Reservation Wage and Unemployment Benefits*

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Abstract

We study the pass-through from unemployment benefit to wages in light of the massive relief the CARES and subsequent Acts provided qualified unemployed individuals. Through rotation data from the CPS, we establish that the fraction of benefit-eligible unemployed individuals increased substantially during the relief period (part of 2020 and 2021). Similarly, the take up rate of UI benefits increased more than 10 percentage points (from around 30 to around 40 percent). We show that this increase in the take up rate was entirely due to changes in benefit amounts, as opposed to changes in the underlying characteristics of eligible individuals. We also show that relative to UI-ineligible unemployed people, the wage premium that UI-eligible people typically command only increased by $70 a week, suggesting a modest pass-through. We corroborate this finding through Benefit Accuracy Measurement (BAM) data, from which we estimate the reservation wage elasticity with respect to benefits to be around 2%. We show that a directed search model that features an endogenous decision to collect benefits is broadly consistent with our empirical findings: while the take up rate rises sharply following a large increase in benefits, wages increase only modestly.

Keywords: Unemployment Benefits, Reservation Wage, CPS, BAM

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1 Introduction

It wasn't lost on anyone that as part of the Coronavirus Aid, Relief, and Economic Security Act, or the CARES Act, the Federal Pandemic Unemployment Compensation (FPUC) program which provided qualified unemployed individuals with an additional $600 per week amounted precisely to $15.00 an hour for 40 hours. While the CARES Act had many objectives, one potentially anticipated outcome was that by providing $15.00 an hour to remain unemployed, individuals would require significantly higher wages to transit to employment.

This paper studies the pass-through from unemployment benefit to (reservation) wages. Specifically, the question we explore is whether the CARES Act and various subsequent Acts led to an increase in the gap in new hires' compensation between those who are eligible for (and collecting) unemployment benefits and those who are not. We first do so empirically using data from the Unemployment Insurance (UI) Benefit Accuracy Measurement (BAM) system as well as rotation data from the Current Population Survey (CPS), and then through the lens of a directed search model with an explicit unemployment benefits take-up decision. The overwhelming message from this paper is that the relationship between benefits and wages following an unemployment spell is tenuous, both empirically and theoretically.

The Unemployment Insurance Benefit Accuracy Measurement (BAM) system is an ideal source of data to compare the reservation wage of UI collectors relative to non-collectors. The UI BAM system provides the basis for assessing the accuracy of UI payments and denials. Two separates samples are drawn each week: one from the set of individuals whose claim was denied, and one from the set of individual UI recipients. We use the latter sample, which allows us to investigate directly the relationship between past wages, benefits, and reservation wages: each individual in this sample is asked about their usual wage prior to separation from their last employer, as well as their current reservation wage.

These data confirm that the amount of benefits received plays a relatively minor role in explaining individuals' reservation wage, especially once we control for usual wage.[1] The reservation wage elasticity with respect to benefits drops from 30% to around 2% after controlling for usual wage. Through a Blinder-Oaxaca decomposition, we establish that observables explain a significant fraction of the (reservation) wage change during extra-

[1]Because UI Benefits are typically a fraction of past wages, these two variables are highly correlated. To mitigate that fact, Ferraro et al. (2022) only use states for which benefits are a function of the highest quarter earnings. Here, we use usual hourly wage, which also avoids high co-linearity.

benefit periods, especially in 2020. Selection into UI benefit application/collection brought the expected reservation wage down about 10% in 2020, and by about 2% in 2021. Had the pool of collectors remained the same as in the pre-COVID period, the reservation wage would have increased by more than 6% in 2021. The overall change in reservation wage was mitigated by the changing composition of collectors.

We use CPS rotation data to construct measures of eligibility and the decision to collect benefits, from which we can compute a UI benefits take-up rate. To be eligible, an *unemployed* individual must satisfy non-monetary and monetary criteria. First, one must have lost a job through no fault of his/her own, measured as all unemployed individuals who (1) did not quit their last job and (2) aren't new or re-entrants into the labor force. We also impose that individuals haven't exhausted their benefits, which typically last 26 weeks in normal times. Monetary eligibility requires evaluating if an individual's past earnings are sufficiently high. We do so by applying date- and state-specific rules to employment income from the previous year available in the March supplement, also known as the Annual Social and Economic Supplement (ASEC).[2] If an individual is found to be monetary eligible thought this procedure, we deem that individual monetary eligible throughout the relevant rotation (the 4 interviews surrounding the March interview). As such, to be in our sample of individuals for whom we can establish UI eligibility, one must have been interviewed in March.

Measuring whether an eligible unemployed individual collects unemployment benefits is more nebulous. We can nevertheless construct a crude measure as individuals in the March supplement are asked the amount of unemployment benefits they received the previous calendar year. Accordingly, we use the March interview in the second rotation to determine UI benefit collection in the first rotation. Since all individuals who have an interview in March during their second rotation must have had an interview in March during first rotation (for whom we can assess eligibility), we can compute a take-up rate for all individuals who had a March interview during their first rotation. While this measure is useful to compute some aggregate statistics like the take up rate of UI benefits, it is not a precise measure of collection, we cannot assign the specific months during which an individual actually collected UI benefits.

The CARES Act (and subsequent COVID related Acts) relaxed eligibility criteria and

[2]We use a version of the UI calculator developed by Ganong et al. (2020), also used in Forsythe and Yang (2021).

enhanced the incentive to collect benefits through several programs, thereby affecting the take-up rate in various ways.[3] Non-monetary eligibility was relaxed to allow not only individuals who had reached their collection limit of 26 weeks (up to 39 weeks), but also those who certified to be unable or unavailable to work because of either of many COVID-19 related reasons (e.g., caring for someone). Furthermore, individuals who qualified received an additional \$600 per week in UI compensation from Aril to July 2020, and \$300 per week from January up to August 2021 for many states.[4]

The fraction of UI-eligible unemployed increased by a whopping 50 basis points (from about 30% to about 80%) at the outset of the COVID relief programs. We estimate that the take up rate increased from less than 30% pre-2020 to close 40% during the relief period. Through Probit regressions, we show that the increase in the take up rate is entirely due to changes in benefit amounts, as opposed to changes in the underlying characteristics of eligible individuals, despite its large increase. Indeed, we detect no break in the fraction of unemployed/eligible along any of the typical characteristics (age, gender, etc.), though the composition across industries/occupation does show some expected patterns.

A perhaps surprising result at first is that while the dollar amount that individual collectors received while unemployed increased quite dramatically during the COVID relief period, the wage premium that UI eligible individuals command relative to individuals who weren't eligible prior to transiting to employment did not increase quite as dramatically. Using a Differences in Differences (DiD) methodology, we estimate the increase in this wage premium to be around \$90 per week throughout the COVID relief period, though that amount drops to zero once year fixed effects are included in the regression. If we exclude 2020 (for which we do not have much data), the wage premium increased by about \$65 per week in 2021 (equivalent to around \$1.60 an hour over a 40-hour work-week), when the extra benefits were \$300 a week. Our estimates thus suggest that the (reservation) wage of job seekers who are eligible to collect UI benefits is relatively inelastic with respect to the UI benefit amount.

Our empirical results lead us to write down a search model to study the relationship between UI benefits and wages for individuals who transit from unemployment to employment. We start with a basic directed search model with a simple unemployment insurance system

[3] The Federal Pandemic Unemployment Compensation (FPUC) program increased benefits; the Pandemic Emergency Unemployment Compensation (PEUC) program extended regular unemployment benefits; and the Pandemic Unemployment Assistance (PUA) program compensated many individuals who did not qualify for regular unemployment benefits by relaxing monetary and non-monetary eligibility.

[4] Several states chose to end the pandemic programs prior to its scheduled sunset.

(Gervais et al. 2022) in which we introduce a decision to collect unemployment benefits along the lines of Auray et al. (2019). More precisely, upon separation, individuals draw an i.i.d. cost of filing for unemployment insurance benefits. As such, the unemployment benefit take-up rate is endogenous and, more importantly, changes with the generosity of the unemployment insurance system.

We show analytically that there exists a unique cut off cost of filing for UI benefits such that any unemployed worker with a cost below that threshold chooses to collect UI benefits, while anyone above that threshold chooses not to collect benefits. Moreover, unemployment duration and starting wage after a transition to employment are strictly decreasing in UI benefit filing cost for UI collectors. In other words, the wage premium is positive in the model. We then show that while the wage of collectors at transition is increasing in benefits, that of non-collectors is non-increasing. The last result rests on the permanent nature of the increase in benefits: the only way for non-collectors to claim high benefits in the future is to find a job now, experience a separation, and draw a low filing cost in the future. As such, increasing UI benefit leads to higher wage dispersion, which is consistent with CPS data.

Our main message—that the relationship between unemployment benefits and wages at transition to employment is relatively week—complements that from the large literature that has emerged since the outset of the COVID-19 pandemic—essentially finding that government intervention had a modest impact on various incentive-related labor market outcomes, despite the large size of the intervention.[5] For example, Petrosky-Nadeau and Valletta (2021) uses a standard search model to impute the implicit benefit level that individuals would need to receive in order to be indifferent between unemployment and employment at the wage of their previous job. Through the eyes of the model, they use data from the CPS to infer that break-even level of benefits. They find that for most workers, the extra benefits in 2020 did not deter them from accepting jobs.[6] Using proprietary bank account data, Ganong et al. (2022) find small increases in the job finding rate at the time the extra benefits ($600 in 2020 and $300 in 2021) expired, suggesting that the job finding rate was not overly affected (negatively) while extra benefits were in place.

[5]It is worth mentioning that some variables evidently did respond in spectacular fashion at the outset of the pandemic. As discussed above, initial unemployment insurance claim increased dramatically for example, just as vacancies were plunging (see Forsythe et al. (2020)).

[6]Boar and Mongey (2020) come to the same conclusion using a very similar model which allows for job offers at the previous wage to expire and the possibility that the next job will offer a lower wage, akin to a loss of human capital during unemployment.

Finally, Michaud (2023) studies the impact of UI expansions to workers earning below eligibility thresholds. Using administrative data she documents that the UI duration for newly eligible under the expansion was 1.7 times longer than the previous eligible. She also reports that, although this behavior is qualitatively consistent with standard economic mechanism, her quantitative model vastly over-predict the increase in duration, leading to a quantitative puzzle.

While the focus of these papers, as well as many others, is on whether unemployed individuals's incentive to look for employment was diminished by extra benefits, we focus on how these benefits affect individual's reservation and subsequent wage upon transiting to employment.

The paper proceeds as follows. Section 2 reviews the unemployment insurance system, as well as how the CARES Act and subsequent Acts altered eligibility and compensation. Sections 3 and 4 contain our empirical evidence from CPS and BAM data, respectively. Section 5 describes our economic environment and characterizes equilibria, while Section 6 uses a calibrated version of the model to study the impact of changes in UI benefit. Section 7 offers a brief conclusion.

2 Overview of the Unemployment Insurance Program

Unemployment Insurance is a joint state/federal program that aims to provide temporary financial assistance to unemployed workers. While each state has specific rules, qualified individuals are typically entitled to a fraction of their earnings over the last four quarters as unemployment benefits, subject to a maximum. Below we review the basic rules governing eligibility to this program, followed by a description of how these rules changed during the COVID era.

2.1 Regular Unemployment Insurance

To be eligible, unemployed individuals must meet two main criteria. First, they need to have lost their job through no fault of their own. Since firms' contribution to the program is a function of the likelihood their workers claim benefits, the 'no fault' condition can sometimes be litigious (see Auray et al. (2019) and Fuller et al. (2015)). Second, individuals need to satisfy state-specific work/earnings requirements. We refer the the first criterion as non-monetary eligibility, and the second as monetary eligibility.

Claimants must also *maintain* eligibility. First, as is well-known, benefits expire after a certain number of weeks. While the duration of benefits available is set at 26 weeks for many states, there are variations that depend of past income and how it is distributed over the previous year, the overall unemployment rate in the state, as well as the amount of weekly benefits itself as some states set a maximum yearly benefit amount.[7] For the purpose of this paper, we use a uniform 26 weeks maximum duration across all States prior to the COVID relief period.[8]

In addition to duration limits, many other requirements need to be satisfied to maintain eligibility. In particular, one must: file weekly or biweekly claims; be able to work, available to work, and actively seek work each week one claims benefits; report any earnings from work one had during the week(s) (States have different rules for how much money you can earn while receiving benefits); report any job offers or job offers one declines during the week; if requested, report to a local UI claims office or American Job Center on the scheduled day and time (benefits may be denied for those who do not attend); some states require registration for work with the State Employment Service; meet any other state eligibility requirements.

2.2 COVID Relief Period

The CARES Act was signed into law on March 27, 2020. The CARES Act expanded unemployment insurance benefits to millions of workers affected by COVID-19 through three main programs: the Federal Pandemic Unemployment Compensation (FPUC) program, the Pandemic Emergency Unemployment Compensation (PEUC) program, and the Pandemic Unemployment Assistance (PUA) program. We briefly describe each program below.

The *Federal Pandemic Unemployment Compensation* (FPUC) program is perhaps the best known program. Under the FPUC program, eligible individuals who collected unemployment benefits received an additional $600 per week from inception until the end of July 2020. Efforts were made to extend this program through an executive order allowing an extra $400

[7] See 'Duration of Benefits' in section 3 of https://oui.doleta.gov/unemploy/pdf/uilawcompar/2022/complete.pdf for details.

[8] Note that most States still had a 99-week cap extension in place up to January 2014.

of benefits, with $300 funded at the Federal level requiring a $100 match by the State, starting August 1, 2020. The funding from this program, which came from previously appropriated funds, quickly ran out and its disbursement was minimal. However, the COVID Relief Bill signed into law December 27, 2020, extended federal unemployment assistance of $300 per week through March 14, 2021. This $300 of extra benefits was further extended through the American Rescue Plan Act (ARPA), signed into law March 11, 2021. While this last extension was scheduled to sunset September 5, 2021, several states chose to end the program as early as June 12, 2021.

The *Pandemic Emergency Unemployment Compensation* (PEUC) program provided up to 13 additional weeks of benefits to individuals who had exhausted their regular unemployment compensation. For most states, this increased the maximum number of weeks of compensation to 39 weeks.

The *Pandemic Unemployment Assistance* (PUA) program affected eligibility along several dimensions. At the outset, this program was only available to individuals who applied for and were denied regular unemployment benefits, or who had exhausted their state UI benefits, including PEUC. In terms of non-monetary eligibility, PUA applied to individuals who were unemployed, partially unemployed, or unable or unavailable to work because of one of several COVID-19-related reasons, running from having COVID itself to caring for someone with COVID or even having quit a job because of COVID. In a nutshell, to receive PUA compensation, applicants only needed to provide self-certification that they are partially or fully unemployed, OR unable and unavailable to work because of one of many COVID-related circumstances. Unlike other programs, PUA claims could in principle be backdated up to February 2, 2020, provided that an individual met the eligibility requirements to receive PUA as of that date, including the requirement that the individual's unemployment was due to the COVID-19 related reasons. For those who qualified, compensation under the PUA program were available for up to 39 weeks.

3 Empirical evidence from CPS Data

We use rotation panel data from the Current Population Survey to measure earnings of individuals who transit from non-employment to employment, and compare these measures across individuals who are eligible to receive UI benefits relative to those who aren't. To do so requires a measure of eligibility, which we discuss below. We also construct a measure of UI benefit collection. Before discussing how we construct these measures, we briefly review the structure of the CPS survey, outlined in Table 1.

As is well known, individuals who take part of the CPS survey are interviewed 8 times over a 16 month period: data is gathered in the first 4 consecutive months (the first rotation), followed by an 8-month hiatus, and a further 4 months of interviews (the second rotation). While basic labor market data (e.g. labor market status) is collected at all 8 interviews, monthly earnings is only measured for the outgoing rotation, i.e. at interviews 4 and 8.

Meanwhile, retrospective income data is collected from all individuals who's rotation spans the month of March, known as the March supplement or the Annual Social and Economic Supplement (ASEC). For example, an individual who is part of the CPS in March 2020 will be asked detailed questions about their income from calendar year 2019. We use that information to impute monetary eligibility to unemployment benefits should an individual experience a spell of unemployment during the months surrounding the March survey.[9] We also use information from the March Supplement to assess whether an individual collected unemployment benefits the previous year. Combining the information from the first rotation (to assess eligibility) and the second rotation (to assess collection) we can construct a measure of the take up rate of unemployment benefits for individuals in their first rotation.

3.1 Measuring UI Benefits Eligibility

Regular Unemployment Benefits To identify eligible individuals in CPS data, we first use individuals' employment status. Through a series of questions, civilians are classified either as employed, unemployed, or not in the labor force.[10] The BLS distinguishes between two types of unemployed individuals: experienced and new workers. We also use the reason that individuals give for being unemployed, which distinguishes between individuals who lost jobs (due to temporary layoff, involuntary job loss, or ending of a temporary job), those who quit jobs, those who re-entered the labor force (re-entrants) and those seeking their first jobs (new entrants). We define eligible workers as experienced unemployed individuals who lost

[9]We use a suitably adapted version of the "UI-Calculator" from Ganong et al. (2020) to impute both eligibility and amount of benefits an individual is entitled to given their earnings history and state rules.

[10]Individuals are deemed unemployed if they did no work for pay or profit, did not have a job from which they were briefly absent, and answered yes to a question about whether they had been looking for work in the past four weeks.

Table 1: Structure of the CPS Survey

D	J	F	M	A	M	J	J	A	S	O	N	D
			1	2	3	4						
		1	2	3	4							
	1	2	3	4								
1	2	3	4									5
			5	6	7	8						
		5	6	7	8							
	5	6	7	8								
5	6	7	8									

Notes: Numbers represent CPS interview number. The top represents the first rotation, the bottom the second rotation. Red numbers represent interviews where current earnings are reported, whereas blue numbers are March ASEC interviews where past income is reported.

their job, i.e., we define quitters, re-entrants, and new entrants as ineligible. In addition, any individual who has been unemployed for more than 26 weeks is deemed ineligible. Accordingly, an unemployed individual is considered *non-monetary eligible* if he/she satisfies the reason for being unemployed and hasn't exhausted benefits.

The BLS does not elicit whether individuals meet monetary eligibility for unemployment insurance. We use information from the March Annual Social and Economic Supplement (ASEC) to simulate filing for unemployment benefits following the methodology outlined in Ganong et al. (2020).[11] While this methodology gives us a sense of the benefits an eligible unemployed individual is entitled to, we mainly use the results of this exercise to evaluate monetary eligibility at the extensive margin, i.e., whether computed benefits are positive or zero.[12] And because we only observe annual income in March for the pervious year, we

[11] State laws are available on a bi-annual basis since 1965 and sporadically since 1940 at https://oui.doleta.gov/unemploy/statelaws.asp#RecentSigProLaws. Since our earnings data pertains to the previous calendar year, we use the rules in place in January of each year.

[12] Since ASEC only elicit total pre-tax wage and salary income for the previous calendar year, we assume, as did Ganong et al. (2020), the most generous distribution of income over the past 4 quarters by attributing weeks worked to the last quarter first, then the second last quarter, and so on. Since most states use the most recent quarters to determine eligibility and benefits, backloading earnings over the calendar year gives

assume that monetary eligibility applies to all months surrounding the March interview for each rotation, as shown in Table 1.

COVID Relief Period As discussed in Section 2, the CARES Act increased benefit amounts through FPUC, increased the duration of regular unemployment benefits through PEUC, and relaxed eligibility through PUA.

We assume that all individuals whom we deem eligible (more on this below) for unemployment benefits from April 2020 until July 2020 received an additional $600 of weekly benefits. Similarly, eligible individuals received $300 in extra weekly benefits from January 2021 until the State-specific date when the program expired.[13] For States which let the program run its course as scheduled until September 5, we assume that individuals kept receiving the extra $300 through the month of August. That being said, we mainly use this program as a period over which unemployment compensation was elevated.

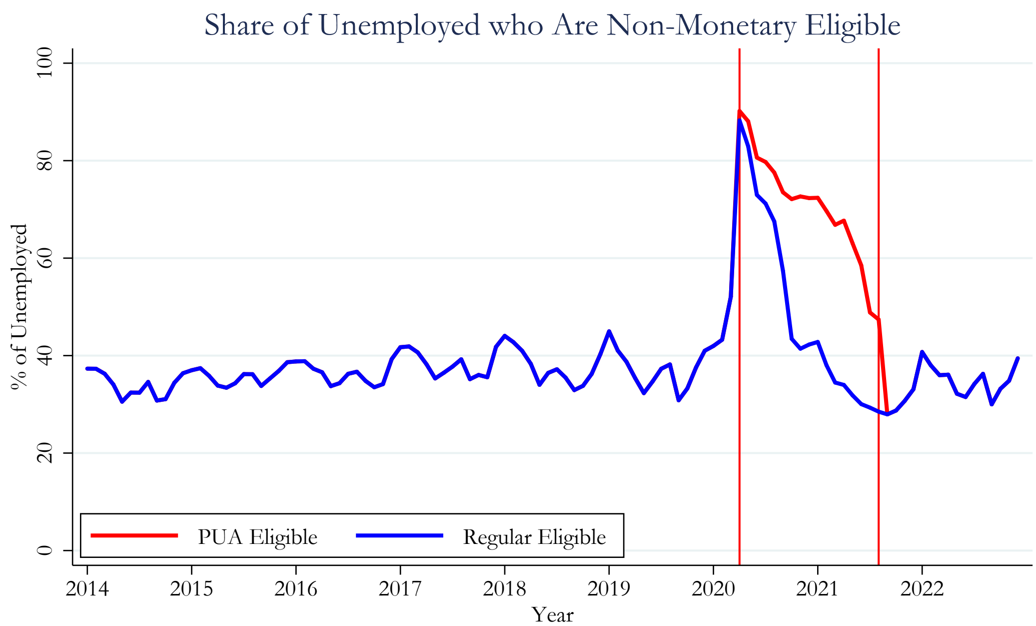
Recall that to be eligible under the Pandemic Unemployment Assistance (PUA) program, an individual who was ineligible for regular benefits needed to certify that they were either unemployed or unable to work because of COVID related circumstances. Our measure of non-monetary eligibility uses two questions that the CPS added in May 2020 asking whether one was 'unable to work due to COVID-19 pandemic', and whether one was 'prevented from looking for work due to COVID-19.' If an unemployed individual answered yes to either of these questions, we consider that individual non-monetary eligible until the end of the PUA program. Also, the PUA extended the duration of eligibility past the usual 26 weeks: we assume that duration became irrelevant during the relief period, though in principle one can only claim PUA (or regular) benefits up to 39 weeks.[14] Figure 1 shows the increase in non-monetary eligibility that resulted from this PUA program relative to the regular rules that govern non-monetary eligibility.

an upper bound to benefits and is the most generous assumption for monetary eligibility. There is no way to test the implications of this assumption using CPS data, though in principle SIPP data could be used to do so.

[13] At the monthly frequency, we deem the entire month a month of extra benefits if the program ended after the 15th of the month. For example, Iowa ended the program on June 12 so we assume that no extra benefits were extended to unemployed people from that state in June, while we assume that people from Indiana, which ended the program on June 19, received an extra $300 a week throughout the month of June.

[14] As noted before, PUA was in principle payable retroactively to eligible individuals for weeks beginning on or after January 27, 2020. However, few people qualified back to February, and our COVID-related questions only start in May 2020 CPS.

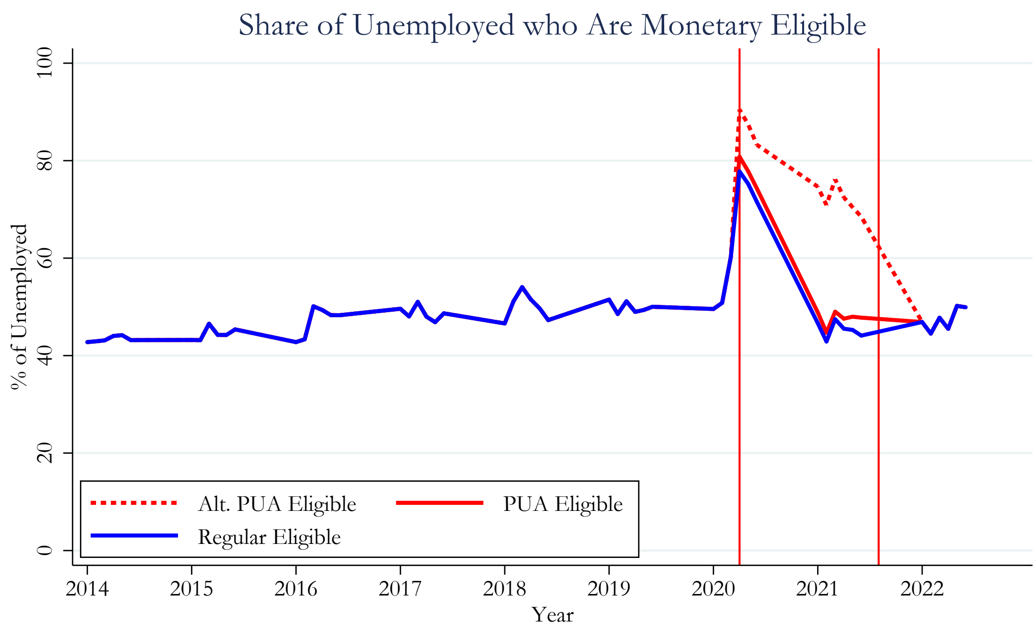
Figure 1: Non-Monetary Eligibility: regular vs PUA



Notes: Regular eligibility refer to the typical rules for non-monetary eligibility. PUA eligibility refers to non-monetary eligibility under the PUA program.

In terms of monetary eligibility, PUA extended the definition of qualifying income (typically earnings) to determine the benefit amount to include income of self-employed workers (including gig economy workers and independent contractors). In principle, unemployed workers had to provide proof (e.g., pay stubs, income tax return, bank statements, offer letter) to document employment or self-employment that was impacted by COVID-19 or to document work that would have begun on or after the date when COVID-19 impacted their employment status. However, providing evidence that some kind of work was interrupted in any kind of way by COVID-19 was essentially sufficient for monetary eligibility, and a minimum unemployment compensation equivalent to 50 percent of the average payment of regular unemployment compensation in an individual's state (ranging from $106 in Mississippi to $267 in Massachusetts) was guaranteed regardless of income. As such, we compute two measures of monetary eligibility. A first measure assumes that state-rules for monetary eligibility apply, but using a broader measure of income that included self-employment income in addition to earnings. The second alternative measure assumes that any positive income (earnings plus self-employment income) in the previous year is sufficient to satisfy

Figure 2: Monetary Eligibility: regular vs PUA



Notes: Regular eligibility refer to the typical rules for monetary eligibility. PUA eligibility refers to monetary eligibility under the PUA program, assuming that state-rules apply to earnings plus self-employment income. The alternative measure of monetary eligibility assumes that any positive past earnings or self-employment income qualifies.

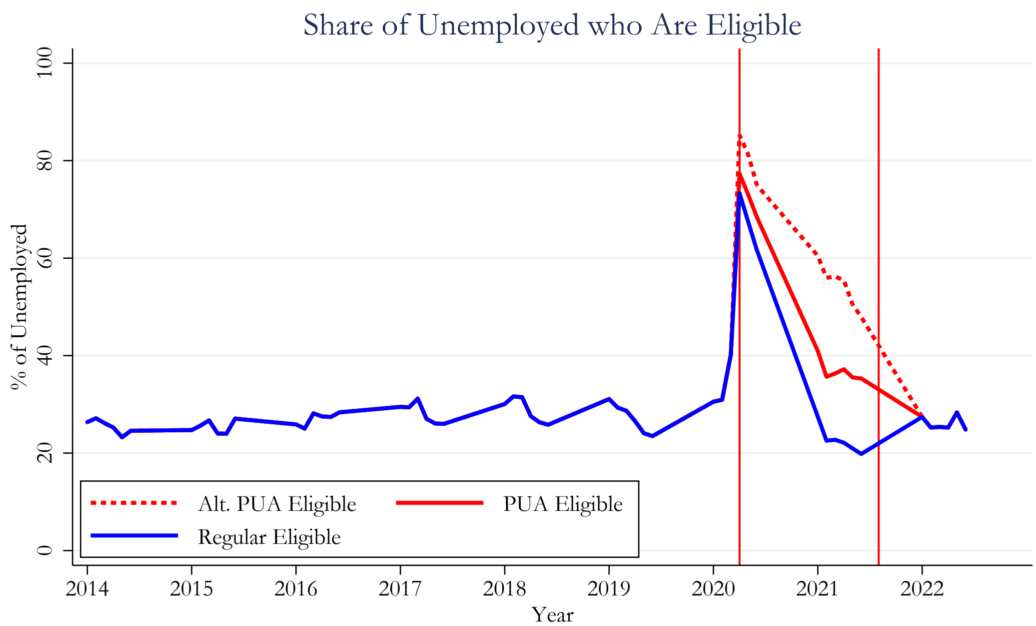
monetary eligibility: the idea is that having any income in the previous year shows some kind of attachment to the labor force. Figure 2 shows how PUA measures of monetary eligibility compare to that for regular unemployment benefits.

Combining non-monetary and either measure of monetary eligibility results in measures of eligibility, which are depicted in Figure 3. While there are clearly differences across the two measures during the relief period, both measures nevertheless suggest that unemployment benefits became more widely available during that period.

3.2 Take up Rate

To measure the take up rate, we need a measure of eligible unemployed individuals who successfully filed a claim for unemployment benefits. The BLS offers an indirect way to measure a take up rate. In the March Supplement, respondents are asked how much income (if

Figure 3: UI Eligibility: regular vs PUA



Notes: Regular eligibility refer to the typical rules for eligibility. PUA eligibility refers to eligibility under the PUA program, both assuming that state-rules apply to earnings plus self-employment income for non-monetary eligibility or that any positive past earnings or self-employment income qualifies for monetary eligibility.

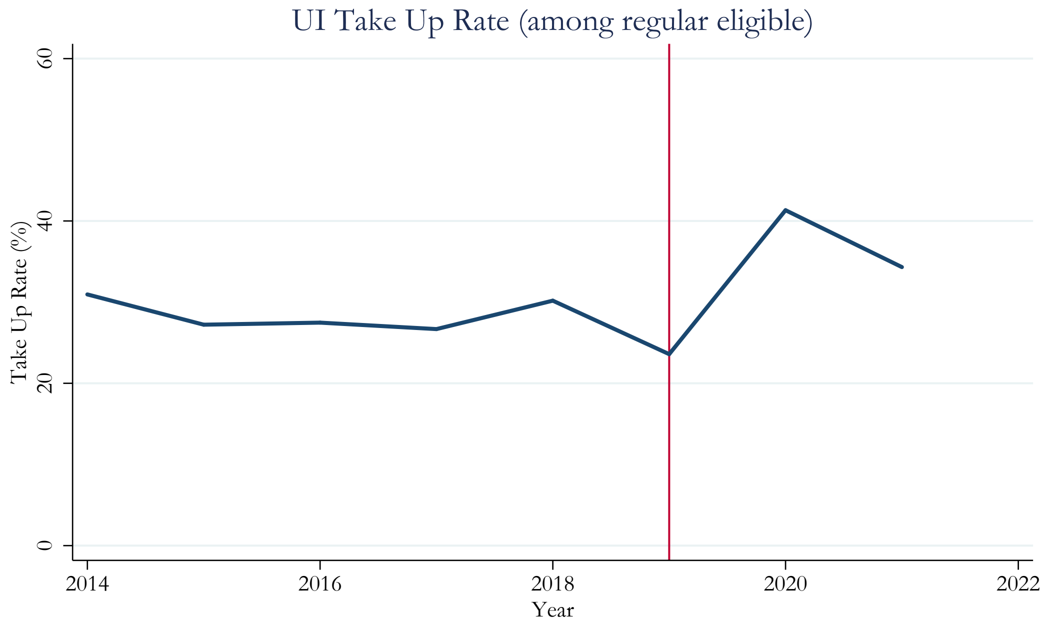
any) they received from unemployment compensation during the previous calendar year.[15] We use the answer to this question to impute whether an individual collected benefits the previous year, though there is no way to know the exact month(s) during which an individual collected benefits. Furthermore, this imperfect measure of collection is evidently only available for individuals who's interview rotation spans March: we use the answer to this question in the second rotation to impute collection in the first rotation (see Table 1).

The take up rate displayed in Figure 4 uses our measure of whether an individual collected UI benefits last year together with our measure of UI eligibility for regular unemployment benefits.[16] Interestingly, the take up rate increased from around 27% prior to 2020 to 41% in 2020 and 34% in 2021. Perhaps more surprising is that the take up rate among individuals

[15] The amount reported can emanate from state or federal unemployment compensation, but also from Supplemental Unemployment Benefits (SUB), but also from union unemployment or strike benefits, though we cannot identify each component separately.

[16] We report the take up rate at the annual frequency as our measure of collection refers to the entire previous calendar year, making any monthly variation misleading.

Figure 4: UI Take up Rate: regular program



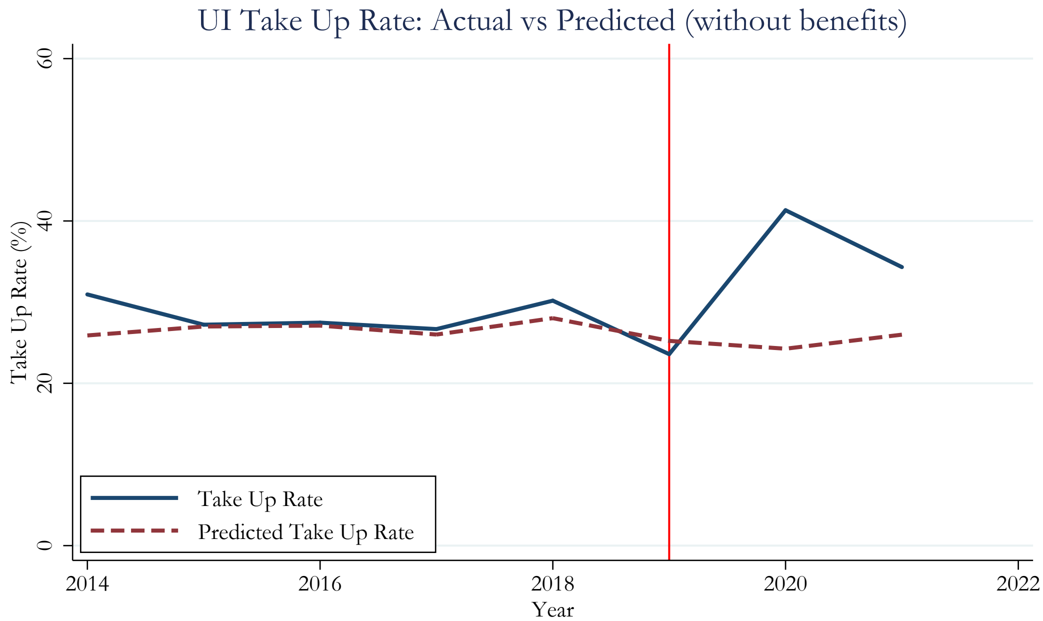
Notes: The take up rate is the fraction of individuals who are eligible to receive regular UI benefits who report having received UI benefits the previous year.

whom we deem eligible under either of our less stringent measures of monetary eligibility is quite similar to that seen in Figure 4: under second alternative measure of eligibility, the take up rate is also 41% in 2020 but 35% in 2021.

Many factors could explain the rise in the take up rate in 2020 and 2021 among individuals who qualify for regular unemployment benefits. In particular the set of eligible individuals could have different characteristics or earnings history, but the increase in benefit amounts could also affect the propensity to claim benefits. We use a Probit regression to estimate the propensity for individuals to claim benefits in normal times (2014–2019) as function of characteristics (age, sex, education, race, occupation, and industry) as well as the duration of their unemployment spell, past earnings, and benefit amounts. We use the coefficients from that regression to predict the take up rate in 2020 and 2021. The results, displayed in Figures 5 and 6, show that the predicted take up rate closely follows the actual take up rate only when benefit amounts are included as a regressor.

The conclusion from this exercise is not surprising: the decision to file for and claim unemployment benefits is closely linked to the amount one will receive once the claim is

Figure 5: Actual and predicted Take up Rate without benefits



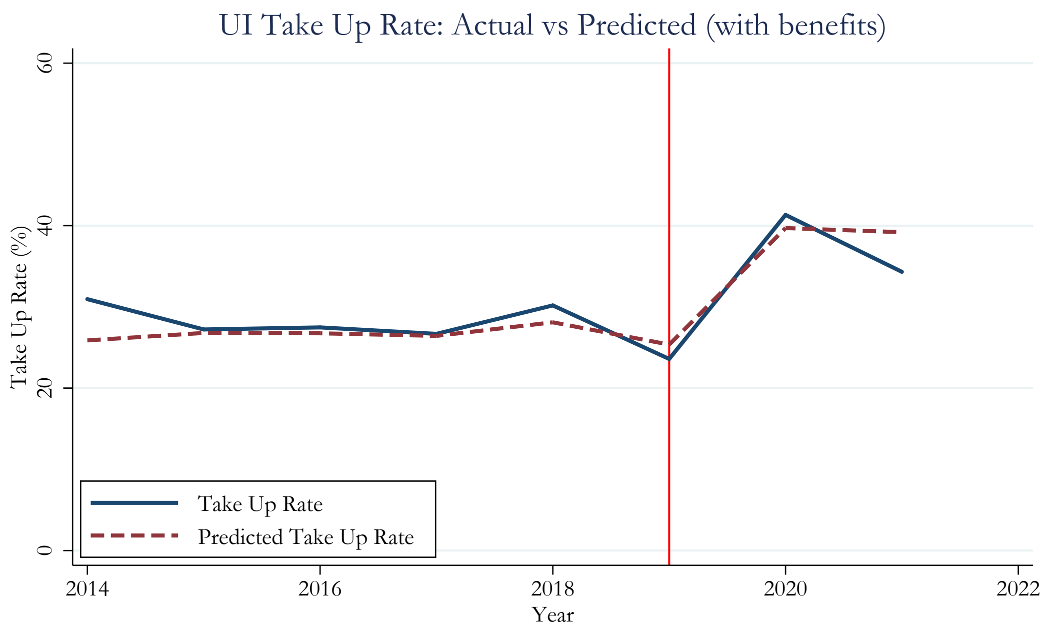
Notes: The take up rate is the fraction of individuals who are eligible to receive regular UI benefits who report having received UI benefits the previous year. The predicted take up rate uses the coefficient of a Probit regression to predict the take up rate out of sample for 2020 and 2021.

approved. Perhaps more surprising is that underlying characteristics of the pool of eligible individuals did not affect the take up rate. We now turn to the next question: to what extent do claimants's reservation wage—and thus the wage they receive upon transiting to employment—react to an increase in benefits?

3.3 Earnings Following Transition to Employment

Recall that earnings are only measured for the outgoing rotation. For the purpose of measuring earnings following a transition to employment, we use the first rotation (the first 4 interviews) and the second rotation (the last 4 interviews) independently. In other words, even if we know that an individual transited into employment during their 8-month hiatus period, we do not consider earning observed in interview 8 as earnings associated with that transition. The main reason are that (1) earnings observed in interview 8 are 8 to 12 months removed from that transition and (2) there may have been more than one labor market

Figure 6: Actual and predicted Take up Rate with benefits



Notes: The take up rate is the fraction of individuals who are eligible to receive regular UI benefits who report having received UI benefits the previous year. The predicted take up rate uses the coefficient of a Probit regression to predict the take up rate out of sample for 2020 and 2021.

transition over that period of time.

Notice that our measurement requirements put a lot of structure on individuals who can be in our sample: they need to be interviewed in March so we can assess eligibility as discussed above, and they must go through a transition to employment either during the first or the second rotation. Looking back at Table 1, respondents whose first (fifth) interview is in March can transit to employment in their second (sixth), third (seventh) or fourth (eighth) interview, and their earnings will be measured in their fourth (eighth) interview. Similarly for respondents whose first interview is in February or January. For respondents whose first interview is in December, since we only compute eligibility starting with their second (sixth) interview, their can only transit to employment in their third (seventh) or fourth (eighth) interview.

Now the FPUC program, which increased benefit amounts by $600 a week, started in April 2020. As such, again looking back at Table 1, individuals could only transit to employment after having received extra benefits in May or June 2020: this evidently leaves us with a very limited sample. In addition, the number of transition to employment during those months were atypically small. For those reasons, results for 2020 should be taken with a grain of salt.

Fortunately, the Federal COVID Relief Bill (signed into law in December 2020) resurrected the FPUC program, now a with a \$300 a week supplement, starting the week of December 26, 2020. Accordingly, all individuals who transited to employment after January 2021 would have potentially received the \$300 supplement. Furthermore, this supplement remained in place, through the the American Rescue Plan Act (ARPA), at least until June 2021: no state ended the program prior to June 2021.[17] As such, all transitions to employment that we observe in 2021 and for which we can measure eligibility, as shown in Table 1, potentially occurred after having received unusually high unemployment benefit amounts.

We can now use a difference-in-difference regression to investigate how the wage of eligible individuals differed from that of ineligible individual prior to relative to during the COVID relief period. From the eligibility methodology outlined above, individuals who aren't eligible for UI benefits fall into one of several categories: new entrants into the labor market; re-entrants into the labor market; individuals out of the labor force; individuals who quit their last job; or individuals who failed to qualify due to monetary reasons. In principle, these individuals weren't affected by the increase in the generosity of UI benefits in 2020 and 2021. Accordingly, we run the following regression

$$w = \alpha_0 \mathbb{I}(\text{eligible}) + \alpha_1 \mathbb{I}(\text{COVID}) + \boldsymbol{\gamma} \mathbb{I}(\text{eligible}) \mathbb{I}(\text{COVID}) + \beta X + \varepsilon,$$

where X includes gender, race, education, and age, as well as industry and occupation indicators. In this equation, γ measures the change in the 'wage premium' that eligible individuals command over ineligible individuals during the COVID relief period relative to pre-COVID.

Table 2 shows that the earnings that eligible unemployed individuals receive relative to ineligible unemployed people when they transit to employment increased by about \$90 while the FPUC program supplemented unemployment benefits amounts, though that drops to zero once year fixed effects are included in the regression. If we exclude 2020 (for which we

[17]The first states to end the program, Arkansas, Iowa, Mississippi and Missouri, did so as off June 12, 2021.

Table 2: Diff-in-Diff Regression: Eligible Wage Premium pre vs COVID

	Include 2020		Exclude 2020	
	(1)	(2)	(3)	(4)
Δ wage premium ($)	90.83***	-3.522	73.03**	64.36**
	(33.83)	(40.86)	(30.08)	(26.64)
year fixed effect	No	Yes	No	Yes
N	7,535	7,535	6,725	6,725

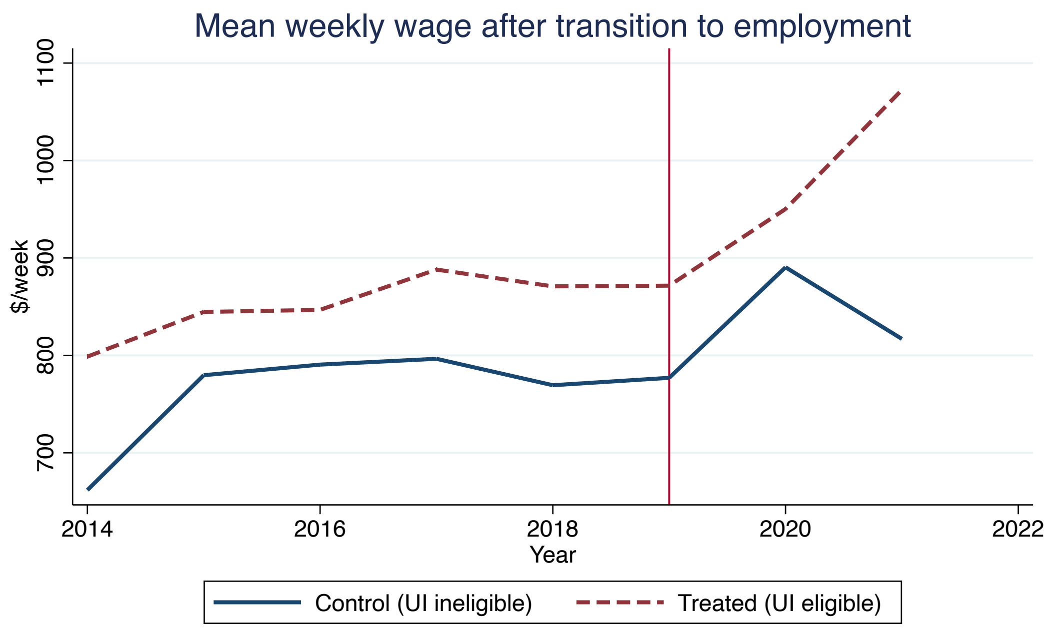
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Notes: Data from the CPS. Additional controls in all regressions are: sex, age, education, race, industry and occupation.

do not have much data as explained above), the wage premium increased by about $65 in 2021, when the extra benefits were $300 a week.

Figure 7 shows the trend line of the average wage that eligible and ineligible individuals received upon transiting to employment over time. This figure shows that prior to the COVID relief period, the distance between wages of eligible and ineligible individuals was stable over time. While wages of eligible people increased significantly during the COVID relief period, so did wages of ineligible people in 2020. In 2021 though, the distance between wages of eligible and ineligible people was around $250. Results from the Diff-in-Diff regressions suggest that a large fraction of that increase can be attributed to changes in characteristics.

Several caveats are in order. First, recall that 2020 was a very unusual year: not only do we have very few data points for that stretch of the COVID relief period, but it is hard to be very confident about eligibility measures during that time period. And while it would be tempting to conclude that the $65 change in the wage premium of eligible individuals represents a lower bound because not every eligible person actually files and claims benefits, there may also be people whom we deem ineligible who were actually collecting benefits. To properly study the set of individuals who actually collect unemployment benefits, we turn to data from the Benefit Accuracy Measurement (BAM) system.

Figure 7: Mean Wage after Transition to Employment



Notes: Measure of the average wage of eligible and ineligible unemployed people upon transiting to employment.

4 Empirical evidence from BAM data

The Benefit Accuracy Measurement (BAM) system assesses the accuracy of payments and claim decisions for unemployment insurance applicants and is administered by the U.S. Department of Labor. The data consists of systematic samples of individuals who are currently receiving UI payments and those who received disqualifying ineligibility determinations. These cases are thoroughly examined to determine whether payments were properly administered to claimants or appropriately denied. We use the sample of paid claims drawn from each state's UI system data in our analysis. The sampling of cases is not proportional to the total population or the unemployed population within each state, but rather a fixed annual number of cases for each state, administered roughly uniformly across all weeks in the year. Variation in sample size from state to state exists, and results are weighted to be representative of the total paid claimant population.

Through the process of investigating each paid or denied claim, the claimant is surveyed about several aspects of their previous job (wage, industry, occupation), job search (reservation wage, searching industry), and unemployment benefits (weekly benefit amount). All investigations center on a reference or "key week" for evaluating appropriate payment of any claims. The denied claims sample also contains similar information on the claimant's work history, search behavior, and information on the benefit amount and reasons for denial of their claim. We use the sample of UI paid claimants to quantify the extent to which individuals' job search behavior might respond to changes in UI benefits.

4.1 Sample

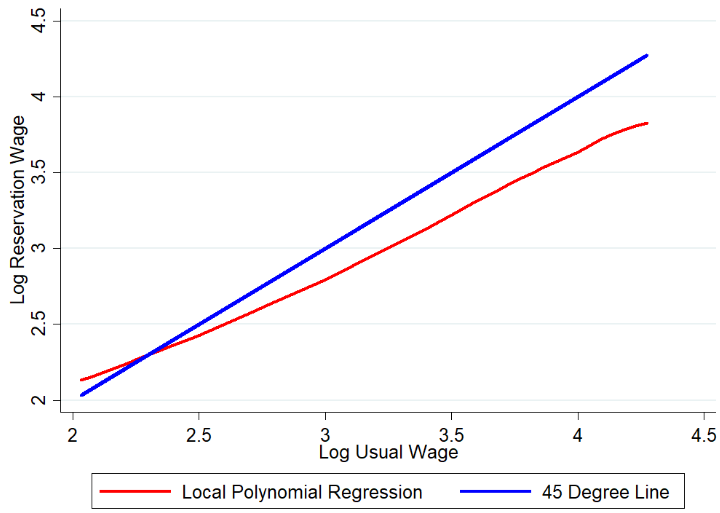
Since individuals in BAM are randomly selected and surveyed, the data are repeated weekly cross-sections of information about unemployment compensation receipt. For our analysis of the relationship between UI collection and benefits, we restrict the sample to claimants between 16 and 65 years of age. We Winsorize usual hourly wage and lowest acceptable hourly wage at the 1st and 99th percentiles. We also Winsorize the weekly benefit amount at the 99th percentile. Consistent with our analysis of CPS, we use data from 2014 to 2022. All values are deflated to 2021 dollars.

4.2 Reservation Wages

Our focus with the BAM sample is on the relationship of UI receipt and search behavior. In other datasets such as the Current Population Survey (CPS), UI eligibility and receipt are not available and must be imputed based on limited earnings and labor market history, as we did in the previous section. Unfortunately, in the Survey of Income and Program Participants (SIPP) where unemployment compensation receipt is asked, under-reporting of UI receipt is a known issue.[18] And because the take up rate of UI benefits is relatively low even amongst the eligible population, it is particularly difficult to directly study the outcomes of those who collect UI benefits without reliable information on their collection status. By contrast, the BAM system is administered by the Department of Labor with access to considerable administrative data on each UI claimant. As such, the identification of who is receiving unemployment compensation is not subject to the same misreporting

[18] See 2021 and 2022 Data User Notes https://www.census.gov/programs-surveys/sipp/tech-documentation/user-notes/2021-usernotes/volat-unemp-comp-during-covid19-pand.html and https://www.census.gov/programs-surveys/sipp/tech-documentation/user-notes/2022-usernotes/2022-undrestim-unemp-comp-dur-pandmc.html

Figure 8: **Reservation Wage and Usual Hourly Wage**



errors as other surveys.

BAM data allows us to directly observe a representative sample of precisely identified UI benefit recipients along with information on their employment and earnings history, search behavior, and demographics. On the flip side, having no panel dimension, our ability to measure labor market outcomes within BAM are limited. As such, we focus on a measure of search behavior that is included in each investigation. Our main analysis focuses on the reservation wage, or lowest acceptable hourly wage, reported by each claimant during their interview.[19]

We first establish some facts about the surveyed reservation wage of UI claimants. First, the surveyed reservation wage is very stable and highly correlated with the worker's usual hourly wage. In our sample, the mean of the usual hourly wage for paid claimants is \$21.56 and the mean of the reservation wage is \$18.51. Figure 8 shows the local polynomial regression of $ln(\tilde{w})$ on $ln(w_{usual})$ plotted against the 45 degree line. We see that this relationship is very linear. The fact that reservation wages are below usual hourly wages suggests that workers fall off the job ladder in unemployment.

[19]Specifically, the reservation wage corresponds to the lowest hourly wage that the claimant was willing to accept during the Key Week.

To condition on other covariates, we can run the following regression:

$$ln(\tilde{w}) = \beta_0 + \beta_1 ln(w_{usual}) + \beta_2 X + \varepsilon \quad (1)$$

where $ln(\tilde{w})$ is the reservation wage in logs, $ln(w_{usual})$ is the worker's reported usual hourly wage in logs, and X is a vector of controls. Table 3 shows the results of this regression with and without controls. Note that there is a strong and statistically significant positive correlation between reservation wage and usual wage in logs.

To measure the elasticity of the reservation wage with benefits, we add the log of weekly UI benefits (including supplemental benefits during Covid) to the regression on reservation wage as follows:

$$ln(\tilde{w}) = \beta_0 + \beta_1 Weekly\,UI\,Benefit + \beta_2 ln(w_{usual}) + \beta_3 X + \varepsilon \quad (2)$$

We present the results in Table 4. We find that the relationship between past wage and reservation wage is still similar. It is positively correlated and the elasticity is close to 0.8. By contrast, the coefficient of logged weekly UI benefits on the logged reservation wage is much smaller, with an elasticity of about 2%.[20] Reservation wages reported by UI claimants are correlated with their benefit level, but this coefficient is much smaller than that of usual wages.

Looking at the relationship of UI benefits and past wages, shown in Figure 9, we see that benefits are highly nonlinear in usual hourly wages. This is largely because UI payments have a relatively low maximum weekly benefit amount, essentially making benefits flat beyond a certain hourly wage.

Figure 10 plots the time-series of the weekly mean of paid claimants' reservation wage and past wage. The past wage and reservation wage of past claimants dropped significantly at the outset of the Covid lockdowns. There is a precipitous drop in the average hourly wage and reservation wage of claimants which recovers gradually into 2020 and 2021. The reservation wage and past wages are higher than the pre-Covid sample by 2022, but the gap

[20] If benefits and usual hourly wages are highly colinear, then there is concern about interpreting the magnitude of the coefficient on benefits. Note that benefits are usually a function of earnings, which is hours times wages over a base period, and not just wages. As an additional check we rerun our regression specification only in states where benefits are a function of high quarter earnings (rather than average earnings during a base period) as in Ferraro et al. (2022). We get similar results when restricting our sample to states where benefits are calculated using highest quarter earnings. See Appendix F Table 4

Table 3: Results

	$ln(\tilde{w})$	$ln(\tilde{w})$	$ln(\tilde{w})$
$ln(w\_usual)$	0.813***	0.762***	0.758***
	(0.018)	(0.020)	(0.022)
age		0.000	0.002**
		(0.001)	(0.001)
agesq		−0.000	−0.000
		(0.000)	(0.000)
female		−0.014***	−0.016***
		(0.005)	(0.005)
Constant	0.395***	0.430***	0.379***
	(0.059)	(0.069)	(0.069)
Education dummies	No	Yes	Yes
Race/Ethnicity dummies	No	Yes	Yes
2 dig SIC dummies	No	Yes	Yes
State dummies	No	Yes	Yes
Time dummies	No	No	Yes
Observations	182,910	181,106	181,106

between the reservation wage and past wage is narrower during the post-Covid sample.

We want to understand what contributes to the large change in levels we observe in the reservation wage and usual wage time-series during the Covid period. We would like to know if this change in the cross-sectional time-series of reservation wages and usual wages is due to compositional changes of those collecting unemployment benefits, or constitute changes related to the behavior of individuals, for instance due to perceived weak labor demand. To do so, we perform a Blinder-Oaxaca decomposition to compare the expectation of the reservation wage during the pre-Covid time period and post-Covid (2020 and 2021 during periods with extended benefits) time periods for UI paid claimants. We run a regression of the log of reservation wage on the log of usual hourly wages and other covariates just as we did for Table 3.[21] We run this regression separately for the pre-Covid time-period, and again

[21] We don't include benefits in this specification as they are part of the policy we want to evaluate. To

Table 4: Results

	$ln(\tilde{w})$	$ln(\tilde{w})$	$ln(\tilde{w})$	$ln(\tilde{w})$
$ln(WeeklyUIben)$	0.365***	0.025***	0.029***	0.018***
	(0.019)	(0.007)	(0.003)	(0.005)
$ln(w\_usual)$		0.800***	0.749***	0.750***
		(0.020)	(0.021)	(0.021)
age			0.000	0.001**
			(0.001)	(0.001)
agesq			0.000	−0.000
			(0.000)	(0.000)
female			−0.013**	−0.015***
			(0.005)	(0.005)
Constant	0.621***	0.280***	0.305***	0.311***
	(0.115)	(0.049)	(0.063)	(0.073)
Education dummies	No	No	Yes	Yes
Race/Ethnicity dummies	No	No	Yes	Yes
2 dig SIC dummies	No	No	Yes	Yes
State dummies	No	No	Yes	Yes
Time dummies	No	No	No	Yes
Observations	182,862	182,600	180,799	180,799

separately for 2020 and 2021. Recall that in our regression equation (1), X includes age and its quadratic, sex, 2-digit SIC code of the worker's usual job, education dummies, and state dummies. The difference in reservation wages pre-and post-Covid is almost entirely accounted for by the changes in endowments in 2020. In other words, the composition of claimants explains most of the observed difference in reservation wage between samples, as we can see in Table 5. It appears that, especially for the large decline in reservation wages over the time period immediately following Covid in 2020, the composition of UI claimants explains a large portion of the change. Selection into UI takeup, either through increased

the extent that benefits encapsulate otherwise unobservable characteristics of workers such as attachment to the labor force, we may want to include benefits minus the FPUC treatment. Doing so yields very similar results and we include them in Appendix F.

Figure 9: **UI Weekly Benefit and Usual Hourly Wage**

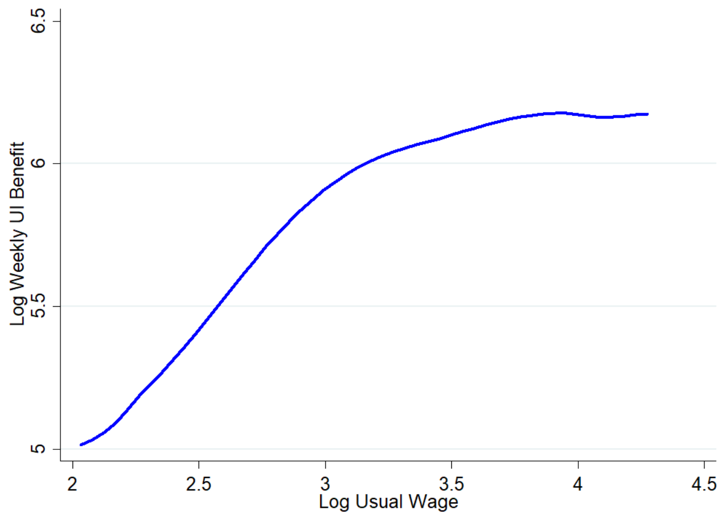
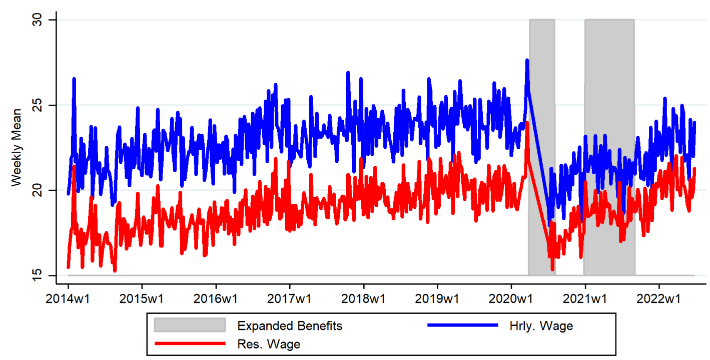


Figure 10: **Reservation Wage and Usual Hourly Wage**



likelihood of low reservation wage workers to apply for UI or via the increased eligibility of these workers for UI, is one mechanism which would be consistent with the change in worker composition over this sample. Holding endowments fixed, we would have expected to see a slight increase in reservation wages based on the changes in coefficients. Note however that we have very limited coverage during weeks where supplemental benefits were available in 2020.

We repeat this exercise using 2021 during the time-period where supplemental benefits were available as the post-Covid sample. Table 6 shows that the difference in the expectation of the reservation wage between samples is small, increasing slightly in the post-Covid period with extended benefits. The decomposition shows that changes in reservation wage were partially offsetting between the explained component (endowments) and the unexplained component (coefficients). That is, the composition of claimants accounts for a decrease in the expected reservation wage of about 2%, but there was an offsetting change in the coefficients of a greater magnitude. In contrast to 2020 and more consistent with intuition that an increase in benefits should increase reservation wages, the expanded benefit period in 2021 sees an increase in the expected reservation wage when holding observables constant. This increase is still relatively small, however, and is partially offset by the compositional change in UI claimants which persisted into 2021 and results in dampening the overall increase in the reservation wage.[22]

Table 5: Blinder-Oaxaca Decomposition Pre and Post Covid 2020

	Decomposition		Percent	
Pre Covid	2.802***	[2.760,2.844]		
Post Covid 2020	2.736***	[2.670,2.801]		
difference	0.067**	[0.015,0.119]		
endowments	0.099***	[0.059,0.138]	148.283***	[88.033,208.534]
coefficients	-0.044***	[-0.064,-0.024]	-66.402	[-145.748,12.943]
interaction	0.012***	[0.005,0.019]		

Table 6: Blinder-Oaxaca Decomposition, Pre and Post Covid 2021

	Decomposition		Percent	
Pre Covid	2.799***	[2.757,2.840]		
Post Covid 2021	2.845***	[2.793,2.898]		
difference	-0.047***	[-0.077,-0.016]		
endowments	0.018*	[-0.001,0.036]	-37.826	[-100.903,25.251]
coefficients	-0.067***	[-0.083,-0.051]	143.820***	[77.236,210.405]
interaction	0.003	[-0.001,0.007]		

[22]We also plot the time-series of the composition of paid claimants by select observable worker characteristics in Appendix F. We find that collectors comprised of significantly younger individuals following 2020. Paid claimants were also less likely to be in the manufacturing sector in 2020.

5 Economic Environment

The empirical evidence discussed above suggests that individuals who transit from unemployment are only modestly affected by the amount of unemployment benefits they receive while unemployed, in the sense that reservation wages are not overly sensitive to unemployment benefits. The evidence also suggests that an important margin is the decision to fill for unemployment benefits. We now describe a parsimonious economic environment with on the job search similar to Gervais et al. (2022), together with an endogenous benefits take up decision inspired by Auray et al. (2019), which is helpful to understand these results.

Agents and Markets

There is continuum of infinitely-lived workers, and a continuum of firms with positive measure. Workers' period utility function $v : \mathbb{R} \to \mathbb{R}$ is twice continuously differentiable, strictly increasing, weakly concave such that $v'(\cdot) \in [\underline{v}', \bar{v}']$, $0 < \underline{v}' \leq \bar{v}'$, where $v'(\cdot)$ is the derivative of $v(\cdot)$. Workers and firms have discount factor $0 < \beta < 1$.

At the beginning of each unemployment spell, an unemployed worker draws a utility cost of filing for and collecting UI benefit $\varepsilon \in [\underline{\varepsilon}, \bar{\varepsilon}]$ from distribution $F(\varepsilon)$.[23] Draws are i.i.d. across workers and across unemployment spells. Each draw stays with the worker until he exits unemployment.[24] If a worker chooses to collect UI benefits, he receives flow consumption b and incur utility cost of collecting benefits ε. If a worker chooses not to collect UI benefits, he receives flow consumption d, with $v(b) - \bar{\varepsilon} < v(d) < v(b) - \underline{\varepsilon} < v(b)$.

There is a continuum of submarkets indexed by the expected lifetime utility x that the firms offer to the workers, $x \in X = [\underline{x}, \bar{x}]$, with $\underline{x} < v(d) / (1 - (1 - \delta)\beta)$ and $\bar{x} > v(y) / (1 - (1 - \delta)\beta)$. Let $\theta(x) \geq 0$ be the market tightness, i.e., the ratio of vacancies created by the firm to the workers looking for a job in submarket x.

Each period consists of four stages: separation, search, matching and production. In the separation stage, an employed workers is separated from his match with probability $\delta \in (0, 1)$. When a worker loses his job, he draws a new UI benefit collection cost ε and must remain unemployed until the start of the search stage next period.

[23] As discussed in Section 2, a worker needs to fulfill several requirements to fill and maintain UI benefit eligibility throughout an unemployment spell.

[24] In Auray et al. (2019), the utility cost is a permanent type.

During the search stage, an individual who has the opportunity to search decides in which submarket to direct his search. While all individuals who have been unemployed for at least one period have the opportunity to search, employed workers only have the opportunity to search with probability $\lambda_e \in (0,1]$. Also, during search stage, a firm chooses how many vacancies to create and where to locate them. The cost of maintaining a vacancy for one period is $k > 0$. Both workers and firms take the market tightness $\theta(x)$ as given.

During the matching stage, a worker meets a vacant job with probability $p(\theta(x))$, where $p : \mathbb{R}_+ \to [0,1]$ is twice continuously differentiable, strictly increasing, and strictly concave function such that $p(0) = 0$, and $p'(0) < \infty$. Similarly, a vacancy meets a worker with probability $q(\theta(x))$, where $q : \mathbb{R}_+ \to [0,1]$ is twice continuously differentiable, strictly decreasing, convex function such that $q(\theta) = p(\theta)/\theta$, $q(0) = 1$, and $q'(0) < 0$, and $p(q^{-1}(\cdot))$ is concave.

A firm who meets a worker in submarket x during the matching stage offers the worker a contract which delivers expected lifetime utility x to the worker. If the worker accepts the offer, he starts working at the new job in the following production stage. Otherwise, the worker retains his previous labor market status (which could be unemployment). Firms and workers cannot coordinate their actions because of search frictions in the labor market: not all workers succeed in finding a job, and not all firms succeed in hiring a worker.

During the production stage, an employed worker produces y, and consumes after-tax wage $(1-\tau)w$. Therefore, the firm's profits equal $y - w$ in that period. Unemployed workers who collect UI benefit consume b (and incur utility cost ε). Unemployed workers who do not collect UI benefit consume d.

Workers

Let $V \in X$ denote the expected lifetime utility that a worker currently receives, either at his current job or being unemployed. Suppose a worker with lifetime utility V has the opportunity to search. During the search stage, he chooses in which submarket to search in order to maximize his value of search. If the worker searches in submarket x, he finds a job with probability $p(\theta(x))$ and the job provides lifetime utility x. If he fails to find a job, which occurs with probability $1 - p(\theta(x))$, he retains employment status in the production stage (which could be unemployment). Accordingly, an individual with current lifetime utility

V who has the opportunity to search chooses the submarket which maximizes his lifetime utility at the beginning of the search stage, $V + R(V)$, where the second term is the net return to search at the beginning of the search stage. The worker's problem at the search stage can thus be written as

$$R(V) \equiv \max_{x \in X} p(\theta(x))(x - V). \tag{3}$$

In the following we denote $m(V) \in X$ as the optimal submarket in which to search. To ease notation, let $\tilde{p}(V) \equiv p(\theta(m(V)))$ denote the probability of finding a job in the optimal submarket.

Let $U(\varepsilon) \equiv \max\left\{U^N, U^C(\varepsilon)\right\}$ denote the lifetime utility of an unemployed worker, with UI benefit collection cost ε, at the beginning of the production stage. This worker has to decide whether to collect UI benefit, or not. If he chooses not to collect UI benefit, his lifetime utility is equal U^N which consists of value of consuming d plus the value of being unemployed and searching next period:

$$U^N = v(d) + \beta\left\{U^N + R\left(U^N\right)\right\}. \tag{4}$$

Note that, since ε is constant during each unemployment spell, a worker who decides not to collect benefit at the beginning of an unemployment spell will always choose not to collect during that unemployment spell. If the worker chooses to collect UI benefit, his lifetime utility is equal $U^C(\varepsilon)$ which consists of the value of consuming b, incurring utility cost ε, plus the value of being unemployed and searching next period:

$$U^C(\varepsilon) = v(b) - \varepsilon + \beta\left\{U^C(\varepsilon) + R\left(U^C(\varepsilon)\right)\right\}. \tag{5}$$

Let $U \equiv \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} U(\varepsilon)\, dF(\varepsilon)$ denote the lifetime utility of an unemployed worker before the realization of UI collection cost ε.

Firms

During the matching stage, firms offer contracts $c \in C$ to workers. A contract specifies the current wage w, and the worker's lifetime utility at the beginning of the next period, V'. This future utility will be attained by an implicit sequence of future wages and unemployment benefits. The firm chooses the contract to maximize expected lifetime profits $J(V)$, while delivering the lifetime utility previously contracted (promise-keeping constraint). The problem of a firm matched with a worker with promised lifetime utility V is therefore given by

$$J(V) = \max_{w,V'} \left\{ y - w + \beta (1-\delta) \left(1 - \lambda_e \tilde{p}(V')\right) J(V') \right\} \tag{6}$$

subject to

$$V = v\left((1-\tau) w\right) + \beta \left[\delta U + (1-\delta)\left(V' + \lambda_e R(V')\right)\right].$$

Let $c = (w, V')$ denote the optimal contract, with associated policy functions $w = w(V)$ for the wage, and $V' = z(V)$ for the worker's lifetime utility next period.

Market tightness

During the search stage, a measure of firms choose whether to enter the labor market by opening a vacancy. Should it choose to enter, a firm posts how much lifetime utility it offers (i.e. chooses a submarket x) for all potential applicants to see. The benefit of creating vacancy is submarket x is the product between the vacancy filling probability $q(\theta(x))$ and the value meeting a worker $J(x)$. The cost of creating a vacancy is k. When the benefit of creating a vacancy in submarket x is strictly smaller than the cost, no vacancy is created in that submarket. When the benefit is strictly greater than k, it is optimal to create infinitely many vacancies. Therefore, free entry implies that the expected value of opening a vacancy cannot exceed the cost of creating one. In other words, in any submarket that is visited by a positive number of workers, the market tightness $\theta(x) \geq 0$ must be such that

$$q(\theta(x)) J(x) \leq k \tag{7}$$

with $\theta(x) > 0$ whenever $q(\theta(x)) J(x) = k$. While the free entry condition must hold with equality for submarkets which are open in equilibrium (i.e. submarkets in which some individuals search), such need not be the case for unvisited submarkets. Following Acemoglu and Shimer (1999) and the subsequent literature, we assume that (37) holds with equality in all submarkets in a relevant range, that is, from the lowest submarket to the submarket where firms would just cover the cost of posting a vacancy with a job filling probability equal to one. Under this assumption, market tightness is a decreasing function of x over the relevant range.

Government

Every unemployed worker enjoys utility of home production d. Therefore, if they decide to collect, they receive $b-d$ as transfer which is financed through taxes on wages on employed workers. The government collects earnings taxes at rate τ to finance the transfer $b-d$ to workers who chose to fill and collect benefits. Let $\phi^E(x)$ be the distribution of employed workers over submarkets, and ϕ^{UC} be the measure of unemployed workers who collect UI benefit. Then the government budget constraint can be written as

$$\tau \int_{\underline{x}}^{\bar{x}} w(x) d\phi^E(x) = (b-d)\phi^{UC} \tag{8}$$

5.1 Recursive Equilibrium

We are now ready to define recursive equilibrium.

Definition 1 *A* Recursive Equilibrium *consists of a policy (b,τ), a market tightness function $\theta : X \to \mathbb{R}_+$, a search value function $R : X \to \mathbb{R}_+$, a search policy function $m : X \to X$, an unemployment value function for collectors $U^C : [\underline{\varepsilon}, \bar{\varepsilon}] \to \mathbb{R}$ and for non-collectors $U^N \in \mathbb{R}$, a decision to collect $\iota^C : [\underline{\varepsilon}, \bar{\varepsilon}] \to \{0,1\}$, a value function for firms $J : X \to \mathbb{R}$, a contract policy function $c : X \to C$, a stationary probability distribution over employed workers $\phi^E : X \to [0,1]$, and measure of unemployed workers who collect UI benefit ϕ^{UC}. These objects satisfy the following requirements:*

1. *θ satisfies (37) for all $x \in X$;*
2. *R satisfies (32) for all $V \in X$, and m is the associated policy function;*
3. *U^N satisfies (33) and U^C satisfies (34) for all $\varepsilon \in [\underline{\varepsilon}, \bar{\varepsilon}]$ who collect UI benefit. Moreover, $\iota^C(\varepsilon) = 1$ whenever $U^C(\varepsilon) \geq U^N$, and $\iota^C(\varepsilon) = 0$ otherwise.*
4. *J (6) for all $V \in X$, and c is the associated policy function;*

5. ϕ^E are ϕ^{UC} are derived from policy functions (m, c), choice over collecting UI benefit, and $F(\varepsilon)$;

6. Government policy (b, τ) satisfies government budget (38).

5.2 Properties of Equilibrium

In this section we establish some properties of equilibrium. To this end, we define $\mathcal{J}(X)$ to be the set of firms' value functions $J : X \to \mathbb{R}$ such that:

J1 For all $V_1, V_2 \in X$, with $V_1 \leq V_2$

$$-\bar{B}_J (V_2 - V_1) \leq J(V_2) - J(V_1) \leq -\underline{B}_J (V_2 - V_1)$$

where $\bar{B}_J \geq \underline{B}_J > 0$ are constants.

J2 For all $V \in X$, $J(V)$ is bounded in $\left[\underline{J}, \bar{J}\right]$.

J3 $J(V)$ is concave.

In short, function $J \in \mathcal{J}$ is bounded, strictly decreasing, weakly concave, and bi-Lipschitz continuous. Lipschitz continuity implies that a function $J \in \mathcal{J}$ is differentiable almost everywhere (Theorem 3.1.6. in Federer, Herbert (1969), Geometric measure theory), and it's derivative is bounded above and below. Menzio and Shi (2010) prove that $\mathcal{J}$ is a non-empty, bounded, closed and convex subset of the space of bounded, continuous functions on X, with the sup norm.

In what follows, we take an arbitrary firm's value function $J \in \mathcal{J}$. Given J, we construct market tightness θ and prove that it is bi-Lipschitz continuous. We also establish some properties of search value R and optimal search m. In particular, we show that R is bi-Lipschitz continuous, decreasing, and convex. Moreover, m is bi-Lipschitz continuous, and increasing. In the appendix, we prove that equilibrium exists and firm value function J belongs to the set $\mathcal{J}$. Our arguments are very similar to Menzio and Shi (2010).[25]

[25] We depart from theirs by imposing stronger assumptions to guarantee concavity of firm value function J without having to allow for lotteries.

Given the properties of θ, R, and m we show that there is a unique cut off ε^* such that any unemployed worker with UI benefit collection cost below ε^* chooses to collect UI benefit (and anyone above it chooses not to collect). Moreover, the unemployment duration and starting wage after transition to employment are strictly decreasing in UI benefit collection cost if $\varepsilon < \varepsilon^*$. This implies that the lowest wage in the equilibrium is associated with those who just transitioned to employment and had UI benefit collection cost ε^* in their most recent unemployment spell.

5.2.1 Market tightness

Let $J \in \mathcal{J}$ be an arbitrary firm value function. For any $x \in X$ such that $J(x) \geq k$, the market tightness that satisfies free entry condition (37) is given by $q^{-1}(k/J(x))$, where $q^{-1}(k/J(x))$ is bounded between 0 and $\bar{\theta} \equiv q^{-1}\left(k/\overline{J}\right)$. For any $x \in X$ such that $J(x) < k$, the market tightness must be zero. The condition $J(x) \geq k$ is satisfied if and only if $x \leq \hat{x} \equiv J^{-1}(k)$. In other words, vacancies are filled with probability 1 in submarket $\hat{x}$. Summarizing above, the function $\theta :\rightarrow \left[0, \overline{\theta}\right]$ defined as

$$\theta(x) = \begin{cases} q^{-1}\left(\frac{k}{J(x)}\right) & x \leq \hat{x} \\ 0 & \text{o/w} \end{cases} \tag{9}$$

is the unique solution to the free entry condition (37). Note that $0 \leq \theta(x) \leq \bar{\theta} \equiv q^{-1}(k/J(x))$. In the following lemma we show that this function is strictly decreasing with respect to x. This is intuitive: since the firm's value from filling a vacancy is lower in a submarket with a higher x, the firm's probability of filling a vacancy must be higher. Moreover, the market tightness function, θ, is Lipschitz continuous in x for all x, and bi-Lipschitz in x for $x < \hat{x}$. This follows from bi-Lipschitz continuity of J and properties of $q^{-1}(\cdot)$. Finally, the probability that a worker meets a vacancy in submarket x, $p(\theta(x))$, decreases at an increasing rate as x increases. This property follows from the concavity of the firm's value function J and of the composite function $p\left(q^{-1}(\cdot)\right)$. We formally state and prove these properties in the following lemma:

Lemma 1 *The market tightness function θ has the following properties*

$$\frac{\bar{B}_J}{q'\left(\bar{\theta}\right)k}(x_2 - x_1) \leq \theta(x_2) - \theta(x_1) \leq \frac{\underline{B}_J k}{q'(0)\,\bar{J}^2}(x_2 - x_1), \quad \textit{if } x_1 \leq x_2 \leq \hat{x},$$

$$\frac{\bar{B}_J}{q'\left(\bar{\theta}\right)k}\left(x_2-x_1\right)\leq\theta\left(x_2\right)-\theta\left(x_1\right)\leq 0,\quad \textit{if } x_1\leq\hat{x}\leq x_2,$$

$$\theta\left(x_2\right)-\theta\left(x_1\right)=0,\quad \textit{if } \hat{x}\leq x_1\leq x_2. \tag{10}$$

where $\underline{B}_J$ *and* $\overline{B}_J$ *are bi-Lipschitz bounds on all functions in* $\mathcal{J}$*. Moreover, the composite function* $p\left(\theta\left(x\right)\right)$ *is strictly decreasing and strictly concave for all* $x\in\left[\underline{x},\hat{x}\right]$*.*

Proof. See appendix A. ∎

5.2.2 Search problem

For a given firm's value function $J\in\mathcal{J}$ we can find market tightness θ as in equation (9). Define $K\left(x,V\right)\equiv p\left(\theta\left(x\right)\right)\left(x-V\right)$. Given θ, the value of search, R, is equal to $\max_{x\in X}K\left(x,V\right)$. Given θ , a search policy function satisfies the equilibrium condition, if it solves this maximization problem for all $V\in X$. Note that the objective function $K\left(x,V\right)$ is negative for all $x\in\left[\underline{x},V\right]$, strictly positive for all $x\in\left(V,\hat{x}\right)$, and zero for all $x\in\left[\hat{x},\overline{x}\right]$. If $V\geq\hat{x}$, the solution includes any points between V and $\overline{x}$. It follows that the unique solution to optimal search problem is the function $m:X\rightarrow X$ defined as

$$m\left(V\right)=\begin{cases}\arg\max_{x\in X}p\left(\theta\left(x\right)\right)\left(x-V\right) & V\leq\hat{x}\\ V & \text{o/w}\end{cases} \tag{11}$$

The following lemma proves that the value of search R is decreasing in V. Intuitively, since the value to a worker from finding a job in submarket x is decreasing in the value of his current employment position, V , and the probability that a worker finds a job in submarket x is independent of V , the return to search is decreasing in V . Also, this lemma, proves that the search policy function, m, is increasing in V . Intuitively, since the marginal rate of substitution between the value offered by a new job and the probability of finding a new job is decreasing in V, the optimal search strategy is increasing in V.

Lemma 2 *For all* $V_1,V_2\in X$ *and* $V_2\geq V_1$*, the search value function* R *satisfies:*

$$-\left(V_2-V_1\right)\leq R\left(V_2\right)-R\left(V_1\right)\leq 0 \tag{12}$$

and the search policy function, m, is such that

$$0 \leq m(V_2) - m(V_1) \leq V_2 - V_1 \tag{13}$$

Proof. See appendix A. ■

Recall that the function $\tilde{p}(V) \equiv p(\theta(m(V)))$ is the probability of finding a job in the optimal submarket, given that his current job provides him the lifetime utility V. The following corollary states that the function $\tilde{p}(V)$ is decreasing and Lipschitz continuous in V:

Corollary 1 *For all $V_1, V_2 \in X$ and $V_2 \geq V_1$, the function $\tilde{p}(V)$ has the following property*

$$-\bar{B}_p(V_2 - V_1) \leq \tilde{p}(V_2) - \tilde{p}(V_1) \leq 0, \tag{14}$$

where

$$\bar{B}_p \equiv -p'(0)\frac{\bar{B}_J}{q'(\bar{\theta})k} > 0.$$

Proof. See appendix A. ■

5.2.3 Value of unemployment and decision to collect UI benefit

We now turn to the problem of unemployed workers and decision on whether or not to collect UI benefits. For a given $J \in \mathcal{J}$, which generate a matching function θ and return to search R, the value of being unemployed is give by equation (33) for those who do not collect UI benefit, and equation (34) for those who do collect UI benefit. In the following lemma we first show that these values exist and are unique for any $\varepsilon \in [\underline{\varepsilon}, \bar{\varepsilon}]$. Moreover, we show that value of collecting UI benefit is strictly decreasing in ε.

Lemma 3 *Let $\underline{U} = (v(b) - \bar{\varepsilon})/(1-\beta)$ and $\overline{U} = v(b) - \underline{\varepsilon} + \beta\bar{x} < \bar{x}$. Then*

1. *There exist a unique $U^N \in [\bar{U}, \underline{U}]$ such that*

$$U^N = v(d) + \beta\left\{U^N + R\left(U^N\right)\right\}$$

2. *For any* $\varepsilon \in [\underline{\varepsilon}, \overline{\varepsilon}]$*, there exists a unique* $U^C(\varepsilon) \in [\bar{U}, \underline{U}]$ *such that*

$$U^C(\varepsilon) = v(b) - \varepsilon + \beta \left\{ U^C(\varepsilon) + R\left(U^C(\varepsilon)\right) \right\}$$

3. *For any* $\varepsilon \in [\underline{\varepsilon}, \overline{\varepsilon}]$*,* $U^C(\varepsilon)$ *is strictly decreasing.*

Proof. See appendix A. ■

Since the value of collecting UI benefit is monotonically decreasing in cost of benefit collection, there must be a unique cutoff for ε above which unemployed workers decide not to collect benefit. The follow lemma formalizes this argument.

Lemma 4 *There exist a unique* $\varepsilon^* \in [\underline{\varepsilon}, \overline{\varepsilon}]$ *such that* $U^C(\varepsilon) < U^N$ *for all* $\varepsilon > \varepsilon^*$ *and* $U^C(\varepsilon) \geq U^N$ *for all* $\varepsilon \leq \varepsilon^*$*.*

Proof. See appendix A. ■

Lemma 4 establishes the existence of cutoff ε^*. In fact, since at $\varepsilon = \varepsilon^*$ the unemployed worker is indifferent between collecting and not collecting, it must be the case that $\varepsilon^* = \nu(b) - \nu(d)$. Together with Lemma 3 this implies that the value of being unemployed is highest for those with the lowest UI benefit collection cost and is lowest for those who do not collect UI benefit. Moreover, for anyone who collects benefit, the value of being unemployed is monotonically decreasing in ε. Recall that current lifetime utility of an unemployed worker determines the submarket in which this worker conducts his search. Also, recall that by Corollary 1, the probability of finding a job in the optimal submarket decreases with the current lifetime utility. Therefore, duration of unemployment is increasing in the current lifetime utility, and therefore, it is decreasing in cost of UI collection. This result is formally stated in the following proposition.

Proposition 1 *The duration of unemployment is decreasing in* ε*, strictly so for* $\varepsilon < \varepsilon^*$*.*

Proof. See appendix A. ■

5.2.4 Firm's problem and optimal contracts

In this section we show that optimal contracts are *backloaded*, in the sense that they offer future lifetime utility, V', that is higher than the current lifetime utility promised to the worker,V, and strictly so if $V \leq \hat{x}$. Moreover, wages w and future lifetime utility V' that are offered in each submarket are monotonically increasing in the lifetime utility V promised in that submarket. In proving these results we rely on properties of firm value functions J that belong to the set $\mathcal{J}$. As a reminder we show in the appendix that under some assumptions, the equilibrium firm value function does indeed satisfy these properties.

Proposition 2 *Let $J \in \mathcal{J}$. The following must hold*

1. *Promised value is back-loaded: for all $V \in X$, $V' = z(V) \geq V$ and strictly so for $V < \hat{x}$.*
2. *Wage is monotone increasing in current promised value: for all $V_1, V_2 \in X$, with $V_1 > V_2$, $w(V_2) > w(V_1)$.*

Moreover, if $(1-\lambda_e \tilde{p}(V))J(V)$ is concave, then $V' = z(V)$ is also monotone increasing in V.

Proof. See appendix A. ■

Note that to prove that future promised utility is increasing current promised utility we require that future pay to the firm, $(1-\lambda_e \tilde{p}(V))J(V)$, be concave. This condition is satisfied if $\lambda_e = 0$, i.e., without on-the-job search. Therefore, by continuity it is also satisfied for small values of λ_e.

The results above immediately imply that unemployed workers who do not collect UI benefit (i.e., those with collection costs above cutoff ε^*) have the lowest wage when they transition to employment.

5.3 Comparative statics with respect to policy

In this section we discuss the effect of increasing UI benefit b on equilibrium allocation. In doing so, we hold taxes exogenously given and fixed. Our ultimate goal in this section is to understand how raising UI benefit affect equilibrium wages and unemployment durations across various UI collection cost types ε.

Unfortunately, we cannot make progress with analytical results without making further assumptions. Therefore, in order to develop insights we are going to assume that there is no on-the-job search by imposing $\lambda_e = 0$.[26] Recall that λ_e is the arrival rate of search opportunities for employed workers. Therefore, we are assuming that when unemployed workers find a job they stay at the same job until they are exogenously separated. We also assume that $\tau = 0$ for expositional purpose.[27]

Without on-the-job search, the firm's problem simplifies to

$$J(V) = \max_{w,V'} \{y - w + \beta(1-\delta) J(V')\} \tag{15}$$

subject to

$$V = v(w) + \beta[\delta U + (1-\delta)V'].$$

It immediately follows that the optimal contract features constant promised value $V' = V$ and

$$v(w(V)) = (1 - \beta(1-\delta))V - \beta\delta U \tag{16}$$

Note that the optimal wage is increasing in the current promised value V and decreasing in the future expected value of unemployment U. We can rewrite the value function of the firm as

$$J(V) = \frac{y - v^{-1}((1-\beta(1-\delta))V - \beta\delta U)}{1-\beta(1-\delta)}$$

Notice that there is a one to one correspondence here between promised value V and wage w. In other words, a worker who searches in submarket $V \in X$ is in fact searching for wage $w(V)$ given by equation (16). Upon finding a job this worker enjoys expected lifetime utility $\frac{v(w)+\beta\delta U}{1-\beta(1-\delta)}$. Also, a firm that posts a position in submarket $V \in X$ is in fact offering wage $w(V)$ has expected profit $\frac{y-w}{1-\beta(1-\delta)}$ upon finding a match.

If wage w is offered a submarket, the market tightness $\theta(w)$ in that submarket is determined

[26] By continuity, any insight we develop here carries on to a model with on the job search when λ_e is small.
[27] This is without loss of generality if we assume wage is after tax wage.

by the free entry condition

$$w = y - (1 - \beta(1 - \delta)) \frac{k}{q(\theta(w))} \tag{17}$$

for $\theta(w) > 0$. Note that given the assumptions on vacancy filling probability $q(\cdot), \theta(w)$ is a strictly decreasing function of w for $w \in [0, y - (1 - \beta(1 - \delta)) k]$. Moreover, in any equilibrium the market tightness is in the interval $\Theta \equiv \left[0, q^{-1}\left((1 - \beta(1 - \delta)) \frac{k}{y}\right)\right]$. Note also that wage and market tightness move in opposition direction: when the wage is higher, market tightness must be lower, and vice versa.

Given the discussion above, we can greatly simply the optimal search problem of an unemployed worker by assuming workers search for wage w among all the wages that are consistent with free entry. This is, of course, equivalent to the search problem 32 thanks to the one to one mapping between wage and promise utility. Let $U(\varepsilon)$ be the unemployed worker's current promised utility and U be the expected future utility of being unemployed. The optimal search problem when unemployed workers search for wages can be written as

$$R(U(\varepsilon)) \equiv \max_{w} p(\theta) \left(\frac{v(w) + \beta\delta U}{1 - \beta(1 - \delta)} - U(\varepsilon) \right). \tag{18}$$

s.t.

$$w = y - (1 - \beta(1 - \delta)) \frac{k}{q(\theta(w))}$$

By the envelope condition the function R is differentiable with respect to $U(\varepsilon)$ and U, and

$$R'(U(\varepsilon)) = -p(\theta), \tag{19}$$

$$\frac{\partial R(U(\varepsilon))}{\partial U} = \frac{p(\theta)\beta\delta}{1 - \beta(1 - \delta)}. \tag{20}$$

Equation (19) states that when the current value of unemployment is higher the return to search is lower. On the other hand, equation (20) states that the return to search is higher if expected future value of unemployment is higher. This is because if future value of unemployment is higher, having a job (at any wage) is more valuable. Since, upon separation, the worker enjoys higher value of being unemployed. The next proposition shows that the value of being unemployed for both collectors and non-collectors is higher when UI benefit b is higher.

Proposition 3 *The future value of unemployment U, the current value for non-collectors U^N, and current value for collectors $U^C(\varepsilon)$ for $\varepsilon \leq \varepsilon^*$, are all increasing in UI benefit b.*

Proof. See appendix A. ■

Recall that from equation (16) we know that wages are monotone increasing in current value of unemployment and decreasing in future value of unemployment. On the other hand Proposition (3) shows that both current and future value of unemployment are increasing in UI benefit. Therefore, whether increasing UI benefit results in increasing wages or not depend on the relative strength of these effects. The following proposition shows that increasing UI benefit leads to an increase in wages of collectors.

Proposition 4 *Let $\theta^C(\varepsilon)$ be the market tightness for current UI collectors with cost ε $(\leq \varepsilon^*)$, and θ^N be the market tightness for current non-collectors. Then $\theta^C(\varepsilon)$ is decreasing, and θ^N is increasing in b.*

Proof. See appendix A. ■

Proposition 4 immediately implies that raising UI benefit b leads to an increase in the wages of all UI collectors. On the other hand it reduces the wage of non-collectors. Recall that from Proposition 1 we know that wages are decreasing in ε with non-collectors earning the lowest wage after an unemployment spell. Therefore, increasing UI benefits reduces the lowest wage in the economy while it increase the wages for anyone else. Hence, it leads to an increase of dispersion in the wage distribution.

6 Numerical Results

We now use a parameterized version of the model to numerically study how the generosity of the unemployment insurance system impacts the search behavior of individuals, focusing on the wage individuals receive once they transit to employment.

The instantaneous utility function is specified as $\nu(c) = (c^{(1-\sigma)} - 1)/(1-\sigma)$, with $\sigma = 2$ and $\beta = 0.996$ (i.e. $\beta = 1/(1.05^{1/12})$). The matching technology is specified as $p(\theta) = \theta(1+\theta^{\gamma})^{-1/\gamma}$, with $\gamma = 0.5$.[28] The elasticity parameter of the matching function, γ, is set to

[28]The underlying matching function, as first introduced by den Haan et al. (2000), is given by $(v^{-\gamma} +$

0.5 to target an elasticity of the job-finding probability with respect to the tightness ratio to be 0.415, to be in the midrange of estimates of this elasticity from Brügemann (2008). The exogenous separation rate is set to $\delta = 0.02$ in order to have an unemployment rate a little over 5%. The vacancy cost, $\kappa = 0.4$, is chosen to have a job finding probability around 35% at the monthly frequency. The probability that an employed worker gets the opportunity to search, λ_e, affects both the job-to-job transition as well as the distribution over wages. We set this parameter at $\lambda_e = 0.25$ to have a reasonable amount of job-to-job transition while at the same time having a reasonable wage distribution, over an admittedly limited range. We use a uniform distribution of utility costs of filing for UI benefits, $\varepsilon \sim U[\underline{\varepsilon}, \overline{\varepsilon}]$. The lower bound $\underline{\varepsilon}$ is set to zero. The upper bound $\overline{\varepsilon}$ is chosen so that in the benchmark calibration the UI take up rate is 67.5% reported in Auray et al. (2019).

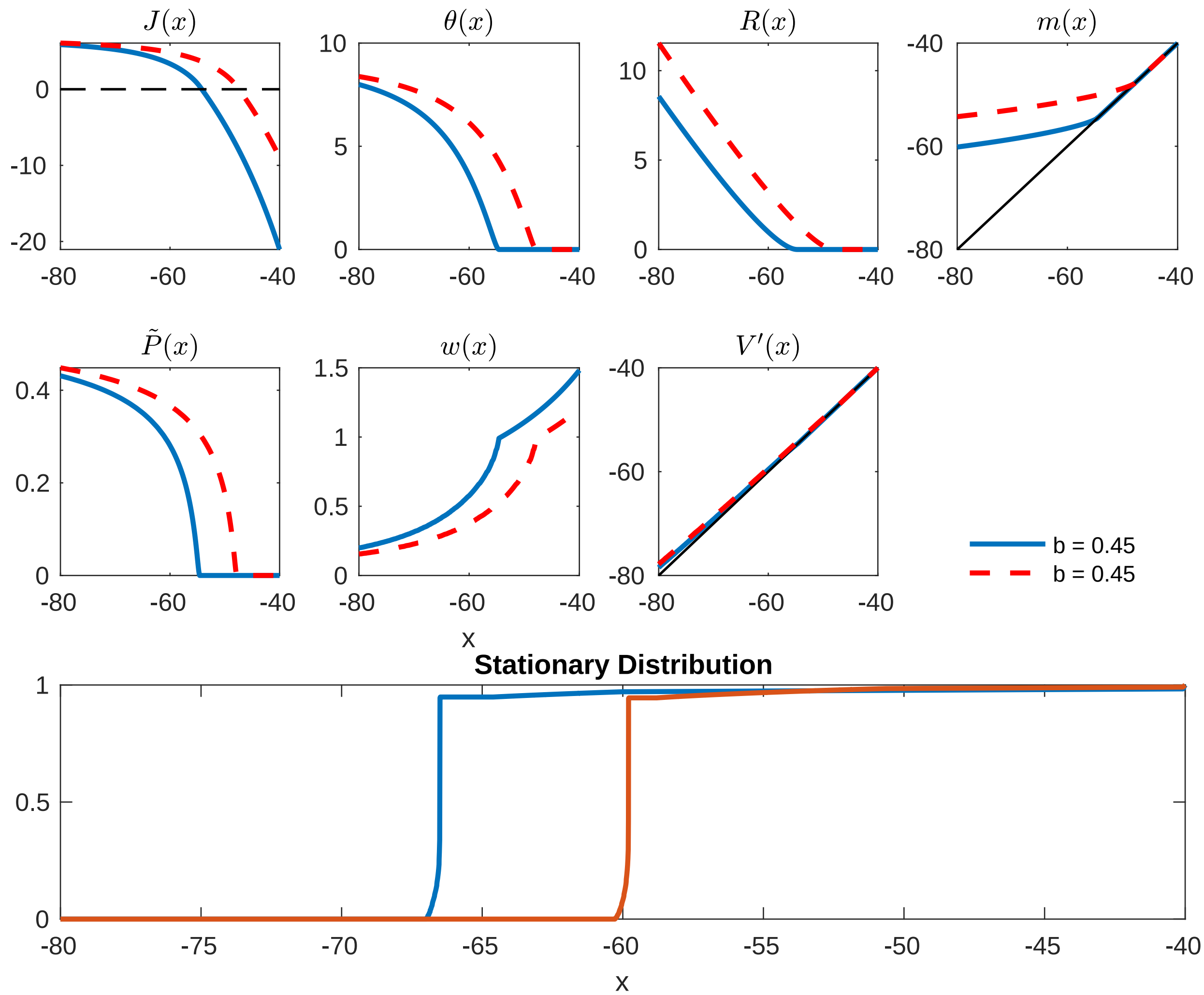
We assume that all unemployed individuals get a value of $d = 0.2$ from not working (this may represent home production or something like that). The initial unemployment benefits is specified to be 0.25 above that level so that $b = 0.45$. Note that when benefits are financed though an earnings tax, only the 0.25 portion of b needs to be financed.

Figure 11 displays various equilibrium value and policy functions, the submarket tightness function, as well as the stationary distribution over open submarkets. Since the value of the firm ($J(x)$) is decreasing in promised utility to its worker, firms need to be compensated by a high job filling probability ($q(x)$) to open vacancies in high submarkets. This translates into a tightness ratio ($\theta(x)$) and a job finding probability ($\tilde{p}(x)$) which decrease as promised utility increases. The optimal submarket in which individuals search ($m(x)$) is increasing in x, though the distance between the current lifetime utility (x) and the lifetime utility associated with the submarket in which individuals search narrows down quickly. It also follows that the value of search ($R(x)$) decreases monotonically with current lifetime utility. The job finding probability drops to zero when promised utility is so high that firms can never be compensated to open a vacancy in such markets (i.e. when $J(x) \leq \kappa$): at that point, on-the-job search is no longer useful so $m(x) = x$ and $R(x) = 0$.

The wage ($w(x)$) and future utility ($V'(x)$) come from the optimal contract chosen by firms. As one would expect, wages and future promised utility both increase with the submarket value. Because of curvature in the periodic utility function, the wage is a convex function of the submarket value over the relevant range: increasingly higher wages are necessary to

$a^{-\gamma})^{-1/\gamma}$, where v and a are the number of vacancies and applicants respectively, and $\theta = v/a$.

Figure 11: How the Economy Works



Notes: Parameter values appear at the beginning of Section 6.

provide the extra lifetime utility. This convex wage function is also evidence that firms design contracts to backload wage payments: by promising higher future utility, firms can keep current wages relatively low while at the same time lowering the worker's job finding probability in the future.[29] Finally, note that the model generates some heterogeneity among

[29]To be more precise, the extent to which firms can backload compensation depends on the current promised utility x. Firms backload compensation by promising increased future utility as a means to postpone wages as well as to retain workers. Since the probability of a successful job-to-job transition is decreasing in the worker's value function, the amount a firm backloads is decreasing in x. Above the value of the highest open submarket, firms have no incentive to backload as there are no vacancies which provide a higher lifetime utility than the worker's current job. In that region, the firm's contract simply specifies $V' = V$ and offers a wage which satisfies the promise keeping constraint.

workers, as shown in the bottom panel of Figure 11. Since unemployed individuals have heterogenous life-time values depending on their decision to collect benefits, individuals search in various submarkets as dictated by the policy function $m(x)$. Through on-the-job search individuals keep searching in higher submarkets, which generates quite a lot of heterogeneity across submarkets in equilibrium. Of course, a limited number of submarkets can emerge without idiosyncratic nor aggregate uncertainty. Naturally, all open submarkets are located between the value of unemployment and the submarket for which firms would just cover the cost of posting a vacancy with a job filling probability equal to one, i.e. the range of wage inequality in limited.

Figure 11 shows policy functions for two values of UI benefit. Notice that at higher benefit firm's value function shifts up. It is more profitable to post jobs at any given submarket. Firms achieve this in through two channels. First, higher UI benefit means that future value of being unemployed is higher. Therefore, larger portion of promised utility is delivered through higher future value of unemployment. Firms responds to this and offer lower wages at any given submarket. They also utilize more backloading. Although this second channel seems to have a small effect.

High UI benefit also lead to higher value of search, higher job finding probability and higher market tightness at a given submarket. However, as we see in the bottom panel, it shifts the distribution open submarkets to the right. In particular the lowest open submarket is now associated with higher promised value. As we showed in section 5 this corresponds to the value of unemployed workers who do not collect UI benefits. Overall, we clearly see the analytical results that we discussed in the previous section under the assumption of no on-the-job search carries through to the model with on-the-job search. Higher UI benefit has a direct negative impact on wages, by lowering the wage offers at each submarket. However, it increases the current value of unemployment and leads workers to optimally search in submarket with higher promised value. We can see this by the top right corner panel ($m(x)$). In equilibrium this leads to a shift in the distribution of open submarkets and hence the equilibrium wage distribution.

Table 7 shows how average equilibrium wages, wages for collectors, and wages for non-collectors change as UI benefits rises. The average wage of collectors has elasticity of about 6.7 percent with respect to UI benefit. This is slightly higher than the elasticity we estimated using BAM data using the sample of collectors. As expected the wages of non-collectors is not responsive to UI benefits at all. Overall, the pretense of non-collectors significantly lower

Table 7: Model with endogenous Take-Up

b	w^N	w^C	$\frac{\%\Delta w^C}{\%\Delta b}$	w	$\frac{\%\Delta w}{\%\Delta b}$	u	ϕ^C/ϕ^U	JFR
0.25	0.659	0.671	n.a.	0.939	n.a.	4.83%	23.9%	37.4%
0.45	0.659	0.702	0.067	0.944	0.012	5.14%	67.5%	35.0%
0.65	0.658	0.718	0.064	0.948	0.013	5.50%	83.6%	32.6%
0.85	0.658	0.731	0.076	0.951	0.015	6.23%	91.0%	28.6%

Notes: Parameter values appear at the beginning of Section 6. Second column is the first wage of non-collectors. Third column is the (average) first wage of collectors. Forth column is the elasticity of collectors wage w.r.t UI benefit. Fifth column is average wage in the economy. Sixth column is the elasticity of average wage w.r.t. UI benefit. Seven, eight, and ninth columns are unemployment rate, UI take up rate and average job finding rate, respectively.

the elasticity of average wages with respect to UI benefit (to about 1.2 percent).

What if the UI collection decision were exogenous? We repeat this exercise in a model where everyone collects UI benefit exogenously and suffers utility cost set to the average collection cost of collectors in our benchmark model. All other parameters are the same as in the benchmark model. In this scenario, the average wage of collectors is more sensitive to UI benefit. The results of this experiment are reported in Table 8. The elasticity is twice as high (13.4 percent). However, the average wage in the economy is not very sensitive to UI benefit. In this model, employed individuals climb the wage ladder and eventually end up at the top of the top of ladder. Although, the initial wage after unemployment is sensitive to UI benefits, the top wage is not sensitive. Since in the stationary equilibrium most workers end up at the top, we get this result that average wage is not very sensitive to UI benefits.

Table 8: Model with exogenous take-Up: ε = average of collectors

b	w^N	w^C	$\frac{\%\Delta w^C}{\%\Delta b}$	w	$\frac{\%\Delta w}{\%\Delta b}$	u	ϕ^C/ϕ^U	JFR
0.25	n.a.	0.656	n.a.	0.938	n.a.	4.80%	100%	37.6%
0.45	n.a.	0.711	0.133	0.949	0.019	5.40%	100%	33.3%
0.65	n.a.	0.742	0.114	0.955	0.017	5.85%	100%	30.6%
0.85	n.a.	0.764	0.094	0.959	0.017	6.24%	100%	28.5%

Notes: Parameter values appear at the beginning of Section 6. Everyone has collection cost ε that is set to be equal to the average of collection cost for collectors in the benchmark. Second column is the first wage of non-collectors. Third column is the (average) first wage of collectors. Forth column is the elasticity of collectors wage w.r.t UI benefit. Fifth column is average wage in the economy. Sixth column is the elasticity of average wage w.r.t. UI benefit. Seven, eight, and ninth columns are unemployment rate, UI take up rate and average job finding rate, respectively.

7 Conclusion

We use CPS and BAM data pre- and post-COVID to establish that the passthrough from UI benefits to (reservation) wages is fairly modest. Our main specification suggest an elasticity in the range of 2%. We show that the introduction of a UI take up margin in an otherwise standard competitive/directed search model goes a long way in rationalizing that modest elasticity.

A Proofs

Proof of Lemma 1: Recall that J is strictly decreasing. If $x_1 \leq x_2 \leq \hat{x}$

$$\theta\left(x_2\right) - \theta\left(x_1\right) = \int_{\frac{k}{J(x_1)}}^{\frac{k}{J(x_2)}} q^{-1\prime}\left(t\right) dt$$

Note that by definition of $\hat{x}$ and monotonicity of J

$$\bar{J} \geq J\left(x_1\right) \geq J\left(x_2\right) \geq J\left(\hat{x}\right) = k > 0$$

Also

$$q^{-1\prime}\left(\frac{k}{J\left(x\right)}\right) = \frac{1}{q'\left(\theta\left(x\right)\right)} \in \left[\frac{1}{q'\left(\bar{\theta}\right)}, \frac{1}{q'\left(0\right)}\right]$$

Therefore

$$\frac{1}{q'\left(\bar{\theta}\right)}\left(\frac{k}{J\left(x_2\right)} - \frac{k}{J\left(x_1\right)}\right) \leq \int_{\frac{k}{J(x_1)}}^{\frac{k}{J(x_2)}} q^{-1\prime}\left(t\right) dt \leq \frac{1}{q'\left(0\right)}\left(\frac{k}{J\left(x_2\right)} - \frac{k}{J\left(x_1\right)}\right)$$

Now, note that

$$\frac{k}{J\left(x_2\right)} - \frac{k}{J\left(x_1\right)} = \int_{J(x_2)}^{J(x_1)} \frac{k}{t^2} dt$$

and

$$\int_{J(x_2)}^{J(x_1)} \frac{k}{t^2} dt \leq \frac{1}{k}\left(J\left(x_1\right) - J\left(x_2\right)\right) \leq \frac{\bar{B}_J}{k}\left(x_2 - x_1\right)$$
$$\int_{J(x_2)}^{J(x_1)} \frac{k}{t^2} dt \geq \frac{k}{\bar{J}^2}\left(J\left(x_1\right) - J\left(x_2\right)\right) \geq \frac{k\underline{B}_J}{\bar{J}^2}\left(x_2 - x_1\right)$$

This established the first claim. Now suppose $x_1 \leq \hat{x} \leq x_2$ and recall that $q'\left(\theta\left(x\right)\right) < 0$ for $x \leq \hat{x}$

$$\theta\left(x_2\right) - \theta\left(x_1\right) = \theta\left(\hat{x}\right) - \theta\left(x_1\right) \leq \frac{\underline{B}_J k}{q'\left(0\right)\bar{J}^2}\left(\hat{x} - x_1\right) \leq 0$$
$$\theta\left(x_2\right) - \theta\left(x_1\right) = \theta\left(\hat{x}\right) - \theta\left(x_1\right) \geq \frac{\bar{B}_J}{q'\left(\bar{\theta}\right)k}\left(\hat{x} - x_1\right) \geq \frac{\bar{B}_J}{q'\left(\bar{\theta}\right)k}\left(x_2 - x_1\right)$$

Finally, for the case $\hat{x} \leq x_1 \leq x_2$, we know $\theta(x_2) = \theta(x_1) = 0$ by the definition of $\hat{x}$.

Since $p(\theta)$ is strictly increasing in θ and $\theta(x)$ is strictly decreasing in x, then $p(\theta(x))$ is strictly decreasing in x. Now supposer $x_1, x_2 \in [\underline{x}, \hat{x}]$, $x_1 \neq x_2$ and $\alpha \in (0,1)$. Let $x_\alpha = \alpha x_1 + (1-\alpha) x_2$. By weak concavity of J and strict convexity of k/x

$$\frac{k}{J(x_\alpha)} \leq \frac{k}{\alpha J(x_1) + (1-\alpha) J(x_2)} < \alpha \frac{k}{J(x_1)} + (1-\alpha) \frac{k}{J(x_2)}$$

Recall that $p(q^{-1}(\cdot))$ is strictly decreasing and weakly concave. Therefore

$$\begin{aligned} p\left(q^{-1}\left(\frac{k}{J(x_\alpha)}\right)\right) &> p\left(q^{-1}\left(\alpha \frac{k}{J(x_1)} + (1-\alpha) \frac{k}{J(x_2)}\right)\right) \\ &\geq \alpha p\left(q^{-1}\left(\frac{k}{J(x_1)}\right)\right) + (1-\alpha) p\left(q^{-1}\left(\frac{k}{J(x_2)}\right)\right) \end{aligned}$$

Therefore $p(\theta(x)) = p\left(q^{-1}\left(\frac{k}{J(x)}\right)\right)$ is strictly concave on $[\underline{x}, \hat{x}]$.

Proof of Lemma 2: Note that

$$R(V_2) - R(V_1) \leq K(m(V_2), V_2) - K(m(V_2), V_1) = -p(\theta(m(V_2)))(V_2 - V_1) \leq 0$$

$$R(V_2) - R(V_1) \geq K(m(V_1), V_2) - K(m(V_1), V_1) = -p(\theta(m(V_1)))(V_2 - V_1) \geq -(V_2 - V_1)$$

Therefore

$$-(V_2 - V_1) \leq R(V_2) - R(V_1) \leq 0$$

Now suppose $V_1 \leq V_2 \leq \hat{x}$ (the other cases are trivial). Then

$$K(m(V_1), V_1) \geq K(m(V_2), V_1)$$

and

$$K(m(V_2), V_2) \geq K(m(V_1), V_2)$$

Therefore

$$\begin{aligned}0 &\geq K\left(m\left(V_2\right),V_1\right)-K\left(m\left(V_1\right),V_1\right)+K\left(m\left(V_1\right),V_2\right)-K\left(m\left(V_2\right),V_2\right)\\&=p\left(\theta\left(m\left(V_2\right)\right)\right)\left(m\left(V_2\right)-V_1\right)-p\left(\theta\left(m\left(V_1\right)\right)\right)\left(m\left(V_1\right)-V_1\right)\\&+p\left(\theta\left(m\left(V_1\right)\right)\right)\left(m\left(V_1\right)-V_2\right)-p\left(\theta\left(m\left(V_2\right)\right)\right)\left(m\left(V_2\right)-V_2\right)\\&=\left(p\left(\theta\left(m\left(V_2\right)\right)\right)-p\left(\theta\left(m\left(V_1\right)\right)\right)\right)\left(V_2-V_1\right)\end{aligned}$$

Since $p\left(\theta\left(\cdot\right)\right)$ is strictly decreasing and $V_2 \geq V_1$, this implies $m\left(V_2\right) \geq m\left(V_1\right)$. Suppose $m\left(V_2\right) < m\left(V_1\right)$ (the other case is trivial). Take Δ such that

$$0<\Delta<\frac{m\left(V_2\right)-m\left(V_1\right)}{2}$$

Then

$$K\left(m\left(V_1\right),V_1\right) \geq K\left(m\left(V_1\right)+\Delta,V_1\right)$$

and

$$\begin{aligned}p\left(\theta\left(m\left(V_1\right)\right)\right)\left(m\left(V_1\right)-V_1\right) &\geq p\left(\theta\left(m\left(V_1\right)+\Delta\right)\right)\left(m\left(V_1\right)+\Delta-V_1\right)\\m\left(V_1\right)-V_1 &\geq \frac{p\left(\theta\left(m\left(V_1\right)+\Delta\right)\right)\Delta}{p\left(\theta\left(m\left(V_1\right)\right)\right)-p\left(\theta\left(m\left(V_1\right)+\Delta\right)\right)}\end{aligned}$$

Similarly

$$K\left(m\left(V_2\right),V_2\right) \geq K\left(m\left(V_2\right)+\Delta,V_2\right)$$

and

$$m\left(V_2\right)-V_2 \leq \frac{p\left(\theta\left(m\left(V_2\right)-\Delta\right)\right)\Delta}{p\left(\theta\left(m\left(V_2\right)-\Delta\right)\right)-p\left(\theta\left(m\left(V_2\right)\right)\right)}$$

By definition of Δ, $m\left(V_1\right)+\Delta \leq m\left(V_2\right)-\Delta$. Since $p\left(\theta\left(\cdot\right)\right)$ is decreasing this implies

$$p\left(\theta\left(m\left(V_1\right)+\Delta\right)\right) \geq p\left(\theta\left(m\left(V_2\right)-\Delta\right)\right)$$

Moreover, $m\left(V_1\right) < m\left(V_2\right)$. Since $p\left(\theta\left(\cdot\right)\right)$ is decreasing and concave this implies

$$p\left(\theta\left(m\left(V_1\right)\right)\right)-p\left(\theta\left(m\left(V_1\right)+\Delta\right)\right) \leq p\left(\theta\left(m\left(V_2\right)-\Delta\right)\right)-p\left(\theta\left(m\left(V_2\right)\right)\right)$$

These observations together with inequalities derived above, imply that

$$m\left(V_1\right)-V_1 \geq m\left(V_2\right)-V_2$$

and, therefore

$$V_2 - V_1 \geq m(V_2) - m(V_1) \geq 0.$$

Proof of Corollary 1: Let $V_2 \geq V_1$. We have already established that

$$V_2 - V_1 \geq m(V_2) - m(V_1) \geq 0$$

since $\frac{\bar{B}_J}{q'(\bar{\theta})k} < 0$, this implies

$$\frac{\bar{B}_J}{q'(\bar{\theta})k}(m(V_2) - m(V_1)) \geq \frac{\bar{B}_J}{q'(\bar{\theta})k}(V_2 - V_1)$$

Also, Lemma 2 above implies

$$\begin{aligned} 0 \geq \theta(m(V_2)) - \theta(m(V_1)) &\geq \frac{\bar{B}_J}{q'(\bar{\theta})k}(m(V_2) - m(V_1)) \\ &\geq \frac{\bar{B}_J}{q'(\bar{\theta})k}(V_2 - V_1) \end{aligned}$$

Since $p(\theta)$ is differentiable, concave, and increasing

$$\begin{aligned} 0 \leq p(\theta(m(V_1))) - p(\theta(m(V_2))) &\leq p'(\theta(m(V_2)))(\theta(m(V_1)) - \theta(m(V_2))) \\ &\leq p'(\theta(m(V_2)))\frac{\bar{B}_J}{q'(\bar{\theta})k}(V_1 - V_2) \\ &\leq p'(0)\frac{\bar{B}_J}{q'(\bar{\theta})k}(V_1 - V_2) \end{aligned}$$

Therefore

$$0 \geq p(\theta(m(V_2))) - p(\theta(m(V_1))) \geq -p'(0)\frac{\bar{B}_J}{q'(\bar{\theta})k}(V_2 - V_1).$$

Proof of Lemma 3: Let's rewrite the equation (33) as

$$(1-\beta) U^N - \beta R\left(U^N\right) = v(d) \tag{21}$$

Envelop condition in optimal search problem (32) implies $R'(V) = -\tilde{p}(V)$. Therefore, the left hand side of (21) is a monotone increasing function with derivative $1-\beta+\beta\tilde{p}\left(\left(U^N\right)\right)$. Note that

$$(1-\beta)\underline{U} - \beta R(\underline{U}) < (1-\beta)\underline{U} = v(b) - \bar{\varepsilon} < v(d)$$

$$\begin{aligned}
(1-\beta)\bar{U} - \beta R\left(\bar{U}\right) &= (1-\beta)(v(b)-\underline{\varepsilon}) + \beta(1-\beta)\bar{x} - \beta R(v(b)-\underline{\varepsilon}+\beta\bar{x}) \\
&= (1-\beta)(v(b)-\underline{\varepsilon}) + \beta(1-\beta)\bar{x} - \beta R(\bar{x}) + \beta R(\bar{x}) - \beta R(v(b)-\underline{\varepsilon}+\beta\bar{x}) \\
&\geq (1-\beta)(v(b)-\underline{\varepsilon}) + \beta(1-\beta)\bar{x} - \beta((1-\beta)\bar{x} - (v(b)-\underline{\varepsilon})) \\
&> (1-\beta)(v(b)-\underline{\varepsilon}) + \beta(1-\beta)\bar{x} - \beta((1-\beta)\bar{x} - (v(b)-\underline{\varepsilon})) = v(b) \\
&= v(b) - \underline{\varepsilon} > v(d).
\end{aligned}$$

Therefore, there is a unique $U^N \in \left[\bar{U}, \underline{U}\right]$ that solves the equation (21). Similar argument can establish the existence and uniqueness of $U^C(\varepsilon)$ for any $\varepsilon \in [\underline{\varepsilon}, \bar{\varepsilon}]$.

To show monotonicity of $U^C(\varepsilon)$, take derivative of the equation (34) and note that

$$\frac{\partial U^C}{\partial \varepsilon} = \frac{-1}{1-\beta-\beta R'\left(U^C(\varepsilon)\right)} < 0.$$

Proof of Lemma 4: For $\varepsilon = \underline{\varepsilon}$

$$U^C(\underline{\varepsilon}) - U^N = \nu(b) - \underline{\varepsilon} - \nu(d) + \beta\left[U^C(\underline{\varepsilon}) - U^N + R\left(U^C(\underline{\varepsilon})\right) - R\left(U^N\right)\right]$$

Suppose $U^N \geq U^C(0)$, then by Lemma 2

$$R\left(U^C(\underline{\varepsilon})\right) - R\left(U^N\right) \geq U^N - U^C(\underline{\varepsilon})$$

Therefore

$$
\begin{aligned}
U^{C}(\underline{\varepsilon}) - U^{N} &\geq \nu(b) - \underline{\varepsilon} - \nu(d) + \beta\left[U^{C}(\underline{\varepsilon}) - U^{N} + U^{N} - U^{C}(\underline{\varepsilon})\right] \\
&= \nu(b) - \underline{\varepsilon} - \nu(d) \\
&> 0
\end{aligned}
$$

This is a contradiction. Therefore

$$U^{C}(\underline{\varepsilon}) > U^{N}.$$

Using similar argument we can show that $U^{C}(\bar{\varepsilon}) < U^{N}$. Since, $U^{C}(\varepsilon)$ is monotone, ε^{*} must exit and must be in the interval $[\underline{\varepsilon}, \overline{\varepsilon}]$

Proof of Proposition 1: By Lemma 3 and 4, $U^{C}(\varepsilon)$ is decreasing in ε and strictly so for $\varepsilon < \varepsilon^{*}$. By Corollary 1, $\tilde{p}\left(U^{C}(\varepsilon)\right)$ is decreasing in $U^{C}(\varepsilon)$ and therefore, it is increasing in ε. Therefore, duration is decreasing ε.

Proof of Proposition 2: Let's rewrite the firm's problem

$$J(V) = \max_{w, V'} \{y - w + \beta(1-\delta)(1 - \lambda_{e}\tilde{p}(V'))J(V')\}$$

subject to

$$V = v((1-\tau)w) + \beta[\delta U + (1-\delta)(V' + \lambda_{e}R(V'))].$$

Let ξ be the multiplier on promised keeping constraint. The first order condition w.r.t to w is

$$-1 + \xi(1-\tau)v'((1-\tau)w) = 0.$$

The envelope condition is

$$J'(V) = -\xi.$$

first order conditions and envelope condition, we get

$$J'(V) = -\frac{1}{(1-\tau)u'((1-\tau)w}.$$

If value function J is concave, then the above implies that w is monotone increasing in V.

Now consider the first order condition with with respect to V'

$$\left(1-\lambda_e\tilde{p}\left(V'\right)\right)J'\left(V'\right)-\lambda_e\tilde{p}'\left(V'\right)J\left(V\right)+\xi\left(1+\lambda_e R'\left(V'\right)\right)=0$$

Replace for ξ from envelope condition and recall that $R'(V)=-\tilde{p}(V)$

$$\left(1-\lambda_e\tilde{p}\left(V'\right)\right)\left(J'\left(V'\right)-J'\left(V\right)\right)=\lambda_e\tilde{p}'\left(V'\right)J\left(V\right)$$

The left hand side is negative (from Corollary 1). Therefore, concavity $J(V)$ implies that $V'>V$.

Monotonicity of V' follows from concavity assumption on $\left(1-\lambda_e\tilde{p}\left(V'\right)\right)J\left(V'\right)$ and first order condition with respect to V'.

Proof of Proposition 3: We need to determine the sign of $\frac{\partial U}{\partial b}$, $\frac{\partial U^N}{\partial b}$, and $\frac{\partial U^C(\varepsilon)}{\partial b}$. Totally differentiate equations (33) and (34) with respect to b and use (19) and (20)

$$\left(1-\beta+\beta p\left(\theta^N\right)\right)\frac{\partial U^N}{\partial b}=\beta p\left(\theta^N\right)\frac{\beta\delta}{1-\beta\left(1-\delta\right)}\frac{\partial U}{\partial b},\tag{22}$$

$$\left(1-\beta+\beta p\left(\theta^C\left(\varepsilon\right)\right)\right)\frac{\partial U^C\left(\varepsilon\right)}{\partial b}=1+\beta p\left(\theta^C\left(\varepsilon\right)\right)\frac{\beta\delta}{1-\beta\left(1-\delta\right)}\frac{\partial U}{\partial b}.\tag{23}$$

Where θ^N and $\theta^C\left(\varepsilon\right)$ are equilibrium market tightness of current non-collectors and collectors, respectively. These equations imply that if $\frac{\partial U}{\partial b}$ is positive, then $\frac{\partial U^N}{\partial b}$, and $\frac{\partial U^C(\varepsilon)}{\partial b}$ are also positive.

Recall that by definition of U

$$U=\int_{\underline{\varepsilon}}^{\varepsilon^*}U^C\left(\varepsilon\right)dF\left(\varepsilon\right)+\left(1-F\left(\varepsilon^*\right)\right)U^N.$$

Using Leibniz rule

$$\frac{\partial U}{\partial b}=\int_{\underline{\varepsilon}}^{\varepsilon^*}\frac{\partial U^C\left(\varepsilon\right)}{\partial b}dF\left(\varepsilon\right)+\left(1-F\left(\varepsilon^*\right)\right)\frac{\partial U^N}{\partial b}.$$

Now replace $\frac{\partial U^C(\varepsilon)}{\partial b}$ and $\frac{\partial U^N}{\partial b}$ from equations (22) and (23)

$$\frac{\partial U}{\partial b} = \int_{\underline{\varepsilon}}^{\varepsilon^*} \left[\frac{1}{1-\beta+\beta p\left(\theta^C(\varepsilon)\right)} + \frac{\beta p\left(\theta^C(\varepsilon)\right)}{1-\beta+\beta p\left(\theta^C(\varepsilon)\right)} \frac{\beta\delta}{1-\beta(1-\delta)} \frac{\partial U}{\partial b} \right] dF(\varepsilon)$$
$$+ \left(1-F(\varepsilon^*)\right) \frac{\beta p\left(\theta^N\right)}{1-\beta+\beta p\left(\theta^N\right)} \frac{\beta\delta}{1-\beta(1-\delta)} \frac{\partial U}{\partial b}.$$

Rearranging terms

$$\frac{\partial U}{\partial b} = \frac{\int_{\underline{\varepsilon}}^{\varepsilon^*} \frac{dF(\varepsilon)}{1-\beta+\beta p(\theta^C(\varepsilon))}}{1 - \frac{\beta\delta}{1-\beta(1-\delta)} \left(\int_{\underline{\varepsilon}}^{\varepsilon^*} \frac{\beta p(\theta^C(\varepsilon))}{1-\beta+\beta p(\theta^C(\varepsilon))} dF(\varepsilon) + \frac{\beta p(\theta^N)(1-F(\varepsilon^*))}{1-\beta+\beta p(\theta^N)} \right)}. \tag{24}$$

The denominator on the right hand side is positive. Therefore, $\frac{\partial U}{\partial b}$ is positive. This immediately implies that $\frac{\partial U^N}{\partial b}$ and $\frac{\partial U^C(\varepsilon)}{\partial b}$ are also positive.

Proof of Proposition 4: Let's start by current UI collectors. Consider the the first order condition for search problem (32) for $V = U^C(\varepsilon)$ (to avoid clutter we suppress dependence on ε) :

$$p'\left(\theta^C\right)\left(\frac{\nu(w)+\beta\delta U}{1-\beta(1-\delta)} - U^C(\varepsilon)\right) + \left(\frac{p'\left(\theta^C\right)\theta^C}{p\left(\theta^C\right)} - 1\right)\nu'(w)\,k = 0,$$

where

$$w = y - \left(1-\beta(1-\delta)\right)\frac{k}{q\left(\theta^C\right)}.$$

Totally differentiate with respect to b

$$p''\left(\theta^C\right)\frac{\partial\theta^C}{\partial b}\left(\frac{\nu(w)+\beta\delta U}{1-\beta(1-\delta)} - U(\varepsilon)\right) + p'\left(\theta^C\right)\left(\frac{p'\left(\theta^C\right)\theta^C - p\left(\theta^C\right)}{p\left(\theta^C\right)^2}\right)k\nu(w')\frac{\partial\theta^C}{\partial b}$$
$$+p'\left(\theta^C\right)\left(\frac{\beta\delta}{1-\beta(1-\delta)}\frac{\partial U}{\partial b} - \frac{\partial U^C(\varepsilon)}{\partial b}\right)$$
$$+\frac{\left(1-\beta(1-\delta)\right)}{p\left(\theta^C\right)}\left(\frac{p'\left(\theta^C\right)\theta^C}{p\left(\theta^C\right)} - 1\right)^2 \nu''(w)\,k^2\frac{\partial\theta^C}{\partial b}$$
$$\left(\frac{\left(p''\left(\theta^C\right)\theta^C + p'\left(\theta^C\right)\right)p\left(\theta^C\right) - p'\left(\theta^C\right)^2\theta^C}{p\left(\theta^C\right)^2}\right)\nu'(w)\,k\frac{\partial\theta^C}{\partial b} = 0$$

Therefore

$$\frac{\partial \theta^C}{\partial b}=\frac{-p'\left(\theta^C\right)\left(\frac{\beta\delta}{1-\beta(1-\delta)}\frac{\partial U}{\partial b}-\frac{\partial U^C(\varepsilon)}{\partial b}\right)}{p''\left(\theta^C\right)\left(\frac{\nu(w)+\beta\delta U}{1-\beta(1-\delta)}-U\left(\varepsilon\right)\right)+\frac{p''(\theta^C)\theta^C}{p(\theta^C)^2}\nu'\left(w\right)k+\frac{(1-\beta(1-\delta))}{p(\theta^C)}\left(\frac{p'(\theta^C)\theta^C}{p(\theta^C)}-1\right)^2\nu''\left(w\right)k^2}.$$

Because of concavity of $p\left(\theta^C\right)$ and $\nu\left(w\right)$, the denominator on the right hand side is negative. Next, we will determine the sign of the numerator. Start by replacing for $\frac{\partial U^C(\varepsilon)}{\partial b}$ from equation (23)

$$\frac{\partial \theta^C}{\partial b}=\frac{\frac{-p'\left(\theta^C\right)}{1-\beta+\beta p(\theta^C)}\left[\frac{(1-\beta)\beta\delta}{1-\beta(1-\delta)}\frac{\partial U}{\partial b}-1\right]}{p''\left(\theta^C\right)\left(\frac{\nu(w)+\beta\delta U}{1-\beta(1-\delta)}-U\left(\varepsilon\right)\right)+\frac{p''(\theta^C)\theta^C}{p(\theta^C)^2}\nu'\left(w\right)k+\frac{(1-\beta(1-\delta))}{p(\theta^C)}\left(\frac{p'(\theta^C)\theta^C}{p(\theta^C)}-1\right)^2\nu''\left(w\right)k^2}.$$

Now let's replace for $\frac{\partial U}{\partial b}$ from equation (24), the numerator on the right hand side is

$$\begin{aligned}
&\frac{\frac{(1-\beta)\beta\delta}{1-\beta(1-\delta)}\int_{\underline{\varepsilon}}^{\varepsilon^*}\frac{dF(\varepsilon)}{1-\beta+\beta p(\theta^C(\varepsilon))}-1+\frac{\beta\delta}{1-\beta(1-\delta)}\left(\int_{\underline{\varepsilon}}^{\varepsilon^*}\frac{\beta p\left(\theta^C(\varepsilon)\right)}{1-\beta+\beta p(\theta^C(\varepsilon))}dF\left(\varepsilon\right)+\frac{\beta p\left(\theta^N\right)(1-F(\varepsilon^*))}{1-\beta+\beta p(\theta^N)}\right)}{1-\frac{\beta\delta}{1-\beta(1-\delta)}\left(\int_{\underline{\varepsilon}}^{\varepsilon^*}\frac{\beta p(\theta^C(\varepsilon))}{1-\beta+\beta p(\theta^C(\varepsilon))}dF\left(\varepsilon\right)+\frac{\beta p(\theta^N)(1-F(\varepsilon^*))}{1-\beta+\beta p(\theta^N)}\right)}=\\
&\frac{\frac{\beta\delta F(\varepsilon^*)}{1-\beta(1-\delta)}-1+\frac{\beta\delta}{1-\beta(1-\delta)}\frac{\beta p\left(\theta^N\right)(1-F(\varepsilon^*))}{1-\beta+\beta p(\theta^N)}}{1-\frac{\beta\delta}{1-\beta(1-\delta)}\left(\int_{\underline{\varepsilon}}^{\varepsilon^*}\frac{\beta p(\theta^C(\varepsilon))}{1-\beta+\beta p(\theta^C(\varepsilon))}dF\left(\varepsilon\right)+\frac{\beta p(\theta^N)(1-F(\varepsilon^*))}{1-\beta+\beta p(\theta^N)}\right)}<\\
&\frac{\frac{\beta\delta}{1-\beta(1-\delta)}-1}{1-\frac{\beta\delta}{1-\beta(1-\delta)}\left(\int_{\underline{\varepsilon}}^{\varepsilon^*}\frac{\beta p(\theta^C(\varepsilon))}{1-\beta+\beta p(\theta^C(\varepsilon))}dF\left(\varepsilon\right)+\frac{\beta p(\theta^N)(1-F(\varepsilon^*))}{1-\beta+\beta p(\theta^N)}\right)}<0
\end{aligned}$$

Therefore, since $p'\left(\theta^C\right)>0$ and the bracket on the left hand side is negative, then $\frac{\partial \theta^C(\varepsilon)}{\partial b}<0$.

The steps to show that θ^N is decreasing in b are identical to the above, and result in the following expression

$$\frac{\partial \theta^N}{\partial b}=\frac{-p'\left(\theta^N\right)\left(\frac{\beta\delta}{1-\beta(1-\delta)}\frac{\partial U}{\partial b}-\frac{\partial U^C(\varepsilon)}{\partial b}\right)}{p''\left(\theta^N\right)\left(\frac{\nu(w)+\beta\delta U}{1-\beta(1-\delta)}-U\left(\varepsilon\right)\right)+\frac{p''(\theta^N)\theta^N}{p(\theta^N)^2}\nu'\left(w\right)k+\frac{(1-\beta(1-\delta))}{p(\theta)}\left(\frac{p'(\theta^N)\theta^N}{p(\theta^N)}-1\right)^2\nu''\left(w\right)k^2}$$

Replace for $\frac{\partial U^N}{\partial b}$ from equations (22) for on the right hand side

$$\frac{\partial \theta^N}{\partial b} = \frac{-p'\left(\theta^N\right)\frac{\beta p\left(\theta^N\right)}{1-\beta+\beta p\left(\theta^N\right)}\frac{\beta\delta}{1-\beta(1-\delta)}\frac{\partial U}{\partial b}}{p''\left(\theta^N\right)\left(\frac{\nu(w)+\beta\delta U}{1-\beta(1-\delta)} - U\left(\varepsilon\right)\right) + \frac{p''\left(\theta^N\right)\theta^N}{p\left(\theta^N\right)^2}\nu'\left(w\right)k + \frac{(1-\beta(1-\delta))}{p(\theta)}\left(\frac{p'\left(\theta^N\right)\theta^N}{p\left(\theta^N\right)} - 1\right)^2\nu''\left(w\right)k^2}.$$

We know from Proposition 3 that $\frac{\partial U}{\partial b} > 0$. Therefore, $\frac{\partial \theta^N}{\partial b} > 0$.

B Simple Model for Intuition: Moen Economy

The textbook directed (or competitive) search model may be useful to show the intuition that by controlling unemployment benefits, the government can target wages. This model has a representative worker who directs his search to his preferred submarket, indexed by a wage and an arrival rate (or market tightness). For simplicity we present arguments assuming $\nu(c) = c$.

Firm behavior and free entry condition is identical to the equation (37)

$$w = y - \left(1 - \beta\left(1 - \delta\right)\right)\frac{k}{q\left(\theta\right)} \tag{25}$$

Note that, wage is decreasing in market tightness:

$$w'\left(\theta\right) = \left(1 - \beta\left(1 - \delta\right)\right)\frac{kq'\left(\theta\right)}{q\left(\theta\right)q\left(\theta\right)} < 0$$

An employed worker who is matched with vacancy and earns wage w enjoys expected utility

$$E\left(w\right) = \frac{w + \beta\delta U}{1 - \beta\left(1 - \delta\right)}$$

where U is the value of being unemployed.

Unemployed workers stay unemployed for at least on period and receive benefit b before they are able to search.

$$\left(1 - \beta\right)U = b + \beta R\left(U\right) \tag{26}$$

where $R\left(U\right)$ is the value of search for a worker who is currently entitled to unemployment value of U

$$R(U) \equiv \max_{w,\theta} p(\theta)(E(w) - U)$$

s.t.

$$w = y - (1 - \beta(1 - \delta)) \frac{k}{q(\theta)}$$

Replace for $E(w)$

$$R(U) \equiv \max_{w,\theta} p(\theta) \left(\frac{w + \beta\delta U}{1 - \beta(1 - \delta)} - U \right)$$

s.t.

$$w = y - (1 - \beta(1 - \delta)) \frac{k}{q(\theta)}$$

Now, let's replace for w and find optimal search strategy

$$R(U) \equiv \max_{\theta} \left(p(\theta) \frac{y - (1 - \beta) U}{1 - \beta(1 - \delta)} - k\theta \right)$$

First order condition

$$p'(\theta) \frac{y - (1 - \beta) U}{1 - \beta(1 - \delta)} = k. \tag{27}$$

Note that $p''(\theta) < 0$ and $p'(\theta) > 0$, therefore

$$p''(\theta) \frac{\partial\theta}{\partial U} \frac{y - (1 - \beta) U}{1 - \beta(1 - \delta)} - p'(\theta) \frac{(1 - \beta)}{1 - \beta(1 - \delta)} = 0$$

implies that

$$\frac{\partial\theta}{\partial U} < 0.$$

Now recall the value of being unemployed

$$(1 - \beta) U - \beta R(U) = b$$

This immediately implies $\frac{\partial U}{\partial b} > 0$.

C Permanent Types

In this section we assume that the cost of collecting UI benefit is a permanent type, rather than a random draw at the beginning of each unemployment spell. An implication of this assumption is that, in a stationary equilibrium, a worker who is collector/non-collector, will always be a collector/non-collector. In the interest of clarity of the arguments we discuss this case assuming $\nu(c) = c$ (none of the arguments depend on this assumption).

Assume same primitives the main model. Also the same free entry condition. However, assume workers are heterogeneous in their cost of collecting UI benefit. The cost $\varepsilon \in [\underline{\varepsilon}, \bar{\varepsilon}]$ is permanent and has distribution $F(\varepsilon)$. Workers who do not collect UI enjoy consumption d. Worker of type ε, who collects UI benefit, enjoys consumption $b - \varepsilon$.

Employed Workers

Employed worker of type ε enjoys utility $E(w, \varepsilon)$

$$E(w, \varepsilon) = \frac{w + \beta\delta U(\varepsilon)}{1 - \beta(1 - \delta)}$$

where $U(\varepsilon)$ is the value of being unemployed.

Unemployed Workers

Unemployed workers have to stay unemployed for at least on period before they are able to search. They can choose to be either collectors or non-collectors. The value of being a non-collectors is

$$(1 - \beta) U^N = d + \beta R\left(U^N\right) \tag{28}$$

and value of being a collector is

$$(1 - \beta) U^C(\varepsilon) = b - \varepsilon + \beta R\left(U^C(\varepsilon)\right) \tag{29}$$

and

$$U(\varepsilon) = \max\left\{U^N, U^C(\varepsilon)\right\}$$

of course, there exists $\varepsilon^* \in [\underline{\varepsilon}, \bar{\varepsilon}]$ such that $\varepsilon^* = b - d$ and every worker with type above(below) ε^* is a non-collector (collector).

The search problem for each type is identical to the above.

$$R(U(\varepsilon)) \equiv \max_{w,\theta} p(\theta)(E(w,\varepsilon) - U(\varepsilon))$$

s.t.

$$w = y - (1 - \beta(1-\delta))\frac{k}{q(\theta)}$$

Replacing for $E(w,\varepsilon)$ and w and simplify, we get the same optimality condition. However, this time there is separate condition for each type

$$p'(\theta)\frac{y - (1-\beta)U(\varepsilon)}{1 - \beta(1-\delta)} = k.$$

Using the same strategy we can solve for equilibrium market tightness for non-collectors and collectors ε. For non-collectors, the equation is

$$y - (1 - \beta(1-\delta))\frac{k}{p'(\theta^{NC})} - \beta p\left(\theta^{NC}\right)\frac{k}{p'(\theta^{NC})} + \beta k\theta^{NC} = d \tag{30}$$

and for $\varepsilon > b - d$ who are collectors

$$y - (1 - \beta(1-\delta))\frac{k}{p'(\theta^{C}(\varepsilon))} - \beta p\left(\theta^{C}(\varepsilon)\right)\frac{k}{p'(\theta^{C}(\varepsilon))} + \beta k\theta^{C}(\varepsilon) = b - \varepsilon \tag{31}$$

Theorem 1 *With permanent types, the following is true*

1. *Non-collectors have the lowest wage and highest market tightness.*
2. *Wage of non-collectors is not affected by the level of UI benefit.*
3. *Wages of each collector $\varepsilon > b - d$ goes up as the level of UI benefit rises.*

Just as above, rising unemployment benefit has two effects for collectors. It raises their current value of being unemployed. It also raises the future value. The effect of first always dominates and leads to increase in dispersion of wage distribution (but does not affect the minimum wage).

Another notable feature of this model is that these results do not depend on the distribution of types. Only the average does.

D Existence of equilibrium

Will be added later.

E Model with benefit expiration and eligibility

Workers

The return to search for UI eligible ($i = E$) and UI ineligible ($i = I$) individuals is given by

$$R^i(V) \equiv \max_{x \in X} p\left(\theta^i(x)\right)(x - V), \quad i \in \{E, I\} \tag{32}$$

If an individual is ineligible to collect unemployment benefits at the beginning of an unemployment spell, that individual will remain ineligible for the entire spell. Let U^N denote the value of being unemployed and ineligible:

$$U^N = v(d) + \beta\left\{U^N + R^I\left(U^N\right)\right\}. \tag{33}$$

Note that the return to search for any unemployed individual is that of a UI ineligible individual as all individuals who transit from unemployment to employment start their employment spell as ineligible for UI benefits.

Now imagine that unemployment benefits expire stochastically with probability ψ each period: one can think of psi as being equal to $1/6$ in normal times so that the average duration of benefits is equal to 6 months. Individuals who are eligible must decide whether they collect or not at the beginning of their unemployment spell. Let $U^E(\varepsilon) \equiv \max\left\{U^N, U^C(\varepsilon)\right\}$ denote the lifetime utility of an eligible unemployed worker with UI benefit collection cost ε. If an individual chooses not to collect UI benefit, his lifetime utility is equal U^N, must like ineligible individuals. Since ε is constant during any unemployment spell, a worker who decides not to collect benefit at the beginning of an unemployment spell will continue to choose not to collect during the entire unemployment spell.[30]

If an eligible individual chooses to collect UI benefit, his lifetime utility is equal $U^C(\varepsilon)$ which consists of the value of consuming b, incurring utility cost ε, plus the value of being unemployed (and potentially remaining eligible) and searching next period:

$$U^C(\varepsilon) = v(b) - \varepsilon + \beta \left\{ (1-\psi) \left[U^C(\varepsilon) + R^I \left(U^C(\varepsilon) \right) \right] + \psi \left[U^N + R^I \left(U^N \right) \right] \right\}. \tag{34}$$

Let $U^E \equiv \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} U(\varepsilon)\, dF(\varepsilon)$ denote the lifetime utility of an unemployed worker before the realization of UI collection cost ε.

Firms

During the matching stage, firms offer contracts $c \in C$ to workers. A contract specifies the current wage w, and the worker's lifetime utility at the beginning of the next period, V'. This future utility will be attained by an implicit sequence of future wages and unemployment benefits, which depend on a worker's future eligibility. A worker starts each employment spell ineligible, in the sense that the worker would not be eligible to benefits should he separate from his job. As the spell develops, the worker stochastically becomes UI eligible with probability φ. The firm chooses the contract to maximize expected lifetime profits $J(V)$, while delivering the lifetime utility previously contracted (promise-keeping constraint). The problem of a firm matched with an ineligible worker with promised lifetime utility V is therefore given by

$$J^I(V) \equiv \max_{w,V'} \left\{ y - w + \beta(1-\delta) \left[(1-\varphi) \left(1 - \lambda_e \tilde{p}^I(V') \right) J^I(V') + \varphi \left(1 - \lambda_e \tilde{p}^E(V') \right) J^E \right] \right\} \tag{35}$$

subject to

$$V = v\left((1-\tau)\, w\right) + \beta \left[\delta \left((1-\varphi) U^N + \varphi U^E \right) + (1-\delta) \left(V' + \lambda_e R^I(V') \right) \right].$$

Similarly, the problem of a firm matched with an eligible worker with promised lifetime

[30] Note that in general individuals must choose to file for benefits soon after having been separated from their employer.

utility V is given by

$$J^E(V) \equiv \max_{w,V'} \left\{ y - w + \beta(1-\delta)\left(1 - \lambda_e \tilde{p}^E(V')\right) J^E\left(V'\right) \right\} \tag{36}$$

subject to

$$V = v\left(\left(1-\tau\right)w\right) + \beta\left[\delta U^E + \left(1-\delta\right)\left(V' + \lambda_e R^E(V')\right)\right].$$

Let $c = (w, V')$ denote the optimal contract, with associated policy functions $w = w(V)$ for the wage, and $V' = z(V)$ for the worker's lifetime utility next period.

Market tightness

During the search stage, a measure of firms choose whether to enter the labor market by opening a vacancy. Should it choose to enter, a firm posts how much lifetime utility it offers (i.e. chooses a submarket x) for all potential applicants to see. Since whether an individual is or would be UI eligible is public knowledge, firms choose whether to target their vacancies at eligible or ineligible individuals. The benefit of creating a type i vacancy, where $i \in \{E, I\}$, in submarket x is the product between the vacancy filling probability $q\left(\theta^i(x)\right)$ and the value meeting a worker $J^i(x)$. The cost of creating a vacancy is k.[31] When the benefit of creating a vacancy in submarket x is strictly smaller than the cost, no vacancy is created in that submarket. When the benefit is strictly greater than k, it is optimal to create infinitely many vacancies. Therefore, free entry implies that the expected value of opening a vacancy cannot exceed the cost of creating one. In other words, in any submarket that is visited by a positive number of workers, the market tightness $\theta(x) \geq 0$ must be such that

$$q\left(\theta^i(x)\right) J^i(x) \leq k \tag{37}$$

with $\theta^i(x) > 0$ whenever $q\left(\theta^i(x)\right) J^i(x) = k$, for $i = \{E, I\}$.

While the free entry condition must hold with equality for submarkets which are open in equilibrium (i.e. submarkets in which some individuals search), such need not be the case for unvisited submarkets. Following Acemoglu and Shimer (1999) and the subsequent literature, we assume that (37) holds with equality in all submarkets in a relevant range, that is, from the lowest submarket to the submarket where firms would just cover the cost of posting a

[31] k could in principle be indexed by i.

vacancy with a job filling probability equal to one. Under this assumption, market tightness is a decreasing function of x over the relevant range.

Government

Every unemployed worker enjoys utility of home production d. Therefore, if they decide to collect, they receive $b-d$ as transfer which is financed through taxes on wages on employed workers. The government collects earnings taxes at rate τ to finance the transfer $b-d$ to workers who chose to fill and collect benefits. Let $\phi^E(x)$ be the distribution of employed workers over submarkets, and ϕ^{UC} be the measure of unemployed workers who collect UI benefit. Then the government budget constraint can be written as

$$\tau \int_{\underline{x}}^{\bar{x}} w(x) d\phi^E(x) = (b-d)\phi^{UC} \tag{38}$$

E.1 Recursive Equilibrium

We are now ready to define recursive equilibrium.

Definition 2 *A* Recursive Equilibrium *consists of a policy (b, τ), a market tightness function $\theta : X \to \mathbb{R}_+$, a search value function $R : X \to \mathbb{R}_+$, a search policy function $m : X \to X$, an unemployment value function for collectors $U^C : [\underline{\varepsilon}, \bar{\varepsilon}] \to \mathbb{R}$ and for non-collectors $U^N \in \mathbb{R}$, a decision to collect $\iota^C : [\underline{\varepsilon}, \bar{\varepsilon}] \to \{0,1\}$, a value function for firms $J : X \to \mathbb{R}$, a contract policy function $c : X \to C$, a stationary probability distribution over employed workers $\phi^E : X \to [0,1]$, and measure of unemployed workers who collect UI benefit ϕ^{UC}. These objects satisfy the following requirements:*

1. *θ satisfies (37) for all $x \in X$;*

2. *R satisfies (32) for all $V \in X$, and m is the associated policy function;*

3. *U^N satisfies (33) and U^C satisfies (34) for all $\varepsilon \in [\underline{\varepsilon}, \bar{\varepsilon}]$ who collect UI benefit. Moreover, $\iota^C(\varepsilon) = 1$ whenever $U^C(\varepsilon) \geq U^N$, and $\iota^C(\varepsilon) = 0$ otherwise.*

4. *J (6) for all $V \in X$, and c is the associated policy function;*

5. ϕ^E *are* ϕ^{UC} *are derived from policy functions* (m, c), *choice over collecting UI benefit, and* $F(\varepsilon)$;

6. *Government policy* (b, τ) *satisfies government budget (38).*

F BAM

If benefits and usual hourly wages are highly colinear, then there is concern about interpreting the magnitude of the coefficient on benefits. Note that benefits are usually a function of earnings, which is hours times wages over a base period, and not just wages. We find that while they are positively correlated, usual wages and benefits are not highly correlated and are unlikely to be colinear. As an additional check we rerun our regression specification only in states where benefits are a function of high quarter earnings (rather than average earnings during a base period) as in Ferraro et al. (2022). These states are NY, TX, FL, AZ, CA, DC, HI, ID, IA, KS, MD, MI, MN, MS, NE, NV, NM, OK, PA, SC, SD, UT, WI, and WY. We find very similar results to our original regression in this subset of states.

We explore the change in the composition of UI paid claimants over time along some dimensions of observable characteristics. Similar to the large change in reservation wages and usual wages that we observed in Figure 10, we find changes in the composition of workers before and after Covid, especially by age (Figure 12) and sector of employment (Figure 15).

Figure 12: **Average Age of Paid Claimants**

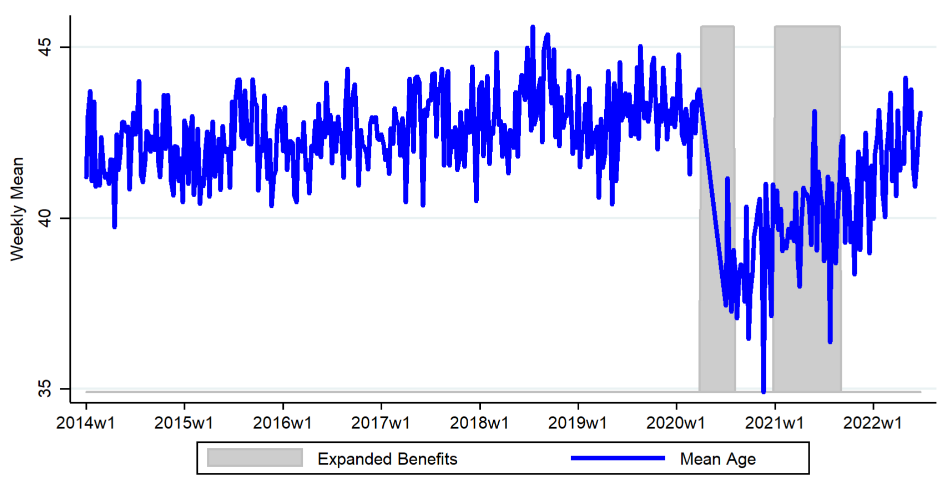


Table 9: Results

	$ln(\tilde{w})$	$ln(\tilde{w})$	$ln(\tilde{w})$	$ln(\tilde{w})$
$ln(WeeklyUIben)$	0.335***	0.015	0.027***	0.016**
	(0.017)	(0.010)	(0.004)	(0.008)
$ln(w\_usual)$		0.787***	0.738***	0.737***
		(0.028)	(0.031)	(0.031)
age			−0.000	0.001
			(0.001)	(0.001)
agesq			0.000	−0.000
			(0.000)	(0.000)
female			−0.009	−0.012*
			(0.007)	(0.006)
Constant	0.782***	0.372***	0.381***	0.393***
	(0.107)	(0.056)	(0.086)	(0.104)
Education dummies	No	No	Yes	Yes
Race/Ethnicity dummies	No	No	Yes	Yes
2 dig SIC dummies	No	No	Yes	Yes
State dummies	No	No	Yes	Yes
Time dummies	No	No	No	Yes
Observations	85371	85269	84464	84464

Here we present the results of the Blinder-Oaxaca decomposition when we include unemployment benefits (excluding FPUC supplement amounts) in the regression specification. The reason one may want to include benefit amounts is they are usually a function of earnings history over a prolonged base period. Heterogeneity in benefit amounts may be informative about the attachment of the worker to the labor force that is otherwise unobservable if we only include usual wages. We get similar results to our baseline specification which does not include benfits. In 2021, there is a slightly larger component of the change in reservation wage which can be ascribed to observables. However, the overall results are very similar. In 2021, the increase in reservation wages was due to the unexplained component (coefficients), which was partially dampened or offset by the composition of workers (endowments).

Figure 13: **Percent of Paid Claimants who are White**

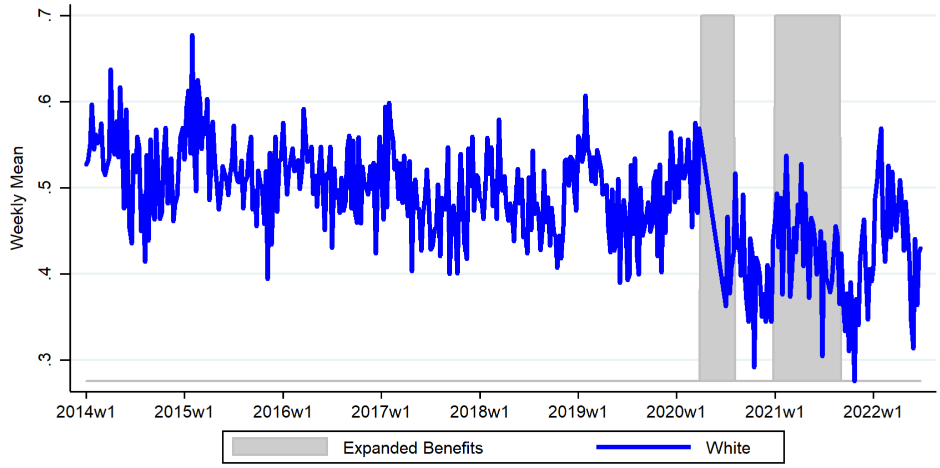


Table 10: Blinder-Oaxaca Decomposition Pre and Post Covid 2020

	Decomposition		Percent	
Pre Covid	2.799***	[2.761,2.836]		
2020 Expanded Benefit	2.717***	[2.658,2.776]		
difference	0.082***	[0.033,0.131]		
endowments	0.120***	[0.080,0.160]	146.095***	[93.018,199.173]
coefficients	-0.044***	[-0.069,-0.020]	-53.978*	[-109.763,1.806]
interaction	0.006*	[-0.000,0.013]		

Figure 14: **Percent of Paid Claimants with Some College Education**

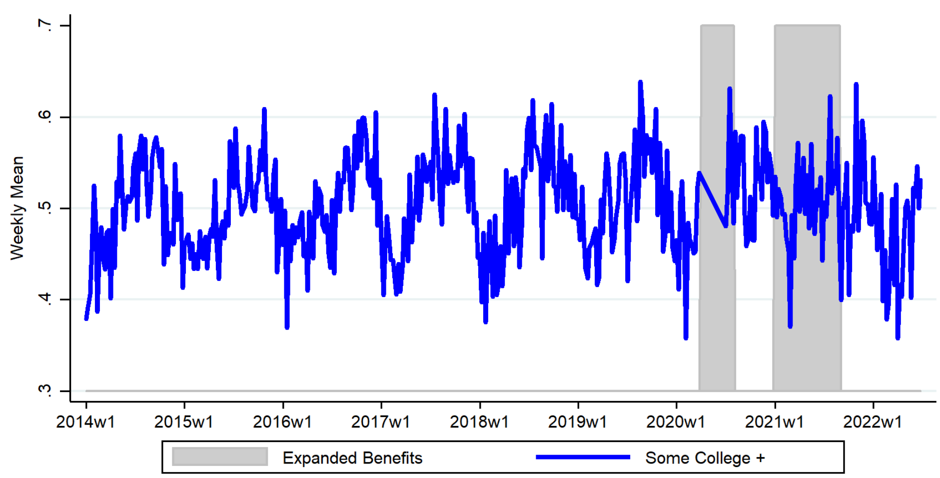


Figure 15: **Percent of Paid Claimants in Manufacturing Sector**

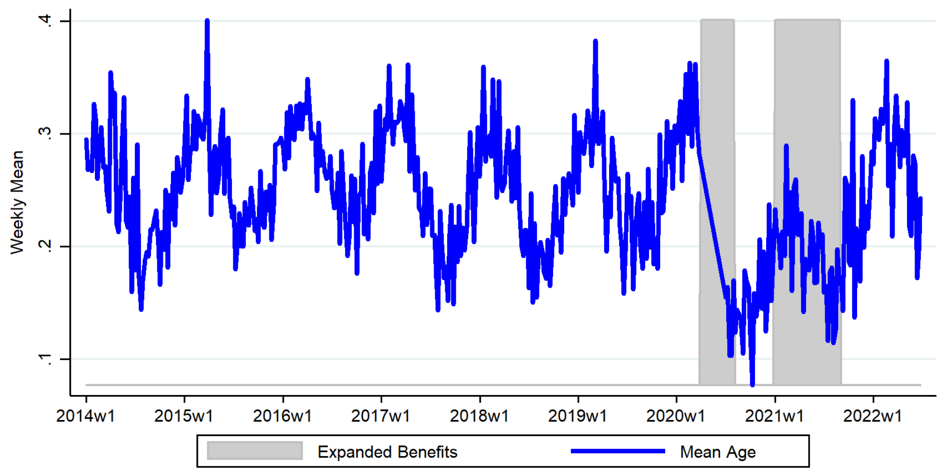


Table 11: Blinder-Oaxaca Decomposition, Pre and Post Covid 2021

	Decomposition		Percent	
Pre Covid	2.799***	[2.761,2.836]		
2021 Expanded Benefit	2.823***	[2.777,2.870]		
difference	-0.025	[-0.055,0.006]		
endowments	0.042***	[0.016,0.069]	-172.948	[-485.959,140.063]
coefficients	-0.068***	[-0.082,-0.054]	276.573*	[-41.159,594.305]
interaction	0.001	[-0.002,0.003]		

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