Optimal Taxation and Social Insurance with Crowdout of Private Insurance*

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Abstract

This paper characterizes the welfare gains from redistributive taxation and social insurance in an environment where the private sector provides partial insurance. We analyze a model in which adverse selection or imperfect optimization in the private sector creates a role for government intervention. We generalize the elasticity-based formulas for optimal taxation and insurance in Saez (2001) and Chetty (2006) to allow for endogenous private insurance. The simple formulas we derive provide a method of mapping estimates of the degree of "crowdout" of private insurance into quantitative predictions for optimal policy. Empirical applications to unemployment and health insurance show that taking private market insurance into account matters significantly for optimal benefit levels.

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1 Introduction

How should redistributive tax and social insurance programs be designed to maximize social welfare? There are large theoretical and empirical literatures that aim to answer this question. The canonical theoretical literature on optimal taxation and insurance provided a number of important insights into optimal policy (e.g. Mirrlees 1971, Baily 1978), but offered relatively little quantitative guidance on optimal tax rates or benefit levels for programs that insure income shocks. A parallel empirical literature beginning in the 1980s documented behavioral responses to many types of government policies and discussed intuitively how these responses affect optimal policy, but again did not map these estimates into quantitative predictions for optimal policy (e.g. Feldstein 1978, Meyer 1990).

A recent literature in public economics has begun to integrate the theory and empirical evidence more tightly by developing simple but robust elasticity-based formulas for optimal policies (see e.g., Saez 2001, Chetty 2006a, Shimer and Werning 2008, Chetty 2008). One important limitation of existing elasticity-based formulas is that they do not allow for private market insurance, implicitly assuming that the government is the sole provider of insurance. Previous studies have emphasized that crowdout of private insurance by social insurance can lower the optimal level of social insurance (e.g. Pauly 1974, Cutler and Gruber 1996a-b, Golosov and Tsyvinski 2007). However, there is currently no method of mapping empirical evidence such as the reduced-form crowdout elasticity estimates of Cutler and Gruber (1996a) into quantitative statements about the optimal level of government insurance.

The goal of this paper is to fill this gap by developing elasticity-based formulas for optimal taxation and social insurance that allow for endogenous private market insurance. The starting point for such an analysis is the specification of the limits of private market insurance and the potential role for government intervention. We consider two failures that can potentially create a role for government intervention. First, adverse selection may constrain the private market's ability to provide insurance relative to the government, which can mandate participation. Second, an emerging literature in behavioral economics has emphasized "individual failures" in planning (e.g. myopia, overconfidence, cognitive limitations) that may make agents' private market insurance choices suboptimal. Such errors in optimization can create a role for social insurance.

We analyze models that incorporate these two limitations of the private market using a simple discrete-state setting in which the individual's earnings vary across states. This variation can be interpreted as uncertainty due to shocks, as in a social insurance problem, or as random variation in skills behind the veil of ignorance, as in an optimal taxation problem. We allow for two types of private insurance: *formal insurance* – market-provided contracts that involve moral hazard – and *informal insurance* – risk sharing arrangements that do not generate moral hazard (i.e. in which agents internalize the effects of their behavior on the cost of the insurance policy).

We derive formulas for the optimal insurance (or, equivalently, tax) policy in terms of empirically estimable parameters. The marginal welfare gain from an additional dollar of public insurance can be expressed as a function of four parameters: the degree of risk aversion or social welfare weights placed on different individuals, the difference in consumption across states, the size of the formal insurance market relative to the public insurance, and the crowd-out elasticity of private insurance with respect to public insurance.

In addition to providing quantitative guidance about optimal policy, the formulas yield three qualitative lessons that challenge and clarify conventional wisdom. First, the welfare gains from government redistribution are strictly reduced by the existence and response of second-best private market contracts. The private insurer does not internalize the effect of his insurance contract through the agent's behavior (in terms of lower effort) on the government's budget This fiscal externality leads the private insurer to over-provide insurance relative to the second-best social optimum. In the extreme case where private markets are complete, the first dollar of government insurance *strictly* reduces welfare (contrary to the results of Golosov and Tsyvinski 2007), so that the best policy is for the government to provide no insurance and let the private market provide insurance. Alternatively, the government would be best off completely ruling out private insurance and providing insurance purely by itself. Given that this may be infeasible, our formulas suggest that the optimal level of government insurance should be lower than previous elasticity-based formulas suggest.

The second lesson is that it is important to distinguish between informal and formal insurance when estimating crowdout effects. When private insurance does not generate moral hazard and is chosen optimally, it has no effect on the formula for optimal government benefits because the private market reaches a constrained optimum (Chetty 2006a; Chetty 2008). Intuitively, the effect of informal private insurance is already captured in the smaller consumption-smoothing effect of public insurance. When private insurance does generate moral hazard, an additional term is needed because there is effectively a pre-existing distortion in market.

The third lesson is that even when the crowdout elasticity directly enters the formula for optimal benefits, it matters for a very different reason than what is emphasized in the existing literature (e.g. Cutler and Gruber 1996a). The conventional wisdom is that more revenue needs to be raised to achieve a given increase in insurance coverage when there is crowdout. Since the marginal cost of public funds exceeds 1, this lowers the welfare gain from public insurance. The flaw in this intuition is that the private insurance contract generates exactly the same moral hazard distortion in effort as public insurance. The added deadweight burden generated by higher taxes to fund public insurance is exactly offset by the reduction in deadweight burden because of lower formal private insurance premiums. Moreover, crowdout of private insurance that is nondistortionary (informal) does not affect the formula if private contracts are optimized, as noted above. The actual reason that the crowdout elasticity for formal insurance matters is that it determines the size of the fiscal externality imposed on the public sector by the private insurance firms.

To illustrate how our formula can be applied to obtain quantitative predictions about optimal policy, we present applications to the case of unemployment insurance (UI) and health insurance. In the unemployment application, we consider severance pay as a form of private insurance. Severance pay generates moral hazard because it can induce workers to shirk on the job, since they do not fully internalize the costs of being laid off. Using cross-state variation in UI benefit laws, we estimate that a 10% increase in UI benefit levels reduces private insurance against job loss (severance pay) by approximately 7%. Plugging this estimate into our formula along with other parameter estimates from the existing literature, we find that there is a wide range of parameters for which standard formulas that ignore private insurance and crowdout (Baily 1978, Chetty 2006a) imply that raising the benefit level would raise welfare when in fact it would lower welfare. Our second application is to calibrate the marginal welfare gain from expanding public health insurance (e.g. Medicare and Medicaid) using existing estimates of behavioral responses to health insurance. Accounting for crowd-out is quite important here as well: the formula that ignores the private insurance provision overstates the welfare gain from public health insurance by a factor of 100. Given existing elasticity estimates, our calibrations suggest that the aggregate level of public health insurance is near the optimum.

The remainder of the paper is organized as follows. Section 2 considers a model in which the government and private sector have the same tools, but the private insurance level is not necessarily set optimally. Section 3 considers a model with market failures due to adverse selection. The empirical applications are given in section 4. Section 5 concludes.

2 Baseline Model

We consider a simple two-state moral hazard model. There is a continuum of identical individuals of measure normalized to one. Individuals exert effort e to produce output z. There are two (exogenous) levels of output $z_H > z_L$. The probability of producing z_H is e. We denote by $\bar{z} = e \cdot z_H + (1-e) \cdot z_L$ the average level of output. The utility of consumption c is $u(c)$ and the disutility of effort is $\psi(e)$. Assume that $u(c)$ is increasing and concave and $\psi(e)$ is increasing and convex.

We will interpret the model in two equivalent ways. The first interpretation is the *optimal tax* scenario where individuals work to produce output and risk aversion creates a case for redistribution. The second interpretation is the *social insurance* scenario where individuals face a risk of income loss (getting the low output z_L due for example to an unemployment or health shock) that can be mitigated by effort.

This section is organized as follows. We begin by characterizing the second-best contract, which is the optimal level of insurance with a single insurer (government or private). We then consider the problem of optimal government insurance given endogenous private insurance, first in the case where the private insurance level is set arbitrarily and then in the case where it is set optimally.

2.1 Benchmark: Second-Best Contract

Because individuals are risk averse, they would like to insure themselves against the risk of producing the low output. If effort were observable, the first best contract would provide full insurance and the agents would be required to exert the first best optimal level of effort. If effort e is unobservable, then the optimal second-best contract specifies consumption levels c_H and c_L contingent on output realization. In this subsection, we characterize this second-best contract. This problem is analogous to those considered in prior studies that ignore private insurance (Saez 2001, Chetty 2006a).

A feasible contract (c_H, c_L) satisfies the budget constraint $\bar{c} \equiv ec_H + (1-e)c_L = \bar{z}$. The individual chooses e to maximize $e \cdot u(c_H) + (1-e) \cdot u(c_L) - \psi(e)$ taking the consumption levels (equivalently, insurance policy) as given. This leads to the first order condition

$$\psi'(e) = u(c_H) - u(c_L)$$

This condition implicitly defines a supply effort function e^* which depends on (c_H, c_L).

Optimal Tax Scenario. Because there are only two states, a contract (c_H, c_L) satisfying the budget constraint can be characterized by a single implicit tax rate t (along with a lumpsum redistribution of taxes collected) such that $c_H = (1-t)z_H + t\bar{z}$ and $c_L = (1-t)z_L + t\bar{z}$. Effort e^* depends on $1-t$. Thus, average earnings is a function of the net-of-tax rate $1-t$, which we denote by $\bar{z}(1-t)$.

The optimal second-best contract chooses t to maximize:

$$W = e^* \cdot u((1-t)z_H + t \cdot \bar{z}(1-t)) + (1-e^*) \cdot u((1-t)z_L + t \cdot \bar{z}(1-t)) - \psi(e^*), \qquad (1)$$

Using the envelope theorem as e^* maximizes expected utility, the first order condition is

$$0 = \frac{dW}{dt} = e \cdot u'(c_H) \cdot \left(-z^H + \bar{z} - t\frac{d\bar{z}}{d(1-t)}\right) + (1-e) \cdot u'(c_L) \cdot \left(-z^L + \bar{z} - t\frac{d\bar{z}}{d(1-t)}\right).$$

Defining $\bar{u}' = eu'(c_H) + (1-e)u'(c_L)$ as the average marginal utility, we can rewrite the first order condition as:

$$\bar{u}' \cdot t \cdot \frac{d\bar{z}}{d(1-t)} = \bar{u}' \cdot \bar{z} - [ez_H u'(c_H) + (1-e)z_L u'(c_L)] = -cov(z, u'),$$

where $cov(z, u')$ denotes the covariance between earnings z and marginal utility u'. Defining the elasticity of income with respect to the net-of-tax rate as $\varepsilon_{\bar{z},1-t} = [(1-t)/\bar{z}] \cdot d\bar{z}/d(1-t)$, we obtain the standard optimal tax formula:

$$\frac{t}{1-t} = \frac{1}{\varepsilon_{\bar{z},1-t}} \cdot \frac{-cov(z, u')}{\bar{z} \cdot \bar{u}'}. \qquad (2)$$

It is useful to observe three aspects of this formula. First, the elasticity $\varepsilon_{\bar{z},1-t}$ is a mix of substitution and income effects as an increase in t reduces the net reward from effort (substitution effects) but also increases the lumpsum component $t \cdot \bar{z}$ (as long as t is less than the revenue maximizing rate). This elasticity is always positive and the optimal tax rate t

decreases with the elasticity $\varepsilon_{\bar{z},1-t}$. Second, because of risk aversion, $u'(c_H) < u'(c_L)$ and hence $cov(z,u') < 0$. Hence the optimal t is positive. If there is no risk aversion, then the optimal t is zero. If risk aversion is infinitely high and $z_L = 0$, then $t/(1-t) = 1/\varepsilon_{\bar{z},1-t}$ is the revenue maximizing tax rate (Rawlsian case). More generally, the optimal tax rate t increases with risk aversion (when keeping $\varepsilon_{\bar{z},1-t}$ constant). Third, formula (2) remains the optimal *linear* tax rate formula even in a model with more than two states (including the standard continuum case). The formula also remains the same if we had posited a "hidden-skill" model (instead of a moral hazard model) where individuals differ in their (privately observed) abilities and choose effort levels after ability is revealed but where the insurance contract is set-up *before* abilities are revealed.[1]

Social Insurance Scenario. Under the social insurance scenario, the optimal contract can be characterized by a benefit b paid out to the individual in the low output state and a premium τ that the individual pays out in the high output scenario. The budget constraint is $\tau = (1-e)\cdot b/e$. The optimal effort choice e^* is a function of b, and we denote by $\varepsilon_{e,b}$ the elasticity of e^* with respect to benefits b. Note that this elasticity is negative as effort decreases with insurance benefits b and is again a composite of income and substitution effects (Chetty 2008). The optimal contract chooses b to maximize

$$W = e^* \cdot u\left(z_H - \frac{1-e}{e}\cdot b\right) + (1-e^*)\cdot u(z_L + b) - \psi(e^*), \tag{3}$$

Using the envelope theorem as e^* maximizes expected utility, the first order condition is

$$0 = \frac{dW}{db} = e\cdot u'(c_H)\cdot\left(-\frac{1-e}{e} + \frac{b}{e^2}\frac{de}{db}\right) + (1-e)\cdot u'(c_L).$$

We can rewrite the first order condition as:

$$\frac{u'(c_L)}{u'(c_H)} - 1 = \frac{-\varepsilon_{e,b}}{1-e}. \tag{4}$$

Equation (4) coincides with the standard formulas for optimal benefits given in Baily (1978) and Chetty (2006a). The left-hand-side is positive and measures the gap in marginal utilities across the two states, and hence the value of insurance. The right-hand-side captures the cost of insurance through the behavioral elasticity $-\varepsilon_{e,b} > 0$. Hence, insurance should be high

[1] Formally, the "hidden-skill" model is a Mirrlees (1971) type model. If insurance contracts or government taxation are restricted to linear schedules, formula (2) remains valid.

when this elasticity is low (and vice-versa). Alternatively, formula (4) can be used to assess whether insurance is too low or too high. If the left-hand-side is larger (smaller) than the right-hand-side, then insurance b is too low (too high).

Note that formulas (2) and (4) are mathematically equivalent, and are both useful representations for different applications. We will apply formulas for the social insurance scenario in Section 4, where we consider the case of unemployment insurance and health insurance.

2.2 Public Insurance with Endogenous Private Insurance

The second best contract described above can be decentralized with competitive insurance companies and without any government intervention as long as insurance companies can provide exclusive contracts to individuals.[2] Alternatively, if private insurance is outlawed, the government can decentralize the second-best by imposing an income tax (or equivalently a social insurance program).

In this section, we assume that private insurance and government taxation coexist. We assume that private insurance responds to the level of public insurance (crowdout effects), but that the level of private insurance is not necessarily optimally set. The private insurance level might not be optimally set because of individual failures – left to their own devices, individuals purchase too little insurance – or because of market failures such as adverse selection. In this section, we do not model explicitly the reason why the level of private insurance might not be set optimally. In Section 3, we introduce the adverse selection market failure explicitly and show that this microfoundation does not affect the formula.

Optimal Tax Scenario. Let τ denote the tax rate chosen by the government and t the implicit tax rate of the private insurance contract. We assume that private insurance applies to output z and we denote by $w = (1-t)z + t\bar{z}$ the net-of-private insurance incomes. Government taxation applies to net-incomes w and we denote by $c = (1-\tau)w + \tau\bar{w}$ final disposable income. We denote by m the total tax rate defined so that $1-m = (1-t)(1-\tau)$ and $c = (1-m)z + m\bar{z}$. Individuals choose effort e to maximize $e \cdot u(c_H) + (1-e) \cdot u(c_L) - \psi(e)$ which defines a supply effort function e^* which depends on $1-m$. Hence, average earnings is a function of the net-of-tax rate $1-m$, which we denote by $\bar{z}(1-m)$ (exactly as in the previous subsection).

[2] As is well known since Pauly (1974), if insurance contracts cannot be made exclusive, the second best cannot be attained.

Because the individuals' effort decision depends solely on m, the analysis carries over with no changes if we assume instead that government taxation happens first and that private insurance is based on net-of government tax incomes. However, we think that the scenario we use is better suited to model insurance provided by firms where pay w is not equal to marginal product z and where government taxation is based on observable pay w.

The private insurance rate t depends on the government tax rate τ as government taxation may crowd out private insurance. We denote by $r = -d\log(1-t)/d\log(1-\tau)$ the crowding out rate. If $r = 0$, there is no crowd-out and if $r = 1$, there is complete crowd-out. In this subsection, we take the function $\tau \to t(\tau)$ as given and we do not assume that private insurance is necessarily optimal.[3]

The government chooses the tax rate τ to maximize:

$$W = e^* \cdot u((1-m)z_H + m \cdot \bar{z}(1-m)) + (1-e^*) \cdot u((1-m)z_L + m \cdot \bar{z}(1-m)) - \psi(e^*), \quad (5)$$

where $m = t(\tau) + \tau - \tau \cdot t(\tau)$ is a function of τ. It is clear that this problem is identical to (1) with m replacing t. Hence, the optimal solution will be the same, namely:

$$\frac{m}{1-m} = \frac{1}{\varepsilon_{\bar{z},1-m}} \cdot \frac{-cov(z,u')}{\bar{z} \cdot \bar{u}'}. \quad (6)$$

Hence, the government should set τ so that the *total* tax rate m satisfies the standard formula. As the government does not observe z directly, it is useful to rewrite (6) as a function of w instead. First, we have $\bar{w} = \bar{z}$ and hence $\varepsilon_{\bar{w},1-m} = \varepsilon_{\bar{z},1-m}$. Second, $cov(w,u') = cov(z(1-t) + t\bar{z}, u') = (1-t)cov(z,u')$. Third, $\varepsilon_{\bar{w},1-\tau} = \varepsilon_{\bar{w},1-m} \cdot (1-r)$ – a one percent increase in $1-\tau$ translates into a $1-r$ percent increase in $1-m$ because of crowding out effects. Finally $m/(1-m) = [\tau/(1-\tau) + t]/(1-t)$. Hence, we can rewrite (6) as:

$$\frac{\tau}{1-\tau} = -t + \frac{1-r}{\varepsilon_{\bar{w},1-\tau}} \cdot \frac{-cov(w,u')}{\bar{w} \cdot \bar{u}'}. \quad (7)$$

Therefore, the presence of private insurance affects the optimal government tax formula in two important ways.[4] First, there is an extra (negative) term $-t$ of the right-hand-side. This term appears because private insurance is equivalent to government taxation and formula (6) shows

[3] We discuss the case with optimal private insurance and its consequences for the crowd-out parameter r in the next subsection.

[4] Again, as mentioned above, formula (7) remains the optimal linear government tax rate in a case with more than 2 earnings outcomes or in a "hidden-skill" type model.

that the *sum* of private and public insurance should be set according to the standard formula. Second, the inverse elasticity term is multiplied by $1 - r$. As we expect $r > 0$, this makes the government tax rate smaller. The intuition is that the observed elasticity $\varepsilon_{\bar{w},1-\tau}$ is smaller than the total behavioral elasticity of output $\varepsilon_{\bar{z},1-m}$ with respect to the total net-of-tax rate $1-m$ because crowding out partially offsets a change in $1-\tau$. However, the relevant elasticity for optimal tax purposes remains the fundamental elasticity $\varepsilon_{\bar{z},1-m}$ which is based on the individual utility function. Note that this intuition for the negative effect of crowding out on the optimal government tax level is different from the conventional wisdom (see e.g., Cutler and Gruber 1996a-b). Under the conventional wisdom, crowd-out makes government interventions less desirable because crowding out requires a larger government expense to achieve a given insurance level and using government funding is costly because of the deadweight burden on taxation. This intuition does not apply in our model because private insurance generates the same moral hazard as government taxation. We explore in Section 2.4 the case where private insurance does not generate moral hazard.

Social Insurance Scenario. Suppose the government sets an insurance benefit level b financed by a premium $\tau = b(1-e)/e$ and the private insurer sets a benefit level b_p financed by a premium $\tau_p = b_p(1-e)/e$. Hence, effort e depends on total benefit $b_T = b + b_p$. The private insurance benefit level b_p depends on the government benefit b according to a function $b_p(b)$. We define $r = -\frac{db_p}{db}$ as the crowdout parameter in this scenario. The government chooses b to maximize:

$$W = e^* \cdot u\left(z_H - \frac{1-e}{e} \cdot (b_p(b) + b)\right) + (1 - e^*) \cdot u(z_L + b_p(b) + b) - \psi(e^*). \tag{8}$$

Again, this is exactly the same problem as (3) with $b_T = b_p(p) + b$ replacing b. Choosing b is equivalent to choosing b_T. Hence, formula (4) applies simply by substituting $\varepsilon_{e,b}$ with ε_{e,b_T}. We have $de/db = e'(b_T) \cdot (1-r)$, and thus, $\varepsilon_{e,b_T} = (b + b_p)e'(b_T)/e = (1 + b_p/b) \cdot \varepsilon_{e,b}/(1-r)$ Hence, the welfare gain of marginal government insurance is:

$$\frac{dW}{db} = (1-e)(1-r) \cdot u'(c_H) \cdot \left[\frac{u'(c_L)}{u'(c_H)} - 1 + \frac{\varepsilon_{e,b}}{1-e} \cdot \frac{1 + b_p/b}{1-r}\right], \tag{9}$$

and the optimal formula can be written as:

$$\frac{u'(c_L)}{u'(c_H)} - 1 = \frac{-\varepsilon_{e,b}}{1-e} \cdot \frac{1 + b_p/b}{1-r}. \tag{10}$$

Analogous to the tax scenario, private insurance makes the optimal government benefit (which is inversely related to the right-hand-side of (10)) smaller through two channels. These channels are captured by the last term in (10): crowdout effect in the denominator and the mechanical effect of b_p in the numerator.

2.3 Special Case: Optimized Private Insurance

We now focus on the special case where private insurance is chosen optimally to maximize expected utility to further characterize the effects of government intervention.

Optimal Private Insurance Contract. In a competitive insurance market, each of the small insurance companies does not have any noticeable impact on the government tax/benefit parameters on its own. Therefore, under the optimal tax scenario, each insurance company takes the government tax rate τ and the government lumpsum grant $R = \tau\bar{w}$ as given when setting t. Therefore, $c = (1-\tau)[(1-t)z + t\bar{z}] + R = (1-\tau)(1-t)z + (1-\tau)t\bar{z} + R$, and $\bar{z}$ is a function of $1 - m = (1-t)(1-\tau)$. Hence, t is chosen so as to maximize (taking τ and R as given):

$$W = e^* \cdot u((1-t)(1-\tau)z_H + t(1-\tau)\bar{z} + R) + (1-e^*) \cdot u((1-t)(1-\tau)z_L + t(1-\tau)\bar{z} + R) - \psi(e^*), \quad (11)$$

Using the envelope condition for e^*, the first order condition with respect to t is:

$$0 = \frac{dW}{dt}|_{R,\tau} = -(1-\tau)(z_H u'(c_H) + z_L u'(c_L)) + (1-\tau)\bar{z}\bar{u}' + t(1-\tau)\bar{u}'\frac{d\bar{z}}{dt},$$

which implies

$$\frac{t}{1-t} = \frac{1}{\varepsilon_{\bar{z},1-t}} \cdot \frac{-cov(z,u')}{\bar{z} \cdot \bar{u}'}.$$

This expression shows that the private insurer sets the optimal t ignoring the government tax τ except through the effect it has on the last term $-cov(z,u')/(\bar{z} \cdot \bar{u}')$.

Similarly, under the social insurance scenario, the private insurer sets the benefit level b_p so that:

$$\frac{u'(c_L)}{u'(c_H)} - 1 = \frac{-\varepsilon_{e,b_p}}{1-e}. \quad (12)$$

Effect of Government Intervention with Optimized Private Insurance. Assume that private insurance is set optimally as in (12). The effect of increasing government taxation by $d\tau$ on social welfare is:

$$\frac{dW}{d\tau} = \bar{u}' \cdot \tau \cdot \frac{d\bar{z}}{d\tau}. \quad (13)$$

The following proposition characterizes the effects of government intervention on private insurance contracts and social welfare.

Proposition 1 *If private insurance is set optimally,*

1) Public insurance partially crowds out private insurance: $0 < r < 1$. *The degree of crowdout follows an inverse U pattern with risk aversion: if* $u(c) = c$ *or if* $u(c) = \min(c_H, c_L)$, $r = 0$.

2) At $\tau = 0$, $dW/d\tau = 0$. *The cost of government insurance is of order* τ^2 *for a small tax rate* τ.

3) Government insurance strictly reduces welfare: $\frac{dW}{d\tau} < 0$.

This proposition shows that the standard lessons of deadweight burden analysis carry over to this case with one important difference. As in the standard analysis, the cost of taxation is proportional to the size of the behavioral response to taxation, and the marginal cost of taxation is increasing with the tax rate. The difference is that in the traditional analysis, deadweight burden is an efficiency cost that the government is willing to trade-off against the benefits of more redistribution. However, in this model, the level of redistribution through market insurance is already optimal given incentive constraints, so there is no benefit and the deadweight burden directly equals the total welfare cost. Hence, a benevolent government should do precisely nothing in this setting. This result is not surprising once one recognizes that, in this context, the market equilibrium with no government intervention is information constrained Pareto efficient.

Intuitively, the reason that government intervention *strictly* reduces welfare when private insurance is set optimally is that crowdout is in general incomplete. The crowdout parameter r follows an inverse U-shape pattern with risk aversion, but r is always less than 1. Crowdout is zero in the polar cases with no risk aversion or infinite risk aversion and r is positive in intermediate cases. Because crowdout is not 1-1, effort and average output decrease when the government intervenes.

To understand the results in the proposition more concretely, consider the following example. Suppose the government naively thinks it can replace the insurance market and provides insurance directly through taxation by setting τ and R such that $(1-\tau)z_H + R = c_H^*$ and $(1-\tau)z_L + R = c_L^*$ where (c_L^*, c_H^*) denotes the optimal insurance contract (with no government taxation). This tax system would effectively replicate the optimal contract (c_L^*, c_H^*) if the insurance market did nothing.

However, this is *not* the contract that will emerge in an economy with a competitive insurance market. Since $z_L(1-\tau)+R < w_H(1-\tau)+R$, the agent would find it worthwhile to purchase further insurance from private providers. This additional insurance would increase the expected utility of the agent and the insurance companies would break even. But this private insurance contract would reduce effort below e^* and hence lead to a lower average output than the government was expecting (the externality effect described above). As a result, the tax system proposed by the government goes into deficit. Thus, if the government wants to impose any positive tax rate τ, the government has to find the equilibrium lump sum amount R which will satisfy its budget constraint, taking into account that the private insurance market will offer contracts that further reduce effort and average output. Indeed, the only way for the government to replicate the optimal contract is by prohibiting the private insurance market from operating. This intuition is similar to the famous result by Pauly (1974) showing that, when private insurance contracts cannot be made exclusive, the equilibrium outcome is sub-optimal because each private insurer does not internalize the negative effects of providing extra insurance on other insurance contracts that the individual client has already taken. The fundamental theoretical point is that, in our context, the private market achieve Pareto constrained efficiency and hence a government price distortion leads to inefficiency (Prescott and Townsend 1984, 1985). In the case of health insurance, Blomqvist and Johannson (1997) and Barrigozzi (2006) make a similar point in a model with public and private health insurance.[5]

An immediate corollary of the preceding result is that in the absence of private market failures, public goods should be financed via a uniform lump-sum tax that generates the desired amount of revenue, even if agents have different marginal utilities of income in each state. The private insurance market will then set redistribution to the optimal level. A distortionary tax to finance the public good would lead to lower expected utility than a lump-sum tax that generated an equivalent amount of revenue.

[5] A small theoretical literature following Besley (1989) has considered the role for public health insurance in the presence of private insurance (see e.g. Selden 1991, Blomqvist and Johansson 1997, Petretto 1999, Encinosa 2003). A larger empirical literature has also analyzed the interaction of private and public health insurance (see e.g., Ginsburg 1988, Taylor et al. 1988, Wolfe and Godderis 1991, Cutler and Gruber 1996a-b, Finkelstein 2004).

2.4 Informal Insurance

The preceding analysis has focused solely on private insurance contracts that generate the same degree of moral hazard as public insurance. In practice, individuals have access to informal risk-sharing mechanisms that do not create moral hazard. Examples include self insurance through spousal labor supply or insurance through relatives where relatives can monitor effort directly.[6] To understand the implications of such insurance for our formulas for optimal government policy, we now consider a model where private insurance does not generate moral hazard. We continue to assume that private insurance responds to government insurance through crowdout effects. As above, we first consider the case where the private insurance is not necessarily optimized and then turn to the case with optimized informal private insurance.

Under the tax scenario, individuals take the government tax rate τ and the government lumpsum $R = \tau\bar{z}$ as given. We have $c = (1-\tau)[(1-t)z + t\bar{z}] + R = (1-\tau)(1-t)z + G + R$, where $G = t(1-\tau)\bar{z}$ is the private insurance lumpsum provided by the private insurer (net of government taxation). When there is no moral hazard, individuals internalize the effect of e on the private insurance lumpsum $G = t(1-\tau)(ez_H + (1-e)z_L)$ when they choose effort e. Therefore, formally, the individual chooses e to maximize:

$$W = e \cdot u[(1-t)(1-\tau)z_H + t(1-\tau)(ez_H + (1-e)z_L) + R] +$$

$$(1-e) \cdot u[(1-t)(1-\tau)z_L + t(1-\tau)(ez_H + (1-e)z_L) + R] - \psi(e).$$

As above, we denote by e^* the optimal effort level and we assume that t is a function of τ. The government then chooses τ to maximize:

$$W = e^* \cdot u[(1-t)(1-\tau)z_H + t(1-\tau)(e^* z_H + (1-e^*)z_L) + \tau\bar{z}] + \tag{14}$$

$$(1-e^*) \cdot u[(1-t)(1-\tau)z_L + t(1-\tau)(e^* z_H + (1-e^*)z_L) + \tau\bar{z}] - \psi(e^*),$$

Using the envelope condition for e^*, the first order condition with respect to τ is:

$$0 = -(ez_H u'(c_H) + (1-e)z_L u'(c_L)) \left(1 - t + (1-\tau)\frac{dt}{d\tau}\right) + \bar{z}\bar{u}' \left(1 - t + (1-\tau)\frac{dt}{d\tau} + \frac{\tau}{\bar{z}} \cdot \frac{d\bar{z}}{d\tau}\right),$$

Hence, using the fact that $1 - t + (1-\tau)dt/d\tau = (1-t)(1-r)$, we obtain:

$$\frac{\tau}{1-\tau} = (1-t) \cdot \frac{1-r}{\varepsilon_{\bar{z},1-\tau}} \cdot \frac{-cov(z,u')}{\bar{z} \cdot \bar{u}'} = \frac{1-r}{\varepsilon_{\bar{w},1-\tau}} \cdot \frac{-cov(w,u')}{\bar{w} \cdot \bar{u}'}. \tag{15}$$

[6] The development literature has explored such local insurance through neighbors in a village. See e.g., Townsend 1994.

where the last equality is obtained using $w = (1-t)z + t\bar{z}$ and hence $\bar{w} = \bar{z}$. This shows that when private insurance has no moral hazard, comparing (7) and (15), the mechanical additive term $-t$ disappears, as private insurance no longer generates a negative fiscal externality through reduced effort. However, one still needs to use the "fundamental elasticity" $\varepsilon_{\bar{w},1-\tau}/(1-r)$ instead of the directly observed elasticity $\varepsilon_{\bar{w},1-\tau}$, so that the crowd-out effect remains.

Similarly, in the social insurance scenario with no moral hazard, e is chosen to maximize $eu(z_H - \tau - b_p(1-e)/e) + (1-e)u(z_L + b + b_p) - \psi(e)$. The government then chooses b to maximize

$$e^* u(z_H - b(1-e(b))/e(b) - b_p(b)(1-e^*)/e^*) + (1-e^*)u(z_L + b + b_p(b)) - \psi(e^*).$$

Using the envelope condition on e^*, we obtain

$$\frac{u'(c_L)}{u'(c_H)} - 1 = \frac{-\varepsilon_{e,b}}{1-e} \cdot \frac{1}{1-r}, \tag{16}$$

which shows again that, when there is no moral hazard for private insurance, the direct mechanical effect of b_p on b disappears but the crowdout effect remains.

Optimized Informal Insurance. In principle, if private insurance does not generate moral hazard, then reaching the first best of full insurance is feasible. In practice, there are costs of informal insurance – such as limits to liquidity or costs of spousal labor supply – which prevent full insurance. Therefore, suppose that informal private insurance entails a loading factor s so that each dollar of benefits requires a premium of $\$1 + s$. In the social insurance scenario with no moral hazard, e and b_p would be chosen simultaneously to maximize $eu(z_H - \tau - (1+s)b_p(1-e)/e) + (1-e)u(z_L + b + b_p) - \psi(e)$. The first order condition with respect to b_p implies that $u'(c_L)/u'(c_H) - 1 = s$. The government then chooses b to maximize

$$e^* u(z_H - b(1-e(b))/e(b) - b_p^*(1-e^*)/e^*) + (1-e^*)u(z_L + b + b_p^*) - \psi(e^*).$$

Using the envelope condition on e^* and b_p^*, we easily obtain

$$\frac{u'(c_L)}{u'(c_H)} - 1 = \frac{-\varepsilon_{e,b}}{1-e}. \tag{17}$$

Hence, when private insurance does not generate moral hazard but is optimized, the standard formula (4) applies. This is consistent with Chetty (2006a), who shows that the Baily (1978) formula is robust to introducing self-insurance as long as self-insurance arises from optimizing behavior with no moral hazard.

3 Market Failure: Adverse Selection

We now introduce market failures that give the government more tools than the private sector. For simplicity, we focus exclusively on the social insurance scenario and consider only formal private insurance in this section. To model adverse selection, consider an environment with two types of individuals. The low type faces the risk of job loss with probability $1 - e$ determined by effort as above. The high type is tenured and has no risk of job loss. Let α denote the fraction of low types in the population. Let c_H^l denote consumption for the low type when employed, c_H^h denote consumption of the high type, and c_L^l denote consumption when unemployed. Importantly, we assume that types are revealed to the individuals *before* they make their private insurance purchase decisions, hence creating adverse selection in the private insurance market.

The private insurance sector offers actuarially fair insurance with moral hazard (as above) against the risk of job loss after the types are realized: it charges a tax τ_p to low-type employed workers and pays a benefit b_p to unemployed workers. In the free-market equilibrium, only low types buy this insurance policy; consumption fluctuations due to ex-ante type risk are left uninsured. The social planner can mandate an insurance plan that charges a tax τ to all employed workers and pays a benefit b to unemployed workers. Let $\frac{P}{G} = \frac{\alpha e \tau_p}{[\alpha e + 1 - \alpha]\tau}$ denote the ratio of total private insurance expenditure to public insurance expenditure. Let $p = 1 - \alpha + \alpha e$ denote the unconditional probability that an agent is employed.

As above, we first assume that private insurance contracts are not necessarily chosen optimally, hence allowing for errors in optimization. We then consider the special case with optimized private insurance.

3.1 General Case

The formula for the optimal benefit level in (10) can be extended to the case of adverse selection under the approximation that the probability of the shock $(1 - e)$ is small, as shown in the following proposition.

Proposition 2 *Assuming that the shock probability $(1 - e)$ is small and hence that $u'(c_H^h) \simeq u'(c_H^l)$, the optimal government benefit level b is determined by*

$$\frac{u'(c_L^l)}{u'(c_H^l)} - 1 = -\varepsilon_{p,b}[1 + \frac{P}{G}]/[1 + \frac{db_p}{db}] \quad (18)$$

Proof. Given a government policy (b, τ), the private insurer chooses (b_p, τ_p) to maximize the agent's expected utility taking into account the behavioral response:

$$\begin{aligned} b_p &= \arg\max_{b_p} eu(w_1 - \tau - \tau_p) + (1-e)u(w_0 + b + b_p) \\ \text{s.t. } e\tau_p &= (1-e)b_p \end{aligned}$$

The social planner chooses (b, τ) to maximize the following utilitarian social welfare function:

$$\begin{aligned} W &= \alpha[(eu(w_1 - \tau - \tau_p) + (1-e)u(w_1 - \tau) - \psi(e)] + (1-\alpha)u(w_0 + b + b_p) \\ &\text{s.t. } [1 - \alpha + \alpha e]\tau = \alpha e b \end{aligned}$$

Differentiating the social welfare function and exploiting the envelope condition for e yields:

$$\frac{dW}{db} = \alpha\left[u'_{e0}(\frac{d\tau}{db} + \frac{d\tau_p}{db}) + (1-e)u'_u(1 + \frac{db_p}{db})\right] - (1-\alpha)u'_{e1}\frac{d\tau}{db}$$

Differentiating the government and private-insurer budget constraints yields

$$\begin{aligned} \frac{d\tau}{db} &= \frac{\alpha(1-e) - \frac{de}{db}\alpha b \frac{1}{1-\alpha-\alpha e}}{1 - \alpha - \alpha e} \\ \frac{d\tau_p}{db} &= \frac{(1-e)\frac{db_p}{db} - \frac{de}{db}\frac{b_p}{e}}{e} \end{aligned}$$

Plugging in these expressions into the formula for $\frac{dW}{db}$ gives

$$\begin{aligned} \frac{dW}{db} &= -\frac{(1-\alpha)u'_{e1} + \alpha e u'_{e0}}{1 - \alpha + \alpha e}[\alpha(1-e) - \frac{de}{db}\alpha b \frac{1}{1 - \alpha - \alpha e}] \\ &\quad + u'_{e0}\frac{de}{db}\frac{b_p}{e} + \frac{db_p}{db}(-\alpha u'_{e0}(1-e) + \alpha(1-e)u'_u) + \alpha(1-e)u'_u \end{aligned}$$

We now make the approximation that marginal utilities are constant while employed

$$Eu'_e = \frac{(1-\alpha)u'_{e1} + \alpha e u'_{e0}}{1 - \alpha + \alpha e} = u'_{e0}$$

to obtain:

$$\frac{dW}{db} = -u'_{e0}\{[\alpha(1-e)(1 + \frac{db_p}{db}) - \varepsilon_{e,b}(\frac{\alpha e}{1 - \alpha + \alpha e} + a\frac{b_p}{b})] + \alpha(1-e)(1 + \frac{db_p}{db})u'_u$$

At the optimum, $\frac{dW}{db} = 0$ and hence

$$u'(c_e)[1 + X] = u'(c_u)$$

where

$$X = -\frac{\varepsilon_{e,b}}{1-e}[\frac{e}{1-\alpha+\alpha e} + \frac{b_p}{b}]/[1+\frac{db_p}{db}]$$

Note that we cannot observe $\varepsilon_{e,b}$ in practice; we can only observe effect of benefit on the total probability of employment, which is

$$\varepsilon_{p,b} = \frac{de}{db}\frac{b}{1-\alpha+\alpha e} = \varepsilon_{e,b}\frac{e}{1-\alpha+\alpha e}.$$

We therefore rewrite the wedge X as:

$$\begin{aligned} X &= -\frac{\varepsilon_{p,b}}{1-e}[1+\frac{b_p}{b}\frac{1-\alpha+\alpha e}{e}]/[1+\frac{db_p}{db}] \\ &= -\frac{\varepsilon_{p,b}}{1-e}[1+\frac{\alpha\tau_p}{\tau}]/[1+\frac{db_p}{db}] \end{aligned}$$

When the probability of the shock $(1-e)$ is small, $\frac{\alpha\tau_p}{\tau} = \frac{P}{G} = \frac{\alpha e\tau_p}{[\alpha e+1-\alpha]\tau}$. Substituting this expression into the equation for X and ignoring the $1-e$ term in the denominator completes the proof. QED.

The formula in Proposition 2 has exactly the same form as the formula obtained in the baseline case with imperfect optimization and no market failures. This shows that our results from Section 2 carry over to the case of adverse selection.

3.2 Special Case: Optimized Private Insurance

With adverse selection, government intervention can be desirable even when the private insurance is optimal. Starting from $b = 0$, we can have $dW/db > 0$ even with optimized private insurance because of the market failure. It is instructive to compare the policy analyzed above with a policy in which the government completely shuts down the private insurance market and acts as the sole provider of insurance. In that situation, the government offers a consumption bundle c_H^h for high type individuals and a bundle (c_H^l, c_L^l) for low type individuals. Incentive compatibility requires that $c_H^h \geq c_H^l$. Because the government wants to redistribute from type h to type l individuals, this constraint will bind at the optimum. Therefore $c_H^h = c_H^l$ and the optimum allocation can be summarized by a single bundle (c_H^g, c_L^g). This allocation is different from the optimal allocation with private insurance which features $c_H^h > c_H^l = c_H^h - \tau > c_L^l$. As the government could of course replicate this allocation (c_H^h, c_H^l, c_L^l), it must be the case that the allocation (c_H^g, c_L^g) yields higher welfare. We summarize these results in the following proposition.

Proposition 3 *In the adverse selection model*

1) A small government tax increases expected welfare

2) Prohibiting private insurance and providing insurance solely through the government leads to higher welfare than optimal government insurance in the presence of private insurance

The intuition for the second result is as follows. Private insurance creates a negative fiscal externality. Because the government needs to use fiscal redistribution in the presence of adverse selection, the fiscal externality of private insurance is harmful. Therefore, the government is better off shutting down the private insurance market or imposing a tax on private insurance which would make it unattractive for private agents to enter into a private insurance arrangement. By acting as the exclusive dealer of insurance, the government can improve welfare, a result that is closely related to the intuition of Pauly (1974).

4 Empirical Applications

In this section, we apply the formula (9) derived in section 2 to characterize the welfare gains from increasing unemployment and health insurance benefits. The calibrations draw primarily on estimates of the key parameters from the prior literature. In the unemployment insurance application, we provide an estimate of the crowdout elasticity to illustrate the type of empirical strategy that is needed to estimate this parameter. These calibrations are intended primarily to illustrate how crowdout responses affect the formula for optimal benefits. The results do not have direct policy relevance because the elasticities do not account for all margins of behavioral responses and do not account for heterogeneity.

4.1 Application 1: Unemployment Insurance

The large existing literature on optimal unemployment insurance effectively ignores the possibility that private insurance contracts that generate moral hazard may respond endogenously to the provision of public insurance. Much of private insurance against unemployment is provided through informal risk sharing that is unlikely to generate much moral hazard, and hence can be ignored in the calculation of optimal benefits according to the results in section 2.4

provided that this informal insurance is set optimally. However, there is some formal private insurance against unemployment that may generate moral hazard. In particular, many private firms provide unemployment insurance in the form of severance payments – lump sum cash grants made at the time of job loss. Severance payments are lump-sum grants made by a firm to the worker it lays off. Unlike government-provided unemployment benefits, severance pay does not distort job search behavior after job loss because it does not affect marginal incentives to search. However, severance pay can distort effort choices while working by changing the relative price of being unemployed relative to having a job.

In this subsection, we calibrate the welfare gain from raising the UI benefit level when the response of severance pay to UI benefits is taken into account. To adapt the optimal UI problem to our static framework above, we ignore the job search decision – effectively treating search effort after job loss as invariant to the UI benefit level. Instead, we focus on the distortion in the probability of job loss (e.g. due to shirking) caused by UI benefits and severance pay. In our static model, both UI benefits and severance pay act as transfers to the unemployed state, and are financed by taxes in the employed state.[7]

Estimation of Crowdout Elasticity. The key new parameter needed to calibrate the welfare gain from raising b with endogenous private insurance is the crowdout elasticity. In the present application, the relevant parameter is the effect of an increase in the UI benefit level on severance pay provision. As an illustration of the empirical strategy needed to implement the formula with endogenous private insurance, we provide a simple estimate of the crowdout elasticity using cross-state variation in UI benefit levels in this subsection.

We use data from a survey conducted by Mathematica on behalf of the Department of Labor. The dataset (publicly available from the Upjohn Institute) is a sample of unemployment durations in 25 states in 1998 that oversamples UI exhaustees. We reweight the data using the sampling weights to obtain estimates for a representative sample of job losers. The dataset contains information on unemployment durations, demographic characteristics, and data on receipt of severance pay. There are 3,395 individuals in the sample, of whom 508 (15%) report receiving a severance payment. See Chetty (2008) for further details on the dataset and sample construction. We obtain data on mean unemployment benefits by state

[7] A more precise calibration would take account of the fact that UI benefits are conditioned on duration, and thus are larger when a worse "state" is realized. This calibration would require separate estimates of the effect of UI benefits and severance pay on the probability of job loss.

in 1998 from the Department of Labor.

Through the analysis, we exploit only cross-state variation in UI benefit levels that comes through variation in the maximum UI benefit level (see e.g. Meyer 1990 or Chetty 2008 for a description of UI laws). Most states pay a fixed wage replacement rate up to a maximum, which varies considerably across states and thereby creates variation in UI benefit levels. The maximum benefit can be viewed as an instrument for individual benefit levels. We do not exploit the variation in benefit levels across individuals within a state because of endogeneity concerns.

Although state benefit maximums are exogenous to individual characteristics, they are not orthogonal to all aspects of the economic environment. In particular, richer states (or those with a higher cost of living) provide both more public and private insurance. As a result, both state unemployment benefit maximums and the fraction of individuals receiving severance pay are positively correlated with mean wage rates in each state. To account for this confounding factor, we control for wages throughout our analysis using a flexible 10 piece spline for the individual log wage.

We begin with a simple graphical analysis to illustrate the crowdout effect. Figure 1 plots the relationship between average severance pay receipt and the maximum UI benefit level, conditioning on wages. To construct this figure, we first regress the severance pay dummy on the wage spline and the maximum UI benefit level on the wage spline and compute residuals. We then compute mean residuals of both variables by state. The figure is a scatter plot of the mean residuals. We exclude states that have fewer than 50 individuals from this figure to reduce the influence of outliers on the graph; all observations are included in the regression analysis below. The figure shows that states with higher UI benefit levels have fewer severance payments, indicating that private insurance is crowded out to some extent by public insurance.

To quantify the amount of crowdout, we estimate a set of regression models of the following form:

$$sev_i = \alpha + \beta \log b_i + f(w_i) + \gamma X_i + \varepsilon_i \tag{19}$$

where sev_i is an indicator for whether individual i received a severance payment, b_i is a measure of the UI benefit level for individual i, $f(w_i)$ denotes the wage spline, and X_i denotes a vector of additional controls.

Specification 1 of Table 1 reports estimates of (19) without any additional (no X), with b_i equal to the maximum benefit level in the state where individual i lives. Standard errors in this and all subsequent specifications are clustered by state to adjust for arbitrary within-state correlation in errors. The estimated coefficient of $\beta = -0.075$ implies that a doubling the UI benefit maximum would reduce the fraction of individuals receiving severance pay by 7 percent. Specification 2 replicates 1 with the following individual-level covariates: job tenure, age, gender, household size, education, dropout, industry, occupation, and race dummies. The point estimate on the UI benefit level is not affected significantly by the inclusion of these controls.

Specifications 1 and 2 can be interpreted as "reduced form" regressions which show the effect of the instrument (maximum benefit levels) on severance pay. To obtain an estimate of the effect of a \$1 increase in the benefit level on the probability of severance pay receipt, we estimate a two-stage least squares regression, instrumenting the log individual benefit level with the log state maximum. The estimate on the log individual benefit, reported in column 3 of Table 2, is $\beta = -0.105$. Doubling the UI benefit level would reduce severance receipt by 10.5 percentage points, relative to a mean value of 15%, implying $\varepsilon_{b_p,b} = -0.7$.

The identification assumption underlying these regressions is that the cross-state variation in UI benefit maximums is orthogonal to other determinants of severance pay receipt conditional on wage levels. Most plausible endogeneity stories would work toward attenuating our estimate of the crowdout effect. For example, suppose states with higher UI benefit maximums are populated by individuals who are more risk averse and therefore place higher value on insurance. Such states would also have higher private insurance, biasing the correlation between the UI benefit level and severance pay receipt upward. Given these concerns about policy endogeneity, our simple empirical analysis should be viewed as illustrative. Future work should exploit within-state variation in UI benefits (e.g. as in Meyer 1990) to obtain a more credible and precise estimate of the crowdout effect.

Calibration. According to (9), the welfare gain of raising the UI benefit level by \$1 is

$$\begin{aligned} \frac{dW}{db} &= (1-e)(1-r)u'(c_H)\{\frac{u'(c_L)}{u'(c_H)} - [1+X]\} \\ \text{where } X &= \frac{-\varepsilon_{e,b}}{1-e} \cdot \frac{1+b_p/b}{1-r} = \frac{\varepsilon_{1-e,b}}{e} \cdot \frac{1+b_p/b}{1-r} \end{aligned}$$

To convert this increase in utility into a money metric, we calculate the welfare gain from increasing total government expenditure on unemployment insurance by \$1 ($\frac{dW}{db}/1-e$)) relative to the welfare gain of a \$1 increasing the wage of the employed agent ($\frac{dW}{dz_H} = eu'(c_H)$):

$$G(b) = \frac{1}{1-e}\frac{dW}{db}/\frac{dW}{dz_H} = \frac{(1-r)}{e}\{\frac{u'(c_L)}{u'(c_H)} - [1+X]\}$$

The value $G(b)$ can be interpreted as the net social surplus created by by a \$1 balanced-budget expansion in the UI program (so that the benefit level b is increased by \$$\frac{1}{1-e}$). We calibrate $G(b)$ by drawing on existing studies for the inputs. As noted above, 15% of job losers receive severance pay. The mean severance payment conditional on receipt of severance pay is equal to 10.7 weeks of wages (Chetty 2008). The mean wage replacement rate for UI benefits is $0.5w$ and the mean unemployment duration is 15.8 weeks (Chetty 2008). Hence, in the aggregate population, the ratio of total private insurance to total public insurance is $\frac{b_p}{b} = \frac{0.15\times 10.7}{0.5\times 15.8} = 0.20$. It follows that $r = -\frac{db_p}{db} = -\varepsilon_{b_p,b}\frac{b_p}{b} = 0.7 \times 0.2 = 0.14$. Gruber (1997) estimates that $\frac{c_u}{c_e} = \frac{1}{0.9}$. Under the approximation that utility exhibits constant relative risk aversion between c_u and c_e, $\frac{u'(c_u)}{u'(c_e)} = (\frac{1}{0.9})^\gamma$ where γ denotes the coefficient of relative risk aversion. Chetty (2006b) estimates that $\gamma \approx 2$ based on labor supply behavior. Hence $\frac{u'(c_u)}{u'(c_e)} = (\frac{1}{0.9})^2 = 1.23$. Finally, the probability of unemployment is $1 - e = 0.05$.

The remaining parameter, for which we have no existing estimate, is $\varepsilon_{1-p,b}$ – the elasticity of the probability of job loss with respect to the UI benefit level b. Leaving this parameter unspecified and plugging in the remaining values into the formula for $\frac{dW}{db}$, we obtain

$$\begin{aligned} G(b) &= \frac{1-0.14}{0.95}\{0.23 - X\} \\ X &= \frac{\varepsilon_{1-e,b}}{0.95}\frac{1+0.2}{1-0.14} = 1.47\varepsilon_{1-e,b} \end{aligned}$$

It follows that if the job loss elasticity $\varepsilon_{1-e,b} > 0.15$, $\frac{dW}{db} < 0$ at present UI benefit levels when crowdout is taken into account. In contrast, if we were to apply a formula that does not take crowdout of private insurance into account, we would obtain

$$G(b) = \frac{1}{0.95}\{0.23 - \frac{\varepsilon_{1-e,b}}{0.95}\}.$$

Hence, an analyst who ignores crowdout would conclude that the welfare gain from raising the UI benefit level is negative only if $\varepsilon_{e,b} > 0.25$. There is a significant range for this elasticity where adjusting the formula for endogenous private insurance leads to significantly different policy implications.

4.2 Application 2: Health Insurance

Health Insurance Model Setup. We adapt our two-state analysis of optimal social insurance to the case of health insurance using an extensive-margin model of health consumption. Suppose that purchasing healthcare costs $\$C$. There is a continuum of agents in the economy who differ only in their valuation of healthcare. Agent i gets a benefit from healthcare equivalent to g_i utils. Hence an agent buys healthcare iff

$$g_i > u(w - \tau - \tau_p) - u(w - C + b + b_p) = z$$

Assume that g_i is distributed according to a cdf G. The fraction of agents who buy healthcare is

$$s = 1 - G(z) = \int_z^\infty dG$$

Let G^{-1} denote the inverse of G. Then $z = G^{-1}(1 - s)$ and the aggregate utility gain from consumption of healthcare is given by

$$g(s) = \int_{G^{-1}(1-s)}^{\infty} g_i dG$$

Aggregating over the agents yields the following social welfare function:

$$W = (1 - s)u(w - \tau - \tau_p) + su(w - C + b + b_p) + g(s)$$

The fraction of agents who consume healthcare s is effectively chosen to maximize W taking the government and private insurance contracts as given. Note that $g(s)$ is an increasing, concave function. Hence, this problem has the same structure as that analyzed in section 2, with e replaced by $1-s$ and $\psi(e)$ replaced by $-g(s)$. Applying the formula in (9) directly yields the following formula for the aggregate utility gain from raising the public health insurance benefit level b by \$1:

$$\begin{aligned} \frac{dW}{db} &= s(1-r)u'(c_H)\{\frac{u'(c_L)}{u'(c_H)} - [1+X]\} \\ \text{where } X &= \frac{\varepsilon_{s,b}}{1-s}\frac{1+b_p/b}{1-r} \end{aligned}$$

Calibration. To convert $\frac{dW}{db}$ into a money metric, we again compare the welfare gain from increasing total government expenditure on health insurance by \$1 ($\frac{dW}{db}/s$)) relative to the welfare gain of a \$1 increasing the wage of the healthy agent ($\frac{dW}{dz_H} = (1-s)u'(c_H)$):

$$G(b) = \frac{1}{1-s}\frac{dW}{db}/\frac{dW}{dz_H} = \frac{1-r}{1-s}\{\frac{u'(c_L)}{u'(c_H)} - [1+X]\}$$

We calibrate the formula using the following inputs:

$$\begin{aligned}
\varepsilon_{s,C} &= -0.2 \text{ from Manning et al. (1987), which implies } \varepsilon_{s,b} = 0.2\frac{b}{C} \\
s &= 0.1 \text{ from Manning et al. (1987) for inpatient usage rate} \\
r &= -\frac{db_p}{db} = 0.5 \text{ from Cutler and Gruber (1996a)} \\
\frac{b_p}{b} &= 0.89 \text{ and } \frac{b}{C} = 0.45 \text{ from Table 6 of National Health Care Statistics (2006)} \\
\frac{c_e}{c_u} &= \frac{1}{0.85} \text{ from Cochrane (1992)} \\
\gamma &= 2 \text{ from Chetty (2006b)}
\end{aligned}$$

Under CRRA utility, these parameters imply that $\frac{u'(c_u)}{u'(c_e)} = (\frac{c_e}{c_u})^\gamma = (\frac{1}{0.85})^2 = 1.384$. Hence

$$\begin{aligned}
G(b) &= \frac{1-0.5}{0.9}[0.384 - X] \\
X &= \frac{0.2 \times .453}{0.9}\frac{1+0.89}{0.5} = 0.381
\end{aligned}$$

It follows that with crowdout taken into account

$$G(b) = \frac{0.5}{0.9}(0.384 - 0.381) = 0.0016.$$

If we had ignored crowdout, we would have obtained

$$G(b) = \frac{0.5}{0.9}(0.384 - \frac{0.2 \times .453}{0.9}) = 0.16$$

Taking crowdout into account lowers the estimate of $G(b)$ by a factor of 100. An analyst who ignored crowdout and applied existing formulas (e.g. Chetty 2006a) would infer that a \$100 million expansion in public health insurance programs would generate \$16 million in net surplus. This analyst would mistakenly conclude that substantial expansions in public health insurance are desirable. Taking crowdout into account implies that we are near the optimum in terms of aggregate public health insurance levels, as a \$100 million across-the-board expansion would generate only \$0.16 million in social surplus.

It is very important to note that this aggregate welfare gain calculation ignores substantial heterogeneity across types of people, conditions, Medicare vs. Medicaid, etc. For some subgroups (e.g. the uninsured), there could be substantial welfare gains from increasing public insurance benefits whereas for others there could be substantial welfare gains from cutting benefits. The same formula can be applied with group-specific estimates of elasticities, consumption drops, etc. to identify precisely which benefits should be increased and decreased to maximize welfare.

5 Conclusion

This paper has characterized the welfare gain from public insurance in the presence of endogenous private insurance. Private insurance that generates moral hazard reduces the optimal level of government insurance through two channels. First, formal private insurance mechanically reduces the need for government insurance as the formal private insurance is a substitute for government insurance. Second, imperfect crowding out of private insurance (either formal or informal) by public insurance also reduces the optimal level of public insurance through a fiscal externality. The only way for the government to replicate the optimal market outcome without generating deadweight burden is to prohibit market insurance and then provide the same insurance contract that the market was previously providing.

Our analysis implies that the role of government should be limited if (a) insurance markets generate optimal contracts given informational constraints, (b) insurance contracts can be signed behind the veil of ignorance (before skills or outputs have been revealed or realized), and (c) the government faces the same informational constraints as private insurance companies. In such environments, the efficiency costs of taxation are always strictly larger than its redistributive benefits. The deadweight burden (net of the redistributive benefits) generated by government taxation follows the same pattern as standard public finance deadweight burden computations (which always ignore redistributive benefits): it increases with the tax rate, is of second order for small tax rates, and is proportional to the magnitude of the behavioral response of earnings with respect to tax distortions.

When these conditions are violated, either because of individual or market failures, there is a role for government intervention. The formulas derived in this paper provide a method of quantifying the optimal degree of government intervention using estimates of the crowdout elasticity and other empirically estimable parameters. Simple applications to the cases of unemployment and health insurance show that accounting for formal private insurance can substantially alter conclusions about optimal government policy.

More generally, the analysis sheds light on the domains in which social insurance and redistributive taxation is warranted. For instance, the government should have limited involvement in redistribution that is likely to be done within firms (e.g. redistributing between workers who experience different wage shocks via a wage insurance policy).[8] It should instead concentrate on insuring shocks such as ex-ante heterogeneity in skills, unemployment, or health that are not well insured by private markets because of individual or market failures. In future work, it would be useful to estimate the elasticities identified here for various markets and subgroups to characterize the optimal scope of social insurance and redistributive taxation more precisely.

[8] The role of private insurance in redistribution can be large in the context of car, real estate, or health insurance but that redistribution is in general fairly neutral with respect to income. In countries such as Japan, where employee-employer relationships are often very long and employees move slowly up the company ranks, it is possible that such private market career contracts generate substantial income redistribution.

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TABLE 1

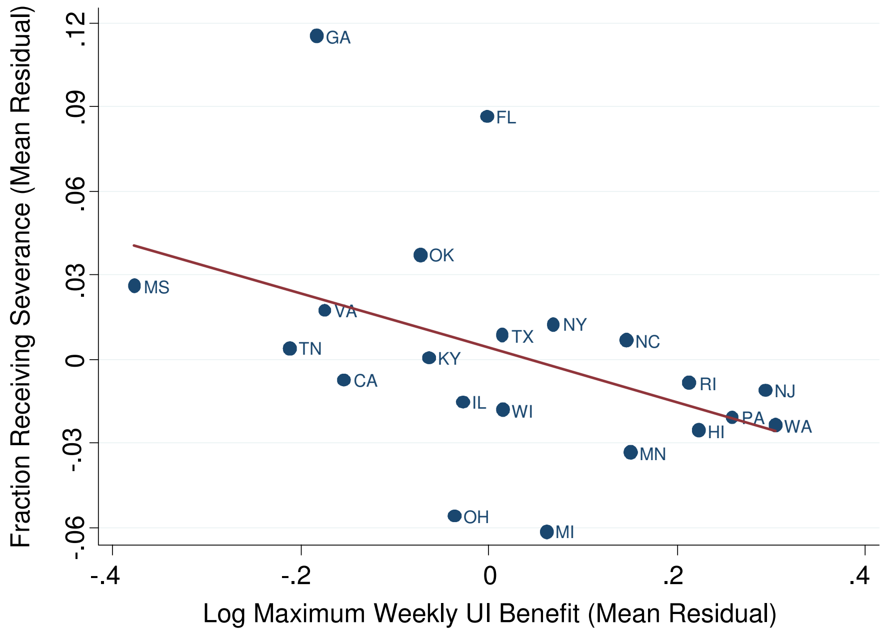
Effect of UI Benefits on Severance pay: Regression Estimates

Dependent Variable: Severance pay

	Reduced-Form OLS		TSLS
	No Controls	With Cntrls	With Cntrls
	(1)	(2)	(3)
log max UI benefit	-.074 (0.030)	-.065 (0.030)	
log individual UI benefit			-.105 (0.054)
Sample Size	2,996	2,733	2,733

NOTE-Specifications 1 and 2 report estimates from an OLS regression; specification 3 reports estimates from a two-stage least squares regression using log state max benefit as an instrument for actual individual benefit reported in data. Specifications 2 and 3 include the following controls: job tenure, age, gender, household size, education, dropout, industry, occupation, and race dummies.

Figure 1
Effect of UI Benefits on Severance Pay



NOTE–Figure plots relationship between fraction of individuals receiving severance pay in each state vs. maximum state UI benefit level, conditioning on wages. Figure shows a scatter plot of the mean residuals by state from a regression of severance pay receipt and log maximum weekly benefit level on a log wage spline (see text for details). Data source: Mathmetica survey of UI Exhaustees in 25 States in 1998. States with fewer than 50 individual observations are excluded from this figure.