

The Effect of Unemployment Benefits on Job Search Duration and Post-Unemployment Wage

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This paper introduces a structural search model that measures the effect of unemployment benefits on a worker's reservation wage. Using data from the National Longitudinal Surveys, survival analysis is used to estimate the effect of unemployment benefits on the duration of search and post-unemployment wages. If a worker's value of remaining unemployed to collect benefits is greater than the value of future wages that comes with a particular job offer, the worker will remain unemployed. The data are split for analysis based on different recessions in United States history. The goal is to see if the elevated rate of long-term unemployment observed in the 2007-2009 recession is a result of a moral hazard problem from the high level of unemployment benefits that were offered in this time period. The results show that higher unemployment benefits lead to longer search durations but do not change post-unemployment wages significantly across all three recessions that were analyzed.

AS THE UNITED STATES ECONOMY begins to recover from the 2007 recession, Congress is wrestling with the issue of unemployment benefit extensions. Since June 2008, unemployment benefits have been extended six times, most recently in 2012. In 2011, long-term jobless individuals were able to collect benefits for up to 99 weeks in some states. Policy makers argue that it would be unjust to allow that aid to lapse while the unemployment rate remains elevated. However, for the six million Americans who would have lost their benefits, the passing of the 2012 benefit extensions is something they may take for granted. Although some economists agree that the high unemployment rate in the most recent recession is due to structural factors that have raised the natural rate of unemployment, empirical studies show that social insurance programs reduce the labor supply. The most obvious interpretation of this result is that unemployment benefits create a moral hazard problem that affects the duration of unemployment through the substitution effect: unemployment benefits reduce the worker's incentive to find a job because they distort the relative price of leisure and consumption (Chetty 2008). Essentially, unemployment insurance can fund unproductive leisure, causing people to comfortably rely on this money without any sense of urgency to find a job. The existing research acknowledges that the relationship between the level of unemployment benefits and search duration is not solely due to a moral hazard problem. Rather, the relationship varies depending on factors such as the liquidity of the individual at the time of job loss (Chetty 2008) and the local rate of unemployment (Kroft & Notowidigdo 2010). Congress has extended unemployment benefits so aggressively in recent years because the period beginning in mid-2011 has been referred to as the "jobless recovery", in which productivity has been increasing and overall

macroeconomic conditions are improving while the unemployment rate remains elevated. In my paper, I observe if the moral hazard problem is more apparent in the most recent recession than in previous recessions as a result of the unprecedentedly long duration of unemployment benefits ever made available. Moreover, I am interested in the productivity of search given the various levels of unemployment benefits collected. If a longer search duration leads to a higher post-unemployment wage, then perhaps the moral hazard problem is not as prevalent as once believed, because it means that workers are rejecting job offers that do not pay an acceptable wage. However, if a longer search duration does not lead to a higher post-unemployment wage, it could either mean that workers are not spending their period of unemployment productively because unemployment benefits are high enough for them to live comfortably, or that there are no high-paying jobs available for those who have been unemployed for a long time. In my paper I first introduce previous research indicating that in the 1970s, a longer search duration led to a higher post-unemployment wage. This finding conflicts with the current observation that long-term unemployed workers have become effectively "unemployable" because they lack the most current skills or lose their professional network, contributing to the jobless recovery. Next, I describe my structural search model that can be estimated to observe the effect of unemployment benefits on search duration. I then introduce my data and provide summary statistics along with a table of important correlations. Finally, I estimate the model using duration analysis and present my findings.

1 Literature Review

Since the 1970s, there has been a significant amount of research done on the relationship between the level of unemployment benefits and search productivity. The field was a popular research area at the time because elevated levels of unemployment following periods of high inflation drew attention to the role that unemployment benefits had in the labor market. Ehrenberg and Oaxaca's 1976 paper called "Unemployment Insurance, Duration of Unemployment, and Subsequent Wage Gain" states that all formal analytical models of job search suggest that increasing the level of unemployment benefits increases the expected duration of unemployment and the expected post-unemployment wage. This implies that getting more unemployment insurance for a longer period of time added to the productivity of the search because individuals could find a higher paying job than they had before. Workers were more willing to sacrifice a few weeks of not earning a wage to look for a higher paying job, meaning they were more likely to reject offers that were unsatisfactory. On the other hand, Holen's 1977 paper "Effects of Unemployment Insurance Entitlement on Duration and Job Search Outcome" considers the possibility that high levels of benefits exacerbate the problem of unemployment because of disincentive effects. Holen agrees with Ehrenberg and Oaxaca that higher benefits increase the duration of unemployment. However, she also states that the results for fu-

ture earnings vary considerably between studies. She conducted her own study using NLS data and found results that support Ehrenberg and Oaxaca: “a \$10 increase in benefits would increase earnings by about \$90 a quarter” (Holen 1977), but she asserted that further investigation is warranted.

In the current economic environment that has been referred to as the “job-less recovery”, the issue of unemployment benefits has once again resurfaced because long-term unemployment rose dramatically during the recent recession and remains elevated. Hornstein and Lubik from the Federal Reserve Bank of Richmond wrote a paper in September 2011 asserting that a primary cause of this is that “more workers with inherently low job finding rates have become unemployed” (Hornstein and Lubik 2011). They argue that the extended duration of unemployment benefits could be a contributing factor because some workers were eligible to collect benefits for up to 99 weeks as of January 2010, whereas the maximum duration for benefits in the early 1980s recession was 55 weeks. This could lower workers’ incentives to look for jobs because the amount of compensation collected increases with duration. If the wages offered do not increase as well, then workers are more likely to reject job offers with the hope of receiving a better one in the future. Unfortunately, this expectation has not been realized for many of the unemployed in the recent recession, and researchers have been finding that people who are unemployed for too long become effectively “unemployable”. This suggests that some characteristics of this recession are making the exit rate from unemployment different from that of previous recessions. In my paper, I attempt to find out if extended unemployment benefits are making the duration of unemployment so long that it affects the exit rate of unemployed workers.

There are a few existing unemployed worker search models. Robert Shimer’s worker’s choice model assumes that the unemployed worker’s after-tax reservation wage encodes all of the relevant information about the individual’s welfare because it reveals the worker’s indifference point between being employed and unemployed. Thus he concludes that raising unemployment benefits is desirable only if it increases the worker’s reservation wage, suggesting that there is an optimal level of benefits. To find this, the responsiveness of reservation wages to unemployment benefits must be determined. His conclusion is that researchers who have previously tried to estimate this relationship were overestimating the responsiveness of reservation wages to benefits, implying large gains from increases in unemployment benefits. He states that since his estimates are much smaller, unemployment benefits are too high.

The model that I use in my paper is more directly based on a similar model that Kenneth Wolpin develops in his 1987 paper called “Estimating a Structural Search Model: The Transition from School to Work”. His goal is to estimate a job search model that is econometrically implemented using the restrictions derived from job search theory. He uses the NLS youth cohort to estimate search parameters such as the cost of search, the probability of receiving an offer, and the discount factor. He finds that increasing the mean wage offer surprisingly increases the reservation wage just enough to increase the expected duration of unemployment. Reducing the cost of search increases the reservation

wage and the expected duration of employment. Furthermore, increasing the offer probability may either increase or reduce the duration of unemployment depending of the responsiveness of reservation wages to offer probabilities. In my paper, I modify this model to include unemployment benefits as a variable to see how this changes the relationship between expected duration of unemployment and the various search parameters.

2 Model

The purpose of this model is to estimate the effect of unemployment benefits on unemployment duration.

2.1 Assumptions and Equations

The assumptions for our model are consistent with the ones that Wolpin uses for his. Each period the individual either obtains an offer of employment or does not. If he gets an offer, he can choose to accept or reject it. If offer is rejected, the individual continues to search at some fixed cost. An offer is assumed to arrive randomly each period, and the likelihood of an offer arriving varies in a known way with the duration of unemployment. Wage offers are identically and independently distributed, so there is no recall. Once a job offer is accepted, the job lasts forever, so wage is the present value of a stream of income. Once a job is obtained, financial market constraints are assumed to be no longer binding. If the individual reaches the terminal date (benefits run out) without receiving an acceptable offer, he is obliged to take the next offer that comes. This terminal date and length of the long-run are completely specified in the model. This length depends on individual's initial assets, rate of time preference, and profile of offer probabilities.

In the model, P_t is the probability of an offer, w_t is the period wage, c is the cost of search in terms of monetary value, β is the subjective discount factor, and b_t is the amount of benefits received. The value of search (the value of entering the next period without a job), is given by:

$$V_t = P_t E \max[U(w_t) + V_{t+1}^{(1)}, U(b_t - c) + \beta V_{t+1}^{(2)}] + (1 - P_t) E[U(b_t - c) + \beta V_{t+1}^{(2)}] \quad (1)$$

Where

$$V_{t+1}^{(1)} = E \left[\sum_{s=t+1}^T \beta^{s-t} U(C_s) \right] \quad (2)$$

$$V_T = P_T E[\max[U(w_T), U(b_T - c)] + (1 - P_T) E[U_T(b_T - c)]] \quad (3)$$

$$V_{T-1} = P_T E[\max U(w_{T-1}) + \beta E[U(w_T)], U(b_T - c) + \beta V_T] + [1 - P_T] V_T \quad (4)$$

Equation (1) is split into two parts. The first part of the equation represents the two choices that a worker has upon receiving a job offer. The worker can either take the job and experience utility from the constant stream of wages that lasts forever, or he can reject the offer and receive unemployment benefits and continue searching at some cost. The second part of the equation represents the utility that the worker will receive when he does not get an offer. The value of search in the final and next to final periods are also shown as equations (3) and (4). The difference between $V_{t+1}^{(1)}$ and $V_{t+1}^{(2)}$ is that the first just represents the present value of all future utility from getting a wage from the job that lasts forever. $V_{t+1}^{(2)}$ accounts for the fact that if the worker rejects the offer or does not receive an offer, he has to enter the next period and make the decision again.

The reservation utility is the utility level that makes a worker indifferent from being unemployed and having a job. In the model, it is expressed as follows:

$$\zeta_t = U(b_t - c) + \beta V_{t+1}^{(2)} \quad \text{where } t = 1, \dots, T-1 \quad (5)$$

$$\zeta_t = \min[U(w_t) + E_{t+1}[\sum_{s=t+1}^{T+\tau} \beta^{s-t} U(w_s)]] \quad \text{where } t = T, T+1, \dots, T+\tau \quad (6)$$

The reservation wage is positively correlated with the mean of wage offers, the probability of an offer, the level of benefits, and the subjective discount factor. It is negatively correlated with the cost of search. These relationships can be determined by making the necessary substitutions and taking the partial derivative of the reservation wage equation with respect to each variable. Cost is the only variable that is negative in the equation, making it negatively correlated with reservation wage. Each worker's objective is to maximize his utility by accepting a job offer only if the utility of getting that wage for the rest of his life is greater than or equal to the reservation utility. Mathematically, a worker will accept a job offer if:

$$U(w_t) + E_t[\sum_{s=t+1}^T \beta^{s-1} U(w_s)] \geq \zeta_t \quad (7)$$

The expression above can be rewritten in simpler terms:

$$\bar{U}_t = E_t[\sum_{s=t}^T \beta^{s-t} U(w_s)] = \beta^0 U(w_t) + E_t[\sum_{s=t+1}^T \beta^{s-1} U(w_s)] \quad (8)$$

Now, the value of job search can be expressed in two parts as seen in equation (9). The first part is the probability of getting a job offer multiplied by the utility gained from having a job times the probability that this is greater than the reservation utility. This is added to the second part, which is the probability of not finding a job multiplied by the reservation utility.

$$V_t = P_t[E[(\bar{U}|U_t \geq \zeta_t) \Pr(\bar{U}_t \geq \zeta_t) + \zeta_t \Pr(\bar{U}_t < \zeta_t)] + (1 - P_t)\zeta_t] \quad (9)$$

For simplicity, we can assume that the utilities are normally distributed to rewrite the valuation function for the normal case. Assume that u is a normal random variable with zero mean and finite variance, σ_u^2 . Then the following equations are true:

$$E[u|u > a] \Pr(u > a) = \sigma_u \phi\left(\frac{a}{\sigma_u}\right)$$

$$\Pr(u < a) = \phi\left(\frac{a}{\sigma}\right) \quad \text{and} \quad \Pr(u \geq a) = [1 - \phi\left(\frac{a}{\sigma}\right)]$$

Our empirical specification of utility is as follows:

$$U(C_s) = \begin{cases} U_w(C_t) = \bar{U}(C_t) + \varepsilon_w & \text{if the worker is employed} \\ U_{nw}(C_t) = \bar{U}(C_t) + \varepsilon_{nw} & \text{if the worker is not employed} \end{cases}$$

Utility is given by known, observable utility $\bar{U}(C_t)$ plus some error term that represents all the noise in the equation.

$$\bar{U}_t = \bar{U}_t^* + \varepsilon_t$$

Through some arithmetic shown in the Appendix, we can obtain an expression for V_t specifically for the normal case:

$$\mathbf{V}_t = \mathbf{P}_t[\bar{\mathbf{U}}_t^* + \boldsymbol{\eta}\phi\left(\frac{\boldsymbol{\eta}}{\sigma}\right) + \boldsymbol{\sigma}_u\phi\left(\frac{\boldsymbol{\eta}}{\sigma}\right)] + (\mathbf{1} - \mathbf{P}_t)\boldsymbol{\zeta}_t \quad (10)$$

3 Data

The model is estimated using the NLSY79 and NLSY97 from the Bureau of Labor Statistics. First, I provide a description of the main data sources, and then explain how the variables used for estimation were constructed from those sources. Finally, I present a summary statistics table.

3.1 NLSY79

The NLSY79 is a nationally representative sample of 12,686 American men and women between 14 and 22 years old when they were first interviewed in 1979. Interviews were conducted annually until 1994, and are now conducted biennially. The survey is useful because it captures information in an event history format, telling the complete story of how an individual moved from school to the labor force, then transitioned between employers with possible

periods of unemployment in between. It reveals when individuals started and ended a job with a particular employer, at which times they were actively looking for work, and the amount of unemployment compensation they received when unemployed. Even though the focus of the NLSY is labor force behavior, there is also a wide range of other information about these individuals, including educational attainment, health conditions, income and assets, and marital and fertility histories. This other information can be used to explain variations in employment status and earnings over time. A weakness of this data is that even though there are many variables included in the survey, there is a lot of missing information. There were many weeks in which no information was available about an individual, so values had to be interpolated for some variables.

3.2 NLSY97

The NLSY97 is a nationally representative sample of 9,000 people between 12 and 16 years old when they were first interviewed in 1997. Since this cohort was younger than that of NLSY79, their parents were involved in the first round of interviews. These youths are still interviewed on a yearly basis. Similarly to the NLSY79, this survey also captures information in an event history format, but there are added variables. The NLSY97 has an entire section of variables called “Job Search” that is not included in the NLSY79. This has information about specific efforts taken to find a job, how the job was found (networking, Internet search, etc.), and reasons that certain individuals were not looking for a job. In general, the variables in the NLSY97 are more comprehensive. For example, The NLSY79 only collected wage information for up to five jobs for each individual, but the NLSY97 allows for up to eight jobs and also distinguishes between “employee” jobs and “freelance” jobs. The strength of these surveys is that the information gathered in both surveys is recorded in a consistent manner in terms of units of time and measure, and therefore the labor market activities of the two cohorts can be directly compared. For example, unemployment benefits are recorded on a monthly basis and presented in the form “amount of benefits received per week in x month in y year” in both surveys.

3.3 Construction of Subsamples

Table 1 in the Appendix shows the summary statistics of the variables used for estimation. To create this subsample, I split the data into four different recession periods. There are five columns because for recession three, data are available from both NLSY79 and NLSY97. It is useful to analyze the data by recession because it is more likely that people in the workforce will lose their job during a recession, and I can more easily see the effect of the level and duration of unemployment benefits on search productivity. Moreover, during different recessions there are varying standards for the level and duration of unemployment benefits, so comparing different recessions is a straightforward way to answer my research question.

The recessions that I chose to isolate are named by the National Bureau of Economic Research as the early 1980s recession (1), early 1990s recession (2), early 2000s recession (3), and late 2000s recession (4). In 1979, the new Iranian government exported oil inconsistently and in a lower volume, driving prices up sharply. The US responded by tightening its monetary policy, leading to the early 1980s recession. The early 1990s recession happened after a period of strong economic growth in the late 1980s, leading to inflation that the Federal Reserve combated by raising interest rates. Tighter monetary policy along with the oil price shock of 1990, debt accumulation from the 1980s, and consumer pessimism produced a brief recession in the early 1990s. The early 2000s recession was brought on by the collapse of the dot-com bubble and the September 11th attacks. Finally, the most recent recession was caused by the subprime mortgage crisis, leading to the collapse of several major financial institutions. For estimation purposes, I used intervals that are six months wider than the officially defined intervals for each recession. The NBER dates peaks and troughs in business cycles, and a recession is defined as a period between a peak and a trough, or a decline in GDP for two or more consecutive quarters. I use an interval that is wider than the given interval because job loss can start before the recession is said to begin, and the six months after the end date will show a pick-up in economic activity during which individuals will find new jobs. With a wider interval, we are more likely to capture the “before” and “after” effects of each recession. Unfortunately, the causes and severity of each recession are different, so it is difficult to isolate the effect of the unemployment benefits solely by comparing the variables in each recession.

A few variables used for estimation had to be constructed, but most were available in the form presented in the summary statistics table (Table 1 in the Appendix). All the categorical variables are equal to 1 if the individual has some characteristic and 0 if not. Employment status is equal to 1 if the individual was associated with an employer or if he was active in the military. It is set equal to 0 if the individual was not working, unemployed, or out of the labor force. A higher value for employment status means that there were more weeks during which people were employed. Marital status is equal to 1 only if the individual is married. All other statuses such as cohabitation, divorce, single, etc. are set to 0. To convert the wages given in cents to dollars, I divided all the values by 100. All of the variables measured in money were deflated using the seasonally adjusted consumer price index for all urban consumers from the Federal Reserve Bank of St. Louis. The NLSY reports the hourly rate of pay at all jobs that the individual had in a given year. To construct the variable “earnings per week”, I first added the hourly rate of pay of all the jobs that the individual had. This could be up to five jobs for the 79 cohort and up to eight jobs for the 97 cohort. The surveys provided the weekly arrays for the number of hours worked each year. I multiplied the summed hourly wage for a particular year by the number of hours he or she worked in each week of that year. By doing this, I made the assumption that the individual’s hourly wage was constant for each week in a given year. This gave me an estimate for the earnings per week in every week of every year. The amount of unemployment benefits received per week was given

in a monthly array, so to convert that to a weekly array, I just assumed that if someone received unemployment benefits in a particular month, he received that amount for each week in that month. The variable “years of completed education” is the maximum education level that an individual achieved in his lifetime because some individuals did not complete their education until a few years after the surveys began. Finally, I created dummy variables for region and race for ease of analysis.

3.4 Summary Statistics

The subsample in Table 1 of the Appendix only consists of people who were employed at some point during the recession, and then became unemployed in that same period. Once they became unemployed, they began to receive weekly unemployment benefits, so we can measure the effect of the amount and duration of benefits on the time it takes to get a new job and the wage received at their next job. The data for each recession have similar qualities. They are all disproportionately urban and white, and the years of completed education are very similar across recessions, although this figure increases slightly as time passes. However, based on the age at interview, we can only meaningfully compare recession 1, recession 3 ('97 cohort), and recession 4. The age distributions for these recessions are shown in Figure 1 (Appendix). Recessions 2 and 3 cannot be used for comparison because the individuals in the cohort are too old. Age is directly correlated to the number of hours worked per week, employment status, and earnings per week. If we compared recessions 1 and 3 ('79 cohort) for example, we would not be able to draw any useful conclusions because age would be a confounding variable. Starting with the first column and ending at the third column, if we just look at age and hours worked per week, we can see that as these young men and women get older, they are more likely to be employed and working more hours per week. Weekly earnings are also significantly higher for the older individuals in columns 2 and 3. Being able to compare earnings is important for my analysis because benefits received are dependent on earnings. Therefore, I chose to compare regressions from recessions 1, 3 ('97 cohort), and 4.

3.5 Results

In Table 2, I present the correlations of 9 different regressions - 3 from each recession period. As predicted in the model, the coefficients in all the regressions are positive and significant. Increasing the amount of benefits received per week by one dollar increases the duration of spell in each recession by approximately 0.02 weeks. A one week increase in the duration of spell increased the post-unemployment weekly earnings by \$8.35 in the early 1980s, \$7.40 in the early 2000s, and \$12.07 in the late 2000s. The higher increase in the most recent recession could give an explanation for the long-term unemployment spells

that are being observed: if one more week of unemployment can increase post-unemployment weekly earnings by almost \$2 per hour, it makes sense that people would choose to receive unemployment benefits for a longer period of time with the hopes of receiving a high offer. Lastly, a one dollar increase in the amount of benefits received per week increases the post-unemployment weekly earnings by \$0.46 in the early 1980s, \$0.36 in the early 2000s, and \$0.38 in the late 2000s. Because a one dollar increase in benefits yields a less than one dollar increase in postunemployment weekly earnings, the results confirm previous studies results indicating that benefits are too high.

3.6 Estimation Issues

In order to use data to estimate the model, there are a few assumptions that need to be made. First, we are observing I individuals during periods $j = 1 \dots J$. Employment status is defined as follows:

$$\text{let } h_j = \begin{cases} 1 & \text{if the worker is employed in period } j \\ 0 & \text{if the worker is not employed in period } j \end{cases}$$

Next, the probability that an individual is unemployed in period t is given by the probability of getting an offer multiplied by the probability that the offer is not accepted plus the probability that he does not get an offer:

$$\Pr(h_t = 0 | \text{unemployment to } t) = P_t \Pr(\bar{U}_t < \zeta_t) + (1 - P_t) \quad (11)$$

Suppose that in the sample of I individuals, K of them are unemployed at $t_i - 1$ and $I - K$ of them remain unemployed until after period t for the duration l_i (they are incompletely observed). The likelihood function (i.e. probability of jointly observing the behavior in the sample):

$$L = \Pi_{i=1}^K \Pi_{j=1}^{t-1} (h_j^i = 0 | \text{unempl. to } j) \Pr(h_t^i = 1, \bar{U}_t^i | \text{unempl. to } t_i) \quad (12)$$

$$\times \Pi_{i=k+1}^I \Pi_{j=1}^{l_i} \Pr(h_j^i = 0 | \text{unempl.to } j)$$

$$L = \Pi_{i=1}^K \Pi_{j=1}^{t-1} [P_j \Pr(\bar{u}_j^i < \zeta_t^i) + (1 - P_j)] P_t \Pr(\bar{u}_j^i \geq \zeta_t^i) \quad (13)$$

$$\times \Pi_{i=k+1}^I \Pi_{j=1}^{l_i} [P_j \Pr(\bar{u}_j^i < s_j) + (1 - P_j)]$$

$$\begin{aligned}
&= \Pi_{i=1}^K \Pi_{j=1}^{t-1} (P_j \phi(\frac{\zeta_t - \bar{u}_j^{*i}}{\sigma_u}) + (1 - P_j) P_t [I - \phi(\frac{\zeta_j - \bar{u}_j^{*i}}{\sigma_u})]) \Pi_{i=k+1}^I \quad (14) \\
&\quad \times \Pi_{j=1}^{l_i} [P_j \phi(\frac{\zeta_t - \bar{u}_j^{*i}}{\sigma_u}) + (1 - P_j)]
\end{aligned}$$

4 Results

To estimate the maximum likelihood function, I used an exponential parametric survival model. Duration analysis begins by specifying a population distribution for the duration. For the population of people who became unemployed during each recession, I observed demographic variables such as education level and marital status, post-unemployment wages, and the benefits received during unemployment. Then I specified a distribution for the unemployment duration conditional on these explanatory variables. The duration variable is the number of weeks for which a person with a completed unemployment spell was unemployed. Failure occurs when a person accepts a job offer. Therefore, I only observed the time period beginning the week that an individual lost his job and ending the week that he accepted one and began to earn a wage, not the entire duration of the recession. Survival analysis enables us to see the effect of various independent variables, such as the level of unemployment benefits, on the survival probability, or how long it takes to get a job. In particular, the hazard function that is used in survival analysis allows me to approximate the probability of exiting unemployment, conditional on having remained unemployed up to the starting time of the interval.

The general model for the hazard rate is as follows:

$$\log(\lambda_i) = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_k x_{ik}$$

Assumptions are that the hazard rate is constant across time, and since the hazard rate will always be positive, the model is linear in the log of the hazard rate. For categorical variables, the exponential of the coefficient gives the relative risk for the groups. For continuous variables, the exponential of the coefficient gives the relative risk between two workers who differ by one unit on the independent variable. The constant gives the hazard rate for the baseline individual (dummy variables all equal 0).

The regression coefficients indicate the relationship between the states described by the explanatory variable and the hazard rate. The estimates are

consistent with my hypothesis. Benefits have a negative effect on the hazard rate, meaning that increased benefits reduce the probability that an individual will accept a job offer. The coefficient of -0.002 leads to a hazard ratio of $\exp(-0.002) = 99\%$, meaning that a one dollar increase in real weekly benefits is associated with a 99% higher hazard rate, or a longer survival time. This implies that there is indeed a moral hazard problem, but it is still unclear if people are using the extra time spent unemployed productively or if they are using the benefits to pay for leisure. Other important correlations to notice are the positive effects of education and living in an urban area, and the negative effects of being black compared to being white, being a woman, and being unemployed for a longer duration. The longer an individual is unemployed, the lower the probability that he will find a job. This observation is consistent with the theory that the long-term unemployed become less and less marketable because they lose relevant skills and the advantages of having a close network. However, we see this effect in a similar magnitude for all the recessions, meaning that the jobless recovery observed in the most recent recession is not solely due to this finding.

Secondly, I present a linear regression in Table 4 of the effect of search duration on the post-unemployment weekly earnings. My hypothesis is that individuals are more likely to reject job opportunities that offer low wages as the level of benefits increases. This is because as benefits increase, an individual's reservation wage also increases. An unemployed worker will only accept a job offer if the wage is higher than the reservation wage, as implied by the model. The estimates from the survival analysis show that there is a positive correlation between the level of benefits and the duration of search. Therefore, post-unemployment weekly earnings should be positively correlated with the duration of search if workers are actively searching for jobs during their period of unemployment.

The coefficients show that the relationship between the length of the unemployment spell and post-unemployment wages is minimal. After controlling for age, race, region, gender, and marital status, a one week increase in search duration does not even change post-unemployment weekly earnings by \$1 in the first two recessions, and reduces earnings by \$1.33 in the most recent recession. However, it is important to note that the summary statistics table (Table 1) indicates that greater amounts of benefits were collected in recessions 1 and 3 (columns 1 and 5, respectively). The coefficients for weeks unemployed for these two recessions are negative, showing that there is a slight negative relationship between search duration and post-unemployment wages. This suggests that after a certain optimal level, unemployment benefits are being used mainly to smooth consumption rather than to provide an extended opportunity for an unemployed worker to find another job that pays a satisfactory wage.

5 Conclusion

Estimates from the duration analysis of the structural search model imply that increased benefits lower the probability that a worker will exit unemployment, confirming previous research. A one dollar increase in unemployment benefits almost doubles the hazard rate for the individual, which may be an overestimate resulting from the characteristics of the data. An OLS regression of post-unemployment wages and search duration shows that a change in the length of unemployment does not change post-unemployment wages by a significant amount. Both of these results show that the level of unemployment benefits may have been too high at least since the early 1980s recession. If a one dollar increase in benefits led to at least a one dollar increase in post-unemployment wages, then the level of benefits would be appropriate. However, increased benefits are correlated with longer unemployment without any increase in post-unemployment wage, meaning that higher benefits are creating disincentive effects. All three recessions produced similar correlations, although I expected the relationships to be more pronounced for the most recent recession because of the jobless recovery phenomenon. My results may have been affected by the fact that the cohorts are relatively young and were most likely working entry level jobs, thereby providing insufficient variation in salary for a realistic analysis. Therefore, it seems that the elevated number of people who are considered long-term unemployed as a result of the late 2000s recession is not solely due to the aggressive extension of unemployment benefits, as these results are also seen in previous recessions. An extension of this research would be to estimate the level of effort that a worker is putting into the job search. This could be accomplished by running regressions with the number of interviews an individual had and the number of offers received as independent variables and benefits as the dependent variable, then comparing the correlations across recessions.

6 Appendix

Derivation of V_t for the normal case:

$$\begin{aligned} V_t &= P_t E[(\bar{U}_t^* + \varepsilon_t | U_t + \varepsilon_t \geq \zeta_t) \Pr(U_t + \varepsilon_t \geq \zeta_t) \\ &\quad + \zeta_t \Pr(\bar{U}_t + \varepsilon_t < \zeta_t)] + (1 - P_t) \zeta_t \end{aligned}$$

$$V_t = P_t E[\bar{U}_t^* | U_t + \varepsilon_t \geq \zeta_t] \Pr(U_t + \varepsilon_t \geq \zeta_t)$$

$$+ P_t E[\varepsilon_t | U_t + \varepsilon_t \geq \zeta_t] \Pr(U_t + \varepsilon_t \geq \zeta_t) + P_t \zeta_t \Pr(\bar{U}_t + \varepsilon_t < \zeta_t)] + (1 - P_t) \zeta_t$$

$$V_t = P_t \bar{U}_t^* \Pr(\varepsilon_t \geq \zeta_t - U_t) + P_t E[\varepsilon_t | \varepsilon_t \geq \zeta_t - U_t] \Pr(\varepsilon_t \geq \zeta_t - U_t)$$

$$+ P_t \zeta_t \Pr(\varepsilon_t < \zeta_t - \bar{U}_t) + (1 - P_t) \zeta_t$$

$$V_t = P_t \bar{U}_t^* [1 - \phi(\frac{\zeta_t - \bar{U}_t^*}{\sigma})] + P_t \sigma_u \phi(\frac{\zeta_t - \bar{U}_t^*}{\sigma}) + P_t \zeta_t \phi(\frac{\zeta_t - \bar{U}_t^*}{\sigma}) + (1 - P_t) \zeta_t$$

$$\text{let } \eta = \zeta_t - \bar{U}_t^*$$

$$V_t = P_t [\bar{U}_t^* [1 - \phi(\frac{\eta}{\sigma})] + \sigma_u \phi(\frac{\eta}{\sigma}) + \zeta_t \phi(\frac{\eta}{\sigma})] + (1 - P_t) \zeta_t$$

$$V_t = P_t [\bar{U}_t^* + \zeta_t \phi(\frac{\eta}{\sigma}) - \bar{U}_t^* \phi(\frac{\eta}{\sigma}) + \sigma_u \phi(\frac{\eta}{\sigma})] + (1 - P_t) \zeta_t$$

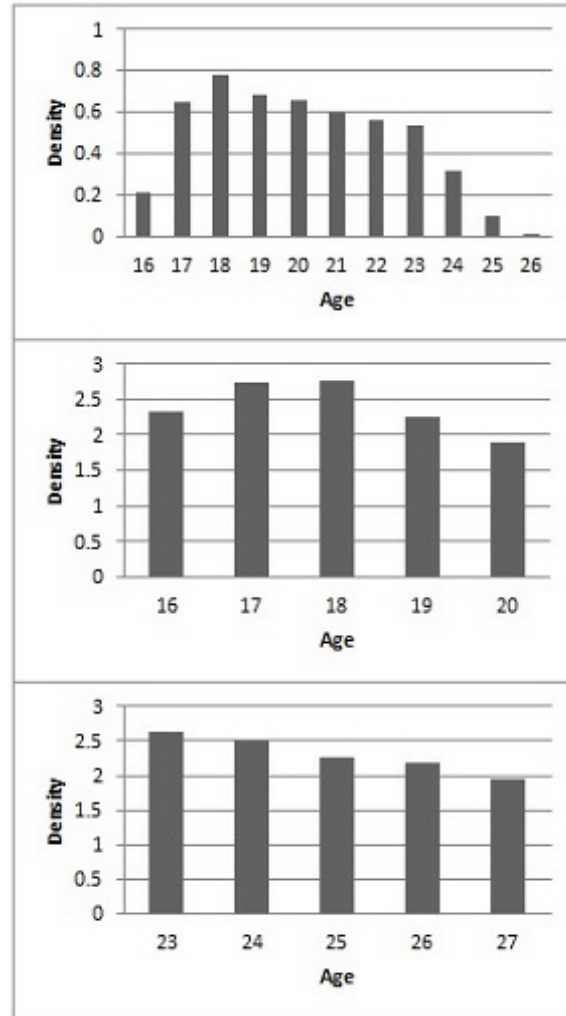
$$V_t = P_t [\bar{U}_t^* + (\zeta_t - \bar{U}_t^*) \phi(\frac{\eta}{\sigma}) + \sigma_u \phi(\frac{\eta}{\sigma})] + (1 - P_t) \zeta_t$$

Table 1: Summary Statistics

	1	2	3	4	5
Hrs. worked/wk	36.707	42.419	44.077	31.573	41.711
	(14.093)	(12.962)	(15.1013)	(17.045)	(15.670)
Empl. status	0.744	0.892	0.934	0.744	0.855
Years of educ.	12.993	13.110	13.242	13.755	13.894
	(2.1370)	(2.211)	(2.073)	(4.517)	(4.637)
Age	20.834	29.129	39.652	18.123	24.972
	(2.358)	(2.328)	(2.345)	(1.363)	(1.393)
Urban/rural	0.793	0.806	0.776	0.773	0.821
Earnings/week	558.037	1010.130	924.364	341.609	531.344
	(456.48)	(930.69)	(1047.23)	(268.78)	(282.65)
Benefits/wk	953.115	1698.088	1369.783	720.948	1086.958
	(253.09)	(1906.73)	(636.72)	(398.54)	(477.51)
Hispanic	0.154	0.166	0.191	0.209	0.217
Black	0.226	0.252	0.298	0.237	0.254
Mixed				0.009	0.009
White	0.620	0.582	0.511	0.545	0.521
Female	0.460	0.464	0.483	0.489	0.485
Marital status	0.2390	0.5324	0.6012	0.0551	0.259
Northeast	0.193	0.175	0.154	0.176	0.157
North central	0.231	0.231	0.241	0.236	0.213
South	0.371	0.393	0.414	0.367	0.400
West	0.205	0.202	0.192	0.222	0.230
Number obs.	1310894	904725	666471	630145	970169

Note: Standard deviations are in parentheses. Column 1 shows the early 1980s recession, column 2 is the early 1990s recession, column 3 is the early 2000s recession (NLSY79), column 4 is the early 2000s recession (NLSY97), and column 5 is the late 2000s recession. There are no standard deviations for dummy variables. Data are from the National Longitudinal Survey of Youth (NLSY) 1979 and NLSY 1997, which are conducted by the Bureau of Labor Statistics. Data for recessions 1 and 2 are from NLSY79 and data for recession 4 are from NLSY97. Both cohorts are used for recession 3. Employment status is equal to 1 if the individual is employed and 0 if not. Urban/rural is equal to 1 for urban and 0 for rural. Weekly earnings and weekly benefits are in real 2009 dollars. “Mixed (not Hispanic)” was not included as an option for race in NLSY79. Marital status is equal to 1 if the individual is married and 0 if not. The differences in the number of observations comes from the fact that the sample only includes individuals who had a job at some point during the recession, and then lost it.

Figure 1: Age Distributions of Comparable Recessions



Note: From top to bottom, the histograms are from the early 1980s recession (79 cohort), the early 2000s recession (97 cohort), and the late 2000s recession (97 cohort). These recessions are comparable because the age distribution of the people in the 1980s recession includes those from the later recessions. Since the age distributions of these three recessions are similar, other characteristics of the subsamples will be similar, like their hours worked per week, employment status, and wages.

Table 2: Correlations

	1	2	3
Benefits on duration of spell	0.023	0.022	0.018
	(0.000)	(0.000)	(0.000)
Number of obs.	7916	5056	3860
Adj. R-squared	0.440	0.422	0.377
Duration of spell on postunemployment wage	8.355	7.401	12.071
	(0.160)	(0.156)	(0.332)
Number of obs.	8192	5179	3299
Adj. R-squared	0.250	0.303	0.286
Benefits on postunemployment wage	0.456	0.363	0.379
	(0.004)	(0.004)	(0.005)
Number of obs.	7791	4776	3114
Adj. R-squared	0.625	0.588	0.684

Note: The three columns represent the recessions that were determined to be comparable based on age similarity of the members of the cohort. Column 1 is the early 1980s recession, column 2 is the early 2000s recession ('97 cohort), and column 3 is the late 2000s recession. To find the effect of benefits on the duration of spell, I used the maximum number of weeks of unemployment (longest spell) for each individual as the dependent variable and the average amount of benefits the person received during this spell as the independent variable. To find the effect of duration of spell on postunemployment wage, I regressed the number of weeks of longest spell on the wage received immediately after the spell ended. To find the effect of benefits on postunemployment wage, I regressed the average amount of benefits received during the longest spell on the wage received immediately after the spell ended.

Table 3: Survival Analysis of the Effect of Benefits on Search Duration

	1	2	3
Weekly benefits	-0.002	-0.001	-0.002
	(0.000)	(0.000)	(0.000)
Years of education	0.144	0.035	0.027
	(0.007)	(0.008)	(0.004)
Age	0.246	-0.010	-2.161
	(0.092)	(0.354)	(0.559)
Age squared	-0.001	0.003	0.045
	(0.002)	(0.010)	(0.011)
Urban/rural	0.317	0.122	0.088
	(0.038)	(0.045)	(0.052)
MSA	-0.003	0.004	0.032
	(0.014)	(0.027)	(0.033)
Black	-0.151	-0.007	-0.188
	(0.044)	(0.053)	(0.057)
White	0.343	-0.011	0.101
	(0.039)	(0.056)	(0.050)
Female	-0.904	-0.112	-0.337
	(0.037)	(0.055)	(0.039)
Married	0.372	0.035	0.296
	(0.039)	(0.081)	(0.045)
Northeast	0.131	-0.020	0.238
	(0.037)	(0.051)	(0.057)
North central	0.398	0.159	0.098
	(0.036)	(0.053)	(0.050)
West	-0.142	0.035	0.166
	(0.037)	(0.047)	(0.051)
Weeks unemployed	-0.059	-0.078	-0.080
	(0.001)	(0.002)	(0.002)
Constant	-7.257	-4.758	24.095

Note: The values in the table are coefficients, not hazard ratios. Standard errors are shown in parentheses. The time variable for the survival analysis is the number of weeks of the completed unemployment spell. The failure variable is employment status. When the individual becomes employed once the spell is over, that is considered failure. Column 1 is the early 1980s recession, column 2 is the early 2000s recession ('97 cohort), and column 3 is the late 2000s recession.

Table 4: OLS Regressions with Real Post-Unemployment Weekly Earnings as the Dependent Variable

	1	2	3
Weeks unemployed	-0.612	0.252	-1.330
	(0.034)	(0.050)	(0.049)
Age	30.777	31.864	7.448
	(0.401)	(0.732)	(0.908)
Black	-23.782	6.620	-8.373
	(2.082)	(2.220)	(2.878)
Female	-139.304	-80.357	-156.733
	(1.838)	(1.912)	(2.543)
Married	18.680	76.172	68.309
	(2.562)	(4.877)	(3.260)
Northeast	18.511	30.029	19.163
	(2.396)	(2.484)	(3.624)
West	54.312	17.632	77.734
	(2.323)	(2.473)	(3.173)
Constant	-140.692	-245.299	340.367
	(8.144)	(13.443)	(22.425)
Adjusted R-squared	9.78%	6.93%	11.96%

Note: Standard errors are shown in parentheses. Column 1 is the early 1980s recession, column 2 is the early 2000s recession ('97 cohort), and column 3 is the late 2000s recession. All coefficients are significant at the 5% level. Data are from the National Longitudinal Survey of Youth (NLSY) 1979 and NLSY 1997, which are conducted by the Bureau of Labor Statistics. Urban/rural is equal to 1 for urban and 0 for rural. MSA is equal to 1 if the individual lives in a Metropolitan Statistical Area, a geographical region with a relatively high population density at its core and close economic ties throughout the area, and 0 if the individual does not. Weekly earnings and weekly benefits are in real 2009 dollars. Marital status is equal to 1 if the individual is married and 0 if not. The regions "Northeast", "North central", and "West" refer to where the individual lived at the time of the survey.

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