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Takeup, social multipliers and optimal social insurance ☆

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Abstract

This paper examines the optimal provision of unemployment insurance (UI) in a framework that accounts for behavioral responses along both the intensive and extensive margins. Two formulations of takeup are considered: in the first, individuals face a takeup cost that is exogenous; in the second, the cost depends endogenously on the takeup rate. Such endogenous costs to takeup lead to a social multiplier, a reduced-form parameter summarizing the strength of social interactions. This paper derives a formula for the optimal replacement rate in terms of the takeup and duration elasticities, and the social multiplier. The formula is applied by estimating the social multiplier using policy variation in UI benefit levels. The results suggest that social multiplier effects account for 35% of the total effect of UI on takeup and yield an optimal replacement rate around 60% of pre-unemployment wages, 20% higher than previous estimates.
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1. Introduction

One of the central assumptions in the theory of social insurance provision is that all agents who are eligible for benefits claim them. This assumption originates in the seminal paper by Baily (1978) and is also present in more recent analyses of optimal unemployment insurance (Lentz, 2005; Chetty, 2006; Shimer and Werning, 2005).[1]

In many social insurance programs however, eligible individuals do not claim their benefits (Currie, 2004). For example, the "takeup rate" of Unemployment Insurance (UI) benefits, the fraction of eligible individuals who claim benefits when unemployed, is well below one. Estimates of the takeup rate are ranging from .4 to .7 (Blank and Card, 1991; Vroman, 1991; McCall, 1995; Anderson and Meyer, 1997). Low takeup rates have also been documented in health insurance programs such as Medicaid and CHIP (Remler et al., 2001).

Moreover, empirical studies have found that takeup rates correlate positively with the size of expected benefits. Krueger and Meyer (2002) in a review of the social insurance literature conclude that the elasticity of takeup with

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[1] Davidson and Woodbury (1997) consider the impact of less than full *eligibility* of optimal unemployment insurance. They find that accounting properly for UI-ineligibles raises the optimal replacement rate by around 10 percentage points to 70–80%. To focus on the issue of takeup, this paper assumes that all individuals who become unemployed are eligible for benefits.

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respect to the benefit level is around 0.5 for both unemployment insurance and workers' compensation. Taken together, these two stylized facts–(1) low takeup and (2) positive effect of benefits on takeup–suggest that there is a cost to taking up benefits and call into question the "full takeup" assumption.

This paper extends the Baily model of optimal UI to encompass behavioral responses along both the intensive (choice of unemployment spell duration) and extensive margins (participation decision) and uses the model to derive a new test for the optimality of current UI benefit levels. In particular, two formulations for the extensive margin are considered. In the first formulation, individuals face a takeup cost that is exogenous. This resembles the fixed cost model that has been traditionally used to study non-participation in social programs (see Moffitt, 1983). Recently, several empirical studies have demonstrated that *social interactions* are prominent in program participation decisions. Examples include the takeup of welfare (Borjas and Hilton, 1996; Bertrand et al., 2000), employer-sponsored health insurance (Sorensen, 2001), retirement plans (Duflo and Saez, 2003), public prenatal care (Aizer and Currie, 2004) and disability insurance (Rege et al., 2006).[2] This evidence motivates a second formulation where the takeup cost endogenously depends on the number of people who takeup social benefits. This captures the intuitive notion that when others are taking up benefits, takeup might be less costly due to a reduction in social stigma or increased learning. Such endogenous costs to takeup lead to a social multiplier, a reduced-form parameter summarizing the strength of social interactions.

The first part of this paper derives a simple expression for the optimal "replacement rate"–the ratio of UI benefits to lost earnings–in terms of the reduced-form elasticities and the social multiplier.[3] This is similar to the approach taken in the optimal linear income tax literature which tries to relate optimal tax formulas to labor supply elasticities that are estimated in empirical studies. The second part of the paper numerically implements the formula for the optimal replacement rate. In particular, the social multiplier is estimated by exploiting variation in UI benefit levels. Importantly, since the estimates do not fully control for economic shocks to UI takeup that are correlated with benefit changes, they only provide preliminary and suggestive evidence. Results indicate that 35% of the total effect of UI benefits on takeup comes through a social multiplier effect, implying an estimate of 2 for the social multiplier. For a coefficient of relative risk aversion of 4.75, estimated in Chetty (2004), the optimal replacement rate is approximately 60%, nearly 20% higher than current replacement rates. This suggests the importance of carefully distinguishing between direct and spillover effects when estimating the takeup response to UI.

The remainder of this paper is organized as follows. Section 2 models the optimal provision of benefits with endogenous takeup. Section 3 calibrates the optimal replacement rate. Section 4 discusses identification and estimation of the multiplier using a reform-based strategy and Section 5 concludes.

2. The Baily model with takeup

2.1. Exogenous takeup cost

This section outlines a simple unemployment insurance problem similar to Baily (1978). There is a population of individuals of measure 1, with well-behaved preferences represented by $u(c)$, where $u'(c)>0$ and $u''(c)<0$. Each individual begins his life unemployed (with probability p) or employed (with probability $1-p$). If employed, an individual works for the entire period at a wage w and pays an unemployment tax of τ. Assume the interest rate and subjective discount rate are zero. Given initial assets A_0, consumption during the period is $c_e=A_0+w-\tau$.

An individual initially unemployed makes two decisions. First, he chooses whether to collect benefits b. If he collects, his utility is $u(c_u)-\psi_i$ where ψ_i, the takeup cost, is known and is continuously distributed across individuals with distribution function F and density function f. Assume that F and f are continuous and that the support of F is bounded below by $\psi\geq 0$. An individual that does not collect benefits has utility $u(c_u)$. This formulation of takeup can reflect information barriers or stigma (Moffitt, 1983; Besley and Coate, 1992).

The second decision is choice of unemployment duration D. Assume costs to search and/or utility from leisure are captured by a smooth, concave and increasing function of D, $v(D)$. Given the choice for D, an individual is reemployed

[2] Other studies have considered the theoretical implications of social interactions in social insurance programs (Lindbeck et al., 1999; Lindbeck and Nyberg, 2006; Lindbeck and Persson, 2006). These studies are purely positive analyses however; as a result, they do not cast light on the normative issue of whether it is important to decompose the general equilibrium effect of a policy change on takeup into partial equilibrium responses and social multiplier responses (Glaeser and Scheinkman, 2002).

[3] Since the formula must be satisfied at the optimum, it can be used to test whether current benefit levels are optimal.

for the remainder of the period $1-D$ and earns wage w. Consumption for those who are unemployed initially and receive UI benefits is $c_u = A_0 + Db + (1-D)w = A_0 + D(b-w) + w$ and for those who do not receive benefits is $c_u = A_0 + (1-D)w$.

There is an unemployment insurance agency who maximizes a weighted sum of individual utilities, with weights corresponding to population weights. The agency controls the benefit level, b, and the unemployment tax, τ. Benefits are paid in proportion to the length of the unemployment spell, and only to those who claim them. Assume that the distribution of ψ_i, F, is known to the insurer. The UI agency is required to balance its budget in expectation.[4]

2.1.1. Elasticity concepts

In this model, there are two types of unemployed agents, UI recipients (R) and non-UI recipients (N), that are defined by a critical value ψ^*. For UI recipients, $\psi_i < \psi^*$, and for non-UI recipients, $\psi_i > \psi^*$. Note that individuals only differ in terms of ψ_i and so this cutoff value will be the same for everyone and is not indexed by i:

$$\psi_i^* = u(c_u^R) - u(c_u^N) + v(D^R) - v(D^N) \equiv \psi^* \tag{1}$$

For the same reason, $D^R(b-w)$, the unemployment duration for a UI recipient, will be independent of i. Denote $P(b-w)$, the fraction of the unemployed population that collect benefits.

The term pPD^R represents the expenditure base. An increase in benefit levels can change the expenditure base for two reasons. First, along the extensive margin, more individuals can takeup benefits. The size of this behavioral response is captured by the elasticity of participation with respect to the net wage. Since the decision to participate depends only on $w-b$, this may be written as

$$v = \frac{w-b}{P} \frac{\partial P}{\partial (w-b)} \tag{2}$$

This elasticity measures the percentage increase in the fraction of *individuals* who takeup UI benefits when the net wage is increased by 1%. Also, along the intensive margin, individuals may extend their unemployment durations. This behavioral response is summarized by

$$\varepsilon^R = \frac{w-b}{D^R} \frac{\partial D^R}{\partial (w-b)} \tag{3}$$

This elasticity measures the percentage increase in the number of *weeks* unemployed for a UI recipient when the net wage is increased by 1%. Since the elasticity does not depend on i, the individual duration elasticity is also the average population duration elasticity. Note that both the takeup and duration elasticities are *uncompensated* elasticities.[5]

2.1.2. Deriving the optimal replacement rate

This subsection follows the proof for the optimal top marginal tax rate in Saez (2001). Start by considering a small increase of db in benefits. This change has two effects on unemployment insurance expenditures, $pbPD^R$. First, there is a mechanical effect, which is the change in expenditures assuming there were no behavioral responses, and second, there is the change in expenditures due to behavioral responses. These are examined sequentially.

2.1.2.1. Mechanical effect. The mechanical effect (denoted by M) represents the dollar amount of the change in benefits paid out to unemployment recipients, if they do not change their behavior. A UI recipient would receive an

[4] For tractibility, the paper focuses on the provision of unemployment insurance benefits and takes the optimal benefit level as constant with respect to the duration of an individual's unemployment spell. The main results also apply more generally to other social insurance programs, such as Health Insurance, Disability Insurance and Workers' Compensation.

[5] Note that the elasticities are defined with respect to the net wage, not the benefit level as in Baily (1978) and Gruber (1997). This is related to the definition of the labor supply elasticities that are used to derive formulas in the optimal income taxation literature (Saez, 2001). The implications of using a different elasticity concept are discussed in Section 3.

additional $D^R \mathrm{d}b$ of benefits. Therefore summing over the population of individuals who receive UI benefits, the total mechanical effect M is

$$M = pPD^R \mathrm{d}b \tag{4}$$

2.1.2.2. Behavioral responses. The benefit increase induces two behavioral responses. First, some individuals who were not collecting benefits choose to collect them. This behavioral response is

$$\mathrm{d}P = \frac{\partial P}{\partial b}\mathrm{d}b = v\frac{P}{w-b}\mathrm{d}b \tag{5}$$

using definition (2). This increases expenditures by $pD^R b\mathrm{d}P$. That the relevant duration in this expression is D^R rather than D^N follows from the fact that an individual's incentives to search are lower when collecting benefits. Second, an individual changes his duration D^R by

$$\mathrm{d}D^R \frac{\partial D^R}{\partial b}\mathrm{d}b = \varepsilon^R \frac{D^R}{w-b}\mathrm{d}b \tag{6}$$

where definition (3) is used. The change in duration displayed in Eq. (6) implies an increase in expenditures for that individual equal to $b\mathrm{d}D^R$. For the population, the total change in expenditures is $pPb\mathrm{d}D^R$. The total increase in expenditures due to the behavioral responses is the sum of the terms $bpP\mathrm{d}D^R$ and $bpD^R\mathrm{d}P$ and is written as

$$B = pPD^R\varepsilon^R\frac{b\mathrm{d}b}{w-b} + pPD^R v\frac{b\mathrm{d}b}{w-b} \tag{7}$$

Expressions (4) and (7) represent how much total expenditures change when benefits increase. To solve for the optimal replacement rate, the ratio of UI benefits to lost earnings, start by considering how this reform affects a UI recipient's utility. Assuming an optimum, the envelope theorem implies that the effect of a small change in benefits on utility is simply $u'(c_u^R)D^R\mathrm{d}b$ where $D^R\mathrm{d}b$ is the mechanical increase in individual benefits. Next, summing over the population of UI recipients gives $u'(c_u^R)M$, the total social welfare gain. Now consider the effect of the reform on individual taxpayers. This is given by $u'(c_e)(-\mathrm{d}\tau)$ where $\mathrm{d}\tau$ is the total increase in individual taxes necessary to balance the budget. Summing over the population $1-p$ of employed taxpayers and noting that the implied individual increase in taxes is $\frac{1}{1-p}(M+B)$ gives $-u'(c_e)(M+B)$, the total social welfare loss. Social welfare is maximized when the total welfare gain is equal to the total welfare loss. It is convenient to define $\overline{g}^R$ as the ratio of marginal utility for an unemployed recipient to the marginal utility for an employed individual. In other words, $\overline{g}^R$ is defined so that the government is indifferent between \$1 consumed by the unemployed and $\overline{g}^R$ consumed by the employed. The first-order condition for an optimum can be expressed as $(\overline{g}^R-1)M+B=0$. Solving this yields the optimal "replacement rate" r, expressed in the following proposition.

Proposition 1. *The optimal replacement rate with endogenous takeup satisfies*

$$\frac{r}{1-r} = \frac{1}{\varepsilon^R + v}(\overline{g}^R - 1) \tag{8}$$

In deriving Eq. (8), it is implicitly assumed that the set of individuals who might jump discontinuously because of the small reform is negligible. In particular, this means that individuals who takeup benefits in response to the small reform do not gain since, on the margin, they are indifferent between taking up benefits and not taking up benefits. More formally, this requires that the c.d.f. F and the p.d.f. f are continuous as is shown in the Appendix.

Finally, to see how the optimal replacement rate in Eq. (8) compares to the optimal replacement rate in the benchmark case with full takeup, define $\overline{g}$, the ratio of marginal utility for an unemployed individual to the marginal utility for an employed individual, and ε, the elasticity of duration for the entire population. When there is full takeup, the optimal replacement rate must satisfy

$$\frac{r}{1-r} = \frac{1}{\varepsilon}(\overline{g} - 1) \tag{9}$$

The key distinction is that the parameters in Eq. (9) are defined over the entire population of unemployed individuals, whereas the analogous parameters in Eq. (8) are defined for the recipient population only.

2.2. Endogenous takeup cost

To study how social interactions affect the optimal provision of unemployment insurance, this subsection generalizes the fixed utility cost model to allow for peer effects in takeup.[6] Formally, let P be the aggregate takeup rate and ψ_i be distributed across individuals with distribution F and density f. An individual who takes up unemployment benefits has utility

$$u(c_u) - (\psi_i + S(P)) \tag{10}$$

The term ψ_i captures takeup costs that are inherently private in nature; for example, distance to the UI office. On the other hand, $S(P)$ captures social costs that depend on how many others are claiming benefits, like stigma or information. Assume that S, F and f are continuous and bounded and f is positive on the whole real line. Assume also that agents take $S(P)$ as given, not internalizing the effect that their behavior has on the takeup rate. In the parlance of the social interactions literature, the dependence of agent i's takeup cost on the action of others reflects *endogenous social interactions*.[7]

When social interactions are present, a change in b elicits two takeup responses: there is a change in takeup since utility depends directly on the benefit level through consumption in the unemployed state, and there is a change in takeup since utility depends indirectly on the benefit level through the takeup rate P. Since the UI agency cares about the total or general equilibrium response, this requires introducing the following elasticity concept.

$$v^e = \frac{w-b}{P^e}\frac{\partial P^e}{\partial(w-b)} \tag{11}$$

This elasticity measures the percentage increase in the fraction of individuals who takeup UI benefits when they are increased by 1%, taking into account spillover effects. There is a close relationship between v^e and v, the partial equilibrium elasticity, that is examined below.

It is also useful to generalize the concept of the marginal social welfare weight with social spillovers. This is defined as:

$$\overline{g}^e = \frac{u'(c_u^R) - \frac{1}{D^R}\frac{\partial S}{\partial P^e}\frac{\partial P^e}{\partial b}}{u'(c_e)} \tag{12}$$

If takeup costs are reduced when more individuals claim benefits (i.e., $S'(P) < 0$), then $\overline{g}^e \geq \overline{g}^R$. It is now a straightforward exercise to derive the formula for the optimal replacement rate with social interactions.

Proposition 2. *The optimal replacement rate with endogenous takeup and social spillovers is defined implicitly as*

$$\frac{r}{1-r} = \frac{1}{\varepsilon^R + v^e}(\overline{g}^e - 1) \tag{13}$$

There are two key changes to the formula for the optimal replacement rate when social interactions are present. First, the optimal replacement rate depends on the macro or total takeup elasticity, including spillover effects, v^e. Second, the formula depends on the externality effect that arises through the reduction in takeup costs from a \$1 increase in benefits, in addition to the more standard consumption benefit. In its current form, formula (13) is difficult to implement empirically. A key difficulty is that $\overline{g}^e$ depends on the primitive function $S'(P)$ which is not directly observable by the

[6] The model developed in this section closely follows Brock and Durlauf (2001) and Glaeser and Scheinkman (2002). The solution concept applied is a *Mean Field Equilibrium*. The technical details of a mean field equilibrium for the model (existence, stability and uniqueness) are available from the author on request.

[7] Since social interactions only affect the takeup cost in this model, the choices of unemployment durations, D^R and D^N, and therefore consumption, c_u^R and c_u^N will be unaffected.

econometrician. The next part of the paper shows that it is possible to express formula (13) entirely in terms of reduced-form parameters that can be estimated from the data.

2.2.1. The social multiplier

The key result of this subsection is to link the parameters v^e and $\bar{g}^e$ in formula (13) to the *social multiplier* (Cooper and John, 1988; Glaeser et al., 2003). The social multiplier is a reduced-form parameter that measures the discrepancy between the initial takeup response to a change in b, holding social spillovers constant, and the full equilibrium response occurring once the change in takeup rates are fully capitalized into takeup costs. Mathematically, the social multiplier is defined locally as $m(b) = \frac{P_b^e}{P_b}$, where $P_b \equiv F_b$. A simple application of the Implicit Function Theorem can be used to show that $m(b) = \frac{1}{1-F_{pe}}$.

It follows immediately from the definition of m that $v^e = mv$, where v denotes the partial equilibrium elasticity holding spillover effects constant. An $m > 1$ amplifies the individual-level takeup response to an increase in benefits. This may explain why the level of aggregation has proved important in estimating the takeup elasticity (Blank and Card, 1991).[8] It may also explain why the long run response to a policy change exceeds the short-run response (Lemieux and MacLeod, 2000; Lindbeck and Nyberg, 2006).[9] The next lemma formally establishes the link between m, $\bar{g}^e$ and $\bar{g}^R$.

Lemma 3. *The social welfare weight $\bar{g}^e$ with social interactions satisfies*

$$\bar{g}^e = m\bar{g}^R \tag{14}$$

where $\bar{g}^R$ is the ratio of marginal utilities.

Proof. First note that by definition of m,

$$\frac{\partial P^e}{\partial b} = mF_b$$

Next, consider the direct effect F_b. To see how this is related to the marginal utility of consumption, first note that

$$F_b = f\frac{\partial \psi^*}{\partial b}$$

Using definition (1), this can be further expressed as

$$F_b = f\left(u'(c_u^R)\frac{\partial c_u^R}{\partial b} + v'(D^R)\frac{\partial D^R}{\partial b}\right)$$

Since $\frac{\partial c_u^R}{\partial b} = D^R + (b-w)\frac{\partial D^R}{\partial b}$, this becomes

$$F_b = fu'(c_u^R)\left(D^R + (b-w)\frac{\partial D^R}{\partial b} + \frac{v'(D^R)}{u'(c_u^R)}\frac{\partial D^R}{\partial b}\right)$$

Agent optimization implies $v'(D^R) = (w-b)u'(c_u^R)$. Substitution gives the result that

$$F_b = fu'(c_u^R)D^R$$

Finally, using the fact that $F_{Pe} = f \cdot S_{Pe}$ along with Lemma 3,

$$\frac{1}{D^R}\frac{\partial S}{\partial P^e}\frac{\partial P^e}{\partial b} = (m-1)u'(c_u^R)$$

thus concluding the proof. □

[8] Glaeser, Sacerdote, and Scheinkman (2003) make a similar point about estimates of the effect of education on wages.

[9] To see this point more clearly, note that a social equilibrium can be regarded as the fixed point of a *dynamic* process where individuals continuously adjust their actions over time in response to the actions of others. In this setting, the long-run response of a change in benefits may exceed the short-run response.

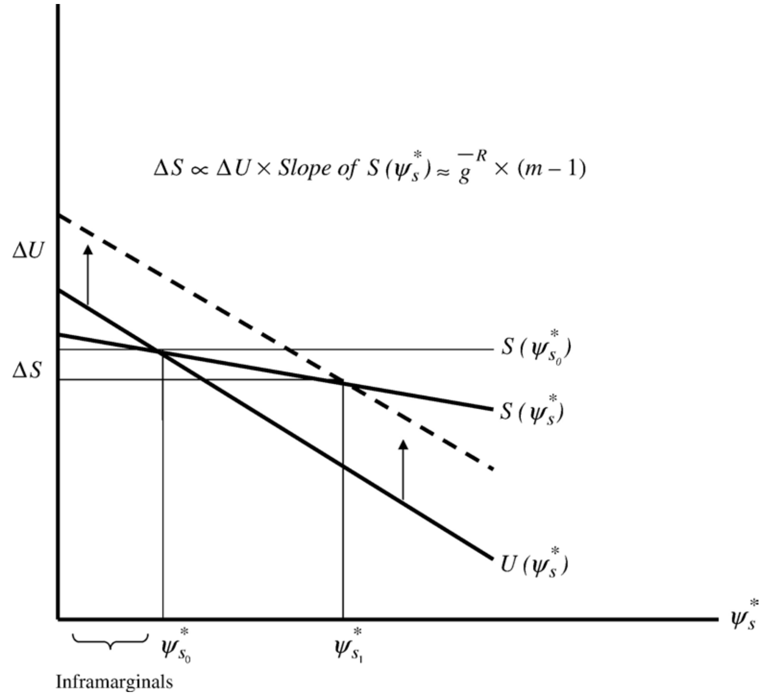

Fig. 1. Connection between direct and indirect utility gains.

A priori, it is not obvious that the term $\frac{1}{D^R}\frac{\partial S}{\partial P^e}\frac{\partial P^e}{\partial b}$ can be expressed simply in terms of the marginal utility of consumption in the unemployed state and the social multiplier. The intuition for this can be seen by considering the case where ψ_i is distributed uniformly between 0 and 1. Define $U(\psi) \equiv u(c_u^R) - u(c_u^N) + v(D^R) - v(D^N) - \psi$ and note that $U(\psi)$ is decreasing in ψ. The marginal agent is defined by the takeup cost ψ^* that satisfies the following equation:

$$U(\psi^*) = S(\psi^*) \tag{15}$$

Starting from an equilibrium, consider the effect of an increase in UI benefits. Since agents take $S(\psi^*)$ as given, this initially causes the left-hand side of Eq. (15) to exceed the right-hand side, increasing takeup. As more individuals claim UI benefits, the social cost $S(\psi^*)$ is reduced until a new equilibrium is reached.[10] Fig. 1 illustrates the mechanics implicit in Eq. (15). The term ΔS measures the positive externality that results from an increase in benefits. The figure shows that the size of this term is related to ΔU, the size of the direct gain, and the slope of S. For an infinitesimal change in benefits, these terms closely correspond to marginal utility, $u'(c_u^R)$, and the multiplier, m respectively. This logic illustrates the deeper connection between the direct and indirect terms that underlies Eq. (14). Interestingly, it implies that knowledge of m, v, ε^R and $\overline{g}^R$, terms that are in principle estimable, are sufficient to identify the optimal replacement rate, as can be seen in the following proposition.[11]

Proposition 4. *The optimal replacement rate with endogenous takeup and social spillovers, summarized by m, is defined implicitly as*

$$\frac{r}{1-r} = \frac{1}{\varepsilon^R + mv}(m\overline{g}^R - 1) \tag{16}$$

[10] Note that if there are no social interactions (i.e., $S(\psi)$ is constant), the marginal individual in the new equilibrium is determined by the intersection of the new curve $U(\psi^*)$ and the line $S(\psi_0^*)$.

[11] Note that if the unemployed were required to pay taxes when they became employed, the takeup response to a change in benefits would also depend on how the UI tax rate τ changed with benefits. In this case, the reduced-form expression for $\overline{g}^e$ in terms of m would implicitly ignore changes in the UI tax rate τ associated with changes in b. This simplification is unlikely to affect empirical estimates of $\overline{g}^e$ if p, the fraction of unemployed agents, is small. To see this, note that as $p \to 0$, $\frac{\partial \tau}{\partial b} \to 0$. As Chetty (2004) remarks, the wage base is very large relative to total UI benefits, implying that p is indeed small in practice.

2.3. Interpretation and implications

2.3.1. Behavioral effects

The formula for the optimal replacement rate in Eq. (16) depends on three key behavioral parameters: the duration elasticity (ε^R)–for the segment of the population that receives UI benefits–the takeup elasticity (v) and the social multiplier (m). When the elasticities are zero, the optimal replacement rate is one. In other words, with no distortions, full insurance is desirable. Note also that when $m=1$ (i.e., there are no social interactions), formula (16) collapses to formula (8).

2.3.2. Social marginal welfare weight

The other key parameter is the social marginal weight $\overline{g}^R$ and this enters the formula for the optimal replacement rate in the numerator.[12] Intuitively, the optimal replacement rate is an increasing function of $\overline{g}^R$, reflecting the fact that as it becomes more difficult to smooth consumption during an unemployment spell, benefits should be more generous. It is important to note that $\overline{g}^R$ is endogenous to the replacement rate. As such, in its current form, the formula for the optimal replacement rate should not be interpreted as an empirically relevant formula. To overcome this problem, $\overline{g}^R$ is approximated by the consumption drop along with the coefficient of relative risk aversion. This is discussed in detail in the next section.

Two final points are worth considering. First, Eq. (16) provides some insight into the debate about whether it is important for policy purposes to separate individual level effects from social multiplier effects. Although the denominator in Eq. (16) shows that only an estimate for the total response, mv, is required to test whether current benefit levels are optimal, the numerator shows that an estimate for m, the social multiplier, is also required. Second, Eq. (16) might appear to imply that optimal UI policy does not depend on whether the source of the takeup cost is stigma, transaction costs or informational barriers. If the objective of the government however, is simply to increase the takeup rate, then it could be very important to know what the underlying cause of low takeup is. To see this, note that if low takeup is really due to lack of information (about how to navigate the bureaucracy, for example) then a policy implication could be that a government that wants to boost takeup should invest more effort in disseminating information on enrollment, navigating the bureaucracy, or should perhaps simplify the process. None of these are implications of a model where stigma is the key driver of takeup.

3. Empirical calibrations

The expressions derived in this paper show that the social welfare weight ($\overline{g}^R$), the elasticity of takeup with respect to the net wage (v), the elasticity of duration with respect to the net wage (ε^R), and the social multiplier (m) are needed to test for the optimality of replacement rates. For tractibility, this paper makes two simplifying assumptions: first, $\overline{g}^R$ is assumed to be well approximated by the empirical consumption drop, for individuals who receive UI benefits, multiplied by the coefficient of relative risk aversion; second, the behavioral elasticities, v and ε^R, are taken to be constant.[13] Under these assumptions, one can obtain a simple expression for the optimal replacement rate in terms of the level of risk aversion and the social multiplier.

3.1. Social welfare weight

This subsection illustrates that one can recover an estimate of the consumption drop for UI recipients from the estimate of the consumption drop for the full population of unemployed individuals. To see this, consider the following econometric specification:

$$\begin{aligned} \Delta c_i &= \beta_0 + \beta_1 \cdot \mathrm{BEN}_i + \epsilon_i \\ \mathrm{BEN}_i &= \pi_0 + \pi_1 \cdot \mathrm{UI}_i + \eta_i \end{aligned} \tag{17}$$

[12] Note that if all individuals were required to pay taxes on earnings, the denominator in $\overline{g}^R$ would be a weighted-average of consumption during employment with the weights reflecting the population distribution. In practice, since individuals spend a small fraction of their lifetimes unemployed, the difference between these terms is likely to be small.

[13] Note that the constant elasticity assumption does not make much sense when the elasticities are defined with respect to the benefit level, since this implicitly imposes undesirable features on the nature of underlying preferences in this case. To see this, note that for the elasticity to be constant as the benefit level tends to zero, the partial effect of a change in benefits on takeup and duration must tend to infinity at the same rate. This problem does not occur when the elasticities are defined with respect to the net wage.

Table 1
Effect of unemployment on consumption growth — UI recipients vs. non-UI recipients

	Full sample	Recipients	Non-UI recipients
(Mean) consumption drop	−0.082	−0.086	−0.088
	(.011)	(.018)	(.017)
(Mean) Consumption drop with individual effects	−0.085	−0.085	−0.095
	(.013)	(.021)	(.020)
Sample size	30,468	28,274	30,468

Notes:
a. Robust standard errors clustered on the individual are reported in parentheses.
b. Data is from the PSID and spans the years 1977 to 1997.
c. Individuals are classified as unemployed if they are currently unemployed at the time of the interview and report a positive number for "weeks unemployed in previous year" in the following interview.
d. An individual is defined as a UI recipient for the current UI spell if he reports receiving unemployment compensation in year t at time $t+1$.
e. All individuals are eligible for UI benefits. According to this definition, for a typical unemployment spell, the takeup rate is 38%.
f. The key specification for the average consumption drop of individual i of period t is given by the following equation: $g_{it}=\alpha+\beta\cdot \text{unemp}_{it}+\varepsilon_{it}$ where $g_t=\log(c_{t-1})$ denotes the growth rate of food, $\text{unemp}_{it}=1$ if individual i is unemployed in year t and 0 otherwise.

where Δc is the change in (log) food expenditures when an individual becomes unemployed, BEN_i measures benefits received and UI_i measures potential benefits, the level of benefits that an individual is eligible for.[14] The structural parameter in this model, β_1, represents the "consumption smoothing benefit of UI"—the amount unemployment consumption would increase if an extra dollar was given to an individual randomly selected from the population of unemployed individuals. The "implied consumption drop" due to unemployment, β_0, reflects how much consumption would fall, in the absence of any government insurance arrangements. Using indirect least squares, Gruber (1997) estimates $\widehat{\beta_0}=.24$ and $\widehat{\beta_1}=-.58$, suggesting that individuals have substantial resources to smooth their consumption.

Both the implied consumption drop and the consumption smoothing effect for UI recipients are easily obtained if it is assumed that the consumption of non-UI recipients does not vary with the benefit level.[15] Under this assumption, the mean consumption drop for non-UI recipients (9%) is also the implied consumption drop for this group. Given a takeup rate of 54% in Gruber's sample, the implied consumption drop for UI recipients is therefore $\frac{.24-.46\times.09}{.54}=0.37$. This also implies that the consumption smoothing effect for those receiving UI benefits is approximately twice as large in magnitude as the effect for the full sample, $-.28\times1.85=-.52$. Based on these estimates, the full consumption drop for UI recipients is

$$\frac{\Delta c^R}{c}\approx .37-.52r \tag{18}$$

It is noteworthy that at a mean replacement rate of .5, the mean consumption drop for UI recipients is 0.11, which is very close to the estimate reported in Table 1.

A potential problem arises however, if the marginal individuals who select into the sample when benefits increase, experience a smaller drop in consumption than the average individual. In this case, the estimate of the consumption smoothing effect is biased downwards. A simple bounding argument shows that this selection bias is likely to be small. First, note a 10% increase in the benefit rate is associated with a 2% increase in the probability of takeup (Anderson and Meyer, 1997). Next, assume that individuals are randomly drawn from the pool of non-recipients when benefits increase. This implies a 10% increase in benefits will cause the average consumption drop to fall through this selection effect by $\frac{2\%}{54\ \%}\times(.37-.09)=0.1\%$. In other words, a 10% increase in the benefit rate causes a 5.1% reduction in the consumption drop for UI recipients, compared to the estimate of 5.2% that is obtained when selection bias is ignored.

[14] In Gruber's specification, the replacement rate an individual is eligible for is actually used. Empirically, $b/w\approx0.5$, giving a mean consumption drop of 0.1 for the full sample.

[15] This assumption is violated if the "option value" of UI is large: when benefits are more generous, individuals may feel less obligated to cut back on spending during a UI spell. It is therefore possible that the consumption of non-UI recipients may respond to the benefit level. In practice, 70% of those who collect benefits do so within the first month of unemployment (Chetty, 2005). This suggests that the dynamic aspect of the takeup problem is second-order and can be taken as evidence that the option value of UI is small.

Table 2
Optimal replacement rates

Coefficient of relative risk aversion	Full takeup $\varepsilon^B=0.5$	Full takeup $\varepsilon=0.5$	$m=1$ $mv=0.5$, $\varepsilon^R=0.8$	$m=1.5$ $mv=0.5$, $\varepsilon^R=0.8$	$m=2$ $mv=0.5$, $\varepsilon^R=0.8$
1	0	.25	.18	.37	.49
2	0	.36	.26	.42	.52
3	.27	.42	.32	.46	.54
4	.41	.47	.36	.48	.56
5	.50	.50	.39	.50	.57
10	.68	.60	.48	.56	.61

Moreover, since the marginal individuals who takeup benefits likely experience a larger drop in consumption than the average individual who does not takeup, the 0.1 is an upper bound for the selection bias.

3.2. Elasticities

The other key elements that determine whether current replacement rates are optimal are γ, m, ε^R and mv. The approach taken in this paper is to assign specific values to the behavioral elasticities, based on estimates from empirical studies, and to consider a range of parameter values for γ and m. Specifically, an estimate of 0.8 from Meyer (1990) is used for ε^R and an estimate of 0.5 from Anderson and Meyer (1997), is used for mv.[16] Table 2 reports the optimal replacement rate based on the empirical estimates of the behavioral elasticities and a range of γ and m. For comparison, the first column reports the optimal replacement rate in the benchmark case with full takeup, using the consumption drop estimated in Gruber (1997) and the elasticity of duration with respect to the benefit level, $\varepsilon^B = \frac{b}{D}\frac{\partial D}{\partial b}$. To isolate the effect of using a different elasticity concept, the second column reports the replacement rate with full takeup, using the duration elasticity defined with respect to the net wage, $\varepsilon = \frac{w-b}{D}\frac{\partial D}{\partial w-b}$.

3.3. Results

The first interesting result to note in Table 2 is that the optimal replacement rate changes from the first to the second column. To see why, recall that ε^B and ε are equal only when $r=0.5$. For $\gamma=5$, Table 2 shows that the optimal replacement rate is .5 in both columns, as expected. Now assume for the sake of argument that $\gamma=3$. The original Baily formula delivers an optimal replacement rate of .27. When $r=0.27$ however, the elasticities are no longer numerically identical, since the scaling factor that relates the two is not 1, but rather $\frac{1-r}{r} = 2.7$. In other words, if one were to scale up ε by 2.7, one would get an optimal replacement rate equal to .27 in column 2, instead of the .42 that is actually obtained. Nevertheless, since the constant elasticity assumption makes more sense when the elasticity is defined with respect to the net wage than when it is defined with respect to the benefit level, column 2 probably provides a more accurate set of estimates than column 1.

Table 2 also reveals two key comparative static results. First, including takeup lowers the optimal replacement rate. This can be seen by comparing the third column with the second column and is primarily due to the added behavioral (takeup) response that occurs when benefits are increased. Although the implied drop for UI recipients is larger than that for the full sample of unemployed implying higher rates, the consumption smoothing effect is also larger. This means that a given marginal change in benefits is more effective in reducing consumption and tends to lower the optimal replacement rate.

The second result is that an increase in m, holding the other terms constant (in particular, the additional cost due to behavioral responses, mv), raises the optimal replacement rate. Intuitively, an increase in benefits that leads to increased takeup can reflect both *private* incentives (increased consumption during unemployment) and *social* incentives (more information reducing takeup costs). Private individual welfare is equal to social welfare under the former interpretation, but not under the latter, since individuals do not internalize the positive effect their own takeup decision has on the

[16] The elasticities estimated in empirical studies are defined with respect to the benefit level. Note the following relationship $\varepsilon = \frac{1-r}{r}\varepsilon^B$. At a mean replacement rate of .5, the elasticities are numerically identical.

welfare of others. Standard economic reasoning dictates that the right corrective measure in this circumstance is a higher benefit level. The next section focuses on estimation of the social multiplier.

4. Estimation of the social multiplier

States periodically change certain parts of their benefit schedule, but not other parts. This benefit variation creates two sources of variation: one source that operates within states and another source that operates across states. Empirical studies that estimate the labor supply effects to social insurance programs typically use both sources of variation (Meyer, 1992). The primary motivation of this strategy is that it addresses the omitted variable bias problem that arises if general shocks to UI takeup or durations are correlated with state benefit changes. This paper argues that if benefit changes indirectly affect individuals in the state–who do not experience a benefit change–through social spillovers, then these studies are implicitly identifying the direct or private effect. Moreover, unless there is a second instrument available, it is not possible to simultaneously identify the direct and spillover effects, a point elucidated in the education literature by Acemoglu and Angrist (1999).

To formalize this intuition and to interpret the results, a simple linear-in-means model is considered. Suppose there are S states ($s=1,\ldots,S$) and the takeup outcomes of Ms individuals are sampled in the sth state in each year $t=1,\ldots, T$. Individuals are unemployed and are eligible for unemployment insurance benefits. Individual i's takeup decision in state s and year t, ω_{sit}, is generated by the following process:

$$\omega_{sit} = \alpha^* + \eta b_{sit} + \beta \overline{\omega}_{st} + \alpha_s^* + \alpha_t^* + \epsilon_{sit} \tag{19}$$

where b_{sit} is the benefit level for individual i in state s and year t, $\overline{\omega}_{st} = \frac{\sum_{i=1}^{M^s} \omega_{sit}}{M^s}$ is the takeup rate in state s and year t. The terms α_s^* and α_t^* capture unobserved state and year effects and ϵ_{sit} is an idiosyncratic error. An exogenous increase in the mean takeup rate of a state translates into a final increased takeup rate for that state of $1/(1-\beta)$ percent through the social multiplier effect.[17]

In general, it is not possible to identify the parameter β; only the composite parameter $\frac{\eta\beta}{1-\beta}$ is identifiable.[18] This identification problem can be overcome however, if there is a "partial-population intervention" that exogenously affects the outcomes of some members of the group but not others (Moffitt, 2001). If UI benefit changes are exogenous, then the quasi-experimental design used in the UI literature by Meyer and others provides a partial-population intervention that can be used to identify the spillover effect. In practice, this condition is unlikely to be satisfied for reasons already discussed. In technical terms, only one instrument is available, the maximum WBA, and two instruments are required for identification. To partially address this concern, the regressions control for macro shocks using the state unemployment rate.

Formally, let the subgroup of high wage earners in state s be denoted by superscript H. The takeup outcome for a high earner is given by:

$$\omega_{sit}^H = \alpha^* + \eta b_{sit}^H + \beta \overline{\omega}_{st} + \alpha_s^* + \alpha_t^* + \epsilon_{sit}^H \tag{20}$$

Let the takeup outcome for the subgroup of low wage earners in state s be given by:

$$\omega_{sit}^L = \alpha^* + \eta b_{sit}^L + \beta \overline{\omega}_{st} + \alpha_s^* + \alpha_t^* + \epsilon_{sit}^L \tag{21}$$

Note the following relationship between the overall mean outcome and the mean outcomes of the subgroups:

$$\overline{\omega}_{st} = m_{st}^H \overline{\omega}_{st}^H + m_{st}^L \overline{\omega}_{st}^L \tag{22}$$

[17] This model implicitly assumes that agents play the same equilibrium in all states at each point of time.

[18] This can be seen by considering the reduced-form of Eq. (20). Manski (1993) considers a similar model and problem and highlights the connection to the problem of estimating a demand or supply function, when only the equilibrium price and quantities are observed by the econometrician.

Table 3
Summary statistics for CPS sample

	Pooled		Eligibles		Non-eligibles	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
State characteristics						
Fraction receiving UI benefits	0.65	0.48	0.66	0.47	0.64	0.48
Previous weekly earnings	\$386	228	\$535	234	\$243	84
Weekly benefit amount (WBA)	\$143	42	\$167	33	\$120	37
Maximum WBA	\$173	32	\$176	43	\$191	43
Individual characteristics						
Tenure in lost job (years)	5.46	6.02	6.47	6.56	4.48	5.27
Female	0.35	0.48	0.23	0.42	0.46	0.50
Reside in S.M.S.A.	0.71	0.45	0.73	0.45	0.70	0.46
Married	0.62	0.48	0.70	0.46	0.55	0.49
Age	36.50	10.43	38.29	9.95	35.00	10.60
Head of household	0.65	0.48	0.77	0.42	0.54	0.50
Children	0.46	0.50	0.47	0.50	0.45	0.50
Blue collar	0.57	0.50	0.52	0.50	0.62	0.48
>12 Years of education	0.35	0.48	0.45	0.50	0.26	0.44
Sample size	8459		4162		4342	

Notes:
a. Data used is from McCall (1995) and includes the 1984, 1986, 1988, 1990, and 1992 CPS Displaced Worker.
b. The sample includes individuals aged 20 to 61, displaced in the two years preceding the survey from nonagricultural, full-time jobs, due to plant closure, slack work, abolishment of position, or the end of seasonal work.
c. To focus on individuals eligible for UI benefits, only those with at least 1 year of previous job tenure and with reported weekly earnings in the lost job greater than the state minimum weekly benefit level are included.
d. UI benefits are imputed from the U.S. Department of Labor using previous weekly earnings and state of residence.
e. Earnings and benefit levels are denominated in 1985 dollars.

where m_{st}^H is the share of high wage earners in state s at time t and $m_{st}^L = 1 - m_{st}^H$. Substituting Eq. (23) into Eqs. (21) and (22), the social equilibrium of this system is given by the reduced-form model:

$$\omega_{sit}^H = \alpha + \eta b_{sit}^H + \beta^R (m_{st}^H b_{st}^H + m_{st}^L \overline{b}_{st}^L) + \alpha_s + \alpha_t + u_{sit}^H \tag{23}$$

$$\omega_{sit}^L = \alpha + \eta b_{sit}^L + \beta^R (m_{st}^H b_{st}^H + m_{st}^L \overline{b}_{st}^L) + \alpha_s + \alpha_t + u_{sit}^L \tag{24}$$

where $\alpha = \alpha^* + \frac{\alpha^*}{1-\beta}, \beta^R = \frac{\eta\beta}{1-\beta}, \ \alpha_s = \alpha_s^* + \frac{\alpha_s^*}{1-\beta}$ and $\alpha_t = \alpha_t^* + \frac{\alpha_t^*}{1-\beta}$. Assume for simplicity that $m_{st}^H = m^H$. Two things should be noted about Eqs. (23) and (24). First, the benefit level for high earners is constant across individuals so that $b_{sit}^H = b_{st}^H$, the maximum weekly benefit amount. Second, the benefit level of those not eligible for the maximum WBA (the 'non-eligibles') does not vary over time. Given the assumption that b_{st}^H is uncorrelated with u_{sit}^H, an OLS regression of the takeup rate of the eligibles on the maximum weekly benefit amount, conditional on state and year effects, will identify $\eta + \beta^R m^H$. Furthermore, under the assumption that b_{st}^H is uncorrelated with u_{sit}^L, an OLS regression of takeup of the non-eligibles on the maximum weekly benefit controlling for state and year fixed effects, will identify $\beta^R m^H$. The maintained assumption is that an observed increase in takeup among low earners in a state, at the time of a benefit increase, is the effect of an exogenous increase in takeup among high earners within the state.[19]

[19] Note that if there is an information campaign following an increase in benefits, this might have an independent effect on takeup outcomes of the low earners. Thus, the estimates might not be capturing an effect that operates through the change in the overall takeup rate per se, but rather a correlated effect that is due to a shock that commonly affects both groups.

Table 4
Reduced-form differences: eligibles vs. non-eligibles

Dependent variable	Takeup rate	Takeup rate	Takeup rate
	(1)	(2)	(3)
Panel A: Effect of benefit changes for eligibles			
Maximum WBA	.0015	0016	.0010
	(0.0006)	(0.0006)	(0.0006)
Year effects	Y	Y	Y
State effects	Y	Y	Y
Individual controls	N	Y	Y
State unemployment rate	N	N	Y
Mean takeup rate	0.66	0.66	0.66
Sample size	4162	4162	4162
Panel B: Effect of benefit changes for non-eligibles			
Maximum WBA	.0009	.0006	.00035
	(0.0005)	(0.0005)	(0.0005)
Year effects	Y	Y	Y
State effects	Y	Y	Y
Individual controls	N	Y	Y
State unemployment rate	N	N	Y
Mean takeup rate	0.64	0.64	0.64
Sample size	4342	4342	4342

Notes:
a. Standard errors are reported in parentheses.
b. Data is from the CPS Displaced Workers Survey.
c. The individual level control variables include tenure, previous weekly wage, reason for displacement, expected recall, head of household, marital status, kids, industry, urban/rural, blue collar, education, age, gender.

4.1. Results

To estimate the multiplier, data is collected from the 1984, 1986, 1988, 1990, and 1992 CPS Displaced Worker Surveys. The sample includes individuals aged 20 to 61, displaced in the two years preceding the survey from nonagricultural, full-time jobs. To focus on individuals eligible for UI benefits, only those with at least one year of previous job tenure and with reported weekly earnings in the lost job greater than the state minimum weekly benefit level are included in the sample.[20] UI benefits are imputed from the U.S. Department of Labor, using previous weekly earnings and state of residence. Since benefit entitlement is conditional on high quarter earnings, there might be measurement error in the estimates. Individuals who report zero weeks of unemployment are also included in the sample. The final sample contains years 1982–1991. Table 3 presents summary statistics for the sample and sub-samples of eligibles and non-eligibles. Individuals are classified as eligibles if the weekly benefit amount exceeds the maximum weekly benefit amount in the previous year. Note that all figures are denominated in 1985 dollars.

4.2. Reduced-form differences

The first set of results provide evidence of the importance of the direct effect. The coefficient estimate from a regression of the maximum WBA on takeup, where the sample consists only of wage earners eligible for the maximum WBA, is reported in Panel A in Table 4. Note that including the state unemployment rate as a control affects the size of the coefficient, but not the sign. Taking the lower bound of the point estimates yields a total effect of .0010: a 10% increase in UI benefits leads to a 1.75 percentage point increase in the probability of takeup. This estimate is similar to the estimates reported in McCall (1995) and Anderson and Meyer (1997).

[20] The sample selection criteria follows McCall (1995).

Next, the coefficient estimate from a regression of the maximum WBA on takeup, only including those with low previous earnings, is reported in Panel B in Table 4. Taking the lower bound of the point estimates, the indirect effect is .00035: a 10% increase in the maximum WBA is associated with a 0.7 percentage point increase in the probability of taking up benefits.

In the sample m^H is on average .50 and is reasonably stable over time. Taken together, these estimates imply that $\hat{\eta}=.00065$ and $\hat{m}=1/(1-\hat{\beta})\approx 2$. This suggests that an exogenous increase in the mean takeup rate of a state translates into a final increased takeup rate for that state of 2% through the social multiplier effect. Put in another way, an increase in benefits that causes 10 individuals to takeup because their benefits were increased, will induce through a spillover effect, on average, an additional 10 individuals to takeup. Note that these estimates imply that 35% of the effect estimated in McCall (1995) and Anderson and Meyer (1997) comes through a social multiplier effect. For a coefficient of relative risk aversion of 4.75, estimated in Chetty (2004), the optimal replacement rate is approximately 60%, nearly 20% higher than current replacement rates.

5. Conclusion

This paper has incorporated the takeup decision into a standard model of unemployment insurance, in a setting with and without social interactions. Formulas for the optimal replacement rate were derived using elasticities and the social multiplier. A key contribution is to show that optimal social insurance policies depend on the ratio of the total takeup effect to the direct takeup effect. In other words, computing the benefits and efficiency costs of social insurance programs requires knowledge of both the total takeup elasticity and the social multiplier.

There are several possible directions for future research. First, one could relax the assumption of a constant replacement rate and explore the optimal time path of UI benefits. This would be similar to Saez (2002), who studies how behavioral responses along the extensive margin affect the optimal shape of an income transfer system. Second, one could consider an alternative approach to estimating the social multiplier. Graham (2005) has shown, for the case of a continuous outcome, that excess variance contrasts are useful for identifying social interactions. This approach might also be useful for binary outcomes.

Appendix A. Derivation of Eq. (8) for *r*

This section provides a formal derivation for Eq. (8). Let $V_i^R=u(c_u^R)+v(D^R)-\psi_i$ and $V_i^N=u(c_u^N)+v(D^N)$. Denote the social welfare function by $V(b,\tau)$. Letting λ_u^R and λ_u^N denote the lagrange multipliers of the individual's optimization problem, this can be written as

$$\begin{aligned} V(b,\tau) = \max_{c_e,c_u^R,c_u^N,D^R,D^N,\lambda_e,\lambda_u^R,\lambda_u^N} &= (1-p)u(c_e) + p\left[\int_{\psi_i=\underline{\psi}}^{\psi_i=\psi^*} V_i^R \mathrm{d}F(\psi_i) + \int_{\psi_i>\psi^*} V_i^N \mathrm{d}F(\psi_i)\right] \\ &+\lambda_e[A_0+(w-\tau)-c_e]+\lambda_u^R[A_0+bD^R+w(1-D^R)-c_u^R] \\ &+\lambda_u^N[A_0+w(1-D^N)-c_u^N] \end{aligned}$$

Assume an interior solution so that b^* satisfies $\frac{\partial V(b^*,\tau)}{\partial b}=0$. Under the assumption that F and f are continuous, Leibniz's Rule for differentiation under the integral sign applies and leads to the following:

$$\frac{\partial V(b^*,\tau)}{\partial b} = -\lambda_e\frac{\partial \tau}{\partial b} + \lambda_u^R D^R = 0 \Rightarrow \lambda_e\frac{\partial \tau}{\partial b} = \lambda_u^R D^R$$

Agent optimization further implies that

$$\begin{aligned} \lambda_e &= (1-p)u'(c_e) \\ \lambda_u^R &= pP(b)u'(c_u^R) \end{aligned}$$

The government's budget balance constraint implies that

$$\frac{\partial\tau}{\partial b}=\frac{p}{1-p}\left[P(b)D^R+bD^R\frac{\partial P}{\partial b}+P(b)b\frac{\partial D^R}{\partial b}\right]$$

This implies that

$$\begin{aligned}\frac{\lambda_u^R}{\lambda_e}D^R &= \frac{p}{1-p}\left[P(b)D^R+bD^R\frac{\partial P}{\partial b}+P(b)b\frac{\partial D^R}{\partial b}\right]\Rightarrow\frac{p}{1-p}\frac{P(b)u'(c_u^R)}{u'(c_e)}D^R\\ &= \frac{p}{1-p}\left[P(b)D^R+bD^R\frac{\partial P}{\partial b}+P(b)b\frac{\partial D^R}{\partial b}\right]\Rightarrow u'(c_u^R)=u'(c_e)\left[1+\frac{b}{P(b)}\frac{\partial P}{\partial b}+\frac{b}{D^R}\frac{\partial D^R}{\partial b}\right]\end{aligned}$$

Substituting using definitions (2) and (3) and $\overline{g}^R=\frac{u'(c_u^R)}{u'(c_e)}$ leads directly to the result.

Appendix B. Data from the PSID

The mean consumption drops for UI and non-UI recipients are estimated using food expenditure data from the PSID.[21] The PSID tracks roughly 6000 households and their splitoffs over time, and is the primary source of longitudinal data on consumption in the US. The data for this analysis spans the years 1977 to 1997. The key variables are food consumption, employment status and unemployment receipt.

Food consumption is obtained from the family files and is defined as the sum of household consumption at home and away, and paid for by food stamps, following Zeldes (1989). The food stamp variable reports the amount an individual received in the previous month and so is scaled up to an annual value. This is deflated using the CPI to obtain real growth rates. All values reported are in 2003 dollars.

The PSID records whether an individual is unemployed in the year of the survey. As well, the PSID records the number of weeks unemployed in the previous year. For the purpose of the analysis, an individual is defined as being in an unemployment spell if two conditions are satisfied: first, the individual reports being unemployed at the time of the current interview and working at the time of the previous interview; second, the individual reports a positive number for "weeks unemployed in previous year", in the year following the survey. Data on unemployment compensation receipt in year t come from the survey in year $t+1$. Prior to 1993, only the amount of unemployment insurance compensation was recorded. Following 1993, individuals were specifically asked whether they received benefits. UI receipt is defined as having received more than \$100 in benefits prior to 1993 and having received benefits after 1993. Eligibility for UI benefits is defined as working in the private sector and having a weekly wage above the minimum weekly benefit amount in a state. This follows Gruber (1997).[22]

Three exclusion restrictions are made to arrive at the core sample. First, only observations for household heads who are between the age of 20 and 65 are included. Second, observations where there was a change in the number of people in the household are excluded. This is done to eliminate changes in total consumption measures due to changes in the size of a household unit. Finally, only individuals who report becoming unemployed at least once during the sample are included.

References

Acemoglu, Daron, Angrist, Josh, 1999. How Large are the Social Returns to Education? Evidence from Compulsory Schooling Law. Working Paper, vol. 7444. NBER.

Aizer, Anna, Currie, Janet, 2004. Networks or neighborhoods? Correlations in the use of publicly-funded maternity care in California. Journal of Public Economics 88 (12), 2573–2585 (December).

[21] Since food is a necessity, households are less likely to cut back on their food consumption during an unemployment spell, relative to other goods. This implies that the calibrated ratio used understates the true ratio.

[22] Thank you to Rick Evans and Tom Koch for providing the code to impute eligibility.

Anderson, Patricia M., Meyer, Bruce D., 1997. Unemployment insurance takeup rates and the after-tax value of benefits. Quarterly Journal of Economics 112 (3), 913–937.
Baily, Martin, 1978. Some aspects of optimal unemployment insurance. Journal of Public Economics 10, 379–402.
Bertrand, Marianne, Luttmer, Erzo F.P., Mullainathan, Sendhil, 2000. Network effects and network cultures. Quarterly Journal of Economics 115, 1019–1055.
Besley, Timothy, Coate, Stephen, 1992. Understanding welfare stigma: taxpayer resentment and statistical discrimination. Journal of Public Economics 48, 165–183.
Blank, Rebecca, Card, David, 1991. Recent trends in insured and uninsured unemployment: is there an explanation? Quarterly Journal of Economics 106 (4), 1157–1190.
Borjas, George, Hilton, Lynette, 1996. Immigration and the welfare state: immigration participation in means-tested entitlement programs. Quarterly Journal of Economics 111 (2), 575–604.
Brock, William A., Durlauf, Steven N., 2001. Discrete choice with social interactions. The Review of Economic Studies 68 (2), 235–260.
Chetty, Raj, 2004. Optimal Unemployment Insurance When Income Effects are Large. Mimeo. UC Berkeley.
Chetty, Raj, 2005. Why do Unemployment Benefits Raise Unemployment Durations? The Role of Borrowing Constraints and Income Effects. Working paper, vol. 11760. NBER.
Chetty, Raj, 2006. A general formula for the optimal level of social insurance. Journal of Public Economics 90, 1879–1901.
Cooper, Russell, John, Andrew, 1988. Coordinating coordination failures in Keynesian models. Quarterly Journal of Economics 103 (3), 441–463.
Currie, Janet, 2004. The Take-Up of Social Benefits. Mimeo. UC Los Angeles.
Davidson, Carl, Woodbury, Steven A., 1997. Optimal unemployment insurance. Journal of Public Economics 64, 359–387.
Duflo, Esther, Saez, Emmanuel, 2003. The role of information and social interactions in retirement plan decisions: evidence from a randomized experiment. Quarterly Journal of Economics 118 (3), 815–842.
Glaeser, Edward L., Scheinkman, Jose A., 2002. Non-Market Interactions. Technical Report, Lecture. Econometric World Society.
Glaeser, Edward L., Sacerdote, Bruce, Scheinkman, Jose A., 2003. The social multiplier. Journal of the European Economic Association 1 (1-2), 345–353.
Graham, Bryan S., 2005. Identifying Social Interactions through Excess Variance Contrasts. Mimeo. University of California at Berkeley.
Gruber, Jon, 1997. The consumption smoothing benefits of unemployment insurance. American Economic Review 87, 192–205.
Krueger, Alan B., Meyer, Bruce D., 2002. Labor Supply Effects of Social Insurance. Working Paper, vol. 9014. NBER.
Lemieux, Thomas, MacLeod, W. Bentley, 2000. Supply side hysteresis: the case of the Canadian unemployment system. Journal of Public Economics 78 (1-2), 139–170.
Lentz, Rasmus, 2005. Optimal Unemployment Insurance in an Estimated Search Model with Savings. Mimeo. Boston University.
Lindbeck, Assar, Nyberg, Sten, 2006. Raising Children to Work Hard: Altruism, Work Norms and Social Insurance. Working Paper. The Research Institute of Industrial Economics.
Lindbeck, Assar, Persson, Mats, 2006. A Model of Income Insurance and Social Norms. Working Paper. Institute for International Economic Studies.
Lindbeck, Assar, Nyberg, Sten, Weibull, Jorgen W., 1999. Social norms and economic incentives in the welfare state. Quarterly Journal of Economics CXIV (1).
Manski, Charles F., 1993. Identification of endogenous social interactions: the reflection problem. Review of Economic Studies 60 (3), 531–542.
McCall, Brian, 1995. The impact of unemployment insurance benefit levels on recipiency. Journal of Business and Economic Statistics 13 (2), 189–198.
Meyer, Bruce D., 1990. Unemployment insurance and unemployment spells. Econometrica 58 (4), 757–782.
Meyer, Bruce, 1992. Using Natural Experiments to Measure the Effects of Unemployment Insurance. Working Paper. NBER.
Moffitt, Robert A., 1983. An economic model of welfare stigma. American Economic Review 73 (5), 1023–1035.
Moffitt, Robert A., 2001. Policy interventions, low level equilibria, and social interactions. In: Durlauf, Steven N., Young, H. Peyton (Eds.), Social Dynamics. MIT Press, Cambridge, Massachusetts, pp. 45–82.
Rege, Mari, Telle, Kjetil, Votruba, Mark, 2006. Social Interaction and Disability Pension Participation: Evidence from Plant Downsizing. Working Paper. Case Western Reserve University.
Remler, Dahlia K., Rachlin, Jason E., Glied, Sherry A., 2001. What Can The Take-up Of Other Programs Teach Us About How To Improve Take-up of Health Insurance Programs. Working Paper, vol. 8185. NBER.
Saez, Emmanuel, 2001. Using elasticities to derive optimal income tax rates. Review of Economic Studies 68, 205–229.
Saez, Emmanuel, 2002. Optimal income transfer programs: intensive versus extensive labor supply responses. Quarterly Journal of Economics 117, 217–230.
Shimer, Robert, Werning, Ivan, 2005. Liquidity and Insurance for the Unemployed. Report. University of Chicago and MIT.
Sorensen, Alan, 2001. Social Learning in the Demand for Employer-Sponsored Health Insurance. Working Paper, UCSD.
Vroman, Wayne, 1991. The Decline in Unemployment Insurance Claims Activity in the 1980s. Technical Report. U.S. Department of Labor.
Zeldes, Stephen P., 1989. Consumption and liquidity constraints: an empirical investigation. Journal of Political Economy 97, 305–346.