Does the Moral Hazard Cost of Unemployment Insurance Vary with the Local Unemployment Rate? Theory and Evidence

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Abstract

We study theoretically and empirically how optimal Unemployment Insurance (UI) benefits vary with local labor market conditions. Theoretically, we derive the relationship between the moral hazard cost of UI and the unemployment rate in a standard search model. The model motivates our empirical strategy which tests whether the effect of UI benefits on unemployment durations varies with the local unemployment rate. In our preferred specification, a one standard deviation increase in the local unemployment rate reduces the magnitude of the duration elasticity by 32%. Using this estimate to calibrate the optimal level of UI benefits, we find that a one standard deviation increase in the unemployment rate leads to a 6.4 percentage point increase in the optimal replacement rate.

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1 Introduction

It is commonly accepted that higher unemployment benefits prolong unemployment durations (Moffitt 1985, Meyer 1990, Chetty 2008). Most of the evidence for this "moral hazard effect" comes from empirical studies that do not distinguish between changes in benefits when local labor market conditions are good and changes in benefits when local labor market conditions are poor.[1] If the moral hazard cost of Unemployment Insurance (UI) depends on local labor market conditions, this may imply that optimal UI benefits should respond to shifts in local labor demand. However, there exists little empirical evidence on measuring how local labor market conditions affect the moral hazard cost of UI, since many of the studies that conduct a welfare analysis of UI do not consider whether and to what extent UI benefits should vary with local labor market conditions (Baily 1978, Chetty 2006, Chetty 2008, Shimer and Werning 2007, Kroft 2008).[2] As Alan Krueger and Bruce Meyer (2002, p64-65) remark:

> [F]or some programs, such as UI, it is quite likely that the adverse incentive effects vary over the business cycle. For example, there is probably less of an efficiency loss from reduced search effort by the unemployed during a recession than during a boom. As a consequence, it may be optimal to expand the generosity of UI during economic downturns ... Unfortunately, this is an area in which little empirical research is currently available to guide policymakers.

Similarly, the Congressional Budget Office writes that the availability of long-term unemployment benefits "could dampen people's efforts to look for work, [but that concern] is less of a factor when employment opportunities are expected to be limited for some time."[3]

In this paper, we conduct both positive and normative economic analyses to investigate how local labor market conditions affect the moral hazard cost of UI. On the positive

[1] Chetty (2008) shows that it is misleading to interpret the behavioral response to UI benefits as a pure moral hazard effect, as part of the observed response could be coming through liquidity effects. In Section 3.2.1, we investigate the importance of liquidity effects and find no evidence that accounting for liquidity effects significantly alters our main results.

[2] Nicholson and Needels (2006) discuss how worsening labor market conditions in the U.S. in the 1970s and 1980s triggered large, policy-driven, increases in benefit payments.

[3] The CBO quote is pulled from the following URL: http://www.washingtonpost.com/wp-dyn/content/article/2010/03/08/AR2010030804927_pf.html.

side, we consider a standard job search model and show that the model implies a steady-state relationship between the disincentive effect of UI and the unemployment rate. We first consider workers who set a reservation wage and face an exogenous arrival rate of job offers. In this version of the model, the relationship between the unemployment rate and elasticity of duration with respect to the UI benefit level is theoretically ambiguous; however, when we calibrate the model using realistic parameter values selected from the literature, the duration elasticity is positively correlated with the unemployment rate.[4] This analysis suggests that the moral hazard cost of UI increases with the unemployment rate, contrary to the speculation of Krueger and Meyer (2002) as well as existing UI policy in the U.S. and many other developed countries.

We extend the search model to encapsulate the more realistic scenario where workers affect the job finding rate by increasing search effort. In this model with an endogenous job offer arrival rate, the elasticity of unemployment duration with respect to the UI benefits is the sum of behavioral responses of (a) reservation wages and (b) search effort. We show that whether moral hazard rises or falls with the unemployment rate depends on the relative importance of these two behavioral channels.

Recent empirical work on the behavioral responses to social insurance programs find that more generous benefits do not lead to higher wages (see Card, Chetty, and Weber 2007). Given that higher UI benefits raise durations, this leads us to suspect that the search effort channel is empirically more important than the reservation wage channel. We examine this question by calibrating the search model with endogenous search effort and considering how variation in local labor market conditions affects the duration elasticity. For different ranges of parameter values, the elasticity can be either positively or negatively related to the unemployment rate. This ambiguity is coming entirely through the search channel – the reservation wage component of the duration elasticity is always increasing with the unemployment rate. We thus conclude from our model and calibrations that the relationship between the duration elasticity and the local unemployment rate is ultimately an empirical

[4] Additionally, we show that we can resolve the theoretical ambiguity by making assumptions on the distribution of wages. If the distribution of wages has a non-increasing hazard rate (as would be the case if wage offers had a Pareto distribution), then the duration elasticity will be increasing in the unemployment rate.

question.

To empirically test how the duration elasticity varies with the local unemployment rate, we exploit variation in UI benefit levels within states over time and interact the effect of UI benefit generosity with the state unemployment rate.[5] Our findings indicate that the elasticity of unemployment duration with respect to UI benefits is significantly lower when the local unemployment rate is high. In our preferred specification, the elasticity of unemployment duration with respect to UI benefits is 0.741 (s.e. 0.340) at the mean unemployment rate. However, a one standard deviation increase in the unemployment rate (an increase of 1.68 percentage points) reduces the magnitude of the duration elasticity by 0.239 to 0.502 (a decline in magnitude of 32.3%). To interpret this finding as evidence that the moral hazard cost of UI falls with the unemployment rate, we conduct a variety of robustness tests to address concerns that the interaction effect we estimate is driven by compositional changes, unobserved trends, sample selection, and liquidity effects, and find no evidence that any of these concerns are primarily responsible for our effect. We therefore conclude that the association between the duration elasticity and the local unemployment rate indicates that the moral hazard cost of UI varies systematically with local labor market conditions.

Finally, we show that when the moral hazard cost of UI depends on local labor market conditions, this has important implications for the welfare consequences of UI. We develop a simple formula for the optimal level of unemployment benefits which takes into account how the behavioral response to UI benefits varies with local labor market conditions. The formula is stated in terms of our reduced-form parameter estimates and is thus in the spirit of the "sufficient statistics" approach to welfare analysis (Chetty 2009). The primary advantage of this method is that it can be implemented with relatively few parameter estimates.[6] Furthermore, these parameters can often be empirically estimated using a credible quasi-experimental research design. One disadvantage of this approach is that it is not well-suited to out-of-sample counterfactual analysis because the sufficient statistics are only valid

[5] In ongoing work we are constructing variation in state unemployment rates that is driven by plausibly exogenous shifts in local labor demand by following the procedure in Bartik (1991).

[6] We cannot conduct a full sufficient statistics analysis without reduced-form estimates of how the consumption smoothing benefits of UI vary with local labor market conditions. We hope that future work will build on Gruber (1997) and investigate this reduced-form effect.

for relatively "local" changes in the policy-relevant parameters. Using our reduced form empirical estimates to calibrate the optimal UI formula implied by our model, we find that a one standard deviation increase in the local unemployment rate leads to a 6.4 percentage point increase in the optimal replacement rate. To give a sense of the magnitude of this policy change, it is roughly equivalent to a one unit change in the coefficient of relative risk aversion in the model (e.g., from $\gamma = 2$ to $\gamma = 3$).

Several recent papers explore theoretically how UI benefits should vary with the unemployment rate (Kiley 2003, Costain and Reier 2005, Sanchez 2008 and Andersen and Svarer 2009). These papers differ in several respects. First, these papers take a structural approach to welfare analysis by imposing functional form assumptions characterizing how labor demand shocks affect search, while we take an approach in the spirit of the "sufficient statistics" literature, allowing us to use our reduced form estimates to calibrate our model. Second, our welfare analysis does not place any restrictions on the model primitives and is therefore valid for a wide range of underlying mechanisms which cause the duration elasticity to vary with unemployment. Third, these studies are primarily calibration analyses; they do not empirically estimate how the duration elasticity varies with local labor market conditions. Lastly, since these papers are mostly based on search models with no reservation wage decision, they do not highlight the distinction between the reservation wage and search effort elasticities.[7]

The remainder of the paper proceeds as follows. The next section develops the search model and describes both the agent and planner problems. Section 3 presents our empirical analysis which estimates how the behavioral response to UI varies with unemployment. Section 4 considers the welfare implications of our empirical findings. Section 5 concludes.

[7] This paper also contributes to a large empirical literature on the behavioral responses to UI by providing empirical evidence on how the elasticity of duration with respect to the benefit level varies with the unemployment rate. There are several papers in this area that indirectly relate to our work (Moffitt 1985, Arulampalam and Stewart 1995, Jurajda and Tannery 2003, and Røed and Zhang 2005).

2 Theory

In this section, we describe the setup of a standard continuous-time, infinite-time horizon, job search model. The model closely follows Shimer and Werning (2007). We make a number of simplifying assumptions for tractability. First, we focus on benefit level, not potential benefit duration, although the latter is clearly an important policy parameter.[8] Second, the model does not allow workers to save or borrow. Thus an unemployed worker's only way to smooth consumption across states is the unemployment insurance agency.[9] Third, we omit leisure. Forth, we assume that workers are homogeneous. Finally, we work in a partial equilibrium setting with no firms. In ongoing work, we are working to relax each of these assumptions and evaluate the robustness of our results to these extensions. We begin by considering a version of the model where the job offer arrival rate is exogenous. We then extend the model to allow for endogenous search. In both cases, we characterize the structural relationship between the moral hazard cost of UI and unemployment. We then exploit this relationship to show how the welfare gain of UI varies with unemployment.

2.1 The Agent and Planner's Problems

Agent's Problem With Exogenous Arrival Rate. Consider a single worker that who has flow utility given by $U(c)$, where $U' > 0$, $U'' < 0$. The worker's subjective discount rate is given by $r \geq 0$. The worker maximizes the expected present value of utility from consumption

$$E \int_0^\infty e^{-rt} U(c(t)) dt \tag{1}$$

If the worker is unemployed, she samples wages exogenously at rate λ from a known distribution function, $F(w)$. The distribution function possesses all of the properties that guarantee a solution exists. Workers who accept a wage offer commence employment immediately. Employment is assumed to end exogenously with separation rate s.

[8] Shimer and Werning (2007) find that socially optimal UI policy is infinite duration, constant benefits in both a hand-to-mouth model and one with free access to savings and lending.

[9] Since we assume that consumption during unemployment is equal to the UI benefit level and consumption during employment is equal to the net wage, there is full consumption-smoothing across time, within states.

If the worker is unemployed, she receives and consumes an unemployment benefit denoted by b. When the worker is employed, she earns a wage w and pays taxes equal to τ which is used to finance unemployment benefit payments. Thus, her consumption is equal to her net wage, $w - \tau$.[10]

Finally, we assume that the model is stationary. Thus, λ, s, $F(w)$, b, τ and r are all assumed to be independent of time. The expressions that we derive in this paper depend on this assumption. For example, if there is duration dependence such that the reservation wage varies in response to the failure to find a job, then the expressions below will not be valid. Empirically, we do not find evidence of duration dependence in our data.

Worker Behavior. We now characterize worker behavior subject to a particular policy (b, τ). Let V_u be the value function (maximal expected lifetime utility) of an unemployed individual and let $V(w)$ denote the value function of a worker who accepts a wage offer of w. The workers solves the following:

$$rV_u = U(b) + \lambda \int_0^\infty \max\{V(w) - V_u, 0\} dF(w) \tag{2}$$

$$rV(w) = U(w - \tau) + s[V_u - V(w)] \tag{3}$$

where rV_u is the (per period) flow value of being unemployed, which is the consumption value plus the expected capital gain of getting an acceptable wage draw in the future (i.e., the "option value"). An employed worker earns $w - \tau$ and then at rate s loses her job and changes states, which she values at $V_u - V(w)$. Rearranging equation (3) results in the following expression:

$$V(w) = \frac{U(w - \tau) + sV_u}{r + s}$$

The reservation wage, w_R, satisfies $V(w_R) = V_u$, implying that $V(w_R) = U(w_R - \tau)/r$.[11]

[10] We do not model the worker's intensive labor supply decision. Since workers supply labor inelastically in our model, taxes are non-distortionary.

[11] Note that $V(w_R) = V_u \implies V(w) - V_u = \frac{U(w-\tau) - U(w_R - \tau)}{r+s}$. Also, $V(w_R) = \frac{U(w_R - \tau) + sV_u}{r+s} = \frac{U(w_R - \tau) + sV(w_R)}{r+s} = \frac{U(w_R - \tau)}{r}$.

Substitution yields the following expression:

$$U(w_R - \tau) = U(b) + \frac{\lambda}{r+s} \int_{w_R}^{\infty} [U(w-\tau) - U(w_R - \tau)] dF(w) \tag{4}$$

Equation (4) is a standard expression in search models, which implicitly defines the reservation wage. The left-hand side of this equation represents the flow utility of accepting a wage offer of w_R. The right-hand side is the flow utility of rejecting a wage offer of w_R and waiting for a better wage draw. Note that $1/(r+s)$ represents the expected present value of a unit of income until a job ends. If there were no risk of job loss, this would be equal to $1/r$ which is the value of a perpetuity with payment of \$1. Therefore, the risk of job loss effectively increases the discount rate.

The job finding rate, p, is equal to the product of the job offer arrival rate and the probability of receiving an acceptable wage offer, $\lambda(1-F(w_R))$. The stationarity assumption implies that p does not depend on how long the agent has been unemployed, meaning that we can express expected duration, D, as $1/p$.

Planner's Problem. We consider a social planner whose objective is to maximize an unemployed worker's utility, V_u. We restrict the class of feasible policies to those where the unemployment benefit level, b, and the employment tax, τ, are constant. We assume that the worker may receive UI benefits so long as she is unemployed. The planner's policy must satisfy a balanced-budget requirement which means that expected benefits paid out equals expected taxes collected, $Db = \frac{\tau}{r+s}$.[12] The right-hand side is roughly equal to the expected tax collected from the worker when she is employed. We solve the planner's problem in two steps: first, we show how the effect of UI on durations depends on unemployment; second, we exploit this relationship to show that the optimal benefit level chosen by the planner depends on the level of unemployment.

[12] One may wonder why taxes are discounted, but unemployment benefits are not. This is because the government must pay benefits currently to a worker who is unemployed and receives taxes later, when the worker becomes employed.

2.2 Moral Hazard and Unemployment

In this reservation wage model, the moral hazard effect depends on responsiveness of reservation wages to benefits (Shimer and Werning 2007). This suggests evaluating this comparative static to see how the elasticity of duration with respect to the benefit level relates to the unemployment rate.

For simplicity, we start with the case where individuals are risk-neutral. Later, we will show how our main results generalize to the case of risk-averse workers. Define $u = \frac{s}{s+p}$ as the fraction of time a worker is unemployed or the unemployment rate.[13] The following lemma provides a simple expression for how the reservation wage responds to the benefit level.

Lemma 1 *For $r \approx 0$ and $U'' \approx 0$,*

$$\frac{\partial w_R}{\partial b} \approx u \tag{5}$$

This result is obtained by differentiating equation (4) with respect to the benefit level and applying Leibniz's rule for differentiation under an integral sign.[14] This expression is similar to the result obtained by Chesher and Lancaster (1983).[15] They were primarily interested in estimating the reservation wage and duration elasticities. In contrast, we are interested in using the search model to uncover the structural relationship between these elasticities and the unemployment rate.

There are several points worth making about expression (5). First, it implies we can measure the responsiveness of the reservation wage to changes in benefits in an extremely simple way – all that is needed is data on the unemployment rate.[16] For the U.S. over the period 1999-2009, $u \in [3.8\%, 10.1\%]$.[17] Feldstein and Poterba (1984) find empirically

[13] Note that u and D have a 1-to-1 mapping in this model since $D = 1/p$ fully determines u, given s.

[14] Note that we will always slightly underestimate $\frac{\partial w_R}{\partial b} = \frac{r+s}{r+s+p} \equiv u^*$. The approximation error is likely to be small. To see this, note that when the unit of time is one month, $p \approx .46, s \approx .04$ (Shimer 2007) and $r \approx .004$ (Shimer and Werning 2007). Since r is about 1/10 the size of s in practice, the error $(u^* - u)/u^* = .09 * (1-u)$. Thus, the error is bounded above by 9%.

[15] In their model, $s = 0$ implying employment is an absorbing state. Since they do not observe p/r in their data, they express this in terms of the reservation wage, the conditional expected wage, and the unemployment benefit level. Specifically, $\frac{p}{r} = \frac{w_R - b}{x - w_R}$.

[16] Estimating the elasticity of the reservation wage with respect to the benefit level requires additional information on benefit levels and reservation wages, at a given unemployment rate.

[17] Source: Bureau of Labor Statistics

that $\frac{\partial w_R}{\partial b} \in [13\%, 42\%]$. As we show below, the marginal effect is higher when agents are risk-averse, which means that these estimates imply that risk aversion is relevant.

Second, each individual can be thought of as having her own "unemployment rate" since she optimally chooses her re-employment probability, p, to some extent. However, data limitations prevent us from calculating this expression at the individual level. Thus, in practice, we rely on the average unemployment rate across individuals.[18]

Third, note that we are not expressing the individual's decision problem explicitly in terms of the unemployment rate to see how it affects her behavior. This is different from decision problems that explicitly model the impact of aggregate variables on individual outcomes.[19] Rather, the result follows from the fact that the search model implies a steady-state relationship between the responsiveness of the reservation wage to benefits and the unemployment rate.

To see the intuition for this expression, let's consider the effect of a benefit increase. The key insight is that this increases benefits *in every period* that an agent remains unemployed. In a bad labor market, an agent is more likely to be unemployed for a long time, holding the reservation wage constant. Therefore, she stands to gain more at the margin from the increase in benefits than would be the case in a strong labor market where she is likely to become employed in the near future. Thus when benefits are increased and local labor market conditions are poor (i.e., local unemployment rate is high), an agent who is unemployed will need a higher wage to induce her into the workforce than would be the case for an agent who faces very favourable local labor market conditions.

Recognizing that w_R is a measure of the private welfare of the unemployed (since $V_u = V(w_R) \propto U(w_R - \tau)$), then an implication of this result is that a marginal increase in benefits increases the unemployed's private utility more when unemployment is bad. Note however, that from a social welfare perspective, what matters is the consumption smoothing benefit of UI which is positive only when the agent is risk-averse, as shown formally below.

We have shown that we can unambiguously determine how the responsiveness of reserva-

[18] In ongoing work, we are constructing unemployment rates across observable demographic groups, using microdata from the CPS.

[19] For example, consider the consumer utility maximization problem where individual demand depends on the market price, which is determined in equilibrium.

tion wages to benefits varies with unemployment. The following proposition considers how the duration elasticity varies with unemployment:

Proposition 2 *For $r \approx 0$ and $U'' \approx 0$,*

$$\varepsilon_{D,b} \approx \theta(w_R)ub \tag{6}$$

where $\theta(w_R) \equiv \frac{f(w_R)}{1-F(w_R)}$ is the hazard rate (or failure rate) of the wage offer distribution.

Proof. Differentiating $D = 1/p$ with respect to b yields the following:

$$\begin{aligned} \frac{\partial D}{\partial b} &= \frac{\lambda f(w_R)}{p}\frac{\partial w_R}{\partial b}D \\ &= \theta(w_R)\frac{\partial w_R}{\partial b}D \\ &\approx \theta(w_R)uD \end{aligned} \tag{7}$$

where the last line follows from Lemma 1. The result follows by multiplying $\frac{\partial D}{\partial b}$ by b and dividing by D. ■

This expression is positive so that an increase in b raises w_R and increases D. The fact that benefits increase unemployment does not necessarily mean the individual is worse off. Since she *chooses* to be unemployed longer, by revealed preference, she must be better off from a private welfare standpoint.[20] Expression (6) shows that the duration elasticity depends on three factors: (1) the hazard rate of the wage offer distribution, (2) the unemployment rate and (3) the unemployment benefit level. How the duration elasticity varies with the unemployment rate depends crucially on how $\theta(w_R)$ varies with u.

We assume that F does not vary directly with the unemployment rate.[21] In order to sign this effect, we need to know how w_R varies with u and how $\theta(w_R)$ varies with w_R.[22]

[20] This does not imply that social welfare is increased since the agent imposes a negative externality on the government's budget. We return to the normative implications below.

[21] This assumption is consistent with the large macroeconomics literature that provides evidence showing that wages are acyclical (Bewley 1999).

[22] Chesher and Lancaster (1983) show that when the wage offer distribution for $w \geq b$ is Pareto, $\theta'(w_R) < 0$. On the other hand, when it is Normal, $\theta'(w_R) > 0$. More generally, any distribution that is log-concave will have a non-decreasing hazard function (see Burdett 1981).

Consider the relationship between w_R and u. The first thing to recognize is that w_R and u are jointly determined and therefore are not causally related.[23] This implies that their relationship will in general depend on the underlying sources of variation.[24]

Because $\frac{\partial \theta(w_R)}{\partial w_R}$ depends on the shape of the wage distribution, the relationship between the unemployment rate and the duration elasticity in a reservation wage model is theoretically ambiguous. According to Van den Berg (1994), most of the distributions used in structural job search analysis have hazards that are decreasing in w_R, $\frac{\partial \theta(w_R)}{\partial w_R} < 0$. In that case, then the model unambiguously predicts that the moral hazard cost of UI increases during recessions, in contrast to the hypothesis of Krueger and Meyer discussed in the introduction. We have also calibrated the model when wages are distributed log-normally, and we also find that the duration elasticity is positively related to the unemployment rate.[25]

Since the job offer arrival rate is exogenous, the relationship between the unemployment rate and the duration elasticity is determined solely through changes in reservation wage response. Below we consider a more realstic model where workers also choose search effort to affect the job offer arrival rate. Before we turn to this richer model, we briefly consider the case where workers are risk-averse, and we carry through the assumption that workers are risk-averse for the remainder of this section.

[23] This casts doubt on research that empirically estimates the relationship between unemployment or unemployment duration and reservation wages. As Jones (1988) points out, job search theory implies that most variables influencing employment probabilities given the reservation wage can be expected to also influence the reservation wage and as a result, the exclusion restriction is likely to be violated.

[24] As an analogy, consider the relationship between the equilibrium values of price and output. A positive demand shock increases price and output, so that the two variables are positively correlated. A negative supply shock on the other hand, increases price and lowers output, so that the two variables are negatively correlated. Variation in unemployment driven by local labor market conditions (e.g., variation in λ) will cause the responsiveness of the duration elasticity to local labor market conditions to depend on $\frac{\partial w_R}{\partial \lambda}$. In this model, $\frac{\partial w_R}{\partial \lambda} > 0$.

[25] The log-normal distribution does not have a monotonic hazard rate, so we cannot sign the association between the duration elasticity and the unemployment rate analytically. However, for a large range of plausible parameter values, we consistently found that the association was positive, just as when the wage offer distribution was Pareto.

2.2.1 Risk Aversion

With risk aversion, it can be shown that for small values of r

$$\frac{\partial w_R}{\partial b} \approx \frac{U'(b)}{U'(w_R - \tau)} u \tag{8}$$

Relative to the risk-neutral case, the marginal effect is amplified by the ratio of marginal utilities since $b < w_R - \tau$ and $U'' < 0$. Intuitively, a risk-averse agent values a guaranteed stream of unemployment benefits more than a risk-neutral agent and so is more sensitive to variations in her certain income. This also implies that

$$\begin{aligned} \frac{\partial D}{\partial b} &= \theta(w_R) \frac{\partial w_R}{\partial b} D \\ &\approx \frac{U'(b)}{U'(w_R - \tau)} \theta(w_R) u D \end{aligned} \tag{9}$$

Therefore,

$$\varepsilon_{D,b} \approx \frac{U'(b)}{U'(w_R - \tau)} \theta(w_R) u b \tag{10}$$

Thus, relative to the risk-neutral case, the duration elasticity is amplified by the ratio of the marginal utilities when unemployed and employed, respectively.

2.2.2 Incorporating Endogenous Search

The search model shows that UI benefits raise unemployment durations since they put upward pressure on reservation wages, which in turn reduces the probability that a worker gets an acceptable wage offer. Some empirical studies, however, have found that increases in benefits do not affect the distribution of accepted wage offers, implying that the effect on reservation wages is small (see Card, Chetty, and Weber 2007).[26] In this section, we allow for the possibility that individuals can affect the job offer arrival rate through costly search effort (Rogerson, Shimer, and Wright 2005). This provides an additional channel through which UI benefits can increase the length of unemployment spells.

[26] One can show that the expected wage satisfies $E_w[w|w \geq w_R] = w_R + \frac{\int_{w_R}^{\infty}[1-F(w)]dw}{1-F(w_R)}$. Thus, if benefits do not affect average wages, they must not affect reservation wages.

Let search effort be denoted by e and let the arrival rate be given by $\lambda(e)$, where $\lambda' \geq 0$ and $\lambda'' \leq 0$. In this case, it can be shown that

$$\varepsilon_{D,b} = \theta(w_R)\frac{\partial w_R}{\partial b}b - \delta(e)\frac{\partial e}{\partial b}b \tag{11}$$

where $\delta(e) \equiv \frac{\lambda'(e)}{\lambda(e)}$. Clearly, how the duration elasticity varies with unemployment depends crucially on how $\frac{\partial e}{\partial b}$ varies with u in addition to how $\frac{\partial w_R}{\partial b}$ varies with u. Thus, adding search intensity to the model potentially changes how moral hazard varies unemployment. The first part of expression (11) is simply the duration elasticity with no search decision. The second term of expression (11) shows that the duration elasticity with search depends on how UI benefits distort search effort ($\frac{\partial e}{\partial b}$) as well as on how the arrival rate varies with search effort ($\delta(e)$). The key "behavioral" parameters of this expression are $\frac{\partial w_R}{\partial b}$ and $\frac{\partial e}{\partial b}$; the terms $\theta(w_R)$ and $\delta(e)$ primarily depend on the economic environment and are only indirectly affected by the behavioral effects.

To analyze the marginal effects in this expression, we need to study the optimality conditions for search and the reservation wage. We assume that the search cost, denoted by $\psi(e)$, is strictly increasing and convex and is separable from consumption utility.[27] To simplify the algebra, it will be convenient to define the *surplus function* $\varphi(w_R) \equiv \int_{w_R}^{\infty}[U(w-\tau) - U(w_R-\tau)]dF(w)$. This represents the difference between the optimized values of employment and unemployment. Intuitively, it measures a worker's expected utility when employed relative to her "reservation employment utility" – the utility she receives at the wage she is just willing to accept to become employed.

We will use the following property of the surplus function, $\frac{\partial \varphi(w_R)}{\partial w_R} = -(1-F(w_R))U'(w_R-\tau)$. This is negative since holding the distribution of wages fixed, a worker gets less surplus when her reservation utility is higher. We show below that $\frac{\partial w_R}{\partial b} > 0$ implying $\frac{\partial \varphi(w_R)}{\partial b} < 0$. Intuitively, an increase in unemployment benefits raises the value of unemployment and hence the reservation wage, and in turn lowers the expected net surplus from employment. In a consumer demand setting, this would be represented by an inward shift of the demand curve

[27] While the separability between search and consumption simplifies the analytics, it may be the case that unemployed individuals affect the job offer arrival rate by changing consumption. This formulation would affect the welfare analysis. In ongoing work, we are studying the effects of incorporating this generalization.

which lowers consumer surplus for a fixed market price. Note that one can also show that $\frac{\partial \varphi(w_R)}{\partial \lambda} < 0$. Intuitively, a higher arrival rate increases the option value of unemployment. The implicit equation for the reservation wage can be written compactly as

$$U(w_R - \tau) = U(b) - \psi(e) + \frac{\lambda(e)}{r+s}\varphi(w_R)$$

The optimal e can be found by maximizing $U(w_R - \tau)$. The first-order condition assuming an interior optimum is

$$\psi'(e) = \frac{\lambda'(e)}{r+s}\varphi(w_R) \tag{12}$$

Thus, the optimal search level equates the marginal cost of effort (left-hand side) with the marginal value of effort (right-hand side). The marginal value of effort depends on the marginal increase in the likelihood of obtaining a job in response to an increase in effort and the expected discounted surplus of getting a job. Note that searching harder only affects the likelihood of getting an offer, but does not affect expected income, conditional on getting a job.[28] The model therefore predicts that a positive shift in local labor demand increases search intensity of the unemployed. In other words, search intensity in this model is negatively correlated with unemployment.

Substituting this equation into the reservation wage equation yields the following expression:

$$U(w_R - \tau) = U(b) + \frac{\lambda(e)}{\lambda'(e)}\psi'(e) - \psi(e) \tag{13}$$

The conditions (12) and (13) comprise a system of equations, which implicitly (and jointly) determine the optimal reservation wage and the optimal level of search effort, as functions of the level of UI benefits. We can differentiate this system with respect to b to solve for $\frac{\partial w_R}{\partial b}$ and $\frac{\partial e}{\partial b}$.

Proposition 3 *Assume r is small. The marginal effects with endogenous search intensity satisfy*

$$\frac{\partial w_R}{\partial b} = \frac{U'(b)}{U'(w_R - \tau)}u \tag{14}$$

[28] This follows from the assumption that search effort affects only the arrival rate, not the wage distribution.

$$\frac{\partial e}{\partial b} = -\frac{\delta(e)(1-u)U'(b)}{\psi''(e) - \frac{\lambda''(e)}{s}\varphi(w_R)} \tag{15}$$

Proof. See Appendix A. ■

First, consider the expression for $\frac{\partial w_R}{\partial b}$. Note that adding endogenous search effort does not change the formula for how the reservation wage responds to the benefit level. However, $\frac{\partial w_R}{\partial b}$ still depends on search effort indirectly through u and w_R. Next, consider the expression for $\frac{\partial e}{\partial b}$. Note that $\frac{\partial e}{\partial b} < 0$; that is, an increase in benefits lowers the marginal gain of search since it decreases expected surplus from employment, $\varphi(w_R)$. The magnitude of this decrease in search effort is determined by three factors: (1) the initial shift in the marginal benefit curve $(-\delta(e)(1-u)U'(b))$, (2) the slope of the marginal cost curve (ψ'') and (3) the slope of the marginal benefit curve $(\frac{\lambda''(e)}{s}\varphi(w_R))$.

To interpret the shift in the marginal benefit curve, recall that the marginal benefit curve as a function of effort is given by $\frac{\lambda'(e)}{r+s}\varphi(w_R)$. Therefore, the shift in response to a change in the level of benefits, for a fixed level of effort, depends on the magnitude of $\frac{\lambda'(e)}{r+s}$ and also on how $\varphi(w_R)$ responds to a change in benefits. The first term which relates to $\delta(e)$ illustrates that the location of the curve matters for the size of the shift. Intuitively, a small value for $\delta(e)$ implies that the arrival rate does not respond much to a marginal increase in effort, lowering the level of the marginal benefit curve and essentially placing a bound on how distortionary benefits can be. To see why the employment rate $1-u$ matters, consider the case where $s \to \infty$, so that $u = 1$. In this case, there is no chance of actually being employed so workers essentially put no weight on expected surplus from employment. That the shift depends on $U'(b)$ follows since this term characterizes how $\varphi(w_R)$ responds to the benefit level.

That $\frac{\partial e}{\partial b}$ depends on the slopes of the curves follows from any standard marginal analysis. If ψ'' is large at a given level of search effort, this means that marginal cost curve is inelastic. As a result, a given reduction in the marginal benefit curve due to an increase in benefits has less of an impact on search effort. Similarly, the effort response depends on the slope of the marginal benefit curve, which is pinned down by λ''. A small value for λ'' implies that the marginal benefit curve is more elastic; hence a reduction in benefits have a larger effect on search.

Examining expression (15), we can see that a decline in local labor demand can impact the distortionary effect of UI benefits on search through it's effect on $\delta(e)(1-u)$.[29] Clearly, a negative labor demand shock is going to increase the unemployment rate, so the sign of the effect ultimately depends on how the shock affects $\delta(e)$. As a reminder, $\delta(e)$ represents the *percentage change* in the job offer arrival rate from an additional unit of search. A larger value of $\delta(e)$ means that search is more productive. Thus, the key determinant of the comparative static is whether search is more productive on the margin in a weak or strong local labor market. In a weak market, we would expect $\lambda(e)$ to be small, which would act to increase $\delta(e)$. On the other hand, $\lambda'(e)$ is also likely to be smaller which lowers $\delta(e)$, so the net effect depends on the rate at which $\lambda'(e)$ falls relative to $\lambda(e)$. As Kiley (2003) discusses, it is possible to specify functional forms so that the net effect can go either way. As a result, the question is ultimately an empirical one. We calibrate the model below by assuming a particular functional form, $\lambda(e) = \overline{\lambda} + \lambda e$. Here $\lambda'(e)$ falls at rate 1 with λ and $\lambda(e)$ falls at rate $e + \lambda\frac{\partial e}{\partial \lambda}$. So, the net effect depends on whether $e(1 + \frac{\lambda}{e}\frac{\partial e}{\partial \lambda}) > 1$. With this functional form assumption, $\lambda'' = 0$ giving

$$\frac{\partial e}{\partial b} = -\frac{U'(b)}{\psi''(e)}\delta(e)(1-u)$$

To see what this implies about the duration elasticity, let's plug the marginal effects into the elasticity formula[30]:

$$\varepsilon_{D,b} = \frac{U'(b)}{U'(w_R - \tau)}\theta(w_R)ub + \frac{U'(b)}{\psi''(e)}(\delta(e))^2(1-u)b \tag{16}$$

This expression shows that whether moral hazard increases or decreases in a recession depends on the relative strength of the reservation channel and search channel. We present a calibration in the next section that is an attempt to disentangle these two channels and also show independently how they vary with the unemployment rate.[31]

[29] It is possible that the recession affects the term $\frac{\lambda''(e)}{s}\varphi(w_R)$, although signing this effect seems less intuitive.

[30] Note that this is the partial elasticity, which captures the effect of a change in benefits on expected duration, holding taxes constant.

[31] In future work, we will allow the distribution of wages to also vary with local labor demand conditions.

2.3 Calibrating $\varepsilon_{D,b}$

Our expression for $\varepsilon_{D,b}$ demonstrates there are two channels by which unemployment can impact moral hazard. This section evaluates the duration elasticity numerically by calibrating the model in the previous section. The calibration sheds light on the plausible quantitative impact of the local unemployment rate on the duration elasticity before turning to the empirical results.

2.3.1 Functional Form Assumptions

In what follows, we rely on Chesher and Lancaster (1983), Shimer (2007) and Chetty (2008). A unit of time for the calibrations is a week. For all of these calculations, we assume $r = 0$.

Wage Offer Distribution. We assume wages are distributed log-normally, with mean weekly wages of \$300 and the standard deviation of weekly wages is \$240. In the Appendix, we follow Chesher and Lancaster (1983) and assume that the wage offer distribution is Pareto.

Arrival Rates. We assume that the arrival rate takes a linear form, $\lambda(e) = \overline{\lambda} + \lambda e$. Separations end exogenously at rate s. Shimer (2007) reports estimates for the job finding and separation probabilities. There is a simple connection between the rates and probabilities. To see this, note that the probability that a worker has not found a job after a spell of length t is $P = e^{-Ht}$, where $H = \lambda(1 - F(w_R))$. Therefore the job finding probability is $1 - P = e^{-(1-H)t}$. It follows that the job finding rate is $-\log(1 - P)$. There is a similar connection between the separation probability and the separation rate. Shimer (2007) finds that the average monthly separation probability in the US from 1948 to 2004 is 0.035. This delivers a separation rate of .02. Converting this to a weekly rate yields $s = .00387$.

UI Benefits. Assume benefits are equal to $b = r \times E[w]$. Following Chetty (2008), we take $r = 0.5$. For these simulations, we assume no taxes, so $\tau = 0$.

Preferences over consumption. Assume that $U(c) = \frac{c^{1-\gamma}}{1-\gamma}$, where $\gamma > 0$ is the risk aversion parameter (As $\gamma \rightarrow 1$, $U(c) \rightarrow \log c$). We follow Chetty (2008) by choosing $\gamma = 1.75$.

Search Effort. We let search costs as a function of effort be denoted by $\psi(e) = \phi\frac{e^{1+\kappa}}{1+\kappa}$, where ϕ is a scaling parameter. The elasticity of search costs with respect to search effort is $1+\kappa$. So a higher κ increases the marginal cost of search and lowers search effort.

2.3.2 Results

Tables 1 and 2 show the results from our calibration. The experiment we consider is to exogenously vary the term λ in the fuction $\lambda(e) = \overline{\lambda} + \lambda e$. Each column in the table represents a different value of λ. To shed some light on the underlying mechanisms, we report the total duration elasticity in equation (16) as well as each of the two terms that comprise the duration elasticity, separately.

In Table 1 we choose a low value of $\overline{\lambda}$ (= 0.02). Looking across the second row ($\varepsilon_{D,b}^{w_R}$), it is clear that an increase in λ increases the responsiveness of reservation wages to UI benefits. The third row ($\varepsilon_{D,b}^{e}$) shows that an increase in λ increases the responsiveness of search effort to UI benefits. Since both move in the same direction, the duration elasticity also increases as λ increases, causing the duration elasticity to be increasing in the unemployment rate. As a result, in this calibration, the moral hazard cost of UI *increases* with the unemployment rate.

Table 2 reports results choosing a higher value of $\overline{\lambda}$ (= 0.1). In this table, we can see looking across the second row ($\varepsilon_{D,b}^{w_R}$) that an increase in λ increases the responsiveness of reservation wages to UI benefits, just as with Table 1. However, unlike Table 1, the third row ($\varepsilon_{D,b}^{e}$) of Table 2 shows that an increase in λ *decreases* the responsiveness of search effort to UI benefits. In this calibration, the search effort effect dominates the reservation wage effect, so that the duration elasticity also decreases as λ increases, causing the duration elasticity to be decreasing in the unemployment rate. As a result, in this calibration, moral hazard *decreases* with the unemployment rate.

This analysis demonstrates the importance of incorporating endogenous search intensity, and that the precise way in which local labor market conditions affect the returns to search effort ultimately determines whether moral hazard increases or decreases with the unemployment rate.

We now turn to what these results imply for optimal policy. In practice, to examine how moral hazard varies with unemployment, we do not need to separately identify the responsiveness of the reservation wage and search intensity to benefits; we only need to identify the duration elasticity. This motivates our empirical strategy, described later, which explores how the duration elasticity varies with the unemployment rate. The next section presents a welfare analysis to show how the optimal benefit level varies with the local labor market conditions.

2.4 Welfare Analysis: Optimal Unemployment Benefits

The social planner solves the following problem

$$\max_{b,\tau} V_u$$

$$s.t.\ Db = \frac{\tau}{r+s}$$

Since $V_u = U(w_R - \tau)/r$, the planner's problem is simply to maximize the worker's after-tax reservation wage, $w_R - \tau$. The following theorem characterizes the optimal benefit level.

Theorem 4 *The optimal benefit level satisfies the following condition:*

$$\frac{U'(b) - U'(w_R - \tau)}{U'(w_R - \tau)} = \varepsilon_{D,b} \tag{17}$$

Proof. See Appendix A. ■

An instructive derivation of this first-order condition is as follows.[32] Let $\overline{g} = \frac{U'(b)}{U'(w_R - \tau)}$ be the amount such that, the government is indifferent between giving \$1 to someone who is unemployed and $\overline{g}$ to someone who is employed. Next, consider a \$1 increase in benefits. This has a mechanical effect on UI expenditures and a behavioral response. The mechanical effect, M, is given by Ddb. The change in expenditures due to behavioral responses, B, is given by $\frac{\partial D}{\partial b} bdb = \varepsilon_{D,b} \frac{D}{b} db$. To obtain the optimal benefit level, we must equalize the expenditure effect, $M + B$, with the welfare effect. A simple application of the envelope theorem implies that the welfare effect is given by $\overline{g}M$. That is, each additional dollar raised by the government to finance UI benefits reduces on average social welfare of the employed

[32] This derivation closely follows the derivation of the optimal top tax rate in Saez (2001).

by $\overline{g}M$. Thus, at an optimum, $(1-\overline{g})M + B = 0$. Rearranging this equation delivers the result.

The test for the optimality of UI benefits compares the difference in consumption between an unemployed worker and a worker employed at her reservation wage with the moral hazard cost of social insurance. This is slightly different than the consumption-based test in Chetty (2006) as the consumption smoothing measure here corresponds to the difference between the lowest acceptable level of consumption while employed and consumption while unemployed, rather than the difference between average consumption while employed and unemployed. The reason for this difference is due to the difference in the maximand in the social planner's problem. In Chetty (2006), the maximand is expected utility. Thus, the social planner trades off consumption utility between the states of employment and unemployment. In this model, the maximand is an unemployed worker's utility. The social planner trades off current consumption utility with the change in utility (surplus) that occurs if the worker becomes employed.

Two final points are worth mentioning. First, since consumption when employed exceeds the net reservation wage, the optimal benefit level in this setting is lower than the optimal benefit level if the planner was interested in maximizing expected utility. The reason is because insurance is more valuable when the state of nature has yet to be realized. Finally, in practice, $\varepsilon_{D,b}$ will not be zero, so we will have $b < w_R - \tau$.

2.4.1 The Optimal Benefit Level and Unemployment

To see how the optimal benefit level varies with the unemployment rate, we need to consider how both sides of equation (17) vary with unemployment. Since we already considered how the moral hazard cost of UI varies with unemployment, let us focus our attention on how the consumption smoothing or insurance effect varies with unemployment. Unemployment has an effect on the left-hand side of equation (17) that operates through the balanced-budget constraint. To see this, consider the case where UI benefits are not distortionary. The government budget constraint implies that for $r = 0$,

$$\frac{\partial \tau}{\partial b} = \frac{u}{1-u}$$

Thus, when unemployment is high, more taxes need to be raised to finance a given level of benefits. This shows that the insurance effect depends indirectly on labor market conditions. In particular, this implies that benefits should fall when unemployment increases. To see this, note when unemployment increases for a given level of benefits, to satisfy the balanced-budget condition, taxes must increase on the employed. This lowers the marginal utility of consumption for the employed relative to marginal utility of consumption for the unemployed (e.g., $w_R - \tau$ is reduced); in order to restore optimality, benefits need to be reduced. Andersen and Svarer (2009) label this a "budget effect" since the effect comes purely from the need to satisfy the budget constraint.

Let us consider how the optimal benefit level b^* varies with the job offer arrival rate $\lambda(e)$. This is given in the following collary.

Corollary 5 *The effect of a change in the offer arrival rate on the optimal benefit level is given by*

$$\frac{\partial b^*}{\partial \lambda} = \frac{U''(w_R - \tau)\frac{\partial (w_R - \tau)}{\partial \lambda}\varepsilon_{D,b} + U'(w_R - \tau)\frac{\partial \varepsilon_{D,b}}{\partial \lambda}}{U''(b)} \tag{18}$$

The proof follows from differentiating condition (17) with respect to $\lambda(e)$. The first term in expression (18) represents the budget effect. Since $U'' < 0$ and $\frac{\partial (w_R - \tau)}{\partial \lambda} > 0$, the budget effect causes benefits to be lower when unemployment is higher. The second term is the effect on distortions. If the moral hazard effect of UI increases with the job finding rate (when unemployment is low), this term causes benefits to be higher when unemployment is high. Thus, the net effect of unemployment on the optimal benefit level depends on the relative strengths of the budget effect and the distortion effect. Once we have empirical estimates of how the duration elasticity varies with local labor market conditions, we can use the estimates to calibrate the social planner's optimal UI problem to compute how UI benefit levels should optimal respond to local labor market conditions. The next section describes our empirical strategy which estimates how the duration elasticity varies with unemployment.

3 Estimation Strategy and Data

Our empirical strategy consists of two parts: (1) graphical evidence and nonparametric tests of survival curves and (2) semi-parametric estimates of proportional hazard models (Cox models). The empirical strategy closely follows Chetty (2008).

We use unemployment spell data from the SIPP spanning 1985-2000. We impose the same restrictions as in Chetty (2008): we focus on prime-age males who (a) report searching for a job, (b) are not on temporary layoff, (c) have at least three months of work history, and (d) took up UI benefits. We focus on two alternative proxies for individual's actual UI benefits: (1) average benefits for each state-year pair and (2) maximum weekly benefit amount. In ongoing work, we are working to implement an instrumental variables hazard model, where the goal is to construct a simulated instrument which isolates policy variation in individual UI benefits that is driven purely by change in UI laws (Gruber 1997).

3.1 Graphical evidence and nonparametric tests

We begin by providing graphical evidence on the effect of unemployment benefits on durations. We split the sample into two sub-samples, according to whether individuals begin their unemployment spell in states with above-median unemployment or in states with below-median unemployment. Each year we define the median unemployment rate across states. We categorize a state as having either above or below median unemployment that year. We assign unemployment ratess to unemployment spells based on the unemployment rate in the state that the individual resides in when the spell began, using monthly data on state unemployment rates. We also categorize unemployment spells based on whether the UI benefit level in a given state and year is above or below the median UI benefit level for that year.

Figures 1 and 2 show the effect of UI benefits on the probability of unemployment for individuals in above-average and below-average unemployment state-years, respectively. In each figure, we plot Kaplan-Meier survival curves for individuals in low-benefit and high-benefit states.[33] The results in figure 1 show that the curves are fairly similar in both

[33] Following Chetty (2008), the plotted curves are adjusted for the "seam effect" in the SIPP panel data,

low-benefit and high-benefit states when the unemployment rate in a state-year is above the median unemployment rate. The curve in high-benefit states is slightly higher, indicating that UI benefits may marginally increase benefits, but a nonparametric test that the curves are identical does not reject at conventional levels ($p = 0.156$). By contrast, in figure 2 the curves are noticeably different; in particular, the durations are significantly longer in high-benefit states, and the difference between the survival curves is strongly statistically significant ($p < 0.001$).

These figures show that the moral hazard effect of UI benefits depends crucially on whether unemployment is high or low. In particular, our findings suggest that the effect of UI benefits on durations is not statistically significant when the unemployment rate is high but is strongly statistically significant when the unemployment rate is low.[34] These comparisons are based on simple comparisons across spells. It is possible, however, that the characteristics of individuals vary with unemployment rate in a way that would bias these comparisons. To investigate this potential bias, the next subsection reports semi-parametric proportional hazard models which include a rich set of individual-level controls. The results from the hazard models are broadly consistent with the results based on these figures.

3.2 Semiparametric Hazard Models

We investigate robustness of graphical results by estimating a set of Cox proportional hazard models in Tables 4 through 8.[35] Each table reports results with alternative sets of control variables in the columns. The baseline estimating equation is the following:

$$\log d_{i,s,t} = \alpha_t + \alpha_s + \beta_1 \log(b_{i,s,t}) + \beta_2(\log(b_{i,s,t}) \times u_{s,t}) + \beta_3 u_{s,t} + \mathbf{X}_{i,s,t}\Gamma + e_{i,s,t} \tag{19}$$

but the test that the survival curves are identical is fully nonparametric and does not make this adjustment.

[34] We have also looked at the subsample of workers with above-median liquid wealth, and we find broadly similar results (see Appendix Figures A1 and A2). These results suggest that liquidity effects are not primarily accounting for the differential duration elasticity between high and low unemployment, which is broadly consistent with our results in Table 7, described below.

[35] We are looking into alternative semiparametric hazard models to broaden the scope of the empirical analysis. Concerns have been raised that Cox models may not be reliable in the presence of ties. As such, we are going to report Han-Hausman estimates which are more reliable when the number of ties is large relative to the sample size.

where $d_{i,s,t}$ is the duration of the unemployment spell, α_t and α_s represents year and state fixed effects, $b_{i,s,t}$ is the unemployment benefit for individual i at start of spell, $u_{s,t}$ is the state unemployment rate at the start of the spell and $\mathbf{X}_{i,s,t}$ is a set of (possibly time-varying) control variables.[36] The unemployment rate at the start of the spell is de-meaned so that the coefficient β_1 gives the elasticity of unemployment durations with respect to UI benefits at average levels of unemployment. The coefficient on the interaction term (β_2) gives the incremental change in the duration elasticity for a one percentage point change in the state unemployment rate.

Before turning to our regression results, we present descriptive statistics in Table 3. The table presents summary statistics for the overall sample and the two sub-samples used to create figures 1 and 2. One can see that in high unemployment states, average income, education, the fraction married, UI benefits, are all lower than in low unemployment states. Individuals are also slightly older in these states. Since the distribution of observables is different across the two samples, one question that arises when considering how the duration elasticity varies with unemployment is whether this relationship is coming from "selection" (i.e., compositional changes in the unemployed population due to changes in the local labor market conditions) and how much of it is coming from an actual change in the behavioral response. This will depend on the extent to which the duration elasticity varies directly with demographics, which we investigate in detail in Table 6 below.

The main results are reported in Table 4. Column (1) of Table 4 reports results of a specification broadly similar to the previous literature (Moffitt (1985), Meyer (1990), Chetty (2008).[37] This specification controls for age, marital status, years of education, a full set of state, year, industry and occupation fixed effects, and a 10-knot linear spline in log annual wage income. The results indicate that the elasticity of durations with respect to the UI

[36]The notation of the estimating equation is a simplified presentation of the actual model. The actual (latent) hazard rate is the true left-hand side variable, but is not actually observed in the data; additionaly, there is a flexible (nonparametric) baseline hazard rate which is also estimated when fitting the Cox proportional hazard model. Following Chetty (2008), we fit a separate baseline hazard rate for each quartile of net liquid wealth, although our results are similar when a single nonparametric baseline hazard rate is estimated instead.

[37]The results are not identical to Chetty (2008) because of slightly different sample restrictions, the inclusion of the state uemployment rate as an additional control, and becauase we estimate a more flexible baseline hazard function (where we nonparametrically estimate a separate baseline hazard for each quartile of net liquid wealth).

benefit level is -0.651 (s.e. 0.318) and the estimate is statistically significant at conventional levels ($p = 0.041$). Column (2) reports estimates of equation (19) above. This column includes the same set of controls in column (1) and estimates the same hazard model; the only difference is the addition of an interaction term between the UI benefit level and the state unemployment rate. The coefficient on the interaction term (β_2) represents the change in the duration elasticity for a one percentage point increase in the state unemployment rate. The results in column (2) show an estimate of β_2 of 0.142 (s.e. 0.068). The bottom two rows show an alternative way to interpret the interaction term. These rows report the duration elasticity and one standard deviation above and below the mean unemployment rate. At one standard deviation below the mean, the duration elasticity is 0.502 (s.e. 0.326), while at one standard deviation above the mean the duration elasticity is 0.980 (s.e. 0.388). These results imply that the moral hazard effect of UI varies significantly with unemployment, and that the magnitude of the duration elasticity is decreasing with local labor market conditions.

3.2.1 Robustness Tests

Alternative Measures of Interaction Term. Table 5 reports results which replace the interaction of UI benefit generosity (average weekly benefit amount) and the state unemployment rate with alternative measures of each variable in the interaction term. Each row reports alternative measures of the interaction term.

The first row of Table 5 reproduces our baseline estimates for comparison. The second row replaces the state unemployment rate with a dummy for whether or not the unemployment rate is greater than the median state unemployment rate in that year. This specification corresponds more closely to the nonparametric results presented above. The third row replaces the average weekly benefit amount with the maximum weekly benefit amount. The maximum weekly benefit amount corresponds more to a specific policy parameter that states directly adjust from time-to-time. Thus, the robustness of the estimates to the use of this measure is likely to shed some light on whether the variation in average weekly UI benefits is plausibly exogenous (conditional on state and year fixed effects). The estimates of the interaction term is similar in magnitude to the baseline specification.

Finally, in the last three rows, we report results that are based on two separate measures of the unemployment rate. The search model predicts that variation in the unemployment rate due to an increase in the job separation rate should have a similar effect on the duration elasticity as a reduction in the job finding rate. To test this hypothesis, we follow the methodology proposed in Shimer (2007) which estimates the job finding and job separation rates, based on gross unemployment and employment flows. Shimer shows that the job finding probability F_t satisfies the following equation:

$$\begin{aligned} u_{t+1} &= (1 - F_t)u_t + u_{t+1}^s \\ F_t &= 1 - \frac{u_{t+1} - u_{t+1}^s}{u_t} \end{aligned} \tag{20}$$

where u_t is the number of unemployed workers in period t and u_{t+1}^s is the number of unemployed workers at the end of the period who were employed at some point during the period. Thus, with data on the unemployed, we can construct a measure of the job finding probability and job finding rate, $f_t \equiv -\log(1 - F_t)$.[38] Next, Shimer shows that the job separation rate, s_t, satisfies

$$u_{t+1} = \frac{(1 - e^{-f_t - s_t})s_t}{f_t + s_t} l_t + e^{-f_t - s_t} u_t$$

where $l_t = u_t + e_t$ and e_t is the number of employed workers in period t. Given the empirical measures f_t and s_t, we construct the following two "unemployment rates":

$$\begin{aligned} u_f &= \frac{\overline{s}}{\overline{s} + f_t} \\ u_s &= \frac{s_t}{s_t + \overline{f}} \end{aligned}$$

where the bar means that they are average values during the sample period. The unemployment rates u_f, u_s measure variation in unemployment coming purely from variation in f_t and s_t, respectively. Rows (4) and (5) in Table 5 report results from interacting benefits with these two measures separately, and row (6) reports results from including both measures

[38] In practice, data on u_{t+1}^s by state is not publicly available. Thus, we make a simplifying assumption by assuming that $\frac{u_{t+1}^s}{u_t}$ is identical across states. In ongoing work, we are constructing short-term unemployment using microdata from the CPS.

together. This allows us to see separately how variation in unemployment rate coming from the separation rate and the job finding rate affect the duration elasticity. Interestingly, we find that the effects in the two rows are fairly similar to the baseline specification and also fairly similar to each other (the p-value of the test that the two interaction terms in row 6 are equal is 0.731). Thus we conclude that the variation in unemployment rate affects the duration elasticity regardless of whether that variation is coming from the job finding rate or the job separation rate.

Composition Bias and Selection on Observables. As explained above, the observation that the duration elasticity varies with unemployment can in principle be explained by two possibilities: first, a change in a given individual's job finding or job separation rate directly changes her responsiveness to benefits. Alternatively, if there is heterogeneity in moral hazard across demographic groups and the distribution of demographics of the unemployed varies with the level of unemployment, then this compositional change could be responsible for the change in the average duration elasticity. To test how much of the magnitude is coming through this compositional channel, we report estimates of our baseline specification where we add interactions between benefits and the demographic controls in the baseline specification: age, marital dummy, years of education, occupation fixed effects, and industry fixed effects. If the estimates of the interaction term in the baseline specification is mostly due to compositional changes (among demographic groups with different duration elasticities), then we would expect to see a reduction in the magnitude of the coefficient on the interaction between benefits and unemployment. Table 6 shows that our main result is quite robust to including such controls. Looking across columns, we see that adding interactions between demographics and benefits does not change the coefficient on our main coefficient of interest (the interaction term) in any substantive way. This appears to be primarily due to the fact that the duration elasticity does not appear to vary greatly with observable demographics.[39]

Moral Hazard versus Liquidity. Recent work by Chetty (2008) raises a concern with interpreting the duration elasticity as a pure moral hazard effect. He presents compelling

[39] Of course, the duration elasticity could vary with unobservable characteristics, though we cannot test this directly. To the extent that the distribution of these unobservable characteristics varies with local unemployment, then our estimates will include the effect of unobserved compositional changes in the sample of individuals experiencing unemployment spells.

evidence that part of the observed duration elasticity is due to a "liquidity effect." This suggests that the interaction term which we estimate in our baseline specification could plausibly represent a liquidity effect which varies systematically with local labor market conditions. We deal with this concern in two ways. First, we note that if it was the case that liquidity effects vary with local labor market conditions, we believe it is likely that liquidity constraints will tend to be more binding when local labor market conditions are poor. This will cause our estimates of how moral hazard varies with local labor market conditions to be downward biased, making it even more likely that the moral hazard cost of UI decreases with the unemployment rate. Second, we report results in Table 7 which directly address concerns about liquidity constraints. Column (1) reports our baseline specification for comparison. Columns (2) and (3) report results for subsamples where liquidity effects are likely to be less important. Column (2) focuses on the subsample of unemployed workers without a mortgage, while column (3) focuses on the subsample of unemployed workers in the 3rd and 4th quartiles of net liquid wealth. In both cases the coefficient on the interaction term is larger than in the baseline. The last two columns report results which include a full set of liquid wealth quartile dummy variables interacted with a combination of occupation fixed effects, industry fixed effects, unemployment duration, and the UI benefit level. The results consistently support the interpretation that the moral hazard cost of UI decreases with the unemployment rate.[40]

Alternative Specifications and Controls. Finally, we report additional results in Table 8 which vary the specification and the set of controls. In column (2), we include region-specific linear time trends and show that our result gets stronger. Column (3) includes a full set of region fixed effects interacted with year fixed effects. Identification in this specification is coming from only from variation in benefits within region-year cells. In column (4), we include state-specific linear time trends. Our main results are fairly robust to these alternative specifications. Finally, columns (5) drops the control variables; the coefficient on the interaction terms fall in magnitude by 33% and is no longer statistically significant at

[40] To save space, we do not report the interactions between the UI benefit level and the wealth quartile dummies in column (5), but the coefficents are very similar to Chetty (2008), implying that including local unemployment rate and its iteraction with UI benefit does not alter inference on the importance of liquidity effects.

conventional levels ($p = 0.162$).

4 Calibrating the Welfare Implications

Our empirical findings suggest that moral hazard decreases with the unemployment rate. To see what this finding implies for optimal policy, we now calibrate the optimal UI level implied by our model, following the spirit of the "sufficient statistic" approach to welfare analysis. To review, this method requires using the reduced form empirical estimates as inputs into the optimal UI formula.

Our search model implies the following structural relationship for the duration elasticity:

$$\varepsilon_{D,b} = \frac{U'(b)}{U'(w_R - \tau)}\theta(w_R)ub + \frac{U'(b)}{\psi''(e)}(\delta(e))^2(1-u)b$$

One can think of $\varepsilon_{D,b} = h(u)$, where $h()$ is non-linear. In order to exploit our empirical estimates, we assume that $h()$ be locally approximated by a linear function of u. A first-order Taylor series expansion of $h(u)$ around $u = \overline{u}$ yields:

$$\varepsilon_{D,b}(u) = \varepsilon_{D,b}(\overline{u}) + \frac{d\varepsilon_{D,b}(\overline{u})}{du} \times (u - \overline{u})$$

This can also be derived directly from our reduced-form estimating equation (19):

$$\log h = \alpha + \beta_1 \log(b) + \beta_2 \log(b) \times (u - \overline{u}) + e \tag{21}$$

With this specification,

$$\varepsilon_{D,b}(u) = \frac{d \log h}{d \log(b)} = \beta_1 + \beta_2 \times (u - \overline{u})$$

Thus, $\beta_1 = \varepsilon_{D,b}(\overline{u})$ and $\beta_2 = \frac{d\varepsilon_{D,b}(\overline{u})}{du}$. Our empirical results imply that $\widehat{\beta}_1 = -0.741$ and $\widehat{\beta}_2 = .142$. To analyze the welfare implications, we will assume that the budget effect can be ignored.[41] This requires assuming that $w_R - \tau$ does not vary with u. In practice, whether the

[41]Incorporating the budget effect increases the complexity of the model and makes a tractable solution

budget effect is likely to bind is related to whether a change in unemployment is temporary or permanent. If the change in unemployment is transitory, it seems safe to assume that the government wouldn't alter financing arrangements. On the other hand, moral hazard varies with unemployment regardless of whether or the change in unemployment is temporary or permanent.

Recall, the consumption smoothing benefit of UI

$$\frac{U'(b) - U'(w_R - \tau)}{U'(w_R - \tau)}$$

Assuming preferences are given by $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$, the consumption smoothing benefit is given by

$$\frac{b^{-\gamma}}{(w_R - \tau)^{-\gamma}} - 1$$

Thus, substituting this into (17), we get:

$$\left(\frac{w_R - \tau}{b}\right)^{\gamma} = 1 + \beta_1 + \beta_2 \times (u - \overline{u})$$

To be consistent with the calibrations above, we maintain the same parameter values.[42] Note that at these parameter values, $w_R - \tau \approx 400$. Plugging in the parameter values and solving for b yields

$$b^* = \frac{400}{(1 + \varepsilon_{D,b})^{1/1.75}}$$

where $\varepsilon_{D,b} = 0.741 - 0.142 \times (u - 6.6\%)$ At $u = 6.7\%$, $b^* = 291$ implying an optimal replacement rate of 72.8%. At an unemployment rate of 8.4% (roughly one standard deviation above the mean unemployment rate), $b^* = 317$, implying a replacement rate of 79.2%. Thus, we see that variation in the unemployment rate can substantially affect replacement rates. Table 9 presents the optimal benefit level and replacement rate, for a range of unemployment rates. The basic lesson to emerge from the table is that plausible variation in the unemployment rate generates wide variation in the optimal level of UI. To give a sense of the quantitative importance of this variation, the magnitude is roughly equivalent to a

less easy to obtain. In ongoing work, we are working to incorporate this effect.

[42] In our data, $\overline{u} = 6.7\%$.

one unit change in the coefficient of relative risk aversion in the model (e.g., from $\gamma = 2$ to $\gamma = 3$).

5 Conclusions

In this paper, we have considered a standard search model and have shown that it implies a relationship between the moral hazard cost of UI and the level of unemployment in the local labor market. This relationship is theoretically ambiguous and depends on the relative strengths of two behavioral channels: the search channel and reservation wage channel. This motivated our empirical strategy which estimated how the elasticity of unemployment duration with respect to the UI benefit level varies with the unemployment rate.

Our empirical findings indicate that moral hazard is lower when unemployment is high, consistent with the speculation of Krueger and Meyer (2002) who claimed that there is likely less of an efficiency loss from reduced search effort by the unemployed when local labor market conditions are poor. We have also shown how one can use the empirical relationship between the duration elasticity and the unemployment rate to calibrate a simple optimal UI formula.

We view the concept that the moral hazard cost of social policies may vary with local labor market conditions as possibly very general. It is plausible that the disincentive effects of other government policies may also be lower in times of high unemployment. For example, if the labor supply response to tax changes is lower during recessions, the deadweight loss of income taxation could vary with aggregate labor market conditions.

While we focused on the UI benefit level as the policy parameter, in practice, the potential benefit duration is extended during times of high unemployment. In ongoing work, we are studying theoretically how government should optimally set the potential benefit duration. This will naturally depend on the responsiveness of UI durations to changes in the potential duration parameter. We hope that this analysis will hopefully shed light on the federal supplemental benefits programs in the U.S. and other developed countries.

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Appendix A: Proofs

Proof of Proposition 3.

Start by differentiating the optimal condition for search with respect to b

$$\psi''(e)\frac{\partial e}{\partial b} = \frac{\lambda''(e)}{r+s}\frac{\partial e}{\partial b}\varphi(w_R) + \frac{\lambda'(e)}{r+s}\frac{\partial \varphi(w_R)}{\partial w_R}\frac{\partial w_R}{\partial b}$$

Note that $\lambda'' < 0$, $\psi'' > 0$, and $\frac{\partial \varphi(w_R)}{\partial w_R} < 0$ so that $sign(\frac{\partial e}{\partial b}) \neq sign(\frac{\partial w_R}{\partial b})$. Next, totally differentiating the reservation wage equation with respect to b yields

$$\begin{aligned}
U'(w_R-\tau)\frac{\partial w_R}{\partial b} &= U'(b) + \frac{\partial e}{\partial b}\frac{\lambda(e)}{\lambda'(e)}\left(\psi''(e) - \psi'(e)\frac{\lambda''(e)}{\lambda'(e)}\right) \\
U'(w_R-\tau)\frac{\partial w_R}{\partial b} &= U'(b) + \frac{\partial e}{\partial b}\frac{\lambda(e)}{\lambda'(e)}\left(\psi''(e) - \frac{\lambda''(e)}{r+s}\varphi(w_R)\right)
\end{aligned}$$

where the last line made use of the FOC. Lets substitute in using the the equation above:

$$\begin{aligned}
U'(w_R-\tau)\frac{\partial w_R}{\partial b} &= U'(b) + \frac{\lambda(e)}{\lambda'(e)}\frac{\lambda'(e)}{r+s}\frac{\partial \varphi(w_R)}{\partial w_R}\frac{\partial w_R}{\partial b} \\
U'(w_R-\tau)\frac{\partial w_R}{\partial b} &= U'(b) + \frac{\lambda(e)}{r+s}\frac{\partial \varphi(w_R)}{\partial w_R}\frac{\partial w_R}{\partial b} \\
U'(w_R-\tau)\frac{\partial w_R}{\partial b} &= U'(b) - \frac{\lambda(e)}{r+s}(1-F(w_R))U'(w_R-\tau)\frac{\partial w_R}{\partial b} \\
U'(w_R-\tau)\frac{\partial w_R}{\partial b} &= U'(b) - \frac{p(e)}{r+s}U'(w_R-\tau)\frac{\partial w_R}{\partial b} \\
U'(w_R-\tau)\frac{\partial w_R}{\partial b}(1+\frac{p(e)}{r+s}) &= U'(b) \\
\frac{\partial w_R}{\partial b} &\approx \frac{U'(b)}{U'(w_R-\tau)}\frac{r+s}{r+s+p(e)} \\
\frac{\partial w_R}{\partial b} &= \frac{U'(b)}{U'(w_R-\tau)}u > 0
\end{aligned}$$

Therefore,

$$\begin{aligned}
\frac{\partial e}{\partial b}\left(\psi''(e) - \frac{\lambda''(e)}{r+s}\varphi(w_R)\right) &= \frac{\lambda'(e)}{r+s+p(e)}\frac{\partial \varphi(w_R)}{\partial w_R}\frac{U'(b)}{U'(w_R-\tau)} \\
\frac{\partial e}{\partial b}\left(\psi''(e) - \frac{\lambda''(e)}{r+s}\varphi(w_R)\right) &= -\frac{\lambda'(e)}{\lambda(e)}\frac{p(e)}{r+s+p(e)}U'(b) \\
\frac{\partial e}{\partial b}\left(\psi''(e) - \frac{\lambda''(e)}{s}\varphi(w_R)\right) &\approx -\frac{\lambda'(e)}{\lambda(e)}(1-u)U'(b) \\
\frac{\partial e}{\partial b} &= -\frac{\delta(e)(1-u)U'(b)}{\psi''(e) - \frac{\lambda''(e)}{s}\varphi(w_R)}
\end{aligned}$$

Proof of Theorem 4.

The first-order condition for the optimal benefit level is:

$$\frac{\partial w_R}{\partial b} + \frac{\partial w_R}{\partial \tau}\frac{\partial \tau}{\partial b} - \frac{\partial \tau}{\partial b} = 0$$

For simplicity, we assume that $\partial w_R/\partial \tau = \partial w_R/\partial b$ and hence $\partial D/\partial \tau = \partial D/\partial b$.[43] This implies that

$$\frac{\partial w_R}{\partial b} = \frac{\frac{\partial \tau}{\partial b}}{1 + \frac{\partial \tau}{\partial b}}$$

Also, using the planner's budget constraint, we can write

$$\frac{\partial \tau}{\partial b} = \frac{D(1+\varepsilon_{D,b})}{\frac{1}{r+s} - D\varepsilon_{D,b}}$$

Thus, at an optimum:

$$\frac{\partial w_R}{\partial b} = \frac{D}{\frac{1}{r+s} + D}(1+\varepsilon_{D,b})$$

Note that for r small, this reduces to

$$\frac{\partial w_R}{\partial b} = u(1+\varepsilon_{D,b}) \tag{22}$$

If the left-hand side is larger than the right-hand side, a marginal increase in benefits raises the worker's after-tax reservation wage and so is welfare-improving. In other words, current benefit levels are too low. Note that this test doesn't quantify *how much* benefits should increase or decrease. This depends on how the left-hand side and the right-hand side respond to a change in benefits.

Substituting equation (14) into equation (22), we get

$$U'(b) = U'(w_R - \tau)(1+\varepsilon_{D,b})$$

Intuitively, $U'(b)$ represents the marginal benefit of raising consumption while unemployed by \$1. The benefit increase means that taxes must be raised by more than \$1 due to the behavioral response which reduces consumption in the employed state. Rearranging this expression delivers equation (17).

[43] This is true if individuals have CARA preferences.

Table 1

Calibration A: Moral Hazard and the Unemployment Rate

λ	0.1	0.09	0.08	0.07	0.06	0.05
u	4.4%	4.9%	5.6%	6.7%	8.3%	11.0%
$\varepsilon_{D,b}^{w_R}$	0.17	0.18	0.19	0.21	0.24	0.29
$\varepsilon_{D,b}^{e}$	1.42	1.49	1.58	1.70	1.82	1.90
$\varepsilon_{D,b}$	1.59	1.67	1.78	1.91	2.07	2.19

Notes:

$$\varepsilon_{D,b}^{w_R} = \theta(w_R)\frac{\partial w_R}{\partial b}b,\ \varepsilon_{D,b}^{b} = -\delta(e)\frac{\partial e}{\partial b}b,\ \varepsilon_{D,b} = \varepsilon_{D,b}^{w_R} + \varepsilon_{D,b}^{e}$$

The model is calibrated under the following assumptions:

1. Wages are log-normally distributed with mean=300 and standard deviation=240

2 $\lambda(e) = \overline{\lambda} + \lambda e, \quad \overline{\lambda} = 0.02$

3. s = 0.003868

4. $r = b/\mathrm{E}[w] = 0.5$

5. $\mathrm{U(c)} = \mathrm{c}^{1-\gamma}/(1-\gamma)$, γ = 1.75

6. $\psi(\mathrm{e}) = \varphi\,\mathrm{e}^{1+\kappa}/(1+\kappa)$, φ = 0.06, κ = 0.2

Table 2
Calibration B: Moral Hazard and the Unemployment Rate

λ	0.16	0.14	0.12	0.1	0.08	0.06
u	5.1%	6.3%	7.9%	9.4%	10.4%	10.7%
$\varepsilon_{D,b}^{w_R}$	0.33	0.40	0.48	0.57	0.62	0.64
$\varepsilon_{D,b}^{e}$	1.79	1.72	1.38	0.76	0.24	0.04
$\varepsilon_{D,b}$	2.12	2.11	1.86	1.33	0.86	0.68

Notes:

$$\varepsilon_{D,b}^{w_R} = \theta(w_R)\frac{\partial w_R}{\partial b}b,\ \varepsilon_{D,b}^{b} = -\delta(e)\frac{\partial e}{\partial b}b,\ \varepsilon_{D,b} = \varepsilon_{D,b}^{w_R} + \varepsilon_{D,b}^{e}$$

The model is calibrated under the following assumptions:

1. Wages are log-normally distributed with mean=300 and standard deviation=240

2 $\lambda(e) = \overline{\lambda} + \lambda e, \quad \overline{\lambda} = 0.1$

3. s = 0.003868

4. $r = b/\mathrm{E}[w] = 0.5$

5. $U(c) = c^{1-\gamma}/(1-\gamma)$, γ = 1.75

6. $\psi(e) = \varphi e^{1+\kappa}/(1+\kappa)$, φ = 0.045, κ = 0.18

Table 3
Descriptive Statistics

	Full Sample		State Unemp. Rate < Median		State Unemp. Rate ≥ Median	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Annual Income ($000's)	20.925	13.570	20.769	12.863	21.012	13.952
Age	37.165	11.066	36.699	11.113	37.426	11.034
Years of Education	12.171	2.877	12.151	2.820	12.183	2.909
Marital Dummy	0.616	0.486	0.610	0.488	0.619	0.486
Weekly Benefit Amount ($'s)	163.33	26.80	163.98	25.71	162.96	27.39
Replacement Rate	0.491	0.082	0.492	0.080	0.490	0.084
Unemployment Duration (weeks)	18.510	14.351	17.158	13.757	19.267	14.620
Number of Spells	4307		1545		2762	

Notes: Data are individual-level unemployment spells from 1985-2000 SIPP. Final sample of unemployment spells is described in main text.

Table 4
How does Moral Hazard vary with the
State Unemployment Rate?

		(1)	(2)
log(Average UI WBA)	**(A)**	-0.651	-0.741
		(0.318)	(0.340)
		[0.041]	[0.029]
log(Average UI WBA) × State Unemployment Rate	**(B)**		0.142
			(0.068)
			[0.038]
State Unemployment Rate		0.008	0.009
		(0.017)	(0.016)
		[0.655]	[0.598]
log(Average UI WBA) × Unemployment Duration		0.004	0.003
		(0.009)	(0.009)
		[0.674]	[0.707]
Age		-0.017	-0.017
		(0.002)	(0.002)
		[0.000]	[0.000]
Marital Dummy		0.208	0.208
		(0.040)	(0.040)
		[0.000]	[0.000]
Years of Education		0.004	0.004
		(0.006)	(0.006)
		[0.489]	[0.499]
Number of Spells		4307	4307
Post-estimation: **(A)** + σ × **(B)**			-0.502
			(0.326)
			[0.124]
Post-estimation: **(A) -** σ × **(B)**			-0.980
			(0.388)
			[0.012]

Notes: All columns report semiparametric (Cox proportional) hazard model results from estimating equation (19). Data are individual-level unemployment spells from 1985-2000 SIPP. Final sample of unemployment spells is described in the main text. Dependent variable is always the log of the individual unemployment duration (in weeks). All specifications include state, year, industry and occupation fixed effects, 10-knot linear spline in log annual wage income, controls for national unemployment rate and national unemployment rate interacted with the log of Average UI WBA and a control for being on the seam between interviews to adjust for the "seam effect." The Average UI WBA is the average weekly benefit amount paid to individuals claiming unemployment insurance. All columns estimate nonparametric baseline hazards stratified by quartile of net liquid wealth. The final two rows reports linear combinations of parameter estimates to produce the duration elasticity when the state unemployment rate is one standard deviation above/below average. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each metropolitan area over time, are in parentheses and p-values are in brackets.

Table 5
Alternative Measures of Interaction Term

			Hazard Model Results			Post-estimation	
			(A)	**(A) × (B)**	**(B)**	**(A)** + σ × **(B)**	**(A)** - σ × **(B)**
(1)	**(A)**	log(Average UI WBA) ×	-0.741	0.142	0.009	-0.502	-0.980
	(B)	State Unemployment Rate	(0.340)	(0.068)	(0.016)	(0.326)	(0.388)
			[0.029]	[0.038]	[0.598]	[0.124]	[0.012]
(2)	**(A)**	log(Average UI WBA) ×	-1.200	0.898	0.000	-0.301	
	(B)	**1**{State Unemployment Rate ≥ Median}	(0.378)	(0.262)	(0.038)	(0.310)	
			[0.002]	[0.001]	[0.996]	[0.331]	
(3)	**(A)**	log(Statutory Maximum UI WBA) ×	-0.269	0.120	0.004	-0.067	-0.471
	(B)	State Unemployment Rate	(0.314)	(0.053)	(0.018)	(0.337)	(0.316)
			[0.392]	[0.024]	[0.815]	[0.842]	[0.136]
(4)	**(A)**	log(Average UI WBA) ×	-0.625	0.079	0.025	-0.525	-0.725
	(B)	State Unemployment Rate (Finding)	(0.313)	(0.108)	(0.032)	(0.280)	(0.392)
			[0.046]	[0.462]	[0.435]	[0.061]	[0.065]
(5)	**(A)**	log(Average UI WBA) ×	-0.694	0.170	-0.004	-0.424	-0.964
	(B)	State Unemployment Rate (Separation)	(0.326)	(0.070)	(0.020)	(0.316)	(0.372)
			[0.034]	[0.016]	[0.829]	[0.179]	[0.010]
(6)	**(A)**	log(Average UI WBA) ×		0.209	0.026	-0.516	-1.034
	(B)	State Unemployment Rate (Finding)		(0.115)	(0.031)	(0.314)	(0.423)
			-0.775	[0.068]	[0.407]	[0.101]	[0.015]
	(A)	log(Average UI WBA) ×	(0.344)	0.243	-0.003	-0.389	-1.160
	(B)	State Unemployment Rate (Separation)	[0.024]	(0.081)	(0.019)	(0.328)	(0.403)
				[0.003]	[0.890]	[0.236]	[0.004]
		Number of Spells	4307				

Notes: All rows report semiparametric (Cox proportional) hazard model results from estimating equation (19); each column reports separate parameter estimate. Data are individual-level unemployment spells from 1985-2000 SIPP. See Table 4 for more details on the baseline specification. The median unemployment rate across all states in sample is calculated separately each year. The Average UI WBA is the average weekly benefit amount paid to individuals claiming unemployment insurance. The State Unemployment Rate variables in rows (4) and (5) isolate variation in the unemployment driven by variation in the job finding rate and job separation rate, respectively. These variables are constructed following the method in Shimer (2007); see main text for details. The final two columns report linear combinations of the parameters. The standard deviation in the unemployment rate (σ) is 0.0168. In row (2) we set σ=1.0 becasue the interaction term includes a dummy variable rather than a continuous measure. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each metropolitan area over time, are in parentheses and p-values are in brackets.

Table 6
How Much Do Demographics Explain Why Moral Hazard Varies
with the State Unemployment Rate?

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
log(Average UI WBA)	**(A)**	-0.741	-0.719	-0.742	-0.718	-0.628	-0.618	-0.577
		(0.340)	(0.337)	(0.339)	(0.334)	(0.347)	(0.359)	(0.349)
		[0.029]	[0.033]	[0.029]	[0.032]	[0.070]	[0.085]	[0.098]
log(Average UI WBA) × State Unemployment Rate	**(B)**	0.142	0.141	0.142	0.140	0.143	0.136	0.138
		(0.068)	(0.068)	(0.068)	(0.067)	(0.070)	(0.069)	(0.068)
		[0.038]	[0.040]	[0.037]	[0.037]	[0.042]	[0.048]	[0.043]
State Unemployment Rate		0.009	0.008	0.009	0.008	0.008	0.009	0.008
		(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
		[0.598]	[0.610]	[0.598]	[0.611]	[0.605]	[0.596]	[0.606]
log(Average UI WBA) × Age			0.007					0.008
			(0.008)					(0.010)
			[0.398]					[0.428]
log(Average UI WBA) × Marital Dummy				0.020				-0.046
				(0.180)				(0.210)
				[0.912]				[0.827]
log(Average UI WBA) × Years of Education					0.049			0.051
					(0.025)			(0.031)
					[0.052]			[0.099]
Number of Spells		4307	4307	4307	4307	4307	4307	4307
log(Average UI WBA) × Occupation FEs		N	N	N	N	Y	N	Y
log(Average UI WBA) × Industry FEs		N	N	N	N	N	Y	Y
Post-estimation: **(A)** + σ × **(B)**		-0.502	-0.483	-0.504	-0.482	-0.388	-0.389	-0.345
		(0.326)	(0.327)	(0.324)	(0.320)	(0.329)	(0.336)	(0.322)
		[0.124]	[0.139]	[0.120]	[0.132]	[0.238]	[0.246]	[0.285]
Post-estimation: **(A)** - σ × **(B)**		-0.980	-0.955	-0.980	-0.953	-0.867	-0.846	-0.809
		(0.388)	(0.383)	(0.389)	(0.382)	(0.400)	(0.414)	(0.407)
		[0.012]	[0.013]	[0.012]	[0.013]	[0.030]	[0.041]	[0.047]

Notes: All columns report semiparametric (Cox proportional) hazard model results from estimating equation (19). Data are individual-level unemployment spells from 1985-2000 SIPP. See Table 4 for more details on the baseline specification. The final two rows reports linear combinations of parameter estimates to produce the duration elasticity when the state unemployment rate is one standard deviation above/below average. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each metropolitan area over time, are in parentheses and p-values are in brackets.

Table 7
Moral Hazard and Liquidity

		(1)	(2)	(3)	(4)	(5)
log(Average UI WBA)	**(A)**	-0.741	-0.780	-0.609	-0.664	
		(0.340)	(0.520)	(0.533)	(0.320)	
		[0.029]	[0.134]	[0.253]	[0.038]	
log(Average UI WBA) × State Unemployment Rate	**(B)**	0.142	0.419	0.164	0.158	0.165
		(0.068)	(0.112)	(0.127)	(0.070)	(0.074)
		[0.038]	[0.000]	[0.196]	[0.025]	[0.026]
State Unemployment Rate		0.009	0.011	-0.004	0.005	0.006
		(0.016)	(0.024)	(0.024)	(0.017)	(0.017)
		[0.598]	[0.636]	[0.852]	[0.771]	[0.727]
Number of Spells		4307	2355	2170	4307	4307
No mortgage only		N	Y	N	N	N
3rd and 4th liquid wealth quartiles only		N	N	Y	N	N
Occupation FEs × Liquid wealth quartile		N	N	N	Y	Y
Industry FEs × Liquid wealth quartile		N	N	N	Y	Y
Unemployment duration × Liquid wealth quartile		N	N	N	N	Y
log(Average UI WBA) × Liquid wealth quartile		N	N	N	N	Y
Post-estimation: **(A)** + σ × **(B)**		-0.502	-0.076	-0.333	-0.399	
		(0.326)	(0.551)	(0.553)	(0.318)	
		[0.124]	[0.890]	[0.547]	[0.210]	
Post-estimation: **(A) -** σ × **(B)**		-0.980	-1.483	-0.884	-0.929	
		(0.388)	(0.555)	(0.594)	(0.362)	
		[0.012]	[0.007]	[0.137]	[0.010]	

Notes: All columns report semiparametric (Cox proportional) hazard model results from estimating equation (19). Data are individual-level unemployment spells from 1985-2000 SIPP. See Table 4 for more details on the baseline specification. The final two rows reports linear combinations of parameter estimates to produce the duration elasticity when the state unemployment rate is one standard deviation above/below average. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each metropolitan area over time, are in parentheses and p-values are in brackets.

Table 8
Robustness to Alternative Specifications and Controls

		(1)	(2)	(3)	(4)	(5)
log(Average UI WBA)	**(A)**	-0.741	-1.010	-1.019	-1.078	-0.787
		(0.340)	(0.420)	(0.480)	(0.523)	(0.352)
		[0.029]	[0.016]	[0.034]	[0.039]	[0.025]
log(Average UI WBA) ×	**(B)**	0.142	0.157	0.156	0.151	0.095
State Unemployment Rate		(0.068)	(0.077)	(0.124)	(0.095)	(0.068)
		[0.038]	[0.041]	[0.207]	[0.113]	[0.162]
State Unemployment Rate		0.009	0.028	0.038	0.029	0.012
		(0.016)	(0.018)	(0.023)	(0.020)	(0.015)
		[0.598]	[0.116]	[0.104]	[0.134]	[0.408]
Number of Spells		4307	4307	4307	4307	4307
Baseline controls		Y	Y	Y	Y	N
Region-specific linear time trends		N	Y	N	N	N
Region × Year FEs		N	N	Y	N	N
State-specific linear time trends		N	N	N	Y	N
Post-estimation: **(A)** + σ × **(B)**		-0.502	-0.746	-0.757	-0.825	-0.627
		(0.326)	(0.420)	(0.472)	(0.551)	(0.299)
		[0.124]	[0.076]	[0.109]	[0.134]	[0.036]
Post-estimation: **(A)** - σ × **(B)**		-0.980	-1.274	-1.281	-1.331	-0.947
		(0.388)	(0.458)	(0.568)	(0.542)	(0.430)
		[0.012]	[0.005]	[0.024]	[0.014]	[0.028]

Notes: All columns report semiparametric (Cox proportional) hazard model results from estimating equation (19). Data are individual-level unemployment spells from 1985-2000 SIPP. See Table 4 for more details on the baseline specification. The final two rows reports linear combinations of parameter estimates to produce the duration elasticity when the state unemployment rate is one standard deviation above/below average. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each metropolitan area over time, are in parentheses and p-values are in brackets.

Table 9
Model Calibrations: Optimal UI and the Unemployment Rate

u	3.3%	5.0%	6.7%	8.4%	10.1%
$\varepsilon_{D,b}$	1.218	0.979	0.741	0.503	0.264
b*	$254	$271	$291	$317	$350
r*	63.4%	67.7%	72.8%	79.2%	87.5%

Notes: All columns report optimal UI benefit levels at various levels of local unemployment. Subsequent rows report elasticity of unemployment duration with respect to UI benefit level, the optimal UI benefit level (b*) and the optimal replacement rate (r*). The optimal replacement rate is computed by dividing UI benefit level by the average wage. See Section 4 for more details on the computations.

Table A1

Calibration C: Moral Hazard and the Unemployment Rate

λ	0.095	0.09	0.085	0.08	0.075	0.07
u	4.6%	5.1%	5.8%	6.7%	7.8%	9.4%
$\varepsilon^{w_R}_{D,b}$	0.51	0.56	0.62	0.71	0.84	1.01
$\varepsilon^{e}_{D,b}$	4.47	4.76	5.07	5.37	5.57	5.48
$\varepsilon_{D,b}$	4.97	5.31	5.69	6.08	6.41	6.48

Notes:

$\varepsilon^{w_R}_{D,b} = \theta(w_R)\frac{\partial w_R}{\partial b}b,\ \varepsilon^{b}_{D,b} = -\delta(e)\frac{\partial e}{\partial b}b,\ \varepsilon_{D,b} = \varepsilon^{w_R}_{D,b} + \varepsilon^{e}_{D,b}$

The model is calibrated under the following assumptions:

1. Wages distributed as $F(w)$ = 1-(w_0/w)^(1/σ), where w_0 = 340 and σ = 0.14

2 $\lambda(e) = \overline{\lambda} + \lambda e, \quad \overline{\lambda} = 0.02$

3. s = 0.003868

4. $r = b$/E[w] = 0.5

5. U(c) = $c^{1-\gamma}/(1-\gamma)$, γ = 1.75

6. ψ(e) = $\varphi e^{1+\kappa}/(1+\kappa)$, φ = 0.035, κ = 0.1

Table A2

Calibration D: Moral Hazard and the Unemployment Rate

λ	0.75	0.7	0.65	0.6	0.55	0.5
u	7.5%	8.4%	9.0%	9.4%	9.6%	9.7%
$\varepsilon^{w_R}_{D,b}$	1.05	1.17	1.26	1.32	1.34	1.35
$\varepsilon^{e}_{D,b}$	2.99	2.05	1.17	0.56	0.23	0.08
$\varepsilon_{D,b}$	4.04	3.23	2.43	1.87	1.57	1.44

Notes:

$$\varepsilon^{w_R}_{D,b} = \theta(w_R)\frac{\partial w_R}{\partial b}b,\ \varepsilon^{b}_{D,b} = -\delta(e)\frac{\partial e}{\partial b}b,\ \varepsilon_{D,b} = \varepsilon^{w_R}_{D,b} + \varepsilon^{e}_{D,b}$$

The model is calibrated under the following assumptions:

1. Wages distributed as $F(w)$ = 1-(w_0/w)^(1/σ), where w_0 = 340 and σ = 0.14

2 $\lambda(e) = \bar{\lambda} + \lambda e, \quad \bar{\lambda} = 0.333$

3. s = 0.003868

4. r = b/E[w] = 0.5

5. U(c) = $c^{1-\gamma}/(1-\gamma)$, γ = 1.75

6. ψ(e) = $\varphi e^{1+\kappa}/(1+\kappa)$, φ = 0.035, κ = 0.1

Figure 1: Survival Curves Under High Unemployment

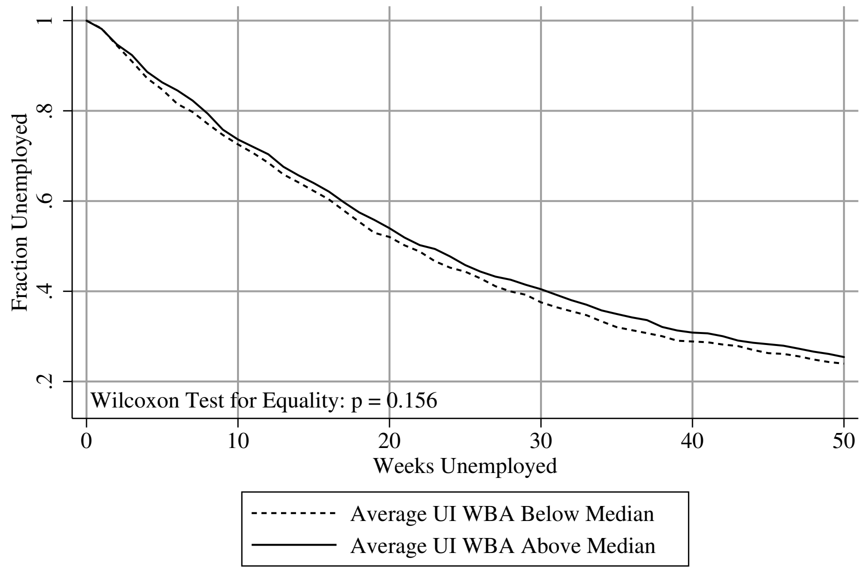
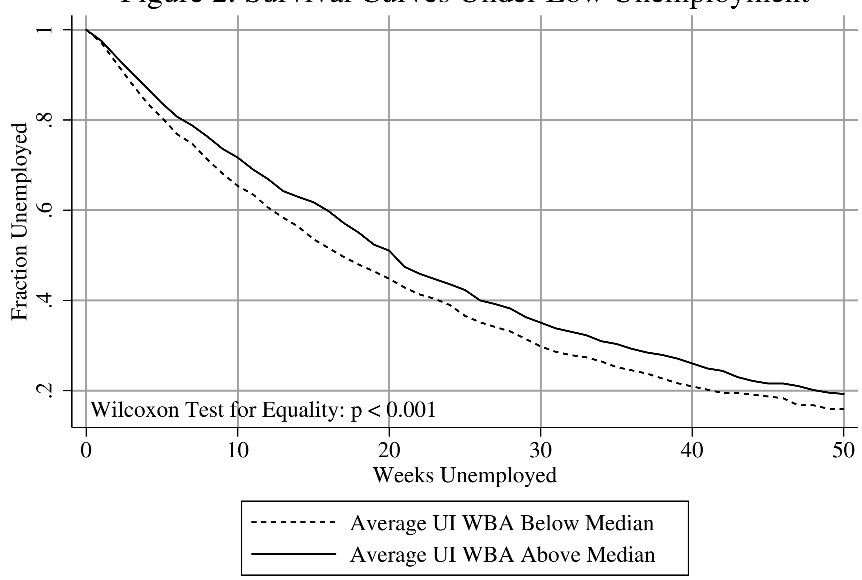
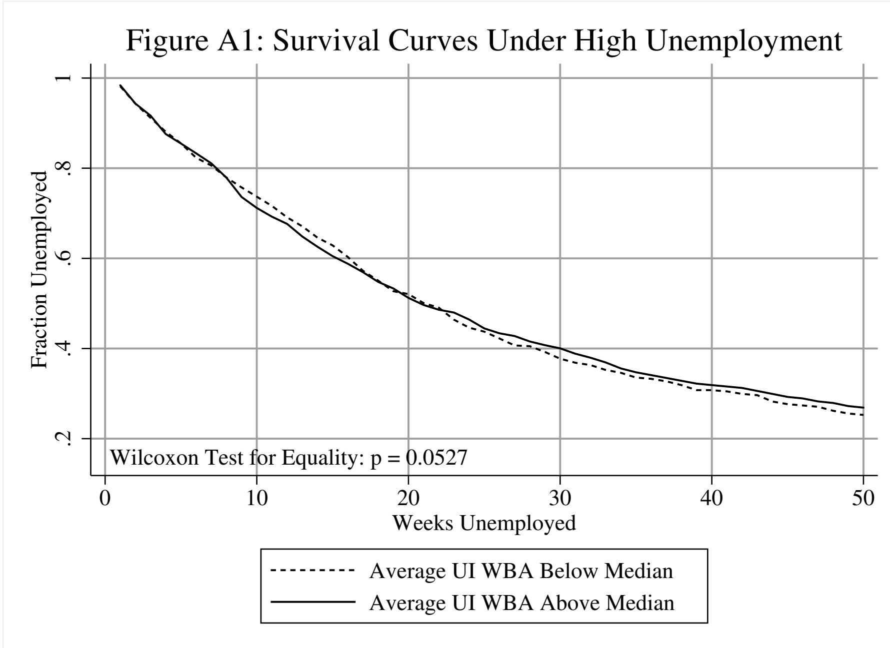
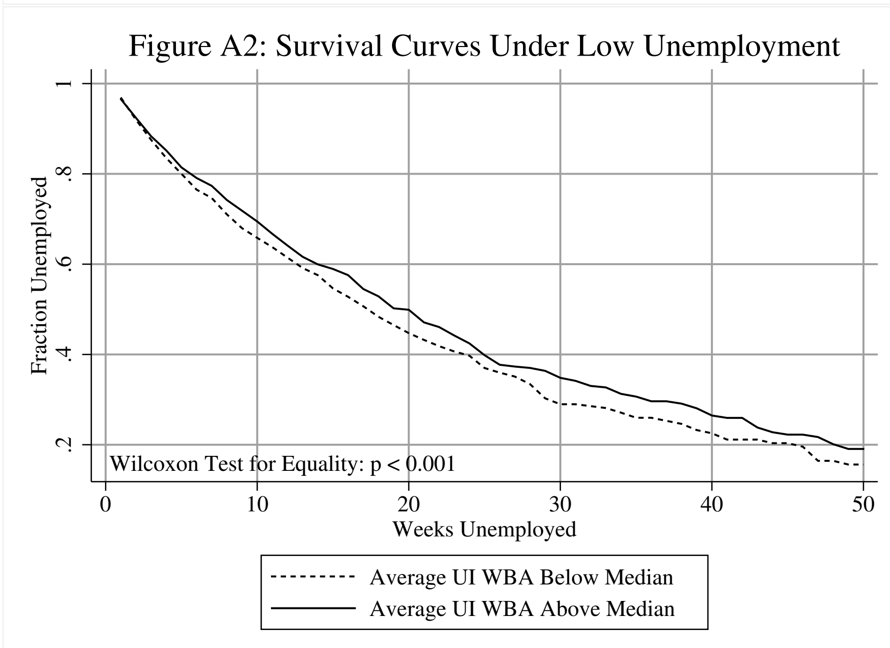


Figure 2: Survival Curves Under Low Unemployment



Notes: Data are individual-level unemployment spells from 1985-2000 SIPP. Each figure plots (Kaplan-Meier) survival curves for two groups of individuals based on whether or not Average UI Weekly Benefit Amount (WBA) in individual's state is above or below the median. The survival curves are adjusted following Chetty (2008), which parametrically adjusts for "seam effect" by fitting a Cox proportional hazard model with a seam dummy and then recovering the baseline hazard.





Notes: Data are individual-level unemployment spells from 1985-2000 SIPP, with the sample limited to unemployed workers with above-median liquid wealth. Each figure plots (Kaplan-Meier) survival curves for two groups of individuals based on whether or not Average UI Weekly Benefit Amount (WBA) in individual's state is above or below the median. The survival curves are adjusted following Chetty (2008), which parametrically adjusts for "seam effect" by fitting a Cox proportional hazard model with a seam dummy and then recovering the baseline hazard.