A Menu of Insurance Contracts for the Unemployed*

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Abstract

Unemployment insurance (UI) programs traditionally take the form of a single insurance contract offered to job seekers. In this work, we show that offering a *menu* of contracts can be welfare improving in the presence of adverse selection and moral hazard. When insurance contracts are composed of (i) a UI payment and (ii) a severance payment paid at the onset of unemployment, offering contracts with different ratios of UI benefits to severance payment is optimal under the equivalent of a single-crossing condition: job seekers in higher need of unemployment insurance should be less prone to moral hazard. In that setting, a menu allows the planner to attract job seekers with a high need for insurance in a contract with generous UI benefits, and to attract job seekers most prone to moral hazard in a separate contract with a large severance payment but little unemployment insurance. We propose a simple sufficient statistics approach to test the single-crossing condition in the data.

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> *Government checks have been a lifeline for many people who would happily work if they could find a job. But the current system also creates perverse incentives and makes it hard to cut off the lazy while helping those in genuine need.*[1]

An important ingredient of social welfare policies is the unemployment insurance program. At heart, an optimal unemployment insurance contract involves a trade-off between the desire to provide unemployment insurance (UI) to job seekers and the need to minimize moral hazard as more generous unemployment insurance raises job seekers' reservation wage and thereby the length of unemployment spells.

In the wake of the Great Recession, the high unemployment rate in many developed economies revived the debate on the deterrent effect of unemployment benefits on job search behavior (e.g., Rothstein, 2011). Notably, policy makers discussed the possibility to further restrict unemployment insurance to individuals with certain *observable* characteristics or appropriate behavior (e.g., not refusing too many decent offers or providing sufficient search efforts).[2]

Such conditional schemes are motivated by the idea that some categories of job seekers are more prone to moral hazard, i.e., more prone to "abuse" the generosity of UI benefits at the expense of other categories of job seekers in dire need of unemployment insurance. Unfortunately, as the characteristics and behavior of job seekers are never fully verifiable, conditioning schemes have clear limitations.

In this paper, we show that offering a menu of unemployment benefits can remedy these limitations. We propose to offer newly unemployed workers not just one type of unemployment benefit contract as is the norm in OECD countries, but instead a *menu* of unemployment benefit contracts. Specifically, each unemployment benefit contract will consist of two separate payments: (i) a traditional unemployment insurance scheme paid during unemployment, and (ii) a lump-sum (and unconditional) payment paid at the onset of unemployment. Different contracts will offer different ratios of unemployment insurance to lump-sum payment and will appeal to different types of workers.

[1] *Unemployment: How the Lazy Are Hurting the Needy*, US News and World Report, April 2012, https://www.usnews.com/news/blogs/rick-newman/2012/04/03/unemployment-how-the-lazy-are-hurting-the-needy. In this paper, we explore the implications of unobserved worker heterogeneity on the design of UI, but we make no moral distinction between one group of workers and another: there is no sense in which one group is *lazy* and the other is in *genuine* need.

[2] A large literature discusses the gains from conditioning unemployment benefits on observable behaviors. Among others, Lalive, van Ours and Zweimüller (2005); Lalive, Van Ours and Zweimüller (2006); Abbring, Berg and Ours (2005) show that sanctions could affect job search, and Boone et al. (2007) study optimal UI contracts with sanctions.

Offering different insurance contracts to different types of job seekers is generally desirable but not always incentive-compatible. We show that a menu of contracts can lead to welfare Pareto improvements over the single pooling contract under the equivalent of a Spence-Mirrlees single-crossing property: The marginal utility of unemployment benefits should be higher for those job seekers who are less prone to moral hazard. Intuitively, if the job seekers who are in most need of UI are also the least prone to moral hazard, a welfare improving menu of contracts can be incentive compatible: the job seekers in high need of UI will choose a contract with a high unemployment insurance component, while the job seekers most prone to moral hazard will choose a contract with a large lump-sum payment but little insurance. This configuration happens for instance when workers differ in their propensity to receive a job offer. Indeed, job seekers with a low job offer rate (i) have a high expected unemployment duration, and thus have a high utility from unemployment insurance, and (ii) accept most job offers coming their way, so that moral hazard is of small concern. By contrast, job seekers with a high job offer rate have little need for unemployment insurance but are most prone to moral hazard.[3]

In the first part of paper, we formalize this intuition in a stylized model of sequential job offers with borrowing and saving à la Shimer and Werning (2008), where both the behavior and the type of job seekers are not verifiable. In that setting, optimal unemployment insurance under perfect information is summarized by two quantities, a flat unemployment insurance profile and an unconditional lump-sum payment at the onset of unemployment. The model is sufficiently tractable to (i) extract general conditions under which a menu of contracts is welfare improving over a single pooling contract, and (ii) provide a closed-form characterization of the optimal separating contracts. We generalize the argument in a framework with borrowing constraints and adjustable search effort. The unemployment insurance contract under perfect information is then characterized by a lump-sum payment and by a duration-specific unemployment insurance payment. We provide a sufficient condition under which a menu of contracts which separates job seekers is welfare improving over a single pooling contract.

We propose a simple sufficient statistics approach to test the single-crossing condition in the data. We show how the condition is similar to a Baily-Chetty formula (Chetty, 2006) and could be tested using a sufficient statistics approach, where the

[3]Two recent contributions suggest that job seekers strongly differ in the recall probability from previous employers (Nekoei and Weber, 2015; Fujita and Moscarini, 2017). Workers under temporary layoffs have a much higher recall rate than workers under permanent layoffs and thus (i) have much less of a need for unemployment insurance, but (ii) are much more prone to moral hazard. This dimension of heterogeneity would call for a menu of contracts.

sufficient statistics are the elasticities of reservation earnings and insurance payments to changes in the level of unemployment insurance. Intuitively, a separating contract is desirable if the willingness to pay for unemployment insurance—the marginal benefit of UI—and the propensity for moral hazard—the marginal cost of UI—are negatively correlated across workers. We illustrate how this test could be implemented in practice using a Swiss dataset that allows us to estimate these sufficient statistics for a (typically unobservable) dimension of heterogeneity: job seekers' search efficiency. We find that the single-crossing property is satisfied in this empirical application: the planner would like to attract the highly-efficient job seekers into a (relatively) low-insurance contract.

We discuss some implementation issues for our policy proposal. In particular, we explore a number of extensions that can be of importance in a real-world setting. We consider the possibilities that (i) the planner can offer an unrestricted set of policy instruments instead of a severance payment and flat unemployment benefits, (ii) there is a continuum of types of job seekers, (iii) job seekers have imprecise or biased beliefs about their types (as in Spinnewijn, 2013, 2015), and (iv) selecting one contract could have adverse consequences for future employment opportunities if a job seeker's choice is used by employers as a signal of that job seeker's type.

The contribution of this paper is to explicitly account for adverse selection in the design of optimal unemployment insurance. The design of unemployment benefits in the presence of moral hazard has received considerable attention from the economic literature. The literature has discussed the size of unemployment benefits relative to wages (Feldstein, 1985) and the shape of unemployment benefits with duration (Shavell and Weiss, 1979; Hopenhayn and Nicolini, 1997; Cahuc and Lehmann, 2000; Shimer and Werning, 2008; Chetty, 2008; Kolsrud et al., 2015). By contrast, there is surprisingly little work on the design of unemployment benefits in a world with heterogeneous job seekers (Shimer and Werning, 2006).[4]

Two recent papers explore the implications of adverse selection for unemployment insurance. Hendren (2017) studies whether adverse selection can explain the absence of a private market for unemployment insurance, while Landais et al. (2017) use Swedish data to estimate whether adverse selection into UI is enough to rationalize a universal UI mandate. Our single-crossing condition echoes Hendren (2017)'s condition determining when a private UI market would unravel as well as Landais et al. (2017)'s condition justifying the use of a choice-based UI policy over a universal UI mandate. However, our objective is more normative, and we analyze the optimal

[4]Heterogeneity across workers has been studied in the literature, but from a redistribution perspective (e.g., Lifschitz, Setty and Yedid-Levi, 2013). For instance, unemployment saving accounts have been proposed to limit such redistribution (Feldstein, 2005; Feldstein and Altman, 2007).

design of UI in a framework where we explicitly model the determinants of adverse selection *and* moral hazard. In our model, it is agents' private information about their own type that determines the extent of adverse selection and moral hazard.

In the context of health insurance, Marone and Sabety (2019) study the desirability of vertical choice in health insurance contracts under agent heterogeneity in health risk and moral hazard in health services consumption. While health insurance and unemployment insurance differ in a number of ways, their framework also explicitly models how private information about one's type determines the extent of adverse selection and moral hazard, and their conclusion carries the same intuition as our single-crossing condition: offering a menu of insurance contracts is desirable if consumers with a higher willingness to pay also have higher efficient levels of insurance coverage.

Our analysis is motivated by the existence of adverse selection and moral hazard between a job agency and job seekers. The existence of moral hazard is supported in the data by the response of job seekers to the generosity of unemployment insurance.[5] Adverse selection is supported by studies quantifying the importance of unobserved heterogeneity in the unemployment pool, from the hazard-based duration models (Van den Berg, 2001) to more recent contributions exploiting multiple unemployment spells (Alvarez, Borovičková and Shimer, 2016).

Finally, our paper builds on an older literature on adverse selection and moral hazard in the context of social insurance. Some papers have looked at optimal contracting in competitive environments (Prescott and Townsend, 1984; Biglaiser and Mezzetti, 1993). Our approach instead considers a unique principal, the unemployment agency, in the spirit of Whinston (1983) and Picard (1987).

The remainder of this paper is structured as follows. In Section 1, we describe the physical environment of the stylized model. In Section 2, we derive the optimal contract(s) and discuss some extensions related to practical implementation issues. Section 3 describes our findings in the general framework. Section 4 presents our sufficient-statistic approach to test the single-crossing condition in the data, and the final section briefly concludes.

1 Environment

We start by describing the environment of the baseline model.

[5]See e.g., Nickell (1979); Narendranathan, Nickell and Stern (1985); Katz and Meyer (1988); Van den Berg (1990); Hunt (1995); Lalive, Van Ours and Zweimüller (2006); Chetty (2008); Card, Chetty and Weber (2007); Schmieder, Von Wachter and Bender (2012).

1.1 Preferences and technology

Time is continuous. We focus on the problem of one potential worker facing an exogenous labor demand. She lives for infinitely many periods and maximizes expected utility. Letting c_t denote her consumption at time t, her expected lifetime utility at t is:

$$E_t[V_t] = E_t \int_0^\infty e^{-\rho s} u(c_{t+s}) ds,$$

where $1 - \rho < 1$ denotes her discount factor and $u(\cdot)$ represents the utility function, which satisfies $u'(\cdot) > 0$ and $u''(\cdot) < 0$. The worker can either be unemployed or employed. When unemployed, she provides inelastically a unit of search and receives interviews at rate f. Upon meeting with the firm, the unemployed worker and the firm draw a wage. Conditional on receiving an interview, let $G(\cdot)$ denote the distribution of wages.[6] The worker can decide to accept the wage offer or instead re-integrate the unemployment pool. If she accepts the offer, the worker remains indefinitely employed in the same firm and under the same contractual terms.

While the worker is unemployed, she produces at home. Let z denote the value of home production. For the sake of exposition and without loss of generality, we will set $z = 0$ throughout the paper, except when we consider heterogeneity along home production.

1.2 Unemployment insurance and financial markets

As in Shimer and Werning (2008), we assume that the job seeker can freely borrow and save at rate r with $r = \rho$, so that there is a preference for perfectly stabilizing consumption over time, but there exist no financial instruments contingent on the employment status of individuals.

Workers are facing two insurance problems. First, an unemployed worker wants to smooth consumption across time, i.e., she wants to bring consumption from future states (in which she will be employed) to the present (where she is looking for a job). She can do so using private financial markets. Second, an unemployed worker would like to be insured ex-ante against unemployment risk, i.e., against the random nature of the time of re-employment. The only asset which can provide such insurance is supplied by the unemployment agency.

There is an unemployment agency minimizing its expenditures subject to a target utility constraint. We assume that the agency offers flat unemployment benefits

[6] In the baseline model, we assume an exogenous distribution of wage offers. Characterizing optimal unemployment insurance in a model with wage bargaining is relatively straightforward and is discussed in an extension (see Section 2.4).

b, whose payments depend on the job status of individuals, and an initial lump-sum payment a, in order to reach initial discounted utility U for the job seeker.[7] Since agents can perfectly smooth their consumption across periods, the lump-sum payment is equivalent to any deterministic stream of payments with the same discounted value. This payment may be positive and can be interpreted as a severance payment. This payment may be negative and can be interpreted as a tax to finance unemployment insurance or the "price" of the insurance contract.

We model moral hazard through an enforcement friction at the job acceptance margin: the unemployment agency cannot force individuals to accept wage offers, because they are not observable.[8] The unemployment agency only observes the status of the worker (either unemployed or employed).

2 Baseline model

The structure of the section is as follows. We describe the job seeker's program and we express her reservation wage as a function of unemployment insurance. We then analyze the planner's problem in two steps. In a first step, we study the perfect information setting and perform useful comparative statics. In a second step, we analyze the optimal contract under adverse selection and we derive a general set of conditions under which a menu of contracts is preferred.

2.1 The worker's program

In this preliminary step, we consider as given the unemployment insurance scheme providing (i) a lump-sum payment a at the onset of unemployment,[9] and (ii) a constant stream of unemployment benefits b conditional on being unemployed.

For tractability, we consider a CARA utility function, $u(c) = -e^{-\alpha c}$, with $\alpha > 0$. We relax this assumption in Section 3. We assume, without loss of generality, that the worker's initial savings are 0. This assumption is innocuous because, as we will see later, wealth does not modify the job seeker's behavior in this baseline model.

[7] We restrict the set of policy instruments to a constant stream of unemployment benefits and a lump-sum payment. This restriction is innocuous, even with heterogeneous job seekers, as long as they have similar CARA preferences $u(\cdot)$ and discount rates $\rho = r$. In such a case, a planner who could directly choose the consumption and reservation wage of job seekers would not do any better than with our simple contracts. The reader interested in the derivation of this result can refer to Appendix C, which extends Shimer and Werning (2008) to a setting with adverse selection.

[8] An alternative approach would be to model moral hazard through an unobservable search effort that affects the probability to receive job offers. We consider such a framework in Appendix E and show that it leads to a similar program for the planner.

[9] The lump-sum payment can also be seen as the "price" of the insurance contract: the government can offer different levels of insurance coverage at different prices. We discuss the financing of the unemployment insurance program in more details in Section 2.4.

We first derive the continuation value of employment W as a function of the remaining assets a_τ at period τ and a certain wage x drawn upon matching with the firm. By assumption, the worker remains indefinitely matched to the same firm and with the same wage x; her discounted utility verifies:

$$W(x, a_\tau) = \frac{u(x + \rho a_\tau)}{\rho}$$

We now describe the process followed by the continuation value of being unemployed, V. The worker's problem can be written as a deterministic optimal control problem; she chooses consumption c in order to maximize:

$$\rho V(a_\tau) = \max_c \left\{ u(c) + \dot{a_\tau} V_a^{'}(a_\tau) + f\left(\int_0^\infty \max\left\{W(x, a_\tau) - V(a_\tau), 0\right\} dG(x) \right) \right\},$$

where the level of remaining assets, a_τ, is the only state variable and the worker depletes these assets following $\dot{a_\tau} = \rho a_\tau + b + z - c$.

In this setting, we show that the problem is quasi-stationary in unemployment duration, i.e., the reservation wage is independent of assets. We thus drop time indices τ in what follows.

Lemma 1 (Reservation wage)**.** *Letting $U(a, b)$ denote the indirect utility of a job seeker as a function of lump-sum payment a and unemployment benefits b, the reservation wage $\omega(b)$ is independent of duration and verifies,*

$$U(a, b) = \frac{u\left(\rho a + \omega(b)\right)}{\rho}.$$

The reservation wage $\omega(b)$ is implicitly defined by,

$$\alpha\left(\omega(b) - b - z\right) = \frac{f}{\rho}\left(1 - G(\omega(b)) + \int_{\omega(b)}^{\infty} u(x - \omega(b)) dG(x)\right). \tag{1}$$

Proof. See Appendix B.1. □

As is apparent in Equation (1), the reservation wage $\omega(b)$ increases in the level of unemployment insurance b, because higher unemployment benefits allow the worker to smooth income across the potential paths to re-employment. Similarly, it depends positively on expected future revenues either through a higher job arrival rate or through a more "generous" distribution of wage offers. With CARA utility and no restriction on inter-temporal smoothing, the reservation wage does not depend on savings, a, because the desire to smooth across periods is the same along different levels of wealth, as in Shimer and Werning (2008).

An important endogenous object will be the job seeker's marginal rate of substitution between unemployment insurance and lump-sum payment, or:

$$MRS_{b,a} = \frac{\partial U}{\partial b} / \frac{\partial U}{\partial a}.$$

The following lemma implicitly characterizes this marginal rate of substitution as a function of model primitives and provides some comparative statics.

Lemma 2 (Comparative statics)**.** *The marginal rate of substitution between unemployment insurance and lump-sum payment verifies:*

$$MRS_{b,a} = \frac{\omega'(b)}{\rho} = \frac{1}{\rho + \frac{f}{\alpha} \int_{\omega(b)}^{\infty} u'\left(x - \omega(b)\right) dG(x)}. \tag{2}$$

$MRS_{b,a}$ is decreasing in the job arrival rate f and increasing in the value of home production z.

Proof. See Appendix B.1. □

The marginal rate of substitution, $MRS_{b,a}$, captures a job seeker's valuation of unemployment insurance compared to a lump-sum transfer, or stated differently, it captures a job seeker's willingness to pay for insurance.[10] For instance, job seekers with a low job arrival have a high valuation for unemployment insurance—high $MRS_{b,a}$—, because they are likely to stay unemployed for a long time. To take another example, job seekers with a high value of home production have a high valuation for unemployment insurance, because they are likely to reject many offers and thus stay unemployed for a long time as well. Importantly, while the two groups—low job arrival rate or high home production—have similarly high valuation of unemployment insurance, the mechanisms leading to such high $MRS_{b,a}$ are different, and the second group is much more prone to moral hazard. As we will see, this difference will be at the core of the design of optimal unemployment insurance in the presence of worker heterogeneity.

2.2 The planner's program

In order to introduce useful notations and a benchmark for the planner's problem, we analyze the problem of a planner under perfect information. Intuitively, we will

[10] In contrast with Hendren (2017) and Landais et al. (2017), our framework explicitly models moral hazard such that the willingness to pay for insurance maps directly to the elasticity of the reservation wage to unemployment benefits.

see that the planner must balance the benefits of insuring job seekers against unemployment risk with the costs due to moral hazard: more generous unemployment benefits raise the reservation wage and lead workers to refuse more job offers with low wages and stay unemployed longer.

Notations and perfect information benchmark The planner minimizes the cost of an insurance policy which delivers at least utility U to the worker by choosing (i) initial lump-sum payment a and (ii) a flow of unemployment benefits b:

$$C(U) = \min_{b,a} \left\{ \frac{b}{\rho + f\left(1 - G(\omega(b))\right)} + a \right\}$$

subject to $u\left(\rho a + \omega(b)\right) \geq \rho U$. In the expression above, the first term captures the expected cost of unemployment insurance: the flow of unemployment benefits b is discounted by the discount rate and the (stationary) probability to exit the unemployment pool, which is the probability to receive an offer, f, times the probability to accept it, $1 - G(\omega(b))$.

We will see that it is helpful to reformulate the problem as if the planner was directly optimizing over the reservation wage w and the certainty equivalent consumption $v = \rho a + \omega(b)$. Using Equation (1) to substitute b as a function of ω, we can write the cost minimization problem as,

$$C(U) = \min_{\omega,v} \left\{ -\Psi(\omega) + \frac{v}{\rho} \right\},$$

subject to $v = u^{-1}(\rho U)$ and with $\Psi(.)$ defined by,[11]

$$\Psi(\omega) = \frac{f}{\rho} \frac{\omega\left(1 - G(\omega)\right) + \frac{1}{\alpha}\left(1 - G(\omega) + \int_{\omega}^{\infty} u(x-\omega)dG(x)\right)}{\rho + f\left(1 - G(\omega)\right)}. \tag{3}$$

In this equivalent representation of $C(U)$, the two choice variables—the reservation wage w and the certainty equivalent consumption v—are pinned down separately. The reservation wage is chosen to minimize $-\Psi(\omega)$ and the lump-sum payment is adjusted such that $v = u^{-1}(\rho U)$. This separability will be convenient

[11]To obtain the expression for Ψ, we substitute $a = v/\rho - \omega(b)/\rho$ and $b = \omega(b) - \frac{f}{\alpha\rho}\left(1 - G(\omega(b)) + \int_{\omega(b)}^{\infty} u(x-\omega(b))dG(x)\right)$ from Lemma 1 in the definition of the cost function $C(U)$, which gives:

$$\frac{\omega(b) - \frac{f}{\alpha\rho}\left(1 - G(\omega(b)) + \int_{\omega(b)}^{\infty} u(x-\omega(b))dG(x)\right)}{\rho + f\left(1 - G(\omega(b))\right)} - \frac{\omega(b)}{\rho} + \frac{v}{\rho}.$$

Re-arranging gives Equation (3).

when we discuss the optimal contract with heterogeneous workers.[12]

The function $-\Psi$ is part of the government cost function; it captures the trade-off between insurance and moral hazard for the unemployment agency. In what follows, we will assume conditions on primitives, i.e., the distribution of wage offers G, such that the planner's problem is convex.[13] A low reservation wage ω would then be inefficient for the unemployment agency, because reaching utility U only through the non-contingent payment a would be very costly for job seekers with a concave utility. A high reservation wage ω would also incur large costs because the job seeker would refuse many offers, remain in the unemployment pool for a long period and the total cost of the contingent payments b would be prohibitively high.

The following lemma summarizes the optimal contract under perfect information:

Lemma 3 (Perfect information)**.** *The solutions ω^* and v^* to the planner's program are such that ω^* minimizes $-\Psi(\cdot)$ and $v^* = u^{-1}(\rho U)$. Since $(b, a) \mapsto (\omega, v)$ is a one-to-one correspondence, there exists a unique pair (b^*, a^*) associated with (ω^*, v^*).*

The planner first sets benefits b^* such that $\omega(b^*) = \omega^*$, and then adjusts the lump-sum transfer a^* to reach utility U.

2.3 Optimal contract schedule with adverse selection

To model adverse selection, we assume the existence of unobservable heterogeneity across job seekers. Agents may differ in job arrival rates (f), in the value of home production (z), in risk aversion (α) or in the distribution of wage offers (G). Heterogeneity along these dimensions would give rise to different marginal rates of substitution between non-contingent and contingent unemployment benefits, i.e., between the lump-sum payment a and the unemployment insurance payment b. Importantly, agents know their type, but the unemployment agency cannot observe nor verify the job seeker's type. We posit that there exist two types of agents denoted by $\{h, l\}$. The high-type (h) are in proportion μ and we assume that their underlying characteristics are such that they have a higher valuation of unemployment insurance, $MRS_{b,a}$, than the low-type (l) *for all* possible values of b.

We consider the problem of a utilitarian planner who can offer two types of contracts: a pooling contract and a set of separating contracts.

[12] This separability derives from the functional form of the utility function and the unconditional access to borrowing and saving. Without a CARA utility or with restrictions on intertemporal smoothing, the arbitrage between incentives and insurance would depend on initial wealth and optimal benefits would not be set independently of the utility target.

[13] See Appendix B.2 for a sufficient condition on the distribution of wage offers G: the function Ψ is concave on some interval if the density of wage offers is decreasing on that interval.

Pooling contract With one pooling contract, the planner minimizes the cost $C(U)$ of the policy by choosing a flow of benefits b and a lump-sum payment a such that:

$$C(U) = \min_{(b,a)} \left\{ -\mu\Psi_h(\omega_h(b)) - (1-\mu)\Psi_l(\omega_l(b)) + \mu\frac{\rho a + \omega_h(b)}{\rho} + (1-\mu)\frac{\rho a + \omega_l(b)}{\rho} \right\}$$

subject to:

$$\mu u_h(\rho a + \omega_h(b)) + (1-\mu)u_l(\rho a + \omega_l(b)) = \rho U$$

Letting $v_h = \rho a + \omega_h(b)$ and $v_l = \rho a + \omega_l(b)$ denote the certainty equivalent consumptions, it is easier to write the problem in terms of v_h and v_l, i.e.,

$$C(U) = \min_{b, v_h, v_l} \left\{ -\mu\Psi_h(\omega_h(b)) - (1-\mu)\Psi_l(\omega_l(b)) + \mu\frac{v_h}{\rho} + (1-\mu)\frac{v_l}{\rho} \right\}$$

subject to a target utility constraint:

$$\mu u_h(v_h) + (1-\mu)u_l(v_l) = \rho U,$$

and the fact that lump-sum payments are the same across types, i.e,

$$v_h - v_l = \omega_h(b) - \omega_l(b).$$

Separating contracts With two contracts, the planner minimizes the total cost $C(U)$ of the policy by choosing a flow of benefits (b_h, b_l) and certainty equivalent consumptions v_h and v_l such that:

$$C(U) = \min_{b_h, v_h, b_l, v_l} \left\{ -\mu\Psi_h(\omega_h(b_h)) - (1-\mu)\Psi_l(\omega_l(b_l)) + \mu\frac{v_h}{\rho} + (1-\mu)\frac{v_l}{\rho} \right\}$$

subject to a target utility constraint:

$$\mu u_h(v_h) + (1-\mu)u_l(v_l) = \rho U,$$

and two incentive-compatibility constraints:[14]

$$\begin{cases} v_h - v_l \geq \omega_h(b_l) - \omega_l(b_l) \\ v_h - v_l \leq \omega_h(b_h) - \omega_l(b_h) \end{cases}$$

Given our assumption that type-h workers have a higher valuation of unemployment insurance than type-l workers, the two incentive-compatibility constraints imply that any feasible solution should verify $b_h \geq b_l$.

Optimal contracts We now derive the optimal contracting schedule. We restrict the analysis to settings where the government cost function $\Psi(\omega)$ is concave on an open convex set including the optimal levels of reservation wages for both types, ω_h^* and ω_l^*, under perfect information.[15]

Letting b_h^* and b_l^* denote the optimal benefits for both types under perfect information, i.e.,

$$\Psi_h'(\omega_h(b_h^*)) = 0, \quad \Psi_l'(\omega_l(b_l^*)) = 0,$$

the following proposition characterizes the optimal contract.

Proposition 1 (Optimal contracts)**.**

1. *If the following condition is verified,*

$$b_h^* > b_l^*, \tag{C1}$$

then there exist separating contracts that are Pareto-equivalent to the best pooling contract (b^p), but incur a strictly lower cost.

2. *In order to minimize the cost of a policy delivering utility U, the planner either offers one unique contract or two contracts.*

   - *When Condition (C1) is not verified, i.e., $b_h^* \leq b_l^*$, the planner offers a unique contract with unemployment insurance b^p.*

[14]These incentive-compatibility constraints are obtained as follows. The flow of benefits (b_h, b_l) and initial lump-sum payments (a_h, a_l) separate type-h and type-l if $v_h \geq \rho a_l + \omega_h(b_l)$ and $v_l \geq \rho a_h + \omega_l(b_h)$. Substituting in v_l and v_h in the first and second equations gives:

$$\begin{cases} v_h \geq v_l + \omega_h(b_l) - \omega_l(b_l) \\ v_l \geq v_h + \omega_l(b_h) - \omega_h(b_h) \end{cases}$$

[15]This would be verified, for instance, if the distribution of wage offers is unimodal and the reservation wages at the optimal policy (ω_h^*, ω_l^*) are higher than the mode of wage offers (see Appendix B.2).

- *When $b_h^* > b_l^*$, there exist separating contracts that are Pareto superior to the best pooling contract, and optimal insurance features two separating contracts b_h^s and b_l^s verifying $b_h^* \geq b_h^s \geq b^p \geq b_l^s \geq b_l^*$.*

3. *Condition (C1) is equivalent to the following condition,*

$$\frac{\partial \Psi_h \left(\omega_h(b^p)\right)}{\partial b^p} < 0 < \frac{\partial \Psi_l \left(\omega_l(b^p)\right)}{\partial b^p}. \tag{C2}$$

Proof. See Appendix B.2. □

A menu of separating contracts is preferred if and only if $b_h^* > b_l^*$. Intuitively, under the single crossing property, $b_h^* > b_l^*$, the planner wants to offer more generous benefits to job seekers with the higher $MRS_{b,a}$.[16] A set of separating contracts is desirable when the worker type who values unemployment insurance the most is also the type that is least prone to refusing job offers. By contrast, when $b_h^* < b_l^*$, separating contracts are not incentive-compatible. The planner would like to provide less insurance to the type-h job seekers but it cannot attract them in such a contract because the type-h are precisely the ones who value benefits unemployment insurance the most.[17] The following corollary relates the single-crossing property to different dimensions of heterogeneity in the unemployment pool.

Corollary 1 (Heterogeneity and contracts)**.** *Under the assumption that the discount rate is negligible compared to the job finding rate, i.e., $f >> \rho$, we have that:*

- *if the two types of job seekers only differ along the job offer rate, the planner offers two separating contracts.*

[16]We derive Proposition 1 under the assumption that, for all values of b, $MRS_{b,a}$ is higher for h-types than for l-types. That being said, the first result of Proposition 1 is more general as it only requires that $MRS_{b,a}$ is higher for h-types at the best pooling contract b^p. Moreover, using the exact same proof structure, we can show that if that $MRS_{b,a}$ condition holds at some pooling contract $\tilde{b}$ with $b_l^* \leq \tilde{b} \leq b_h^*$, it is possible to construct a separating contract that is Pareto-equivalent but incurs a strictly lower cost. This last result can be useful in a practical policy setting in order to evaluate the desirability (and political feasibility, Bierbrauer and Boyer, 2018) of a marginal deviation from the status quo—the pooling contract currently in place—without assumptions on the optimality of previous policies.

[17]In this stylized framework, the planner's program can be decomposed into two successive programs: a standard moral hazard problem with perfect information about the agent's type, and an adverse selection model à la Rothschild and Stiglitz (1976). The unemployment agency first solves for the type-specific contract under perfect information. The first-best replacement rate then captures the endogenous risk due to moral hazard. Job seekers with low incentives to refuse job offers would be attributed a high replacement rate. Second, the unemployment agency solves an adverse selection problem à la Rothschild and Stiglitz (1976) in which the exogenous attribute, i.e., the risk, interacts with the endogenous risk due to moral hazard. A trade-off between efficiency and informational rent shapes the optimal separating contracts.

- *if the two types of job seekers only differ along the value of home production, the planner offers a unique pooling contract.*

Proof. See Appendix B.2. □

Graphical illustration To illustrate graphically how offering separating contracts can be Pareto improving over a pooling contract, we consider the case of heterogeneity in job contact rates, i.e., $f_h < f_l$, under which Condition (C1) is verified. Starting from the optimal pooling contract, we will illustrate in Figure 1 how two separating contracts can generate the same welfare but at a lower budgetary cost for the government. For illustration purposes, we make the simplifying (and realistic) assumption that $f >> \rho$, which has the benefit that the government cost function $\Psi(.)$ becomes proportional to f and its shape is thus identical for both types of job seekers.

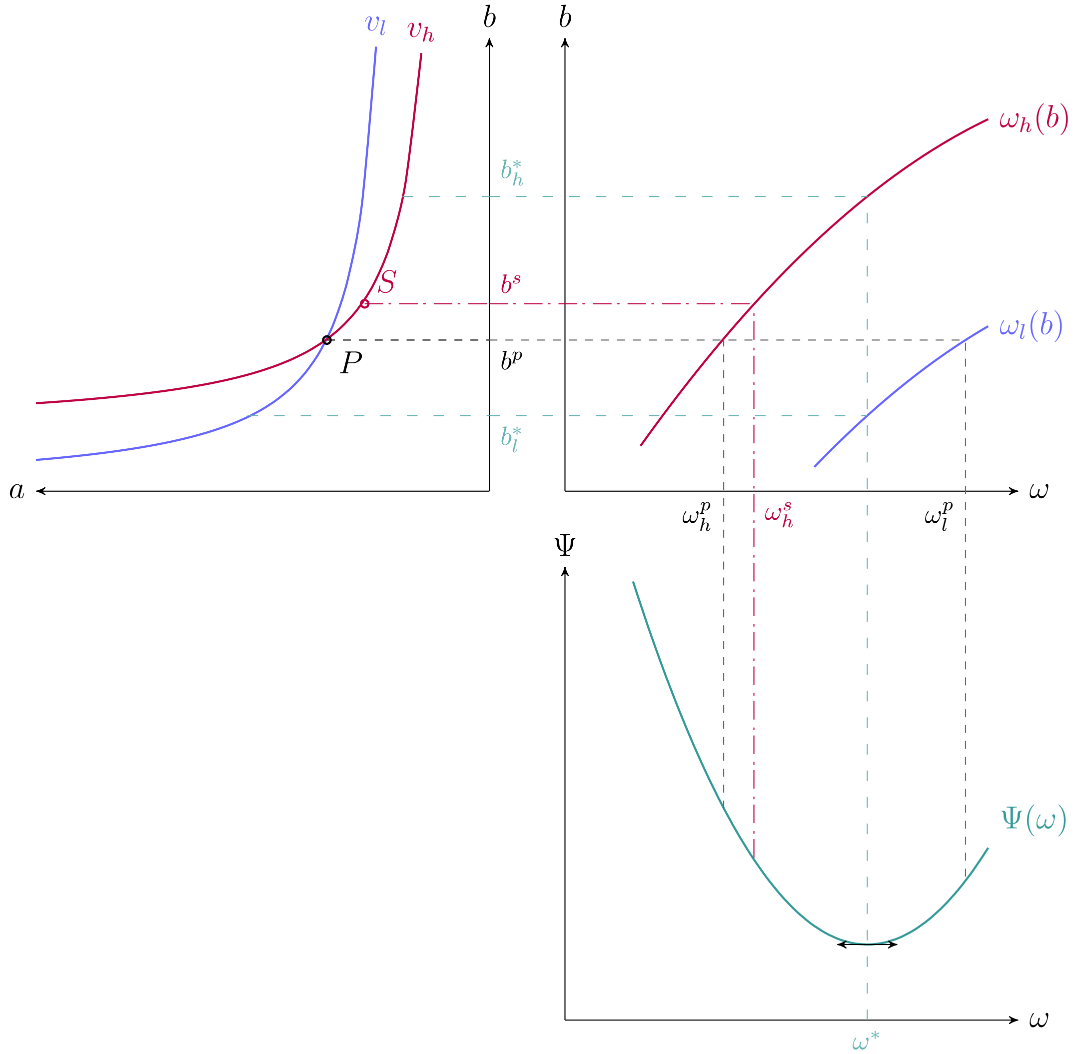
Figure 1 relates any insurance contract (b, a) to a reservation wage ω and a corresponding cost of insuring the job seeker in three interconnected panels. The top-left panel displays the indifference curves for job seekers of type-h and type-l in the (b, a) plan, $\{(b, a),\ \omega(b) + \rho a = \bar{v}\}$. Crucially, high-MRS job seekers have a flatter indifference curve. The top-right panel then transforms the insurance contracts displayed in the left panel into their corresponding reservation wages ω for the two types. With heterogeneity in MRS stemming from heterogeneity in job contact rate (f), the reservation wage schedule $\omega(b)$ is lower for high MRS job seekers. Finally, the bottom-right panel translates the reservation wage associated with a certain contract into the cost function of the unemployment agency $(-\Psi)$.

Consider first a world with perfect information (types are observable). The planner would offer two contracts b_h^* and b_l^* that minimize the government cost function $-\Psi$, as depicted in Figure 1.

Consider now a world with unobserved types. The optimal pooling contract P is depicted in the left panel along with the associated indifference curves for both types, $\left\{(b, a),\ \omega_i(b) + \rho a = \omega_i(b^p) + \rho b^p\right\}$. As apparent in the right panel, the optimal pooling contract implies that the reservation wage of the type-h (high $MRS_{b,a}$) is too low and the reservation wage of the type-l (low $MRS_{b,a}$) too high—compared to the perfect information benchmark. The cost function $-\Psi$ is no longer minimized and this implies a budgetary loss for the government.

However, and this is the key point of this paper, it is possible to construct contracts that can deliver the same utility to both worker types at a lower budgetary cost. We deviate from the pooling contract as follows. We construct another contract S with $b^s > b^p$, and situated on the type-h indifference curve that passes through the pooling contract P. By construction, type-h workers are indifferent between

Figure 1. Optimal pooling contract and gains from deviations for type-h and type-l with $f_h < f_l$.



Notes: This figure represents the optimal pooling contract and one Pareto-superior set of separating contracts when the single-crossing condition is verified ($b_h^* > b_l^*$). The top-left panel plots indifference curves $\omega(b) + \rho a = v$ for types h and l in the (b, a) plane. The top-right panel plots the reservation wage ω for both types as functions of the income replacement rate b. The bottom-right panel depicts the government cost function Ψ as a function of reservation wage ω. The point P represents the optimal pooling contract, with unemployment benefit b^p and corresponding reservation wages ω_h^p and ω_l^p. The point S represents an alternative contract offering $b^s > b^p$ and leaving type-h indifferent with the pooling contract P. Under the alternative contract, the reservation wage of type-h implies a lower budgetary cost Ψ for the government. Note that type-l agents strictly prefer the pooling contract since S is below their indifference curve going through P.

this new contract and the pooling contract. Type-l agents are not attracted to this contract—it lies below their indifference curve—, as the insurance component of the contract is too high for low $MRS_{b,a}$ job seekers. In that case, separating type-h and type-l workers into the new contract and the pooling contract is desirable for the planner because it raises type-h reservation wage $\omega_h(b^s) > \omega_h(b^p)$ and brings it closer to the minimum of the government cost function. Thus, both types of job seekers are indifferent between the menu of contracts $\{P, S\}$ and the pooling contract P, but the menu generates a lower budgetary cost and lower informational rents.

2.4 Extensions and practical considerations

In this section, we consider a number of extensions that can be of importance in a real-world setting. Specifically, (i) we consider an unrestricted set of policy instruments, study when (b, a) contracts achieve the second-best allocation under information asymmetry, and we discuss more explicitly the financing of the UI program; (ii) we show how having a continuum of types does not affect our conclusions and yields a single crossing condition like Equation (C2); (iii) we study how the single-crossing condition is modified when workers have an imprecise or biased signal about their own type; (iv) we extend the analysis to a model with wage bargaining and study how the single-crossing condition is affected when the contract choice can be exploited by potential employers to infer workers' type. We leave the proofs behind the main results in Appendix D.

Policy instruments and the financing of UI Constraining policy instruments to a severance payment and flat unemployment benefits may seem restrictive. In theory, a principal could choose the consumption per period conditional on employment status and a period-specific reservation wage. The principal is only constrained by information asymmetry regarding the job seeker's type and wage offers. We describe such a general mechanism in Appendix C, and we show that the restrictions in contractual choices imposed in the baseline model—(b, a) contracts—are innocuous as long as workers do not differ in their preferences, thereby extending the result of Shimer and Werning (2008) to a setting with information asymmetry.

An interesting implication of this result is that the method of financing of the UI program, e.g., an employment tax or a tax paid at the onset of unemployment, is irrelevant in our model. Indeed, for any menu of unemployment benefits, lump-sum payments and employment taxes, there is an equivalent menu consisting of (b, a) pairs as considered in our baseline framework. Specifically, when workers share the same preferences, a Ricardian equivalence holds allowing to front-load payments: unemployment benefits and lump-sum payments are perfect substitutes for unemployment benefits and employment taxes. Optimal unemployment insurance can thus be set with arbitrarily sized lump-sum payments, positive benefits and be financed through corresponding employment taxes.[18]

[18] That being said, this equivalence result is unlikely to hold in practice. On the one hand, front-loading payments—a larger lump-sum payment at the onset of unemployment—may be more

Continuum of types Instead of having only two types of workers, we now consider a continuum of types indexed by $i \in [0,1]$. We assume that types can be uniformly ordered such that the marginal willingness to pay for insurance, at any level b, is decreasing in type i.

As in the case with discrete types, we assume that the functions $\{\Psi_i\}_{i\in[0,1]}$ are concave on an open convex set including the reservation wages $\{\omega_i^*\}_{i\in[0,1]}$ at the optimal policy under perfect information. The optimal contract has the following features (see Appendix D.1). Similar to Condition (C1) in the discrete case, when the optimal benefit schedule under perfect information, $\{b_i^*\}_{i\in[0,1]}$, is decreasing in the worker type i, a continuum of separating contracts is optimal. Unemployment benefits $\{b_i^s\}_{i\in[0,1]}$ are decreasing in i, and high-MRS individuals sort themselves into high insurance contracts, while low-MRS individuals sort themselves into contracts with a more generous severance payment component.

Noisy and biased beliefs about workers' type We now consider the possibility that job seekers only have a noisy signal about their own type, e.g., they do not have a clear view about their labor market prospects. This signal could also be biased, e.g., workers could be overconfident in their ability to find a job.

To capture the idea that workers can be uncertain about their own type, we assume that there are two different types of job seekers *ex-ante*, type-h and type-l, who draw their *ex-post* type $i \in [0,1]$ from two distributions H_h and H_l. We suppose that H_h is (first-order) stochastically dominated by H_l, and that $MRS_{b,a}$ is decreasing in the ex-post type i—such that the ex-ante type-h is also more likely to be a type-h ex-post. While more involved in terms of notations, the optimal contract is qualitatively similar to the one characterized in Proposition 1. The planner either offers one unique contract or two contracts. When the optimal benefit schedule under perfect information, $\{b_i^*\}_{i\in[0,1]}$, is increasing in the ex-post type i, the planner offers a unique contract. When the optimal benefit schedule under perfect information on the ex-post type, $\{b_i^*\}_{i\in[0,1]}$, is decreasing in the ex-post type i, there exist separating contracts that are Pareto superior to the best pooling contract, and the planner offers two separating contracts with $b_h^s > b_l^s$. The formal derivations can be found in Appendix D.2. Importantly, uncertainty does not prevent the planner from separating agents: the planner separates job seekers based on their imprecise

attractive to workers because of salience, impatience and/or borrowing constraints. A front-loaded payment is also appealing to the unemployment agency for its simplicity and ease of implementation. On the other hand, a too large front-loaded payment may lead to opportunistic behavior where workers and firms collude to engineer a temporary layoff that allows workers to collect the large lump-sum payment. A cap on the lump-sum payment may limit such abuse by back-loading some of the unconditional transfer with a lower employment tax.

(but unbiased) belief regarding their type. We explore next the case of biased beliefs.

In practice, some workers may be overconfident about their job market prospects (Dubra, 2004; Spinnewijn, 2013, 2015), and some high-types, i.e., high-MRS individuals, may (wrongly) sort themselves into the low-type contract. To account for overconfidence, we go back to the baseline model and posit that, with probability ε, a type-h worker (wrongly) thinks that she is a low-risk individual.

Overconfidence does modify the structure of optimal insurance, but we can show that there still exists a condition under which a menu of contracts is optimal. Letting b_h^* and b_l^* denote the optimal replacement rates under perfect information (for agents and the planner), the sufficient condition supporting separating contracts over the pooling contract is more stringent than in the baseline of section 2. Intuitively, the planner cannot force optimistic high-type job seekers to behave differently than low-type (i.e., low MRS) job seekers,[19] but a menu of contracts can still generate budgetary gains from the non-zero share of unbiased high-types. These gains can compensate for the losses incurred from attracting biased high-type workers into a low-insurance contract. This has two implications. First, a menu of insurance is less desirable than in the baseline, and the sufficient condition for its optimality is more stringent. Second, even when a menu of insurance is optimal, the variation in insurance coverage across types is less pronounced than in the baseline. We formally characterize the optimal contract in Appendix D.3.

Wage negotiation and signaling While the baseline setup ignored the issue of wage determination—taking the distribution of wage offers as given—, wage negotiation between firm and worker could affect optimal unemployment insurance. To explore this possibility, we consider the following alternative to the baseline framework. There is an exogenous mass of heterogeneous vacancies, and there is random matching: let $G(\cdot)$ denote the distribution of potential match output y. Upon matching, a wage bargaining process takes place between the firm and its only job candidate. A share ν of the surplus goes to the worker and a share $1-\nu$ goes to the firm. Letting $\bar{w}$ the reservation wage of a job seeker upon a job interview, a stream of wages $\bar{w}+\nu(y-\bar{w})$ would be permanently transferred to the worker if the match is productive, i.e., if $y \geq \bar{w}$. The analysis is almost identical to the one underlying Lemma 1—in which the worker receives a stream of wages $\bar{w}+(x-\bar{w})$ upon matching with an exogenous wage offer $x \geq \bar{w}$. In the alternative model, the

[19]When offered a menu of insurance, this share of high-type types will prefer the low-insurance contract which generates utility losses and thus budgetary losses through a compensation in lump-sum payment.

reservation wage verifies,

$$\alpha\left(\omega(b)-b-z\right)=\frac{f}{\rho}\left(1-G(\omega(b))+\int_{\omega(b)}^{\infty}u\left(\nu(y-w(b))\right)dG(y)\right)$$

which slightly modifies the derivation of the cost function Ψ, but the structure of optimal unemployment insurance is left unchanged.

Wage bargaining also allows us to discuss the implication of information asymmetry between the potential worker and a recruiter. With information asymmetry, choosing a particular UI contract against another sends a signal about one's type and thus about one's reservation wage. Thus, the contract choice can affect wage negotiation and distort how job seekers sort themselves into contracts. In order to capture such a signaling channel, we suppose that a recruiter can observe the worker's choice of unemployment insurance and use it to form a prior on the worker's type.

This extension is more difficult to study than the previous ones because it introduces endogenous priors for the possible employer; we only develop the full argument in Appendix D.4. Signaling reduces the set of incentive-compatible contracts. Intuitively, individuals with a low reservation wage have an additional incentive to deviate and choose the contract intended for individuals with a high reservation wage: low-reservation wage individuals would signal themselves as high-reservation wage individuals and thereby extract a larger share of a match surplus than under perfect information. This additional incentive to deviate restricts the capacity of the planner to separate types but does not fundamentally modify the optimal menu of contract when feasible.

3 A general model

In this section, we extend the baseline model to a more general framework with sequential job offers. We relax the assumption of a CARA utility, we posit imperfect access to borrowing (Lentz and Tranaes, 2005), and we model moral hazard with an unobservable search-effort margin. In that framework, reservation wages depend on unemployment duration (as in e.g., Burdett and Vishwanath, 1988; Vishwanath, 1989) and optimal unemployment benefits may be constant, declining or increasing with duration (see e.g., Hopenhayn and Nicolini, 1997; Shimer and Werning, 2008; Chetty, 2008; Kolsrud et al., 2015).

In contrast with the baseline model, we assume that time is discrete. Let $d \in \mathbb{N}$ denote the unemployment duration and β denote the discount factor.

3.1 The worker's program

We consider unemployment insurance contracts consisting of two components: (i) a sequence of unemployment benefits $\{b_d\}_{d\in\mathbb{N}}$, and (ii) an initial lump-sum payment, a, paid irrespective of future employment status.[20]

We write below a general recursive program for the worker. At duration d and with savings s, the job seeker maximizes her value of being unemployed, U_d,[21]

$$V_d(s) = \max_{\omega,c,s',e} \left\{ u(c) - \varphi_d(e) + \beta G_d(\omega, e) V_{d+1}(s') + \beta \int_{\omega}^{+\infty} W(x, s') dG_d(x, e) \right\} \quad (4)$$

where ω is the worker's reservation wage, e is search effort, c is the period consumption, $G_d(\cdot, e)$ is the distribution of wage offers, $\varphi_d(\cdot)$ is the cost of search, and $W(x, s')$ is the value of being employed with wage x and savings s'. The job seeker is subject to a budget constraint,

$$c + s' = b_d + s/\beta,$$

and a credit constraint,

$$f(s', s) \leq 0.$$

We define $U\left(a, \{b_d\}_{d\in\mathbb{N}}\right)$ as the indirect utility evaluated at duration $d = 0$, for a job seeker with initial level of savings $s_0 + a$.

3.2 The planner's program

We start by deriving the cost of insurance from the viewpoint of the planner.

Recursive formulation and perfect information Consider the severance payment a and the sequence of benefits $\{b_d\}_{d\in\mathbb{N}}$ as given. Ignoring the severance payment for now, the planner faces the following discounted cost for a worker unemployed at

[20]In contrast to our previous model, modeling the non-contingent payment component as a lump-sum payment upon layoff rather than as a per-period transfer is not completely innocuous. While these two formulations are exactly equivalent under free access to borrowing and saving (as in Section 1), this is no longer the case with borrowing constraints and the two formulations would only be "qualitatively" equivalent. For the sake of exposure, we choose to focus on a (positive) initial severance payment rather than a per-period transfer, as the former generates higher welfare than the latter. With borrowing constraints, the job seeker would prefer to bring as much endowment as possible from future states of nature.

[21]For the sake of parsimony, we model the influence of search efforts along the extensive and intensive margins as affecting directly the distribution of wage offers G_d. A model with an explicit extensive margin of search efforts, e.g., not receiving any interview, would be equivalent to receiving interviews with unacceptable wages.

duration d:

$$C(d) = b_d + \beta G_d(\omega_d, e_d)\, C(d+1) \tag{5}$$

where $\{\omega_d\}_{d\in\mathbb{N}}$ and $\{e_d\}_{d\in\mathbb{N}}$ are the reservation wage and search intensity policy functions which solve Equation (4). In what follows, we define the indirect cost $\Psi\left(a, \{b_d\}_{d\in\mathbb{N}}\right)$ as the solution of this program evaluated at duration $d = 0$ and accounting for the initial payment a, i.e.,

$$\Psi\left(a, \{b_d\}_{d\in\mathbb{N}}\right) = C(0) + a.$$

Under perfect information, the planner solves

$$\min_{a,\{b_d\}_{d\in\mathbb{N}}} \Psi\left(a, \{b_d\}_{d\in\mathbb{N}}\right),$$

subject to

$$U\left(a, \{b_d\}_{d\in\mathbb{N}}\right) \geq U_0.$$

As in Section 2, we assume that the government cost function Ψ is convex, while the indirect utility function, V, is concave.[22]

Adverse selection We now introduce unobservable worker heterogeneity as in the baseline model of Section 2. We assume that there are two types of job seekers, type-h in proportion μ and type-l in proportion $1-\mu$. The type-h job seeker has a higher marginal rate of substitution between unemployment insurance and non-contingent severance payment (at any duration d),

$$\frac{\partial U_h/\partial b_d}{\partial U_h/\partial a} > \frac{\partial U_l/\partial b_d}{\partial U_l/\partial a}, \quad \forall b_d, \forall d. \tag{6}$$

The previous conditions (6) are equivalent to ranking workers according to their marginal rate of substitution between insurance and unconditional payments (Section 2), but in a "dynamic" model where the job seeker may value differently unemployment benefits across periods.

The best *pooling* contract $P = \left(\tilde{a}, \left\{\tilde{b}_d\right\}_{d\in\mathbb{N}}\right)$ is the solution to:

$$\min_{a,\{b_d\}_{d\in\mathbb{N}}} \mu\Psi_h\left(a, \{b_d\}_{d\in\mathbb{N}}\right) + (1-\mu)\Psi_l\left(a, \{b_d\}_{d\in\mathbb{N}}\right),$$

[22]The concavity of V can be shown using the envelope theorem and the additive separability of $\{b_d\}_{d\in\mathbb{N}}$ in the associated Lagrangian.

subject to,

$$\mu U_h \left(a, \{b_d\}_{d\in\mathbb{N}}\right) + (1-\mu)U_l \left(a, \{b_d\}_{d\in\mathbb{N}}\right) \geq U_0.$$

It is straightforward to show that P verifies,

$$\mu \frac{\partial \Psi_h}{\partial b_d} + (1-\mu)\frac{\partial \Psi_h}{\partial b_d} = \frac{\mu \frac{\partial U_h}{\partial b_d} + (1-\mu)\frac{\partial U_h}{\partial b_d}}{\mu \frac{\partial U_h}{\partial a} + (1-\mu)\frac{\partial U_h}{\partial a}} \tag{7}$$

and the target utility constraint $\mu U_h + (1-\mu)U_l = U_0$.

In the following proposition, we provide a sufficient condition for a set of Pareto-equivalent incentive-compatible separating contracts to lower the cost of insurance relative to the best pooling contract.

Proposition 2 (Optimal contracts)**.** *If there exists a duration d for which the following condition is verified,*

$$\frac{\partial \Psi_h}{\partial b_d} < 0 < \frac{\partial \Psi_l}{\partial b_d}, \tag{C3}$$

when evaluated at the pooling contract P, then there exist separating contracts that are Pareto-equivalent to the best pooling contract but incur a strictly lower cost. Under Condition (C3)*, any set of contracts minimizing the cost function need to separate the two types into two distinct contracts.*

Proof. See Appendix B.3. □

The proof of Proposition 2 proceeds exactly as the proof of Proposition 1 for the simpler model. We construct, for any of the duration d in which Condition (C3) holds, a contract which promises a more generous stream b_d of unemployment benefits than the pooling contract. As in Figure 1 for the baseline scenario, these contracts deliver the same utility for high-MRS job seekers but at a lower cost for the government. Such a menu of contracts provides the same welfare level for both worker types at a lower budgetary cost.

4 A sufficient statistics approach to assess the desirability of a menu of contracts

In this section, we take a practical approach to our policy proposal and study how a government could test whether a menu of contracts would be an improvement over a single pooling contract.

We show that the sufficient condition underlying the optimality of a menu of contracts—Condition (C2) in the baseline framework—could be tested in the data in a relatively simple manner provided that one can observe two sufficient statistics:

(i) the elasticity of the reservation wage to unemployment benefits b, which allows to estimate the welfare gains of more generous UI payments and thus the marginal benefit of raising the level of unemployment insurance,[23] and (ii) the elasticity of the cost of the unemployment insurance program to b, which allows to estimate the extent of the moral hazard problem and thus the marginal cost of raising the level of unemployment insurance.[24] We then illustrate this approach using Swiss data for which these two sufficient statistics are observable along one important but typically unobserved dimension of heterogeneity: search efficiency.

4.1 An empirical test for the single-crossing condition

Consider the baseline framework of Section 2 in which the planner minimizes, under perfect information, the cost of an insurance policy delivering at least utility U to the worker:

$$C(U) = \min_{b,a} \left\{ \frac{b}{\rho + f\left(1 - G(\omega(b))\right)} + a \right\}$$

subject to $u\left(\rho a + \omega(b)\right) \geq \rho U$. Under the assumption that $\rho << f$, the program can be written as follows:

$$C(U) = \min_{b,a} \left\{ P(b) + a \right\}$$

subject to $\rho a + \omega(b) \geq u^{-1}\left(\rho U\right)$, where $P(b) = bD(b)$ and $D(b)$ are respectively the expected payment of benefits and the expected duration of the unemployment spell. The optimal level of unemployment benefits should verify:

$$\underbrace{P^{'}(b)}_{MC(b)} = D(b) + bD^{'}(b) = \underbrace{\omega^{'}(b)/\rho}_{MB(b)} \tag{8}$$

The marginal cost of unemployment insurance is the loss in budget induced by an increase in benefits. This cost is composed of (i) a direct cost as more generous benefits need to be paid during $D(b)$ periods, and (ii) an indirect cost due to moral hazard, $bD^{'}(b)$, as the job seeker is more likely to reject offers and to experience a longer unemployment spell. The marginal benefit is the relative gain in budget induced by the lower lump-sum payment required to reach utility U. This optimality condition for unemployment insurance is the same condition that we encountered earlier. Under

[23] The test exploits the fact that reservation wages directly capture welfare in our theoretical framework (as in Shimer and Werning, 2007).

[24] The traditional (and related) statistics that is used in most of the empirical literature assessing the disincentive effects of unemployment insurance is the elasticity of non-employment duration to the generosity of unemployment benefits. See Chetty and Finkelstein (2012) for a review.

perfect information, the optimal contract satisfies $\Psi'(\omega(b)) = MC(b) - MB(b) = 0$ where $\Psi(\cdot)$ is the cost function introduced in Section 2.

With heterogeneous workers and information asymmetry, Proposition 1 states that a set of separating contracts is preferred to the optimal pooling contract b^p if, and only if,

$$\frac{\partial \Psi_h(\omega_h(b^p))}{\partial b^p} < 0 < \frac{\partial \Psi_l(\omega_l(b^p))}{\partial b^p}$$

or

$$MC_h(b^p) - MB_h(b^p) < 0 < MC_l(b^p) - MB_l(b^p) \tag{C}$$

In the next empirical section, we propose to test whether this condition holds in the data, i.e., whether offering a menu of contracts can be Pareto improving in practice.

4.2 Application using a survey of reservation earnings

To illustrate how Condition (C) can be tested in the data, we exploit a dataset from Switzerland that allows us to estimate the marginal costs and marginal benefits of varying the generosity of unemployment insurance for two different categories of job seekers with high and low search efficiency.

Data and context In the context of the evaluation of a profiling survey in the canton of Fribourg, Switzerland (see Arni and Wunsch, 2014, for a description of the experiment), all newly-registered job seekers between September 2012 and March 2014 had to report their reservation earnings during the first meeting with their case-worker, typically in the first three weeks after registration.[25] The dataset (SECO, 2014) covers about 8,000 unemployment spells for which we observe the replacement rates of benefits and the realized unemployment duration; these quantities allow us to construct the total amount paid in unemployment benefits.

To measure the elasticities of the reservation wage and payments to changes in b, we exploit a discontinuity in the Swiss unemployment insurance system: eligible job seekers are entitled up to 200 working days of benefits if they register before 25 years old, but up to 400 working days if they register after 25. This discontinuity can be used as exogenous variation in the generosity of unemployment insurance. We thus select all job seekers between 18 and 35 having reported a reservation wage during the first meeting and being eligible for some unemployment insurance (200 or 400 working days), which leaves us with about 4,000 unemployment spells.

[25]The reservation earnings is extracted from the question: "What is the minimum level of monthly earnings that [the job seeker] is willing to accept?". This question is part of the profiling experiment, and it is never used by the case worker to implement sanctions.

Finally, to rank job seekers along their valuation of unemployment insurance, we exploit the fact that caseworkers were required to provide a subjective assessment of the job seeker's search efficiency. That way, we are able to condition on a typically unobserved dimension of heterogeneity: the individual search efficiency.[26] We divide job seekers along their search efficiency, type-h job seekers being those whose search efficiency is considered low by the caseworker, which implies that they should have a high valuation of unemployment insurance according to our model.

Empirical strategy Our objective is to test whether Condition (C) holds across job seeker's types, as classified along their assessed search efficiency. This exercise requires that we estimate the local elasticity of the reservation wage with respect to the generosity of unemployment insurance, $MB(b^p)$, and the local elasticity of total insurance payments with respect to the generosity of unemployment insurance, $MC(b^p)$, at the optimal pooling contract b^p. The exercise thus relies on the assumptions that (i) we observe *local* variations in unemployment insurance around the *optimal* pooling contract, and (ii) the assignment of the unemployment insurance schemes across job seekers is as good as *random*.

Regarding the *local* nature of the variation in benefits, the difference between the UI schemes offered before and after 25 may seem large, with benefits going from 200 to 400 working days of coverage. However, in practice few workers stay unemployed during 400 working days, and the effective change in benefit payments will be estimated to be reasonably small—between 8 and 18%. As to whether that local variation is around the *optimal* pooling contract, we simply assume that the UI scheme offered in the Fribourg canton is close to the optimal pooling contract. We later discuss how relaxing this assumption affects the interpretation of our results.

Regarding the second assumption, the identification of the marginal cost and marginal benefits by worker type relies on a discontinuity argument. We assume that the assignment of the treatment, i.e., benefiting from the more generous insurance coverage, is sharply discontinuous at age 25 while other covariates (including search efficiency) are continuously distributed around the threshold.[27] We rely on the

[26]For heterogeneity along observable characteristics (e.g., age, sex or last wage), introducing (incentive-compatible) separating contracts is not needed a priori, since unemployment insurance payments could be made conditional on these verifiable characteristics.

[27]One threat to identification could be delayed registration. A job seeker only a few months away from 25 could delay registration in order to claim the more generous unemployment insurance. To reduce concerns about selection into treatment, we show the distribution of age upon registration in panel (a) of Appendix Figure A1: we do not observe any significant difference in the density of job seekers on both sides of the age threshold. We also show the distribution of type-l job seekers around the threshold in panel (b) of Appendix Figure A1. We also show the *average* effects of unemployment insurance on the reservation wage and insurance payments in panels (c) and (d).

regression discontinuity estimator with optimal bandwidth selection (Imbens and Kalyanaraman, 2012), and we estimate

$$y_i = \alpha + \beta T_i + f(a_i) + \varepsilon_i, \tag{9}$$

where $f(a_i)$ is a local "polynomial" of degree 1 in age, T_i is a dummy equal to 1 for individuals older than 25, and the bandwidth is optimally set around the cut-off $a = 25$ following Imbens and Kalyanaraman (2012). When we estimate the marginal cost of extending unemployment insurance, the dependent variable is the (log) reservation wage; when we estimate the marginal benefit of extending unemployment insurance, the dependent variable is the (log) total payment granted by the unemployment agency during the unemployment spell.[28]

Results Table 1 reports the marginal benefits—sensitivity of reservation earnings (column 1)—and marginal costs—sensitivity of insurance payments (column 2)—of extending insurance coverage for type-h job seekers with low search efficiency (Panel A) and type-l job seekers with high search efficiency (Panel B). The necessary and sufficient condition underlying the optimality of separating contracts is supported by the data. Specifically, the pointwise estimates imply that $MC_h(b^p) < MC_l(b^p)$ and $MB_l(b^p) < MB_h(b^p)$, and thus

$$\Psi_h'(\omega(b^p)) < 0 < \Psi_l'(\omega(b^p))$$

since $\Psi_i'(\omega(b)) = MC_i(b) - MB_i(b)$ and since $\mu\Psi_h'(\omega(b^p)) + (1-\mu)\Psi_l'(\omega(b^p)) = 0$.

In other words, the single-crossing condition along search efficiency seems to be supported in our data. Under the assumption that the UI scheme offered in the Fribourg canton is the optimal pooling contract, our results imply that the optimal contract is a separating one.[29] A planner would want to offer a contract with a high unemployment insurance component for the low-efficiency job seekers and to offer a separate contract with a low insurance component to the high-efficiency job seekers.

Discussion One limitation of the present study is that we only rank job seekers along one specific dimension of unobserved heterogeneity—search efficiency—, and

[28]Note that the realized insurance payment for a particular individual i is different from the expected payment underlying Condition (8). However, with a large sample of job seekers, the average value of realized payments will coincide with expected UI payments so that the estimated elasticity β will capture the variation in expected payment, $P'(b^p)$.

[29]If we relax the assumption that the current UI program is (close to) the optimal pooling contract, our results show that there exists a (local) menu of contracts which would be a Pareto improvement over the current program, but not necessarily that the optimal contract is separating.

Table 1. Sensitivity of reservation wage and insurance payment to benefits, across job seekers with different search efficiency (type-h job seekers have *low* search efficiency).

	Reservation wage	Insurance payments
	Panel A: type-h job seekers	
Treatment	.1102	.0733
	(.0616)	(.1088)
	[1,882]	[1,049]
	Panel B: type-l job seekers	
Treatment	.0715	.1809
	(.0465)	(.0980)
	[2,526]	[1,607]

Robust standard errors are reported between parentheses. The number of observations is reported between square brackets. Note that the bandwidth is selected optimally following Imbens and Kalyanaraman (2012) and includes fewer observations, typically between 600 and 1,000. The dependent variable is the (log) reservation wage (column 1) and the (log) total payment granted by the unemployment agency during the unemployment spell (column 2). We report the conventional local-polynomial regression-discontinuity estimate, which are not bias-adjusted. Type-h job seekers are respondents whose search efficiency is estimated to be low by the caseworker; type-l job seekers are respondents whose search efficiency is estimated to be high.

we test whether Condition (C) holds along that dimension. Another limitation is that we estimate whether the condition holds for a sub-sample of the population (individuals around the age of 25). Looking forward, the ideal empirical implementation of our test would rank job seekers along their valuation of unemployment insurance, i.e., along their $MRS_{b,a}$. Specifically, to test whether a menu of contracts is an improvement over the pooling contract, two conditions must be satisfied. First, the empirical setting should allow the econometrician to rank job seekers in terms of their $MRS_{b,a}$. Second, the empirical setting should allow the econometrician to measure $P'(b)$—the elasticity of insurance payments to changes in the level of insurance b—for individuals with different $MRS_{b,a}$.

A practical approach would consist in using a random forest approach as in Wager and Athey (2018) in order to rank individuals based on their *predicted* $MRS_{b,a}$, using for that purpose a rich array of typically unobserved job seekers characteristics (notably risk aversion, home production and search efficiency).[30] This method requires quasi-random variation in the generosity of unemployment insurance *and* a large dataset with rich information on worker characteristics in order to explore treatment heterogeneity.

An alternative approach would be to design a controlled experimental setting in which the $MRS_{b,a}$ is directly elicited at the individual level. We detail a possible

[30] This approach would be similar in spirit but much broader than our current approach based on predicting workers' $MRS_{b,a}$ from one characteristic alone: their search efficiency.

approach in Appendix F and focus on the intuition here. Consider having two contracts A and B, where contract B has a slightly higher level of insurance than contract A. The idea is to introduce some randomness in the UI contract ultimately given to each worker. Each job seeker would not choose contract A or B but instead a probability p to receive contract B versus contract A. By making workers pay a price $c(p)$ to get a given probability p—the higher the probability the larger the cost—, it is possible to infer a worker's willingness-to-pay for UI, i.e., her $MRS_{b,a}$. Indeed, from the worker's perspective, the marginal gain of increasing p by one unit is simply her willingness-to-pay for UI (i.e., $MRS_{b,a}$) while the marginal cost is $c'(p)$. At the optimum, a worker's choice should equate marginal cost and marginal benefit, meaning that the we can recover $MRS_{b,a}$ from her choice p, as long as $c(p)$ is sufficiently convex (to avoid corner solutions).

5 Concluding remarks

While the level and the duration profile of unemployment benefits have been extensively discussed, this paper shows that one important step towards reducing moral hazard and raising welfare could be to offer a menu of contracts rather than a single contract. A menu of contracts allows the government to reduce the extent of the moral hazard problem, while insuring the ones in most need.

To make our point, we study a simple theoretical problem in which a planner—the unemployment agency—faces two frictions. First, there is an enforcement friction: as standard in the literature, the planner cannot force job seekers to accept job offers. Second, there is adverse selection: there exists unobservable heterogeneity among job seekers. In this setting, we show that offering a menu of contracts with different ratios of UI benefits to severance payment is optimal under the equivalent of a single-crossing condition: job seekers in higher need of unemployment insurance should be less prone to moral hazard. This configuration happens, for instance, if job seekers differ mostly in their capacity to find a job.

While we found that the single-crossing condition is robust to a number of model extensions, an important task for future research is to explore the general equilibrium implications from offering a menu of contracts.[31]

In the final section of the paper, we take the perspective of a policy maker contemplating offering a menu of contracts. We propose a simple sufficient statistics

[31] Intuitively, introducing another contract to attract high-risk workers, as we do in Section 2 and Figure 1, would raise the low reservation wage of high-risk workers and thereby reduce entry of low productivity firms. Since a rightward shift in the productivity distribution disproportionately hurts the job prospects of high-risk workers, the general equilibrium effect will shrink the difference in $MRS_{b,a}$ between high-risk and low-risk workers and make the separation of types more costly.

approach to assess the desirability of a menu of contracts, illustrate its feasibility using a Swiss dataset and suggest an ideal experiment.

Data Availability Statement

The data that support the findings of this study are provided by the Swiss State Secretariat of Economic Affairs (SECO) by permission. Data may be obtained with a Data Use Agreement (data protection contract) issued by SECO. The replication package is available at https://doi.org/10.5281/zenodo.4545223.

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