Expanding Unemployment Insurance Coverage

Amanda M Michaud *
Federal Reserve Bank of Minneapolis

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Abstract

This paper develops a quantitative framework to study the impact of Unemployment Insurance (UI) expansions to workers earning below eligibility thresholds. A model of how UI affects welfare and labor supply is developed and calibrated with microeconomic data, including consumption. The model predicts that the current ineligible would choose to stay on UI longer than the current eligible and the margins of why this is the case are quantified. The model is applied to the Great Recession by identifying ineligible workers in the data using machine learning and to an actual expansion during COVID-19 using administrative data. The UI duration for newly eligible under the expansion was 1.7 times longer than the previous eligible but is one-third shorter than the model's economic incentives predict. This suggests caution in extrapolating from the COVID-19 data and the model is used to predict impacts of smaller scale expansions during non-pandemic times.

1 Introduction

Unemployment insurance programs in the United States do not cover all workers. Eligibility generally requires the following three criteria to be met. First, the worker has had a sufficient amount of earnings in the last few quarters subject to an employer tax paid into the unemployment system. Second, the worker has been laid off at no fault of their own. Third, the worker is actively seeking employment. The specific parameters of these criteria are set by states but commonly ineligible groups include self-employed workers, contract or gig workers, workers with low earnings, and new entrants to the labor market. The group of ineligible due to their earnings history is important. They make up over a quarter of the labor force and their share has been growing over time.

There is a clear economic argument in favor of requiring a sufficient earnings history to qualify for unemployment insurance articulated, for example, in Hopenhayn and Nicolini (2009). If it cannot be distinguished whether a worker was laid off at no fault of their own or if they quit voluntarily then conditioning benefits on work history can limit the moral hazard incentive to quit a job in order to collect benefits.[1] While the theoretical impetus to study eligibility rules is strong, the quantitative study of the optimal work history duration and earnings level thresholds for unemployment insurance eligibility has been limited.

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[1]Some studies such as Khoury et al. (2020) show that there is, indeed, a spike of employment separations after the threshold of work history to qualify is met. This suggests that the quit moral hazard is a relevant feature for unemployment insurance design.

This paper provides a quantitative framework to study the effects of UI expansions to ineligible groups and applies it to the UI expansion during COVID-19. The research strategy is as follow. First, a theoretical framework is developed to establish the factors that affect an individual's value of the UI program and the impact of the UI program on an individual's labor supply. Second, facts about how ineligible workers differ from workers who are eligible for UI during normal times are documented using high-frequency panel data. These facts are used to calibrate the model to reflect actual labor supply decisions and consumption dynamics around unemployment. The calibrated model provides predictions for what should happen if UI were extended and why incentives and welfare values differ for the current ineligible group compared to the eligible. Third, the model is combined with machine learning techniques to study the Great Recession, and with administrative UI data to study the UI expansion during COVID-19. The model well replicates observed dynamics around the Great Recession but under-predicts unemployment to employment flows around COVID-19. This suggests that UI expansions have lower moral hazard impacts on the job search behavior of the current ineligible than a standard theory would predict although the moral hazard is larger than compared to the eligible group.

The theoretical framework includes two margins of how unemployment insurance affects labor supply. First, there is the typical moral hazard component on job search. Receiving unemployment benefits lowers the net value of taking a job. This is quantitatively tempered by the types of jobs a worker is likely to get. Workers with higher earning (and higher earnings growth rates), longer lasting, and easier to find jobs have higher value of looking for employment. They would be expected to have lower unemployment duration for a given level of UI and even be likely to take a job that pays less than their current UI benefit payment because of the dynamic value of the job. Second, unemployment eligibility rules affect labor supply decisions for those close to the threshold. A worker who would choose hours that put earnings just below the threshold in absence of a UI program would have the incentive to marginally raise those hours off of their labor supply curve in order to qualify for UI.

The quantitative impact of UI on labor supply depends on the extent of these factors. Data from the PSID are used to calibrate a quantitative model of labor supply that hits targets for both the eligible and the ineligible. The ineligible are found to have lower wages, higher job loss rates, and less earnings growth on the job. These work to lower the value of employment and increase the predicted moral hazard impact of a UI extension. By contrast, the ineligible have higher job finding efficiency and a lower extensive utility cost of working. These generally work to reduce moral hazard although job search will increase less as a worker gets closer to the maximum duration they can collect UI benefits for (exhaustion threshold) when jobs are easier to find. The data also provide evidence of a positive effect on hours in order to cross the threshold for benefit Just as has been established with the EITC, low wage individuals have the ability and demonstrate the willingness to change hours to qualify for the program. The excess mass around the threshold from a bunching estimator disciplines the elasticity of hours to the UI program.

The theoretical framework also makes predictions of who should value unemployment insurance the most. This isn't necessarily low wage or even poor workers. It is workers who otherwise would have had a larger fall in consumption during unemployment in absence of the program. Consumption insurance, however, can be provided through other means such as precautionary savings or transfers from family and other government social programs. The PSID provides consumption data that is used to calibrate the model in this regard. Consumption patterns do not fit a typical precautionary model. There are large declines following a job loss in some high income households, small declines in some low income households, and high variance of these changes overall. Behavior around the job loss of a high earner disciplines the role of liquidity constraints in tempering precautionary savings. Behavior around the job loss of a low earner disciplines the role of other transfers, including spousal income. This last point is important. Ineligible workers are by definition low earners but they are not necessarily poor or individuals with high marginal value of consumption in unemployment. They are disproportionably secondary earners in middle class households, young people with parental support, or retirees working part time jobs. Yes, poor households are in the ineligible group and suffer the most around unemployment but the point is that there is high heterogeneity with middle class hand-to-mouth households suffering as well.

The model is applied to provide insight into the impact of UI expansions, on the margin. The main result is that lowering the earnings threshold, compared to the duration requirement, tends to have larger negative impacts on employment, output, and the UI budget relative to the welfare gains. This is for several reasons. First, the group that is ineligible due to shorter duration tends to be higher productivity new entrants. UI has smaller disincentive effects on their labor supply due to benefit to them of working and building human capital. Second, changing the duration threshold does not affect the labor supply of those who are currently employed. The data have shown that job duration does not change around the eligibility threshold. By contrast, the hours of the employed respond to the earnings threshold. They fall when the threshold is lowered. This works to negatively impact GDP but the moral hazard impact on unemployment duration is quantitatively more important. All of these impacts are non-linear. Lowering the earnings or duration thresholds have large impacts than raising them by the same amount just as lowering them by 20% has more than twice the impact of lowering them by 10%.

The quantitative model replicates the cross section of hours, labor market flows, and consumption changes on average, but how well does the model predict behavior during recessions or when UI changes? This is a test that a model intended to be used for studying UI extensions, particularly during recessions, should pass. The model is first tested against outcomes in the Great Recession. This test requires establishing facts about how job options and outcomes changed for ineligible versus the eligible during the period. The Current Population Survey has a large enough sample and is at monthly frequency which makes it suitable for studying labor market flows over the business cycle. The CPS, however, does not have information on unemployment insurance eligibility and only asks about receipt once every two years in the

Displaced Workers Survey. I use machine learning to train an algorithm on the DWS data that is then used to predict UI eligibility and receipt in every CPS month to track the data for eligible and ineligible over the Great Recession. I find the model has decent predictive power. It over-predicts job finding rates of the ineligible by only 4 percent.

A second test of the model is on an actual UI extension. The Federal Pandemic Unemployment Assistance Program (PUA) expanded unemployment insurance eligibility to virtually all workers. Newly covered workers included those not meeting the typical earnings criteria: the self employed, contract or gig workers, new labor force entrants, and low earners. It also extended benefits for individuals not meeting other criteria including workers who quit or were not looking for work due to pandemic related factors such as illness or child care needs. PUA recipients ended up comprising a significant amount of continued claims, over 40% by the end of the summer of 2021.

Administrative claims data are used to provide real-time estimates that show the typical PUA claimant remained on the unemployment rolls for longer durations than the typical claimant covered through eligibility for regular state unemployment programs.[2] I find that PUA claimants remain on the unemployment rolls for 1.7x longer than regular UI claimants. This 36% longer relative to the eligible than the unemployment duration of the same group of workers during in the Great Recession when UI was not expanded to them. This number suggests that UI has a larger disincentive impact on the ineligible and that UI expansions would increase unemployment rates non-linearly. The increase in unemployment duration for PUA recipients, however, was not as large as the model predicted. Indeed, UI replacement rates were so high for this group that the model cannot rationalize that low wage workers would want to return to work at all. The low tenure high earners also covered by PUA would be predicted to return to work but they are not a large enough share of PUA recipients to provide the flows observed in the data resulting in the model under predicting unemployment exit rates for the PUA group by about one third. The lesson is that, although UI is associated with longer unemployment durations for workers below the standard threshold (PUA), these durations are less than would be predicted by the economic incentives faced by the group. Thus there are either some omitted factors, incentives, or constraints in the standard theory that should be included in a quantitative framework to study UI extensions or the COVID-19 episode had unique factors that may or may not be relevant to future episodes and caution should be used when extrapolating to future policy.

Finally, the model is used to provide some insight into the impact of UI expansions, on the margin. The main result is that lowering the earnings threshold tends to have larger negative impacts on employment, output, and the UI budget relative to the welfare gain when compared to lowering the duration threshold. This is for several reasons. First, the group that is ineligible due to shorter duration tends to be higher productivity new entrants. UI has smaller disincen-

[2] This includes those workers entering through regular state unemployment and staying on through federal extensions either through the Extended Benefit (EB) or Pandemic Emergency Unemployment Compensation (PEUC). Including extensions implies an apples to apples comparison where total length of potential benefits was similar across both groups.

tive effects on their labor supply due to benefit to them of working and building human capital. Second, changing the duration threshold does not affect the labor supply of those who are currently employed. The data have shown that job duration does not change around the eligibility threshold. By contrast, the hours of the employed respond to the earnings threshold. They fall when the threshold is lowered. This works to negatively impact GDP but the moral hazard impact on unemployment duration is quantitatively more important. All of these impacts are non-linear. Lowering the earnings or duration thresholds have large impacts than raising them by the same amount just as lowering them by 20% has more than twice the impact of lowering them by 10%.

Literature. There is a large literature on the work disincentive effects of unemployment benefits. The objective of this paper is to provide new information about job search tradeoffs of workers current eligible and ineligible for UI. In this review, I will focus on literature regarding either expanding coverage to new workers or pandemic insurance changes.

Most research on the temporary changes to unemployment benefits during the COVID-19 pandemic focus on changes to the weekly amounts paid to an unemployed worker, also referred to as a replacement rate. The Federal Pandemic Unemployment Compensation (FPUC) and other programs increased weekly payments by $300-$600. This was a subject of intrigue because some workers now received more money through unemployment benefits each week than they had earned on their previous job. Boar and Mongey (2020), Petrosky-Nadeau and Valletta (2021), and Fang et al. (2020) use structural models to assess the expected impact of increased UI replacement rates on job finding rates. These papers emphasize that the choice to take a job is a dynamic one. The value of a job relative to unemployment is generally higher than the value of a week of earnings on the job relative to a week of unemployment benefits. All three papers predict that many workers with replacement rates over 100% would still return to their old job. Petrosky-Nadeau and Valletta (2021) provide some evidence this is true using variation in replacement rates across US states. Other empirical papers generally find higher replacement rates lowered return to work but also emphasize the unique context provided by the pandemic, (Finamor and Scott (2021)). Ganong et al. (2021) find smaller disincentive effects during the early months of the pandemic. They emphasize that a scarcity of job opportunities and expected recall, both unique in scope to the pandemic, likely tempered disincentive effects relative to a normal recession. This paper focuses on newly insured PUA recipients who I show would not be predicted to return to work. My results for the increased replacement rates of workers entering through regular UI, however, are broadly consistent with these studies.

Normative research, and particularly quantitative normative research, studying expanding unemployment eligibility to workers with lower earnings or instable employment history has been rather scarce. Most studies focus on optimal benefit levels and duration for all workers and ignore eligibility. Hopenhayn and Nicolini (2009) provide a theoretical underpinning of the screening advantages of limiting eligibility using work history when quits cannot be distinguished from layoffs. Baker and Rea Jr (1998) find a substantial increase in moral hazard– that is unemployment duration– when eligibility was expanded in a natural experiment in Canada. Khoury et al. (2020) study work duration eligibility in matched French employee-employer data. They find that separations increase significantly after the eligibility threshold (indicating moral hazard concerns are real) and workers just on the other side of this threshold search significantly longer but do not have better job quality outcomes. The analysis in this paper does not address normative issues and no welfare calculations are provided. As a consequence moral hazard and a host of issues dealing with different notions of labor market equilibrium, dynamic contracting, mechanism design, etc. are justifiably ignored. The objective is instead to provide an understanding of how job search tradeoffs change from a worker's perspective across the earnings and job stability spectrum in order to set up a quantitative environment for normative study.

2 Background: Unemployment Insurance Eligibility in the United States.

Base Unemployment Insurance systems in the United States are funded and administered by state governments within guidelines provided by the Federal government. State governments levy taxes to fund the program and set program parameters determining eligibility and benefit schedules. A key exception is supplemental and emergency programs funded by the Federal government but administered by states. These programs will be addressed later in this paper.

Eligibility criteria have several dimensions. Often, a worker must have earned a sufficient amount of money (earnings threshold) over a sufficient amount of time (duration threshold). The ranges of these parameters are large and nuanced. A typical UI system in 2020 required $2500 of earnings in one of the last two quarters and a lower level such as 50% as much in another quarter. Some states have hours requirements. Others only count certain types of earnings such as those above a minimum wage thus excluding labor exempt from minimum wages. Most states also define quarters on a calendar basis meaning that a worker who loses his or her job in the last week of a quarter has reference quarters six and nine months ago instead of a worker who loses a job a week later whose reference quarters are three and six months ago. Eligibility often excludes certain types of work such as the self employed or "gig" workers. Workers often need to have lost their job at "no fault of their own", log active job search while unemployed, and be seeking fulltime work to continue to receive unemployment benefits.

The complicated parameters of state UI policies make it arguably impossible to identify exact eligibility in any data set. This paper will focus on eligibility determined by earnings and work history only. Earnings, employment, and hours are constructed at the weekly frequency using data from the Panel Study of Income Dynamics (PSID). This data set also has the advantage in that consumption is also reported. Individuals are designated as being ineligible if they fail to meet New York state's rules of $2600 of earnings in one of the two most recent quarters and half as much in the other quarter. The sample is restricted to workers who have some attachment to

mean or % of Group	Eligible	Ineligible
Months Employed	11.8	9.3*
Child age 0-6	16.1	13.4
Under age 25	2.3	10.7*
Over age 65	6.6	24.9*
White	88.7	86.6
Black	11.3	13.4
Female	49.7	62.6*
College	72.3	59.3*
% of Workers	74.0	26.0
% of Workers not working	31.0	69.0

Statistically different at 95% CI.

Table 1: Characteristic of workers in the PSID by regular state unemployment coverage status.

the labor force. They are either currently employed or have been non-employed for six months or less.

Table 1 provides summary statistics on individuals by the type of their current or most recent job. Workers in ineligible jobs make up approximately a quarter of all employed individuals and two-thirds of all individuals out of work for six months or less. Eligible workers generally work more than uncovered workers on the intensive margin as well but the total contribution of ineligible workers to the economy remains significant. Women are more likely to work in uncovered jobs but this difference is not accounted for by child care responsibilities. The presence of young children is statistically insignificant across workers in covered and uncovered jobs. There is, however, a significantly different share of workers in uncovered jobs that are outside of the prime-age working years: 35.6% versus 8.9%. Uncovered workers are significantly less likely to have a college degree. Interestingly, the difference in the racial composition of workers in each type of job is not statistically significant. This suggests that racial discrimination may not play a large role in sorting. Of course, further analysis is needed to definitively accept or reject the implications of these mean differences.

Table 2 tabulates statistics related to economic security at the household level. Households are put into the ineligible column if they contain an ineligible worker and into the eligible column if they contain an eligible worker. Thus households may appear in both columns. These data suggest that ineligible workers' households show higher consumption needs than those of eligible workers. They are significantly more likely to be in poverty, have food insecurity, and receive government transfers over $1,000 per year. There is, however, significant heterogeneity in the socioeconomic status of workers of both job types. Some eligible households struggle with food insecurity, 9.3%. By contrast, some ineligible households are well-off. A share of 22.1% of workers in ineligible jobs have a total family income over $100k per year. In these households the ineligible worker is often not the sole earner in the household which provides some additional insurance in the case of job loss.

A measure of economic need surrounding an unemployment spell is how much consumption declines. In models of perfect insurance the decline should be zero. The PSID contains annual

% of Group	Eligible	Ineligible
Poverty	0.8	13.0*
Food Insecurity	9.3	24.0*
Gov Transfers> $1k	21.1	45.5*
Fam Income > $100k	55.5	22.1*
Av. Fall in Food if Unemployed	5.7%	17.0%

Statistically different at 95% CI.

Table 2: Characteristic of households in the PSID by workers' regular state unemployment coverage status.

reports on food consumption in three categories: food used at home, food delivered to the home, and food consumed away from the home. Total spending on food is an imperfect measure of tangible consumption. Newly unemployed workers may report a fall in food spending as they substitute more expensive convenience products towards similar products from the grocery store now that they have a less busy schedule. The methodology of Attanasio and Pistaferri (2014) is used to address this and other issues. Real food expenditure in each category is estimated by controlling for the category-specific deflator in the Consumer Price Index, education, and age. This estimate of real food expenditure is then adjusted for household size and composition (ages of members) according to OECD standards. Annual change in food consumption is measured as the log change in this real estimate, year over year. Changes around unemployment are predicted from a regression with a dummy each for the presences of an unemployment spell in the past year for eligible and ineligible workers; as well as controls for education interacted with the life-cycle profile, year fixed effects, and individual fixed effects. This sample is limited to workers who have been in the data set for more than two years prior to their unemployment spell.

The average fall in spending on annual food consumption in a year of an unemployment spell is three times larger for uncovered workers' households. Their food spending, including the value of food stamps, falls 17%. A fall of this magnitude is likely significant in utility value and a signal of serious economic hardship if a job is lost. Eligible households also experience declines in food consumption associated with unemployment, 5.7% on average. Declines are larger down the income gradient.Middle class households earning $50-$120k have declines just over 10%.[3]

The consumption analysis identifies a substantial hole in the social safety net. The data show that even upper middle class households are not well insured in the case an uncovered secondary earner loses a job loss. They will not receive unemployment benefits, do not qualify for need-based welfare programs, and do not appear to be well insured by the earnings of other household members. This is consistent with the evidence of "wealthy hand-to-mouth" households that have higher income but also high debt obligations that limit their liquid savings for discretionary spending in times of need. From a policy perspective, this means that income or asset based welfare programs leave a large gap of unmet need surrounding an unemployment

[3] A candidate explanation for these facts is differential access to credit markets as studied in Braxton et al. (2020) and Herkenhoff (2019).

event.

3 Basic Theory of Unemployment Duration

This section develops a structural model of the factors that determine the asset value of a job.[4] It will be calibrated to explore whether these factors can help account for the differential unemployment duration of workers who do and do not meet the earnings requirements to be eligible for unemployment insurance; as well as the increased duration of ineligible workers when covered by the PUA program during the pandemic. The model will be partial equilibrium which is suitable to explore the incentives determining past behaviour because equilibrium outcomes such as wages and job arrival rates can be asserted as they were. They do not have to be predicted by theory as would be necessary if the model were to be used to evaluate counterfactual situations such as future outcomes or policy proposals.

The model will be described for a generic job type. In the quantitative section I will explain the difference in the parameter values across ineligible and eligible jobs.

Worker Types. There is a continuum of ex-ante non-identical workers. Workers are distinguished by a fixed permanent type $i \in \{1, 2\}$ each with share m_i in the population. A type will relate to the labor market productivity, and job finding and job loss rates for workers of that type. A share β^D of each type of workers die each period and are replaced by new labor market entrants of the same type.

Individual workers are further distinguished by ex-post and evolving individual states: their labor productivity z, labor market status q, weeks in their current state d, asset holdings a, and current asset liquidity x. Labor force status takes three values: $q \in \{E, U, N\}$ or Employed, Unemployed, and Not in the Labor Force, respectively. Workers are classified as employed if they have a job, unemployed if they do not have a job but are searching, and not in the labor force if they do not have a job and are not searching. New entrants begin as not in the labor force and are endowed with an initial level of labor productivity from their type i's distribution $z \in \{z_{i1}, z_{i2}, ...z_{in}\}$ which will evolve stochastically during periods of employment and unemployment. The weeks in a state variable d will be used to calculate a worker's eligibility status for unemployment benefits. Assets are restricted to the bounded set $a \in [\underline{a}, \bar{a}]$. Current liquidity takes two values, high and low: $x \in \{x_\ell, x_h\}$.

Preferences. Employed workers gain utility from consumption c and suffer disutility in hours worked h and a fixed utility cost of work depending on individual fixed type ϕ_i. Unemployed workers gain utility from consumption and suffer disutility from search effort s. These preferences are represented by the flow utility function $U(c, h, s) = u(c, h) - v(s) - \phi_i \mathcal{I}_{q=e}$. The function $u(\cdot)$ is increasing and concave in the first argument and decreasing and convex in the second. The disutility from search is separable and the function $v(\cdot)$ is increasing and convex in s.

[4] The dynamic tradeoffs to a worker typical in search models are dicussed by Boar and Mongey (2020)

Choices. Each period all individuals make consumption c and savings a' choices. Employed workers choose how many hours to work at their job $h \in (0, \bar{h}$. Non-employed workers choose how much effort to put into searching for a job $s \in [0, \bar{s}$. A non-employed worker who chooses $s = 0$ is classified as not in the labor force. A non-employed worker who chooses $s > 0$ is classified as unemployed.

Constraints, Technologies, and Laws of Motion for Workers. The consumption resources available to an individual depends partially on their labor market status. All have asset income from savings in the prior period $(1 + r)a$ and transfers: $T_i^q(z, h)$. Only $x(1 + r)a$ of assets are available for consumption today but $c + a'$ is bounded by total resources including the non-liquid portion of asset holdings. Transfers capture government payments to individuals that are not unemployment insurance such as food stamps and welfare, as well as informal transfers within households or from other non-governmental organizations.[5] Employed individuals collect labor income $(1 - \tau)w_i zh$ each period after taxes τ are removed. Total labor income is a function of the wage per efficiency unit paid to the worker's fixed type w_i, her idiosyncratic productivity z, and her hours worked h. Labor income is taxed at a common rate τ for all workers. Non-employed individuals collect unemployment benefits that are subject to rules that are calculated based on their fixed type, current productivity, and weeks employed: $b(w_i, z, d)$.

The law of motion for weeks in current state is somewhat complicated to match the complexity of UI determination. An individual who is non-employed and stays non-employed has the process $d' = d + 1$. An individual who is currently employed and becomes non-employed has the process $d' = \bar{d}$ if either they had not worked long enough on their prior job $d < \underline{d}^b$ or they do not search $s = 0$; and $d' = 0$ otherwise. An individual who is employed and remains employed has the process $d' = d + 1$ if they earn enough $w_i zh > \underline{earn}^b$ and $d' = d$ otherwise. An individual who was non-employed and becomes employed restarts their clock at $d' = 0$.

Idiosyncratic productivity z follows a sparse Markov chain dependent on labor market state. The function $\rho^z(z'|q, z)$ describes the probability a particular value is drawn for z' and is also conditional on the current value of z. It sums to one across all potential values of z' for a given q and z. Productivity is weakly increasing while employed akin to a theory of learning by doing. It is weakly decreasing while non-employed to replicate a human capital theory of wage losses following job loss.

Jobs are destroyed with a type-specific hazard rate $\delta_i(d)$ that is weekly decreasing in the measure of job duration d. Job opportunities arrive for non-employed workers at a rate $\pi_i s$, proportional to the type-specific productivity π_i and chosen search intensity s.

The state of asset liquidity is also Markov. The transition between high and low states is given by the Markov transition function $\rho_i^x(x'|x)$. This will aid in matching the savings rates of households and their consumption dynamics by individuals' types.[6]

[5] These transfers are meant to replicate falls in consumption during unemployment and are not part of the government budget balance since we cannot completely distinguish what percentage of the fall in consumption is buffered by government programs.

[6] This modelling approach is used to capture observed consumption declines of high earners while still allowing

The value of a job. The value of a job to a worker with fixed type i, earnings potential z, completed job duration d, assets a, and liquidity status x is as follows.

$$\begin{aligned}
J_i(z,d,a,x) &= \max_{h,a'} u_i(c,h) - \phi_i + \\
&\quad \beta \mathbf{E}_{z',x'|z,x}[(1-\delta_i(d))\max\{J_i(z',d'_e,a',x'),V_i(z',\bar{d},a',x')\} + \delta_i(d)V_i(z',d'_{ne},a',x')] \\
st &\quad c + a' = (1-\tau)w_i zh + T_i^q(z,h) + (1+r)a \\
&\quad c \leq (1-\tau)w_i zh + T_i^q(z,h) + x(1+r)a \\
&\quad a' \geq 0 \quad h \in (0,\bar{h} \\
&\quad d'_e = d+1 \;\; \text{if} w_i zh > \underline{earn}^b \;; \;\; = 0 \;\; \text{o/w} \\
&\quad d'_{ne} = 0 \;\; \text{if} d > \underline{\text{d}}^b \;; \;\; = \bar{d} \;\; \text{o/w} \\
&\quad z' \sim \rho^z(z'|q=e,z) \quad x' \sim \rho^x(x'|x)
\end{aligned}$$

The continuation value of a job is discounted at rate $\beta \in (0,1)$ that includes death probability. With probability $\delta_i(d)$, the worker loses her job and her expected continuation value is the expected value of non-employment $V_i(z',d'_{ne},a',x')$ over possible values of z' and x' tomorrow. With probability $1-\delta_i(d)$, the worker keeps her job and her expected continuation value is the maximum of the expected value of employment $J_i(z',d'_e,a',x')$ and the expected value of quitting $V_i(z',\bar{d},a',x')$. If the worker quits, they will not be eligible for unemployment insurance and so $d' = \bar{d}$ the duration threshold at which UI benefits terminate. Expectations are over possible values of z' and x' tomorrow and are rationally consistent with the actual Markov transitions.

The value of Non-employment. The value of non-employment to an individual with fixed type i, earnings potential z, completed job duration d, assets a, and liquidity status x is as follows.

$$\begin{aligned}
V_i(z,d,a,x) &= \max_{s,a'} u_i(c,h=0) - v(s) + \beta \mathbf{E}_{z',x'|z,x}[(1-\pi_i s)V_i(z',d'_{ne},a',x') + \pi_i s J_i(z',d'_e,a',x')] \\
st &\quad c + a' = b(w_i,z,d) + T_i^q(z,h) + (1+r)a \\
&\quad c \leq b(w_i,z,d) + T_i^q(z,h) + x(1+r)a \\
&\quad a' \geq 0 \quad s \in (0,\bar{s} \\
&\quad d'_{ne} = d+1 \\
&\quad d'_e = 0 \\
&\quad z' \sim \rho^z(z'|q=e,z) \quad x' \sim \rho^x(x'|x) \\
&\quad q = u \;\; textif s > 0 \;; \;\; = n \;\; \text{o/w}
\end{aligned}$$

The asset value of non-employment includes the asset value of a job for workers who search. Workers who search for a job find one with probability $s\pi_i \in [0,1)$ where s is the worker's search effort and π is an exogenous linear search efficiency. Search has a convex, non-pecuniary

for precautionary saving. It follows Nakajima (2023) cost $v(s)$. Workers who do not find a job or do not search remain unemployed. All workers' stochastic state z', x' may change next period while the assets evolve according to their chosen value. The "time in state" variable d' increases by one if the individual remains non-employed and resets to zero if the individual takes a job and moves to employment.

Firms. There is a single representative firm in the economy. Output is a function of total efficiency units of labor hired of each type of labor, $i \in \{1, 2\}$: $Y = F(L_1, L_2)$. The market for labor is assumed to be competitive. Wages paid to each type of labor equal their marginal product: $w_i = \frac{dY}{dL_i}$.

Stationary Equilibrium. An equilibrium is a set of decision rules for the household: hours $g_i^h(z, d, a, x; q)$, savings $g_i^a(z, d, a, x; q)$, and job search $g_i^s(z, d, a, x; q)$; a stationary distribution $\theta_i(z, d, a, x; q)$; labor demand L_1, L_2, and prices w_1, w_2 such that given all exogenous parameters the following hold true.

1. Households Optimize: $g_i^h(z, d, a, x; q)$, $g_i^a(z, d, a, x; q)$, and $g_i^s(z, d, a, x; q)$ are solutions to the dynamic programs above.
2. Labor Markets Clear: $L_i = \sum_{izdax} \theta_i(z, d, a, x; q = e) z g_i^h(z, d, a, x; q = e)$
3. Distribution $\theta_i(z, d, a, x; q = e)$ is consistent with policy rules and is stationary $\theta_i(z, d, a, x; q = e)' = \theta_i(z, d, a, x; q = e)$ for all i, z, d, a, x, q in their bounded ranges.
4. Government Budget Balance holds for UI. $\sum_i \tau L_i = \sum_{izdax} \theta_i(z, d, a, x; q = u) T_i^{q=u}(z, h)$

A few notes about the equilibrium concept. First, search markets and the market for assets are partial equilibrium. The job destruction rate is partially exogenous as a worker may choose to quit. Second, the only government program considered is unemployment benefits. As in the US system, unemployment insurance taxes are levied on both on workers earning below and above the eligibility threshold.

Comparative Statics. The quantitative part of this paper focuses on the nuances of the asset value of jobs and unemployment; and how they may account for differing behavior of eligible and non-eligible workers. If workers were myopic $\beta = 0$ then the value of unemployment and employment would be equal to the flow values of consumption alone. In this case, the search choice of a worker is easy. She searches harder when her earnings potential minus her utility cost of work exceeds the value of her unemployment benefits more. This comparative static is still true in the full model, but is quantitatively tempered by variation in the asset values of employment and unemployment. Generally, the asset value of employment is higher than the current flow value for three reasons: productivity is weakly increasing in tenure (learning by doing); UI qualification requires working several periods; and having a job today increases the chance of having a job tomorrow (and at no extra search cost) compared to when unemployed. Conversely, the asset value of unemployment is generally lower than the current flow value for two reasons: productivity is weakly decreasing in unemployment duration (wage scarring); and current UI claimants lose benefits and become unqualified stochastically as unemployment continues.

Formally, these claims are as follows.

Proposition 1 (Quitting Threshold): For a given i, z, d, a, x such that $J_i(z,d,a,x) > V_i(z,0,a,x)$: the asset value of a job $J_i(z,d,a,x)$ is weakly increasing in:

- (i) the rate of productivity growth on the job; $(\hat{J}_i(z,d,a,x) - \hat{V}_i(z,0,a,x)) \geq (J_i(z,d,a,x) - V_i(z,0,a,x))$ for $\hat{\rho}^z(z; q=e) \succ_{FSD} \rho(z; q=e)^z$.
- (ii) the speed of gaining UI qualification; $(\hat{J}_i(z,d,a,x) - \hat{V}_i(z,0,a,x)) \geq (J_i(z,d,a,x) - V_i(z,0,a,x))$ for $\hat{\underline{\mathrm{d}}}^b < \underline{\mathrm{d}}^b$.
- (iii) the expected duration of the match; $(\hat{J}_i(z,d,a,x) - \hat{V}_i(z,0,a,x)) \geq (J_i(z,d,a,x) - V_i(z,0,a,x))$ for $\delta_i\hat{(d)} < \delta_i(d)$ for all d in the range.

Proposition 2: For a given i, z, d_e, a, x, the asset value of non-employment $V_i(z,d,a,x))$ is weakly decreasing in:

- (i) the rate of productivity decay while off the job; $\hat{V}_i(z,d,a,x) \geq \hat{V}_i(z,d,a,x)$ for $\hat{\rho}^z(z; q \neq e) \succ_{FSD} \rho(z; q \neq e)^z$.
- (ii) the speed of losing UI qualification; $\hat{V}_i(z,d,a,x) \geq \hat{V}_i(z,d,a,x)$ for $\hat{d} > \bar{d}$.

A corollary is that a comparison of flow earnings on a job to flow unemployment benefits $b(w,e)$ is an insufficient determinant of job search intensity. Indeed, the latter can exceed the former and an unemployed worker can still want a job due to the comparison of asset values.

4 Calibration and Quantitative Analysis.

The main quantitative application of the model is to ask whether the differences in job characteristics can account for the differences in unemployment duration of eligible and non-eligible workers in three historical cases: (1) normal times (2014-2019); (2) the great recession (2008-2012); and (3) the COVID pandemic September 2020-May 2021.

The quantitative analysis includes two job types: eligible and ineligible. Eligible jobs are those with high enough earnings such that a worker will become eligible for unemployment insurance if they work for a sufficient duration. Ineligible jobs are those with earnings that are too low to qualify for unemployment insurance even if the worker is employed for the duration required to qualify. Workers will be assigned to a job type and there is no switching probability in the baseline model. This is because switches into eligible jobs, those with high enough earnings, are rare enough to be negligible, about 7% annually in the PSID data.

It is important to distinguish that the job type of a worker is distinct from their UI qualification status. An eligible worker is only qualified if they work for a sufficient duration. An ineligible worker can never be qualified. This distinction will be important later on when discussing the impact of the PUA program because PUA claims include all workers in ineligible jobs and also workers in eligible jobs who are not yet qualified. Thus, the discussion of workers will include both their job types and qualification statuses.

4.1 Calibration.

Technological parameters of the two job types differ but workers have the same preferences except for the flow cost of work. The model period is one week and the discount factor is set to $\beta = 0.99$.

Preferences over consumption c, hours worked h, and search effort s take the following functional form:

$$u_i(c,h,s) = \frac{1}{1-\sigma}(c - \chi_h \frac{h^{1+\sigma_h}}{1+\sigma_h} - \chi_i \mathcal{I}_{h>0} - \chi_s s^\eta$$

The inter temporal elasticity, σ is set to 2, a standard value. The utility specification over hours is chosen to eliminate the impact of wealth effects on labor supply. This allows the model to replicate the positive relationship between hours and earnings that critically distinguish the eligible and ineligible groups in the data. The eligible group is high productivity (by definition) and works the longest hours. The ineligible group is low productivity and works fewer hours. Further, a sizeable portion of the ineligible group has high consumption in the data. They are secondary earners, adult children, or retirees. The model includes these transfers to match their consumption and would have a hard time inducing them to work at all if there were negative wealth effects on labor supply.

Variation in hours around the eligibility threshold are included as targets intended to discipline the parameters related to the elasticity of hours worked. These targets are chosen since the impact of unemployment insurance rules on labor supply choices is of main interest to this study. The first target is the average weekly hours worked during weeks with positive hours for those earning \$1000-\$4000 per quarter: about 20% of a full time job. The second target is the excess mass around the UI eligibility threshold. Since the threshold differs by state a range of \$2400-\$3000 is chosen instead of a single number. The mass in this range is 2.6x the amount predicted by a best fit density. The density plot is shown in Figure 1. The right-hand panel shows a discrete jump in hours around the eligibility threshold. The model interprets this as workers choosing higher hours off of their labor supply curve to clear the threshold and qualify for UI.[7] As a side note, there is no excess mass in job separations above the threshold in US data. Based on these facts the model includes the impact of UI on the hours margin but not the impact of UI on the likelihood of separation.

[7]The model predicts hours should also fall shortly after the threshold is cleared. The absence of this symmetry around threshold behavior is common in the public literature using bunching estimators around a qualification point. It has been attributed to factors such as uncertainty around whether hours would be available to meet the threshold which drives workers to overshoot. Still, the ability to adjust hours to meet a threshold and evidence that workers do has been found in other studies of UI (Le Barbanchon (2016) in US state administrative data) and in studies of EITC (Saez (2010) and Mortenson and Whitten (2015)), among others. This corroborates the evidence here that the hours manipulation margin is available to low income, part time workers.

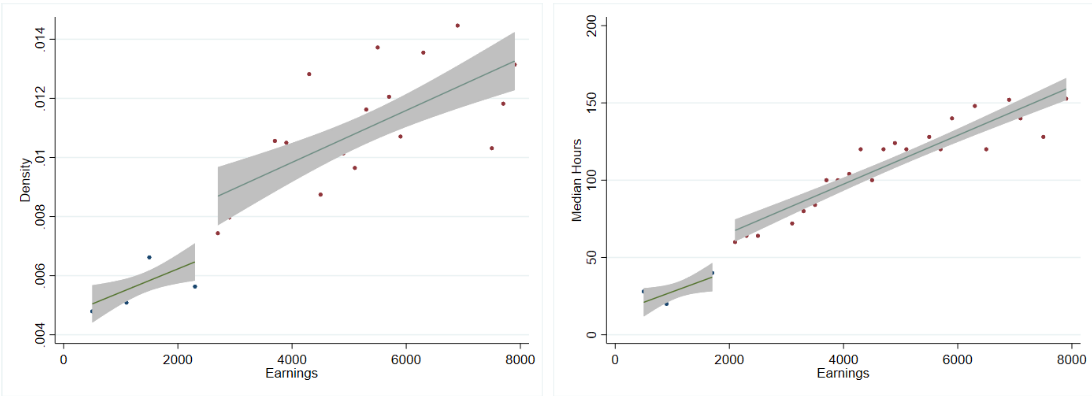


Figure 1: Density of earnings and hours around the eligibility threshold in the PSID

The utility cost of job search takes a common form in the literature: $\chi_s s^\eta$. Studies using microeconomic time use data provide a range of estimates of η and I choose a central value $\eta = 3.0$.[8] The cost parameter χ_s is calibrated such that endogenous job search effort of unqualified workers matches the average search time of unqualified workers estimated in time use data by Krueger and Mueller (2010): 47 minutes out of a potential 4 hours for job search in a day.[9] The fixed flow utility cost of work $\chi_i \mathcal{I}_{h>0}$ is normalized to zero for ineligible jobs and, for eligible jobs, is calibrated to match the average search time of UI recipients in Krueger and Mueller (2010): 33 minutes a day.[10] The calibration implies that workers' endogenous search decisions provide a consumption equivalent flow utility cost ranging from 0.4-3.3% of their flow earnings. The flow cost of work for eligible jobs is equivalent to 0.28% of median eligible earnings, or \$12 per week.

The remaining parameters are chosen to match estimates from the Panel Study of Income Dynamics.[11] These data were used to construct a panel on monthly earnings and labor force status matched with annual data on individual demographics and household composition, income, and consumption. Employment data and earnings are used to construct whether a worker is in an eligible job and if she or he has worked long enough to qualify for UI coverage. All statistics for unemployment include those reporting non-participation as well but they must have worked within the past 12 months and have non-employment durations of less than six months.

Earnings for each type of job are estimated from the PSID data for eligible and ineligible workers. The earnings ladder for each job is chosen to match the median life-cycle income profile for each. Individuals also receive government transfers which are calibrated to be equal to the median EITC and food stamp values in the PSID data for their earnings level. This accounts for elaborate benefit formulas and also claiming behavior and household composition which are not included in this model.

[8] Gomme and Lkhagvasuren (2015); Faberman et al. (2017).

[9] Potential hours are set at 4 to match the range of typical job search per week in ATUS studies.

[10] The higher utility cost of work for eligible jobs is necessary because the other job-specific parameters of the model do not provide the difference in job search intensity seen in the data. A higher cost, however, is not unreasonable since eligible jobs have higher hours than ineligible jobs in the PSID data.

[11] Panel Study of Income Dynamics (2021). Analysis used the package Kohler (2015).

The UI program rules are set to replicate modal state rules. The duration ($\underline{d}^b$ for UI for workers in eligible jobs to become qualified is set to 26 weeks. The earnings threshold defining the maximum earnings in an ineligible job is set to $2400 per quarter. The duration of unemployment benefits ($\bar{d}^b$) is set to 26 weeks during normal times and will be extended to 99 weeks in the Great Recession. The duration of unemployment benefits is set to 75 weeks during the pandemic resulting in termination in mid-July. This is to account for the states that ended the emergency federal programs early and is consistent with the duration of the analysis of DOLETA stocks and flows for the PUA group in the motivation section.

Unemployed workers who are qualified for unemployment benefits receive a government transfer equal to the formula provided for New York State. This formula roughly replaces half of lost income up to a threshold of $500 per week. Unemployed workers continue to receive government transfers equal to those estimated in the PSID data for their income group. The interest rate is set to $r = 0\%$. Additional family income and/or informal transfers are chosen to replicate the average drop in consumption equal to the estimated fall in household food consumption during a year in which unemployment occurs. Food consumption declines are estimated in a regression controlling for age, family composition, inflation, and individual family fixed effects. The asset liquidity shock can take two values: zero or one; meaning that assets are completely liquid or completely illiquid in a given period. The fraction of households with no liquid assets available is set to one-third following the estimates of Weidner (2014). Transition probabilities are set to zero.

Workers in each job become unemployed with a weekly probability that replicates, on average, the monthly separation rate for each type of job in the PSID data. The growth rate of productivity on the job and it's decay during non-employment are set to values estimated from Mincer regressions in the PSID.

Target	Covered	Uncovered
Annual earnings growth in E	2.6%	1.8%
Annual earnings loss in U	3.4%	5.7%
Median annual earnings	$48k	$8.6k
Search time	33 min	47 min
Monthly U to E	35%	35%
Monthly E to U	0.5%	2.5%
Consumption drop in U	5.7%	17%

Table 3: Calibration Target Highlights

The model is exactly identified and targets can be matched, sequentially, one for one by choosing the relevant parameter. This implies that the calibration, through the algorithm described, is both unique and that all of the targets are exactly replicated in the model.

Mechanics of the Baseline Model. Figure 2 shows the average search intensity according to the search functions for workers. Those who are not eligible for employment insurance have average search effort that shows a kink. If their productivity is too low, workers will not search and do better consuming transfers and not incurring the utility costs of work. As productivity

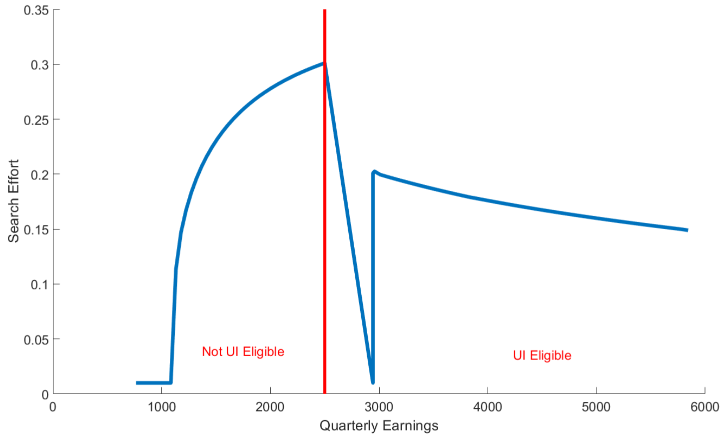


Figure 2: Search policy functions from the baseline non-recessionary calibration

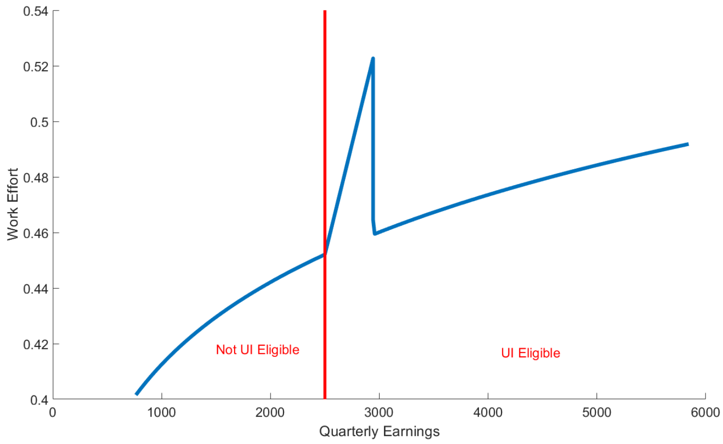


Figure 3: Hours policy functions from the baseline non-recessionary calibration

increases a job becomes preferred and search effort increases but is concave due to the convex costs of search. Search effort plummets just over the qualification threshold. This is for two reasons. First, non-employed workers start receiving UI benefits and this raises the value of non-employment and disincentivizes search effort. Second, the value of working is actually diminished for these workers. This is because these individuals are working many more hours on the job in order to qualify for UI benefits. Figure 3 shows hours worked in the cross section of the model. The fact that these workers are off of their static labor supply curve and work higher hours in order to reap the higher value of unemployment benefits should they lose their job works to ameliorate the value of a job and push them closer to indifference with unemployment. The sharp rise in search effort further on in the eligibility space marks where hours are no longer distorted due to incentives to qualify for UI. Comparing this point with the search effort of workers who are ineligible gives a good idea of the role of the UI benefits alone in closing the net benefit of the job by raising the value of unemployment. By additional comparison, the minimum point contains the role of UI benefits combined with the role of higher hours reducing the value of a job

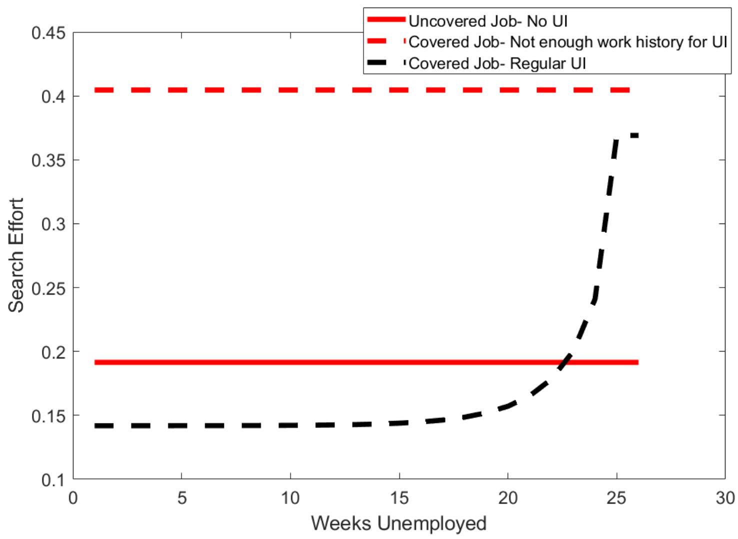


Figure 4: Hours policy functions from the baseline non-recessionary calibration

Job search intensity is also impacted by how close an unemployed worker is to exhausting their benefits. Figure 4 shows three scenarios about coverage status. The solid line is ineligible workers. These are low earners that will never qualify or receive UI during normal times. Their search effort is slightly less, on average, than other workers. Their low net value of a job is largely due to their low average wage. The grey dashed line on the top of the graph are eligible workers who have not worked long enough to qualify for UI. Most are new entrants. Their high search effort is due to three factors: (i) they are low on the human capital growth profile where it is more steep; (ii) they have higher average wage than ineligible workers, by definition; and (iii) they are not receiving UI which increases the net benefit of a job over unemployment. The role of the last factor alone can be seen in the black dashed line. This is the search effort for qualified workers who receive unemployment benefits until week 26. Comparing week 26 to week 0 shows the disincentive role of UI benefits alone. Benefits reduce search effort by more than half for this group. Search effort gradually increases close to the date of exhaustion because it takes time to find a job, highlighting the role of expectations and forward looking behavior

Table 4 decomposes how the difference in each job characteristic across job types impacts search intensity with and without UI coverage. The calibrated benchmark features the eligible with UI and the ineligible without UI, marked in bold. They have similar job finding rates.[12] The top portion shows the total counterfactual: what if workers in eligible jobs didn't have UI and workers in ineligible jobs did? In that reversal, workers ineligible jobs would choose lower search intensity than eligible workers who do receive UI. What explains the generally lower search effort of workers in ineligible jobs? This question is addressed under the heading "Counterfactual for Ineligible" by assigning, one at a time in isolation, the characteristics of eligible jobs to workers ineligible jobs. We see that the estimated lower efficiency of search χ

[12] A note of caution that figures 2 and 4 show search intensity and not job finding rates! Eligible and ineligible differ in job search technologies and that makes up the difference. These technologies are estimated to reconcile observed time spent searching and job finding rates.

Baseline		
	w/ UI	w/out UI
Eligible	**35.0**	48.0
Ineligible	28.7	**35.0**
Counterfactual for Ineligible		
If had covered...	w/ UI	w/out UI
Job finding efficiency	32.3	37.7
Job loss rate	29.3	35.4
Job ladder	28.7	35.0
Earnings levels	37.4	38.5
Disutility of work	22.0	28.8

*** Matched data values in baseline calibration**

Table 4: Counterfactual decomposition of determinants of search intensity across job type

and lower earnings levels are key factors lowering job search effort of ineligible workers. This is interesting because earnings in eligible jobs are six times larger than ineligible while the search efficiency in eligible jobs is only 10% larger than in ineligible. Yet, the response to each of these counterfactuals is not much different in magnitude. Neither the difference in job loss rate nor the difference in earnings growth on the job have a significant impact on differences in job search. The difference in the estimated utility cost of work across jobs is the strongest driver increasing the relative search effort of workers in ineligible jobs. This cost was calibrated to match the job search intensity of workers in eligible jobs given all other parameters of the model. The value is approximately $12/week. This is relatively small at the median value of weekly earnings of $923 dollars for eligible jobs but is higher at the median value for ineligible jobs with median weekly earnings of $165. This is not an implausible result given that workers in ineligible jobs work on average 12 hours per week compared to 36 on eligible jobs.

Comparing the columns for with and without UI in the counterfactual section of Table 4 provides insight on how the disincentives of UI are tempered by each margin. For most factors, the finding rate with UI is 5-6 percentage points lower than without UI. The exception is earnings levels. For high earnings levels the disincentives from UI decrease. This makes sense because the UI program is progressive with a cap on replacement rates.

5 Expanding Unemployment Insurance.

The model to provide insight on what would happen to individual's welfare and to the economy as a whole if UI were to be expanded to some currently ineligible workers on a permanent basis. Two types of expansions are considered. The first is lowering the earnings threshold to include more workers with earnings below what is currently required. The second is lowering the duration threshold to include workers who had recent earnings histories of less than two quarters. In this exercise, each the earnings threshold or the duration is changed one at a time while holding the other fixed. A $500 (about 20 percent) reduction in the earnings threshold is chosen and a 1 month reduction in the duration requirement. An experiment where each are increased by the same amount is also shown to make the point that local changes in these

Δ baseline	Lower $500	Raise $500	Lower 1mo	Raise 1mo
Unemployment	+8.2%	-5.2%	+0.8%	-0.6%
Hours	-0.4%	+0.2%	-0.12%	+0.008%
GDP	-0.005%	+0.06%	-0.0.01%	+0.007%
UI % of GDP	+3.5%	-3.6%	+0.3%	-0.2%
Job Finding non-UI	-15%	+12%	- 6%	+ 6%
Job Finding UI	-2.8%	+4.3%	+2.5%	-2.1%
Marginal Welfare	+0.1%	-0.1%	+1.2%	-1.2%

Table 5: Policy experiments in the calibrated model.

parameters have non-linear impacts. All experiments maintain the equilibrium assumptions: agents optimize in response to the new policies; and wages and taxes adjust to clear markets and balance the government budget.

Table 5 shows the results of the policy experiments. Welfare is reported for the marginal agent that gains/loses UI. The broad takeaway is that changing the duration threshold has higher welfare impacts and lower economic impact than changing the earnings threshold. There are a couple of reasons why. First, there are fewer workers that do not qualify because of the duration threshold than because of the earnings threshold. The former make up 8% of employment and the later make up 20%. Second, the labor supply of workers ineligible due to the duration threshold is less elastic than the labor supply of workers ineligible due to the earnings threshold. These facts explain why aggregate output and employment react less to changes in the duration threshold.

Workers newly insured when the earnings threshold is lowered have welfare gains less than 10% of the welfare gains of a worker newly insured when the duration requirement is lowered. This is because the marginal newly covered worker under the lower earnings threshold raises their hours to work much more than they were previously. Indeed, the most marginal entrant is raising his or her hours to earn above the threshold to the point where the greater utility cost of additional work exactly equals and cancels out all of her welfare gains from qualifying for UI.

6 Applying the Model: Interpreting the Great Recession and the COVID-19 Pandemic.

The model is applied to analyze behavior across job types for the Great Recession and the COVID-19 pandemic. The Great Recession serves as a benchmark where unemployment benefits where extended for the eligible but not expanded to include the ineligible. This tests whether the model can replicate elasticity of behavior to a recession for workers with and without UI coverage. The COVID-19 recession serves as an example of when unemployment insurance was expanded to include all workers ineligible due to failure to meet the earnings threshold or duration requirement. This tests whether the model is a good predictor of what occurs when UI benefits are extended.

Facts around labor supply behavior of each group must first be established for each recession. As of this writing, there has been little work done on this front. An exception is **?** who use a non-representative sample of clients at a large bank. This section will proceed by first developing methodologies to identify workers of each eligibility type in administrative data from the Department of Labor Employment and Training Administration (DOLETA) and in data from the Current Population Survey. Next, estimates of outcomes for each type of worker will be presented. Finally, experiments will be run in the model to test it's replication ability.

6.1 Worker outcomes in the Great Recession.

Data from the monthly outgoing rotational group (MORG) of the Current Population Survey (CPS) are commonly used to estimate variation in monthly flow rates from unemployment to employment at the business cycle frequency. I expand this methodology by categorize workers as either eligible or ineligible for regular state unemployment. A difficulty in doing so is that the MORG is a short panel. Workers are interviewed in each month for four months, removed from the sample for eight months, interviewed for another four months, and then dropped from the sample. Thus eligibility based on employment duration and earnings cannot be constructed directly in accordance with the two quarter reference time frame specified by most states. Some eligibility can be categorized directly, such as for the self-employed who are not eligible, and in these cases I categorize workers directly.

To categorize workers as eligible or ineligible based on earnings thresholds and duration criteria I implement a machine learning strategy (LASSO) trained on data from the Displaced Workers Supplement (DWS). The DWS cannot be used directly because it only occurs once every two years. The DWS includes supplemental questions to workers who experience a job loss and asks them questions about whether they are receiving Unemployment Benefits. I train the algorithm to predict unemployment receipt on these data including an array of demographic and employment data available in both the MORG and the DWS as well as my own constructed eligibility variable. The algorithm is similar to propensity score matching but with using the LASSO algorithm to select the set of predictive variables. The outcome is a prediction for each worker in the MORG that specifies the probability he or she is eligible. I conduct the analysis on higher confidence subsets: those workers in the top 30% and bottom 30% of likelihood, denoted "eligible" and "ineligible" respectively. Note that this algorithm predicts actual claims and not just eligibility. This is the right classification for comparison to the administrative claims data I'll use for the COVID-19 pandemic later on. This is advantageous over analysis that deduces eligibility from micro data on earnings only. With the DWS data, no assumptions on which eligible workers file claims need to be made which is important because almost half of eligible workers do not file claims and this share is not stable over time.

The outcome of interest are unemployment duration and it will be measured using data on flows out of unemployment. Using flows from unemployment to employment only is quantitatively similar as using unemployment to any other state, as shown in Figure 5. The time series of exit rates estimated for ineligible and eligible UI claimants contrast in two ways. First, the exit rate from unemployment falls more for eligible UI claimants than the ineligible during the Great Recession. The average rate of duration is approximated as the inverse of the exit rate. The estimated unemployment duration for the ineligible is 1.25x longer than for the eligible. Second, the exit rate of each group becomes similar during the recovery and stabilizes as similar over the course of the expansion prior to the COVID pandemic in 2020.

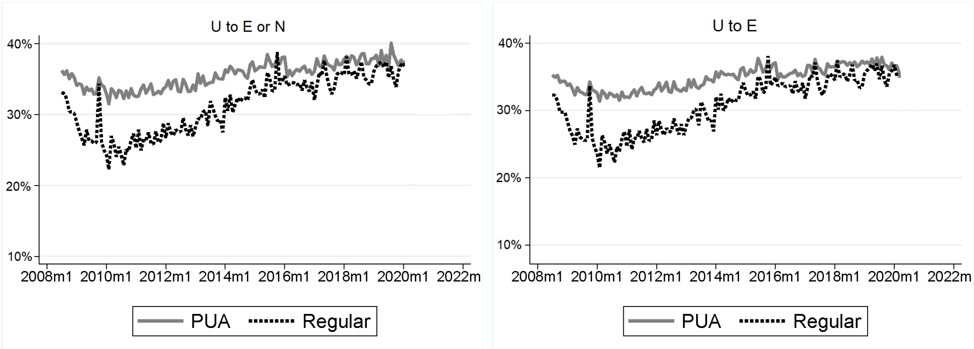


Figure 5: Estimated Monthly Exit Rate for Regular UI claimants and those who would have been eligible for a PUA-like program.

The behavior over the time series of the CPS sample is consistent with a work disincentive effect of unemployment insurance. Unemployment insurance programs were more generous and lasted longer during the Great Recession but was not expanded to the ineligible. The job finding rate of those estimated to be likely eligible for unemployment falls more than those estimated to not be eligible during this time but the rates become similar after the more generous UI programs are ended.

6.2 Worker Outcomes in the COVID-19 Pandemic.

Unemployment insurance was expanded during the COVID-19 pandemic through the Pandemic Unemployment Assistance Program (PUA). PUA was a temporary Federal program that extended unemployment benefits eligibility to workers not meeting states' earnings history criteria. I perform a stock flow analysis of aggregated claims data to deduce how the claim duration of PUA recipients differed from those whose initial claims met regular state unemployment insurance eligibility. Administrative data has flaws that I attempt to accommodate but they also have advantages over survey data. Standard large surveys did not collect data on PUA claimants consistently. This stock-flow methodology uses the universe of claims and not subject to selection bias or surveying lags. The newness of the program and the decentralization of its administration across states present several hurdles to any methodology an I detail how I deal with them in the following paragraphs.

The United States Department of Labor provides data on initial and continued claims for the Pandemic Unemployment Assistance (PUA) and regular state unemployment systems, as well as continued claims for the Pandemic Emergency Unemployment Compensation (PEUC) and the Extended Benefits (EB) programs. An initial claim is a request for determination of UI eligibility from an unemployed individual who recently was separated from his or her employer. A continued claim is a claim for an additional week of unemployment from an individual who has already filed an initial claim. The former approximates a flow onto an unemployment program and the latter is the stock of individuals continuing prior claims.[13]

The PEUC and EB programs are federally funded and extend the duration of benefits for claimants in the regular state programs.[14] Moving from a regular state program to PEUC or EB constitutes a continued claim. I will define total continued claims in regular state programs as the sum of continued claims across the regular program, PEUC, and EB.[15]

The PUA program provides up to 79 weeks of federally funded payments to workers with reduced income who are not eligible for regular state programs. The program initially provided payments through December 31, 2020 but was extended by President Trump on December 28, 2020 to last until March 14, 2021. In January 2021, it was extended again by President Biden through September 6, 2021. Additionally, the program provides retrospective payments for reduced income events beginning on or after January 27, 2020. Administration of the PUA program began at different times across different states in April-June 2020.

The retrospective payments, staggered start dates, and the requirement of some states that PUA claimants first file a regular unemployment claim all present hurdles for a stock-flow analysis. I deal with the first two issues by simply starting the analysis on July 15, 2020. The analysis is ended on May 1, 2021 which a month prior to when a subset of states withdrew from federal programs including PUA and PUEC. To deal with the second issue, I categorize states into three groups: those that require an applicant to apply for PUA through being rejected from the regular state program; those that accept PUA applications directly, and those that either changed protocol at some point or whose protocol cannot be determined.[16] The states in the third category are dropped.

For the states that take PUA applications indirectly through regular state programs, both the initial PUA and regular state claims data must be adjusted to reflect true flows onto each program. I do this by using the time series of rejection rates of initial claims due to insufficient work history which is available for each state from the Department of Labor. These are the true rejection rates for claims made to and intended for regular state UI program in the states

[13] These are approximate measurements. For example, some initial claims are rejected and never result in payment and some programs allowed retrospective claims during the pandemic. Both of these issues will be addressed in the analysis.

[14] PEUC provided up to an additional 13 weeks of federally funded insurance due to special actions dealing with the pandemic. The EB program is automatic and provides up to 13 additional weeks if a state is experiencing high unemployment. The EB program may extend duration in eligible states after a claimant's PEUC weeks run out.

[15] This is because we are interested in the stocks of claimants by eligibility type and not the state versus federal funding distinction.

[16] I find that roughly half of the sample, 25 states plus the District of Columbia, require PUA applicants to first file for regular benefits and be denied. We check this categorization by comparing rejection rates to regular state programs in each group. Indeed, the group that requires PUA applicants to file for regular benefits and be rejected has a 12.6 percentage point higher rejection rate of initial claims to state programs (44.3% versus 31.7%) based on insufficient work credits than those that take PUA applications directly and separately.

that process PUA claims separately from regular ones. I extrapolate these rejection rates to the states that took PUA and regular claims together by assuming that the mean rejection rate due to insufficient work history of claims intended for the regular state program is the same in each set of states. I apply the mean rejection rate to regular initial claims from these states to those states that did not take PUA claims directly and assign any excess rejections as initial applications to the PUA programs.

In specific notation, let $\{a_t^{pj}, c_t^{pj}, r_t^j\}$ be the true initial claims, continued claims, and rejections to program p in state type j at time t. Let $\{\hat{a}_t^{pj}, \hat{c}_t^{pj}, \hat{r}_t^j\}$ be the same objects reported in the DOLETA data. For states that take PUA and regular claims separately, the observed objects reported by DOLETA should be the actual ones, subject perhaps to measurement error. For the states that require PUA claims to be filed first as regular claims and then rejected, the approximation of the true values are:

$$\begin{aligned}
\tilde{r}_t^j &= mean_{j\in\{direct\}}(\hat{r}_t^j) \\
\tilde{a}_t^{regularj} &= \hat{a}_t^{regularj} * (1 - (\hat{r}_t^j - \tilde{r}_t^j)) \\
\tilde{a}_t^{PUAj} &= \hat{a}_t^{regularj} * (\hat{r}_t^j - \tilde{r}_t^j) \\
\tilde{c}_t^{pj} &= \hat{c}_t^{pj}
\end{aligned}$$

The data are cleaned in a third and final way by removing four states with swings in PUA continued claims data that exceed 200% starting in July 2020.

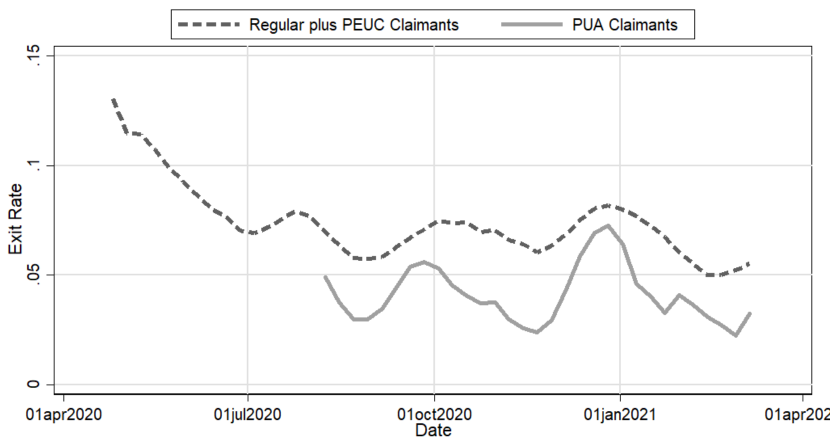
Results The stock-flow estimates of the weekly exit rate from unemployment programs are shown in Figure 6. The figure depicts the results for all states with rejection rates imputed as described above. I also present numbers here for only the subset of states where PUA and regular claims are taken separately. The former establishes a higher estimate of PUA duration than the latter.

PUA claimants had lower exit rates from unemployment insurance than those entering through regular state program eligibility. The typical PUA claimant claimed 9.5 to 11.5 more weeks of benefit payments than the typical claimant claimed through regular state UI programs. This is an additional 57 to 82 percent weeks of claims per claimant.

The basic accounting impact of the longer duration of PUA claimants on total claims paid is as follows. Total unemployment claims would have been 9.8 to 17.6 percent lower from May 2020 to May 2021 if PUA claimants had the same average exit rate as claimants on combined regular state and extended UI benefit programs. This difference amounts to approximately 120 to 220 million additional claim weeks. The increase in claims caused by the lower PUA exit rates grew larger in 2021 because PUA exit rates fell further behind those of regular claimants as the Pandemic recovery progressed.

Further Evidence: Anticipated Expiry in December 2020. The CARES act created the PUA program which extended UI to those previously not eligible, and the PEUC which extended the duration of claims to regular programs from 26 to 39 weeks. Both programs were temporary measures. PUA, PEUC, and also the full federal funding of Extended Benefits (EB) were originally slated to expire on December 26, 2020. As of the first week of December 2020, there were 9.7 million PUA continued claims and 5.0 million PEUC continued claims representing unemployed persons at risk of losing coverage if the programs were to have ended on December 26.[17] On December 21, 2020 the text of a bill that would extend PUA and PEUC for an additional 11 weeks was made public. The provision was signed into law by President Trump on December 27, 2020.

Economic theory, as was made explicit in the prior section, postulates that UI claimants would start looking for work in anticipation of their benefits expiring and increase the rate at which they exit unemployment before they are actually terminated. This, however, is only the case if the presence of the UI program had a negative causal impact on job search behavior to begin with. The exit rate estimates shown in Figure 6 provide some suggestive evidence that the UI programs did have negative impacts on job finding rates. The exit rate of both PUA and combined regular UI and PEUC claimants rise in December 2020 before falling sharply at the end of the month when the extension is announced. There could be other factors at play such as seasonal work and so this is only suggestive evidence but the magnitude is significant and this all occurred during the largest spike in measured virus cases thus far in the pandemic.



Sample of analysis September 2020-May 2021

Figure 6: Estimated Weekly Exit Rate from Unemployment Programs.

The fact that PUA claimants claimed unemployment insurance for longer than individuals entering through regular state programs is not alone a smoking gun that work disincentives from unemployment programs are higher for the state ineligible group compared to the eligible group. It could be that the type of workers claiming under PUA take, on average or during recessions, a longer time getting back to work than regular state claimants. Comparing the CPS sample to the estimates from the pandemic also provide further interpretation of the finding that workers on PUA had longer duration of claims than those on regular UI programs during

[17] All claims data published by the Department of Labor.

the pandemic. We see this is not likely due to fixed characteristics of each group of workers since their job finding rates were similar right before the pandemic. It is also not normal recessionary phenomenon. The duration of workers ineligible for regular UI relative to those eligible for regular state UI increased by 36% in the pandemic when they were covered by PUA benefits than in the Great Recession when they received no unemployment benefits.

6.3 Analysis of the Great Recession.

The model is applied to analyze whether the theory can replicate behavior across job types that I previously estimated for the Great Recession. The unemployment insurance program is adjusted to include the 20 week increase in the duration of benefits that was enacted during this time. Next, the efficiency of search technology, χ is adjusted downwards for the workers in eligible jobs such that the endogenous job search response to both changes replicates their lower job finding rate estimated in the CPS data of 26%. The search efficiency for ineligible jobs is then adjusted downwards by the same proportion. The implicit assumption here is that eligible and ineligible jobs became equally more difficult to find during the Great Recession.

This model does a decent job in matching the gap in job finding rates across job types during the Great Recession. During normal times workers in both job types find new jobs at a similar rate. During the Great Recession, workers estimated to not be collecting unemployment found jobs at a 25% higher rate than those estimated to be collecting unemployment in the CPS data. The model predicted a 23% higher rate. Thus, the benchmark calibration does a decent job at replicating the search incentives for both groups tied to search efficiency and the incentives tied to UI for the eligible group, at least in these smaller deviations.

The model can also be used to asses what would have happened if a PUA like program extending coverage to workers not qualifying for regular state UI had been put in place during the Great Recession. This counterfactual predicts a job finding rates for the PUA covered workers would have been 53% lower than what they were if they could have had the same UI benefits as workers covered by regular UI during the Great Recession.

6.4 Analysis of the COVID-19 Pandemic Recession.

The model is applied similarly to analyze the Pandemic Recession. First, the unemployment insurance program is adjusted to look like enacted measures. The duration of benefits for regular UI workers and coverage for PUA workers are each extended to match, probabilistically, coverage from March 2020 until July 2021.[18] To be clear, regular UI workers in the model are workers who earned qualification for UI in eligible jobs. PUA workers in the model are those in ineligible jobs and those in eligible jobs that did not yet work long enough to earn qualification for regular UI. The level of benefits is also increased by $400 per worker. This roughly replicates

[18]PEUC and PUA were terminated early in a subset of states and, without a doubt, there was uncertainty all along about coverage duration. These choices serve as a benchmark. Adding greater uncertainty or changing the expected length of coverage does not greatly change the duration of PUA workers *relative* to regular UI workers in the model which is the primary focus here. It would change the duration for both groups.

the average increase due to FPUC programs. Second, the efficiency of search technology, χ is adjusted downwards by 22% for the workers in eligible jobs such that the endogenous job search response to both changes replicates their lower job finding rate of 5.5% estimated in the DOLETA administrative data for the sample period of September 2020-May 2021. This sample period avoids the higher incidence of recall early in the recession. The χ is adjusted downwards by the same ratio for uncovered jobs. The assumption that the fall in efficiency is the same across job types serves as a baseline and was also shown to be a good assumption for the Great Recession.

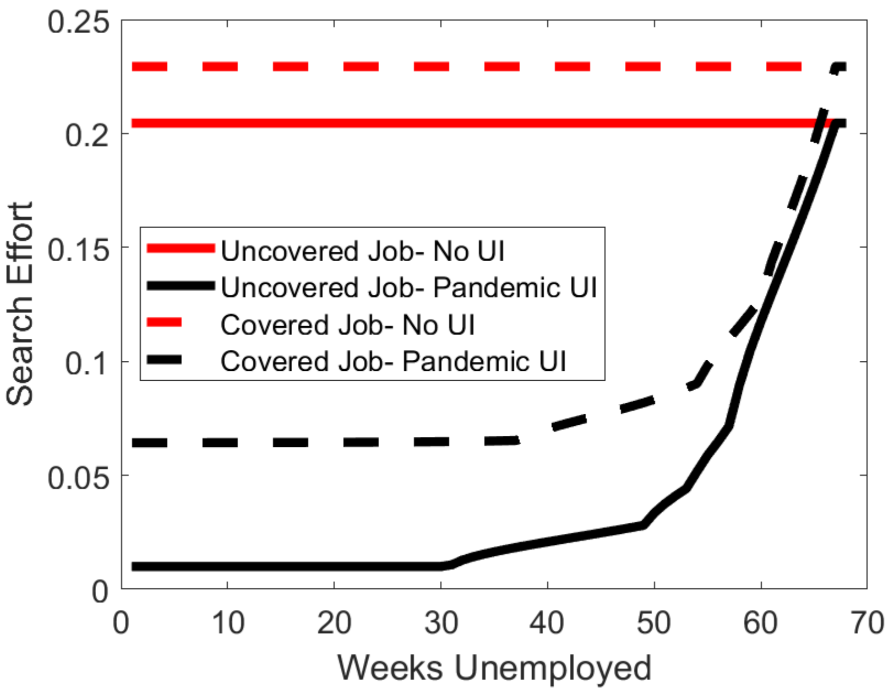


Figure 7: Model search effort during the COVID-19 pandemic recession.

The results for the COVID-19 Pandemic are shown in Figure 7. The results are striking. The model predicts that the value of unemployment benefits were high enough to make workers in ineligible jobs not want to search at all, at least while they were far enough from their exhaustion horizon. Through the lens of this model the PUA claimants in ineligible jobs would not be even close to the margin of job search. By contrast, the workers in eligible jobs that did not have enough tenure to qualify for regular UI and collected PUA continue to show positive job search effort that is even above the values for eligible workers covered by regular UI. That means that, through the lens of the model, the only workers on PUA who world be searching for a job are new entrants.

The model results provide an unusual interpretation of the results of the stock-flow analysis of the PUA claims data. The empirical results showed that exit rate from unemployment of PUA claimants fell much more than for regular UI claimants during the pandemic than compared to prior recessions. This might have been interpreted as suggesting the search disincentives of UI are much stronger for PUA claimants. When compared to the model, however, the observed exit rates are about one-third higher than would be expected: 15% in the data versus 10% in the model. The story the model tells is that these jobs have such low earnings and dynamic asset values that a rational workers would be much better off collecting unemployment benefits which often exceeded 100% of their potential wage. The story the data tells is that, while disincentives may have been larger for the PUA group, they are much smaller than would have been predicted for regular UI claimants facing similar tradeoffs. In this sense, the moral hazard component can be thought of as smaller for the PUA group given the job opportunities available to them.

This result is extremely robust. No difference in the job finding efficiency can reconcile these facts. All workers from ineligible jobs reject job offers and so the finding rate hinges solely on workers in eligible jobs covered by PUA. Even if we give these workers a 100% job finding rate, we can not close the gap between model and theory. It is possible that wages increased in ineligible jobs. However, they would have had to increase by almost 4-fold to close the gap between model and data. More stories can be told. Perhaps ineligible workers jumped on the chance to look for eligible jobs which is not allowed in the model. It would be required that they all have access to the 50th percentile of eligible jobs to close this gap. Although analysis may show the pandemic was a special case where this was possible, the PSID data show that the flow into an eligible job from a non-eligible is only 11% per year. This is concentrated mostly among the workers in eligible jobs gaining concentration and cannot close the gap.

6.5 Robustness.

This section discusses three features absent to the baseline calculations. All three features would exacerbate the inability of the baseline model to explain the unemployment duration of PUA claimants and thus strengthen the results of this paper. They are: asset accumulation including other cyclical government transfers such as economic impact payments and child tax credits; recall; and duration dependence.

Assets accumulation and expanded government transfers. Prior literature has presented mixed results on whether work disincentive effects of UI are stronger for households with higher or lower access to liquid assets.[19] In a later section I will document in the PSID that household income is a poor indicator of which households suffer a larger consumption loss associated with unemployment, suggesting that liquidity constraints or other barriers are important. None-the-less I discuss the implications.

Both an increased role of self insurance through asset accumulation and increased government transfers would have strengthened the results of this paper by increasing the unemployment duration of unqualified workers. Workers who are unqualified because they were working ineligible jobs already would reject any job offer. The unqualified workers who search for jobs are those in eligible jobs that have not accrued enough earnings history to qualify for UI. Increasing

[19] Meyer and Mok (2014) present evidence that disincentive effects are not dependent on liquid assets. Chetty (2008) find the opposite.

the flow value of unemployment through previously accrued assets or extra government transfers would reduce their job search effort. Both also increase the asset value of unemployment by increasing the flow value of consumption after expanded UI or extra government transfers end and this also decreases job search. For both of these reasons, the results of the model are amplified.

An alternative exercise would be to recalibrate the model with all households facing zero liquidity constraints. Matching the consumption drops associated with unemployment that we see for them in the PSID, however, would be likely impossible without other constraints or changes to the baseline included. Perhaps variation in discount rates or other factors could achieve this goal but that is left for future exploration.

Recall. The COVID pandemic was unique in that recall of unemployed workers to their former employer was much higher than in both normal times and during previous recessions. Hall and Kudlyak (2021) show that temporary unemployment accounted for more than three-quarters of all unemployment in early 2021 but declined to 26 percent by November 2020. The November statistic is close to normal times if compared with the finding of Fujita and Moscarini (2017) that 30% of unemployed workers return to a previous employer. Given these facts, I consider that my stock-flow analysis partially addresses this concern by focusing on the period from September 2020-May 2021. Further, the estimates in 6 show that the exit rate of regular claimants plus PEUC had stabilized from the initial burst of recall before the time period of analysis in this paper starting in September 2020.

Including recall in the model would only weaken these results if recall were more common for workers who don't qualify for UI than for those who do. This is because the puzzle is why workers who don't qualify go back to work so quickly when the model is calibrated to match the finding rate of workers who do qualify. Indeed, there is no recall rate that can rationalize the return to work of unqualified since no ineligible workers would accept a job offer while the PUA program is in place in the model. The value of the benefits is just far too high. The only unqualified workers who return to work are those in eligible jobs that have not accrued enough tenure. They are about 15% of all unqualified workers and so would have needed a monthly recall rate of 100% to replicate the 15% job finding rate in the data.

Duration Dependence. The model implicitly includes duration dependance through the earnings potential process. Duration dependence is an empirical phenomenon whereby workers who have been unemployed for a longer duration have a lower monthly probability of returning to employment. The model generates this through both a composition effect and a causal duration effect. The composition effect is that lower wage workers choose lower job search effort and so make up a larger portion of long-term unemployed. This mechanically lowers the average job finding rate of long-term unemployed workers. The causal duration effect is that, if we construct panel data on model workers, workers who are unemployed longer are more likely to have moved down the earnings potential ladder relative to where they were before. This reduces their job search effort relative to where it was in the beginning of their unemployment spell.

Increasing the impact of duration dependence through either the selection or causal channels strengthens the results of this paper by increasing the difference in unemployment duration between eligible and ineligible workers.[20] This is because the sharp progressivity of unemployment benefits and the greater variance in earnings potential (longer job ladder) of the eligible workers implies a job search policy with more variance than for the ineligible workers. In other words, eligible workers change their search effort more at different points of the job ladder than ineligible workers. As a result, there is more quantitative room for duration dependence than for ineligible workers who choose more similar search efforts since the net value of a job versus unemployment does not change much for them along their job ladder.

Match Quality. There is no match quality in this analysis. Studies considering match quality conjecture that the longer unemployment durations accompanying more generous UI policies yield better matches through longer and pickier search. Multiple studies refute this conjecture and find the opposite: workers take worse jobs after longer unemployment spells induced by more generous UI (Schmieder et al. (2013), Schmieder et al. (2012)).[21] Studies that do find better match quality after longer unemployment spells induced by more generous UI find this effect to be quantitatively small (Griffy and Rabinovich (2022)). The omission of match quality is, therefore, unlikely to account for the large quantitative gap between the value of a job an unemployment documented in this paper for PUA recipients.

7 Conclusion.

The almost universal expansion of unemployment benefits during the COVID-19 pandemic showed the willingness of the Federal Government to consider expanding UI during economic downturns. It also provided an interesting experiment where outcomes of a UI expansion could be observed. Yet the pandemic was an unusual context and one that will hopefully not be repeated. How should observed outcomes be interpreted? What is their meaning in terms of individuals' welfare and causal impact on the economy? How can these lessons be extended to future considerations of UI expansions? This paper filled an important gap by providing a quantitative framework to contextualize this event.

Context proved to be important in understanding the outcomes of PUA recipients. PUA claimants remained on UI almost 1.7 times longer than claimants through regular state eligibility standards and this difference was not typical to prior normal or recessionary times. The quantitative framework of job search developed in this paper showed that dynamic considerations around the value of a job could easily rationalize the claim durations of claimants entering through regular state UI eligibility. These same incentives could not rationalize PUA claim

[20] Two exercises are done to confirm this claim. One is ρ^u is increased uniformly for each job type. The second is an extreme version of selection that asserts only the lowest 40% of each job type face job loss risk.

[21] Similarly, Rebollo-Sanz and Rodríguez-Planas (2020) finds no decline match quality when benefits are made less generous.

durations. PUA claims were actually almost two-thirds shorter than what would be predicted. Through the lens of the model a surprising puzzle emerges of "why were PUA claims *so short*"? Keep in mind that the model well replicated labor market flows of normal claimants over the business cycle and of the ineligible during the Great Recession. This suggests there were some circumstances unique to the pandemic.

PUA was an expansive expansion. It completely eliminated the earnings threshold and duration requirement to claim UI. The framework can be used to understand what happens when these levers are changed independently and for more marginal expansions. The results showed that lowering the duration requirement had smaller negative impacts on the economy and larger welfare gains. It also shows that impacts of changing either threshold are highly non-linear. Lowering the earnings threshold by $500 has less than twice the negative impact on the economy as lowering the threshold by $1,000 and yet the welfare gain for the marginal recipient in each case is similar.

Another take away for future economic research is that economic need for government aid around an unemployment spell is not necessarily higher when a lower earner loses a job compared to a high earner. Household consumption falls, on average, 17% in a year of an unemployment spell and middle-class households earning $50-120k still see drops over 10%. This suggests that modelers need to be mindful that many low earners live in high income households and that the roles of precautionary savings or household insurance in standard models needs to be tempered by the reality of consumption dynamics.

For policy makers, the main take away is that extending UI has high marginal cost: current ineligible would stay on the program longer than current eligible; but high marginal gains for some: current ineligible tend to have higher insurance value of the program than current eligible. These are claims about the average. High variance of these results across people motivates the exploration of alternative instruments to achieve goals around social insurance and equity.

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