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Assessing Job Acceptance Impacts of Increased UI Payments**

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# Reservation Benefits: Assessing job acceptance impacts of increased UI payments

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August 4, 2020\*

## Abstract

Job acceptance decisions weigh the value of a job against remaining unemployed. A reservation level of benefit payments exists in this dynamic decision problem at which an individual is indifferent between accepting and refusing an offer. This reservation benefit is a simple statistic summarizing the decision problem conditional on the believed state of the labor market and the weeks of Unemployment Insurance (UI) compensation remaining. Estimating the reservation benefit for a wide range of US workers suggests few would turn down an offer to return to work at the previous wage under the CARES Act expanded UI payments.

JEL Classification: J64, J65.

Keywords: Unemployment, Unemployment insurance, Job acceptance, COVID-19.

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\*Petrosky-Nadeau: FRB San Francisco, 101 Market Street, San Francisco CA 94105; e-mail: Nicolas.Petrosky-Nadeau@sf.frb.org. Olivia Lofton provided excellent research assistance. The views expressed are those of the author and do not necessarily reflect the views of the Federal Reserve Bank of San Francisco or the Federal Reserve System.

# 1 Introduction

The Coronavirus Aid, Relief, and Economic Security (CARES) Act, through the Pandemic Unemployment Compensation (PUC) provision, provided an additional \$600 per week to supplement regular unemployment benefits during the initial outbreak of COVID-19 through the end of July 2020. The generosity of the program raised concerns it could delay the speed of the labor market recovery as certain individuals, earning more per week unemployed with the additional support than on the previous job, would reject offers to return to work.<sup>1</sup>

This concern overlooks the dynamic nature of employment, comparing static weekly earnings to benefit amounts instead of the expected payoff of an entire job spell to that of remaining unemployed. This paper uses a dynamic model of job acceptance decisions to derive the level of benefits necessary for workers to be indifferent between accepting a job offer at the previous wage and rejecting it to remain unemployed conditional on the remaining number of weeks of unemployment compensation. An offer is accepted if the current level of benefits is below this *reservation benefit*.

For a given wage offer, the level of reservation benefit to reject the job is determined by: (i) the expected duration of the employment spell – longer lasting jobs have a greater value and are rejected only for commensurately generous unemployment insurance (UI) payments; (ii) the rate of arrival of new job offers – in a depressed labor market, when job offers are few and far between, any job offer is costly to refuse. Higher (reservation) UI payments are needed to reject a job offer, and; (iii) the duration of benefits remaining – an additional week of benefits raises the opportunity cost of accepting an offer. In the limit of indefinite UI duration the reservation benefit converges to the wage offered. With one week remaining of UI payment, the reservation benefit is always above the wage offered.

Applying the reservation benefit statistic to the period covered by the provision in the CARES Act, including the extension of benefit payments for up to 52 weeks with the Pandemic Emergency Unemployment Compensation (PEUC) and state emergency extensions, suggests few worker types would refuse an offer to return to work at the previous pay. These findings are obtained from using data from the Bureau of Labor Statistics' (BLS) Current Population Survey (CPS) to estimate reservation benefit levels for workers of different skill (education), in different occupations, and across US states. A typical high school educated worker, with \$800 in weekly earnings and UI payments near 125% of the previous wage in early May 2020, would not have been deterred from accepting an job offer. In fact, the PUC payment would need to be increased by an additional \$250 per week before this person would consider rejecting the job offer. From the perspective of the first week of June 2020, with 8 weeks of supplementary UI payment remaining and as states were moving to re-open their economies, only workers in the lowest paid occupation (food services, with typical earnings of \$460 per week) would be about indifferent between accepting an offer

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<sup>1</sup>The CARES Act includes two provisions that stand out relative to previous policy responses: it relaxes UI eligibility requirements, and provides a temporary and uniform additional \$600 per in UI payments. The latter provision has attracted much attention as many unemployed earn more per week than on their previous jobs (see Ganong, Noel and Vavra, 2020).

and remaining unemployed. For all other occupations replacement rates over 100% under CARES were unlikely to be the cause of rejected job offers. The value of a job, especially in a depressed labor market, significantly outweighs the value of the temporary additional UI income.

Early studies into the effects of the expansions to UI under the CARES Act find little impact exit rates out of unemployment. Bartik et al. (2020) and Altonji et al. (2020) find states with more generous UI systems have not experienced weaker labor market rebounds during the initial phase of reopening.<sup>2</sup> The values of the reservation benefits calculated here are in line with these finds as the additional UI income is found to deter job acceptance for only a few categories of workers, and states with the more generous UI payments also tended to have the highest reservation benefits replacement rates.<sup>3</sup> Taken together, the additional income provided to the unemployed through the CARES Act likely had little labor supply induced impact on the unemployment rate over the past couple months. Rather, the additional income would have acted as an effective targeted fiscal transfer supporting aggregate demand.

These findings align with research on the effects of UI extensions during prior recessions. During the Great Recession, in particular, successive extensions increased coverage from a usual 26 weeks to up to 99 weeks. A preponderance of studies based on individual worker data find negligible effects of extending the duration of UI payments on the unemployment exit rates for eligible unemployed workers. Moreover, UI extensions appear to reduce the labor force exit of the unemployed rather than their employment probabilities, with an effect that is strongest among the long term unemployed, and aggregating the micro responses to UI extensions concludes the effect on the overall unemployment rate is negligible (Rothstein 2011, Farber and Valletta, 2015, Chodorow-Reich, Coglianese and Karabarbounis, 2019). Moreover, the magnitude of the effect is highly cyclical, with little to no effect of UI duration extensions during recessions (Kroft and Notowidigdo, 2016).<sup>4</sup>

The literature on optimal UI emphasizes a basic equity/efficiency trade-off arising from the moral hazard effect on worker search behavior (Feldstein 1976, Baily 1978, Acemoglu and Shimer 1999, Chetty 2008, Kroft and Notowidigdo, 2016). While earlier work emphasizes the disincentive effect of UI on worker search, leading to longer unemployment spells and higher unemployment, Acemoglu and Shimer (1999) show a positive amount of UI increases output by improving the allocation of risk averse workers to high wage, high productivity jobs.<sup>5</sup> The reservation benefit

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<sup>2</sup>There is some evidence that more generous UI payments increased separations out of employment during the pandemic. In theory, UI does not necessarily increase layoffs when there is a fall in demand (see Burdett and Hool 1983 in an implicit contract framework between a pool of attached workers and a firm which faces uncertain product demand).

<sup>3</sup>Several studies documenting the labor market disruptions of the pandemic note that job losses have been more heavily concentrated among workers that take significantly longer to find stable jobs in the future (see Gregory, Menzio and Wiczer, 2020 for example).

<sup>4</sup>See Moffitt (1985) for an early study of the effect of UI on unemployment durations. Lalive, Landais and Zweimüller (2015) find contrasting results in Austrian data, arguing an extension in the duration of UI benefits deteriorates overall conditions for the demand for labor. A related question not addressed here is the impact of UI provisions on the joint behavior of workers and firms, and in particular on the duration of employment spells (see, for instance, Feldstein 1976 and Baker and Rea 1998).

<sup>5</sup>See also Acemoglu (2001) for an analysis of the impact of UI on the composition of job and labor productivity across

statistic developed here does not take into account risk aversion, which would increase the value of a long stream of earned income on the job compared to temporary UI payments. It is most closely related to the concept of reservation wages of Shimer and Werning (2007). This after-tax reservation wage is the take home pay required to make a worker indifferent between working and remaining unemployed.

The rest of this paper is organized as follows. Section 2 describes the decision problem and derives a reservation benefit as a function of the state of the labor market, the wage offer and the number of weeks of UI payments remaining. Section 3 adapts the reservation benefit statistic to the details of the CARES Act and uses data from the Current Population Survey (CPS) to calculate benefit amounts for different categories of workers. Section 4 concludes.

## 2 UI income and job acceptance decisions

This section describes the problem of a risk neutral insured job seeker considering a job offer at the previous wage,  $w$ . It compares the present value of the job,  $W_E(w)$ , to that of remaining unemployed with UI benefits  $b$  and  $t$  remaining weeks of eligibility,  $W_U(b, t)$ .<sup>6</sup> The decision takes into account the likely duration of the job and that of finding an alternative offer – through the probabilities of losing and finding a job  $s$  and  $f$ , respectively – and the discounting of time at rate  $r$ :

$$W_E(w) = w + \frac{1}{1+r} [(1-s)W_E(w) + sW_U(b, T)] \quad (1)$$

$$W_U(b, t) = b + \frac{1}{1+r} [(1-f)W_U(b, t-1) + f \max [W_E(w), W_U(b, t-1)]] \text{ for } 1 < t \leq T \quad (2)$$

$$W_U(b, 1) = b + \frac{1}{1+r} [(1-f)W_U(0) + f \max [W_E(w), W_U(0)]] \quad (3)$$

$$W_U(0) = 0 + \frac{1}{1+r} [(1-f)W_U(0) + f \max [W_E(w), W_U(0)]] \quad (4)$$

where  $T$  is the maximum duration of UI,  $W_U(0)$  is the value of unemployment after exhaustion of unemployment benefits,  $W_U(b, T)$  is the value of unemployment at the start of a new unemployment spell following a job loss, and for a positive wage,  $\max [W_E(w), W_U(0)] = W_E(w)$ .<sup>7</sup>

If employment is preferred to remaining unemployed at a date  $t + 1$  then, from the value functions above, the value of unemployment up to the maximum duration of UI of  $T$  weeks can be re-expressed as:

$$W_U(b, t) = B(t) + \left( \frac{f}{r+f} \right) W_E(w) \text{ for } 1 < t \leq T \quad (5)$$

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US states. See Hopenhayn and Nicolini (2009) for an analysis of optimal UI in asymmetric information environments in which workers experience multiple unemployment spells.

<sup>6</sup>The exercise considers offers to return to work at the same wage. Although there is little evidence of significant wage cuts so far in the Pandemic Recession, the approach developed here is straightforward to adapt to any wage offer.

<sup>7</sup>It is assumed employment immediately affords eligibility to full UI whereas state UI systems have different work and earnings requirements to establish UI eligibility. Detailed derivations for all results are provided in the appendix.

which highlights that unemployment is valued for the discounted present value of expected UI payments with  $t$  weeks of eligibility remaining,  $B(t) = \sum_{i=0}^{t-1} b \left( \frac{1-f}{1+r} \right)^i$ , and the discounted value of finding a job and moving into employment.

## 2.1 Reservation benefits

Since the value of unemployment in (5) is increasing in the weekly benefit amount, there exists a reservation benefit  $b^r(t, w)$  to be paid out for the remaining weeks of eligibility  $t$  such that a job offering pay  $w$  is not preferred to remaining unemployed. That is, a job offer with pay  $w$  will be turned down if the current level of weekly benefit payments  $b$  is greater than this reservation level  $b^r(t, w)$ . Formally:

**Proposition 1.** *The reservation benefit for an unemployed individual with  $t$  weeks of UI eligibility remaining and considering a job offer at wage  $w$  solves:*

$$W_U(b^r(t, w), t) = W_E(w) \quad (6)$$

Given the value function for employment and unemployment (1) and (5) the reservation benefit is

$$b^r(t, w) = \frac{b^r(1, w)}{\sum_{i=0}^{t-1} \left( \frac{1-f}{1+r} \right)^i} \text{ for } 0 < t \leq T \quad (7)$$

where

$$b^r(1, w) = \left( \frac{r}{r+f} \right) W_E(w) = \left( \frac{r}{r+f} \right) \left( \frac{(1+r)w + sW_U(b, T)}{r+s} \right) > w \quad (8)$$

Job seekers will accept an offer to return to their previous wage if weekly income while unemployed is lower than their reservation level of benefits with  $t$  weeks of payments remaining,  $b < b^r(t, w)$ .

For a given wage offered, the level of reservation benefits to reject the job is determined by the duration of benefits remaining ( $t$ ), the expected duration of the employment spell ( $\approx 1/s$ ), and the rate of arrival of new job offers ( $f$ ). With an indefinite duration of UI payments ( $T \rightarrow \infty$ ) the reservation benefit is equal to the wage  $b^r(\infty) = w$ . In this limit, replacement rates cannot exceed 100% for workers to return to jobs at previous wages. With one week remaining, the reservation benefit  $b^r(1, w)$  is the annuity value of the present discounted value of the job offered. It is always the case that, with a week remaining, the reservation benefit is greater than the wage offer ( $b^r(1, w) > w$ ). In other words, replacement ratios above 100% do not necessarily lower job offer acceptance rates. More generally, for UI benefit payments of finite duration, the reservation benefit  $b^r(t)$  is declining with weeks remaining of UI benefits, trading off an additional week of benefits at the reservation level against the forgone employment value. The level of the reservation benefit depends crucially on the expected duration of the employment spell and the rate of arrival

of new job offers. Longer lasting employment spells (lower  $s$ ) have a greater value and are rejected only for commensurately generous unemployment insurance (UI) payments. In a depressed labor market, when job offers are few and far between (low  $f$ ), any job offer is costly to refuse as new offers are hard to find. This can be seen in the discounting terms in equations (7) and (8).

### 3 Reservation benefits during the pandemic

This section provides estimates of reservation benefits for different categories of workers during the Pandemic Recession by first adapting the general problem to reflect CARES Act specific institutional details and then using micro data from the CPS to obtain the relevant moments entering the definition of a reservation benefit level. The main set of results are based on the experience during the recovery out of the Great Recession. Additional results, obtained by varying the assumptions on the expected durations of unemployment and employment spells, are provided and are meant to capture bounds on reservation benefit levels at different horizons of remaining UI eligibility.

#### 3.1 CARES Act specific formulation

The temporary nature of the supplemental PUC income relative to the duration of payments of baseline UI requires a small modification to the unemployment Bellman equations above. Let  $t_c$  denote the weeks of expanded UI eligibility, and  $t_p$  the weeks of supplemental UI income under the PUC, remaining for a given unemployment spell. For simplicity it is assumed that  $t_p < t_c$  for all unemployed. In addition, let  $\bar{b}$  denote baseline UI payments and the additional income provided through the PUC by  $b_p$ . The value of unemployment under the CARES Act is:

$$W_U(\bar{b}, t_c, b_p, t_p) = \bar{b} + b_p + \frac{1}{1+r} [(1-f) W_U(\bar{b}, t_c - 1, b_p, t_p - 1) + f \max [W_E(w), W_U(\bar{b}, t_c - 1, b_p, t_p - 1)]] \text{ for } t_c, t_p > 1 \quad (9)$$

$$W_E(w) = w + \frac{1}{1+r} [(1-s) W_E(w) + s W_U(\bar{b}, T_c)] \quad (10)$$

Following similar steps as in the previous section, the value of unemployment under the CARES Act with  $t_c$  weeks of regular UI payments and  $t_p$  weeks of PUC payments may be expressed as:

$$W_U(\bar{b}, t_c, b_p, t_p) = \bar{B}(t_c) + B_p(t_p) + \frac{f}{r+r} W_E(w)$$

where  $\bar{B}(t) = \sum_{i=0}^{t-1} \bar{b} \left(\frac{1-f}{1+r}\right)^i$  and  $B_p(t) = \sum_{i=0}^{t-1} b_p \left(\frac{1-f}{1+r}\right)^i$ .

The level of *supplemental* UI payments leading to indifference to job offers at the previous wage  $w$  with 1 and  $t$  weeks remaining in PUC payments, respectively, are given by:

$$b_p^r(1, t_c, w) = \frac{r}{r+f} W_E(w) - \bar{B}(t_c) \quad (11)$$

$$b_p^r(t, t_c, w) = \frac{b_p^r(1, t_c, w)}{\sum_{i=0}^{t-1} \left(\frac{1-f}{1+r}\right)^i} \quad (12)$$

The level of the supplemental benefit depends on the wage offer, the number of weeks of supplemental UI payments remaining, and the number of weeks of regular benefit payments remaining,  $t_c$ .

The reservation benefits during the pandemic calculated below is the sum of regular and supplemental reservation benefit payments,  $b^r(t, t_c, w) = \bar{b} + b_p^r(t, t_c, w)$ , and make the following further assumptions. A baseline UI program, outside the additional provision under the CARES Act, is specified as a weekly payment  $\bar{b} = \min[\bar{\tau} \times w, b_{cap}]$  for a maximum duration of  $\bar{T} = 26$  weeks, where  $\bar{\tau} \in (0, 1)$  is a replacement rate set to 50 percent and  $b_{cap}$  a cap on weekly payments of \$500.<sup>8</sup> The PEUC extended the duration of UI payments an additional 13 weeks for a total of 39 weeks, but in some states emergency extensions provide an additional 13 weeks for a maximum of 52 weeks.  $T^c$  is set to 52 weeks. The additional income provided through the PUC is denoted by  $b_p = \$600$  per week. Payments first began the week ending April 4 and the last week ending July 25, for a total of  $T_p = 17$  weeks. Finally, the CARES Act provision of additional UI income is assumed to no longer be available at the end of the employment spell of the job offer under consideration.<sup>9</sup>

### 3.2 Data

The moments required to calculate reservation benefits are obtained from the monthly CPS. Table 1 reports mean and median weekly earnings, and several measures of expected unemployment and employment spell duration implied by job arrival and separation rates ( $f$  and  $s$ ) for the overall population, prime aged workers, by level of education, and occupation. Weekly earnings are based on the full calendar year 2019, while measures of duration in the baseline exercise are drawn from the early recovery phase following the Great Recession (the full calendar year 2010). The arrival rate  $f_t = UE_t/U_{t-1}$  is the sum of transitions from unemployment to employment over the previous period's unemployed. The separation rate  $s_t = (EU_t + EN_t)/E_{t-1}$  is the sum of transitions out of employment into either unemployment or non-employment over the preceding period's employment. Note that durations of unemployment spells based on outflow rates are significantly shorter than the average durations reported by CPS respondents.<sup>10</sup>

<sup>8</sup>This assumption for regular UI compensation is somewhat more generous than the typical US state program. See Department of Labor (2019) for a review of the heterogeneity in eligibility requirements and benefit levels and duration across US states. Note also the discount rate  $r$  is set to an annualized 5%.

<sup>9</sup>Allowing for the additional UI income to be available upon reemployment, at least partially, would increase the value of a job offer. The levels of the reservation benefit would be somewhat higher due to strong discounting over the duration of a typical employment spell.

<sup>10</sup>Table A1 provides durations of unemployment spells as self-reported in the CPS for comparison to the durations implied by the finding rate  $f$ . In particular, it reports the average duration of the unemployment spell preceding a transition into employment which can be compared to the imputed finding rate based durations by occupation. Table A3 of the appendix reports the equivalent moments for 2019.



Transitions in and out of employment are not easily defined from responses to labor market status questions in the CPS for certain categories of workers or jobs. This applies to the transition rate  $f$  by occupation, and the approach here is to estimate a logit on the outcome of a transition from unemployment into employment,  $f = \exp(\beta_f X) / [1 + \exp(\beta_f X)]$ , based on a set of demographic characteristics in the vector  $X$  that includes age, education, race/ethnicity, sex and marital status. The regressions, using all months of 2010, are then used to predict the average transition rate by occupation. (see appendix B for further details).

### 3.3 Results: Overall, by education and by occupation

The discussion focuses on reservation benefit levels, and the corresponding replacements rates, for individuals with either 12 or 8 weeks of UI eligibility remaining. With the PUC benefit expiring July 31st, this corresponds to individuals considering an offer to return to work at the previous wage the first week of May and the first week of June, 2020, respectively.

An average worker, earning about \$1000 per week, received \$1100 per week in UI payments under the CARES act, or 110% of prior earnings. Considering an offer at the previous wage takes into account that the proposed employment spell is expected to last just under two years and, if rejected, unemployment can be expected to last 22 weeks (see the first row of Table 1). An offer during the first week of May 2020 would be accepted as long as the average worker's reservation benefit was below  $b^r(12) = \$1,550$ . This is \$450 above weekly UI payments under CARE. UI payments less than 155% of the previous wage would not push this worker to reject the job offer due to the temporary duration of UI payments and the possibility of a long employment spell. An offer during the first week of June, with 8 weeks of PUC payments remaining, is all the more attractive. These conclusions are similar when restricting to the prime age workforce, aged 25 to 54 years old (see the second row of Table 1).

The next three rows of Table 1 present the results for workers with three levels of education (less than high school, high school, and college and above). The additional payments under the CARES Act are far from affecting college educated workers: employment spells have long durations (3 years) with earnings well above augmented UI payments. High school educated workers have earnings close to the national median at \$800 per week, and expected durations of employment and rates of finding jobs close to the overall average. A 124% replacement rate under the CARES Act is below a replacement rate for indifference to a job offer at the previous wage in early May (155%), and well below in June 2020. Finally, based on the decision factors in the definition of a reservation benefit, only individuals with less than a high school education were likely to have been influenced by the augmented UI payment when considering a job offer in May 2020. However, a job offer in June 2020, when many states were moving to reopen their economies, would have been preferable to remaining unemployed.

Table 1: Reservation benefits and replacement rates

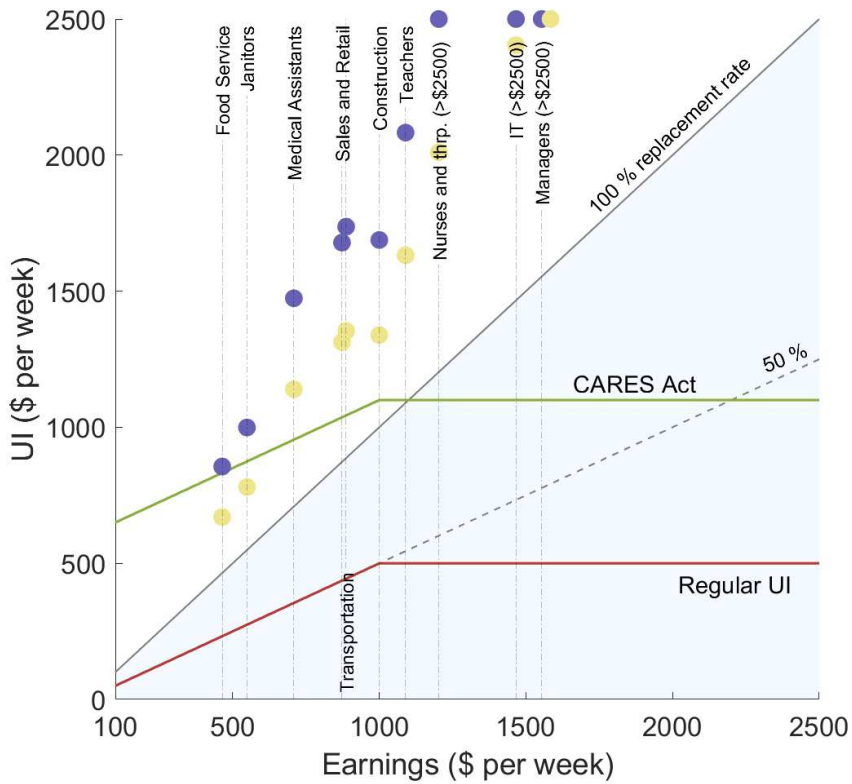
	Earnings	Duration of:		Weekly UI compensation				Replacement rates (%)			
	$w$ (wkly)	$U$ (wks)	$E$ (yrs)	$\bar{b}$	$b^C$	$b^r(12)$	$b^r(8)$	$\bar{\tau}$	$\tau^C$	$\tau^r(12)$	$\tau^r(8)$
Overall	1007	22	1.7	500	1100	1553	1995	50	109	154	198
Age 25 to 54 years	1087	21	2.3	500	1100	1732	2234	46	101	159	206
Education:											
Less than HS	513	23	0.74	256	856	708	907	50	167	138	177
High School	807	22	1.6	403	1003	1246	1602	50	124	155	199
College and above	1389	19	2.8	500	1100	2226	2884	36	79	160	208
Occupation:											
Food Service	464	21	1.1	232	832	670	856	50	179	144	184
Janitors	549	22	0.9	274	874	780	999	50	159	142	182
Medical Assi.	709	23	1.9	354	954	1139	1474	50	135	161	208
Sales and Retail	873	21	1.6	436	1036	1313	1679	50	119	150	192
Transportation	887	21	1.6	444	1044	1354	1737	50	118	153	196
Construction	1000	20	0.9	500	1100	1339	1668	50	110	134	169
Teachers	1090	19	1.9	500	1100	1632	2083	46	101	150	191
Nurses and therap.	1203	21	3.4	500	1100	2010	2614	42	91	167	217
IT	1466	19	4.5	500	1100	2404	3116	34	75	164	213
Managers	1554	20	3.2	500	1100	2589	3381	32	71	166	218

Notes: Earnings data calculated using the Dec. 2018 to Dec. 2019 CPS. Durations calculated using Dec. 2009 to Dec. 2010 CPS.  $w$ : weekly earnings; Weekly job finding and separation rates entering the reselection benefits are obtained by converting the monthly flow rates to a weekly frequency (see appendix for details);  $\bar{b}$ : regular weekly unemployment benefits;  $b^C$ : weekly benefits under CARES act,  $\bar{b} + 600\$$ .

The last rows of Table 1 present results for 10 major occupations. Weekly earnings in 2019 range from under \$500 a week (Food services) to over \$1550 a week (Managers), with average durations of employment spells from under a year (janitors and construction) to over three years (managers, nurses and therapists). The reservation benefits levels with 12 and 8 weeks remaining in PUC payments for each occupation are summarized in Figure 1 plotting an occupation's weekly earnings against reservation benefits by occupation. A 100% replacement rate (black line) separates the graph in two regions, shaded in blue for replacement rates below 100%. Regular UI payment rates are represented by the bottom line (red), increasing at a rate of 50% of the prior wage until hitting a cap at \$1000 in weekly earnings for a maximum benefit payment of \$500 per week. The UI payment schedule under the CARES Act is shifted up by \$600 (green line), and any individual with earnings below \$1100 per week receives more on UI with the PUC payments than on the previous job. Each occupation's weekly earnings and reservation benefit level with 12 and 8 weeks of PUC supplemental payments remaining are plotted as yellow and blue dots, respectively. At the time several states moved to reopen their economies, only insured unemployed workers who had been in food services were close to indifferent with returning to work at the previous wage.

Figure 2 reports the same information but focuses on replacement rates explicitly. Under the CARES Act, all but three occupations out of ten have a replacement rate below 100%. From the perspective of the first week of June, the vast majority of occupations show sizable gaps between their replacement rates with PUC payments and replacement rates that would cause the unemployed to be indifferent to a job offer at the previous wage.

In order to provide bounds for the values of reservation benefits, the same calculations are performed under an alternative assumption for job offer arrival rates and durations of employment spells. This alternative uses the data from 2019 to obtain transition rates and would represent a situation in which the unemployed, when considering a job offer, expect a strong labor market rebound with far less difficulty finding a job. The result of increasing the arrival rate of job offers by about 50%, as reported in Table A3, is to lower the level of reservation benefits in all occupations such that two occupations, food services and janitors, would find unemployment more attractive to accepting a job at the previous wage during the first week of June 2020. This example is based on a scenario for the labor market that was not likely to be in the modal expectation of unemployed individuals and is meant to provide a bounds on possible levels of reservation benefits during the period of increased UI payments under the CARES Act.



Weekly UI payments to reject job offer with:  
 ● 8 weeks of PUC remaining ● 12 weeks of PUC remaining

Figure 1: Regular, CARES Act and reservation level UI benefit payments  
 Notes: Each dot corresponds to the reservation benefit for an average worker within each occupation calculated according to (12) with 12 (first week of May) or 8 (first week of June) weeks of PUC payments remaining.

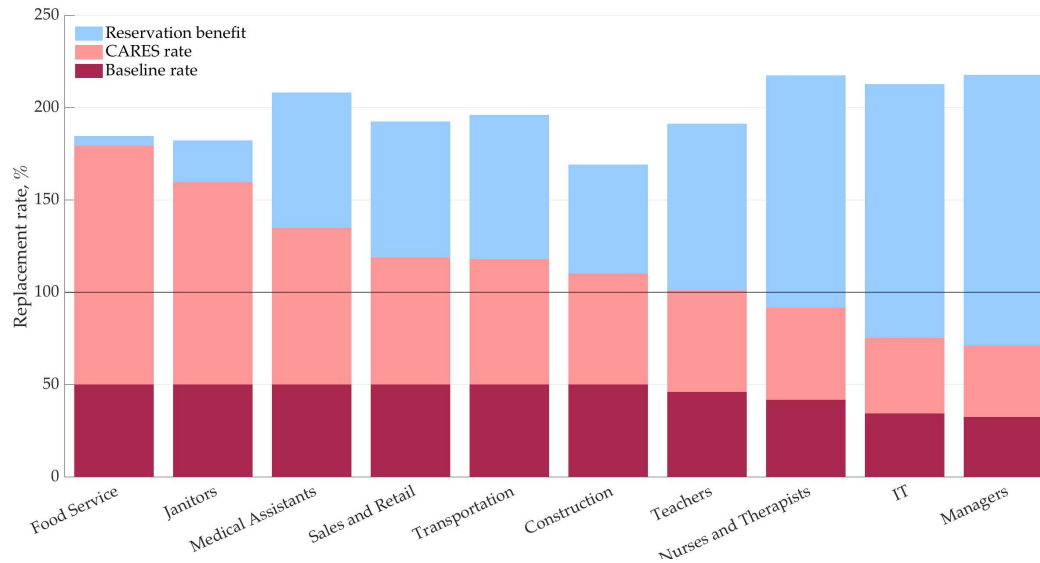


Figure 2: Regular, CARES Act and reservation level UI benefit replacement rates

Notes: The figures reports reservation benefit replacement rates with 8 weeks (first week of June) remaining to the PUC program.

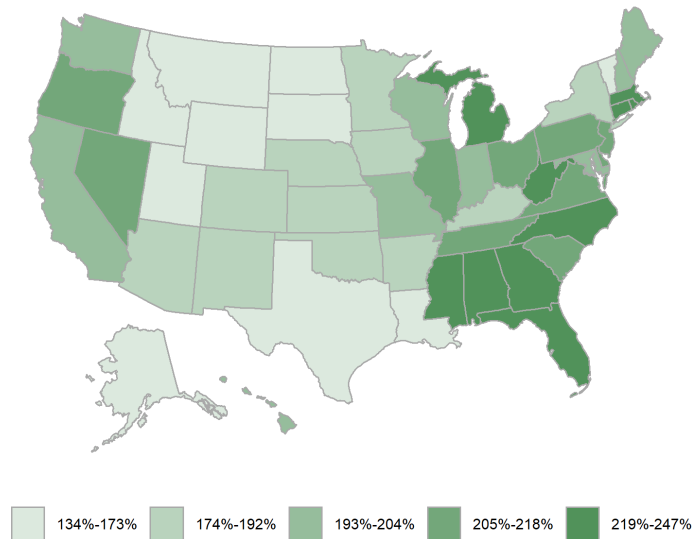
### 3.4 State level estimates

Regular UI benefit payments vary substantially across states, and by extension with the supplemental PUC payments. Regular weekly UI payments in Alabama were capped at \$275 compared to \$790 in Washington in 2019, for example (Department of Labor 2019). This section calculates reservation benefits by state.

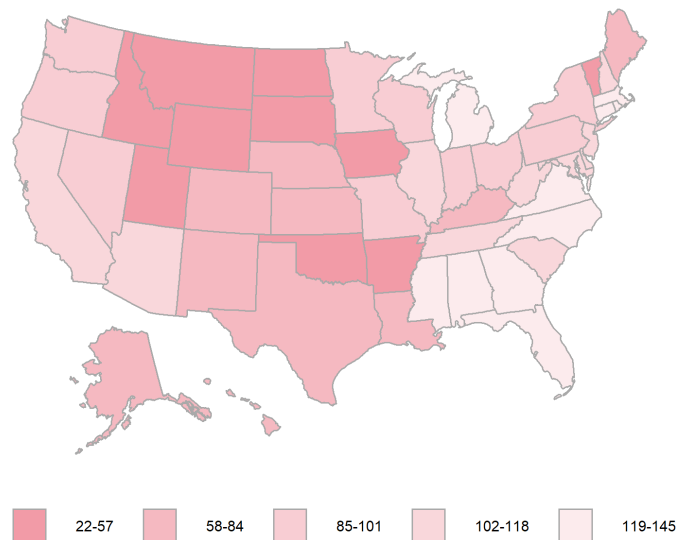
Reservation replacement rates with 8 weeks of PUC payments remaining for all 50 states are calculated following the same approach as earlier and mapped in Figure 3a.<sup>11</sup> The map separates states in reservation replacement rate quintiles. The reservation replacement rates with 8 weeks of PUC payments remaining range from 134% of the previous wage in North Dakota to 247% in Massachusetts. North Dakota’s lower reservation replacement rate is a result of the state’s dynamic labor market with very short durations of unemployment spells. The typical unemployment spell in North Dakota in 2010 was expected to last 10 weeks. The elevated reservation replacement rate in Massachusetts is largely explained by significantly longer expected durations of job search, around 28 weeks.

This contrasts with replacements rate under the CARES Act for the average earner in the two states that are relatively similar: 111% in North Dakota and 102% in Massachusetts (weekly state UI benefits were calculated adapting Ganong, Noel and Vavra (2020)’s UI calculator). The gap between CARES replacement and reservation replacement rates in North Dakota is relatively small but not negligible: 22 percentage points. The margin in Massachusetts, 145 percentage points, is quite wide. The large difference in reservation replacement rates and gaps with state UI under

<sup>11</sup>The full set of state average earnings, job finding and separation rates, and results are available in appendix Table A4.



(a) Reservation replacement rates



(b) Percent point gap between CARES and reservation replacement rates

Figure 3: State level CARES and reservation replacement rates with 8 weeks of PUC payments remaining

Notes: weekly earnings calculated from the monthly CPS, weekly state UI benefits calculated adapting Ganong, Noel and Vavra (2020)'s UI calculator. See appendix B for further details.

CARES across the two states suggests the potential impacts of the supplemental PUC payments on job acceptance decisions should differ significantly. Figure 3b maps quintiles of the percentage point gaps between CARES replacement rates and reservation replacement rates for all 50 states. Bartik et al. (2020) find that the pick up in the labor market during the initial attempts at reopening was strongest among the states with the highest UI benefit replacement rates. The analysis here shows these states also tended to have the largest gaps between the reservation benefit replacement rates and CARES UI replacement rates (light pink states in Figure 3b). These are states where the generous supplemental PUC payments would have been the least likely to distort the job acceptance decisions (see, for example, Florida, Georgia, and North Carolina).

## 4 Conclusion

This paper derives a level of benefit payments over the duration of remaining UI eligibility at which workers are indifferent between a job at the previous wage and remaining unemployed. This reservation benefit reflects the value of forgoing a job offer compared to continued unemployment and, with fixed benefit duration, is always above the previous wage. In a depressed labor market with lower job offer arrival rates, the gap between the previous wage and the reservation benefit widens, leaving room for replacement ratios above 100% without negative effects on job acceptance rates in particular and the labor market in general. Using CPS micro data on weekly earnings, average durations of employment spells and job finding rates, few categories of workers would refuse an offer to return to work at the previous pay even with three months of increased UI income under the CARES Act remaining.

It is worth noting a few considerations that may have a meaningful impact on an individual's job acceptance decision. First, there is no disutility to search/unemployment, nor additional utility while unemployed relative to working. Disutility from search would push job seekers to accept job offers and lower the level of reservation benefits. The additional utility from leisure would have the opposite effect. Second, the specification does not model the depreciation of skill or human capital or of other factors that would result in a declining in the job arrival rate over the duration of the unemployment spell. This consideration would act to increase the reservation benefit level, especially as individuals experience longer unemployment spells during a protracted slowdown. Finally, these are partial equilibrium exercises and do not take into account general equilibrium effects of expanding UI policies, which include supporting aggregate demand, on job offer arrival and separation rates. This is left to future work.

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## Online appendix

### A Detailed derivations

#### A.1 Main derivations

Recall the Bellman equations:

$$W_E = w + \frac{1}{1+r} [(1-s)W_E + sW_U(b, T)] \quad (\text{A.1})$$

$$W_U(b, t) = b + \frac{1}{1+r} [(1-f)W_U(b, t-1) + fW_E] \text{ for } T \geq t > 1 \quad (\text{A.2})$$

$$W_U(b, 1) = b + \frac{1}{1+r} [(1-f)W_U(0) + fW_E] \quad (\text{A.3})$$

$$W_U(0) = 0 + \frac{1}{1+r} [(1-f)W_U(0) + fW_E] \quad (\text{A.4})$$

From the last line we have  $W_U(0) = \frac{f}{r+f}W_E$ , then:

$$W_U(b, 1) = b + \frac{1}{1+r} \left[ (1-f) \frac{f}{r+f}W_E + fW_E \right] = b + \frac{f}{r+f}W_E$$

$$\begin{aligned} W_U(b, 2) &= b + \frac{1}{1+r} [(1-f)W_U(b, 1) + fW_E] \\ &= b + b \left( \frac{1-f}{1+r} \right) + \frac{1}{1+r} \left[ (1-f) \frac{f}{r+f} + f \right] W_E \\ &= b + b \left( \frac{1-f}{1+r} \right) + \frac{f}{r+f}W_E \end{aligned}$$

and finally:

$$W_U(b, t) = \sum_{i=0}^{t-1} b \left( \frac{1-f}{1+r} \right)^i + \left( \frac{f}{r+f} \right) W_E$$

Let  $b^r(t, w)$  denote the value of unemployment benefit with  $t$  weeks of eligibility remaining such that an individual is just indifferent between a job offer and remaining unemployed. With one week of benefits remaining:

$$\begin{aligned} W_U(b^r(1, w), 1) &= W_E \\ b^r(1, w) + \frac{f}{r+f}W_E &= W_E \\ b^r(1, w) &= \left( \frac{r}{r+f} \right) W_E \end{aligned}$$

With two weeks remaining:

$$\begin{aligned}
W_U(b^r(2, w), 2) &= W_E \\
b^r(2, w) \left[ 1 + \left( \frac{1-f}{1+r} \right) \right] + \frac{f}{r+f} W_E &= W_E \\
b^r(2, w) &= \frac{\left( \frac{r}{r+f} \right) W_E}{\left[ 1 + \left( \frac{1-f}{1+r} \right) \right]} = \frac{b^r(1, w)}{\left[ 1 + \left( \frac{1-f}{1+r} \right) \right]}
\end{aligned}$$

such that  $b^r(2, w) < b^r(1, w)$ . More generally: for  $T > t > 1$

$$b^r(t, w) = \frac{b^r(1, w)}{\sum_{i=0}^{t-1} \left( \frac{1-f}{1+r} \right)^i}$$

Finally, we can re-express the value of employment as:

$$\begin{aligned}
W_E &= \frac{w + \frac{s}{1+r} W_U(b, T)}{1 - \left( \frac{1-s}{1+r} \right)} \\
W_E &= \left( \frac{1+r}{r+s} \right) w + \left( \frac{s}{r+s} \right) W_U(b, T) = \left( \frac{1+r}{r+s} \right) w + \left( \frac{s}{r+s} \right) B(T) + \left( \frac{s}{r+s} \right) \left( \frac{f}{r+f} \right) W_E \\
rW_E &= \frac{r+f}{r+f+s} [(1+r)w + sB(T)]
\end{aligned}$$

such that

$$b^r(1, w) = \frac{(1+r)w + sB(T)}{r+s+f}$$

## A.2 Application to the 2020 CARES Act

The value of unemployment under the CARES Act is:

$$\begin{aligned}
W_U(\bar{b}, t_c, b_p, t_p) &= \bar{b} + b_p + \frac{1}{1+r} [(1-f) W_U(\bar{b}, t_c - 1, b_p, t_p - 1) \\
&\quad + f \max [W_E(w), W_U(\bar{b}, t_c - 1, b_p, t_p - 1)]] \text{ for } t_c, t_p > 1 \\
W_U(\bar{b}, t_c, b_p, 1) &= \bar{b} + b_p + \frac{1}{1+r} [(1-f) W_U(\bar{b}, t_c - 1, 0, 0) + f \max [W_E(w), W_U(\bar{b}, t_c - 1, 0, 0)]] \\
W_U(\bar{b}, t_c, 0, 0) &= \bar{b} + \frac{1}{1+r} [(1-f) W_U(\bar{b}, t_c - 1, 0, 0) + f \max [W_E(w), W_U(\bar{b}, t_c - 1, 0, 0)]] \\
W_U(\bar{b}, 1, 0, 0) &= \bar{b} + \frac{1}{1+r} [(1-f) W_U(0) + f \max [W_E(w), W_U(0)]] \\
W_U(0) &= \frac{f}{r+f} W_E(w) \\
W_E(w) &= w + \frac{1}{1+r} [(1-s) W_E(w) + sW_U(\bar{b}, T_c)]
\end{aligned}$$

With one week and  $t_c$  weeks of regular UI remaining and exhaustion of PUC benefits:

$$W_U(\bar{b}, 1, 0, 0) = \bar{b} + \frac{f}{r+r} W_E(w)$$

$$W_U(\bar{b}, t_c, 0, 0) = \bar{b} \sum_{i=0}^{t_c-1} \left( \frac{1-f}{1+r} \right)^i + \frac{f}{r+r} W_E(w) = \bar{B}(t_c) + \frac{f}{r+r} W_E(w)$$

With  $t_c$  weeks of regular UI payments and one week of PUC payments:

$$W_U(\bar{b}, t_c, b_p, 1) = \bar{b} + b_p + \frac{1}{1+r} [(1-f) W_U(\bar{b}, t_c - 1, 0, 0) + f W_E(w)]$$

$$W_U(\bar{b}, t_c, b_p, 1) = \bar{B}(t_c) + b_p + \frac{f}{r+r} W_E(w)$$

With  $t_c$  weeks of regular UI payments and  $t_p$  weeks of PUC payments:

$$W_U(\bar{b}, t_c, b_p, t_p) = \bar{B}(t_c) + B_p(t_p) + \frac{f}{r+r} W_E(w)$$

Reservation supplemental benefit with one week of PUC remaining  $b^r(t_c, t_p = 1, w)$ :

$$W_U(\bar{b}, t_c, b_p^r(1), 1) = W_E(w)$$

$$\bar{B}(t_c) + b_p^r(1, t_c) + \frac{f}{r+r} W_E(w) = W_E(w)$$

$$b_p^r(1, t_c) = \frac{r}{r+f} W_E(w) - \bar{B}(t_c)$$

Reservation supplemental benefit with two weeks of PUC remaining  $b^r(t_c, t_p = 2, w)$ :

$$W_U(\bar{b}, t_c, b_p^r(2), 2) = W_E(w)$$

$$\bar{B}(t_c) + B_p(2) + \frac{f}{r+r} W_E(w) = W_E(w)$$

$$b_p^r(2, t_c) = \frac{\frac{r}{r+f} W_E(w) - \bar{B}(t_c)}{\sum_{i=0}^1 \left( \frac{1-f}{1+r} \right)^i}$$

Reservation supplemental benefit with  $t$  weeks of PUC remaining  $b^r(t_c, t_p = t, w)$ :

$$W_U(\bar{b}, t_c, b_p^r(t), t) = W_E(w)$$

$$\bar{B}(t_c) + B_p(t) + \frac{f}{r+r} W_E(w) = W_E(w)$$

$$b_p^r(t, t_c) = \frac{\frac{r}{r+f} W_E(w) - \bar{B}(t_c)}{\sum_{i=0}^{t-1} \left( \frac{1-f}{1+r} \right)^i}$$

## B Data

Unemployment duration is the inverse of the weekly job finding rate calculated by converting the monthly flow rate  $f_m = UE_t/U_{t-1}$ , to a weekly frequency as  $f_w = 1 - (1 - f_m)^{1/4}$ ; The duration of an employment spell is the inverse of the weekly job separation rate calculated from the monthly flow rate  $s_m = (EU_t + EN_t)/E_{t-1}$ , converted to a weekly rate by solving  $s = s_w \left\{ [(1 - f_w) + (1 - s_w)] \left( 2s_w f_w + (1 - f_w)^2 + (1 - s_w)^2 \right) \right\}$ .

Table A1: Measures of weekly earnings, unemployment and employment duration

	Weekly earnings		Duration of: unemployment <sup>a</sup>			employment <sup>b</sup>
	mean	median	Reported		Flow	Flow
			mean	cond. on U-E	1/ $f_w$	1/ $s_w$
Overall	807	641	31.74	20.53	21.84	1.82
Age 25 to 54 years	875	720	33.73	22.12	21.31	2.52
Education:						
Less than HS	397	350	28.56	18.37	23.19	0.80
High School	659	560	32.46	21.06	22.09	1.76
College and above	1174	1000	32.80	21.10	19.97	3.08
Occupation:						
Construction	800	692	–	18.91	22.09	0.94
Food Service	352	300	–	16.91	21.21	1.19
Information Technology	1374	1185	–	20.64	19.82	5.09
Janitors	438	388	–	22.85	22.77	1.01
Managers	1340	1154	–	23.90	21.00	3.51
Medical Assistants	548	449	–	16.70	21.31	2.09
Nurses and Therapists	884	788	–	16.37	20.33	3.87
Sales and Retail	671	480	–	21.09	21.25	1.69
Teachers	936	865	–	17.85	19.63	2.34
Transportation	735	615	–	20.33	22.81	1.79

Notes: (a) weeks; (b) years. Earnings data calculated using the Dec. 2018 to Dec. 2019 CPS. Durations calculated using Dec. 2009 to Dec. 2010 CPS.  $w$ : weekly earnings; Weekly job finding  $f_w$  and separation  $s_w$  rates calculated by converting the monthly flow rates to a weekly frequency.

Job finding rates by major occupation are obtained from a logit on the outcome of a transition from unemployment into employment,  $f = \exp(\beta_f X) / [1 + \exp(\beta_f X)]$ , based on a set of demographic characteristics in the vector  $X$  that includes age, education, race/ethnicity, sex and marital status. The regression results are reported in Table A2.

Table A2: Predicting Finding and Separation Rates for 2010

	<i>UE</i>		<i>EU + EN</i>	
Age				
25-34	0.0128	-0.0539	-0.953	-0.833
	(0.0341)	(0.0362)	(0.0215)	(0.0227)
35-44	-0.0316	-0.135	-1.166	-0.976
	(0.0356)	(0.0408)	(0.0222)	(0.0257)
45-54	-0.195	-0.310	-1.274	-1.070
	(0.0363)	(0.0430)	(0.0220)	(0.0263)
55-64	-0.333	-0.460	-0.970	-0.757
	(0.0437)	(0.0504)	(0.0230)	(0.0275)
65-79	-0.468	-0.604	-0.0557	0.159
	(0.0759)	(0.0812)	(0.0268)	(0.0315)
Education				
H.S. Diploma	0.0721	0.0755	-0.536	-0.529
	(0.0336)	(0.0336)	(0.0211)	(0.0211)
Some College	0.149	0.170	-0.672	-0.672
	(0.0355)	(0.0356)	(0.0214)	(0.0215)
College Degree & Above	0.287	0.309	-1.020	-1.014
	(0.0408)	(0.0410)	(0.0236)	(0.0236)
Race/Ethnicity				
Black	-0.373	-0.343	0.408	0.356
	(0.0353)	(0.0357)	(0.0221)	(0.0224)
Hispanic	0.147	0.137	0.269	0.268
	(0.0322)	(0.0323)	(0.0209)	(0.0209)
Asian/Pacific Islander	-0.248	-0.260	0.147	0.141
	(0.0635)	(0.0637)	(0.0338)	(0.0338)
Other	-0.0771	-0.0627	0.291	0.267
	(0.0623)	(0.0624)	(0.0403)	(0.0404)
Sex				
Female		-0.169		0.0984
		(0.0238)		(0.0141)
Marital Status				
Married (Spouse Absent)		0.243		0.221
		(0.0866)		(0.0572)
Widowed		-0.0420		0.109
		(0.0962)		(0.0465)
Divorced		-0.133		0.0810
		(0.0393)		(0.0254)
Separated		0.00183		0.213
		(0.0669)		(0.0477)
Never Married		-0.185		0.291
		(0.0323)		(0.0195)
Constant	-1.540	-1.314	-1.761	-2.070
	(0.0323)	(0.0450)	(0.0210)	(0.0277)
Observations	52442	52442	536849	536849

Note: Groups "16-24", "Less than H.S. Diploma", "White", "Male", and "Married (Spouse Present)" are included as reference categories, respectively.

## C Additional tables and figures

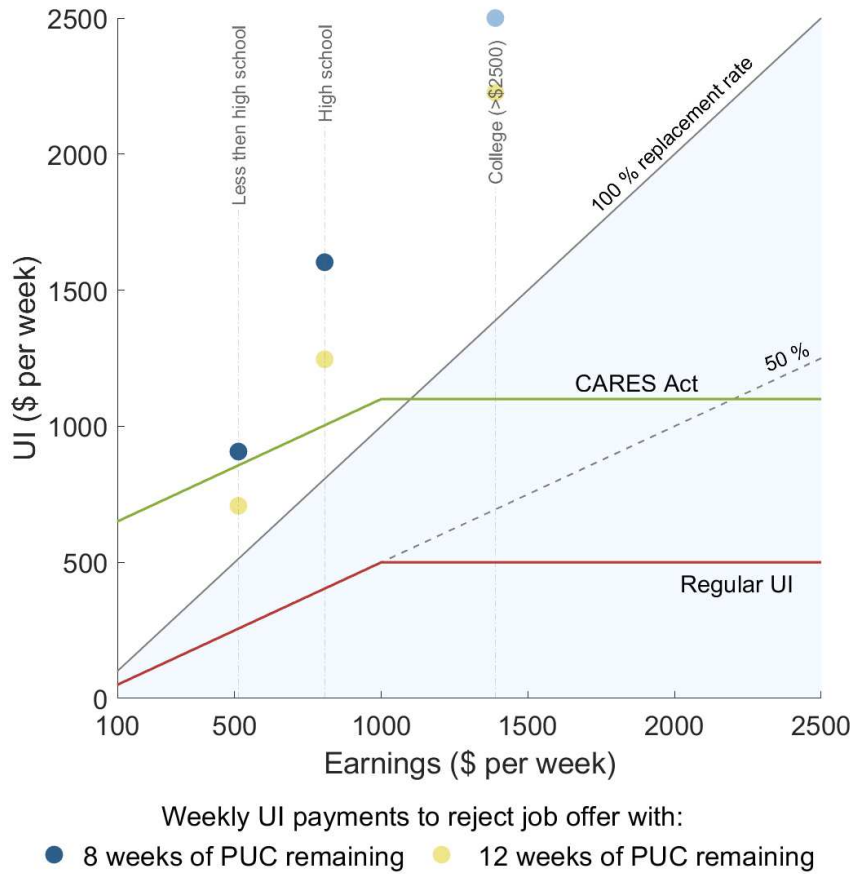


Figure A1: Regular, CARES Act and reservation level UI benefit payments - baseline

Notes: Each dot corresponds to the reservation benefit for an average worker of a particular level of educational attainment calculated according to (12) with 12 (first week of May) or 8 (first week of June) weeks of PUC payments remaining.

Table A3: Reservation benefits and replacement rates - quicker re-opening

	Earnings	Duration of:		Weekly UI compensation				Replacement rates (%)			
	$w$ (wkly)	$U$ (wks)	$E$ (yrs)	$\bar{b}$	$b^C$	$b^r(12)$	$b^r(8)$	$\bar{\tau}$	$\tau^C$	$\tau^r(12)$	$\tau^r(8)$
Overall	1007	13	1.7	500	1100	1238	1481	50	109	123	147
Age 25 to 54 years	1087	13	2.5	500	1100	1369	1645	46	101	126	151
Education:											
Less than HS	513	14	0.8	265	856	602	725	50	167	117	141
High School	807	13	1.5	403	1003	982	1171	50	124	122	145
College and above	1389	13	2.5	500	1100	1798	2199	36	79	129	158
Occupation:											
Construction	1000	12	1.4	500	832	1168	1374	50	110	117	137
Food Service	464	13	1.0	232	874	541	642	50	179	116	138
IT	1466	12	3.4	500	954	1871	2271	34	75	128	155
Janitors	549	13	1.0	274	1036	643	765	50	159	117	139
Managers	1554	12	2.4	500	1044	1961	2388	32	71	126	154
Medical Assi.	709	13	1.7	354	1100	862	1026	50	135	122	145
Nurses and Thrp.	1203	12	2.9	500	1100	1509	1813	42	91	125	151
Sales and Retail	873	12	1.5	436	1100	1038	1227	50	119	119	141
Teachers	1090	12	1.5	500	1100	1295	1536	46	101	119	141
Transportation	887	12	1.4	444	1100	1061	1258	50	118	120	142

Notes: Earnings and duration data calculated using the Dec. 2018 to Dec. 2019 CPS.  $w$ : weekly earnings; Weekly job finding  $f_w$  and separation  $s_w$  rates calculated by converting the monthly flow rates to a weekly frequency (see appendix for details);  $\bar{b}$ : regular weekly unemployment benefits;  $b^C$ : weekly benefits under CARES Act,  $\bar{b} + 600\%$ .



Table A4: UI payments and reservation benefits: State average worker

State	$U$ (wks)	$E$ (yrs)	Earnings	UI payments		Replacement rates	
				CARES	Reservation	CARES	Reservation
Alabama	25.97	2.08	944.84	875.00	2180.19	92.61	230.75
Alaska	13.93	1.42	1039.19	970.00	1573.04	93.34	151.37
Arizona	20.87	1.57	966.28	840.00	1858.37	86.93	192.32
Arkansas	18.11	1.47	885.76	1042.88	1548.43	117.74	174.81
California	22.80	1.36	1104.16	1050.00	2240.94	95.09	202.95
Colorado	19.81	1.57	1089.39	1161.00	2064.46	106.57	189.51
Connecticut	25.02	2.13	1105.53	1152.77	2545.33	104.27	230.24
Delaware	24.41	1.64	983.48	1000.00	2106.64	101.68	214.20
Florida	27.66	1.70	945.51	875.00	2212.75	92.54	234.03
Georgia	25.85	1.55	991.11	965.00	2186.48	97.37	220.61
Hawaii	20.74	1.78	1000.42	1219.31	1947.56	121.88	194.67
Idaho	15.72	1.55	877.42	1038.71	1419.68	118.38	161.80
Illinois	24.04	1.70	1058.60	1084.00	2282.95	102.40	215.66
Indiana	22.02	1.72	927.93	990.00	1869.44	106.69	201.46
Iowa	17.40	1.94	909.00	1081.00	1596.55	118.92	175.64
Kansas	17.43	1.88	936.40	1088.00	1641.58	116.19	175.31
Kentucky	20.95	1.47	904.17	1122.00	1728.68	124.09	191.19
Louisiana	17.56	1.49	935.23	847.00	1607.74	90.57	171.91
Maine	20.97	1.77	914.90	1045.00	1792.67	114.22	195.94
Maryland	20.13	1.78	1186.25	1030.00	2344.59	86.83	197.65
Massachusetts	28.25	1.84	1154.46	1177.23	2846.98	101.97	246.61
Michigan	28.24	1.71	988.07	962.00	2347.61	97.36	237.60
Minnesota	19.65	2.03	1041.75	1120.87	2004.20	107.60	192.39
Mississippi	25.39	1.59	846.83	835.00	1853.06	98.60	218.82
Missouri	21.46	1.61	957.18	920.00	1880.86	96.12	196.50
Montana	16.34	1.44	886.34	1060.90	1455.23	119.69	164.18
Nebraska	17.07	2.05	916.36	1040.00	1598.51	113.49	174.44
Nevada	24.77	1.35	941.18	1069.00	1973.61	113.58	209.69
New Hampshire	20.21	2.03	1080.92	1027.00	2135.58	95.01	197.57
New Jersey	24.42	1.52	1153.97	1292.38	2509.16	111.99	217.44
New Mexico	21.88	1.26	883.68	1061.00	1697.00	120.07	192.04
New York	20.51	1.45	1093.88	1104.00	2096.51	100.93	191.66
North Carolina	24.90	1.80	967.19	950.00	2127.43	98.22	219.96
North Dakota	10.38	2.09	976.31	1088.16	1307.54	111.46	133.93
Ohio	23.02	1.79	968.19	1080.00	2018.68	111.55	208.50
Oklahoma	17.83	1.63	912.10	1115.53	1597.44	122.30	175.14
Oregon	23.31	1.77	1017.07	1248.00	2143.49	122.70	210.75
Pennsylvania	22.92	1.78	1013.57	1118.47	2111.67	110.35	208.34
Rhode Island	27.77	1.90	1050.95	1126.00	2532.72	107.14	240.99
South Carolina	23.29	1.48	930.02	926.00	1904.25	99.57	204.75
South Dakota	14.32	1.75	920.61	1014.00	1430.07	110.14	155.34
Tennessee	23.34	1.81	929.56	875.00	1959.49	94.13	210.80
Texas	17.55	1.52	981.26	1110.26	1689.79	113.15	172.21
Utah	16.13	1.55	919.75	1054.87	1510.50	114.69	164.23
Vermont	15.24	1.71	1000.23	1113.00	1605.14	111.27	160.48
Virginia	22.43	2.38	1138.18	978.00	2476.84	85.93	217.61
Washington	20.84	1.69	1111.50	1156.31	2202.80	104.03	198.18
West Virginia	25.80	1.79	867.80	1024.00	1953.24	118.00	225.08
Wisconsin	19.96	2.07	958.91	970.00	1850.30	101.16	192.96
Wyoming	13.85	1.65	938.23	1087.88	1423.91	115.95	151.76

Notes: Notes: Earnings data calculated using the Dec. 2018 to Dec. 2019 CPS. Durations calculated using Dec. 2009 to Dec. 2010 CPS.  $w$ : weekly earnings; Weekly job finding and separation rates entering the reservation benefits are obtained by converting the monthly flow rates to a weekly frequency; regular weekly unemployment benefits calculated with the Ganong et al (2020) UI calculator; reservation benefits reported for 8 weeks of PUC payments remaining.