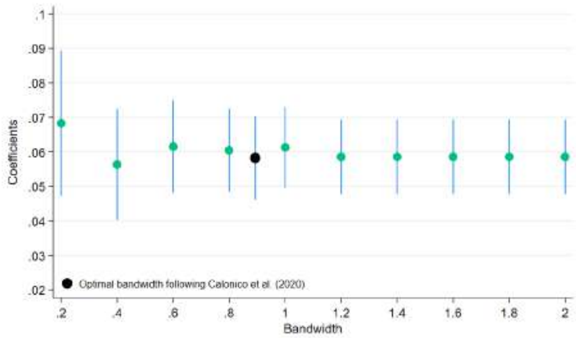

(a) PBD, log benefit duration



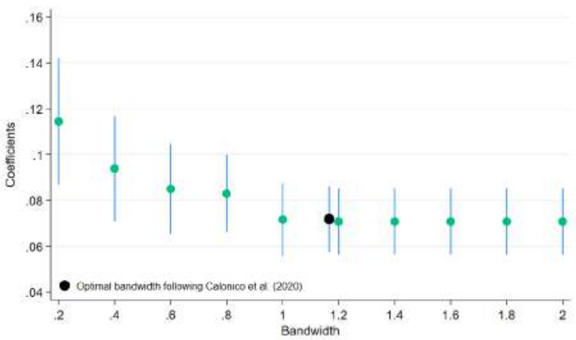

(b) PBD, log unemployment duration



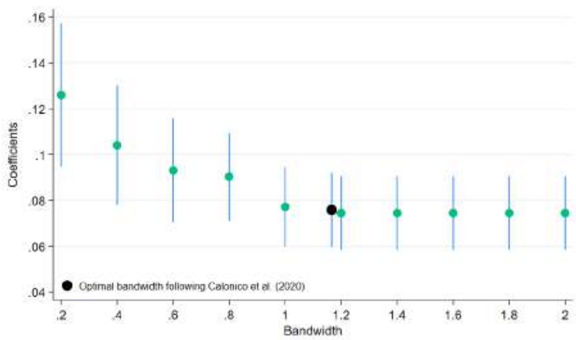

(c) BL, 6 months PBD, log benefit duration




(d) BL, 6 months PBD, log unemp. duration



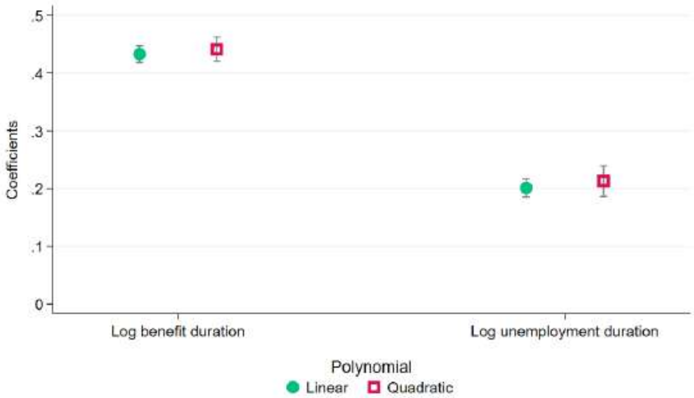

(e) BL, 12 months PBD, log benefit duration



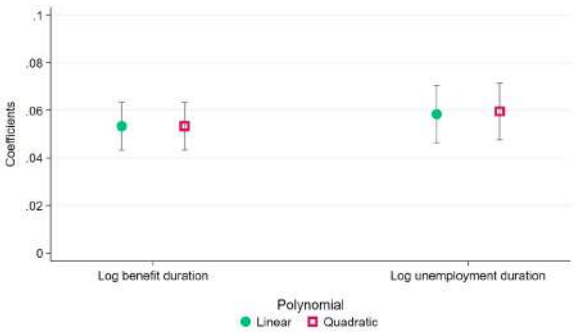

(f) BL, 12 months PBD, log unemp. duration

*Notes:* Whiskers indicate 95% confidence intervals.

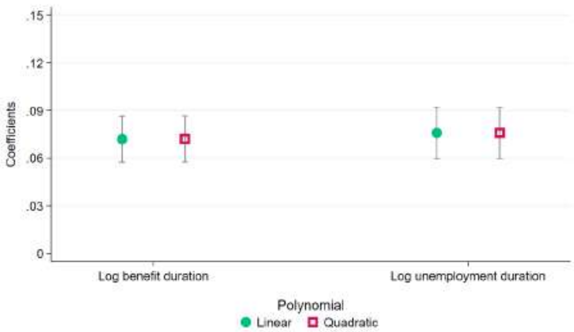
Figure B.13: Robustness to quadratic polynomial




(a) PBD



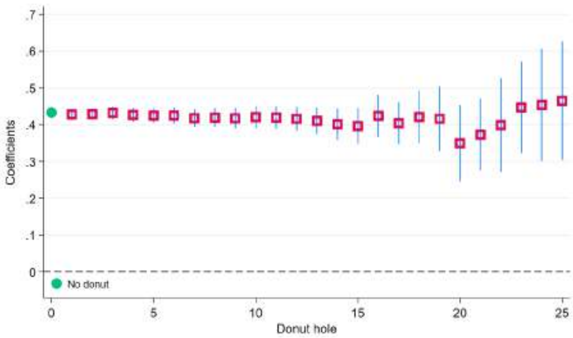

(b) BL, 6 months PBD



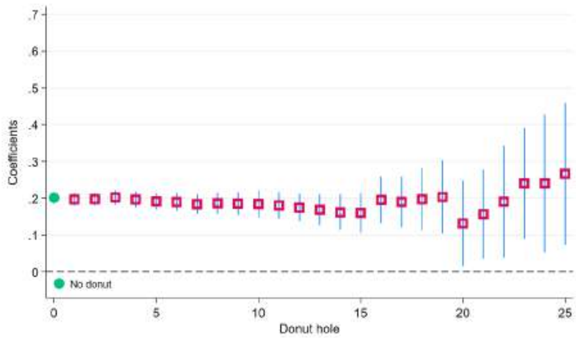

(c) BL, 12 months PBD

*Notes:* Whiskers indicate 95% confidence intervals.

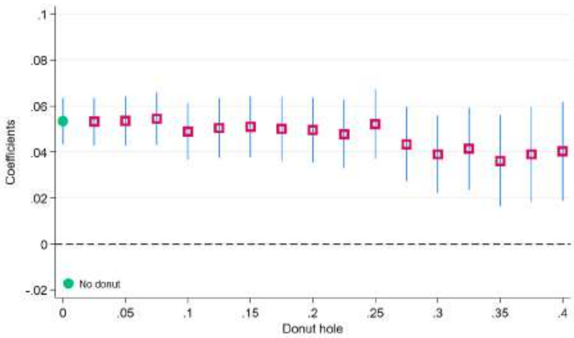
Figure B.14: Robustness to RD donut hole



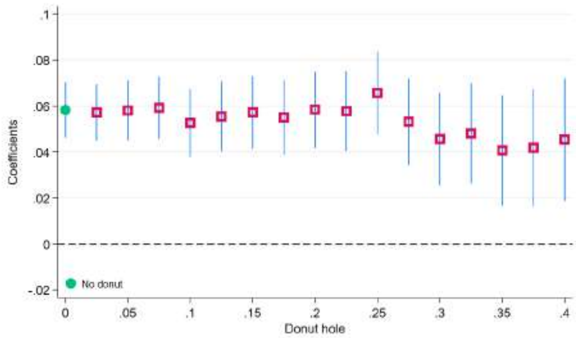

(a) PBD, log benefit duration



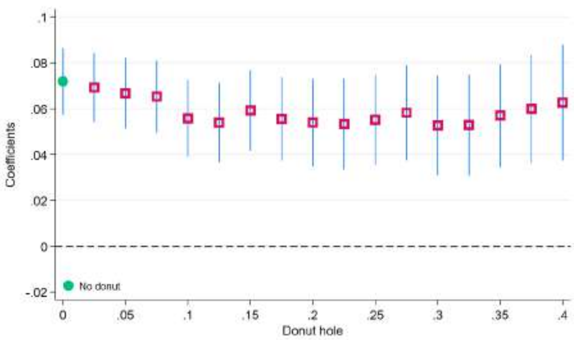

(b) PBD, log unemployment duration



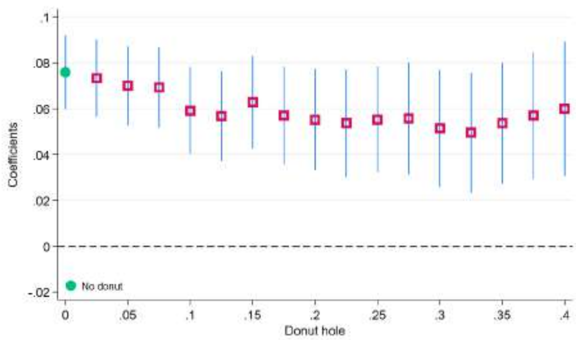

(c) BL, 6 months PBD, log benefit duration




(d) BL, 6 months PBD, log unem. duration



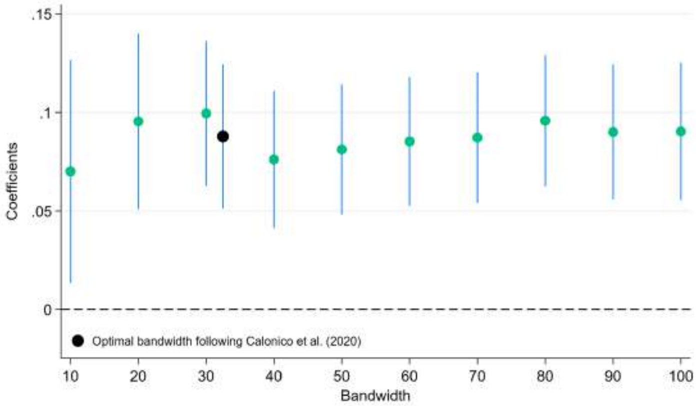

(e) BL, 12 months PBD, log benefit duration



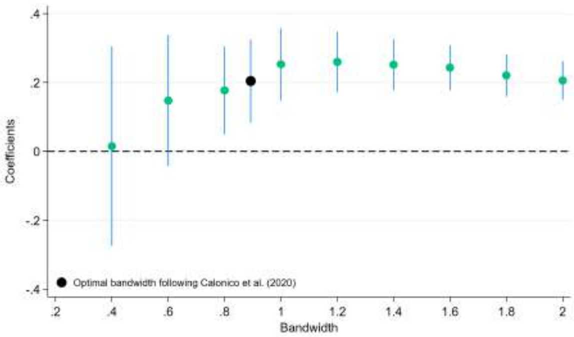

(f) BL, 12 months PBD, log unem.t duration

*Notes:* Whiskers indicate 95% confidence intervals.

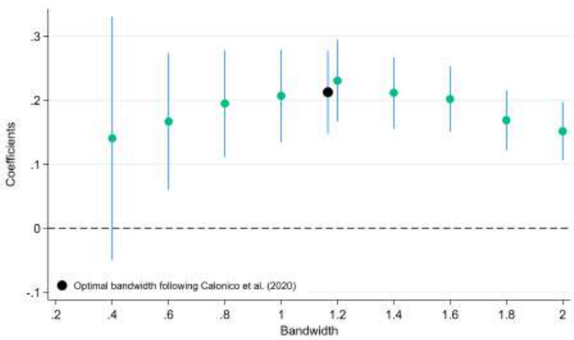
Figure B.15: Robustness of inflow effects to bandwidth




(a) PBD



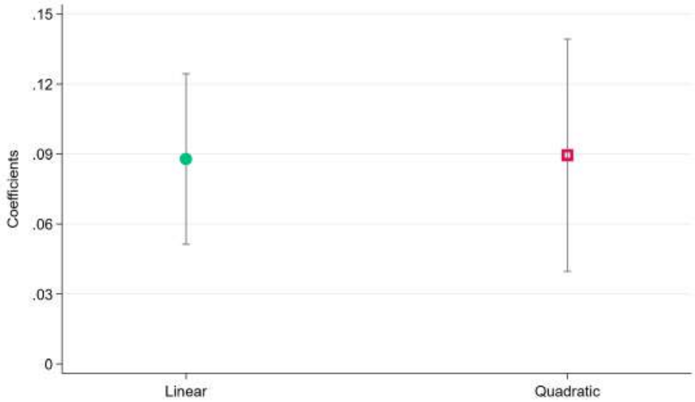

(b) BL, 6 months PBD



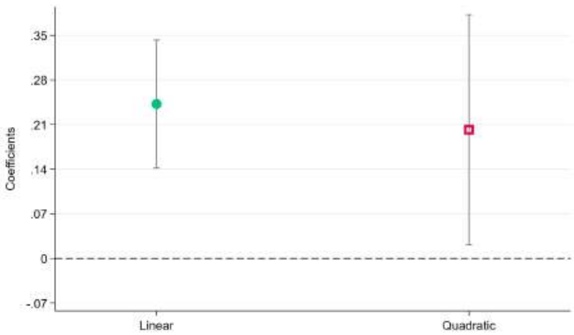

(c) BL, 12 months PBD

*Notes:* For the effects by benefit level, the estimates with a bandwidth of 0.2 are omitted as the wide confidence intervals make it difficult to accurately assess the magnitude of other coefficients. Whiskers indicate 95% confidence intervals.

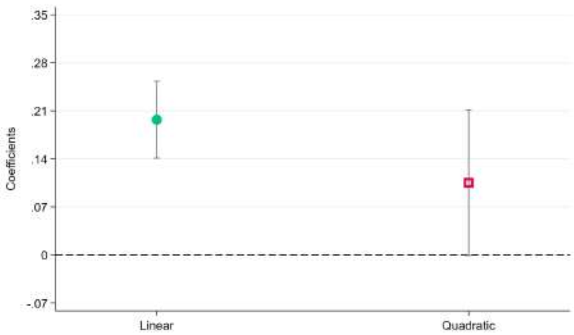
Figure B.16: Robustness of inflow effect to polynomial choice




(a) PBD



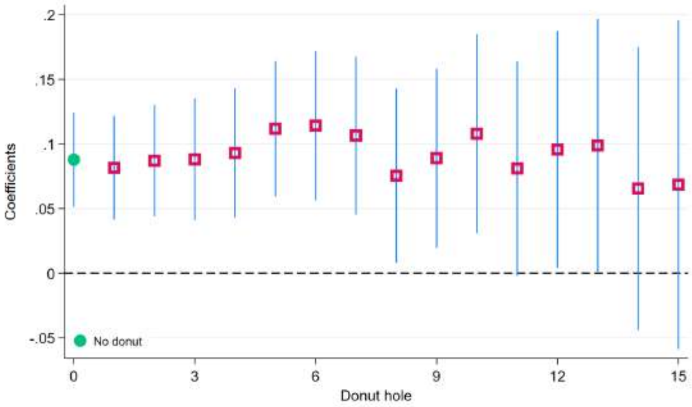

(b) BL, 6 months PBD



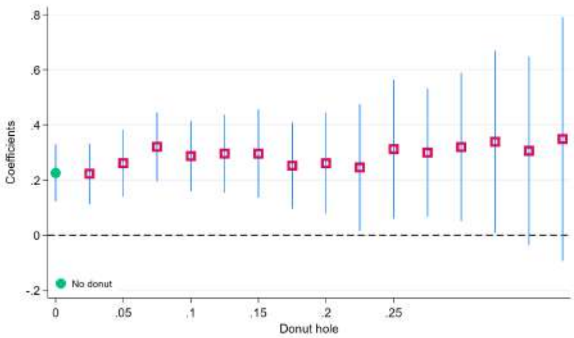

(c) BL, 12 months PBD

*Notes:* Whiskers indicate 95% confidence intervals.

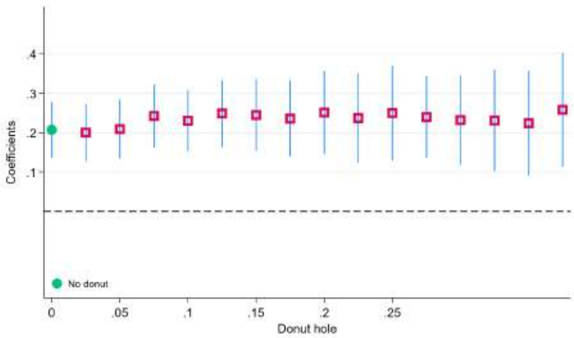
Figure B.17: Robustness of inflow effect to donut hole




(a) PBD




(b) BL, 6 months PBD




(c) BL, 12 months PBD

*Notes:* Whiskers indicate 95% confidence intervals.

# C Tables

Table C.1: Effects of more generous UI on benefit and unemployment durations—same sample

| Variation: | 6 months longer PBD | | 25% higher BL | | | |
|---|---|---|---|---|---|---|
| Dependent variable: | Months of | | | | | |
| | benefit receipt | unemployment | benefit receipt | | unemployment | |
| PBD: | | | 6 mo | 12 mo | 6 mo | 12 mo |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Panel A: Levels | | | | | | |
| RD estimate | 3.1515*** | 2.2664*** | 0.0938*** | 0.3137*** | 0.1871 | 0.6066*** |
| | (0.0561) | (0.1342) | (0.0274) | (0.0454) | (0.1423) | (0.1420) |
| Panel B: Logs | | | | | | |
| RD estimate | 0.4027*** | 0.1998*** | 0.0419*** | 0.0672*** | 0.0468*** | 0.0723*** |
| | (0.0107) | (0.0124) | (0.0116) | (0.0112) | (0.0135) | (0.0121) |
| *Elasticities* | 0.581 | 0.288 | 0.188 | 0.301 | 0.210 | 0.324 |
| Observations | 292,351 | 292,486 | 120,424 | 134,595 | 120,493 | 134,650 |

*Notes:* Table corresponds to Table 2 but restricts the sample to observations contained in the bandwidths of both the PBD and BL estimates. Estimates are based on equation (1). For the PBD estimates (columns 1-2) the running variable is the relative county unemployment rate and for BL estimates (columns 3-6) contributory years. All estimates include county and year fixed effects and a linear function of the running variable interacted with the treatment indicator. Sample period is 2004-2019. Standard errors clustered at the county-level in parentheses. Significance levels: $^{*} < 10\%$ $^{**} < 5\%$ $^{***} < 1\%$.

Table C.2: Distribution of characteristics of the unemployed around the threshold

| Dependent variable: | Age | Female | Education | Number of prev. unemp. spells | Contr. years |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Panel A: PBD threshold | | | | | |
| RD estimate | 0.3080*** | 0.0171*** | 0.0027 | -0.0033 | 0.2834*** |
| | (0.0507) | (0.0024) | (0.0020) | (0.0037) | (0.0557) |
| Relative effect | 0.009 | 0.036 | 0.005 | -0.002 | 0.031 |
| Observations | 3,040,286 | 3,040,286 | 3,035,637 | 3,040,286 | 3,040,286 |
| Panel B: BL threshold—6 months PBD | | | | | |
| RD estimate | 0.4139*** | -0.0032 | -0.0137*** | 0.0519*** | |
| | (0.0477) | (0.0035) | (0.0032) | (0.0043) | |
| Relative effect | 0.014 | -0.006 | -0.021 | 0.037 | |
| Observations | 385,720 | 385,720 | 385,452 | 385,720 | |
| Panel C: BL threshold—12 months PBD | | | | | |
| RD estimate | 0.3410*** | -0.0053 | -0.0213*** | 0.0803*** | |
| | (0.0599) | (0.0045) | (0.0041) | (0.0064) | |
| Relative effect | 0.012 | -0.010 | -0.040 | 0.051 | |
| Observations | 258,547 | 258,547 | 258,401 | 258,547 | |

*Notes:* Relative effects relate the RD estimate to the average of the estimation sample. Education is coded as a binary indicator for having at least secondary education. All estimates include county and year fixed effects and a linear function of the running variable interacted with the treatment indicator. Significance levels: $^{*} < 10\%$ $^{**} < 5\%$ $^{***} < 1\%$.

Table C.3: RD estimates for current and previous unemployment spell

| Dependent variable: | Log benefit duration | | Log unemployment duration | |
|---|---|---|---|---|
| Spell: | Current (1) | Previous (2) | Current (3) | Previous (4) |
| Panel A: PBD threshold | | | | |
| RD estimate | 0.4038*** | 0.0062 | 0.2155*** | 0.0203** |
| | (0.0092) | (0.0106) | (0.0097) | (0.0098) |
| Elasticity | 0.583 | 0.009 | 0.311 | 0.029 |
| Observations | 813,093 | 813,471 | 814,023 | 814,023 |
| Panel B: BL threshold—6 months PBD | | | | |
| RD estimate | 0.0459*** | 0.0037 | 0.0569*** | 0.0071 |
| | (0.0083) | (0.0083) | (0.0101) | (0.0096) |
| Elasticity | 0.206 | 0.017 | 0.255 | 0.032 |
| Observations | 129,492 | 129,510 | 129,569 | 129,569 |
| Panel C: BL threshold—12 months PBD | | | | |
| RD estimate | 0.0579*** | -0.0034 | 0.0629*** | -0.0041 |
| | (0.0127) | (0.0088) | (0.0134) | (0.0098) |
| Elasticity | 0.259 | -0.015 | 0.282 | -0.018 |
| Observations | 111,991 | 111,991 | 112,048 | 112,048 |

*Notes:* The sample is restricted to unemployed who have had a previous unemployment spell. Significance levels: $^{*} < 10\%$ $^{**} < 5\%$ $^{***} < 1\%$.

Table C.4: Effects of more generous UI on benefit and unemployment durations: PBD threshold including quitters

| Dependent variable: | Months of | | | |
|---|---|---|---|---|
| | benefit receipt (1) | unemployment (2) | benefit receipt (3) | unemployment (4) |
| **Panel A: Levels** | | | | |
| RD estimate | 3.5088*** | 2.4168*** | 3.7934*** | 2.2548*** |
| | (0.0480) | (0.1406) | (0.0470) | (0.2100) |
| **Panel B: Logs** | | | | |
| RD estimate | 0.4807*** | 0.1968*** | 0.8216*** | 0.1670*** |
| | (0.0067) | (0.0076) | (0.0120) | (0.0084) |
| *Elasticities* | | | 0.748 | 0.152 |
| Sample | Quitters and laid off | | Quitters only | |
| Bandwidth | 32.47 | 32.47 | 32.47 | 32.47 |
| Observations | 3,514,394 | 3,514,394 | 474,108 | 474,108 |

*Notes:* Table shows RD estimates at the PBD threshold as in Table 2, but additionally includes unemployed who have quit their jobs. These have a PBD of either 3 or 9 months depending on the relative unemployment rate of the county. Table 2 only contained unemployed who were laid off. See that table for other notes. Significance levels: * < 10% ** < 5% *** < 1%.

Table C.5: Effects of more generous UI on benefit and unemployment durations: BL threshold including quitters

| Dependent variable: | Months of | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | benefit receipt | | unemployment | | benefit receipt | | unemployment | |
| PBD: | 3/6 mo (1) | 9/12 mo (2) | 3/6 mo (3) | 9/12 mo (4) | 3 mo (5) | 9 mo (6) | 3 mo (7) | 9 mo (8) |
| **Panel A: Levels** | | | | | | | | |
| RD estimate | 0.1564*** | 0.3420*** | 0.1625*** | 0.5038*** | 0.0361** | 0.2577*** | -0.0763 | 0.5970*** |
| | (0.0114) | (0.0288) | (0.0541) | (0.0949) | (0.0152) | (0.0551) | (0.1408) | (0.1954) |
| **Panel B: Logs** | | | | | | | | |
| RD estimate | 0.0592*** | 0.0695*** | 0.0369*** | 0.0618*** | 0.0333*** | 0.0633*** | 0.0034 | 0.0494*** |
| | (0.0048) | (0.0069) | (0.0053) | (0.0074) | (0.0101) | (0.0159) | (0.0086) | (0.0118) |
| *Elasticities* | 0.265 | 0.312 | 0.165 | 0.277 | 0.149 | 0.284 | 0.015 | 0.221 |
| Sample | Quitters and laid off | | | | Quitters only | | | |
| Bandwidth | 0.89 | 1.17 | 0.89 | 1.17 | 0.89 | 1.17 | 0.89 | 1.17 |
| Observations | 467,186 | 309,157 | 467,186 | 309,157 | 81,466 | 50,610 | 81,466 | 50,610 |

*Notes:* Table shows RD estimates at the BL threshold as in Table 2, but additionally includes unemployed who have quit their jobs. These have a PBD of either 3 or 9 months depending on the relative unemployment rate of the county, unemployed who were laid off have a PBD of 6 or 12 months. Table 2 only contained unemployed who were laid off. See that table for other notes. Significance levels: * < 10% ** < 5% *** < 1%.

Table C.6: Effects of more generous UI on inflows into unemployment:
PBD threshold including quitters

| Dependent variable: | (Log) inflows into unemployment | | | | | |
|---|---|---|---|---|---|---|
| Sample: | Full year<br>(1) | Feb-Sep<br>(2) | June<br>(3) | Full year<br>(4) | Feb-Sep<br>(5) | June<br>(6) |
| RD estimate | 0.1355*** | 0.0892*** | 0.0961*** | 0.1392*** | 0.1314*** | 0.1392*** |
| | (0.0116) | (0.0109) | (0.0167) | (0.0152) | (0.0166) | (0.0301) |
| *Elasticity* | | | | 0.127 | 0.120 | 0.127 |
| Sample | Quitters and laid off | | | Quitters only | | |
| Bandwidth | 32.47 | 32.47 | 32.47 | 32.47 | 32.47 | 32.47 |
| Observations | 2,980 | 2,980 | 2,980 | 2,980 | 2,980 | 2,980 |

*Notes:* Table shows RD estimates at the PBD threshold as in Table 4, but additionally includes unemployed who have quit their jobs. These have a PBD of either 3 or 9 months depending on the relative unemployment rate of the county. Table 4 only contained unemployed who were laid off. See that table for other notes. Significance levels: * < 10% ** < 5% *** < 1%.

Table C.7: Effects of more generous UI on inflows into unemployment:
BL threshold including quitters

| Dependent variable: | (Log) inflows into unemployment | | | |
|---|---|---|---|---|
| PBD: | 3/6 mo<br>(1) | 9/12 mo<br>(2) | 3 mo<br>(3) | 9 mo<br>(4) |
| RD estimate | 0.2299*** | 0.1930*** | 0.1454*** | 0.1399*** |
| | (0.0356) | (0.0271) | (0.0350) | (0.0277) |
| *Elasticity* | 1.030 | 0.865 | 0.652 | 0.627 |
| Sample | Quitters and laid off | | Quitters only | |
| Bandwidth | 0.89 | 1.17 | 0.89 | 1.17 |
| Observations | 643 | 839 | 643 | 839 |

*Notes:* Table shows RD estimates at BL threshold as in Table 4, but additionally includes unemployed who have quit their jobs. These have a PBD of either 3 or 9 months depending on the relative unemployment rate of the county. Table 4 only contained unemployed who were laid off. See that table for other notes. Significance levels: * < 10% ** < 5% *** < 1%.

Table C.8: Parameters and estimates: PBD

| | Description | Value |
|---|---|---|
| $\left.\frac{dD_b}{dP}\right\rvert_M$ | Share exhaustees of benefit recipients | .62 |
| $e$ | Share employed | .9 |
| $\tau$ | Tax liability + social assistance | .48 |
| $b$ | Benefits - social assistance | .13 |
| $\frac{d\delta}{dP}$ | Marginal effect of PBD change on separations | 0 |
| $\delta$ | Job destruction rate | .01 |
| $D$ | Unemployment duration | 11.9 |
| $\frac{dD}{dP}$ | Marginal effect of PBD change on unemployment duration | .41 |
| $\left.\frac{dD_b}{dP}\right\rvert_B$ | Marginal behavioral effect of PBD change on benefit duration | .02 |
| $u_b$ | Share receiving benefits | .05 |

$$BC = \frac{1}{\left.\frac{dD_b}{dP}\right\rvert_M}\left(\underbrace{e\frac{\tau}{b}}_{3.23}\left(\underbrace{\frac{d\delta}{dP}}_{\text{Value}}\underbrace{\delta}_{\text{Value}}\underbrace{D}_{\text{Value}}+\underbrace{\frac{dD}{dP}}_{\text{Value}}\right)+\underbrace{\frac{d\delta}{dP}}_{\text{Value}}\underbrace{\frac{De}{\delta}}_{\text{Value}}+\underbrace{\left.\frac{dD_b}{dP}\right\rvert_B}_{\text{Value}}-\underbrace{\frac{dD}{dP}}_{\text{Value}}\underbrace{u_b}_{\text{Value}}\right)$$

Table C.9: Parameters and estimates: BL

| | Description | Value 6 months | Value 12 months |
|---|---|---|---|
| $e$ | Share employed | .9 | . |
| $D$ | Unemployment duration | 11.9 | . |
| $D_b$ | Benefit duration | 5.52 | . |
| $\tau$ | Tax liability + social assistance | .48 | . |
| $b$ | Benefits - social assistance | .13 | . |
| $\eta_{\delta,b}$ | Elasticity of separations wrt the benefit level | 1.07 | .97 |
| $\eta_{D,b}u_b$ | Elasticity of unemployment duration wrt the benefit level | .26 | .34 |
| $\eta_{D_b,b}$ | Elasticity of benefit duration wrt the benefit level | .24 | .32 |
| $u_b$ | Share receiving benefits | .05 | . |

$$BC = \underbrace{e\frac{\tau}{b}}_{\text{Moin}}\underbrace{\frac{D}{D_b}}_{\text{Value}}\left(\underbrace{\eta_{\delta,b}}_{\text{Value}}+\underbrace{\eta_{D,b}}_{\text{Value}}\right)+\underbrace{\eta_{\delta,b}}_{\text{Value}}+\underbrace{\eta_{D_b,b}}_{\text{Value}}-\underbrace{\eta_{D,b}}_{\text{Value}}\underbrace{u_b}_{\text{Value}}$$

Table C.10: Required consumption losses in percent for 0 welfare effect

| Coefficient of relative risk aversion (CRRA): | 1 | 2 | 5 |
|---|---|---|---|
| | (1) | (2) | (3) |
| *Panel A: PBD variation* | | | |
| Fixed inflows | 71.12 | 46.26 | 22 |
| Endogenous inflows | 78.15 | 53.25 | 26.23 |
| *Panel B: BL variation (6 months PBD)* | | | |
| Fixed inflows | 68.72 | 44.07 | 20.74 |
| Endogenous inflows | 91.45 | 91.45 | 38.85 |
| *Panel C: BL variation (12 months PBD)* | | | |
| Fixed inflows | 69.61 | 44.87 | 21.19 |
| Endogenous inflows | 89.06 | 89.06 | 35.76 |

*Notes:* xx